MECHANICAL & ELECTRICAL

Volume 1 of 1
(METCON O&M is integrated to this manual)

OPERATION & MAINTENANCE MANUAL

PANGNIRTUNG TRUCK FILL STATION

PANGNIRTUNG, Nunavut

Government of Nunavut #: 08-2009

September 2016

OWNER:	**GOVERNMENT OF NUNAVUT**
CONSULTING ENGINEER:	**CHIARELLI ENGINERRING**
GENERAL CONTRACTOR:	**KUDLIK CONSTRUCTION INC.**
MECHANICAL & ELECTRICAL CONTRACTOR:	**SIFEC NORTH INC.**

MECHANICAL & ELECTRICAL

VOLUME 1 OF 1

CHAPTER 33 HEAT TRACE

CHAPTER 34 ALARM UNIT

CHAPTER 35 CHLORINATION INJECTION SYSTEM

CHAPTER 36 WATER FILTER

CHAPTER 37 GENERATOR GROUP

CHAPTER 38 CONTROL

Chapter 1 DOCUMENT VERSION

Year of Completion: **2016**
Original Scope: **ELECTRICAL & MECHANICAL**

Date	**Description of Change**
23-08-2016	PRELIMINARY
12-09-2016	PRELIMINARY 2
19-09-2016	Final Manual Site Correction September 19th 2016 Free Chlorine
20-09-2016	Final Manual Including METCON O&M chapter 35

MECHANICAL & ELECTRICAL

Project History

Owner:	**Rocky Jaworenko, Contract Clerk Department of Community & Government Services, Projects Division 2nd Floor, GNO Building P. O. Box 379 Pond Inlet, NU X0A 0S0 P: (867) 899-7317 F: (867) 899-7328**
Project Engineer:	**CHIARELLI ENGINEERING MANAGEMENT LTD 203-100 crai henry DR. Nepean, Ontario, K2G 5W3 Mech Project no : 13-072 T (613) 225-1123 F (613) 225-7298 info@cemlottawa.com**
General Contractor:	**Kudlik Construction Ltd. P.O. Box 727, 1519 Federal Road Iqaluit, NU X0A 0H0 Mr. Dominique Marceau Phone: (867) 979-1166 Fax: (867) 979-1169**
Mechanical & Electrical Subcontractor:	**Sifec North Inc. P.O. Box 556, Rankin Inlet, NU, X0C 0C0, Mr. Guy Fauteux, Pres. P.Eng. Tel: (866) 437-4001 (from Nunavut) Fax: (206) 338-2249**
Community Work Foreman:	**John Hussey Interim Senior Administrative Officer Hamlet of Pangnirtung PO Box 253 Pangnirtung, NU X0A 0R0 867-473-8953 ext. 257 pang_sao@qiniq.com**

Chapter 2 INTRODUCTION

2.1 GENERAL INFORMATION

This project consists in the construction of a new Truck Fill Station. This new filtration building includes 2 strainers (one per pump), 3 new filters Harmsco & chlorination system to clean-up water pumped from the reservoir.

Water is pumped from one storage reservoir constructed adjacent to truck fill station. Two intakes are installed. The pumps in the intake are normally fed by a 120/208V, 3Ø line from QEC power line. A Back-up 80kW generator located in the building provides power to existing truck fill station in case of a power failure.

2.2 PROCESS INFORMATION

This project is a water Truck Fill Station, following feature are part of this design.

- Two skid mounted 20 hp submersible pumps inserted at low level in the water storage lake inserted in a 12’’insulated casing and feeding a 3’’ HDPE line up to the plant.
- Two 12 inches’ pipe casing with 6 heat trace each, 3 per pipe in service, are pump housing with a screen at intake and 3 spare heat trace cable per casing.
- One electronic heat trace controller per casing connected to 3 heat trace in parallel with alarm in case of fault.
- At high point at building entrance there is one 2’’ return insertion point on casing # 2 for return water used for water sampling instrumentation located in chlorination room. A sump pump insures level compatibility.
- Similarly, at building casing inlet #1 we find a 2’’ return line from the truck fill arm, this water return point is used to empty filling line at each truck filling.
- One contactor starter per pump with 3 position selector manual-off-auto.

- In building at each pump outlet pipe, we find a flow switch use for the pump sequencer control panel.

- Pump sequencer panel insure pump alternation and flow supervision

- One strainer per pump with 3mm mesh to capture debris and one differential pressure indicator for indication of restricted strainer.

- One header for water capture and flow meter feeder.

- At header output before the first metering we find a chlorine injector receiving is chlorine mix from the injections pumps.

- One flow meter indicating water speed in conduit, flow of water in liter per hours, and a cubic meter cumulative data, 4-20 ma programmable output proportional to flow. (flowmeter is programmable to suit preference by example (gal/HR or liter /HR)

- At flow meter output we find a water sampling point feeding a sample of treated water to a chlorine analyzer probe and controller.

- Past the water sampling point we find two motorized valves connected in standard ‘’C’’ arrangement. (One flow direction is possible at a time).

- In normal operation water pass true filter and the 15,000-liter contact tank.

- In fire mode as initiated by truck operator at loading arm loaded water bypass filtration and contact tank.

- In normal operation this filtration loop also includes 3 new in line filters with following order of filtration 20 micron, 5 microns and 1 micron followed by a 15,000-liter contact tank at filter output.

- At last filter outlet we find the #2 chlorine injection point followed by a second flowmeter.

- Past the #2 flowmeter we find a second water sampling point feeding a second chlorine content measurement probe supplying information to the chlorine analyzer #2.

- A 15,000 liter contact tank is located under floor grating followed by 6’’ rising piping to truck fill arm.

- Two truck fill arm and truck position are available, each fill line position include a motorized valve activated by a start and stop station located at eyes level once on truck top.

- On each 4’’ water supply line we find a 2’’ motorized valve opening to return after truck filling the excess water to be returned to pump intake casing.

2.3 ELECTRICAL & CONTROL INFORMATION

- On the electrical side we find a 285 amps 3 phase 120/208 volts’ underground feeder connected to ‘’QEC’’ the electrical supplier.

- At main breaker outlet we find a metering box with an outside cabinet for meters.

- At outlet of metering box, we find a 400 amps 120/208 volts 3 phase an automatic transfer switch that order generator start upon power failure and transfer power of building to generator.

- At outlet of this transfer switch we find the main power panel feeding himself two three Secondary panel, one for pump house distribution, one for generator room, one for old decommission pump house.

- At control and supervision level we find two panel

    - the main control panel with supervision of multi point of supervision, an auto dialer that should eventually inform by telephone with a recording of the nature of the alarm and the capacity to acknowledge at distance such a fault by the operator of a malfunction at the plant, capacity to latch a transient alarm, and running an amber strobe at roof under alarm condition. On panel face an acknowledge push button permit to stop telephone alarm emission, an strobe at roof top, panel fault indication light remains on until fault is corrected.

- the pump sequencer panel as is name imply change pump in usage at each truck filling.

2.4 PLAN OVERVIEW

2.4.1 Mechanical plans

Plan M1

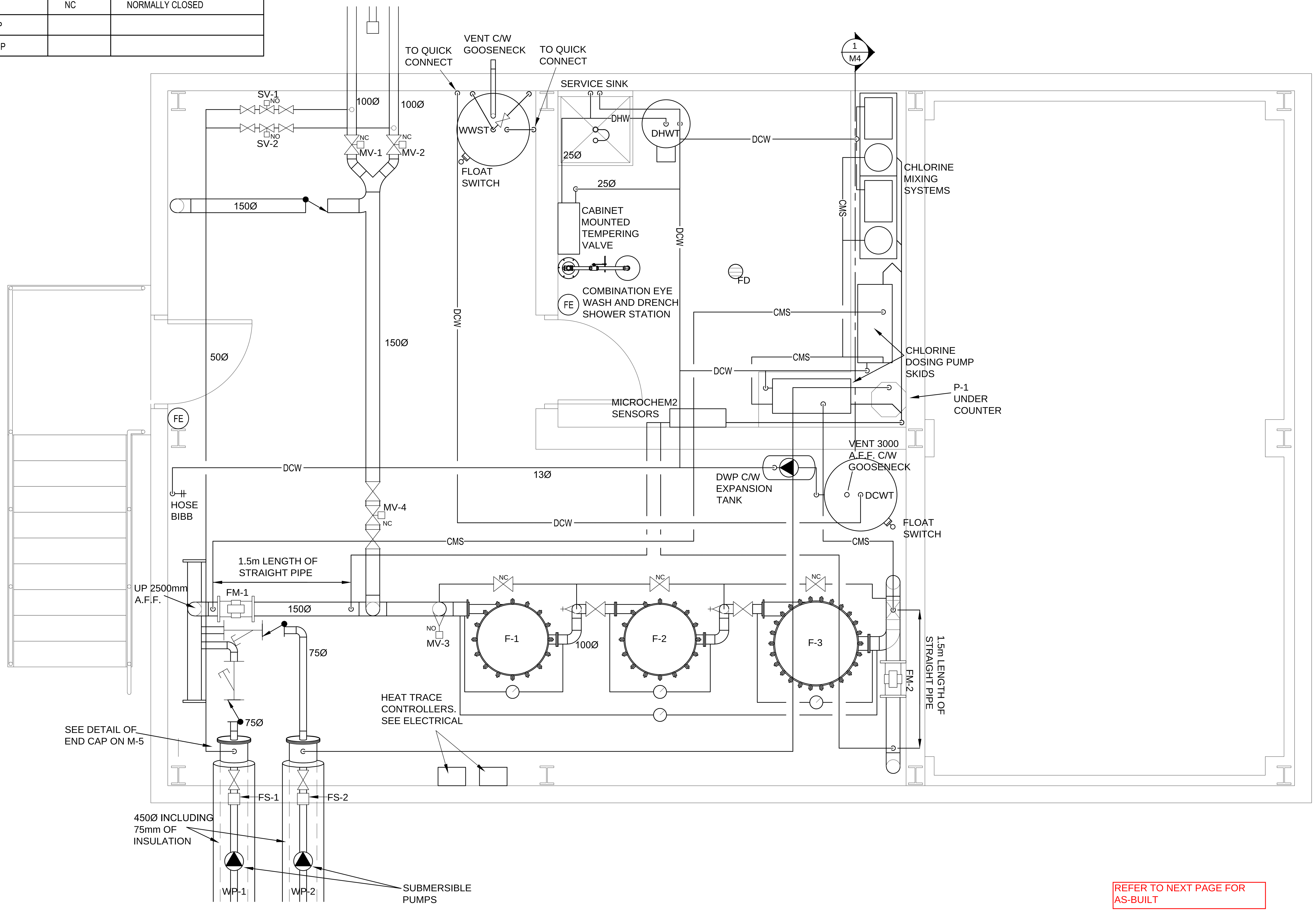
Plan M2

Plan M3

Plan M4

Plan M5

LEGEND			
CMS	CHEMICAL SUPPLY	DWP	DOMESTIC WATER PUMP
DHW	DOMESTIC HOT WATER	FS	FLOW SWITCH
DCW	DOMESTIC COLD WATER	F	FILTER TANK
SAN	SANITARY	MV	MOTORIZED VALVE
⋈	BALL VALVE	SV	SOLENOID VALVE
	CHECK VALVE	DCWT	DOMESTIC COLD WATER TANK
	PUMP	WWST	WASTE WATER STORAGE TANK
	PRESSURE GAUGE	CS	CHLORINE SENSOR
FE	FIRE EXTINGUISHER	DHWT	DOMESTIC HOT WATER TANK
FM	FLOW METER	DP	DIFFERENTIAL PRESSURE GAUGE
CFM	CHEMICAL FLOW METER	NO	NORMALLY OPEN
SP	SUMP PUMP	NC	NORMALLY CLOSED
WP	SUBMERSIBLE PUMP		
CP	CHLORINATION PUMP		



REFER TO NEXT PAGE FOR AS-BUILT

1
M1
PLUMBING PLAN - HIGH ELEVATION
1:25

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MECH. PROJECT No: 13-072

No.	DATE: (dd/mm/yy)	BY:	DESCRIPTION:
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5	14/04/14	R.S.	REISSUED FOR TENDER
4	12/02/14	R.S.	ISSUED FOR TENDER
3	15/01/14	R.S.	ISSUED FOR 99% REVIEW
2	25/11/13	R.S.	RE-ISSUED FOR 50% REVIEW
1	15/11/13	R.S.	ISSUED FOR 50% REVIEW

STAMP

REGISTERED PROFESSIONAL ENGINEER
M.M. MARLET
APR 2014
NWT/NU

CONSULTANT: CEML
DRAWN BY: R.S.
DESIGNED BY: M.M.
APPROVED BY: M.M.
DATE: JANUARY 2013

STAMP

CONSULTANT:
DRAWN BY:
DESIGNED BY:
APPROVED BY:
DATE:

LOCATION:

PANGNIRTUNG
QIKIQTAALUK REGION OF NUNAVUT
X0A 0R0

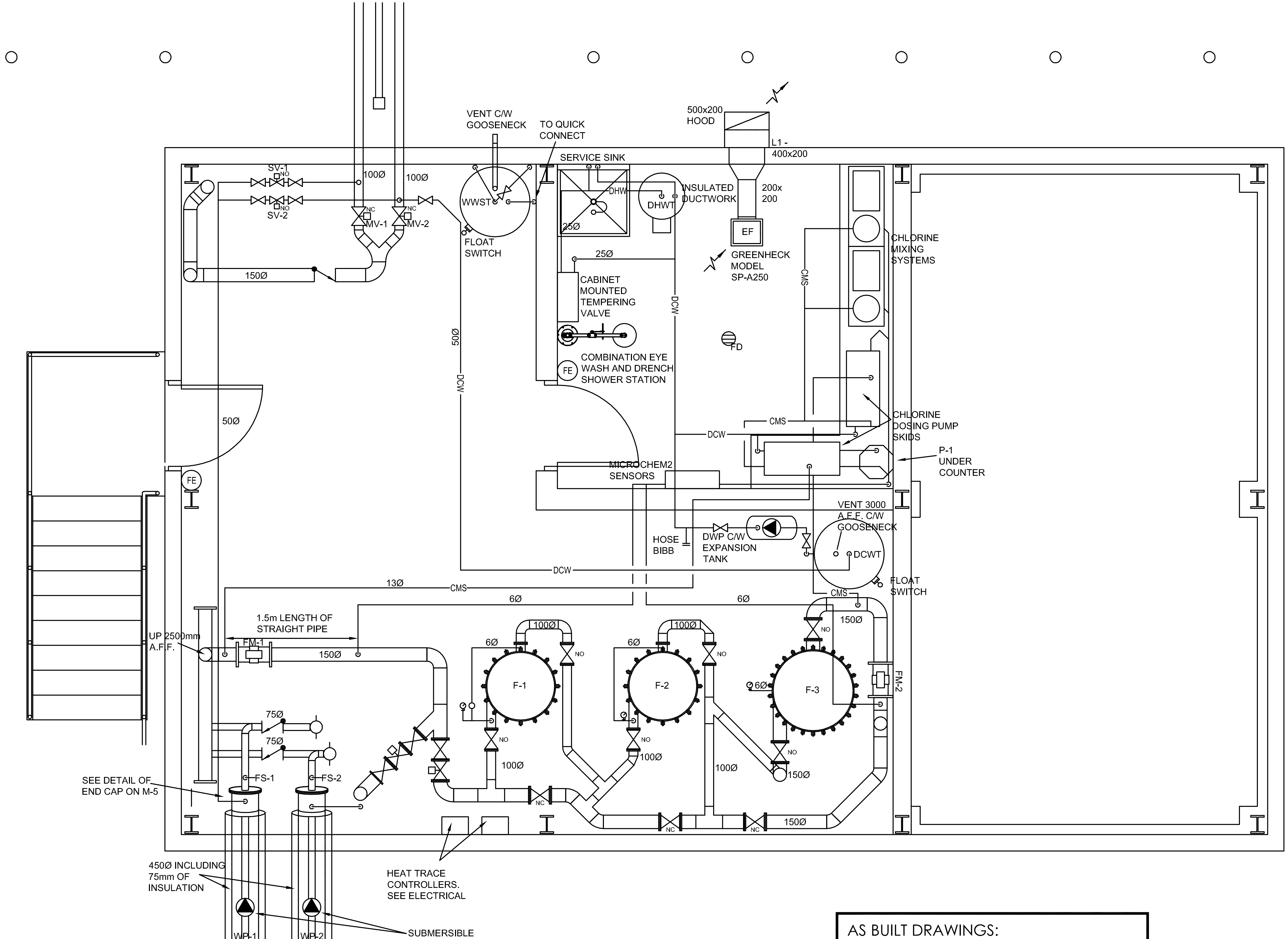
PROJECT:

OPTIMIZATION OF DRINKING WATER SUPPLY

DRAWING TITLE:

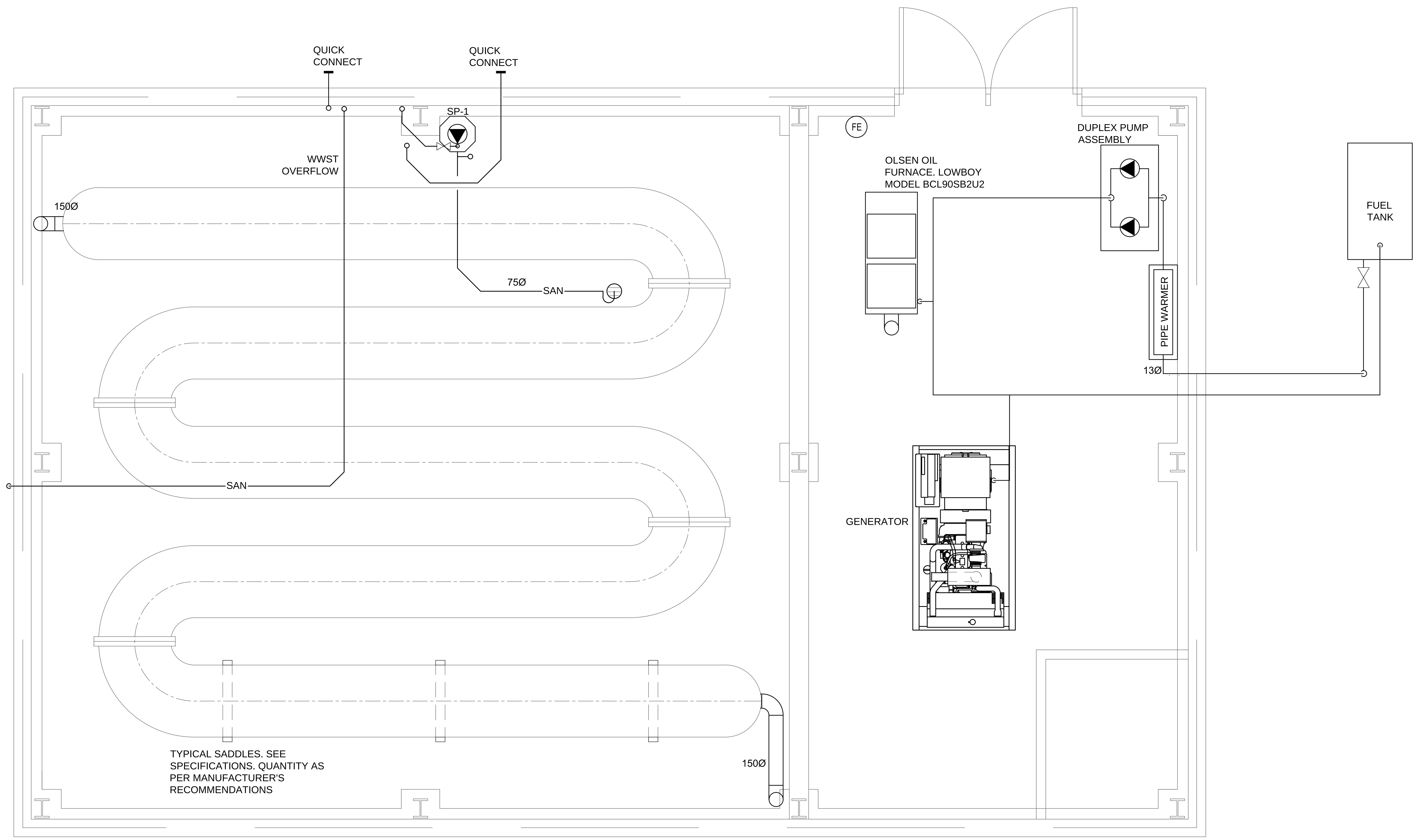
PLUMBING LAYOUT - HIGH ELEVATION

MECH FILE NAME:	DWG NO:	OF:	SCALE:
13-072	M1	5	AS NOTED



AS BUILT DRAWINGS:
This drawing has been revised to show mechanical/electrical systems as installed.
Rhéa Fauteux, P.Eng. 2016-09-20

M1



1
M2

PLUMBING PLAN - LOW ELEVATION
1:25

REFER TO NEXT PAGE FOR AS-BUILT

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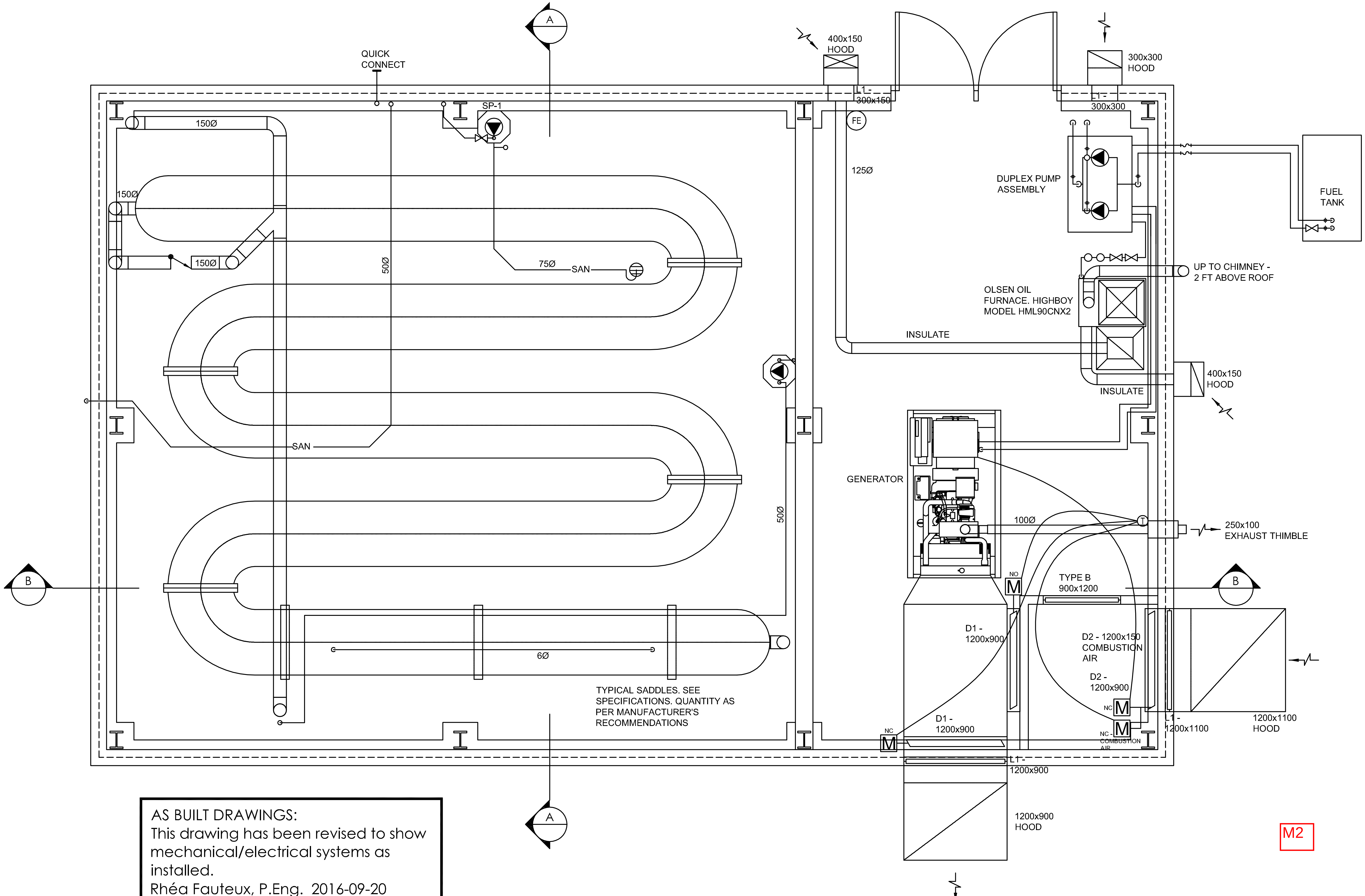
13-072	M2	5	AS NOTED



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M2

REGISTER/LOUVRE SCHEDULE	
TYPE A	NAILOR MODEL 61CD PATTERN 1A REGISTER
TYPE B	NAILOR MODEL 6155 RETURN/EXHAUST GRILLE
L1	VENTEX 2215
D1	VENTEX 3165 DAMPER
D2	VENTEX 3965 INSULATED DAMPER

AS-BUILT DRAWINGS :
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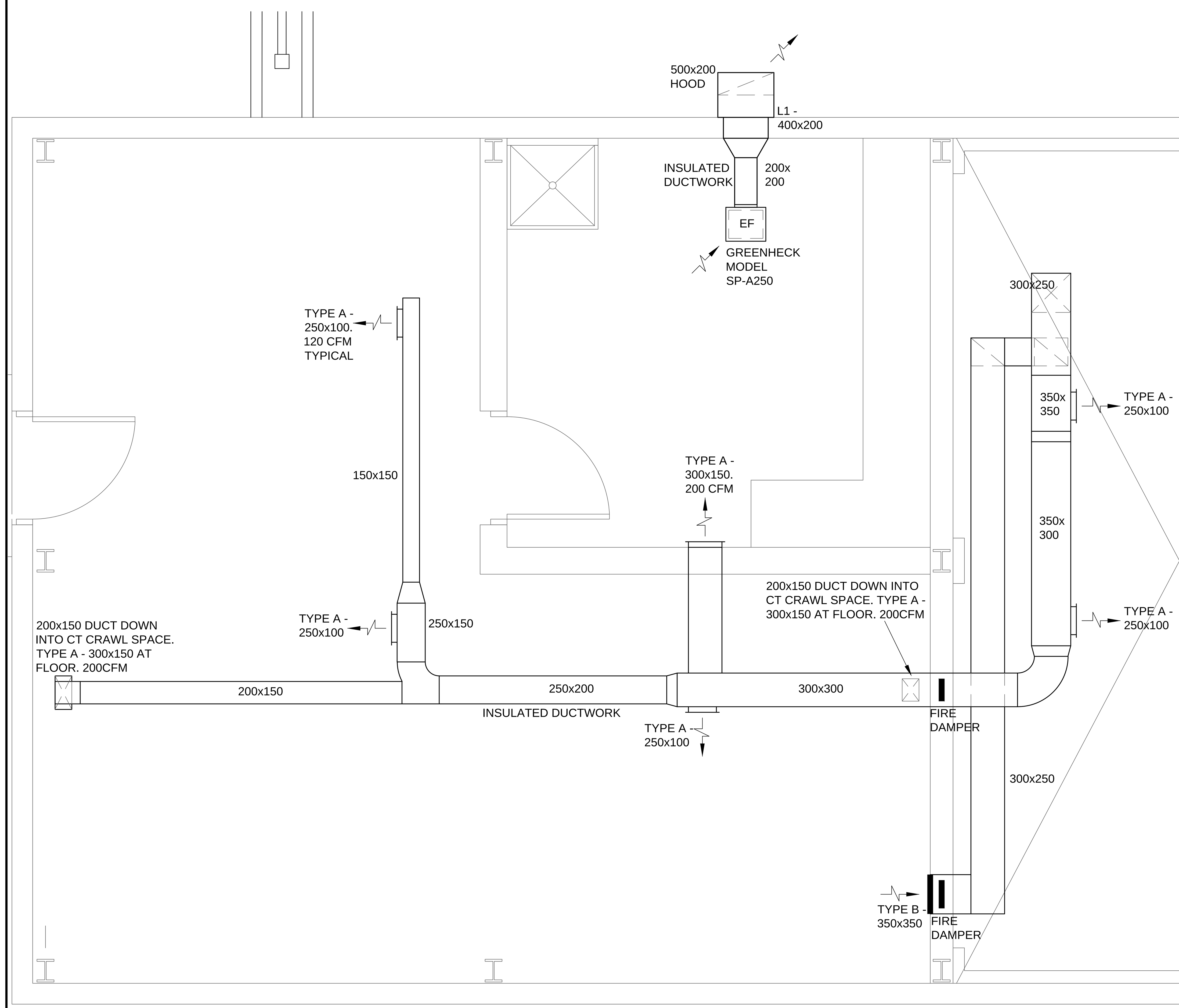
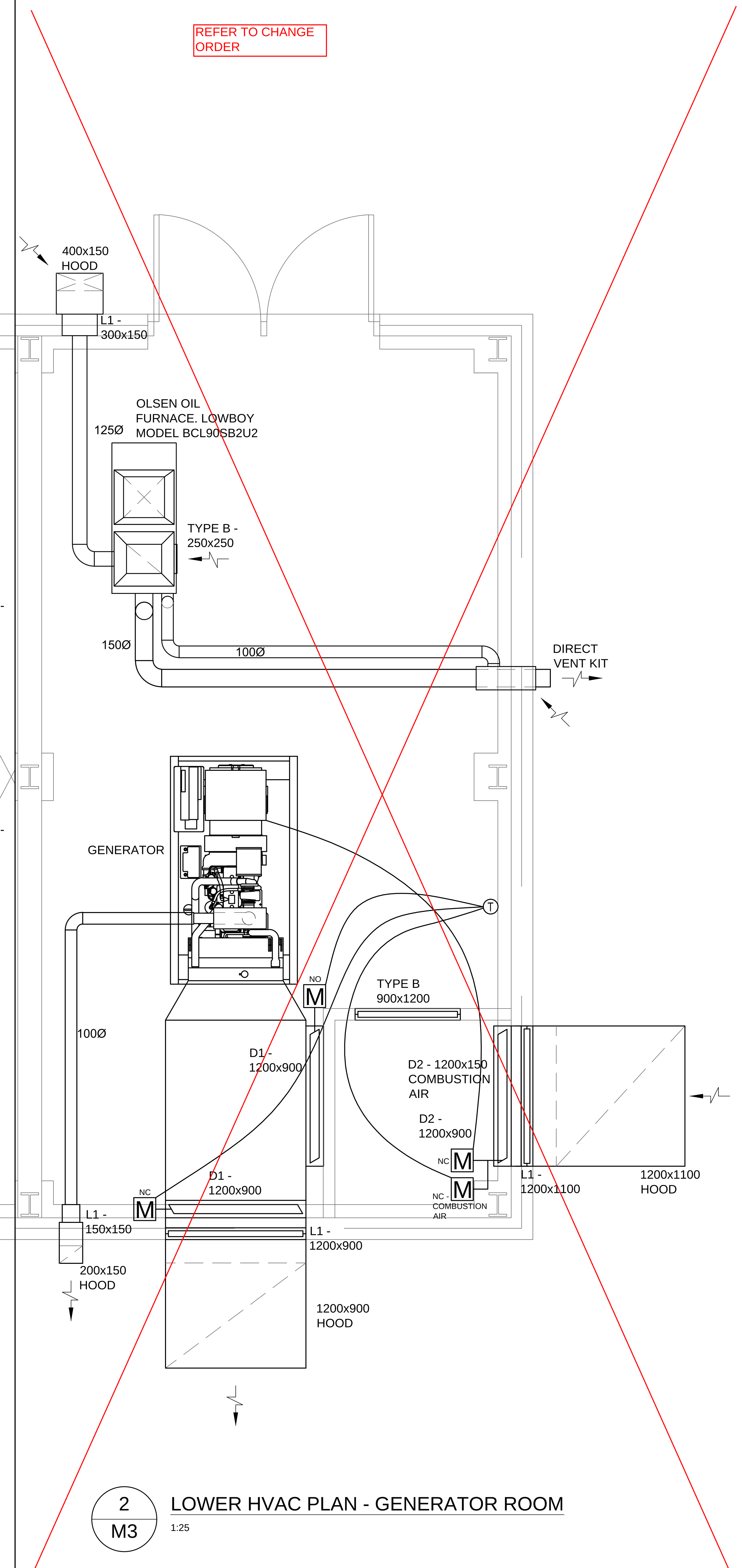
Rhéa Fauteux, P.Eng. 2016-09-30



1 M3 UPPER HVAC PLAN
1:25

REFER TO CHANGE ORDER



2 M3 LOWER HVAC PLAN - GENERATOR ROOM
1:25

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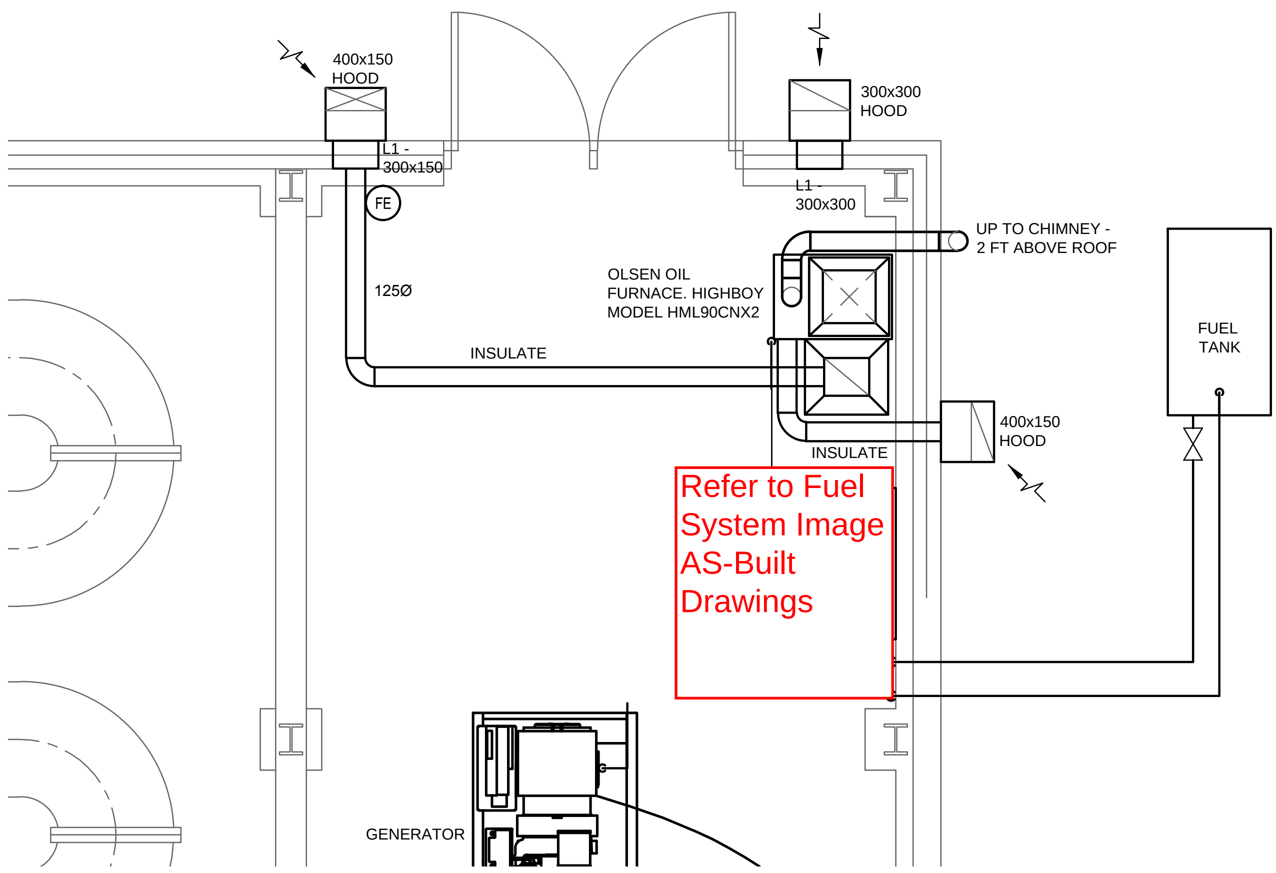
PROJECT:
OPTIMIZATION OF DRINKING WATER SUPPLY

DRAWING TITLE:
HVAC LAYOUTS

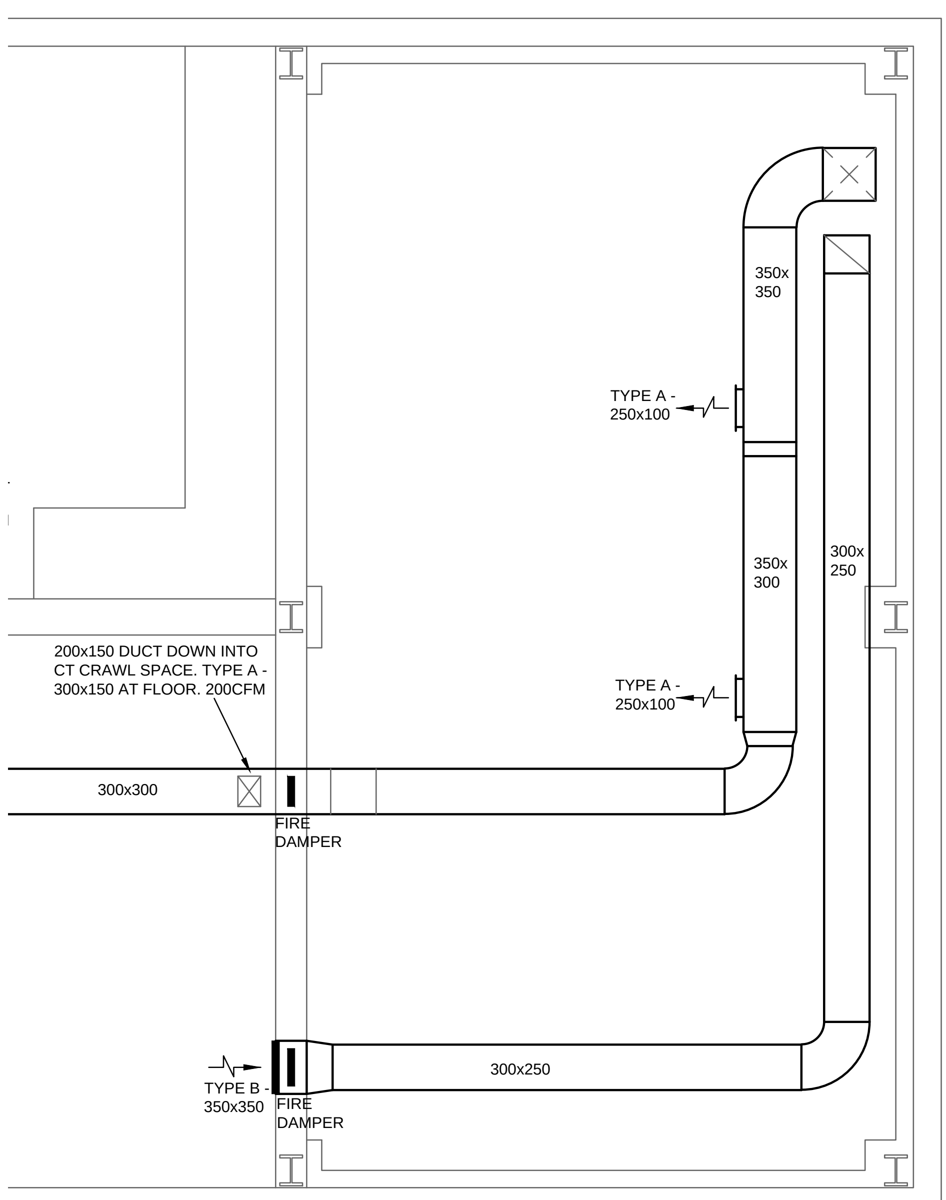
MECH FILE NAME: 13-072
DWG NO. M3
OF: 5
SCALE: AS NOTED



1
MSK3

MECHANICAL LAYOUT - LOW ELEVATION

1:50



AS-BUILT DRAWINGS :
This drawing has been revised to show mechanical/electrical system as installed.
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M.M. MAILLET
MAR 2015
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2
MSK3

MECHANICAL LAYOUT - HIGH ELEVATION

1:50

No.	Date	Revision
1.	24/03/15	ISSUED WITH CCN M&E #1

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Project:	**Pangnirtung** **Qikiqtaaluk Region of Nunavut** X0A 0R0
Drawing: REVISED FURNACE	Drawing no: MSK3
Project no: 13–072	Scale: AS SHOWN	Date: 24/03/15

AS-BUILT DRAWINGS :
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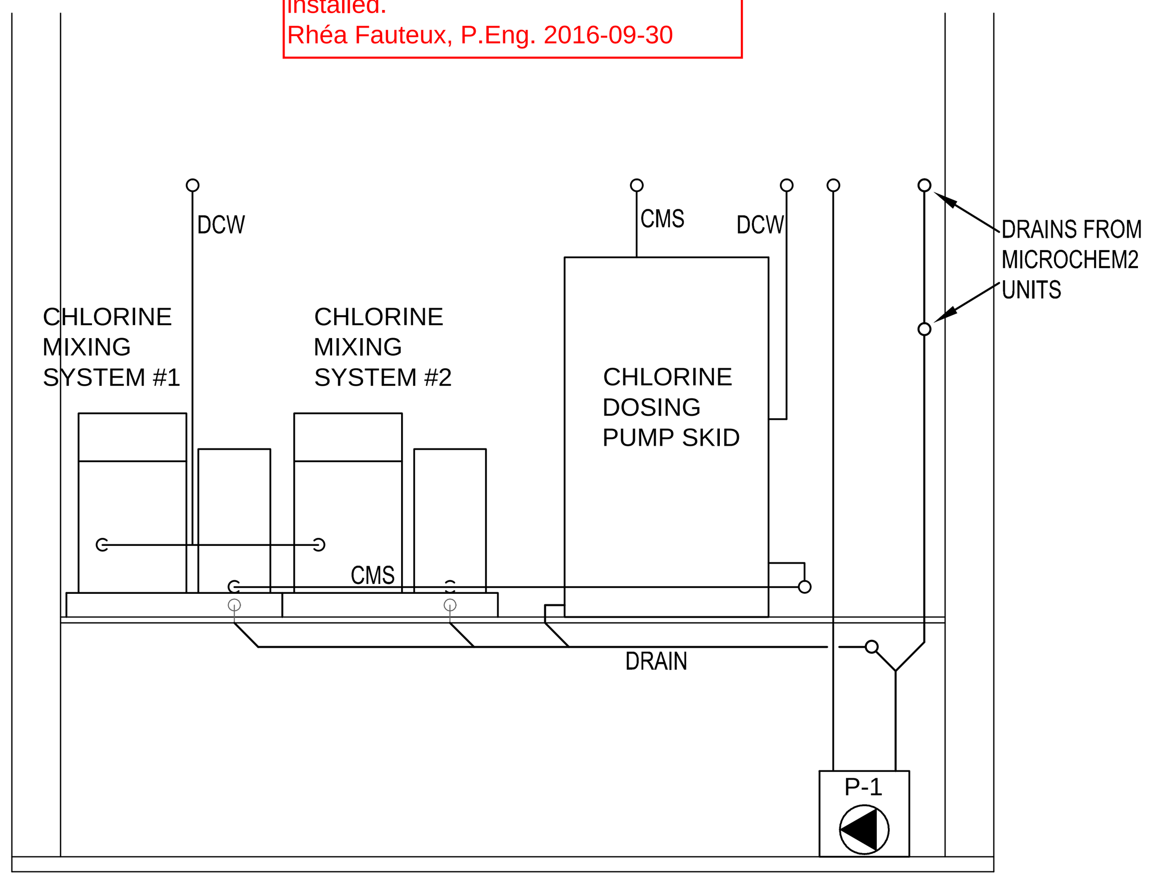
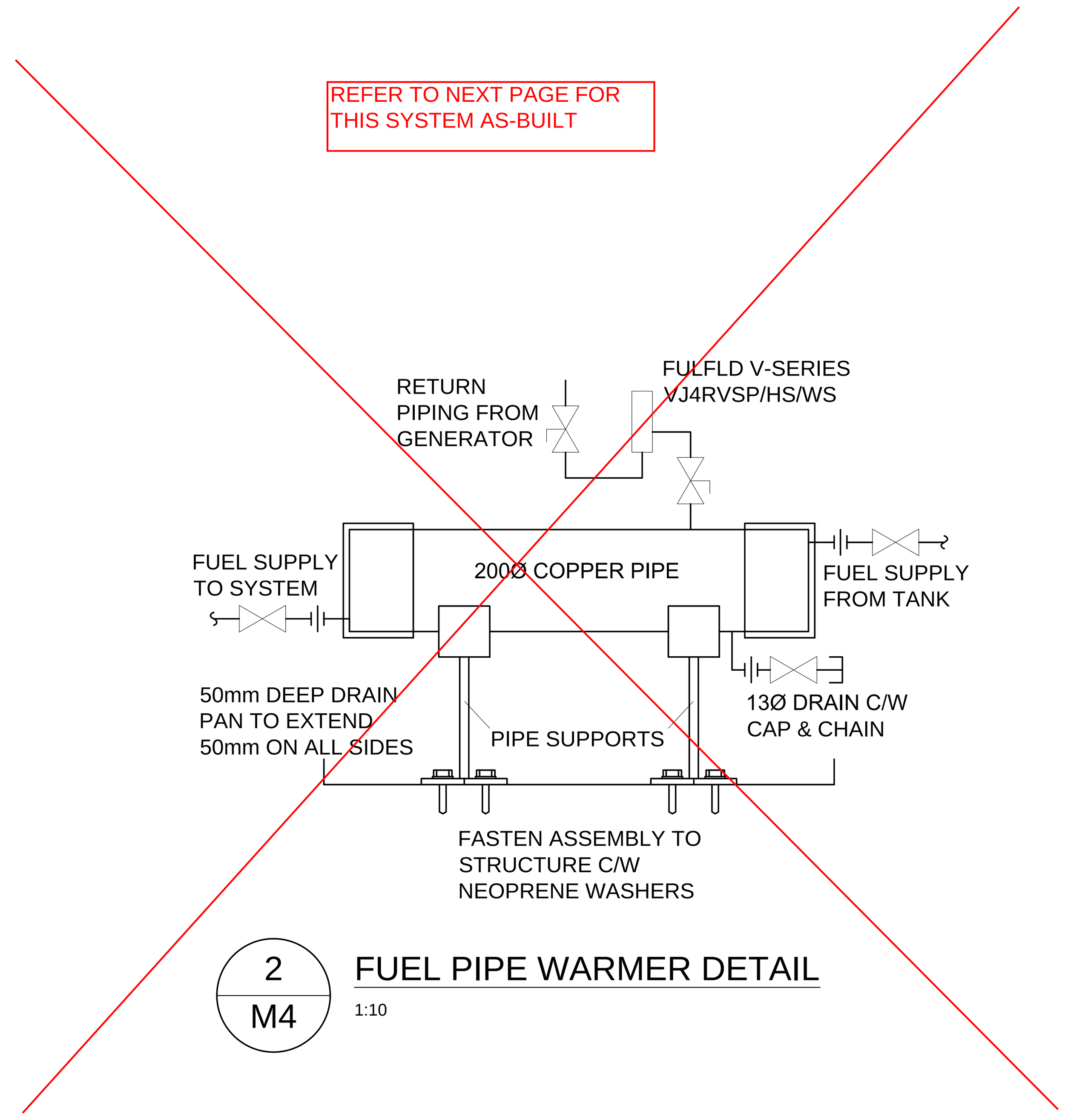


1 M4 CHEMICAL TANK DETAIL
1:25

REFER TO NEXT PAGE FOR THIS SYSTEM AS-BUILT



2 M4 FUEL PIPE WARMER DETAIL
1:10

1. SEQUENCE OF OPERATION DOMESTIC WATER PUMP (DWP):

a. THE DOMESTIC STORAGE TANK WILL BE FILLED BY ONE OF THE WATER TRUCKS VIA AN OUTSIDE INLET THAT WILL PERMIT THE FILLING OF THE TANK. THERE WILL BE A LOW WATER ALARM TO ADVISE THE OPERATOR THAT THE TANK IS LOW.
b. UPON A DROP IN PRESSURE, THE PUMP WILL START AND PROVIDE WATER TO BOTH THE SINK AND THE TO THE DOMESTIC HOT WATER TANK.
c. ONCE THE SUPPLY FIXTURES ARE CLOSED, THE PRESSURE IN THE SYSTEM WILL INCREASE AND SHUT OFF AT 40 PSIG AND SHUT OFF.

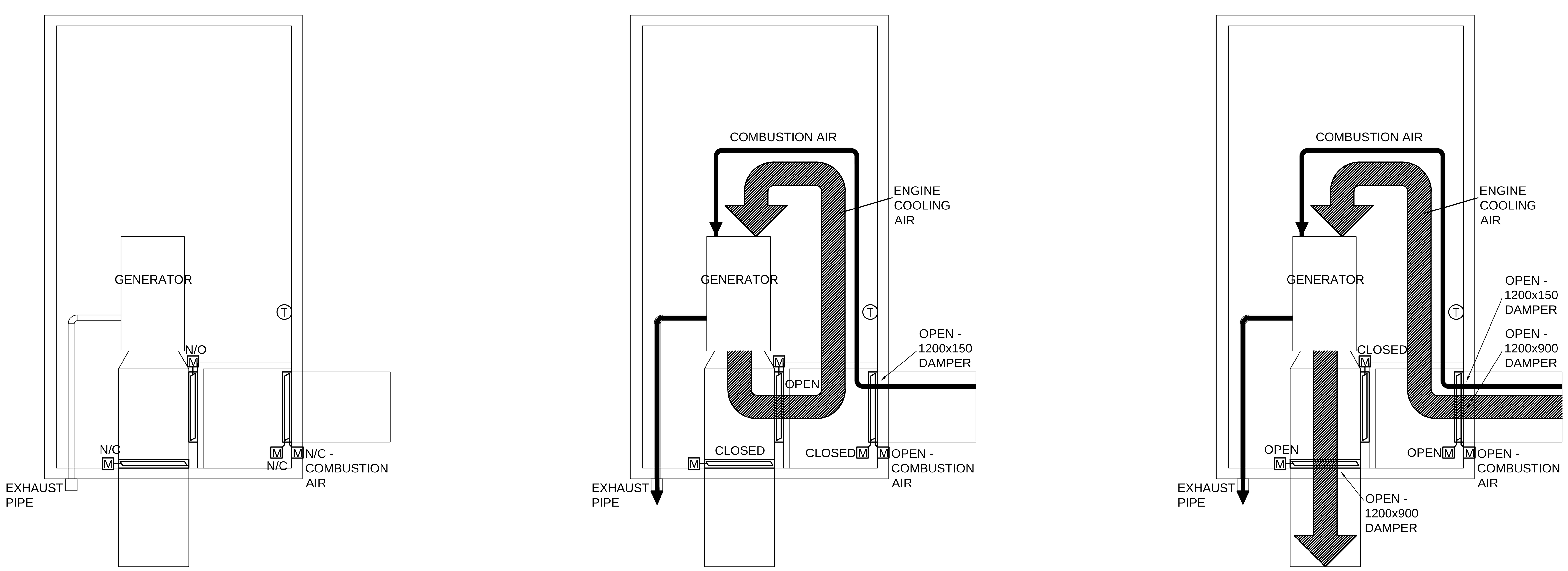
2. SEQUENCE OF OPERATION SUMP PUMP (SP-1):

a. THE DRAIN FROM THE SERVICE SINK AND THE FLOOR DRAINS WILL DRAIN INTO A SUMP PUMP PACKAGE THAT WILL DISCHARGE INTO A WASTEWATER STORAGE TANK. THERE WILL BE A HIGH WATER ALARM TO ADVISE THE OPERATOR OF WHEN THE TANK IS TO BE DRAINED OR IF THE PUMP FAILED TO START.

GENERATOR NOT RUNNING

GENERATOR RUNNING. ROOM IS COLDER THAN THERMOSTAT SET POINT

GENERATOR IS RUNNING. ROOM IS WARMER THAN THERMOSTAT SET POINT



AS-BUILT DRAWINGS :
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3 M4 GENERATOR SEQUENCE
NTS

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M.M. MALLET
APR 2014
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APPROVED BY: M.M.
DATE: JANUARY 2013

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CONSULTANT:
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DESIGNED BY:
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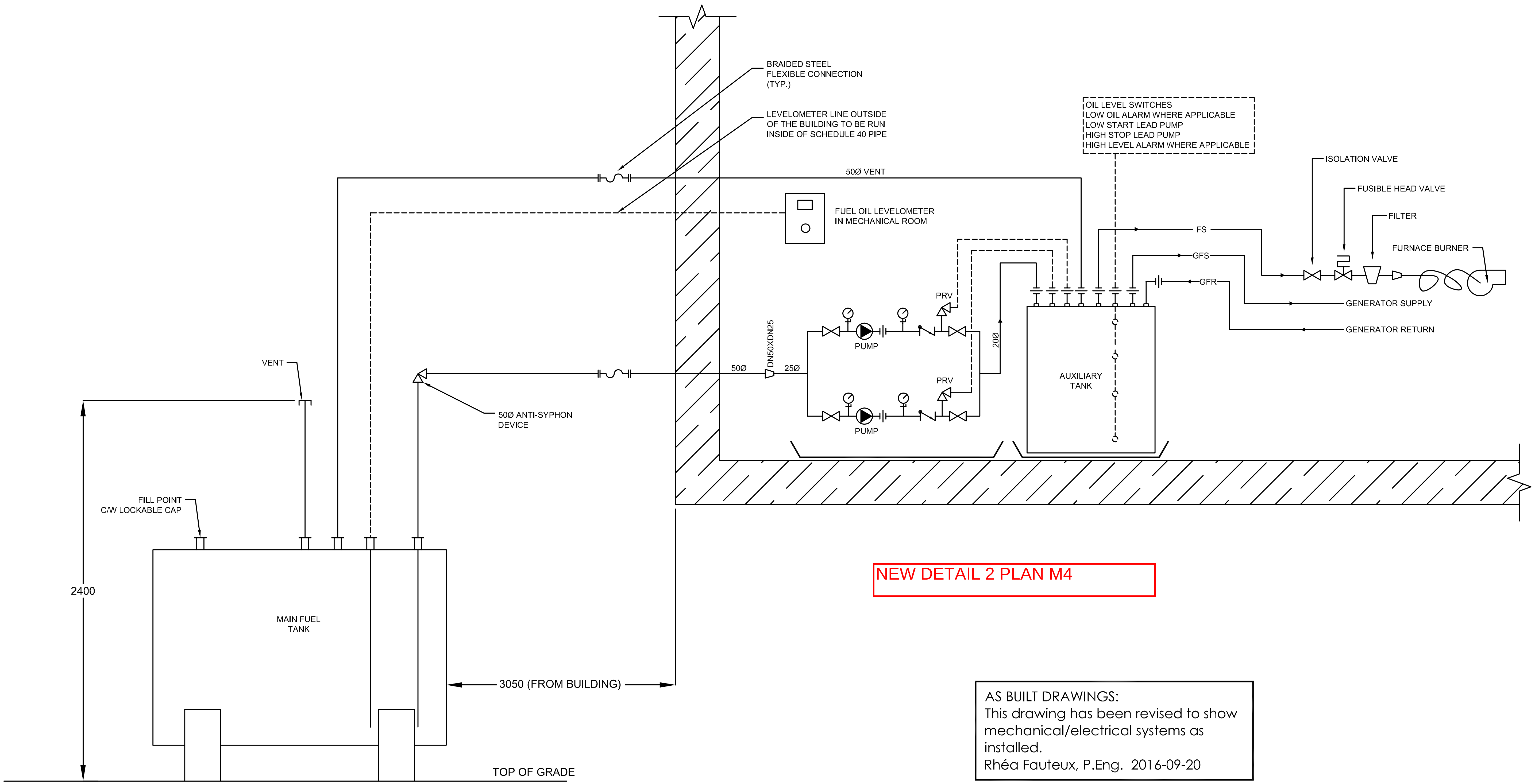
DATE:

LOCATION:
PANGNIRTUNG
QIKIQTAALUK REGION OF NUNAVUT
X0A 0R0

PROJECT:
OPTIMIZATION OF DRINKING WATER SUPPLY

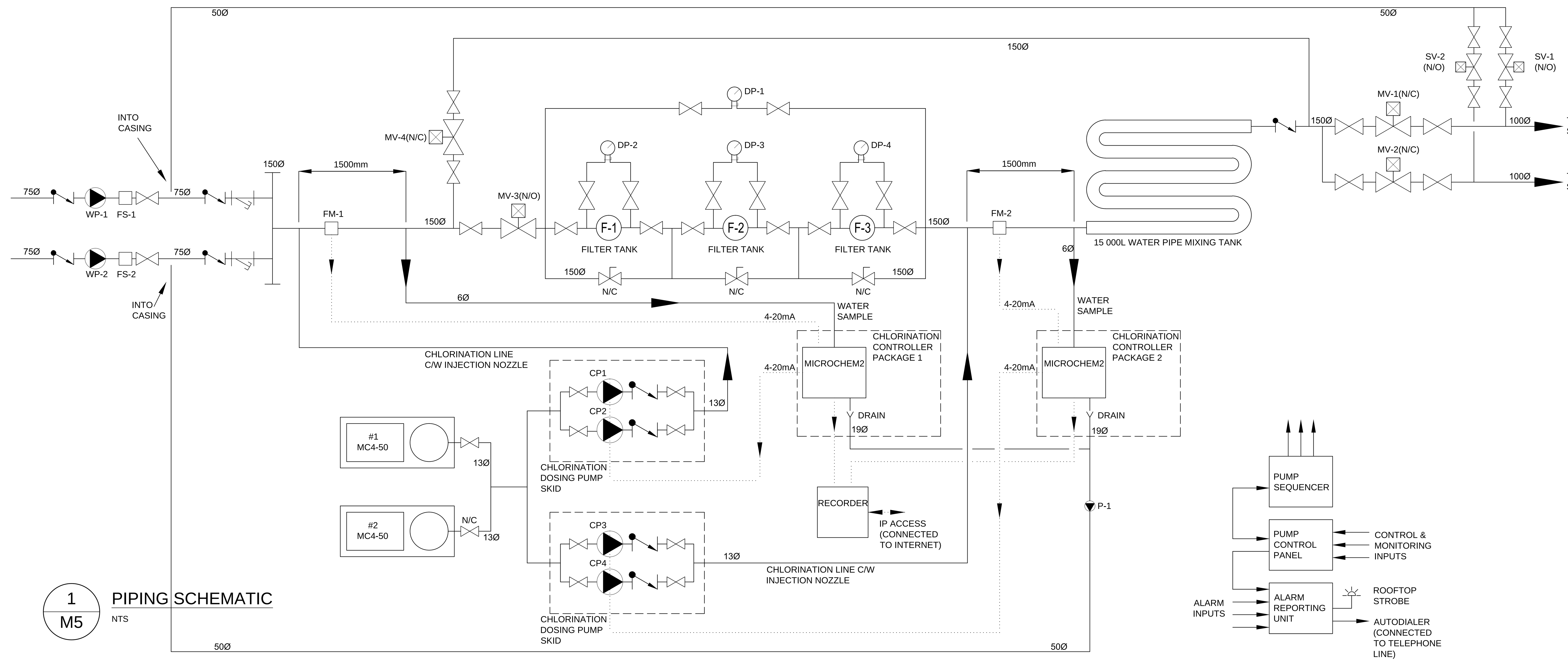
DRAWING TITLE:
MECHANICAL SECTIONS AND SCHEMATICS

MECH FILE NAME:	DWG NO:	OF:	SCALE:
13-072	M4	5	AS NOTED



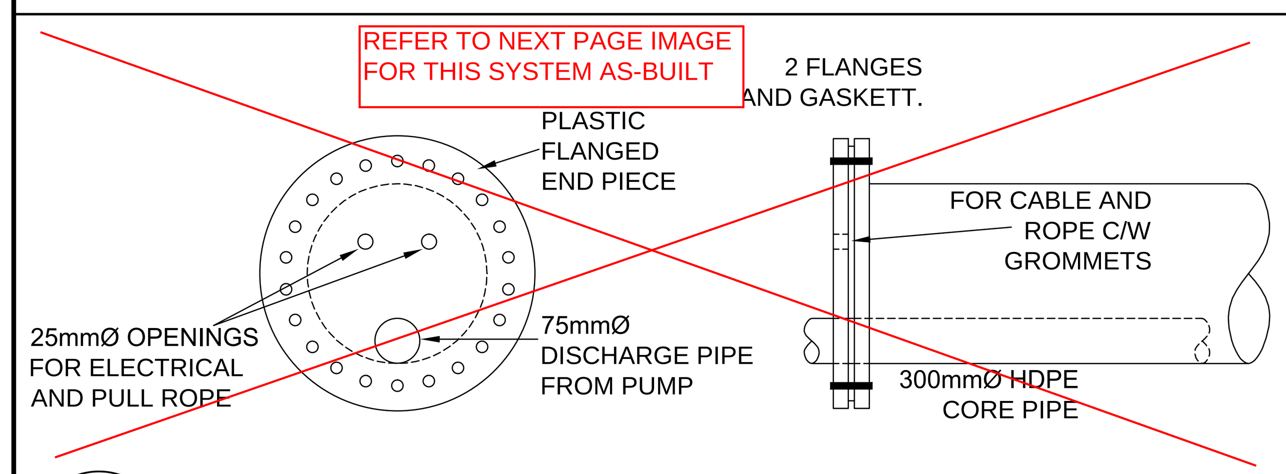
NEW DETAIL 2 PLAN M4

AS BUILT DRAWINGS:
This drawing has been revised to show mechanical/electrical systems as installed.
Rhéa Fauteux, P.Eng. 2016-09-20



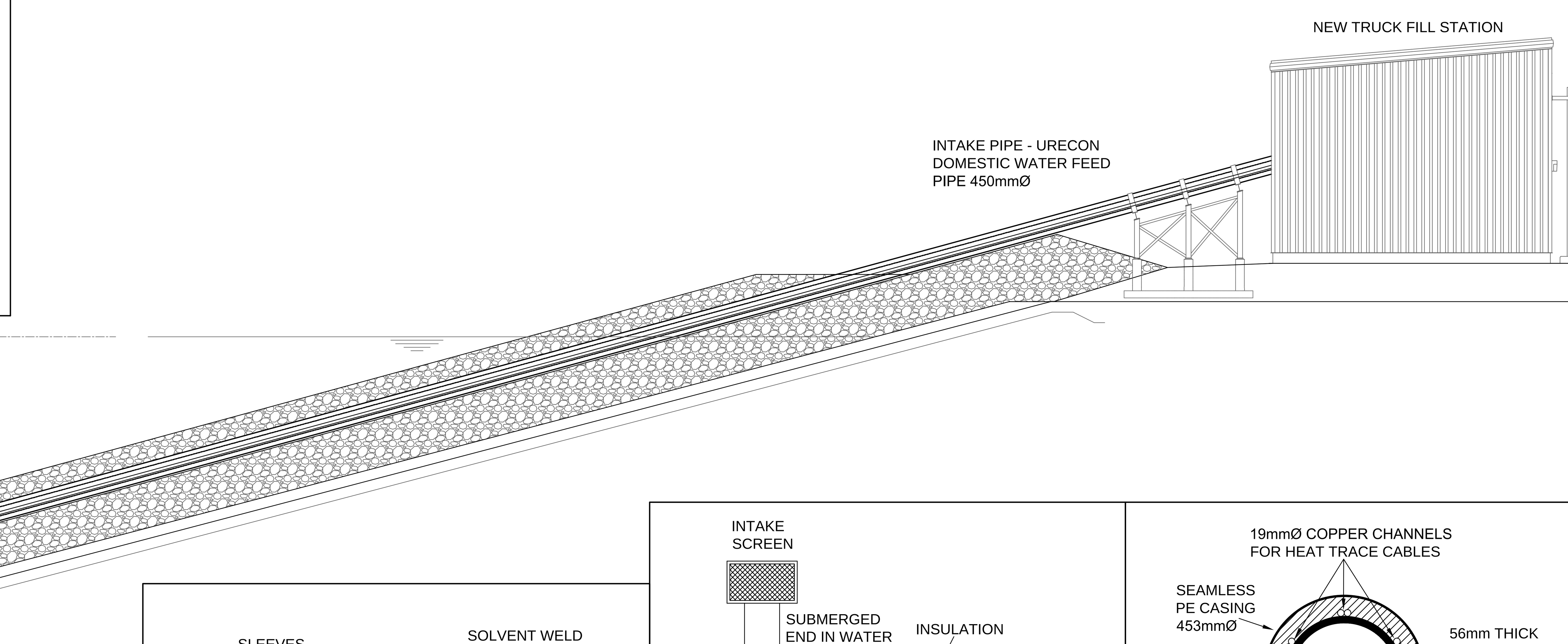
1 M5 PIPING SCHEMATIC

NTS



2 M5 END CAP DETAIL & SECTION

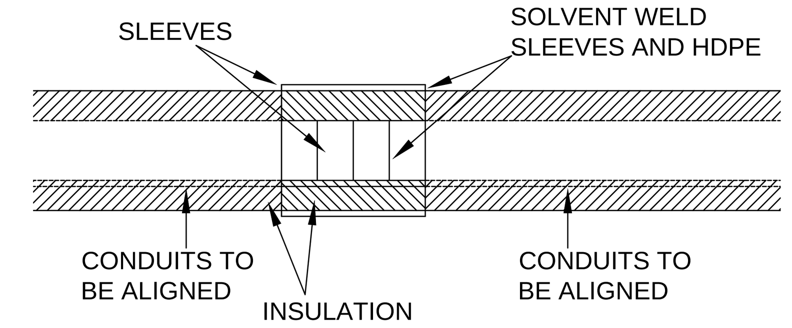
1:10



3 M5 INTAKE PIPE SECTION

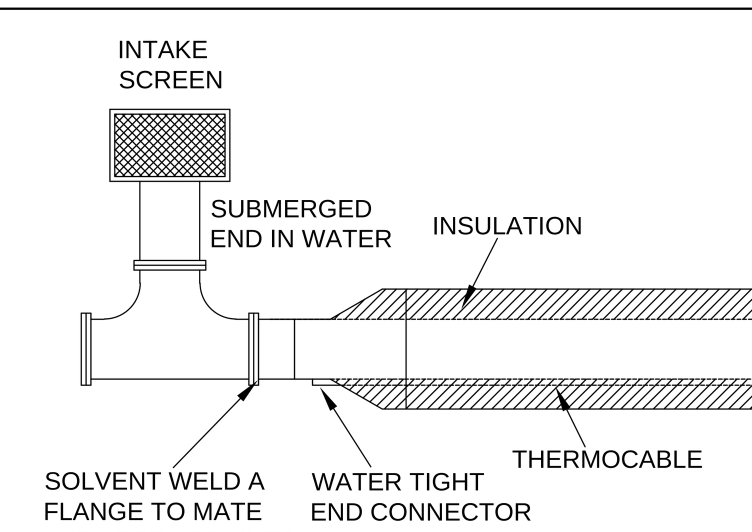
1:100

AS-BUILT DRAWINGS :
This drawing has been revised to show mechanical/electrical system as installed.
Rhéa Fauteux, P.Eng. 2016-09-30



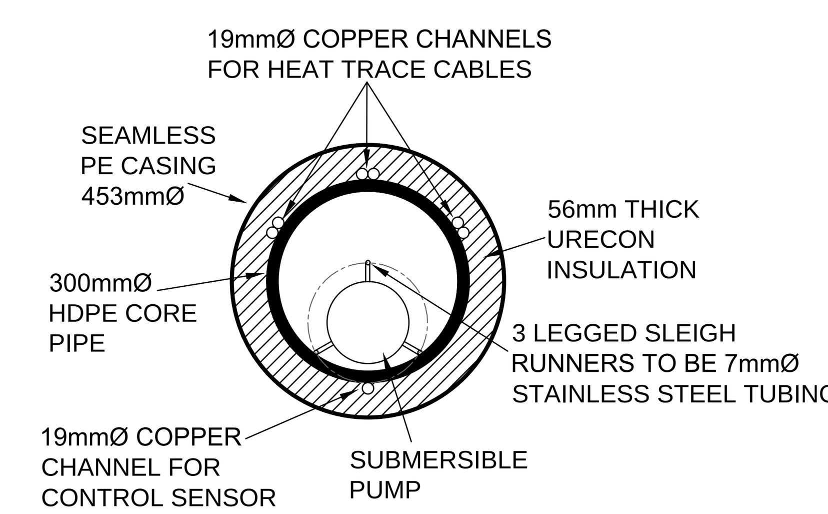
4 M5 INTAKE PIPE JOINT - TYPICAL

1:25



5 M5 SUBMERGED END CAP DETAIL

1:25



6 M5 INTAKE CROSS SECTION

1:10

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STAMP

REGISTERED PROFESSIONAL ENGINEER M.M. MAILLET APR 2014 NWT/NU

CONSULTANT: CEML
DRAWN BY: R.S.
DESIGNED BY: M.M.
APPROVED BY: M.M.
DATE: JANUARY 2013

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CONSULTANT:
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DESIGNED BY:
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DATE:

LOCATION:
PANGNIRTUNG
QIKIQTAALUK REGION OF NUNAVUT
X0A 0R0

PROJECT:
OPTIMIZATION OF DRINKING WATER SUPPLY

DRAWING TITLE:
MECHANICAL SECTIONS AND SCHEMATICS

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13-072	M5	5	AS NOTED

AS-BUILT DRAWINGS :
This drawing has been revised to show mechanical/electrical system as installed.
Rhéa Fauteux, P.Eng. 2016-09-30

2.4.2 Electrical plans

Plan E1

Plan E2

Plan E3

Plan E4

Plan E5

Plan E6

ELECTRICAL SCOPE OF WORK

ALL WORK SHALL BE CARRIED OUT IN ACCORDANCE WITH:

A) ELECTRICAL DRAWINGS 13-072 E1 THROUGH E6, NOTES AND SPECIFICATIONS
B) ALL APPLICABLE CODES, BYLAWS AND BEST-RECOMMENDED PRACTICES

FOR THE PURPOSES OF THIS PROJECT, 'PROVIDE' SHALL MEAN TO SUPPLY AND INSTALL.

FOR THE PURPOSES OF THIS PROJECT, 'DEMOLISH' SHALL MEAN MATERIALS AND EQUIPMENT ARE TO BE REMOVED FROM THEIR INSTALLED LOCATION AND DISPOSED OF, UNLESS MATERIAL IS RECYCLABLE, IN WHICH CASE IT SHALL BE SORTED IN FERROUS AND NON-FERROUS CONTAINERS SUPPLIED BY CONTRACTOR. THE REMAINDER SHALL BE CONSIDERED GARBAGE. CONTRACTOR SHALL BE RESPONSIBLE FOR DISPOSAL OF GARBAGE IN ACCORDANCE WITH CODES, STANDARDS AND REGULATIONS, AND PROVIDE HIS OWN WASTE REMOVAL SERVICES

WHERE MATERIALS AND EQUIPMENT ARE IDENTIFIED AS 'SALVAGE', THEY SHALL BE REMOVED FROM THEIR INSTALLED LOCATION WITHOUT DAMAGE AND HANDED TO THE OWNER AT THE DESIGNATED DROP LOCATION WITHIN THE FACILITY.

MAKE PRIOR ARRANGEMENTS AND CAREFULLY PLAN THE DISCONNECTING AND SHUT-DOWN OF ANY EQUIPMENT WITH OWNERS FACILITIES DEPARTMENT. GIVE MINIMUM 48 HOURS NOTICE OF ANY SHUT-DOWN.

IT IS THE RESPONSIBILITY OF THIS CONTRACTOR TO CAREFULLY COORDINATE HIS WORK WITH THAT OF OWNER'S STAFF FOR THE BEST SUCCESS OF THIS PROJECT.

CONTRACTOR TO:

A. VERIFY EQUIPMENT ROUTING.
B. VERIFY ALL DIMENSIONS PRIOR TO EQUIPMENT PURCHASE.
C. VERIFY ALL LIGHTING VOLTAGE PRIOR TO EQUIPMENT PURCHASE.
D. PROTECT BUILDING STRUCTURE FROM DAMAGE.
E. ENSURE ADJACENT AREAS ARE NOT AFFECTED BY ANY WORK ON THIS PROJECT.
F. RETURN ALL RECYCLABLE MATERIALS (COPPER, METAL, BUILDING WIRE, ETC) TO OWNER.
G. PROVIDE SEISMIC RESTRAINTS PER SPECIFICATION. PROVIDE STRUCTURAL DESIGN AND SHOP DRAWINGS, STAMPED BY STRUCTURAL ENGINEER.
H. SUBMIT FOUR (4) HARD COPIES OF EQUIPMENT SHOP DRAWINGS OR ELECTRONIC COPIES OF SHOP DRAWINGS FOR APPROVAL BY THE ENGINEER PRIOR TO COMMENCING ANY WORK OR ORDERING OF ANY EQUIPMENT.
I. OBTAIN RELATED PERMITS TO CARRY OUT THE WORK OF THIS PROJECT.

THE NUMBERS INSIDE HEXAGONS SHOWN ON THE PLANS REFER TO THE NUMBERED POINTS BELOW. NOT ALL POINTS ARE SHOWN ON THE PLANS.

1. MAKE ARRANGEMENTS WITH THE LOCAL POWER UTILITY TO DISCONNECT THE EXISTING SERVICE & RECONNECT THE NEW SERVICE ONCE NEW FACILITY IS COMPLETED.
2. PROVIDE BURIED CABLE AND CONDUIT BETWEEN EXISTING POWER POLE AND NEW TRUCK FILL STATION, AND BETWEEN NEW TRUCK FILL STATION AND OLD TRUCK FILL STATION; SIZED ACCORDING TO SINGLE LINE DIAGRAM.
3. PROVIDE MAIN 250A CIRCUIT BREAKER, CURRENT TRANSFORMER CABINET AND 13JAW REVENUE METER BASE.
4. PROVIDE MAIN PANELBOARD P-1 TO BE 120/208V/3PH/60CCT/400AF SURFACE MOUNT WITH 250A MAIN BREAKER. PROVIDE SUBPANEL P-2 TO BE 120/208V/3PH/30CCT/100AF SURFACE MOUNT TO BE PROTECTED BY 100A/3PH BREAKER IN PANEL P-1. PROVIDE TWO 120V/15A CIRCUIT BREAKERS IN PANEL P-2 AS SPARES.
5. PROVIDE GENSET FOR BACKUP EMERGENCY POWER. INCLUDED ARE GENSET CONTROLLER AND GENSET LOAD CENTRE. PROVIDE 260A-RATED AUTOMATIC TRANSFER SWITCH (ATS) TO SWITCH BETWEEN NORMAL GRID AND EMERGENCY BACKUP POWER. PROVIDE 208V/3P/30A CIRCUIT BREAKER IN PANEL P-2 FOR GENSET LOAD CENTRE.
6. PROVIDE WALL-MOUNTED THERMOSTAT (TS-1) TO CONTROL GENERATOR VENTILATION DAMPERS. PROVIDE 120V/15A CIRCUIT BREAKER IN PANEL P-2 AND PROVIDE WIRING TO DAMPER MOTORS.
7. PROVIDE COMBINATION BATTERY PACK/ PICTOGRAM EXIT SIGN/ DUAL-HEAD EMERGENCY LIGHT PACKS TO BE MOUNTED ABOVE DOORWAYS WHERE INDICATED. EMERGENCY LIGHTING CIRCUIT TO BE ON SAME CIRCUIT AS INTERIOR LIGHTING CIRCUIT ON PANEL P-2. PROVIDE 120V/15A DUPLEX RECEPTACLE ABOVE DOORWAY NEXT TO EACH COMBO PACK.
8. PROVIDE INTERIOR LIGHTING WHERE INDICATED. 'A' LUMINAIRES ARE TO BE SUSPENDED BY CHAINS AT 3m AFF. PROVIDE WALL-MOUNTED SWITCHES WHERE INDICATED. PROVIDE 120V/15A CIRCUIT BREAKER IN PANEL P-2 FOR INTERIOR LIGHTING.
9. PROVIDE EXTERIOR LIGHTING WHERE INDICATED. DESIGNATED 'B' LUMINAIRE ARE TO BE MOUNTED ADJACENT TO DOORWAY ENTRY AT TOP OF STAIRS. DESIGNATED 'C' LUMINAIRES ARE TO BE MOUNTED AT 4m AGL. OUTDOOR LIGHTS TO BE CONTROLLED BY COMBINATION OF PHOTOCELL AND TIMER. PROVIDE 120V/15A CIRCUIT BREAKER IN PANEL P-2 FOR EXTERIOR LIGHTING.
10. PROVIDE CONVENIENCE RECEPTACLES WHERE INDICATED, TO BE WALL-MOUNTED STANDARD 300mm AFF. PROVIDE TWO 120V/15A CIRCUIT BREAKERS IN PANEL P-2 FOR THE RECEPTACLE CIRCUITS. RECEPTACLES WITHIN 1.5m OF WATER ZONES TO BE GFCI PROTECTED.
11. PROVIDE DIRECT ELECTRICAL CONNECTION TO CEILING EXHAUST FAN (EF). EF TO BE CONNECTED TO SAME CIRCUIT AS INTERNAL LIGHTING AND ALWAYS POWERED 'ON'.
12. PROVIDE DIRECT ELECTRICAL CONNECTION TO BACKUP UNIT HEATERS UH-1 -- 5; EACH UNIT TO BE PROTECTED BY ITS OWN 208V/3P/15A CIRCUIT BREAKER IN PANEL P-1. UNITS TO BE INDIVIDUALLY CONTROLLED BY INTERNAL THERMOSTATS, SET TO 5°C LOWER THAN FURNACE THERMOSTAT. EACH UNIT SPECIFIED TO HAVE INTEGRAL DISCONNECT SWITCHES. PROVIDE WALL-MOUNT BRACKETS AND MOUNT UNITS BELOW MAXIMUM HEIGHT OF 8'.
13. PROVIDE 120V/15A CIRCUIT BREAKER IN PANEL P-2 FOR OIL-FIRED FURNACE. PROVIDE WALL SWITCH IN GENERATOR ROOM BETWEEN EXIT DOORWAY AND FURNACE UNIT, SEPARATE FROM ANY OTHER CONTROLS, AND LABELED AS "FURNACE SHUTOFF".
14. PROVIDE 120V/1P/15A CIRCUIT BREAKER IN PANEL P-2 FOR DUPLEX OIL PUMP CONTROLLER (DPC) IN GENERATOR ROOM. PROVIDE DIRECT ELECTRICAL CONNECTION TO DPC, TO BE SPECIFIED AS HAVING INCLUDED DISCONNECT SWITCH.
15. PROVIDE 120V/25A CIRCUIT BREAKER IN PANEL P-2 FOR DOMESTIC WATER PUMP (DWP). PROVIDE DIRECT ELECTRICAL CONNECTION TO DWP.
16. PROVIDE 208V/3P/15A CIRCUIT BREAKER IN PANEL P-1 FOR DOMESTIC HOT WATER TANK (DHWT). PROVIDE DIRECT ELECTRICAL CONNECTION TO DHWT WHERE INDICATED.
17. PROVIDE TWO 120V/15A CIRCUIT BREAKERS IN PANEL P-2 FOR TWO PUMPS (SP-1, & P-1). PROVIDE DEDICATED WALL-MOUNTED 120V GFCI-PROTECTED DUPLEX OUTLETS AT EACH PUMP LOCATION.
18. PROVIDE 120V/20A CIRCUIT BREAKER IN PANEL P-2 AND DEDICATED CSA CONFIGURATION 5-20R RECEPTACLE FOR CHLORINE MIXING SYSTEM (CMS) SKID. A BACKUP UNIT IS TO BE PROVIDED BUT ONLY ONE POWERED AT A TIME.
19. PROVIDE 120V/15A CIRCUIT BREAKER IN PANEL P-2 FOR DIRECT ELECTRICAL CONNECTION TO CHLORINE DOSING PUMP (CDP) SKIDS. SKID INCLUDES QUAD RECEPTACLE FOR CONNECTION TO DOSING PUMPS AND CHLORINATION CONTROLLER PANELS (CCP).
20. PROVIDE TWO 208V/2P/30A CIRCUIT BREAKERS IN PANEL P-1 FOR HEAT TRACE CONTROLLERS (HTC-1 - 2). PROVIDE DEDICATED ELECTRICAL CONNECTION TO EACH HTC. EACH WATER INTAKE PIPE TO ALSO INCLUDE A THERMAL SENSOR KIT C/W 3 TEMPERATURE PROBES FOR CONTROL AND PROTECTION.
21. PROVIDE TWO 208V/3/80A TIME DELAY CIRCUIT BREAKERS IN PANEL P-1 FOR SUBMERSIBLE WATER PUMPS (WP-1 AND WP-2). PROVIDE DIRECT ELECTRICAL CONNECTION TO EACH PUMP. PUMPS ARE TO BE CONTROLLED BY PUMP SEQUENCER UNIT, LOCATED AS SHOWN.
22. PROVIDE 120V/15A CIRCUIT BREAKER IN PANEL P-2 FOR ALARM CONTROL PANEL. PROVIDE 120V/15A DUPLEX RECEPTACLE FOR CONNECTION TO INCLUDED AC ADAPTER.
23. PROVIDE WALL-MOUNTED TELEPHONE JACK FOR CONNECTION TO AUTODIALER OF ALARM REPORTING UNIT. WIRE PHONE JACK BACK TO TELEPHONE DEMARCATION POINT OF BUILDING.
24. PROVIDE AMBER STROBE WARNING LIGHT TO BE MOUNTED EXTERIOR ABOVE LEVEL OF OUTDOOR LUMINAIRE 'B' AT FRONT CORNER OF BUILDING AS SHOWN. UNIT WILL FLASH IF ALARM CONTROLLER DETECTS ANY ALARM CONDITION.
25. PROVIDE EXTERIOR RATED WARNING LIGHT TO INDICATE WASTE WATER STORAGE TANK IS FULL.
26. PROVIDE CEILING-MOUNTED HEAT-DETECTORS IN EACH ROOM AS SHOWN. PUMP ROOM AND CHEMICAL MIXING ROOM ARE TO HAVE FIXED TEMPERATURE 135F UNITS AND GENERATOR ROOM IS TO HAVE FIXED TEMPERATURE 200F UNIT. PROVIDE LOW-VOLTAGE WIRING FOR CONNECTION BACK TO ALARM PANELBOARD.
27. PROVIDE WALL-MOUNTED THERMOSTAT TS-2 FOR LOW-TEMPERATURE ALARM AT LOCATION SHOWN. PROVIDE LOW-VOLTAGE WIRING TO ALARM PANELBOARD.
28. PROVIDE WEATHERPROOF CONTROL BOXES TO BE MOUNTED AT TRUCK TOP HEIGHT. PROVIDE STOP AND START PUSHBUTTONS, IN-USE INDICATOR LIGHTS, FIRE PUSHBUTTON AND FIRE STROBE LIGHT AND LINE-VOLTAGE CONNECTIONS BACK TO PUMP CONTROL PANELBOARD.
29. PROVIDE ALL NECESSARY CONTROL DEVICES AS DESCRIBED IN E5-1 SCHEMATIC (LOW-VOLTAGE TRANSFORMER, RELAYS, PUSHBUTTONS, SWITCHES, MOTORIZED VALVES, INDICATOR LIGHTS) AND CONNECTIONS BETWEEN DEVICES, ALARM REPORTING UNIT, EXPANDER & POWER SUPPLY AND PUMP CONTROL PANEL.
30. ONCE NEW TRUCK FILL STATION HAS BEEN COMMISSIONED, DEMOLISH ALL ELECTRICAL EQUIPMENT, WIRING AND CONDUIT IN OLD FILL STATION BUILDING.
31. PROVIDE NEW PANELBOARD PA-1 IN OLD PUMP STATION TO BE 120/208V/3PH/24CCT/60AF SURFACE-MOUNT. PROVIDE BURIED CONNECTION BACK TO PANEL P-1 AND PROVIDE 208V/3P/60A BREAKER IN PANEL P-1. PROVIDE TWO 120V/15A CIRCUIT BREAKERS IN PANEL PA-1 AS SPARES.
32. PROVIDE INTERIOR LIGHTING OF LUMINAIRE TYPE 'A', TO BE CHAIN-SUSPENDED FROM CEILING AT 3m AFF. PROVIDE WALL-MOUNTED LIGHT SWITCHES WHERE INDICATED. PROVIDE 120V/15A CIRCUIT BREAKER IN PANEL PA-1 FOR INTERIOR LIGHTING.
33. PROVIDE COMBINATION BATTERY PACK/ PICTOGRAM EXIT SIGN, DUAL-HEAD EMERGENCY LIGHTS TO BE MOUNTED DIRECTLY ABOVE DOORWAYS. POWER TO BE ON SAME CIRCUIT AS INTERIOR LIGHTING. PROVIDE DUPLEX 120V RECEPTACLES TO BE WALL-MOUNTED NEXT TO EACH COMBO UNIT.
34. PROVIDE WALL-MOUNTED CONVENIENCE RECEPTACLES WHERE INDICATED, TO BE WALL-MOUNTED AT 300mm AFF. PROVIDE TWO 120V/15A CIRCUIT BREAKERS IN PANEL P-2 TO POWER RECEPTACLES IN EACH ROOM.
35. PROVIDE INTERNET CONNECTION, WALL JACK AND REQUIRED ETHERNET CABLING FOR DATA RECORDER.
36. TRACE ALL CIRCUITS OF PANELBOARDS RELATED TO THIS PROJECT AND PROVIDE NEATLY TYPED, UPDATED CIRCUIT DIRECTORIES IN A PLASTIC HOLDER ON THE INSIDE DOORS OF ALL PANELBOARDS, WITH COPY IN MANUAL.
37. IDENTIFY AND LABEL EACH DEDICATED RECEPTACLE FOR ITS INTENDED USE ONLY.
38. IDENTIFY ALL PULL BOXES, JUNCTION BOXES, FIXTURES, CONTROL PANELS, MOTOR STARTERS, AND DISCONNECT SWITCHES WITH PERMANENT MARKER IDENTIFICATION INDICATING PANEL AND CIRCUIT NUMBERS.
39. CLEAN AREA OF ANY DEBRIS CREATED DURING DEMOLITION WORK.
40. AFTER CONSTRUCTION COMPLETION, MARK UP DRAWINGS INDICATING ANY AND ALL DEVIATIONS FROM THE DRAWINGS AND PROVIDE TWO COPIES TO OWNER.

ELECTRICAL SYMBOL LEGEND

SYMBOL	DESCRIPTION
A	TYPE 'A' LIGHT FIXTURE ROUGH SERVICE CEILING/SUSPEND MOUNT 79W, 5725lm, 4100K, CRI65, ASYMMETRIC BEAM, MVOLT DRIVER
B	TYPE 'B' LIGHT FIXTURE EXTERIOR WALL-PACK 19W, 1017lm, 5000K, 120V, PHOTOELECTRIC CELL, DARK BRONZE FINISH
C	TYPE 'C' LIGHT FIXTURE EXTERIOR WALL-PACK 45W, 3149lm, 5000K, 120V, PHOTOELECTRIC CELL, DARK BRONZE FINISH
STROBE	PENDANT-MOUNT STROBE WARNING LIGHT, WEATHERPROOF 12W, 2Mcp, 60fl/min, 90-130VAC, 3/4" CONDUIT ENTRY, AMBER LENS
E	COMBO ALUMINUM 6V 36W CAPACITY BATTERY UNIT W/ 2x PAR18 4W LED HEADS, LED BACKLIT PICTOGRAM SIGN, 120/347VAC INPUT
$	SINGLE POLE WALL-MOUNT SWITCH
	WALL-MOUNT DUPLEX RECEPTACLE CSA CONFIGURATION 5-15R
	WALL-MOUNT DUPLEX RECEPTACLE CSA CONFIGURATION 5-15R ON DEDICATED CIRCUIT
	WALL-MOUNT DUPLEX RECEPTACLE WITH INTEGRAL GFCI PROTECTION
	WALL-MOUNT DUPLEX RECEPTACLE WITH INTEGRAL GFCI ON DEDICATED CIRCUIT
	WALL-MOUNT QUAD RECEPTACLE CSA CONFIGURATION 5-15R
	WALL-MOUNT SPECIAL PURPOSE DIRECT CONNECTION TO EQUIPMENT VOLTAGE, NUMBER OF PHASES AND CIRCUIT BREAKER AMPERAGE AS STATED
▼	TELEPHONE JACK WALL-MOUNT
▽	DATA JACK WALL-MOUNT
	ELECTRICAL DISTRIBUTION PANEL
	ELECTRICAL POWER PANEL
	ELECTRICAL PANEL, LOW-VOLTAGE OR SPECIAL-PURPOSE
kWh	WATT-HOUR REVENUE METER
G	EMERGENCY DIESEL ENGINE-GENERATOR SET 208V 3ϕ 60Hz 80kW 100kVA 278A
	AUTOMATIC TRANSFER SWITCH SOLID NEUTRAL, 3-POLE, 3ϕ, 260A, 208V, C/W WINDOW KIT
UF	UNFUSED DISCONNECT SWITCH
	MOTOR, SINGLE-PHASE
	MOTOR, THREE-PHASE
EF	EXHAUST FAN CEILING-MOUNTED
	HEAT DETECTOR CEILING-MOUNTED
T	THERMOSTAT, WALL-MOUNT
FS	FLOW SWITCH
	LEVEL SWITCH
	MOTORIZED VALVE
DP	DIFFERENTIAL PRESSURE METER
	FLOW METER
M	MOTORIZED DAMPER
M	MOTORIZED DAMPER PARALLEL BLADE
	HEAT TRACE CABLE
HTC	HEAT TRACE CONTROLLER
	UNIT HEATERS UH-1--5 4.0kW, 208V 3ϕ 11.2A, INTERNAL THERMOSTAT, 40A DISCONNECT SWITCH

EQUIPMENT LIST

1. MB, MAIN BREAKER, 250 AMPS, 250V, 3 POLE BREAKER IN A NEMA 4 ENCLOSURE, IR PER SPEC
2. G, EMERGENCY GENERATOR, DIESEL ENGINE-GENERATOR, STANDBY, AIR CHARGED-AIR COOLED, 3 PHASE, 120/208 V, 80KW, 100 KVA, C/W MAIN BREAKER, LOAD CENTRE AND GFI RECEPTACLE, COMPLETE WITH AN INTEGRATED CONTROLLER, BATTERY CHARGER AND STARTING BATTERIES, BLOCK HEATER AND FIRE ALARM CAPABLE CONTROL PANEL WITH TROUBLESHOOTING AND MAINTENANCE ASSISTANCE CAPABILITIES. MONITORING THE FOLLOWING: VOLTAGES, FREQUENCY, CURRENTS, KILOWATTS AND THE FOLLOWING ALARMS AND FAULTS: LOW OIL PRESSURE, LOW OIL LEVEL, LOW COOLANT LEVEL, HIGH ENGINE TEMPERATURE, NO START UP, ENGINE OVER-SPEED, MIN./MAX. ALTERNATOR VOLTAGE, MIN./MAX. BATTERY VOLTAGE AND EMERGENCY STOP AND THE FOLLOWING ENGINE PARAMETERS: HOURS COUNTER, OIL PRESSURE, COOLANT TEMPERATURE, ENGINE SPEED, BATTERY VOLTAGE, BATTERY CHARGING AMPS, ROOM TEMPERATURE AND STATUS OF COOLANT HEATER (CURRENT)..
3. ATS, AUTOMATIC TRANSFER SWITCH, SOLID NEUTRAL, 3 POLE, 3 PHASE, 120/208 V, 260 AMPS, C/W WINDOW KIT, ASCO CAT. NUMBER: 300 3 260 C 1 C 123 120/208V, 60 HZ, OR EQUIVALENT, IR PER SPEC, MONITORING THE FOLLOWING: A.T.S. POSITION, VOLTAGES, FREQUENCY AND CURRENTS, KILOWATTS, ATS TROUBLE.
4. P1, PANEL BOARD, 120/208V, 3 PHASE, 4 WIRE, 400 AMP FRAME, SURFACE MOUNT, 60 CIRCUITS, NEMA 4 ENCLOSURE. C/W 250A/3P MAIN BREAKER AND THE FOLLOWING LOAD BREAKERS: 100A/3P, 2X 80A/3P TIME DELAY, 60A/3P, 2X 30A/2P, 7X 15A/3P. IRS PER SPEC.
5. P2, PANEL BOARD, 120/208V, 3 PHASE, 4 WIRE, 100 AMP FRAME, 30 CIRCUITS, SURFACE MOUNT, NEMA 4 ENCLOSURE. C/W THE FOLLOWING LOAD BREAKERS: 30A/2P, 25A/1P, 20A/1P AND 13X 15A/1P. IRS PER SPEC
6. PA-1, PANEL BOARD, 120/208V, 3 PHASE, 4 WIRE, 60 AMP FRAME, 24 CIRCUITS, SURFACE MOUNT, NEMA 4 ENCLOSURE. C/W THE FOLLOWING LOAD BREAKERS: 4X 15A/1P. IRS PER SPEC
7. UH-1 TO 5, 4kW 208V 3PHASE UNIT HEATER, C/W INTERNAL THERMOSTAT AND 40A DISCONNECT SWITCH. CHROMOLOX MODEL NUMBER: LUH-04-83-34-40-1. C/W WALL-MOUNT BRACKET MODEL NUMBER: WUH-01A
8. LIGHT 'A': SUSPEND MOUNT LED ROUGH SERVICE FIXTURE, LITHONIA LIGHTING MODEL NUMBER: VAP 79LED ASY, C/W 8' CHAIN MOUNT BRACKET MODEL: VAPCMB MSI8
9. LIGHT 'B': 19W 1017LM LED WALL LUMINAIRE C/W PHOTOCELL, LITHONIA LIGHTING MODEL NUMBER: TWS LED 1 50K 120 PE
10. LIGHT 'C': 45W 3149LM LED WALL LUMINAIRE C/W PHOTOCELL, LITHONIA LIGHTING MODEL NUMBER: TWP LED 20C 700 50K T3M 120 PE DDBXD
11. EXIT SIGNS: COMBO ALUMINUM LED PICTOGRAM EXIT SIGN, DUAL HEAD 4W PAR18 LED LIGHTS AND 36W BATTERY PACK, AIMLITE MODEL: CARPW0636 U M-2SM4LJ WHT/ATD
12. ALARM REPORTING UNIT: BARNETT ENGINEERING MODEL: B1290 PROTALK PLUS, C/W ONE EXPANDER UNIT MODEL: B1292 AND ONE BATTERY BACKUP POWER SUPPLY MODEL: OPTION 004
13. STROBE: PENDANT-MOUNT STROBE WARNING LIGHT, WEATHERPROOF, ¾" CONDUIT ENTRY, AMBER LENS. APPLIED STROBE TECHNOLOGY MODEL: AST-2-90-130-AC-AM
14. FIRE BEACON: RED, FLASHING LED, 24V AC/DC, WERMA SIGNALTECHNIK PART NUMBER: 22410075
15. HD-1 TO 2, FIXED TEMPERATURE 135F MOISTURE-PROOF HEAT DETECTOR, MIRCOM MODEL: CF-135MP
16. HD-3: FIXED TEMPERATURE 200F MOISTURE-PROOF HEAT DETECTOR, MIRCOM MODEL: CF-200MP
17. K0 TO 3: 4PDT, 120VAC COIL RELAY
18. K4 TO 5: 4PDT, 24VAC COIL RELAY
19. HTC-1 TO 2: HEAT TRACE CONTROLLER, URECON MODEL NUMBER: UTC-2030-11, WITH GROUND FAULT DETECTION CIRCUITRY, 120-240VAC, 30A, 2 POLES IN A NEMA 4 PAINTED STEEL ENCLOSURE. CONTROLS FACTORY SET @ 3°C AND HIGH LIMIT: 65°C FOR PROTECTION OF PLASTIC PIPING. EACH HTC TO CONTROL: 2 HEAT TRACE CABLES, AND 3 RTD TEMPERATURE SENSORS, PER INTAKE PIPE. FOR INSTALLATION DETAILS OF HEAT TRACE COMPONENTS SEE: SPEC 224201_13-072 REV PLUMBING SPECIALTIES AND ACCESSORIES, SECTION 2.8: INTAKE PIPES.
20. HEAT TRACE CABLES: THERMOCABLE MODEL# C13-240-COJ, 12AWG BUS WIRES WITH OUTPUT OF 9.75 W/m @ 208VAC AND MAXIMUM CIRCUIT LENGTH OF 220m. EACH INTAKE PIPE TO HAVE A REDUNDANT SET OF THREE SPARE HEAT TRACE CABLES PULLED UPON INSTALLATION.
21. 100 Ω RTD TEMPERATURE SENSOR URECON MODEL: ERTD-15-G WITH 15 m OF GREY PVC LEAD WIRE.
22. 100 Ω RTD TEMPERATURE SENSOR URECON MODEL: ERTD-15-R WITH 15 m OF RED PVC LEAD WIRE.
23. 100 Ω RTD TEMPERATURE SENSOR URECON MODEL: ERTD-30-G WITH 30 m OF GREY PVC LEAD WIRE.

AS-BUILT DRAWINGS :
This drawing has been revised to show mechanical/electrical system as installed.
Rhéa Fauteux, P.Eng. 2016-09-30

PUMP STATION OVERVIEW:

MAJOR COMPONENTS:

1. PUMP SEQUENCER: ITS FUNCTION IS TO SEQUENCE THE 2 SUBMERSIBLE PUMPS (WP-1 AND WP-2), SO THAT EACH PUMP IS EXERCISED EQUALLY OVER TIME.
IN CASE OF A PUMP FAILURE (DETERMINED BY THE RELEVANT FLOW SWITCH FS-1 OR FS-2), THE SEQUENCE SWITCHES TO THE NEXT AVAILABLE PUMP AND INITIATES AN ALARM CONDITION.
2. PUMP CONTROLLER: IT TIES ALL CONTROL DEVICES AND SENSORS TOGETHER. THE CONTROL LIGHTS INDICATE WHICH FILLING STATION IS IN USE AND WHICH PUMP IS RUNNING. IT ALSO INDICATES SOME OF THE ALARM CONDITIONS AND PROVIDES AN EMERGENCY POWER OFF AND RESET PUSHBUTTONS.
3. ALARM REPORTING UNIT: ITS FUNCTION IS TO TURN ON THE ROOFTOP STROBE AT ANY OF THE 10 ALARM CONDITIONS AND TO DIAL PRE-PROGRAMMED PHONE NUMBERS WITH A RECORDED MESSAGE WARNING OF THE ALARM CONDITION.

OPERATION:

4. DEPRESSING THE “ON” PUSHBUTTON OF FILLING STATION #1 LOCATED ON THE FILLING ARM WILL START THE CHLORINATION LOOP, CLOSE VALVE SV-1 AND OPEN MV-1. THIS OPERATION TAKES APPROX. 3 SECONDS. AFTER A 3 SECOND DELAY, THE PUMP SEQUENCER STARTS THE “NEXT” AVAILABLE PUMP. DEPRESSING THE SAME “ON” PUSHBUTTON AGAIN WILL HAVE NO IMPACT.
5. PUMPING MUST BE STOPPED BY DEPRESSING THE “OFF” PUSHBUTTON OF FILLING STATION #1. DEPRESSING THE “OFF” PUSHBUTTON WILL STOP THE CHLORINATION AND THE PUMP IT STARTED. IT ALSO CLOSES VALVE MV-1 AND OPENS VALVE SV-1 WHICH DRAINS THE OUTSIDE PORTION OF THE FILL ARM.
6. THE PROCESS IS IDENTICAL FOR FILL STATION #2 (EXCEPT IT WORKS WITH VALVES MV-2 AND SV-2).

THE CHLORINATION LOOP:

7. THE MICROCHEM2 CHLORINE CONTROLLER PACKAGE (CCP-1) IS THE CONTROLLING UNIT FOR THE PRIMARY CHLORINATION PROCESS. SINCE THE WATER FLOW IN THE MAIN 100mm WATER PIPE CAN VARY DEPENDING ON WHETHER 1 OR 2 WATER PUMPS ARE RUNNING, THE CONDITION OF THE FILTERS AND WATER LEVEL IN THE LAGOON, THE FLOW IS PRECISELY MEASURED BY THE FLOW METER (FM-1). THE CCP-1 SENDS A 4-20mA SIGNAL TO ITS CHLORINE DOSING PUMP (CDP-1) THAT IS PROPORTIONAL TO THE WATER FLOW MEASURED BY FM-1. A WATER SAMPLE IS TESTED CONTINUALLY BY CHLORINATION AND pH/TEMPERATURE PROBES CONNECTED TO CCP-1 AND CCP-1 WILL ADJUST THE AMOUNT OF CHLORINE PUMPED BY CDP-1 TO ENSURE THE REQUIRED LEVEL OF PRIMARY CHLORINATION.
8. CCP-2 IS A POST-CHLORINATION LOOP IDENTICAL TO CCP-1. ITS FUNCTION IS TO CHECK CHLORINATION LEVEL OF WATER DELIVERED TO TRUCKS AND ADD CHLORINE IF REQUIRED. THE FLOW IS PRECISELY MEASURED BY THE FLOW METER (FM-2). THE CCP-2 SENDS A 4-20mA SIGNAL TO ITS CHLORINE DOSING PUMP (CDP-2) THAT IS PROPORTIONAL TO THE WATER FLOW MEASURED BY FM-2. A WATER SAMPLE IS TESTED CONTINUALLY BY CHLORINATION AND pH/TEMPERATURE PROBES CONNECTED TO CCP-2 AND CCP-2 WILL ADJUST THE AMOUNT OF CHLORINE PUMPED BY CDP-2 TO ENSURE THE REQUIRED LEVEL OF POST-CHLORINATION.
9. THE INFORMATION GATHERED BY CCP-1 AND CCP-2 (WATER DELIVERY, CHLORINATION AND pH LEVELS, TEMPERATURE) CAN BE STORED IN THE DATA RECORDER AND ACCESSED THROUGH A USB PORT OR REMOTELY THROUGH AN IP ADDRESS.
10. ONLY ONE OF THE CDP SUBCOMPONENT DOSING PUMPS (CP-1 OR CP-2) IS “ON”. THE SECOND PUMP IS A BACKUP IN CASE THAT THE ACTIVE PUMP HAS FAILED. THIS MUST BE SWITCHED MANUALLY. THE CDP DOSING PUMP SKID ALSO CONTAINS CALIBRATION AND CLEANING ACCESSORIES.
11. THE CHLORINE SOLUTION FOR THE DOSING PUMPS IS PREPARED BY AN “MC4-50” CHLORINE MIXING SYSTEM (CMS). HERE AGAIN THE SECOND SYSTEM IS A BACKUP IF THE ACTIVE ONE FAILS. IT IS RECOMMENDED TO KEEP THE BACKUP SYSTEM DRY & CLEAN AND ONLY ACTIVATE IT UNTIL IT IS REQUIRED.

SYSTEM FAILURES AND ALARMS:

12. THE ALARMS ARE LISTED IN THE ALARM REPORTING TABLE. THERE ARE 10 ALARMS CONNECTED TO THE ALARM REPORTING UNIT. IT ALSO CAN ACCOMMODATE ANOTHER 6 ALARM INPUTS IN THE FUTURE IF REQUIRED.
13. SOME OF THE ALARM LEVELS ARE SETTABLE: A). - THE LOW TEMPERATURE ALARM ON THERMOSTAT TS-1 LOCATED IN THE MAIN PUMPING ROOM, AND B).- PRESSURE DROPS ACROSS THE WATER FILTERS MEASURED BY DP-1. DP-1 HAS TWO ADJUSTABLE ALARM SETTINGS: HIGH (H) - WHEN ONE TRUCK IS BEING FILLED (ONE WATER PUMP IS RUNNING), AND HIGH/HIGH (H/H) WHEN TWO TRUCKS ARE BEING FILLED (TWO WATER PUMPS ARE RUNNING). THE SETTINGS OF DP-1 WILL NEED TO BE ESTABLISHED BY EXPERIENCE. HOWEVER, THE PRESSURE SHOULD NOT EXCEED 15LB ACROSS THE FILTER BANK WHEN TWO PUMPS ARE RUNNING (H/H). THE HIGHER THE ALLOWED PRESSURE DROP ACROSS THE FILTERS, OVER TIME IT WILL TAKE LONGER TO FILL THE TRUCKS AS THE FILTERS CATCH MORE SEDIMENT, BUT THE

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CHIARELLI ENGINEERING MANAGEMENT LTD.
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MECH. PROJECT No: 13-072

No	DATE: (dd/mm/yy)	BY:	DESCRIPTION:
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4	13/02/14	B.P.	ISSUED FOR TENDER
3	15/01/14	B.P.	ISSUED FOR 99% REVIEW
2	25/11/13	B.P.	RE-ISSUED FOR 50% REVIEW
1	15/11/13	B.P.	ISSUED FOR 50% REVIEW

STAMP

REGISTERED PROFESSIONAL ENGINEER
M.M. MAILLET
APRIL 2014
NWT/NU

CONSULTANT: CEML
DRAWN BY: B.P.
DESIGNED BY: N.K.
APPROVED BY: M.M.
DATE: NOVEMBER 2013

STAMP

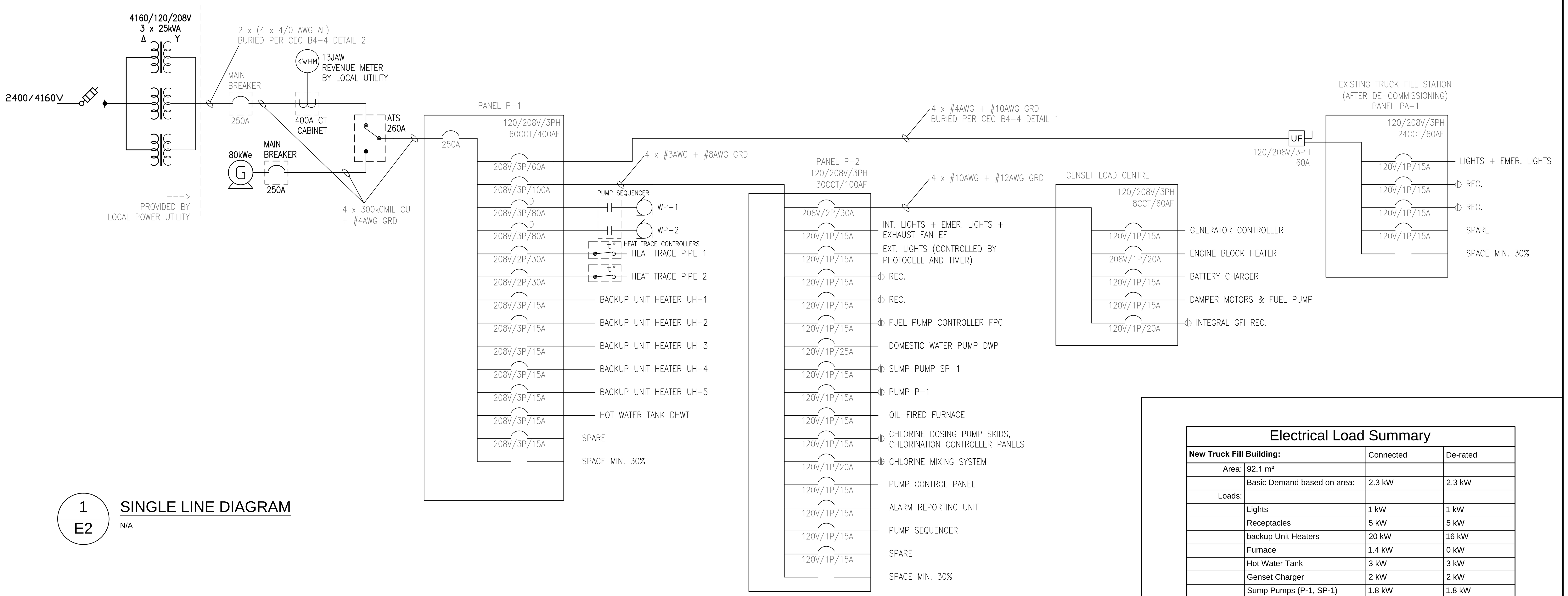
CONSULTANT:
DRAWN BY:
DESIGNED BY:
APPROVED BY:
DATE:

LOCATION:
PANGNIRTUNG
QIKIQTAALUK REGION OF NUNAVUT
X0A 0R0

PROJECT:
OPTIMIZATION OF DRINKING WATER SUPPLY

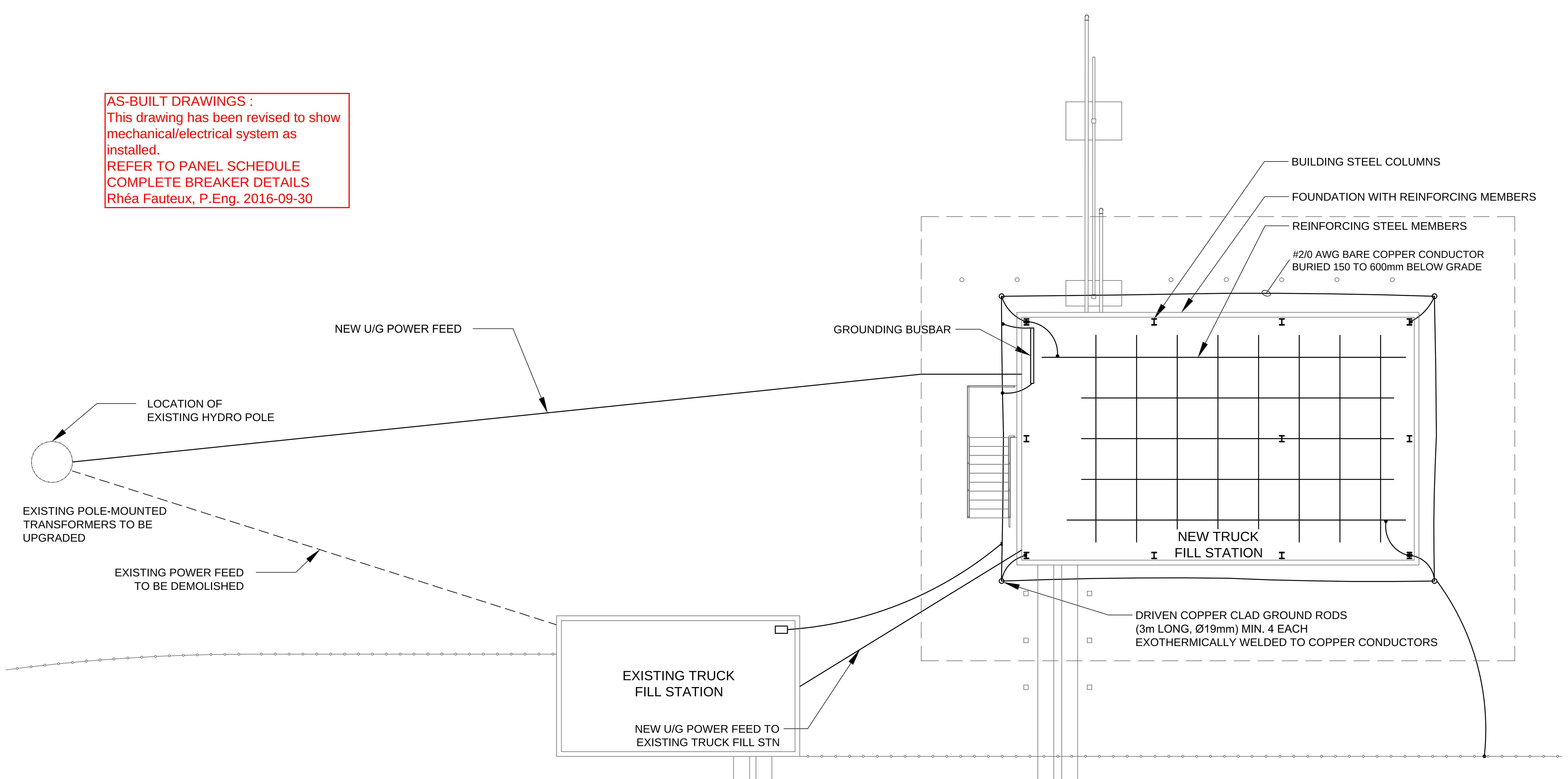
DRAWING TITLE:
ELECTRICAL
SCOPE OF WORK, LEGEND AND
MAJOR EQUIPMENT SCHEDULE

MECH FILE NAME:	DWG NO:	OF:	SCALE:
13-072_E	E1	6	AS NOTED



1
E2
SINGLE LINE DIAGRAM
N/A

AS-BUILT DRAWINGS :
This drawing has been revised to show mechanical/electrical system as installed.
REFER TO PANEL SCHEDULE COMPLETE BREAKER DETAILS
Rhéa Fauteux, P.Eng. 2016-09-30



2
E2
SITE PLAN - POWER DISTRIBUTION & GROUNDING SCHEME
N/A

Electrical Load Summary			
New Truck Fill Building:		Connected	De-rated
Area:	92.1 m²		
	Basic Demand based on area:	2.3 kW	2.3 kW
Loads:			
	Lights	1 kW	1 kW
	Receptacles	5 kW	5 kW
	backup Unit Heaters	20 kW	16 kW
	Furnace	1.4 kW	0 kW
	Hot Water Tank	3 kW	3 kW
	Genset Charger	2 kW	2 kW
	Sump Pumps (P-1, SP-1)	1.8 kW	1.8 kW
	Main Pumps (WP1, WP2) 20HP	22.3 kW	22.3 kW
	Heat Trace Cables	5.1 kW	5.1 kW
	Domestic Water Pump (DWP)	0.9 kW	0.9 kW
Existing Truck Fill Building:			
Area:	26.7 m²		
	Basic Demand based on area:	0.7 kW	0.7 kW
Loads:	Lights	0.3 kW	0.3 kW
	Receptacles	0 kW	0 kW
	TOTAL Connected Load:	**65.8 kW**	
	TOTAL De-rated Load:		**60 kW**
	Minimum Service (at 125%)	75.4 kVA	209.4 A
	Required Service	**75 kVA fused at**	**250 A**

GROUNDING NOTES:

1. PERFORM COMPLETE INSTALLATION AND EQUIPMENT IN STRICT ACCORDANCE TO THE STRINGENT MOST REQUIREMENTS OF A) CSA C22.1-12 - 22ND EDITION OF THE CANADIAN ELECTRICAL CODE 2012 B) GN/CGS- PROTECTION SERVICES DIVISION-ELECTRICAL / MECHANICAL SAFETY SECTION -ELECTRICAL BULLETINS.
2. ALL GROUNDING EQUIPMENT SHALL BE CSA APPROVED. GROUNDING SHALL BE DONE IN ACCORDANCE WITH THE CANADIAN ELECTRICAL CODE 2012 AND INSPECTED BY ESA PRIOR TO BACKFILLING. EXCAVATION TO BE BACKFILLED AND COMPACTED TO 600 mm WITH THE BALANCE OF THE EXCAVATION TO REMAIN OPEN FOR GROUNDING INSTALLATION BY CONTRACTOR UNTIL INSPECTION IS COMPLETED.
3. PROVIDE MINIMUM FOUR DRIVEN COPPER CLAD GROUND RODS NOT LESS THAN 3 m LONG AND 19 mm IN DIAMETER, SPACED AT LEAST THE ROD LENGTH APART, LOCATED AROUND THE PERIMETER WALL OF THE BUILDING. INTERCONNECT THE GROUNDING RODS WITH NO. 2/0 AWG BARE COPPER CONDUCTOR AT A MINIMUM DEPTH OF 150 mm BELOW THE FINISHED GRADE OF THE BUILDING.
4. BOND THE REINFORCING STEEL OF THE FOUNDATION AND SLAB TO THE BURIED GROUNDING WIRES WITH AT LEAST IN 2 PLACES USING 2/0 AWG BARE COPPER CONDUCTORS.
5. BOND THE STEEL COLUMNS OF THE BUILDING TO THE BURIED GROUNDING SYSTEM AS SHOWN.
6. BOND THE EXISTING TRUCK FILL STATION AND THE CHAIN LINK FENCE TO THE NEW BURIED GROUNDING SYSTEM AS SHOWN.
7. CHECK RESISTANCE TO GROUND BEFORE ENERGIZING. TEST GROUND RESISTANCE FOR THE PROSPECTIVE FAULT CURRENT UNDER BOTH SHORT CIRCUITS AND EARTH FAULT CONDITIONS AND AT EVERY RELEVANT POINT OF THE COMPLETE INSTALLATION. PERFORM CONTINUITY TEST, INSULATION RESISTANCE TESTS AND POLARITY TEST FOR EARTH FAULT LOOP IMPEDANCE.
8. PROVIDE ADDITIONAL GROUNDING RODS IF THE MEASURED GROUNDING RESISTANCE IS HIGHER THAN 15 OHMS.
9. PROVIDE COPPER GROUND BUSBAR AT THE INCOMING ELECTRICAL SERVICE. CONNECT THE BUSBAR TO THE BURIED GROUNDING CONDUCTOR IN AT LEAST 2 PLACES AND GROUND ALL NON-CURRENT CARRYING METAL PARTS OF THE EQUIPMENT AND STRUCTURES IN THE BUILDING TO IT.

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LOCATION:
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QIKIQTAALUK REGION OF NUNAVUT
X0A 0R0

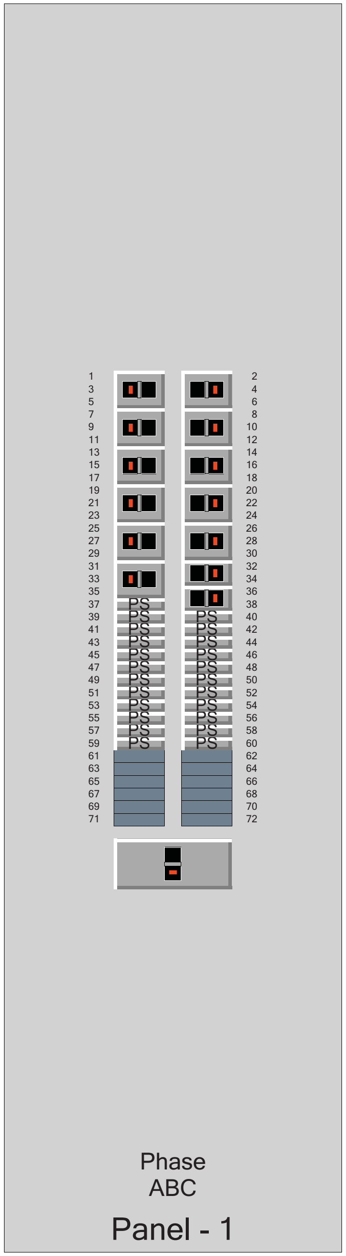
PROJECT:
OPTIMIZATION OF
DRINKING WATER SUPPLY

DRAWING TITLE:
SINGLE LINE DIAGRAM AND
SITE POWER DISTRIBUTION &
GROUNDING SCHEME

MECH FILE NAME:	DWG NO:	OF:	SCALE:
13-072 E	E2	6	AS NOTED

Panel P-1

Shop Drawings
Contractor Approval
Approved by: S.B.S., G. F.
Date: Apr 28, 2015
SIFEC NORTH INC



Panel - 1

Feeder 100A / 3P QOB_VH PH ABC
Feeder 80A / 3P QOB_VH PH ABC
Feeder 80A / 3P QOB_VH PH ABC
Feeder 60A / 3P QOB_VH PH ABC
Feeder 15A / 3P QOB_VH PH ABC
Feeder 15A / 3P QOB_VH PH ABC
Feeder 15A / 3P QOB_VH PH ABC
Feeder 15A / 3P QOB_VH PH ABC
Feeder 15A / 3P QOB_VH PH ABC
Feeder 15A / 3P QOB_VH PH ABC
Feeder 30A / 2P QOB_VH PH AB
Feeder 15A / 3P QOB_VH PH ABC
Prepared Space 15A / 1P PH A
Feeder 30A / 2P QOB_VH PH CA
Prepared Space 15A / 1P PH B
Prepared Space 15A / 1P PH B
Prepared Space 15A / 1P PH C
Prepared Space 15A / 1P PH C
Prepared Space 15A / 1P PH A
Prepared Space 15A / 1P PH A
Prepared Space 15A / 1P PH B
Prepared Space 15A / 1P PH B
Prepared Space 15A / 1P PH C
Prepared Space 15A / 1P PH C
Prepared Space 15A / 1P PH A
Prepared Space 15A / 1P PH A
Prepared Space 15A / 1P PH B
Prepared Space 15A / 1P PH B
Prepared Space 15A / 1P PH C
Prepared Space 15A / 1P PH C
Prepared Space 15A / 1P PH A
Prepared Space 15A / 1P PH A
Prepared Space 15A / 1P PH B
Prepared Space 15A / 1P PH B
Prepared Space 15A / 1P PH C
Prepared Space 15A / 1P PH C
Main 250A LA

Properties

Property	Value
Panel Type	NQ Standard
System	208Y/120-VAC 3-Phase, 4-W
Panel Number	1
H x W x D	74 x 20 x 6.5
Enclosure Type	Type 3R/4/4X/5/12 Stainless
Max # of Circuits	72
Trim Front	Not Required
Interior amps	400
Feed	ThroughTheBottom

AS-BUILT DRAWINGS :
This drawing has been revised to show mechanical/electrical system as installed.
REFER TO PANEL SCHEDULE
COMPLETE BREAKER DETAILS
Rhéa Fauteux, P.Eng. 2016-09-30

PANEL G-1

1		OIL PUMPS CONTROL PANEL	2
3		GENERATOR CHARGER	4
5		GENERATOR HEATER	6
7		SPARE	8
9		OIL PUMP #1	10
11		OIL PUMP#2	12
13		THERMO T775 – BELIMO	14

PANEL P-2

1	GENERATOR ELECTRICAL PANEL	DOMESTIC WATER PUMP	2
3		CHLORINE MIXING SYSTEM	4
5		ELECTRICAL PLUGS	6
7	FURNACE	PUMPS AND ALARM CONTROL PANEL	8
9	EXTERIOR LIGHT	HEAT TRACE LOADING ARM	10
11	INTERIOR and EMERGENCY LIGHTS	CHLORINE DOSING SYSTEM	12
13	CHLORINATION ROOM TEST WATER – RETURN PUMP	ELECTRICAL PLUGS	14
15	SUMP PUMP – WASTE WATER	SPARE	16
17	SPARE	SPARE	18
19	SPARE	PUMP SEQUENCER	20

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REFER TO PANEL SCHEDULE COMPLETE BREAKER DETAILS
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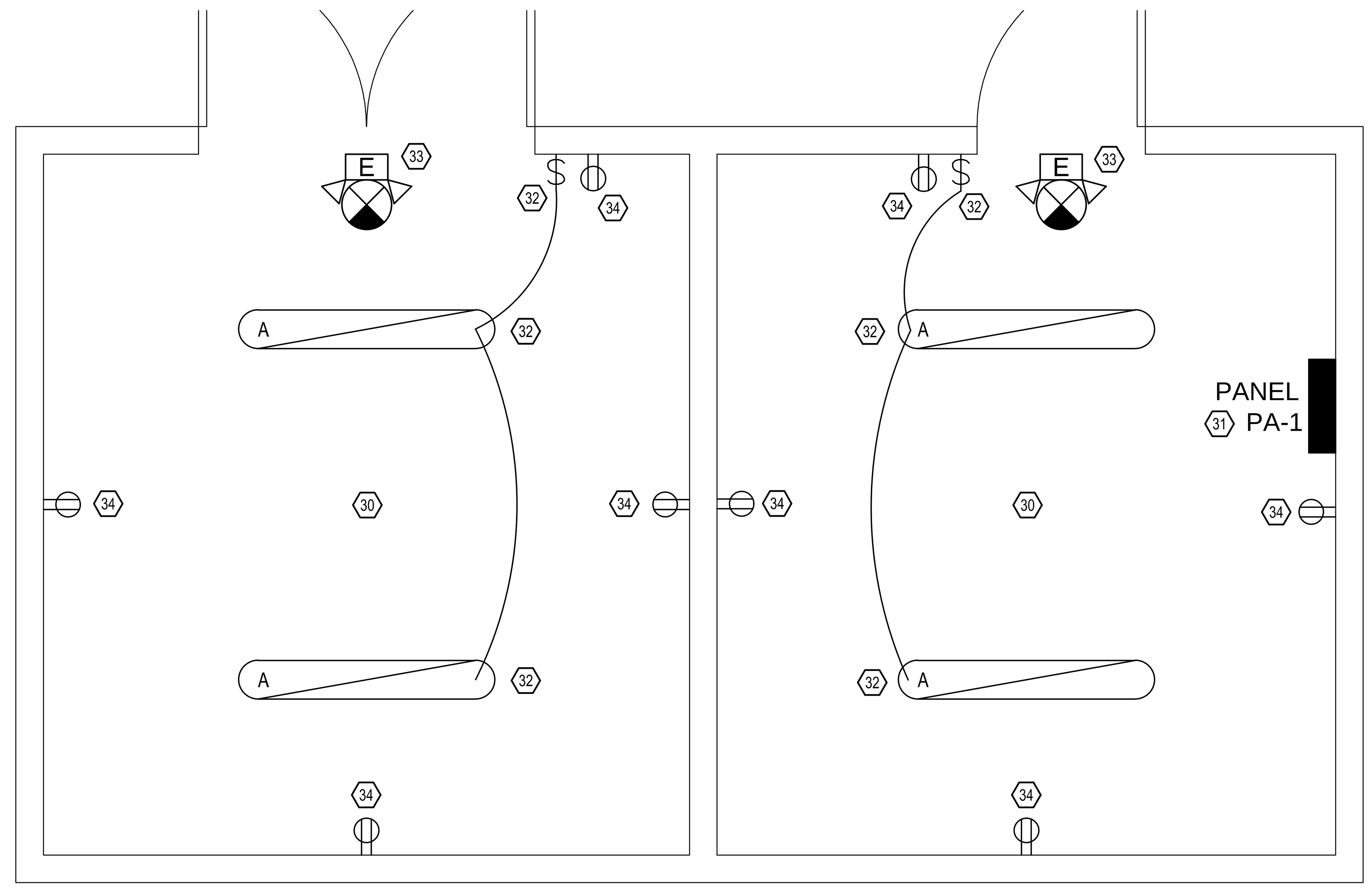


2
E3

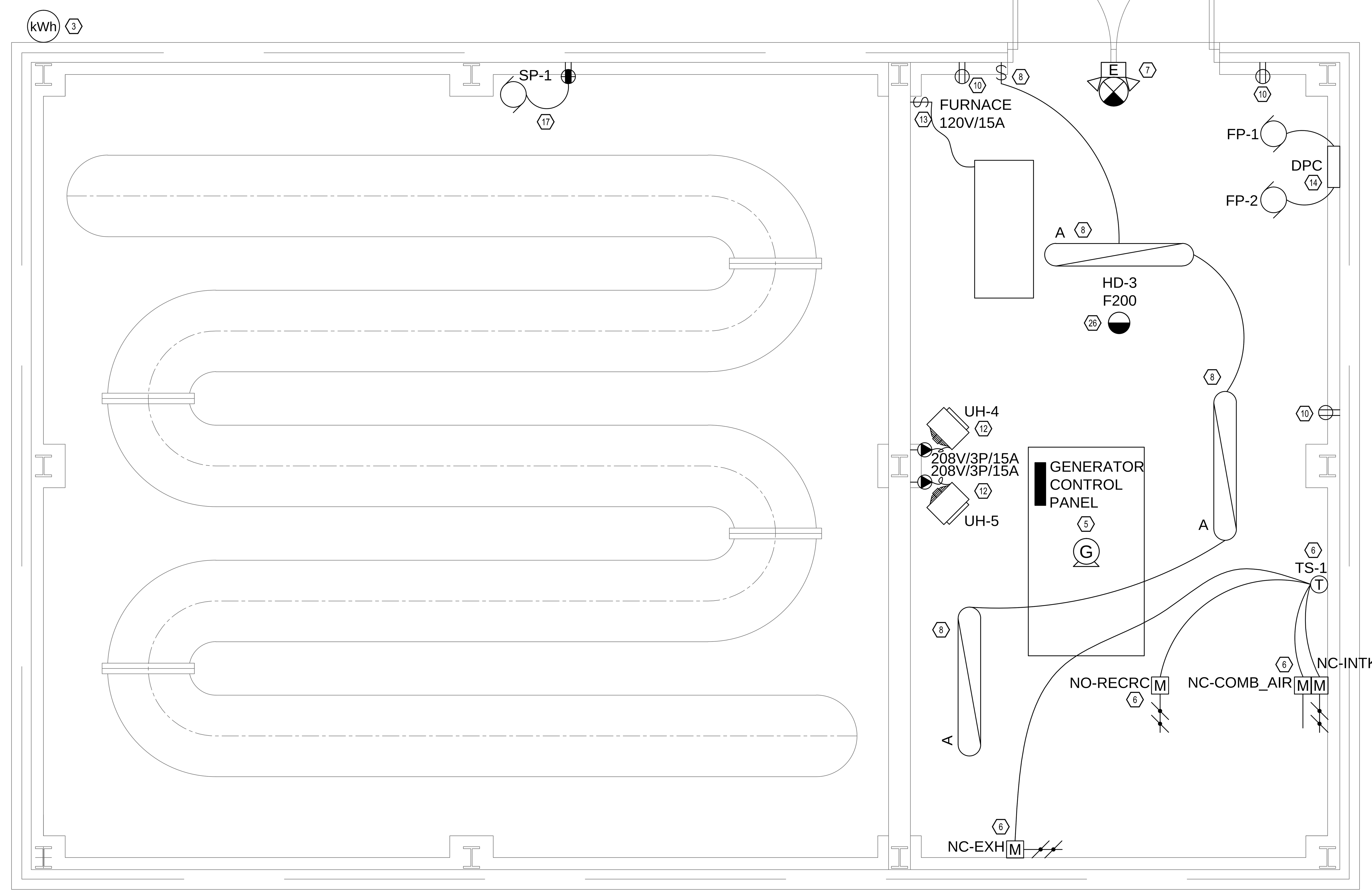
ELECTRICAL LAYOUT - DECOMMISSIONED PUMP STATION

1:25

1
E3

ELECTRICAL LAYOUT - LOWER LEVEL - NORMAL POWER AND LIGHTING

1:25



AS-BUILT DRAWINGS :
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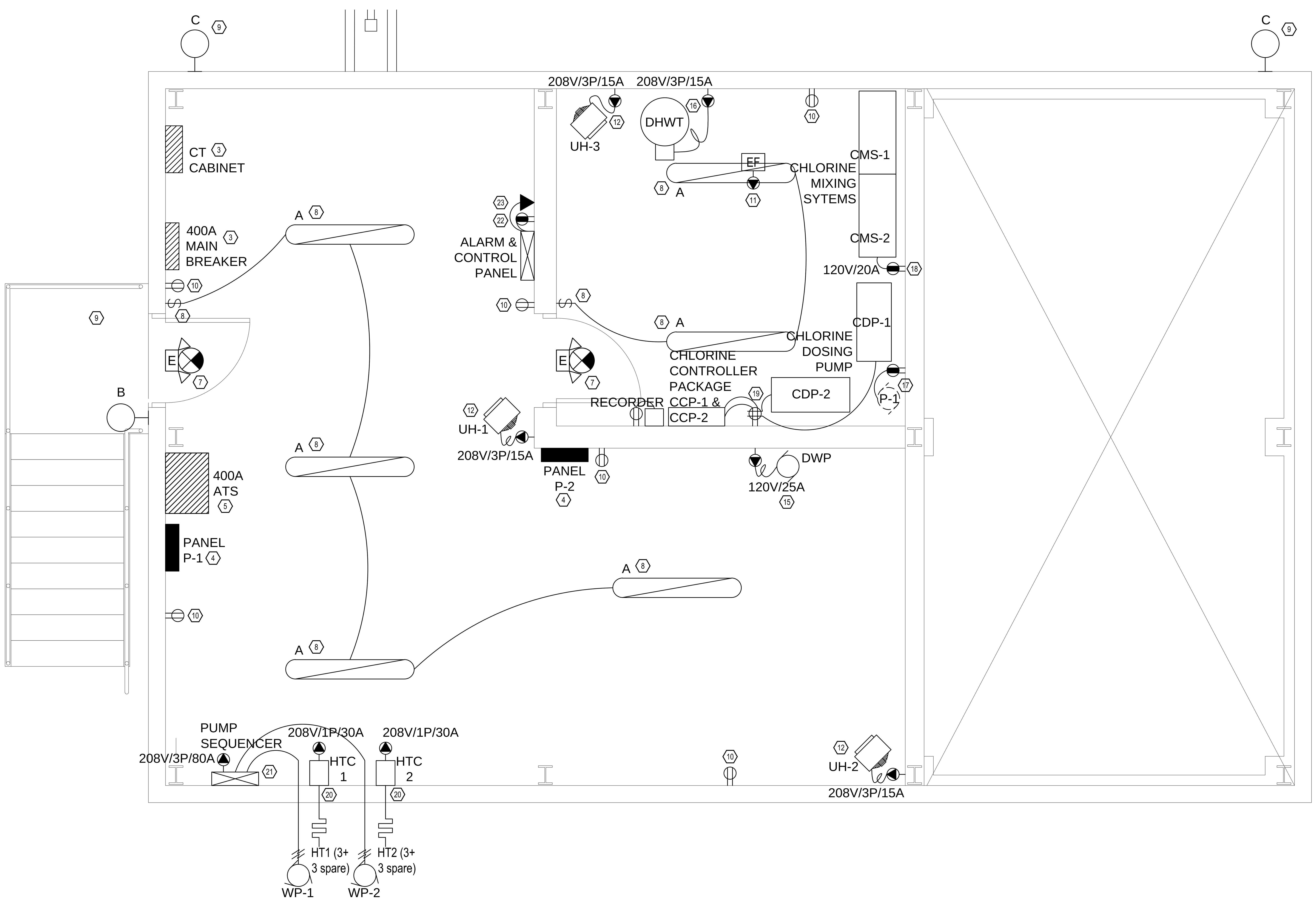
X0A 0R0

PROJECT:
OPTIMIZATION OF DRINKING WATER SUPPLY

DRAWING TITLE:
ELECTRICAL POWER & LIGHTING LAYOUT LOWER LEVEL

MECH FILE NAME:	DWG NO:	OF:	SCALE:
13-072 E	E3	6	AS NOTED



1
E4

ELECTRICAL LAYOUT - UPPER LEVEL - NORMAL POWER AND LIGHTING

1:25

AS-BUILT DRAWINGS :
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PROJECT:

OPTIMIZATION OF
DRINKING WATER SUPPLY

DRAWING TITLE:

ELECTRICAL POWER &
LIGHTING LAYOUT
UPPER LEVEL

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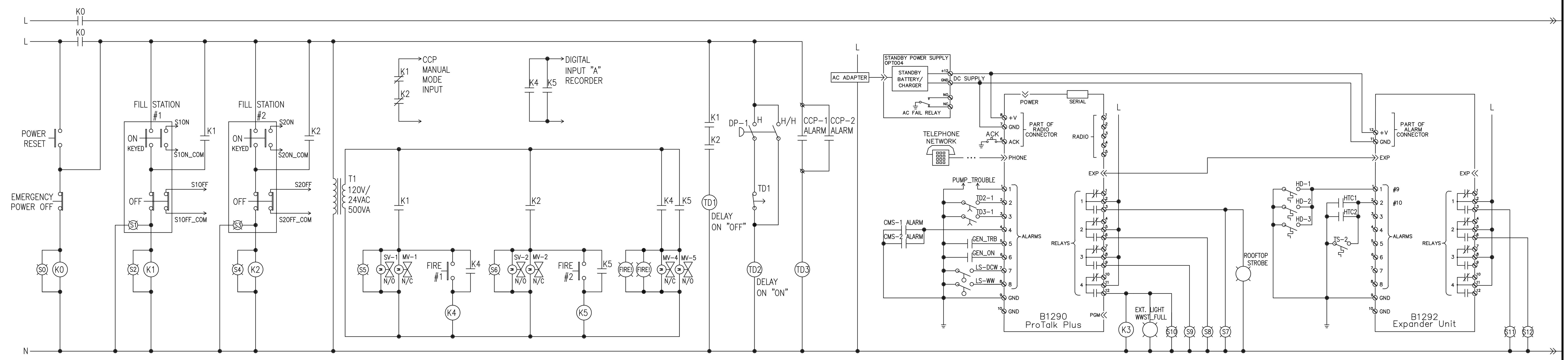
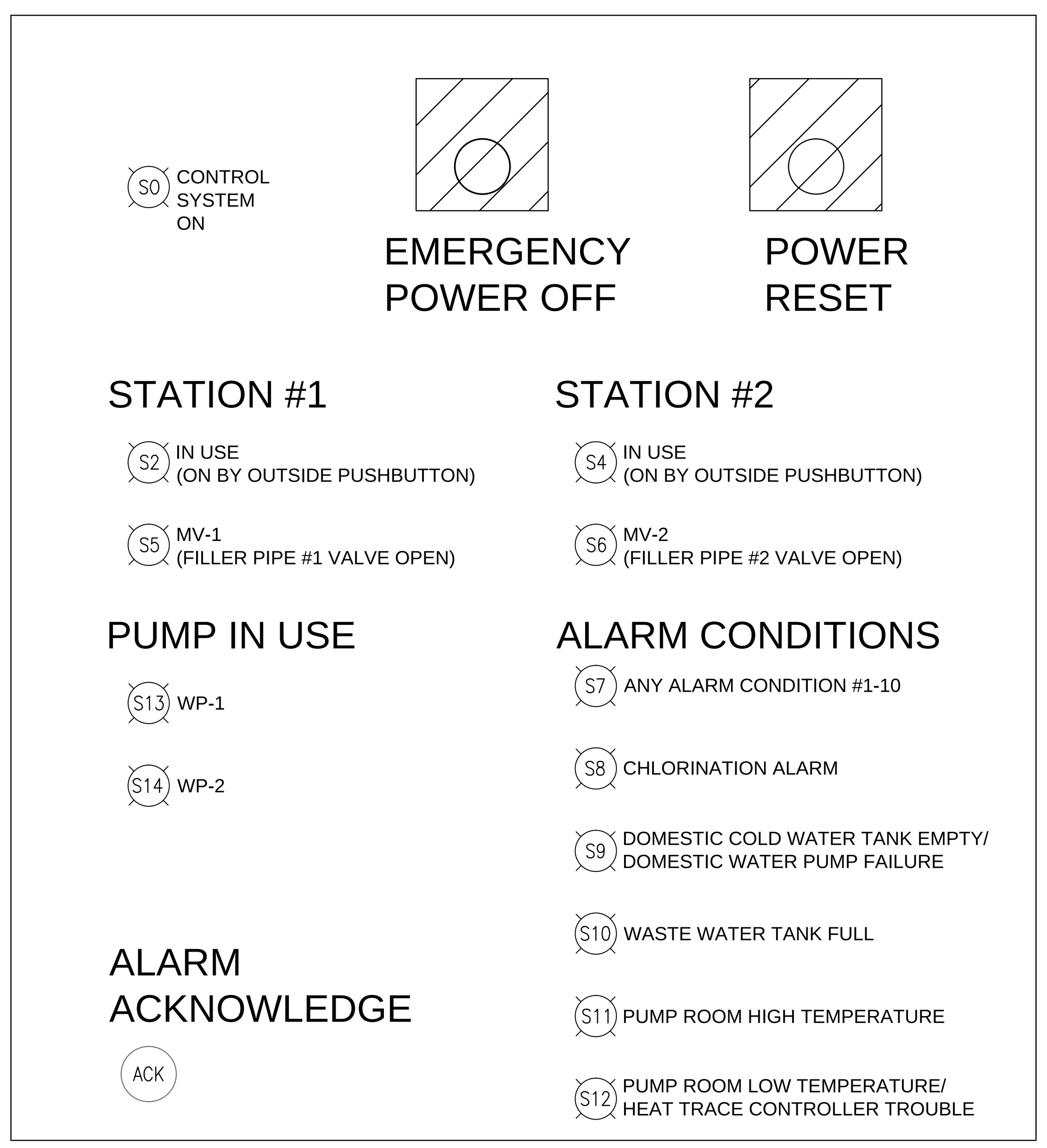


1 / E5

PUMP CONTROL SYSTEM & ALARM SYSTEM LADDER LOGIC DIAGRAM

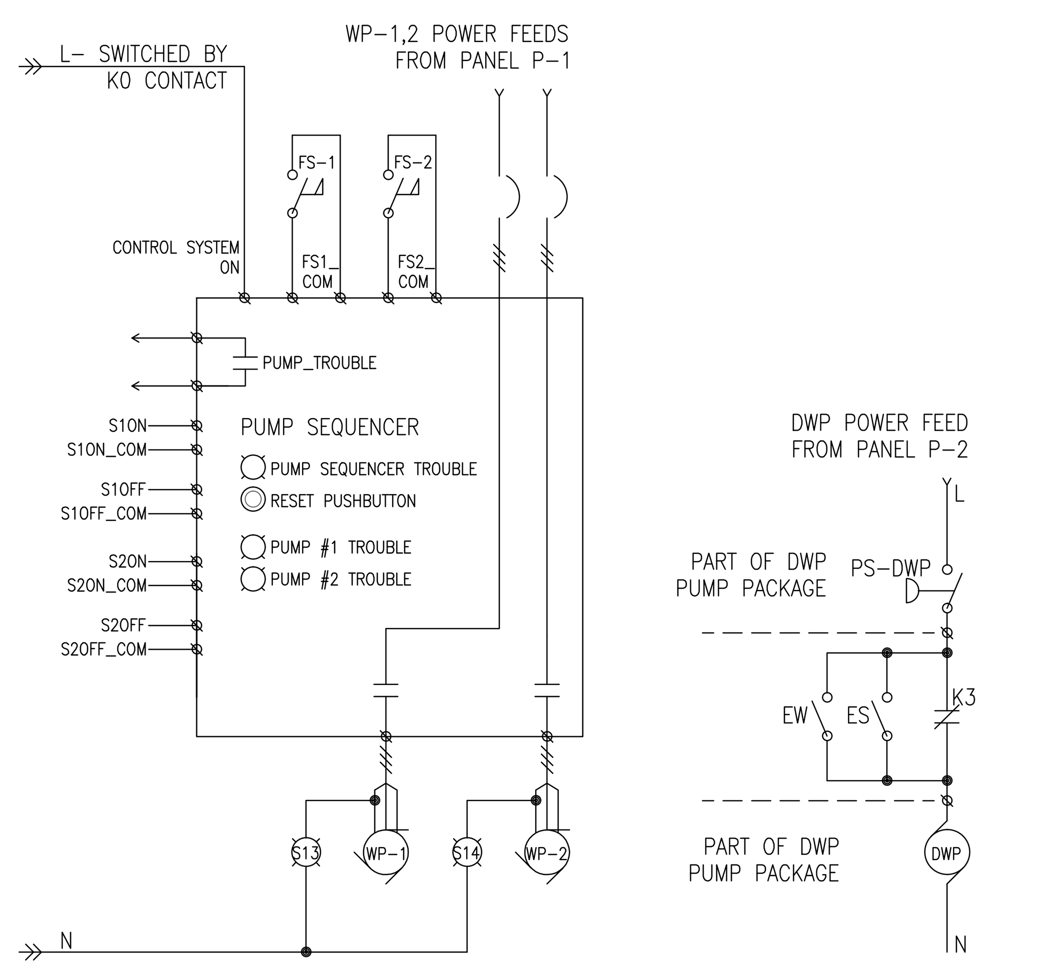
N/A

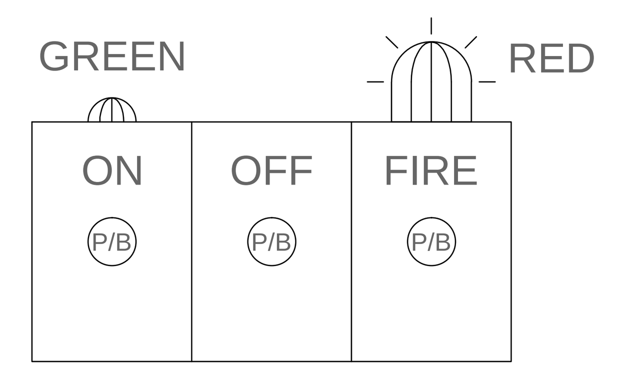


2 / E5

PUMP CONTROL SYSTEM PANELBOARD LAYOUT

N/A





CONTROLS TO BE PLACED ON FILL ARM IN MID-ROAD LOCATION FOR BOTH TRUCK FILL SPOTS

3 / E5

FILL ARM CONTROL BOX LAYOUT

N/A

ALARMS:

1. ALARM ACTIVATES IF A FLOW SWITCH (FS-1 OR FS-2) SENSES NO FLOW IN 15 (ADJUSTABLE) SECONDS AFTER ITS RELEVANT PUMP (WP-1 OR WP-2) IS TURNED ON.
   ACTION: CHECK THE PUMP CONTROLLER, DETERMINE WHICH PUMP FAILED AND WHY.
   REPAIR THE PROBLEM, RESET THE PUMP SEQUENCER AND ACKNOWLEDGE THE ALARM CONTROLLER.

2. ALARM ACTIVATES IF A DIFFERENTIAL PRESSURE SWITCH (DP-1) SENSES HIGHER THAN SET (H) (ADJUSTABLE) PRESSURE ACROSS FILTERS IN 15 SECONDS (ADJUSTABLE) AFTER ONE PUMP IS TURNED ON. ALARM ACTIVATES IF A DIFFERENTIAL PRESSURE METER (DP-1) SENSES HIGHER THAN SET H/H (ADJUSTABLE) PRESSURE ACROSS FILTERS IN 15 SECONDS (ADJUSTABLE) AFTER TWO PUMPS ARE TURNED ON.
   ACTION: CLEAN ALL 3 WATER FILTERS, ONE AT A TIME. ACKNOWLEDGE ALARM CONTROLLER.

3. ALARM ACTIVATES IF EITHER CHLORINATION CONTROLLER PANELS CCP1 OR CCP2 SENSES OUT-OF-SPEC CONDITIONS FOR 15 SECONDS (ADJUSTABLE).
   ACTION: DETERMINE THE REASON FOR THE CHLORINATION CONTROLLER ALARM.
   FIX THE PROBLEM AND RESET THE CHLORINATION CONTROLLERS AND ACKNOWLEDGE THE ALARM CONTROLLER.

4. ALARM ACTIVATES IF CHLORINE MIXING SYSTEM SENSES TROUBLE.
   ACTION: CHECK THE CHLORINE MIXING SYSTEM AND FIX THE PROBLEM.
   RESET THE CHLORINE MIXING SYSTEM AND ACKNOWLEDGE ALARM CONTROLLER.

5. ALARM ACTIVATES IF GENERATOR CONTROLLER SENSES OUT-OF-SPEC CONDITION WITH GENERATOR.
   ACTION: CHECK THE GENERATOR CONTROLLER AND DETERMINE THE CAUSE FOR THE ALARM.
   FIX THE PROBLEM AND RESET THE GENERATOR CONTROLLER AND ACKNOWLEDGE ALARM CONTROLLER.

6. ALARM ACTIVATES IF NORMAL GRID POWER IS LOST AND AUTOMATIC TRANSFER SWITCH ENGAGES EMERGENCY GENERATOR.
   ACTION: DETERMINE THE REASON WHY THE GENERATOR IS RUNNING.
   ENSURE THE GENERATOR HAS ENOUGH FUEL IF THE POWER OUTAGE IS PROLONGED. ACKNOWLEDGE ALARM CONTROLLER.

7. ALARM ACTIVATES IF DOMESTIC COLD WATER STORAGE TANK (DCWST) LOW LEVEL FLOAT SWITCH (LS-DCW) DETECTS LOW WATER LEVEL.
   ACTION: ARRANGE TO RE-FILL THE DCWST AND ACKNOWLEDGE THE ALARM.

8. ALARM ACTIVATES IF WASTE WATER STORAGE TANK (WWST) HIGH LEVEL FLOAT SWITCH (LS-WW) DETECTS HIGH WATER LEVEL.
   ACTION: ARRANGE TO PUMP OUT THE WWST AND ACKNOWLEDGE THE ALARM.

9. ALARM ACTIVATES IF ANY OF THE ROOM FIRE ALARM HEAT DETECTORS (HD-1, -2 OR -3) SENSES HIGH ROOM TEMPERATURE.
   ACTION: DETERMINE THE REASON FOR THE HIGH TEMPERATURE. FIX THE PROBLEM. ACKNOWLEDGE THE ALARM.

10. ALARM ACTIVATES IF THE ROOM THERMOSTAT (TS-2) SENSES LOW ADJUSTABLE ROOM TEMPERATURE OR IF ANY OF THE 2 HEAT TRACE CONTROLLERS SENSES TROUBLE WITH THE HEAT TRACE CABLES.
    ACTION: DETERMINE WHAT IS CAUSING THE ALARM. TAKE APPROPRIATE ACTION: (A) PROVIDE TEMPORARY HEAT SOURCE FOR THE PUMP ROOM IF THE ROOM TEMPERATURE FALLS BELOW SET POINT (10°C ADJUSTABLE), OR (B) DETERMINE WHICH HEAT TRACE CONTROLLER ALARMED AND TAKE ACTION TO FIX THE PROBLEM. ACKNOWLEDGE THE ALARM.

ALARM REPORTING UNIT RELAYS:

1. PROGRAMMED TO TURN "ON" WITH ANY OF THE 1-10 ALARM INPUTS. TURNS "ON" AN OUTDOOR STROBE BEACON LOCATED OUTSIDE THE PUMP STATION TO DISPLAY THAT THE PUMP STATION REQUIRES ATTENTION. TURNS "ON" AN INDICATOR LIGHT ON THE MAIN PANEL LABELED "ANY ALARM CONDITION #1-10"

2. PROGRAMMED TO TURN "ON" WITH EITHER ALARM INPUT #3 OR #4. TURNS "ON" AN INDICATOR LIGHT ON THE MAIN PANEL LABELED "CHLORINATION ALARM"

3. PROGRAMMED TO TURN "ON" WITH ALARM INPUT #7. TURNS "ON" AN INDICATOR LIGHT ON THE MAIN PANEL LABELED "FRESH WATER TANK EMPTY OR DWP PUMP FAILURE"

4. PROGRAMMED TO TURN "ON" WITH ALARM INPUT #8. TURNS "ON" AN INDICATOR LIGHT ON THE MAIN PANEL LABELED "WASTE WATER TANK FULL". TURNS "ON" AN OUTDOOR WARNING LAMP TO INDICATE FULL TANK REQUIRING SERVICE. FULL WWST WILL DISABLE (K3) DOMESTIC WATER PUMP TO PREVENT OVERFILL, UNLESS EMERGENCY EYEWASH (EW) OR EMERGENCY SHOWER (ES) IS USED.

ALARM EXPANDER UNIT RELAYS:

1. PROGRAMMED TO TURN "ON" WITH ALARM INPUT #9. TURNS "ON" AN INDICATOR LIGHT ON THE MAIN PANEL LABELED "PUMP ROOM HIGH TEMPERATURE"

2. PROGRAMMED TO TURN "ON" WITH ALARM INPUT #10. TURNS "ON" AN INDICATOR LIGHT ON THE MAIN PANEL LABELED "PUMP ROOM LOW TEMPERATURE / HEAT TRACE CONTROLLER TROUBLE"

PUMP SEQUENCER OPERATION:

BY DEPRESSING THE "ON" PUSHBUTTON AT FILL STATION #1 OR #2 (SEQUENCER INPUT CONTACTS S1ON OR S2ON) THE SEQUENCER STARTS THE "NEXT" PUMP WITH A DELAY OF 3 SECONDS.
DEPRESSING THE SAME "ON" PUSHBUTTON AGAIN WILL DO NOTHING UNTIL THE RELEVANT "OFF" BUTTON IS PRESSED.
ONCE THE PUMP IS RUNNING, IT CAN BE TURNED "OFF" BY DEPRESSING THE "OFF" PUSHBUTTON (SEQUENCER INPUT CONTACTS S1OFF OR S2OFF) AT THE INITIATING FILL STATION.
DEPRESSING THE SAME "OFF" PUSHBUTTON AGAIN WILL DO NOTHING.
BASED ON THE ABOVE, 1 OR 2 PUMPS CAN RUN SIMULTANEOUSLY.

THE SEQUENCE OF THE "NEXT PUMP" IS WP-1 -> WP-2 -> WP-1 -> WP-2 -> ETC...

FLOW SWITCHES WILL PROVIDE FEEDBACK SO THAT WHEN A PUMP IS TURNED "ON" IT ACTUALLY DELIVERS WATER.
F THE FLOW SWITCH OF ITS RELEVANT PUMP IS NOT "ON" WITHIN 15 SECONDS, THE PUMP SEQUENCER WILL TURN THAT PUMP "OFF" AND TURN THE "NEXT" PUMP "ON".
THIS WILL CAUSE THE AFFECTED PUMP TO BE TAKEN OUT FROM THE SEQUENCE OF THE "NEXT PUMP". IT WILL ALSO TURN "ON" A "PUMP # TROUBLE" ALARM LIGHT AND TURN "ON" A SET OF DRY OUTPUT ALARM CONTACTS "PUMP TROUBLE".
ATCHING OF A FAILED PUMP "OFF" CAN BE RESET BY DEPRESSING A "RESET" BUTTON ON THE PUMP SEQUENCER.

ALARM REPORTING UNIT

ALARM #	ALARM DESCRIPTION	ALARM CONDITION	ALARM GENERATED BY
1	PUMP TROUBLE	NO FLOW OF WATER WHEN PUMP TURNED ON	PUMP SEQUENCER & WATER PUMP FLOW SWITCHES FS-1 -- 2
2	FILTER BLOCKED	INSUFFICIENT FLOW OF WATER WHEN PUMP IS RUNNING	DIFFERENTIAL PRESSURE SWITCH DP-1
3	CHLORINATION STOPPED	INSUFFICIENT FLOW OF CHLORINE WHEN CCP-1 OR CCP-2 IS RUNNING	CHLORINATION CONTROLLER PANEL CCP-1 OR CCP-2
4	CHLORINE FEED TROUBLE	CHLORINE MIXING SYSTEM TROUBLE	CHLORINE MIXING SYSTEM CMS-1 OR CMS-2
5	EMERGENCY GENERATOR TROUBLE	ANY OUT-OF-SPEC CONDITION	GENERATOR CONTROLLER
6	EMERGENCY GENERATOR RUNNING	NORMAL GRID POWER LOST	AUTOMATIC TRANSFER SWITCH ATS
7	WATER STORAGE TANK EMPTY	LOW LEVEL IN DOMESTIC COLD WATER STORAGE TANK	FRESH WATER STORAGE TANK LOW LEVEL FLOAT SWITCH LS-DCW
8	WASTE WATER TANK FULL	HIGH LEVEL IN WASTE WATER STORAGE TANK	WASTE WATER STORAGE TANK HIGH LEVEL FLOAT SWITCH LS-WW
9	PUMP STATION HIGH TEMPERATURE	HIGH PUMP STATION ROOM TEMPERATURE	3 ROOM HEAT DETECTORS HD-1 -- 3
10	PUMP STATION LOW TEMPERATURE	LOW PUMP STATION ROOM TEMPERATURE / HEAT TRACE TROUBLE	ROOM THERMOSTAT & 2 HEAT TRACE CONTROLLERS

AS-BUILT DRAWINGS :
This drawing has been revised to show mechanical/electrical system as installed.
Rhéa Fauteux, P.Eng. 2016-09-30

ARKTIS SOLUTIONS
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CONSULTANT NAME AND ADDRESS:
CHIARELLI ENGINEERING MANAGEMENT LTD.
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TEL. (613)225–1123
FAX. (613)225–7298
E–MAIL: info@cemlottawa.com
MECH. PROJECT No: 13–072

No	DATE: (dd/mm/yy)	BY:	DESCRIPTION:
10			
9			
8			
7			
6			
5	14/04/14	B.P.	REISSUED FOR TENDER
4	13/02/14	B.P.	ISSUED FOR TENDER
3	15/01/14	B.P.	ISSUED FOR 99% REVIEW
2	25/11/13	B.P.	RE-ISSUED FOR 50% REVIEW
1	15/11/13	B.P.	ISSUED FOR 50% REVIEW

STAMP

REGISTERED PROFESSIONAL ENGINEER
M.M. MAILLET
APRIL 2014
NWT/NU

CONSULTANT: CEML
DRAWN BY: B.P.
DESIGNED BY: N.K.
APPROVED BY: M.M.
DATE: NOVEMBER 2013

STAMP

CONSULTANT:
DRAWN BY:
DESIGNED BY:
APPROVED BY:
DATE:

LOCATION:

PANGNIRTUNG
QIKIQTAALUK REGION OF NUNAVUT
X0A 0R0

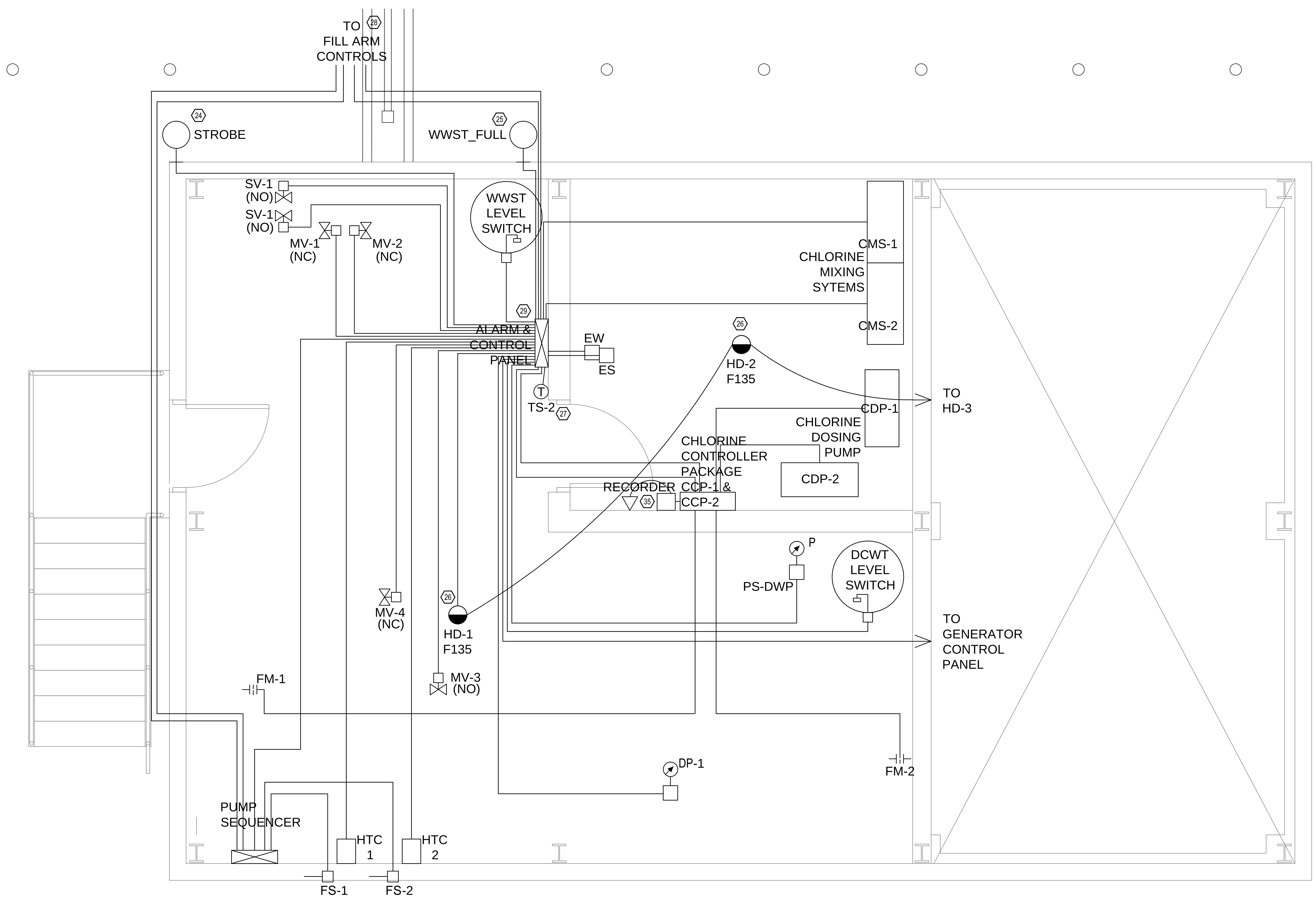
PROJECT:

OPTIMIZATION OF DRINKING WATER SUPPLY

DRAWING TITLE:

PUMP CONTROL & ALARM SYSTEM SCHEMATIC AND SEQUENCE OF OPERATIONS

MECH FILE NAME:	DWG NO:	OF:	SCALE:
13-072_E	E5	6	AS NOTED



1 E6 LOW-VOLTAGE ELECTRICAL LAYOUT - UPPER LEVEL - CONTROL AND MONITORING SYSTEM

1:25

AS-BUILT DRAWINGS :
This drawing has been revised to show mechanical/electrical system as installed.
Rhéa Fauteux, P.Eng. 2016-09-30

ARKTIS SOLUTIONS
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MECH. PROJECT No: 13-072

No	DATE: (dd/mm/yy)	BY:	DESCRIPTION:
10			
9			
8			
7			
6			
5	14/04/14	B.P.	REISSUED FOR TENDER
4	13/02/14	B.P.	ISSUED FOR TENDER
3	15/01/14	B.P.	ISSUED FOR 99% REVIEW
2	25/11/13	B.P.	RE-ISSUED FOR 50% REVIEW
1	15/11/13	B.P.	ISSUED FOR 50% REVIEW

STAMP

REGISTERED PROFESSIONAL ENGINEER M.M. MAILLET APRIL 2014 NWT/NU

CONSULTANT: CEML
DRAWN BY: B.P.
DESIGNED BY: N.K.
APPROVED BY: M.M.
DATE: NOVEMBER 2013

STAMP

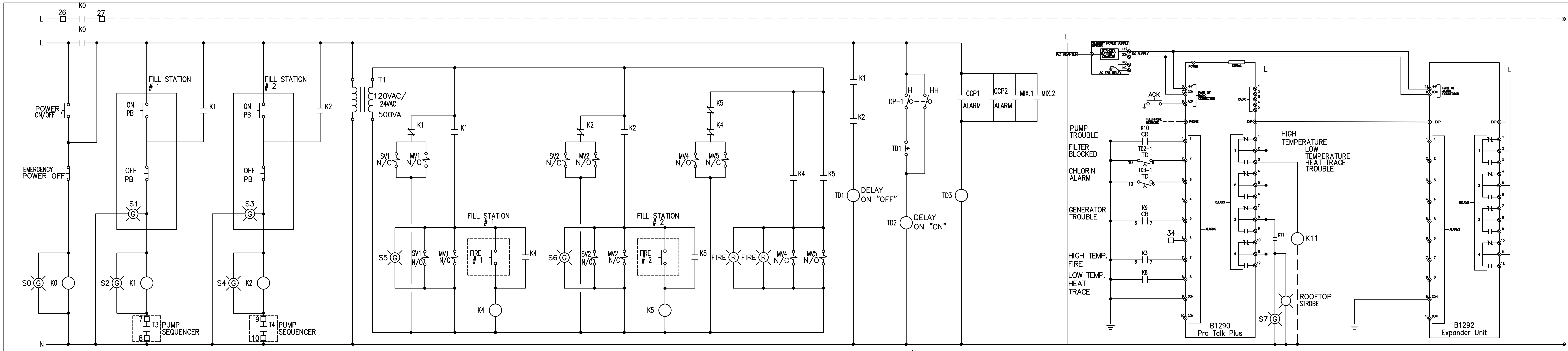
CONSULTANT:
DRAWN BY:
DESIGNED BY:
APPROVED BY:
DATE:

LOCATION:
PANGNIRTUNG
QIKIQTAALUK REGION OF NUNAVUT
X0A 0R0

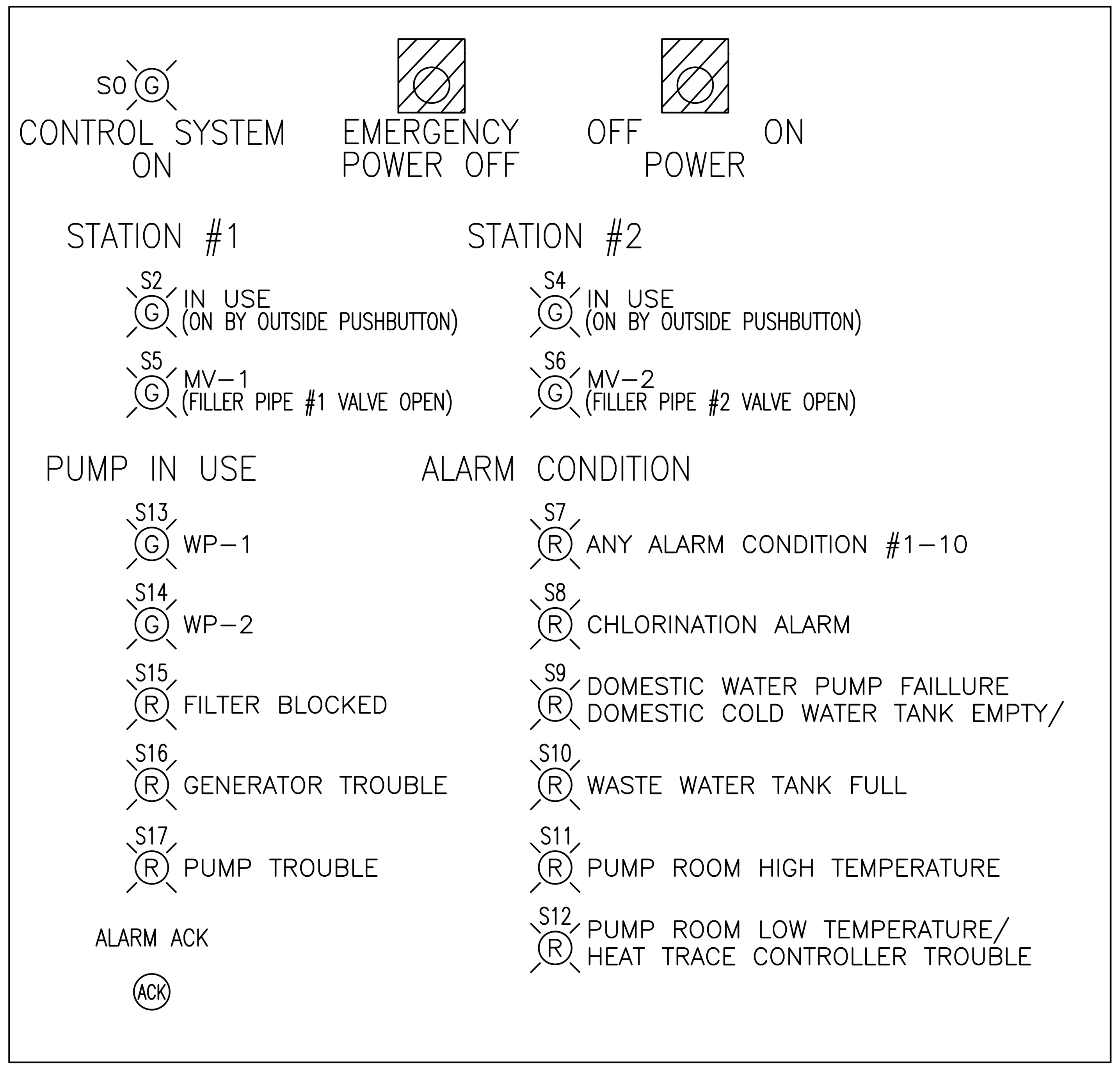
PROJECT:
OPTIMIZATION OF DRINKING WATER SUPPLY

DRAWING TITLE:
LOW-VOLTAGE ELECTRICAL LAYOUT UPPER LEVEL

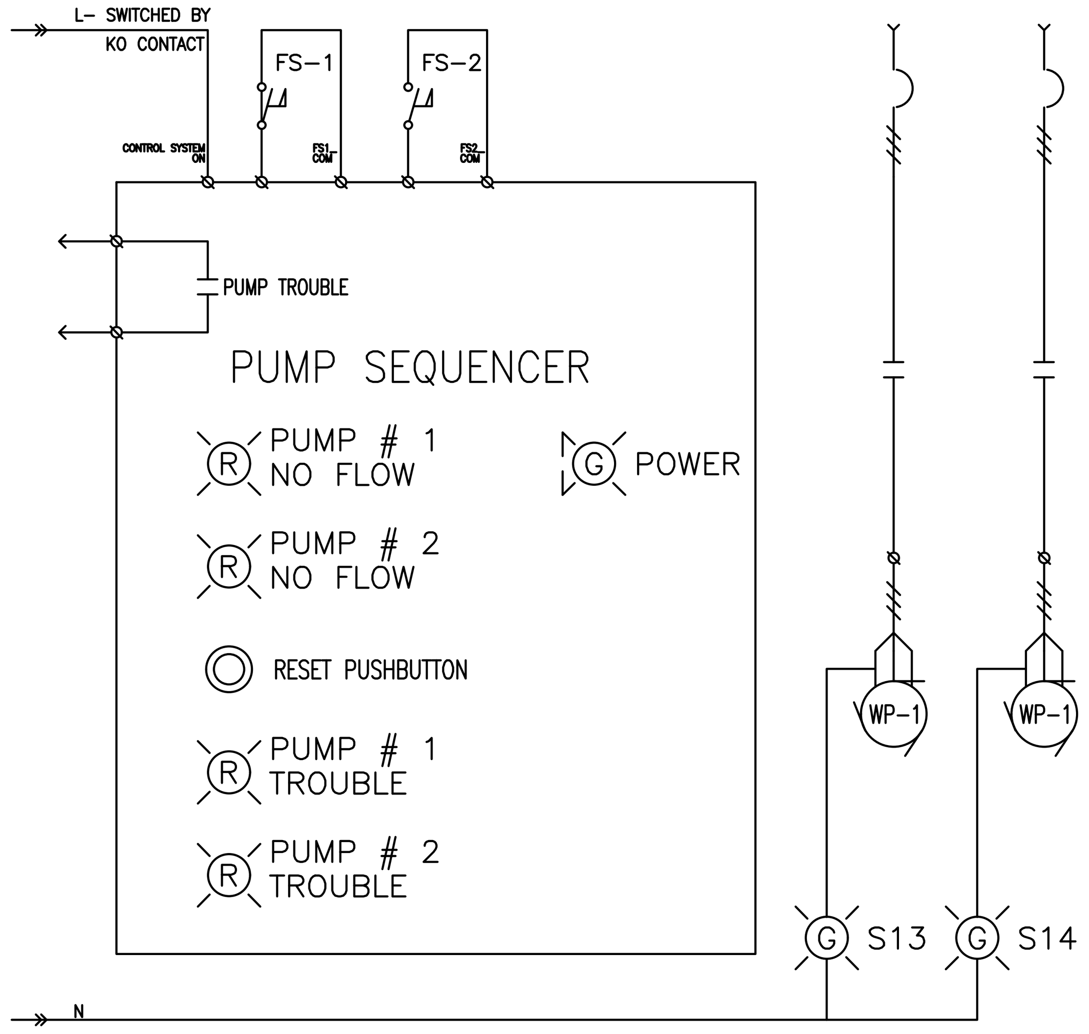
MECH FILE NAME:	DWG NO:	OF:	SCALE:
13-072 E	E6	6	AS NOTED

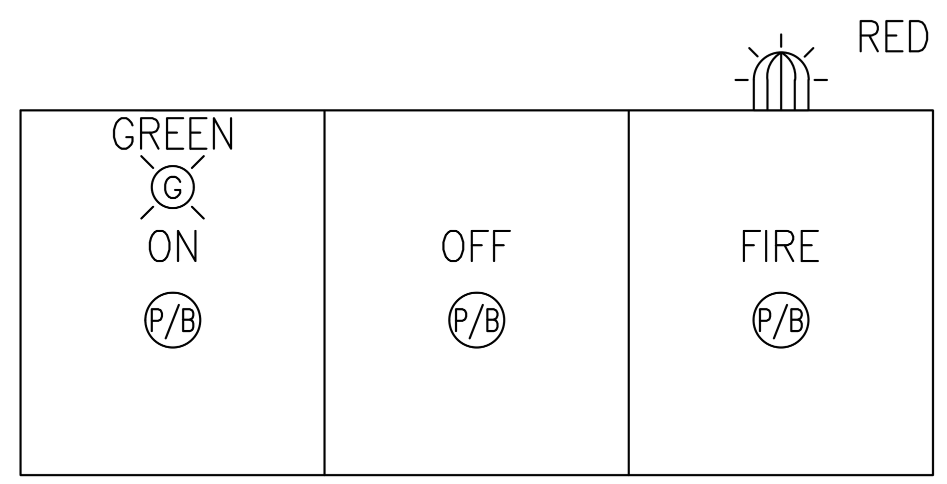


1 E5 PUMP CONTROL SYSTEM & ALARM SYSTEM LADDER LOGIC DIAGRAM
N/A



2 E5 PUMP CONTROL SYSTEM PANEL BOARD LAYOUT
N/A





CONTROLS TO BE PLACED ON FILL ARM IN MID-ROAD LOCATION FOR BOTH TRUCK FILL SPOTS

3 E5 FILL ARM CONTROL BOX LAYOUT
N/A

Alarms:

1– ALARM ACTIVATES IF A FLOW SWITCH (FS–1 OR FS–2) SENSE NO FLW IN 15 (ADJUSTABLE) SECONDS AFTER ITS RELEVANT PUMP (WP–1 OR WP–2, TIMER TD–1 AND TD–2) IS TURN ON
ACTION: CHECK THE PUMP CONTROLLER, DETERMINE WHICH PUMP FAILED AND WHY. REPAIR THE PROBLEM, RESET THE PUMP SEQUENCER AND ACKNOWLEG=DGE THE ALARM CONTROLLER.
2– ALARM ACTIVATES IF A DIFFERENTIAL PRESSURE SWITCH (DP–1) SENSES HIGHER THAN SET (H) (ADJUSTEBLE) PRESSURE ACROSS FILTERS IN 15 SECONDS (ADJUSTABLE) AFTER ONE PUMP IS TURNED ON. ALARM ACTIVATES IF A DIFFERETIAL PRESSURE METER (DP–1) SENSE HIGHER THAN SET H/H (ADJUSTABLE) PRESSURE ACROSS FILTERS IN 15 SECONDS (ADJUSTABLE) AFTER TWO PUMPS ARE TURNED ON.
ACTION: CLEAN ALL 3 WATER FILTRES, ONE AT THE TIME. ACKNOLEDGE ALARME CONTROLLER.
3– ALARM ACTIVATES IF EITHER CHLORINATION CONTROLLER PANNRLS CCP1 OR CCP2 SENSES OUT–OF–SPEC CONDICTION FOR 15 SECONDS (ADJUSTABLE).
ACTION: DETERMINE THE REASON FOR THE CHLORINATION CONTROLLER ALARM. FIX THE PROBLEM AND RESET THE CHLORINATION CONTROLLERS AND ACKNOLEDGE THE ALARM CONTROLLER.
4– ALARM ACTIVATES IF CHLORINE MIXING SYSTEM SENSES TROUBLE.
ACTION: CHECK THE CHLORINATION MIXING SYSTEM AND FIX THE PROBLEM. RESET THE CHLORINE MIXING SYSTEM AND ACKNOLEDGE ALAMR CONTROLLER.
5– ALARM ACTIVATES IF GENERATOR CONTROLLER SENSES OUT–OF–SPEC CONDITION WITH GENERATOR.
ACTION: CHECK THE GENERATOR CONTROLLER AND DETERMINE THE CAUSE FOR THE ALRM. FIS THE PROBLEM AND RESET THE GENERATOR CONTROLLER AND ACKNOLEDGE ALEARM CONTROLLER.
6– ALARM ACTIVATES IF NORMAL GRID POWER IS LOST AND AUTOMATIC TRANSFER SWITCH ENGAGES EMERGENCY GENERATOR.
ACTION: DETERMINE THE REASON WHY THE GENERATOR IS RUNNING. ENSURE THE GENERATOR HAS ENOUGH FUEL IF THE POWER OUTAGE IS PROLONGED. ACKNOLEDGE ALARM CONTROLLER.
7– ALARM ACTIVATES IF DOMESTIC COLD WATER STORAGE TANK(DCWST) LOW LEVEL FLOAT SWITCH (LS–DCW)DETECTS LOW WATER LEVEL. THIS ALARM IS ONLY A LOCAL ALARM.
ACTION: ARRANGE TO RE–FILL THE DCWST AND ACKNOLEDGE THE ALARM.
8– ALARM ACTIVATES IF WASTE WATER STORAGE TANK (WWST) HIGH LEVEL FLOAT SWITCH (LS–WW) DETECTS HIGH WATER LEVEL. THIS ALARM IS ONLY A LOCAL ALARM.
ACTION: ARRANGE TO PUMP OUT THE WWST AND ACKNOLEDGE THE ALARM.
9– ALARM ACTIVATES IFANY OF THE ROOM FIRE ALARM HEAT DETECTORS (SD–1,–2 OR –3) SENSE HIGH ROOM TEMPERATURE.
ACTION: DETERMINE THE REASON FOR THE HIGH TEMPERATURE. FIX THE PROBLEM. ACKNOLEDGE THE ALARM.
10– ALARM ACTIVATES IF THE ROOM THERMOSTAT (TS–2) SENSES LOW ADJUSTABLE ROOM TEMPERATURE OR IF ANY OF THE 2 HEAT TRACE CONTROLLERS SENSES TROUBLE WITH THE HEAT TRACE CABLES.
ACTION: DETERMINE WHAT IS CAUSING THE ALARM. TAKE APPRPRIATE ACTION(A) PROVIDE TEMPORARY HEAT SOURCE FOE THE PUMP ROOM IF THE ROOM TEMPERATURE FALLS BELOW SET POINT (10°C ADJUSTABLE), OR (B) DETERMINE WHICH HEAT TRACE CONTROLLER ALARMED AND TAKE ACTION TO FIX THE PROBLEM. ACKNOLEDGE THE ALARM.

ALARM REPORTING UNIT RELAYS:

1– PROGRAMMED TO TURN "ON" WITH ANY OF THE 1–10 ALARM INPUTS TURN "ON" AN OUTDOOR STROBE BEACON LOCATED OUTSIDE THE PUMP STATION TO DISPLAY THAT THE PUMP STATION REQUIRES ATTENTION. TURN "ON" AN INDICATOR LIGHT ON THE MAIN LABELED "ANY ALARM CONDITION #1–10".

PUMP SEQUENCER OPERATION:

BY DEPRESSING THE "ON" PUSHBUTTON AT FILL STATION #1 OR #2 (SEQUENCER INPUT CONTACTS S1ON OR S2ON) THE SEQUENCER STARTS THE "NEXT" PUMP WITH THE DELAYS OF 3 SECONDS. DEPRESSING THE SAME "ON" PUSHBUTTON AGAIN WILL DO NOTHING UNTIL THE RELEVANT "OFF" BUTTON IS PRESSED. ONCE THE PUMP IS RUNNING, IT CAN BE TURNED "OFF" BY DEPRESSING THE "OFF" PUSH BUTTON (SEQUENCER INPUT CONTACTS S1OFF OR S2OFF) AT THE INITIATING FILL STATION. DEPRESSING THE SAME "OFF"PUSHBUTTON AGAIN WILL DO NOTHING. BASED ON THE ABOVE, 1 OR 2 PUMPS CAN RUN SIMULTANEOUSLY.
THE SEQUENSER OF THE "NEXT PUMP" IS WP–1 -> WP–2 -> WP–1 -> WP–2 -> ETC....
FLOW SWITCHES WILL PROVIDE FEEDBACK SO THAT WHEN A PUMP IS TURNED "ON" IT ACTUALLY DELIVERS WATER. THE "NEXT" PUMP "ON". THIS WILL CAUSE THE AFFECTED PUMP TO BE TAKEN OUT FROM THE SEQUENCER OF THE "NEXT PUMP". IT WILL ALSO TURN "ON" A "PUMP # TROUBLE" ALARM LIGHT AND TURN "ON" A SET OF DRY OUTPUT ALARM CONTACTS "PUMP TROUBLE". LATCHING OF A FAILED PUMP "OFF" CAN BE RESET BY DEPRESSING A "RESET" BUTTON ON THE PUMP SEQUENCER.

ALARM REPORTING UNIT

ALARM #	ALARM DESCRIPTION	ALARM CONDITION	ALARM GENERATED BY
1	PUMP TROUBLE	NO FLOW WATER WHEN PUMP TURN ON	PUMP SEQUENCER & WATER PUMP FLOW SWITCHES FS–1––2
2	FILTER BLOCKED	INSUFFICIENT FLOW OF WATER WHEN PUMP IS RUNNING	DIFFERENTIAL PRESSURE SWITCH DP–1
3	CHLORINATION STOPPED	INSUFFICIENT FLOW OF CHLORINE WHEN CCP–1 OR CCP–2 IS RUNNING	CHLORINATION CONTROLLER PANEL CCP–1 OR CCP–2
4	CHLORINE FEED TROUBLE	CHLORINE MIXING SYSTEM TROUBLE	CHLORINE MIXING SYSTEM CMS–1 OR CMS–2
5	EMERGENCY GENERATOR TROUBLE	ANY OUT–OF–SPEC CONDITION	GENERATOR CONTROLLER
6	EMERGENCY GENERATOR RUNNING	NORMAL GRID POWER LOST	AUTOMATIC TRANSFER SWITCH ATS
7	WATER STORAGE TANK EMPTY	LOW LEVEL IN DOMESTIC COLD WATER STORAGE TANK	FRESH WATER STORAGE TANK LOW LEVEL FLOAT SWITCH LS–DCW
8	WASTE WATER TANK FULL	HIGH LEVEL IN WASTE WATER STORAGE TANK	WASTE WATER STORAGE TANK HIGH LEVEL FLOAT SWITCH LS–WW
9	PUMP STATION HIGH TEMPERATURE	HIGH PUMP STATION ROOM TEMPERATURE	3 ROOM HEAT DETECTORS HD–1––3
10	PUMP STATION LOW TEMPERATURE	LOW PUMP STATION ROOM TEMPERATURE	ROOM THERMOSTAT & 2 HEAT TRACE CONTROLLERS

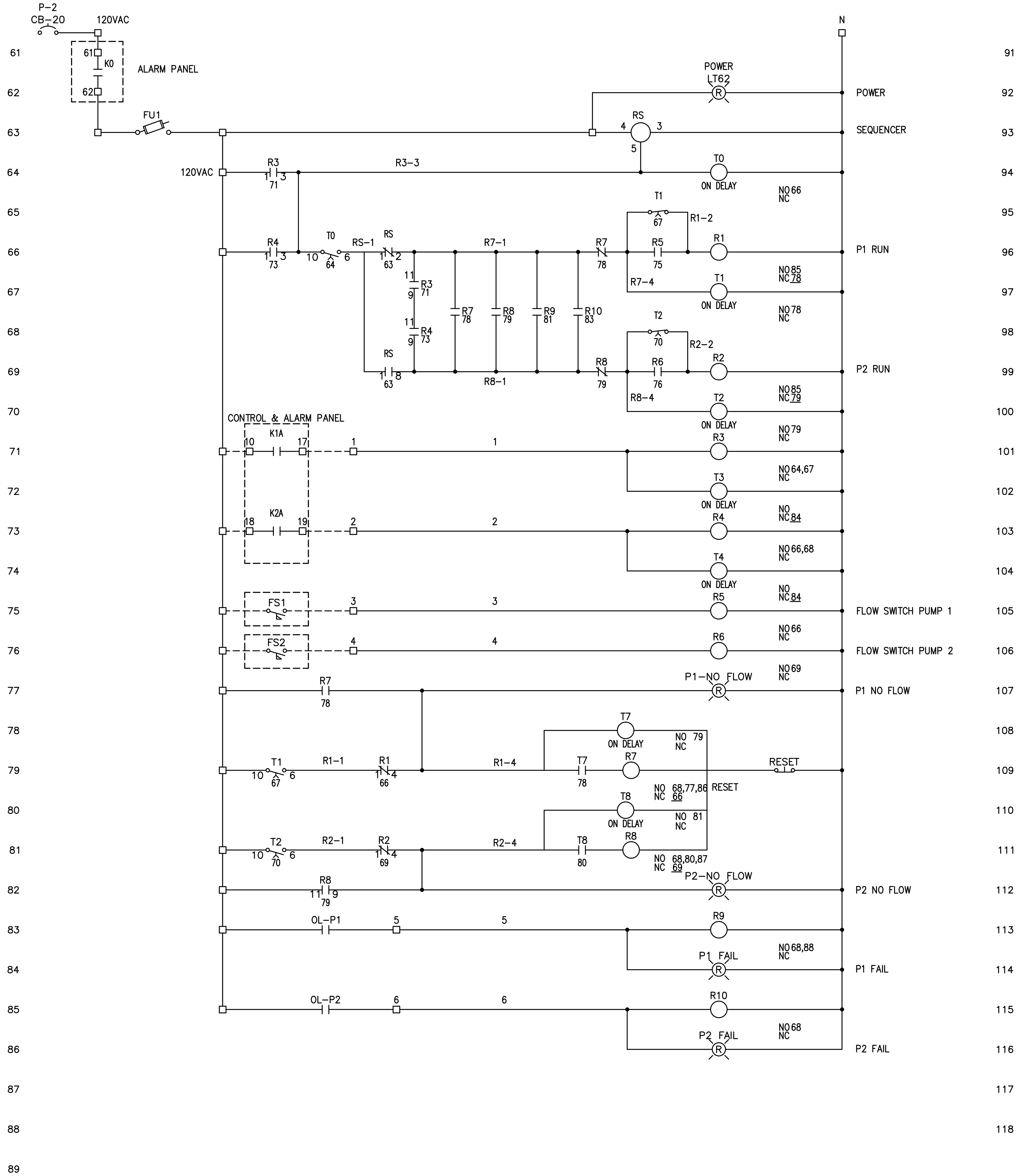
AS-BUILT DRAWINGS :
This drawing has been revised to show mechanical/electrical system as installed.
Rhéa Fauteux, P.Eng. 2016-09-30

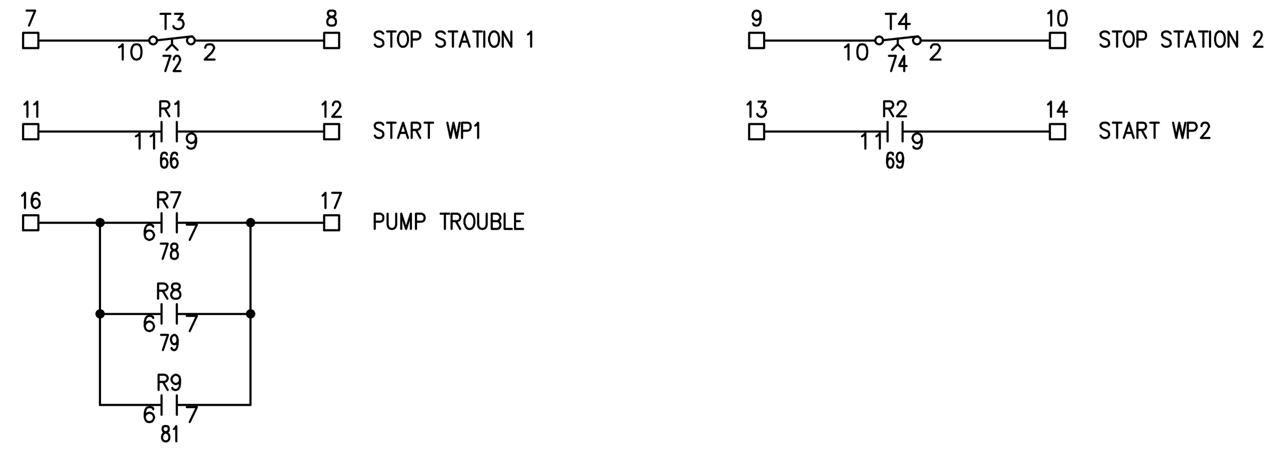
REV.	DESCRIPTION	DATE	BY
0	ISSUED_FOR_APPROVAL	–	–
1	AS_BUILT	29/09/16	GF
2	–––		

Controles OPTOINFO INC.
TEL:450–436–6050
FAX:450–436–4846
Canada, J7Z–2B1

PANGNIRTUNG, NUNAVUT
TRUCK FILL STATION

DRAWN BY: _ CHECKED BY: _	SCALE: NTS	SHEET NO 1 OF 4
CADD SYSTEM AutoCAD	DWG NO. PUMP CONTROL SYSTEM	CONTRACT –





AS-BUILT DRAWINGS :
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Rhéa Fauteux, P.Eng. 2016-09-30

REV.	DESCRIPTION	DATE	BY
0	ISSUED_FOR_APPROVAL	–	–
1	AS_BUILT	29/09/16	GF
2	---		

Controles OPTOINFO INC.
TEL:450-436-6050
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PANGNIRTUNG, NUNAVUT
TRUCK FILL STATION

DRAWN BY: _ CHECKED BY: _	SCALE: NTS	SHEET NO 2 OF 4
CADD SYSTEM AutoCAD	DWG NO. PUMP SEQUENCER PANEL	CONTRACT -

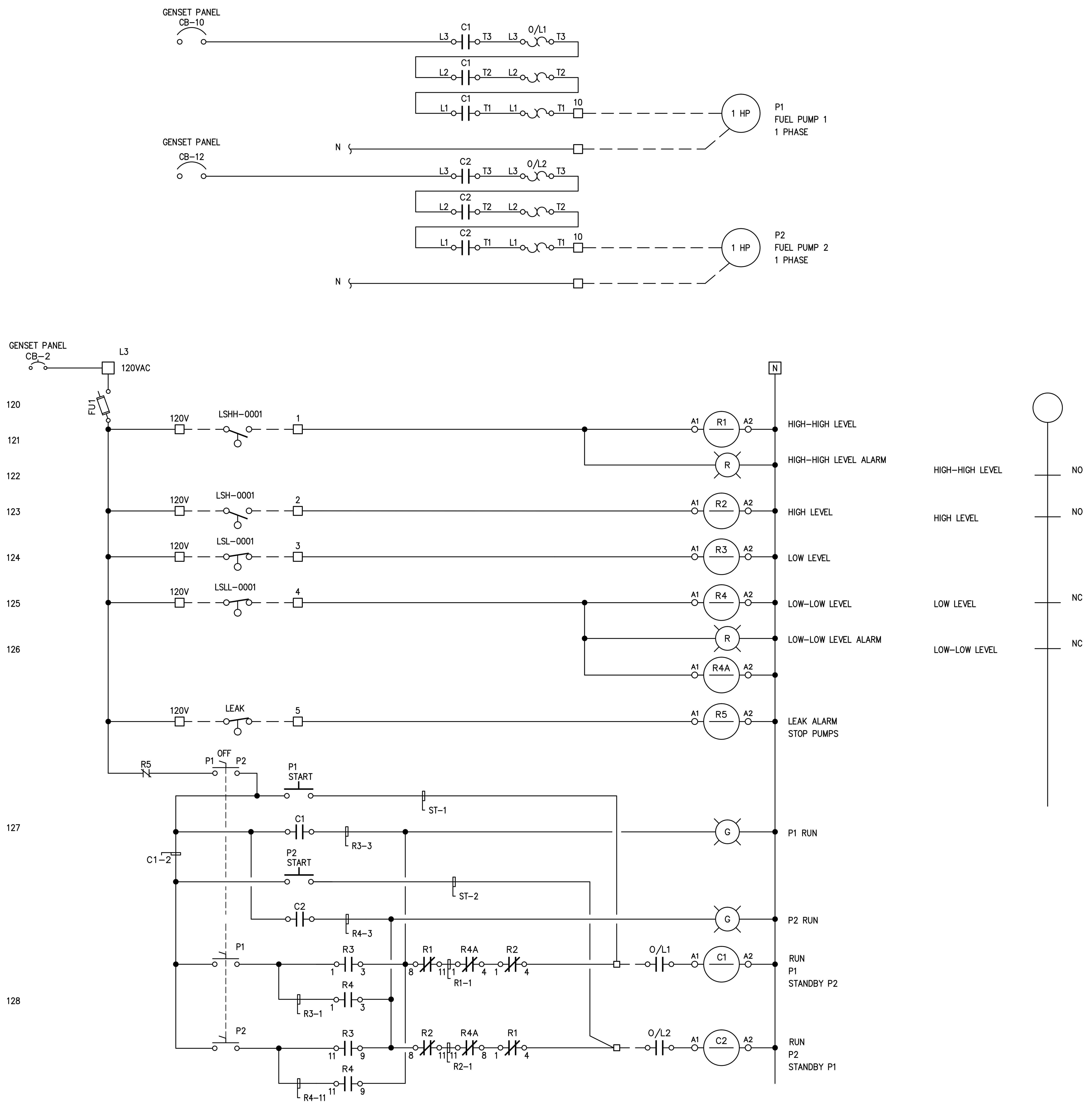
AS-BUILT DRAWINGS :
This drawing has been revised to show mechanical/electrical system as installed.
Rhéa Fauteux, P.Eng. 2016-09-30

REV.	DESCRIPTION	DATE	BY
0	ISSUED_FOR_APPROVAL	–	–
1	AS_BUILT	29/09/16	GF
2	– – –		

Controles
OPTOINFO INC.
TEL:450-436-6050
FAX:450-436-4846
Canada, J7Z-2B1

PANGNIRTUNG, NUNAVUT
TRUCK FILL STATION

DRAWN BY: _ CHECKED BY: _	SCALE: NTS	SHEET NO 3 OF 4
CADD SYSTEM AutoCAD	DWG NO. PUMP CONTROL & ALARM SYSTEM	CONTRACT –



NOTE:
1. TO REPRIME, FOLLOWING OUTSIDE OIL SHORTAGE OR O.L. TRIP, HOLD AND MAINTAIN P1 AND P2 UNTIL CONTROL RESUME OPERATION.

AS-BUILT DRAWINGS :
This drawing has been revised to show mechanical/electrical system as installed.
Rhéa Fauteux, P.Eng. 2016-09-30

REV.	DESCRIPTION	DATE	BY
0	ISSUED_FOR_APPROVAL	-	-
1	AS_BUILT	29/09/16	GF
2	---		

Controles
OPTOINFO INC.
TEL:450-436-6050
FAX:450-436-4846
Canada, J7Z-2B1

PANGNIRTUNG, NUNAVUT
FUEL CONTROL PANEL

DRAWN BY: _ CHECKED BY: _	SCALE: NTS	SHEET NO 4 OF 4
CADD SYSTEM AutoCAD	DWG NO. FUEL CONTROL SCHEMATICS	CONTRACT -

Chapter 3 PROCESS SYSTEM OPERATION

3.1 WATER PUMPS

3.1.1 Description

When trucker push on the start button the control panel automatically starts one of the two water submersible pumps 20HP located in the raw water intake pipe. Only one pump will run at a time. Actually, water pumps are alternating. The Control Panel changes automatically switch to the other pump in case of failure or maintenance. The operator can force the operation on a specific pump by putting to off one pump.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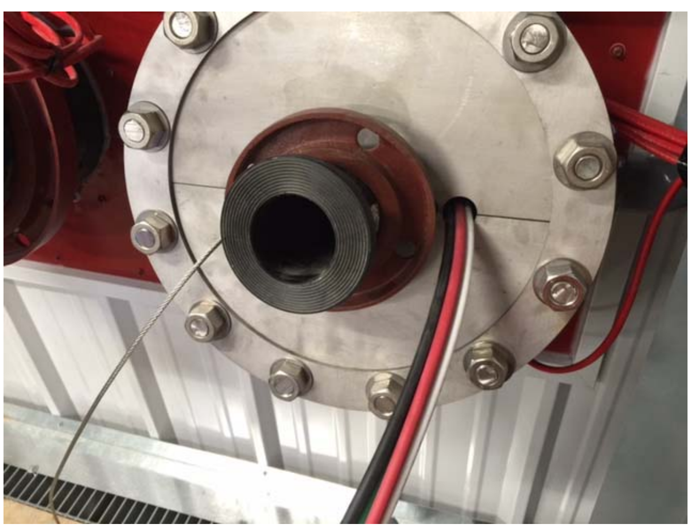


3.1.2 Operation

1. Every day check if the water pump work correctly by using the Control Panel.

2. No alarm shown on the control panel and/or the sequencer panel then everything is OK

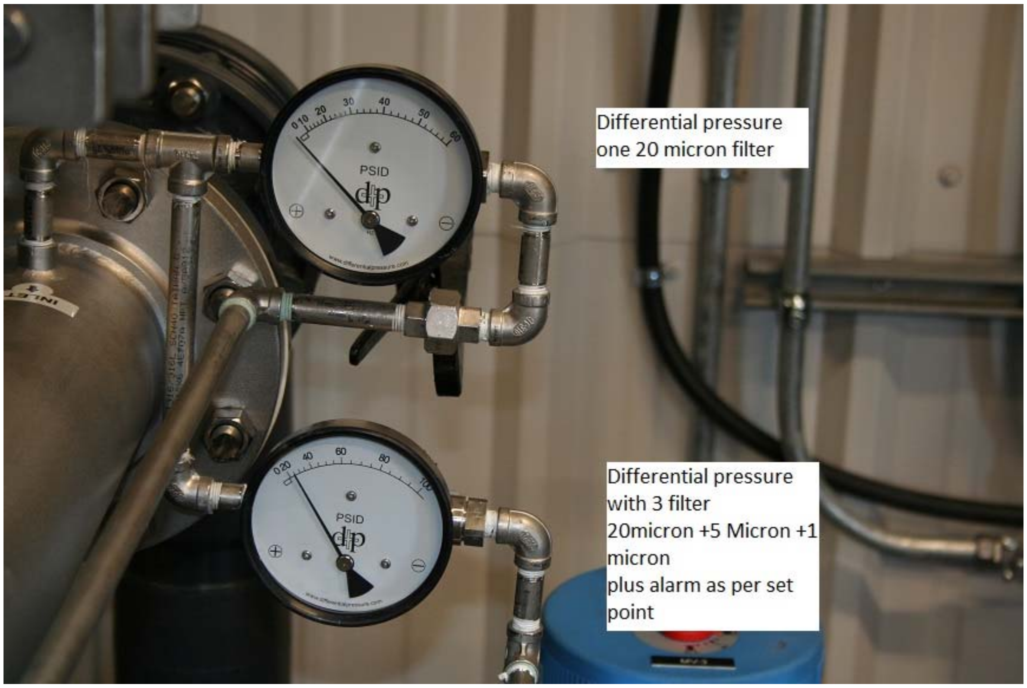
The rest of the system is automatic. No operation should be required. If the system fails to operate properly, go to **Chapter 7**, "trouble shooting". For more information, refer to Chapter 38 & Chapter 29 & Chapter 17 .

3.2 FILTERS

3.2.1 Description

The Filtration building is equipped of 3 filters and 2 strainers one for each pump. The filters are positioned in series for a filtration capacity going from basket with 3mm hole to 1 µm filter. In flow order, we find that capacity as shown in plan, Chapter 1:

1. Strainer equip with a filter of basket with 3mm hole
2. Filter Housing #1 – 20µm capacity (HC/170-20 Hurricane Fltr Cart)
3. Filter Housing #2 – 5µm capacity (HC/170-5 Hurricane Fltr Cart)
4. Filter Housing #3 – 1µm capacity (HC/170-LT2 Hurricane Fltr Cart)



3.2.2 Filters replacement

Filters need to be changed accordingly to water quality. Also, filters need to be cleaned, following procedures of Harmsco**.**

Step 1

Open pump breaker in truck fill station, Pump P1 and P2. Make sure that pumps are disabling.

One more option is to flip the filtration mode selector to bypass mode. In this case, Filtration building is bypassed by motorise valve MV3 & MV4

One more option with the filter butterfly valves you isolate the filter requiring maintenance.

Step 2

Close valves between filter Housing. **Refer to Harmsco for cleaning procedure and filter changes.**

Step 3

Always isolate and remove pressure from housing before servicing. Housing is to be shut off, drained of fluid by first opening the lower drain.

Step 4

Open filter housing by turning eye nuts counter-clockwise, disengaging swing bolts, and removing lid.

Step 5

Remove new cartridges from packaging and make sure centre cores are clear of all obstructions, mainly from shipping materials.

Step 6

Install cartridge lifting handle into cartridge

Step 7

Insert cartridge into housing and into stand-pipe, cartridge is to contact Tube sheet of housing

Step 8

Position housing O-ring seal in groove housing.

Step 9

Position Lid onto housing and properly align on seal before applying swing bolts. Do not allow tilting or cocking of lid on gasket.

Step 10

Close filter housing by tightening Eye Nuts clockwise by hand. Use a star pattern several times to tighten all of the eye nuts properly.

Step 11

Slowly open inlet valve to begin operation, allowing fluid to fill housing.

Step 12

Open filter housing outlet valve.

Step 13

It is recommended to flush the system by running water trough the filter at the recommended rate for 10 minutes.

Step 14

Start pump, if applicable, and operate filter.

Refer to **Chapter 36** for more details

3.3 CHLORINATION DOSING PUMPS (Prominent Solenoid Metering Pump)

3.3.1 Description

Operation of those pumps being the key to proper chlorine injection a full morning of training was dedicated to program those pumps.

3.3.2 Operation

In this particular case, two mode are interesting :

- manual (in case of emergency by example failure of the flow meter)
- proportionnal (the comprehension of programming parameter is very important). Analog mode must be selected at all time, instruction as per page 31 of PROMINENT manual (Catalog Part No. 987604).

Following sequence of parameter must be selected

- analog mode-curve type upper sideband
- P1 on curve should be set at 5ma to insure operation when there is flow only at P1 Frequency of pulsation typical for start 60 pulses per minutes
- P2 on curves frequency of pulsation to obtain required chlorine for start is 80 pulses per minutes
- Error on or off (set it at on) If by flow meter is unplug and or defective an alarm will appear on the injection pump and transmitted to the alarm control panel.

- **P1 and P2 frequency is determine with the day to day free chlorine value taken at truck load arm and may change depending of water PH. Only experience will determine correct setting**
- **Each pump should at all time have the same P1 and P2 setting.To prevent clogging pump in usage should be alternate weekly.That mean that each pump should be use one week each month.There is 4 pumps.**
- **Of course injection pump acting after filter are useless if the 3 filter line is out of service.**

Energy for the metering pump is supplied from a 120 volts plug.

Under low chlorine level in tank, pump stop for its protection. The feed power for injection pump is originating from

This system is automatic. No operation should be necessary. If the system does not run as described in this section, refer to **Chapter 35**.

3.4 CHLORINE CONTROLLER (Microchem 2 c/w CL4000 sensor)

3.4.1 Description

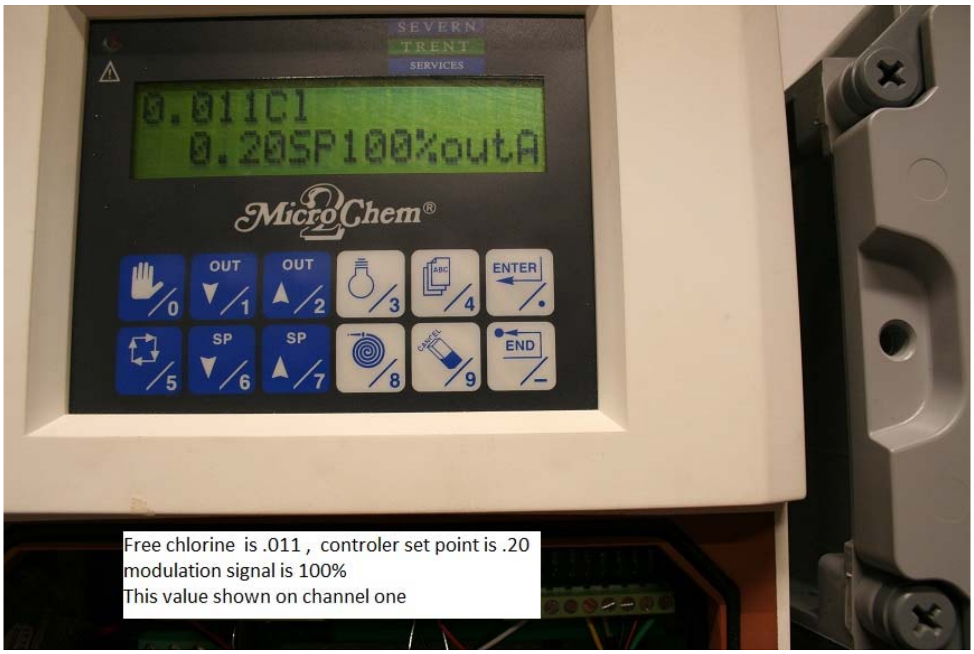
The intent of this controller is to allow a complete automatic operation with a PID fine tuning superpose to the proportional flow signal from flowmeters.

The two key component are the chlorine probes and PH probes.

After reading and studying numerous document on those sensors and testing on site numerous scenarios. CL4000 require a continuous flow. In this project it's no the case. Then, residual chlorine could not be perfectly match. A mathematical model base on slope between two-point permit to transform the flow signal to a corresponding milli amps signal use by the injection pumps.

- CL4000 chlorine probes requires 30 litres of stable and continuous flow and time to settle.
- 5 minutes on and one hours off or 16 hours off and 10 minutes on is not continuous flow

The only way that we did succeed obtaining decent reading was after 12 hours of continuous flow from our drinkable water storage tank that is filled with water line to truck. Refer to attach Picture.



3.4.2 Operation

This system is not automatic. Calibration operation should be necessary. If the system does not run as described in this section, refer to following CHLORINATION INJECTION SYSTEM:

This periodic preparation of chlorine under liquid form and periodic testing of concentration in delivery truck is the biggest operating challenge. All other operations are generally completely automatic and don’t normally require close follow up.

The chlorine injector pump starts automatically once flow is detected in flow meter This is the reason of the 4.5 ma setting at P1 (when flow reach this engineering value of 4.5 ma injection pump start). Chlorine is added proportionally to the slope selected on P1 anP2 in the injection pump. Normally higher flow must produce more frequent injection stroke to maintain same free chlorine content in water.

Only experience will determine the better choice of the frequency of injection at P1 and P2

At commissioning we are presently set at 5 ma for P1 and a frequency of 60 pulses when ma reach 5 ma (5 ma correspond to minimum flow for injection pump activation) Below 5ma nothing happen injection pump don’t run

At commissioning we are presently set at 14ma (engineering value that was made compatible with bandwidth of the flow meter operation) that value is selected by the commissioning engineer on a total possible of 20 ma

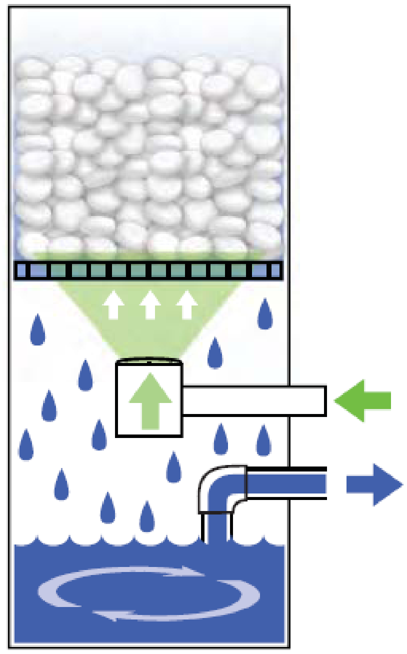
And a frequency at this point of 80 pulse

That is a starting setting that should evolve with time and condition.

By example if PH of water get to acidic and or to basic (caustic) more chlorines will need to be added to reach the same free chlorine content.

3.5 BRIQUETTE CHLORINATOR (ARCH Chemical)

3.5.1 Description



The patent spray technology utilizes a "spray-tree" or manifold which has specific nozzles attached to spray upwards into the suspended bed. The nozzles are vane-less, full cone and all plastic and the pattern of the spray is dependent on inlet water pressure. The height of the nozzle manifold from the bottom of the suspended bed is a critical parameter, as the spray pattern generated at 45 psi *[3.10 bar]* inlet water pressure penetrates the bed of calcium hypochlorite briquettes to a specified and acceptable depth. If the water pressure is not sufficient (<40 psi *[2.76 bar]*), the full-cone spray is not developed and not enough water contacts the briquette bed, which creates un-dissolved product and poor product performance. The unit is equipped with an inlet water pressure regulator to reduce water pressure in excess of 50 psi *[3.45 bar]* to the specified 45 psi *[3.10 bar]*.

3.5.2 Operation

IMPORTANT: Refer to Chapter 35 for Safety Details regarding this equipment.

- Inlet raw water supply 1.0 gpm [3.8 lpm] at 45 psi [3.10bar] or greater enters water supply manifold
- Solenoid valve opens, allowing pressurized water to spray bed of calcium hypochlorite briquettes, which are suspended over solution reservoir
- Calcium hypochlorite briquettes are dissolved, making a solution of available chlorine in the reservoir
- Level sensors turn on or turn off inlet solenoid valve
- Pump circulation system constantly mixes the solution in the reservoir
- Chemical dosing pump withdraws solution from the reservoir tank to point of application

3.5.3 Briquette Supply

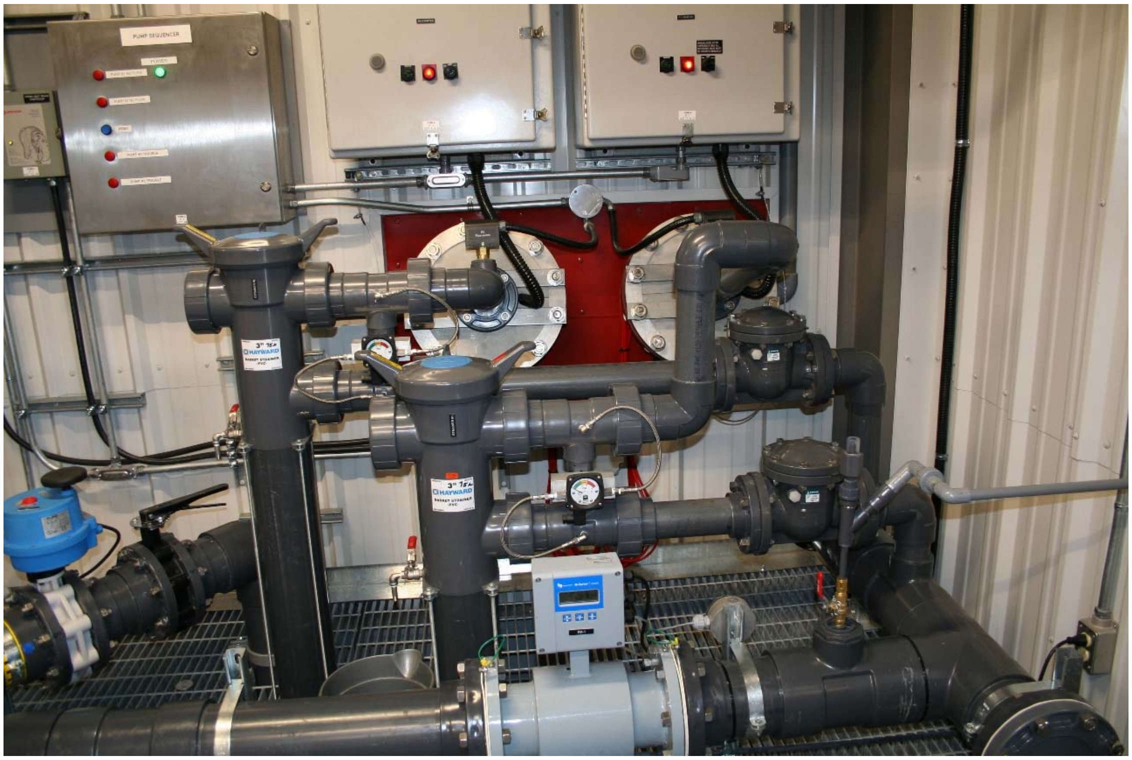
- Turn Off the Chemical Dosing Pump
- Turn off Power
- Inlet ball valve on the water supply line should be in the closed position.
- Remove Lid on unit.
- Fill the hopper approximately half full with Constant Chlor® Briquettes. (The first batch of solution will be ~0.10-0.50% weaker than the normal 1.50% available chlorine solution and will increase steadily as the bed conditions and the solution turns over).
- Replace lid on unit.
- Turn Power ON.
- Slowly open the inlet ball valve to allow water to flow through the manifold. You will hear an audible clicking of the solenoid valve opening.
- Check to make sure that pressure gauges are operating, indicating flow. The gauge on the left should read 45 psi [3.10 bar].
- The circulation pump should be OFF and as the tank begins to fill, the TANK LOW light will go off and the circulation pump will turn on
- As the circulation pump develops head pressure to >5 psi [0.34 bar]
- The tank will continue to fill until the TANK FULL light is ON.
- Turn ON the chemical dosing (metering) pump on the control panel.

IMPORTANT Refer to Chapter 35 for Safety Details

3.6 FLOW METER

Two flowmeters are present in this installation.

-One is at pump outlet before the 3-way valve set up (this meter all water coming out from pumps. (include water when fire button is press on loading arm and valves bypass filters)



-One is at filter outlet. (any water passing true filter is meter)

-Those flow meter supplies a 4-20 MA signal proportional to flow.

-The level of this signal must be programmed by the commissioning engineer to suit proportional chlorine injection.

This signal is use by the 4 chlorine metering pump and the Microchem2 controller.

3.7 PROCESS WATER CAPTURE AND TANK FILLING

To fill process water tank, system must be in filtration mode. A simple filling valve is actuated by a float located at process water tank top.

Whenever a truck fills up in filtration mode, the process water tank is capped.

Chapter 4 BUILDING MECHANICAL SYSTEM OPERATION

4.1 Sump pump and Waste water pit

During service sink use, filter change, and floor cleaning, waste water is drained to the waste water pit. Integrated in the sump pump is a control float operating directly at 120 volts in the supply line of the sump pump. That pump expels excess waste water level to the waste water holding tank.

Chlorine room sump pump. This 120 volts' individual package sump pump return to pipe casing intake water drain at chlorinator and microchem2 controller.

4.2 Waste water tank and signal

Under high waste water conditions in tank, two actions are taking place:

1. Red outside indicating lamp is on (high waste water level in storage tank)

2. Domestic pump is blocked and not operating

Pump out is required to resume normal operation.

4.3 Domestic Water Tank

This tank is now filling by gravity when truck fill is ongoing on loading arm #2. Farm float type control filling. Low level float is present at low level in tank to interlock drinkable water from operating during low level condition.

4.4 Domestic Water Pump

Domestic water pump and is interlock where found operating as per spec. (pump stop if drinkable water tank low and or waste water tank full). Domestic water pump is set at 40 PSI of pressure. This level of pressure is required for the chlorine briquette chlorinator.

The domestic water pump is a self contain automatic pump. When water is demanded, it maintains water pressure for service sink, cleaning hose, chlorine tank filling, etc.

Following conditions stop operation of pump:

1. Waste water tank full thus preventing pump operation.
2. Float for this task is located in the waste water storage tank.
3. Refer to **Chapter 15** for more details

4.5 FUEL SYSTEM

4.5.1 General Operation

Fuel Control Panel has a strobe to horn in case of failure. The fuel control panel is located near the daily fuel tank. When this problem occurs, the operator must find the problem immediately.

4.5.2 Fuel Storage Tank

The purpose of this system is to provide fuel oil to the furnace and the back-up generator. The furnace, primary source of heating, runs all the time with fuel oil. Without fuel oil, the back-up unit heater will take on the heating with electrical input. Otherwise, the building and the pipes will freeze.

4.5.3 Description

Fuel is stored in 4546 liters (1000 imp. Gal.) storage tank outside the building. When full, this tank holds enough fuel to run the building heating system.

A second, smaller tank 227Liters (50 Gallon imp.) is located near the boiler, and holds enough fuel to supply the furnace and the back-up generator.

Refer to Chapter 25 & Chapter 26 for more information.

4.6 FUEL PUMPS

4.6.1 Description

Fuel pumps located in the building automatically draw fuel from the larger tank to fill the smaller tank. Fuel Control Panel (FCP) use Float switches in the smaller tank automatically turn on the pumps when the fuel level is low (40%), and shut the pumps off when the small tank is nearly full near (90%). The operator can manually fill up the day tank using the FCP panel and select ‘’HAND’’ mode. Important: after the operation move back the selector in AUTO mode.

If the level in the small tank gets too low or to high, a "fuel alarm" will show on the interface. If this happens, go to the "trouble shooting” 0.

4.6.2 Operation

- Every 4 days check the fuel level in the large storage tank outside by reading the gauge of the main tank. Located beside the fuel control panel.
- If the fuel level is low, phone the supplier for more fuel.
- The rest of the system is automatic. No operation should be required. If the system fails to operate properly, go to Chapter 7, "trouble shooting".

Refer to Chapter 25 & Chapter 26 for more information.

4.7 HVAC

4.7.1 General Description

Heating for the building is provided by an Oil Fired Furnace.

For safety consideration there is a fan (EF-1) in Chlorination Room. This Fan is running all the time and the Furnace Heating fan make sure to provide a positive pressure in chlorination room.

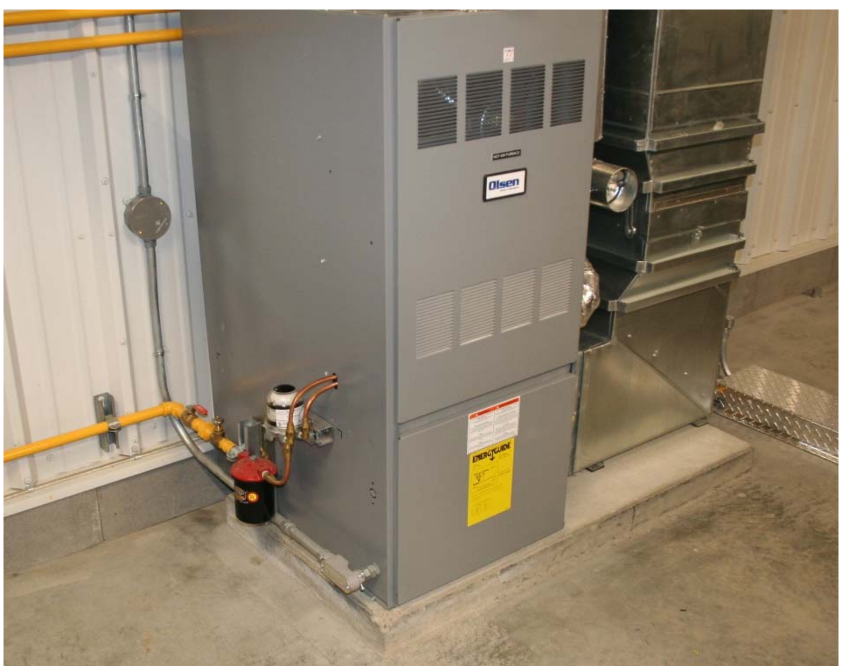
The entire system is self-directed. In case of building low temperature, the systems automatically dial-up the operator.

If any part of the system fails to work, go to the "trouble shooting" **Chapter 7.**

4.8 HEATING FURNACE

4.8.1 Description

The Oil Furnace suck the fuel from fuel day tank. The Oil furnace supplied hot air to the three rooms via a series of air duct: Chlorination Room, Generator Room & Filter Room. An independent Thermostat located in filter room is controlling the furnace. Refer to Olsen Chapter for more information about the furnace.



4.8.2 Operation

- Every day check if the Furnace works properly.
- Furnace Fan must

The rest of the system is automatic. No operation should be required. If the system fails to operate properly, go to **Chapter 7.** "trouble shooting".

Refer to Chapter 25 for more information.

4.9 UNIT HEATERS (UH-1…)

4.9.1 Description

The Electrical Unit Heater are only for Emergency Purpose. They kick-off only under low temperature set-point. Electrical Unit Heater are suspended from the ceiling. Each Unit have their own internal thermostat. Refer to Chapter 27 for more information about the Unit Heater.

4.9.2 Operation

- Every day check if the Thermostat is set around 10°C.

- Every day check if there is no apparent malfunction.

The rest of the system is automatic. No operation should be required. If the system fails to operate properly, go to **Chapter 27**, "trouble shooting".

Chapter 5 ELECTRICAL OPERATION

5.1 Electrical power

The installation is powered by QEC new power line at 208 volts 3 phase with a 250amps 3 phase breaker.

There is a backup generator 120/208 volts 3 phase of 80 kW capacity feeding an automatic transfer switch ready to start at all times, in case of a Power failure from QEC.

The 20 HP main power pumps are fed at 208 volts 3 phase.

Refer to As-built Plans in Chapter 1, for more details.

5.2 Submersible Pumps

A selector switch on control panel in the building allows pump selection. Two independent intakes with their own water reservoirs are available as water source. Pushing the start button located on the water loading arm, activate the selected 20 HP pump. Only one pump at a time can run in normal condition.
In case of ‘’High Flow Demand’’ (Fire in the Hamlet) the two submersible pumps work at the same time to provide maximum flow to loading arm.

Automatic motorised isolating valve assure maximum flow to the loading arm preventing water to back flow in the standby pump.

The selected pump can be stopped using the "Truck Fill Stop" button on the start/stop at the arm level and or at ground level in a second station.

At all times, pumps can be started inside building directly on their respective starter by use of a selector mounted directly on the starter box. Turn the selector and manually start the pump. Return to off position or auto stop the pump.

For more information, refer to Chapter 38 & Chapter 29 & Chapter 17 .

5.3 Heat Trace

Heat trace system is installed on each water intake. Heat trace and their respective control panel for pipe#1 and pipe #2 was tested and found conform to design. Freezing protection is more than adequate. Spare tubing are available for heat trace running.

Each HTC to control: 2 heat trace cables and 3 RTD temperature sensors. There are 3 sensors per intake pipe: at 15 meters and at 30 meters.

One control panel per intake controls and supervises heat trace operations.

In summary, each heat trace control panel keeps the following tasks under control;

a) To be code conform ground fault protection must be guaranteed at all times. This control monitor continuously leaks current to ground and gives an alarm on such a condition and cuts the electric circuit to the faulty heat trace.

b) Temperature control inside pump casing. With its probe inserted in the insulated intake casing the controller turns the heat trace on and off to adjust with set point.

c) Control supervises the correct range of operation at all times, following the alarm set point of operation given at installation. (By example under heating demand if the controller detects no corresponding electrical current. This is a fault condition and control fall in alarm condition).

d) For more information, refer to Chapter 383.

Chapter 6 CONTROL OPERATION

6.1 Main Control Panel (Alarm & Pump Control)

On main Control Panel you can choose between ‘’ Filtration’’ mode or ‘’No Filtration’’ mode. The selector should always be on ‘’Filtration’’ mode. In case of fire flow demand, the operator needs to select ‘’No filtration’’ mode.

The main control panel inside the truck fill station has red indicating lights to warn of any trouble with the system. When one of these lights is on, the operator must acknowledge the problem, find and resolve the problem according to the alarm:

The control panel houses all necessary control relay and supervision relay for alarm purpose.

As long as the alarm condition is not acknowledged by the operator, the control panel sends an alarm condition to the auto-dialler.

The possible alarm conditions are as follow:

a. Generator Trouble

b. Chlorination Alarm

c. Domestic Cold Water Tank Empty/Domestic Water Pump Failure

d. Waster Tank Full

e. Pump Room High Temperature

f. Pump Room Low Temperature/Heat Trace Trouble.

g. Filter Block

h. Pump Trouble

The main control panel in truck fill station building also manages the following items:

2. Motorised Valve No.1
3. Motorised Valve No.2
4. Motorised Valve No.3
5. Motorised Valve No.4
6. Starter Pump No.1 (SS1)
7. Starter Pump No.2 (SS2)
8. Solenoid Valve No.1
9. Solenoid Valve No.2
10. Relay for outdoor Operator Stations (Start & Stop)
11. Selector for mode of operation.

6.1.1 Filtration Mode Selection

On the main control panel, the operator must select the desire method of operation for is plant. This choice is made via a selector on this main control panel.

Following mode is available

1. -Operation with filtration plant
2. -Operation without filtration plant

With filtration plant mode selected motorized valves MV3 and MV4 automatically divert water flow to the filtration building. Here are the other automatic actions that are undertaken

If filtered water circulation is detected in the filtration loop by the flow meter, the chlorine injection pump is activated. As required, the process water tank fills up.

Following the selection of operation, if it is without filtration plant mode, the motorized valves MV3 and MV4 automatically isolate filtration plant.

6.2 Pump Sequencer

The pump sequencer main goal is to alternate working pumps after each truck fill. In case of pump failure an alarm shows off. If the flow switch of its relevant pump is not ‘’ON’’ within 15 seconds, the pump sequencer will turn that pump ‘’OFF’’ and turn the next pump ‘’ON’’. This will cause the affected pump to be taken out from the sequence of the ‘’NEXT PUMP’’. It will also turn ‘’ON’’ a ‘’Pump Trouble No. X’’. Latching of a failed pump ‘’OFF’’ can be reset by depressing a ‘’RESET’’ button on the pump sequencer.

The possible alarm conditions are as follow:

1) Pump No.1 No Flow

2) Pump No.2 No Flow

3) Water Pump No.1 Fail

4) Water Pump No.2 Fail

For more information, refer to **Chapter 38.**

Chapter 7 TROUBLESHOOTING

7.1 Submersible Pumps

Mechanically speaking, there is no periodic maintenance to do on those pumps.

If they are found to be defective, they must be replaced as a unit. The pumps or electric motor can't be repaired, just replace the complete unit motor and pump. The key to avoiding problems with the pumps or electrical motor is a good installation procedure.

The submersible pump motor needs good, water tight electrical connection, especially for the underwater part of the wiring. This three-phase motor can run in either direction depending on how it is connected to the power supply. When the three cable leads are first connected to the power supply, there is a 50 % chance that the motor will run in the proper direction.

During the replacement of a pump, special care must be taken to rebuild electrical connection with compressed lug and heat shrink, following instructions in this manual.

After replacing the pump, if it does not deliver the expected flow, check the direction of rotation. Rotation can be reversed by exchanging any of the three wires feeding pump.

Great care must be taken to rebuild those connections. Failure to do so will result in fault condition below.

7.2 Truck Fill "Start button is pressed but does not start pump"

A) Is power present in building from NPC and/or Generator (regular lighting is on and emergency light is off?)

B) Is the corresponding pump insulation contactor besides the door live and red light on, if not, check the following: Is selector on insulating contactor on auto. Turn selector to run for trouble shooting purpose. If pump does not start, continue investigation.

1) Is there a ground fault indication on the corresponding ground fault Panel? If yes, push reset button. If unable to reset pump, the motor is defective to ground. Confirm with a 1000 volts megger insulation condition on pump. If test shows a resistance less than 1 meg ohms, pump motor is to be replaced.

2) Is the red indicating light live on contactor with selector position to Run. If not :

   - Try the other pump turn selector to run. If also dead, problem could be related to control panel 120 volts AC power source.

   - Check and replace fuse as required. If control continues to burn the fuse, find a control technician for repair.

7.3 Direct Start

Main function of this electronic device is start the pumps. It will provide the submersible pump with an instantaneous current. Making it start at once with its full power.

7.4 Pump failure -Removal of Pumps for Servicing

If previous troubleshooting clearly indicates a pump malfunction, then we must plan to replace pump.

Step 1

Call the Area Maintenance Officer.

Step 2

Disconnect the intake line from the building piping.

Step 4

The intake line is around 100 feet long., guide the pipe outside by pulling it out.

Step 5

Pull the pump into the building. Do not let pump drop onto concrete floor.

7.5 GENERAL

7.5.1 Auto-Dialler Calls

- Fire Alarm.
- Panel Alarm

7.5.2 Alarm Interface is not working properly

- Verify fuse on main control panel.
- Validate if interface is well connected behind Interface door. If not, connect it.
- If is still not working, call 855-437-4001 for Technical support.

7.5.3 Building Low temperature

- Verify thermostat settings for the individual Unit Heaters (UH-1 @ UH-5) and the furnace. If the temperature is below 10°C, boost thermostats to 20°C. Wait 10 minutes and validate. If they do not work properly refer to Chapter 27.
- Go to step 7.5.4.

7.5.4 The furnace do not work properly

- Validate if fuel pump are working properly. If not, go Chapter 25
- Validate if the furnace work properly, if not, go to Chapter 20.

7.5.5 The Fuel Pumps does not work properly

- Validate if Fuel Pumps are in AUTO mode. If not, select AUTO mode.
- Pumps should starts and fill up day tank.
- Validate if fuel is available in the day tank. If not, validate if fuel is available in the main tank. If the fuel level is low, phone the supplier for more fuel.
- If fuel pumps are not pumping, Refer to the fuel pump manual Chapter 25.

7.5.6 Fire Alarm system does not work properly

- Fire head are only connected to the alarm panel as high temperature alarm, no supervision is available on those sensor

7.5.7 Units Heater systems are not working properly

- If Unit Heater are not working properly, refer to Chapter 27

7.5.8 Damper Actuator is not working properly

- If Damper Actuator is not working properly, refer to Chapter 23

7.6 MAINTENANCE

The following outline for a maintenance program is general information and a program for essential, effective, economic, and safe operation of mechanical equipment, systems and services

The key to generally low maintenance costs for the systems is a standard preventative maintenance program based upon the manufacturer's recommended procedures.

With the sophistication of mechanical systems for environmental control, there is a greater need for proper operation and maintenance of the systems to avoid costly breakdown or failure in performance. The total costs of such breakdown includes not only the cost of necessary repairs and the replacement of damaged parts, but also the loss of use, inconvenience, down time and possibly partial or even complete shutdown of the facility.

Sound operating procedures and maintenance programs as itemized below, can serve to achieve these benefits:

1 Become familiar with the manufacturer's information in the operating manuals,
2 Stocking an adequate supply of spare parts.
3 Develop a program and provide an adequately managed and trained staff to implement the program.
4 Consider an option of a service contract for all specialized systems such as refrigeration systems and automatic controls.

7.7 Preventive maintenance and Safety

To ensure uninterrupted use, equipment should be regularly inspected, tested and proper repairs made and recorded.

The objective is to minimize equipment operating problems and prevent failures by making minor or necessary repairs before major difficulties occur. The importance of record keeping cannot be over emphasized. Good maintenance protects the Owner's interest with manufacturer warranties, continuity of maintenance despite staff turnover and equipment reliability track record.

Environmental and operating conditions are key elements affecting proper and reliable operating of equipment.

Costly repairs can be minimized if the following items are attended to -

KEEP IT TIGHT
KEEP IT CLEAN

Day-to-day accumulation of normal atmospheric particles lint, metallic particles from mechanical equipment cause problems with equipment over a long period of time. As accumulation affects equipment reliability and operating life. **ALL equipment should be regularly cleaned.**

7.8 Keep it Tight

All dynamic equipment and control devices operate with high speed movement. This motion creates vibration that can loosen hardware and other parts. External vibration from equipment may cause the loosening of hardware and connections in any equipment. **All hardware and connections should be tightened regularly**. This simple procedure takes only a small amount of time and can save hours of searching for intermittent problems. All rotating equipment such as motors is affected by vibrations causing alignment problems resulting in bearing failures.

7.9 Renewal Parts

Availability of parts can be a major problem in **PANGNIRTUNG**. This may make any part a long delivery item.

For this reason, local distributors should be contacted and parts availability assessed. Any critical part affecting the reliability of the system should be ordered, recorded and stored.

7.10 Schedule Maintenance Program

Scheduled maintenance is an effective means to improve service from systems and equipment. Where failure of equipment can result in shut down, scheduled maintenance is an economical alternative.

Most maintenance can be done by average personnel, with a minimum need for specialized service.

7.11 Causes of equipment failure

An effective maintenance program will attempt to remove or reduce causes of equipment failure. Common causes of failure are:

1 Clogged filters
2 Improper lubrication and oiling or lack of
3 Persistent overloading
4 Above normal temperatures
5 Below normal temperatures
6 Obstruction of system by foreign objects or material (blockage or air, dirt on components -etc.)
7 Normal deterioration
8 Severe weather conditions.

7.12 Maintenance list

Refer to spare parts list

Chapter 8 CERTIFICATIONS

8.1 TESTING/TRAINING SHEET

SIFEC NORTH inc.
P.O. BOX 556
Rankin Inlet, NU
X0C 0G0

Project #: Pang water truck fill day Date : sept 18 sept 07 , 2016

proof of presence traning plat operation

Name	chlorine system	generator room system	pumps system &control	Building supervision	divers
	oM	all system	review		
Douglas Etuangat					
Daniel Mike					
Tim Nuvagiq					

SIFEC NORTH inc.
P.O. BOX 556
Rankin Inlet, NU
X0C 0G0

Project #: Pang water truck fill

Date : 17 sept ~~sept 07 , 2016~~

proof of presence traning plat operation

Name	chlorine system	generator room system	pumps system &control	Building supervision	divers
	testing chlorine injection as per report				
				✓	
X David Mike	✓		✓	✓	
Tim Nuvagiq	✓		✓	✓	
Douglas Etuksat	✓		✓	✓	

SIFEC NORTH inc.
P.O. BOX 556
Rankin Inlet, NU
X0C 0G0

SIFEC NORTH

Project #: Pang water truck fill

Date : 16 sept ~~sept 07, 2016~~

proof of presence traning plat operation

Name	chlorine system X	generator room system	pumps system &control	Building supervision	divers
	full Time [illegible]		✓		
✓ Douglas Etuangat	✓				
✓ Tim Nuvagiq	✓				
✓ Daniel Mikel	✓				

SIFEC NORTH inc.
P.O. BOX 556
Rankin Inlet, NU
X0C 0G0

Project #: Pang water truck fill

Date : 9-09-16 ~~sept 07 , 2016~~

proof of presence traning plat operation

Name	chlorine system	generator room system	pumps system &control	Building supervision	divers
Tim Nuvagiq	✓				
Daniel Mike	✓				
Douglas .E.	✓				
Douglas Etuangat	/				

SIFEC NORTH inc.
P.O. BOX 556
Rankin Inlet, NU
X0C 0G0

Project #: Pang water truck fill

Date : sept ~~07~~ 08, 2016

proof of presence traning plat operation

Name	chlorine system	generator room system	pumps system &control	Building supervision	divers
Douglas, Etuangat	✓	✓	✓	✓	
Jim Nuvagiq	✓				
Jimmy Keekatnak	✓				

8.2 SPARE PARTS

SPARE PARTS LIST PANGNIRTUNG TRUCKFILL

2	white coverall
1	Long beaker 100ml
1	Small beaker 25ml
1	Box of nitrile gloves
5	Pairs of latex gloves
1	Bottle of buffer solution PH4
1	Bottle of buffer solution PH7
1	Bottle of buffer solution PH10
4	Fuse 6A 6.3mm X 32mm GGC6
5	Fuse 3A 6.3mm X 32mm GGC3
5	Fuse 3A 5.2mm X 20mm GGM3
5	Fuse 2A 5.2mm X 20mm GGM2
5	Fuse 1A 5.2mm X 20mm GGM1
1	Water pump
1	Water pump engine
1	Urecon control box with probes for heat trace
2	exterior light fixture (light part only, no casing)
10	water filter 20 micron
10	water filter 5 micron
16	water filter 1 micron
2	union ball valve 1/2" PVC SCH80
1	union ball valve 3/4" PVC SCH80
2	union ball valve 1" PVC SCH80
2	butterfly valve 3"
3	Furnace oil (fuel) filter element 2A-710
2	Oil (fuel) filter element 1A-30
4	5 Gallons of Chlorine
1	Gallon of distilled water

SIFEC NORTH representant::
Signature:

Truckfill Station Representant:
Signature: Doug

8.3 WARRANTY LETTER

SIFEC NORTH

P.O. Box 556, Rankin Inlet, NU, X0C 0G0, Tel: 1-866-437-4001

September 29th, 2016

John Hussey
Interim Senior Administrative Officer
Hamlet of Pangnirtung
PO Box 253
Pangnirtung, NU
X0A 0R0
867-473-8953 ext. 257
pang_sao@qiniq.com

SUBJECT: ***PANGNIRTUNG TRUCK FILL STATION***
CGS Tender #08-2009
Substantial Completion Date – September 23th 2009

SIFEC NORTH INC. warranties the mechanical, electrical systems and related equipment according to the contract herein before mentioned, for a one year period effective from date of the interim inspection.

Rhea Fauteux, P.Eng.
Project Manager

Chapter 9 MECHANICAL IDENTIFICATION

MANUFACTURER/DISTRIBUTOR:

LUMEN ST-JÉRÔME
Richard Chamberland
Phone: (450) 436-3225
Fax: (450) 436-2537
Richard.chamberland@sonepardis.ca

Tenaquip Limited
20701, Chemin Sainte-Marie,
Sainte-Anne-de-Bellevue, QC
H9X 5X5
Phone: 514-457-7800
Call: 1-800-661-2400
Fax: 1-800-661-2212

9.1 BRADY PRINTER

BRADY
WHEN PERFORMANCE MATTERS MOST™

Brady B-7425 Workhorse® Series Thermal Transfer Labels

www.BradyID.com/lab

As part of Brady's Workhorse Label Series, the B-7425 thermal transfer labels are engineered to withstand the harshest environments across a wide variety of laboratory applications. These labels are constructed with durable polypropylene material to provide a tough and economical solution for improved identification and workflow tracking in the lab. They're ideal for a broad range of processes and applications, including samples, inventory, general tracking, and identification of vials, tubes, racks, flasks, bags and other sample containers.

Features:

- Economical solution for vials and tubes from 0.5ml to 50ml
- Use on tubes, vials, boxes, racks, slides, microplates, flasks, dishes, bags or other general needs
- Apply to dry room temperature samples with no overlap needed
- Adhere to stainless steel, glass and polypropylene
- Withstand temperature ranges from -196°C to 121°C (-320°F to 248°F)
- Use in LN2, freezers, autoclave, and hot water baths.
- Chemical resistance to ethanol, DMSO, IPS, short term xylene, 10% formalin, 50% acetic acid and toluene
- Prints best with R6400 black ribbon (can also use R4300 or R6200 black ribbon)
- Stock sizes available for Brady portable and benchtop thermal transfer printers, as well as 1" and 3" core rolls for other industry printers
- Custom label sizes and print automation options available

For more information, call a Brady Lab Specialist at 1-800-356-9951, contact your lab distributor or visit BradyID.com

Brady B-7425 Workhorse® Series Thermal Transfer Labels

Catalog #	Size	Core Size	Printer Compatibility
IP Printer, PR+ Printers			
THT-257-7425-2	0.825" x 0.250"	3" Core	IP Printer, PR+
THT-249-7425-2	1.000" x 0.375" w/ 0.375" dia top	3" Core	IP Printer, PR+
THT-251-7425-2	1.000" x 0.500" w/ 0.440" dia top	3" Core	IP Printer, PR+
THT-152-7425-2	1.000" x 0.375"	3" Core	IP Printer, PR+
THT-59-7425-2	1.000" x 0.500"	3" Core	IP Printer, PR+
THT-88-7425-2	1.000" x 0.750"	3" Core	IP Printer, PR+
THT-179-7425-2	1.000" x 1.000"	3" Core	IP Printer, PR+
THT-256-7425-2	1.300" x 0.600"	3" Core	IP Printer, PR+
THT-37-7425-2	1.500" x 0.500"	3" Core	IP Printer, PR+
THT-136-7425-2	1.500" x 0.750"	3" Core	IP Printer, PR+
THT-235-7425-2	1.500" x 1.000"	3" Core	IP Printer, PR+
THT-258-7425-2	1.500" x 1.750"	3" Core	IP Printer, PR+
THT-53-7425-2	2.000" x 0.500"	3" Core	IP Printer, PR+
THT-151-7425-2	2.000" x 0.250"	3" Core	IP Printer, PR+
THT-137-7425-2	2.000" x 1.000"	3" Core	IP Printer, PR+
BBP12 Printer			
THT-257-7425-2-SC	0.825" x 0.250"	1" Small Core	BBP12 only
THT-249-7425-2-SC	1.000" x 0.375" w/ 0.375" dia top	1" Small Core	BBP12 only
THT-251-7425-2-SC	1.000" x 0.500" w/ 0.440" dia top	1" Small Core	BBP12 only
THT-152-7425-2-SC	1.000" x 0.375"	1" Small Core	BBP12 only
THT-59-7425-2-SC	1.000" x 0.500"	1" Small Core	BBP12 only
THT-88-7425-2-SC	1.000" x 0.750"	1" Small Core	BBP12 only
THT-179-7425-2-SC	1.000" x 1.000"	1" Small Core	BBP12 only
THT-256-7425-2-SC	1.300" x 0.600"	1" Small Core	BBP12 only
THT-37-7425-2-SC	1.500" x 0.500"	1" Small Core	BBP12 only
THT-136-7425-2-SC	1.500" x 0.750"	1" Small Core	BBP12 only
THT-235-7425-2-SC	1.500" x 1.000"	1" Small Core	BBP12 only
THT-258-7425-2-SC	1.500" x 1.750"	1" Small Core	BBP12 only
THT-53-7425-2-SC	2.000" x 0.500"	1" Small Core	BBP12 only
THT-151-7425-2-SC	2.000" x 0.250"	1" Small Core	BBP12 only
THT-137-7425-2-SC	2.000" x 1.000"	1" Small Core	BBP12 only
BBP33 Printer			
B33-257-7425	0.825" x 0.250"	B33 Series Roll	BBP33
B33-249-7425	1.000" x 0.375" w/ 0.375" dia top	B33 Series Roll	BBP33
B33-251-7425	1.000" x 0.500" w/ 0.440" dia top	B33 Series Roll	BBP33
B33-152-7425	1.000" x 0.375"	B33 Series Roll	BBP33
B33-59-7425	1.000" x 0.500"	B33 Series Roll	BBP33
B33-88-7425	1.000" x 0.750"	B33 Series Roll	BBP33
B33-179-7425	1.000" x 1.000"	B33 Series Roll	BBP33
B33-256-7425	1.300" x 0.600"	B33 Series Roll	BBP33
B33-37-7425	1.500" x 0.500"	B33 Series Roll	BBP33
B33-136-7425	1.500" x 0.750"	B33 Series Roll	BBP33
B33-235-7425	1.500" x 1.000"	B33 Series Roll	BBP33
B33-258-7425	1.500" x 1.750"	B33 Series Roll	BBP33
B33-53-7425	2.000" x 0.500"	B33 Series Roll	BBP33
B33-151-7425	2.000" x 0.250"	B33 Series Roll	BBP33
B33-137-7425	2.000" x 1.000"	B33 Series Roll	BBP33
BMP21-Plus, BMP21-LAB Printers			
M21-375-7425	0.375" x 21'	Cartridge	BMP21
M21-500-7425	0.500" x 21'	Cartridge	BMP21
M21-750-7425	0.750" x 21'	Cartridge	BMP21

USA
Customer Service: 1-888-272-3946
Inside Sales: 1-888-311-0775
BradyID.com

Canada
Customer Service: 1-800-263-6179
BradyCanada.ca

Mexico
Customer Service: 1-800-262-7777
Inside Sales: 1-800-262-7777 ext 177
BradyLatinAmerica.com

WHEN PERFORMANCE MATTERS MOST™

Chapter 10 HOT WATER TANK

MANUFACTURER/DISTRIBUTOR:

WOLSELEY Inc.
4200, Hickmore
St-Laurent, QC, H4T 1K2
Phone: (514) 344-9378
Fax : (514) 344-9341

10.1 DOMESTIC HOT WATER TANK A.O. SMITH DEL30D (HWT-1)

AOSmith®

Commercial Electric Water Heaters

DHWT

™

Designed for use as a recovery heater having its own storage tank. Available in upright standard models (DEN) and lowboy models (DEL).

GLASSLINED TANK - Thirteen sizes; 6 thru 119 gallon capacity. Tank interior is coated with glass specially designed by A. O. Smith for water heater use.

ELEMENTS - Zinc plated copper sheaths for longer life. Medium watt density means lower surface temperature to minimize scale build-up and more surface to heat water. Element sizes from 1.5 to 6 KW. Maximum input 12 KW (see chart on back).

STANDARD VOLTAGES - 120, 277 single phase and 208, 240 and 480V unbalanced three-phase delta; easily converted to single-phase at terminal block (except 208V with 6000 watt elements). Single element heater, single-phase only.

TERMINAL BLOCK - Factory-installed. Just bring the service to heater and connect to block. Terminal block not supplied on 120V & 277 volt models. (No junction box on DEL6-20)

CONTROLS - Temperature control (adjustable through arange of 110° to 170°F on single element and 120° to 180°F on dual element) and manual reset high temperature cutoff per element (dual element models). Factory-wired for non-simultaneous operation; easily converted to simultaneous element operation (three phase models only).

CSA CERTIFIED AND ASME RATED T&P RELIEF VALVE

SIMPLIFIED CIRCUITRY, COLOR CODED FOR EASE OF SERVICE

ANODE ROD FOR MAXIMUM CORROSION PROTECTION

CABINET HAS BONDERIZED UNDERCOAT WITH BAKED ENAMEL FINISH

TOP INLET AND OUTLET OPENINGS

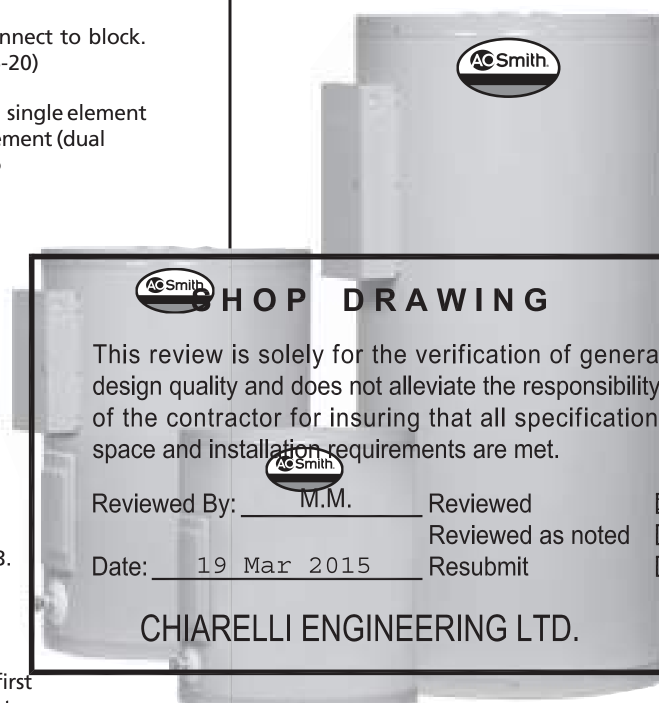
DRAIN VALVE (EXCLUDES DEL 6-20)

UL APPROVED FIELD CONVERSION PROGRAM - The 6 through 20 models are UL listed to UL 174 and the 30 through 120 models are listed to UL 1453.

COMPLIANCE - Meets the standby loss Requirements of the U.S. Department of Energy and current edition of ASHRAE/IESNA 90.1.

LIMITED WARRANTY OUTLINE - If the tank should leak any time during the first three years, under the terms of the warranty, A. O. Smith will furnish a replacement heater; installation, labor, handeling and local delivery extra. THIS OUTLINE IS NOT A WARRANTY. For complete information consult the written warranty or A. O. Smith Water Products Company.

DEN/DEL MODELS



SHOP DRAWING

This review is solely for the verification of general design quality and does not alleviate the responsibility of the contractor for insuring that all specification, space and installation requirements are met.

Reviewed By: M.M. Reviewed ☒
Reviewed as noted ☐
Date: 19 Mar 2015 Resubmit ☐

CHIARELLI ENGINEERING LTD.

ELEMENT AVAILABILITY CHART

Input	120V	208V	240V	277V	480V
1,500	YES	YES	YES	YES	—-
2,000	YES	YES	YES	YES	YES
2,500	YES	YES	YES	YES	YES
3,000	YES	YES	YES	YES	YES
3,500	—-	—-	YES	—-	—-
4,000	—-	YES	YES	YES	YES
4,500	—-	YES	YES	YES	YES
5,000	—-	YES*	YES*	YES*	YES*
5,500	—-	—-	YES*	—-	—-
6,000	—-	YES**	YES	YES	YES

Shop Drawings Contractor Approval
Approved by: M.A.G., G. F.
Date: Mar 03, 2015
SIFEC NORTH INC

NOTE: DEL-6 not available in above 2.5 KW.
DEL-6 not available in 480V.

* Not available in DEL-10, DEL-15 and DEL-20.
** A6 non-simultaneous circuit only.

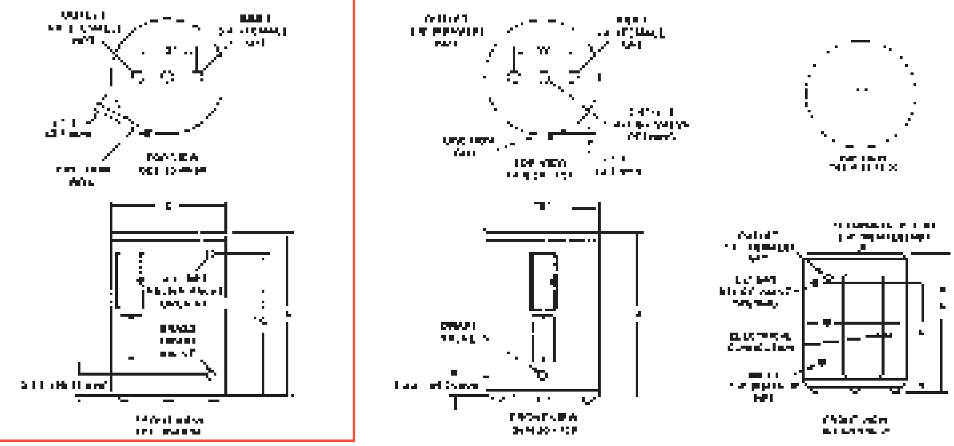
Low Lead Content

A.O. Smith | Commercial Electric Water Heaters

Dura-Power™

PRODUCT SPECIFICATIONS

DHWT



ROUGH-IN DIMENSIONS

Models Dimensions	No. of Elements	Tank Capacity US Gals.	Tank Capacity Litres	A inches	A mm	B inches	B mm	C inches	C mm	D inches	D mm	Shipping Weight. Lbs.	Shipping Weight. Kg.
DEL-6	1	6	23	15 1/2	394	14 1/4	362	11	279	-	-	35	15.9
DEL-10	1	10	38	18 1/4	464	18	457	12 1/2	318	-	-	54	24.5
DEL-15	1	15	57	26	660	18	457	20 1/2	521	-	-	58	26.3
DEL-20	1	20	76	22 1/4	565	21 3/4	552	15 3/8	391	-	-	73	33.1
DEL-30	2	30	114	30 7/8	784	21 3/4	552	24 1/8	613	8	203	100	45.4
DEL-40	2	40	151	32 1/4	819	24	610	25 9/16	649	8	203	125	56.7
DEL-50	2	50	189	32 1/4	819	26 1/2	673	25 1/8	638	8	203	166	75.3
DEN-30	2	30	114	34 1/2	876	20 1/2	521	-	-	8	203	98	44.5
DEN-40	2	40	151	45 1/8	1146	20 1/2	521	-	-	8	203	113	51.3
DEN-52	2	50	189	54 7/8	1394	20 1/2	521	-	-	8	203	131	59.4
DEN-66	2	66	250	60 3/4	1543	21 3/4	552	-	-	8	203	176	79.8
DEN-80	2	80	303	59 3/8	1508	24	610	-	-	8	203	211	95.7
DEN-120	2	119	450	62 7/16	1586	29 3/8	746	-	-	8	203	326	147.9

RECOVERY CAPACITIES

Element Wattage (Upper/Lower)	INPUT KW	F° / C°	36F° 20C°	40F° 22.2C°	54F° 30C°	60F° 33.3C°	72F° 40C°	80F° 44.4C°	90F° 50C°	100F° 55.5C°	108F° 60C°	120F° 66.6C°	126F° 70C°
NON-SIMULATANEOUS OPERATION													
/1500		GPH	17	15	11	10	8	8	7	6	6	5	5
	1.5	LPH	64	58	43	38	32	29	26	23	21	19	18
/2000		GPH	23	20	15	14	11	10	9	8	8	7	6
	2.0	LPH	85	77	57	51	43	38	34	31	28	26	24
/2500		GPH	28	25	19	17	14	13	11	10	9	8	8
	2.5	LPH	107	96	71	64	53	48	43	38	36	32	30
3000/3000		GPH	34	30	23	20	17	15	14	12	11	10	10
	3.0	LPH	128	115	85	77	64	58	51	46	43	38	37
4000/4000		GPH	45	41	30	27	23	20	18	16	15	14	13
	4.0	LPH	170	153	114	102	85	77	68	61	57	51	49
4500/4500		GPH	51	46	34	30	25	23	20	18	17	15	14
	4.5	LPH	192	173	128	115	96	86	77	69	64	58	55
5000/5000		GPH	56	51	38	34	28	25	23	20	19	17	16
	5.0	LPH	213	192	142	128	107	96	85	77	71	64	61
6000/6000		GPH	68	61	45	41	34	30	27	24	23	20	19
	6.0	LPH	256	230	170	153	128	115	102	92	85	77	73
SIMULATANEOUS OPERATION													
3000/3000		GPH	68	61	45	41	34	30	27	24	23	20	19
	6	LPH	256	230	170	153	128	115	102	92	85	77	73
4000/4000		GPH	90	81	60	54	45	41	36	32	30	27	26
	8	LPH	341	307	227	205	170	153	136	123	114	102	97
4500/4500		GPH	101	91	68	61	51	46	41	36	34	30	29
	9	LPH	384	345	256	230	192	173	153	138	128	115	110
5000/5000		GPH	113	101	75	68	56	51	45	41	38	34	32
	10	LPH	426	384	284	256	213	192	170	153	142	128	122
6000/6000		GPH	135	122	90	81	68	61	54	49	45	41	39
	12	LPH	511	460	341	307	256	230	205	184	170	153	146

Recovery capacities at 100° F rise equal: for non-simultaneous element operation = 4.1 gal. x kW of one element; for simultaneo us element operation = 4.1 gal. x 2/3 kW of both elements. For other rises multiply element kW as previously explained by 410 and divide by temperature rise. Full load current for single phase = total watts ÷ voltage.

SHOP DRAWING

This review is solely for the verification of general design quality and does not alleviate the responsibility of the contractor for insuring that all specification, space and installation requirements are met.

Reviewed By: M.M. — Reviewed ☐ — Reviewed as noted ☒ — Resubmit ☐

Date: 19 Mar 2015

CHIARELLI ENGINEERING LTD.

SUGGESTED SPECS

The water heaters(s) shall be Dura-Power™ Model(s) No. ________________________ as manufactured by A. O. SMITH or an approved equal. Heater(s) shall be rated at ______kW, ______volts, ______ phase, 60 cycle AC, and listed by Underwriters' Laboratories. Models shall meet the standby loss requirements of the U.S. Department of energy and current edition of ASHRAE/IESNA 90.1. Tank(s) shall be ________gallon capacity. Heater(s) shall have 150 psi working pressure and be equipped with extruded high density anode rod. All steel by firing at a temperature range of 1600°F. Electric heating elements shall be medium watt density with zinc plated copper sheath. Each element shall be controlled by an individually mounted thermostat and high temperature cutoff switch. The outer jacket shall be of backed enamel finish and shall be provided with full size control compartment for performance of service and maintenance through hinged front panels and shall enclose the tank with foam insulation. Electrical junction box with heavy duty terminal block shall be provided (except on 120V & 277V {no junction box on DEL-6 thru 20}). The drain value shall be located in the front for ease of servicing. Heater tank shall have a three year limited warranty as outlined in the written warranty. Fully illustrated instruction manual to be included.

For Technical Information and Automated Fax Service, call 800-527-1953. A. O. Smith Corporation reserves the right to make product changes or improvements without prior notice.

Chapter 11 PLUMBING FIXTURES

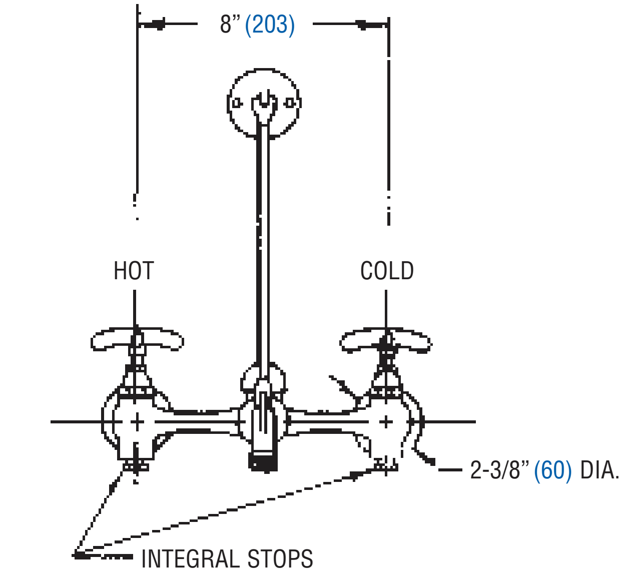
MANUFACTURER/DISTRIBUTOR:

WOLSELEY Inc.
4200, Hickmore
St-Laurent, QC, H4T 1K2
Phone: (514) 344-9378
Fax : (514) 344-9341

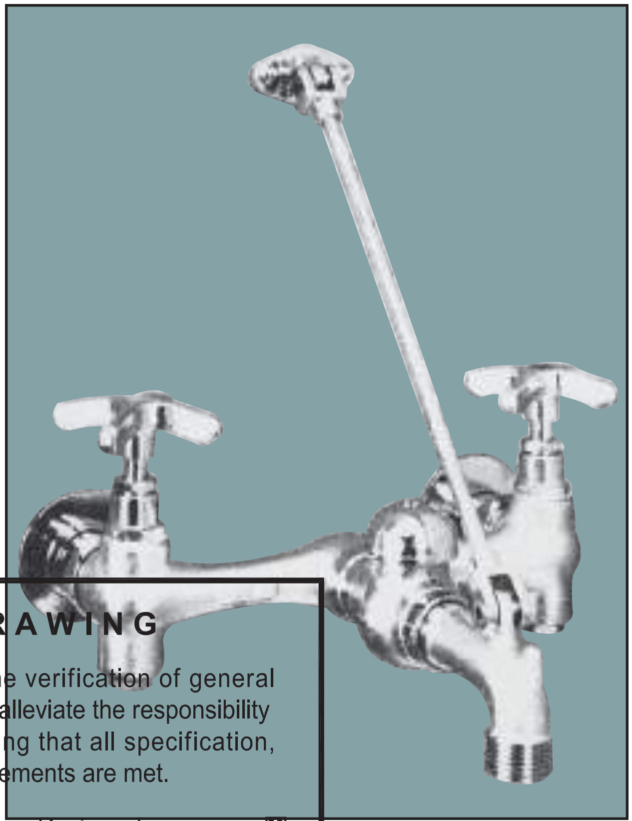
Service-Sink Faucet
Model: 830-AA

FIAT

Service Sink and Faucet



FRONT VIEW



SHOP DRAWING

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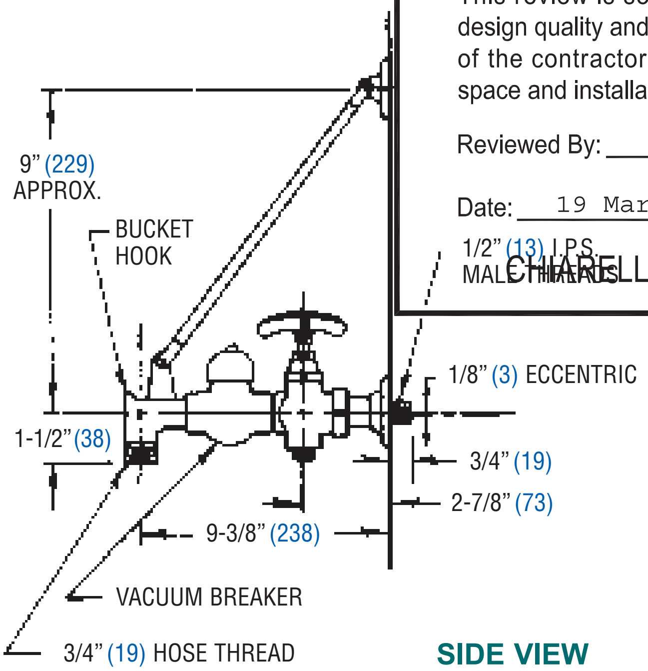
Reviewed By: M.M. — Reviewed ☒ — Reviewed as noted ☐ — Resubmit ☐

Date: 19 Mar 2015

CHIARELLI ENGINEERING LTD.



SIDE VIEW

NOTE: These roughing measurements may vary 1/4" (plus or minus).

General: 830-AA Service Faucet - Chrome plated with vacuum breaker, integral stops, adjustable wall brace, pail hook and 3/4" hose thread on spout. Body inlets 8" center to center, four arm handles. Valves contain renewable hub, ~~renewable seats~~, swivel discs, encased washers and brass washer screws.

Material: Commercial red brass alloy casting-rough finish.

Finish: Chrome plating exceeding requirements of ANSI/ASTM B-456-71. Indicators cold (blue) and hot (red) are included.

Specifications and Codes: In the U.S.A., meets or exceeds requirements of ANSI-A112.18.1M-1979 for "Finished and Rough Brass Plumbing Fixture Fittings." In Canada, meets or exceeds the requirements of CSA standards B125 - "Plumbing Fittings," B64.1.1 - "Vacuum Breakers - Atmosphere Type" and B64.0 - "General Requirements for Backflow Preventers and Vacuum Breakers," and is approved under Product Class No. 6811 01 under Report #LM57412-1. Conforms to ASSE 1001.

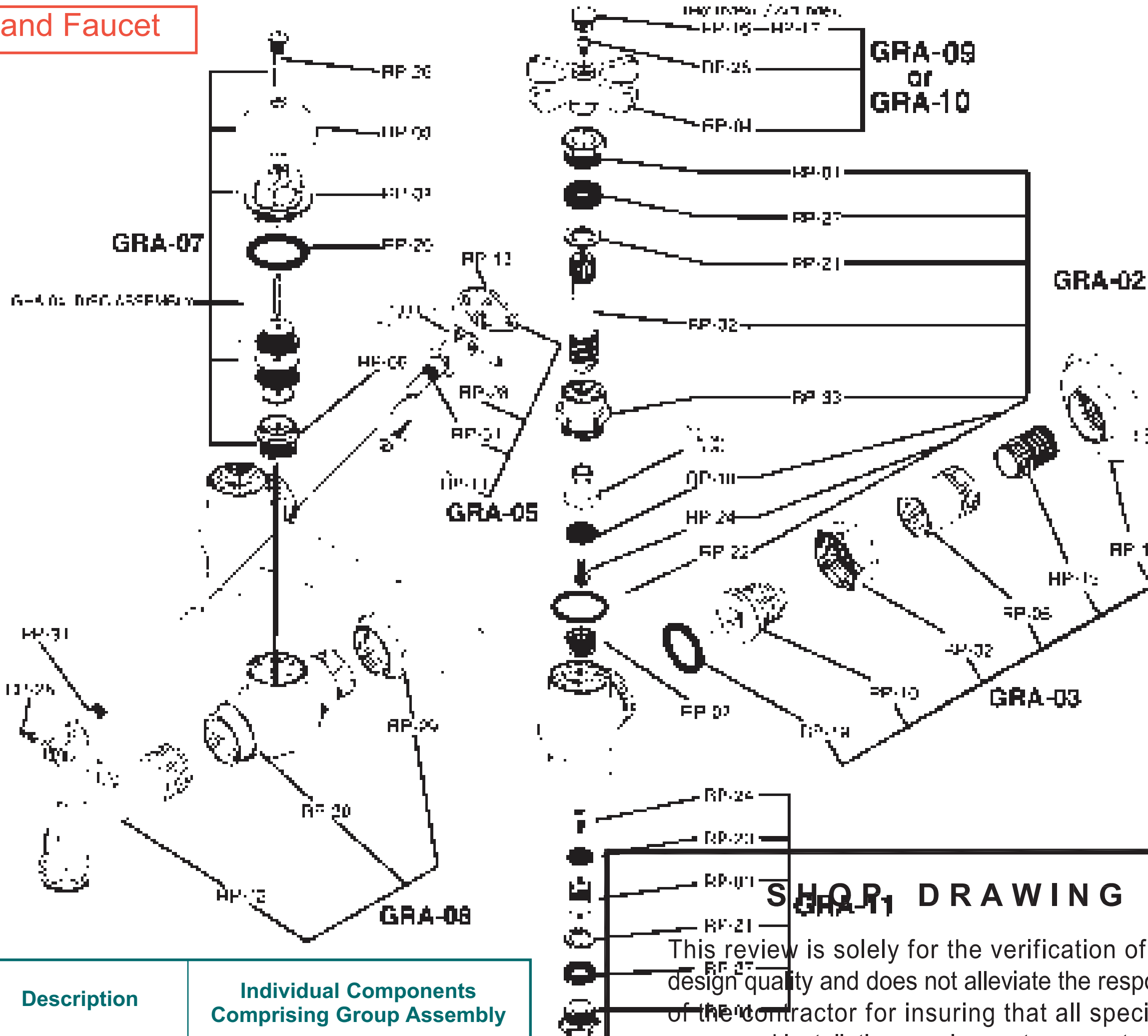
FIAT PRODUCTS®
A CRANE PLUMBING COMPANY
255 Hutchings St. • Winnipeg, MB • R2X 2R4 • Ph. 800-665-7531 • 204-633-6122 • Fx. 2
e-mail: info@fiat.ca • website: www.fiat.ca
A subsidiary of CR/PL, L.L.C. Company – Evanston, IL

Shop Drawings
Contractor Approval
Approved by: M.A.G., G. F.
Date: Mar 03, 2015
SIFEC NORTH INC

830-AA Group Replacement Assembly Parts List

FIAT®

Service Sink and Faucet



Group Assembly Part #	Description	Individual Components Comprising Group Assembly	
GRA-02	Handle Mounting Group Assembly	RP-01	Packing Nut
		RP-27	Packing
		RP-21	Brass Washer
		RP-32	Spindle
		RP-33	Handle Hub
		RP-18	Seat Washer
		RP-24	Seat Washer Screw
		RP-22	Hub Washer
GRA-03	Coupling Assembly	RP-14	Wall Flange
		RP-15	Nipple
		RP-05	Bushing (socket)
		RP-02	Coupling Nut
		RP-10	Swivel
		RP-19	Washer
GRA-05	Brace Assembly	RP-13	Brace Flange
		RP-28(2)	S.S. Roll Pin
		RP-31	Wall Brace Rod
		RP-11(2)	Wood Screw
GRA-07	Vacuum Breaker & Disc Assembly	RP-26	V.B. Cap Screw
		RP-09	Cap
		RP-08	V.B Hub
		RP-20	V.B Hub Washer
		RP-06	Seat
		GRA-04	Vacuum Breaker Disc Assembly

SHOP DRAWING

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Reviewed By: M.M. Reviewed ☒
Reviewed as noted ☐
Date: 19 Mar 2015 Resubmit ☐

CHIARELLI ENGINEERING LTD.

Group Assembly Part #	Description	Individual Components Comprising Group Assembly	
GRA-08	Complete Body Assembly	RP-29	Center Body
		RP-30	V.B. Body
		RP-12	Nozzle
GRA-09	Handle Assembly (Cold)	RP-17	Cold Index
		RP-25	Handle Screw
		RP-04	Handle
GRA-10	Handle Assembly (Hot)	RP-16	Hot Index
		RP-25	Handle Screw
		RP-04	Handle
GRA-11	Integral Stop Assembly	RP-24	Seat Washer Screw
		RP-23	Washer
		RP-03	Spindle
		RP-21	Brass Washer
		RP-27	Packing
		RP-01	Packing Nut
RP-07	(2 per package)	RP-07	Seat

Service Sink and Faucet

FIAT PRODUCTS

SERV-A-SINK® LAUNDRY TUBS
MODELS FL-1, L-1, DL-1

FL-1 FLOOR MOUNTED SERV-A-SINK®
L-1 WALL HUNG SERV-A-SINK®
DL-1 DROP-IN SERV-A-SINK®

Fiat Products uses a specialized SMC process (Molded Stone®) to manufacture all laundry tubs. Moldings are manufactured in matched metal dies under heat and pressure resulting in a homogeneous molded unit. Drain(s) with stopper(s) are furnished as standard equipment. Capacity shall be 76 litres (17 Imp gal) for the single tub sink and 152 litres (33 Imp gal) for the double tub sink. Laundry sinks available in white only.

- All single compartment laundry tubs are available in sixpacks (L-6 and FL-6) and bulk quantities.
- All products must be installed in accordance with installation instructions provided. Failure to do so may invalidate warranty at manufacturer's discretion.

FL-1 Floor Mounted Serv-A-Sink®
- White baked enamel angle legs that slip into molded sockets for rigid, friction-fit. (Included)
- Easy leveling devices are provided for fast, even planing. Tub is capable of handling 600 pounds.

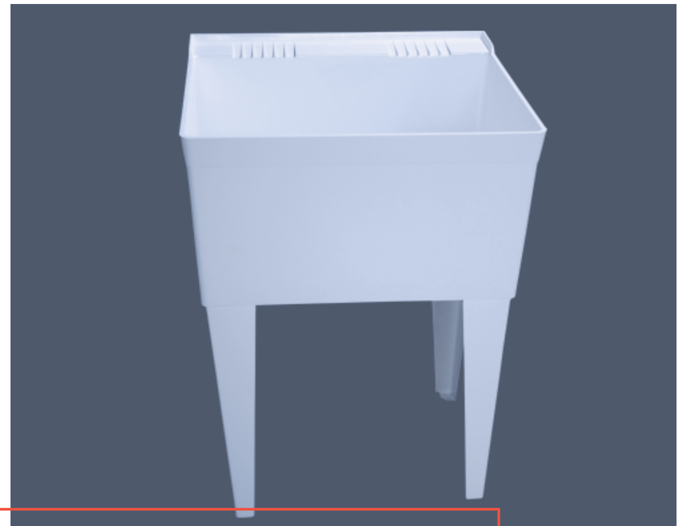
Nominal Dimensions:
Overall Outside Dimensions:
20-1/4" x 17-1/4" x 13" (514 x 438 x 330mm)
Overall height from floor
34-3/4" (883mm) CSA Approved

L-1 Wall Hung Serv-A-Sink®
- Heavy gauge galvanized - steel bracket capable of withstanding 600 pounds. (Included)
- Side fillers and bottom tub support, which are assembled in field to the mounting brackets, are made of white molded plastic polymer.

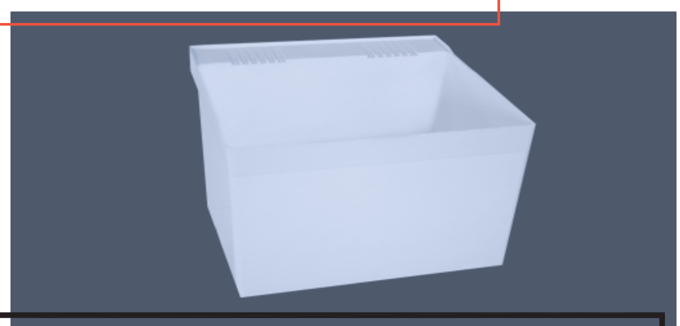
Nominal Dimensions:
20-1/4" x17-1/4" x 13" (514 x 438 x 330mm)

DL-1 Drop-In Serv-A-Sink®
- Designed for a countertop installation.
- Self-rimming flange, four locking corner bars and screws for fast tightening into integral molded mounting legs and against the underside of the countertop. (Included)

Nominal Dimensions:
22-1/8" x 17" x 12-3/7" (562 x 432 x 324mm)
Underside flange rim sealant for watertightness supplied by others.



FL-1 Floor Mounted Serv-A-Sink®



L-1 Wall Hung Serv-A-Sink®

SHOP DRAWING

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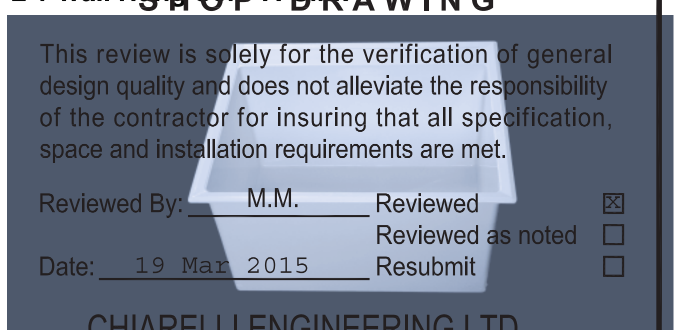
Reviewed By: M.M. Reviewed ☒
Reviewed as noted ☐
Date: 19 Mar 2015 Resubmit ☐

CHIARELLI ENGINEERING LTD.



DL-1 Drop-In Serv-A-Sink®

SEE REVERSE FOR ROUGHING-IN DIMENSIONS

All products are UPC listed

FIAT
QUALITY FOR LIFE

Customer Service Canada
1-800-387-0369
www.fiat.ca

Customer Service United States
1-800-442-1902
www.fiatproducts.com

Shop Drawings
Contractor Approval
Approved by: M.A.G., G. F.
Date: Mar 03, 2015
SIFEC NORTH INC

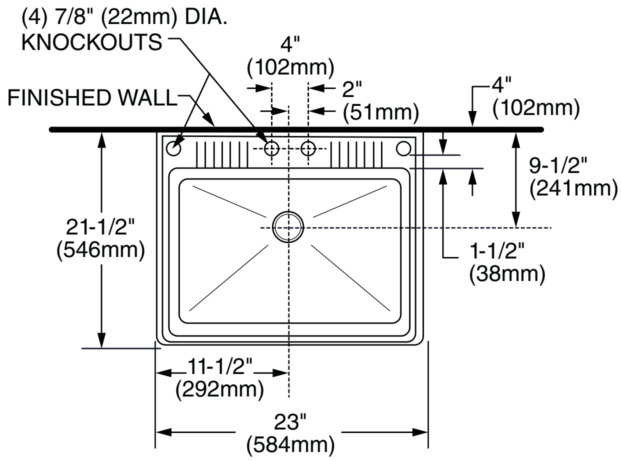
Revised 11/13

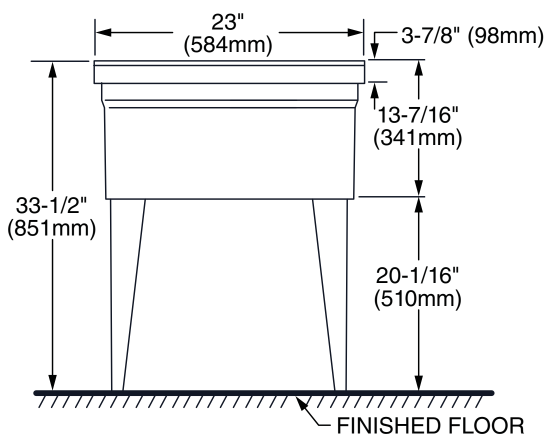
Service Sink and Faucet

FIAT PRODUCTS

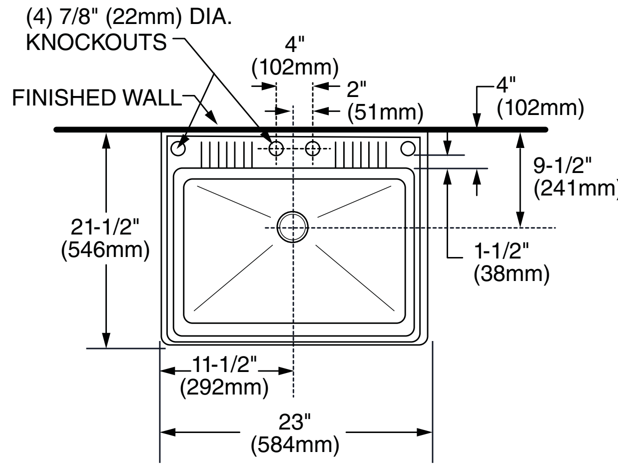
SERV-A-SINK® LAUNDRY TUBS
MODELS FL-1, L-1, DL-1

MODEL FL-1
FLOOR MOUNTED





MODEL L-1
WALL HUNG



IMPORTANT: Roughing-in dimensions may vary 1/2" and are subject to change or cancellation without prior notice.

SHOP DRAWING

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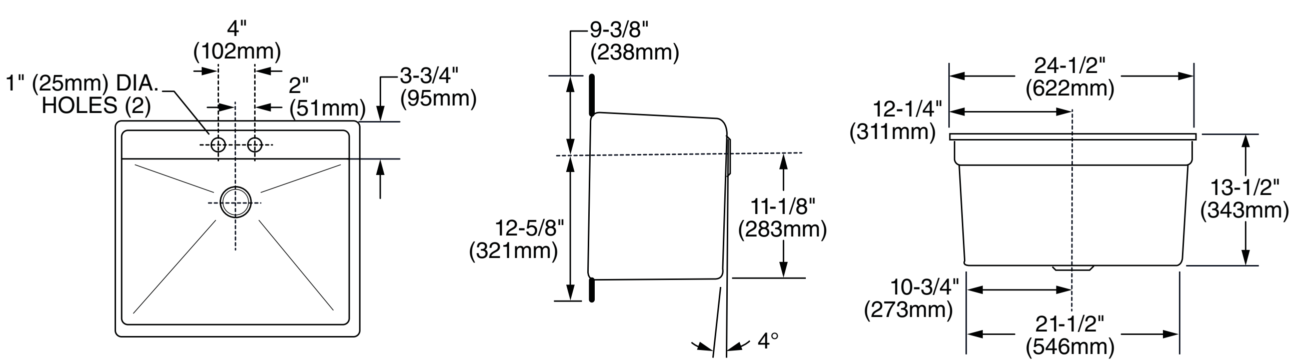
Reviewed By: M.M. — Reviewed ☒
Reviewed as noted ☐
Date: 15 Mar 2015 — Resubmit ☐

CHIARELLI ENGINEERING LTD.

MODEL DL-1
DROP-IN



FIAT
QUALITY FOR LIFE

Customer Service Canada
1-800-387-0369
www.fiat.ca

Customer Service United States
1-800-442-1902
www.fiatproducts.com

Revised 11/13

Certified

SPECIFICATION

1135: Stainless strainer assembly with polypropylene shell and tailpiece. Suitable to 18 and 20 gauge stainless steel product and granite product.

1135 **FUN#112.0040.565**
1135/60 **FUN#112.0061.322**
1135-CS **FUN#112.0181.283** is the 1135 assembly packaged in a clam shell

Franke Kindred Canada Limited
P.O. Box 190, 1000 Franke Kindred Road, Midland, Ontario, Canada, L4R 4K9   Phone: 866-687-7465   Fax: 800-361-8408

Plumbing Fixture / Kitchen Sinks 15410
Franke Kindred Canada Limited   Printed in Canada   61558   0316

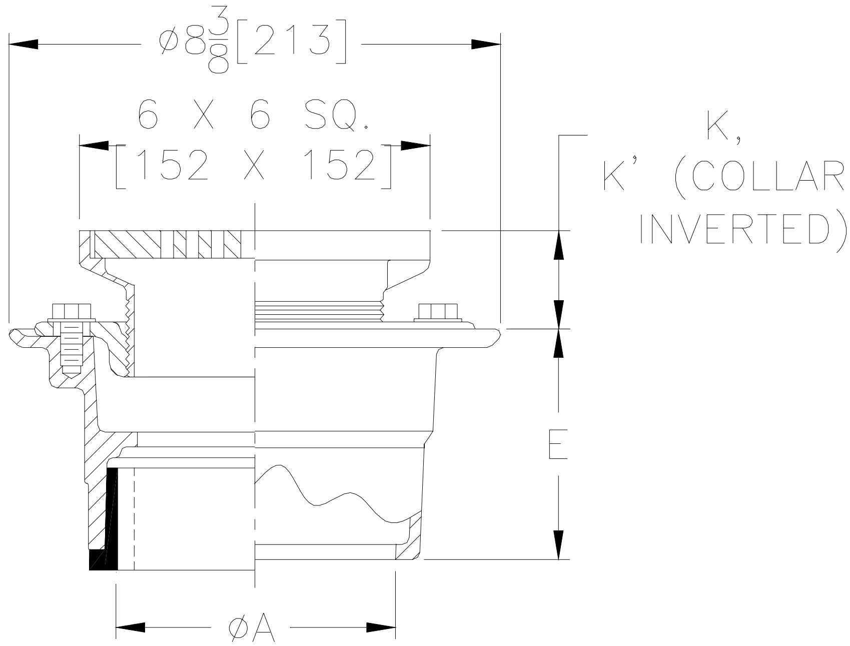
SPECIFICATION SHEET

ZXN-415-H

BODY ASSEMBLY WITH "TYPE H" STRAINER

TAG _____

Dimensional Data (inches and [mm]) are Subject to Manufacturing Tolerances and Change Without Notice



Str. Desig	Dimensions In Inches / [mm] A Pipe Size	Str. Dia.	K Min.	K Max.	K' Min.	K' Max.	Approx. Wt. Lbs. / (kg)	Strainer Open Area Sq. In. / [sq cm]
-H6	2-3-4-6 [51-76-102-152]	6 x 6 [152 x 152]	1-1/4 [32]	2 [51]	2-1/8 [54]	3-1/4 [83]	15 [7]	3 [19]

ENGINEERING SPECIFICATION: ZURN ZXN-415 Floor and Shower Drain, Dura-Coated cast iron body with bottom outlet, combination invertible membrane clamp and adjustable collar with "TYPE H" heavy-duty polished nickel bronze strainer.

OPTIONS (Check/specify appropriate options)

PIPE SIZE		(Specify size/type) **OUTLET**	**'E' BODY HT. DIM.**
2 thru 4 [50 thru 100]	____	IC Inside Caulk	3 7/8 [98]
2 thru 4 [50 thru 100]	____	IG Inside Gasket	3 7/8 [98]
2 thru 4, 6 [50 thru 100, 152]	____	IP Threaded	2 5/8 [67]
2 thru 4 [50 thru 100]	____	NH No-Hub	3 7/8 [98]
2 thru 4 [50 thru 100]	____	NL Neo-Loc	4 5/8 [117]

SUFFIXES

____ -AR Acid Resisting Epoxy Coated Cast Iron
____ -G Galvanized Cast Iron
____ -P 1/2" [13] Trap Primer Connection
____ -U 1" [25] - 3" [76] High Extension Adapter
____ -VP Vandal Proof Secured Top
____ -X Squeezin Backwater Valve
____ -Y Sediment Bucket
____ -6NH 6" [152] No-Hub Outlet (6IP w/Z-1040)
____ -90 2" [51], 3" [76] or 4" [102] Side Outlet Body Assembly (IP or NH only)

*REGULARLY FURNISHED UNLESS OTHERWISE SPECIFIED

REV. **DATE: 11/15/99** **C.N. NO. 83464**
DWG. NO. 65032 **PRODUCT NO. ZXN-415-H**

Emergency eyewash and shower

Guardian

Safety Stations with WideArea™ Eye/Face Wash

☐ **G1909** Safety Station with WideArea™ Eye/Face Wash, Stainless Steel Bowl

☐ **G1909P** Safety Station with WideArea™ Eye/Face Wash, Plastic Bowl

Application: Combination WideArea™ eye/face wash and shower safety station. Four GS-Plus™ spray-type outlet heads deliver a flood of water over a wide area of coverage for complete rinsing of eyes and face.

Shower Head: 10" diameter orange ABS plastic.

Shower Valve: 1" IPS chrome plated brass stay-open ball valve. Valve is US-made with chrome plated brass ball and Teflon® seals. Furnished with stainless steel actuating arm and 29" stainless steel pull rod.

Spray Head Assembly: Four GS-Plus™ spray heads. Each head has a "flip top" dust cover, internal flow control and filter to remove impurities from the water flow.

Eye/Face Wash Bowl: 11-1/2" diameter. Bowl is stainless steel (G1909) or orange ABS plastic (G1909P).

Eye/Face Wash Valve: 1/2" IPS chrome plated brass stay-open ball valve. Valve is US-made with chrome plated brass ball and Teflon® seals.

Pipe And Fittings: Schedule 40 galvanized steel. Furnished with orange polyethylene covers for vertical piping for high visibility and corrosion resistance.

Supply: 1-1/4" NPT female top or side inlet.

Waste: 1-1/4" NPT female outlet. Outlet can be positioned at either 9-1/4" or 19-5/8" above finished floor by reversing lower pipe nipples.

Sign: Furnished with ANSI-compliant identification sign.

Quality Assurance: Valve and spray head assemblies are factory assembled and water tested prior to shipment.

SHOP DRAWING

This review is solely for the verification of general design quality and does not alleviate the responsibility of the contractor for insuring that all specification, space and installation requirements are met.

Reviewed By: M.M. — Reviewed ☐

Reviewed as noted ☒

Date: 19 Mar 2015 — Resubmit ☐

CHIARELLI ENGINEERING LTD.

Available Options

☐ **GC** Powder coated finish on galvanized pipe and fittings. Available colors include orange, yellow, red and green.

☐ **FC20** Regulates shower flow rate to 20 GPM.

☐ **GRN** Green ABS plastic shower head.

☐ **YEL** Yellow ABS plastic shower head.

☒ **SSH** Stainless steel shower head.

☐ **AP275-100 Electric Light and Alarm Horn**
Light and alarm horn summon assistance when eye/face wash or shower is activated.

☐ **AP250-015 Modesty Curtain**
Modesty curtain for mounting on safety station.

☒ **TMV** G3800 thermostatic mixing valve precisely blends hot and cold water to deliver warm (tepid) water as required by ANSI Z358.1-2009.

Shop Drawings Contractor Approval
Approved by: M.A.G., G. F.
Date: Mar 03, 2015
SIFEC NORTH INC

Guardian Equipment
1140 N North Branch St
Chicago, IL 60642

312 447 8100 TELEPHONE
312 447 8101 FACSIMILE
gesafety.com

Listed 8116. Units have been tested to and comply with ANSI Z358.1-2009 and the Uniform Plumbing Code.

ETL Listed 101496. Units have been tested to and comply with ANSI Z358.1-2009.

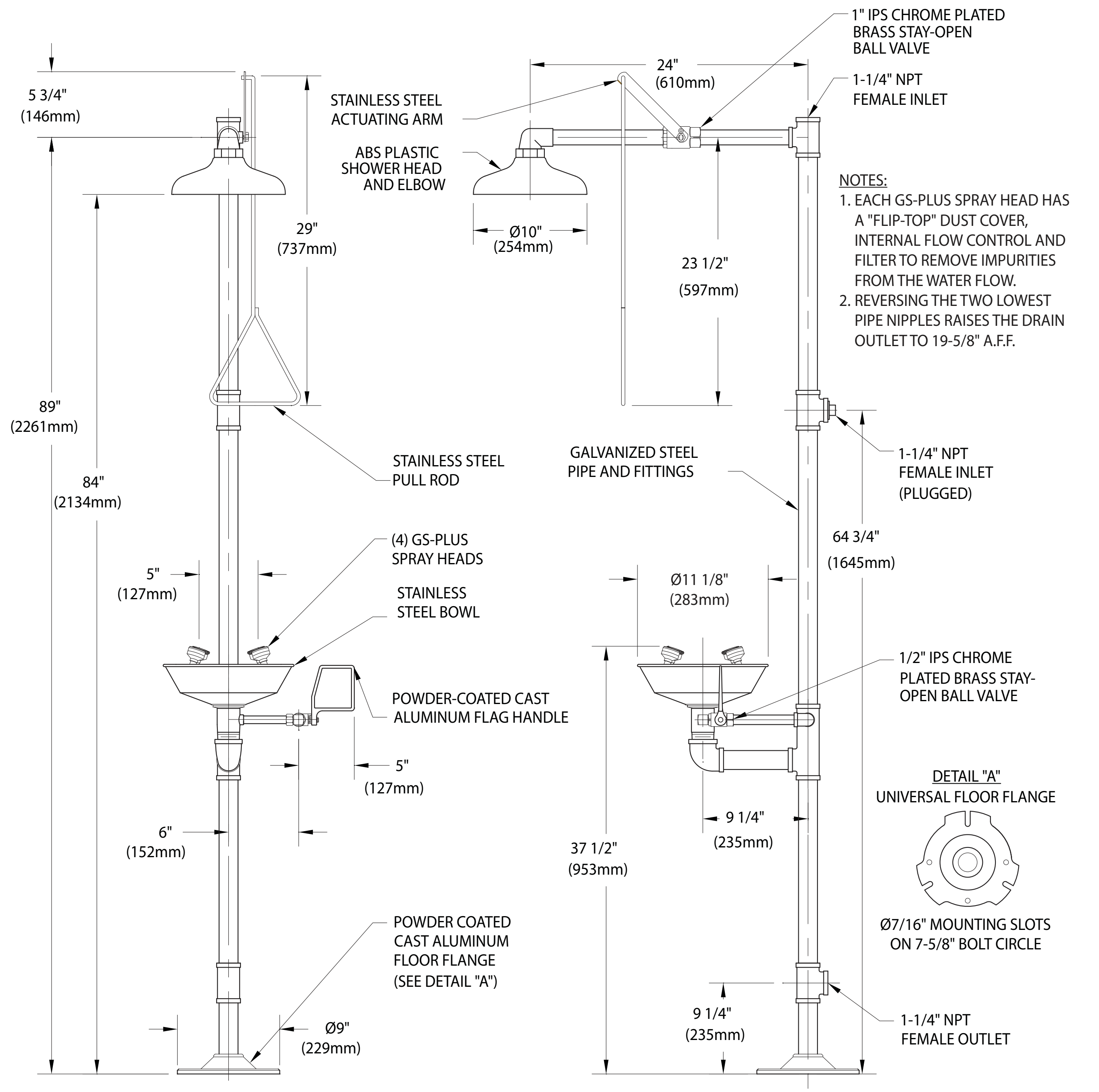
Emergency eyewash and shower

Guardian

Safety Stations with WideArea™ Eye/Face Wash

☐ **G1909** Safety Station with WideArea™ Eye/Face Wash, Stainless Steel Bowl

☐ **G1909P** Safety Station with WideArea™ Eye/Face Wash, Plastic Bowl



NOTES:

1. EACH GS-PLUS SPRAY HEAD HAS A "FLIP-TOP" DUST COVER, INTERNAL FLOW CONTROL AND FILTER TO REMOVE IMPURITIES FROM THE WATER FLOW.
2. REVERSING THE TWO LOWEST PIPE NIPPLES RAISES THE DRAIN OUTLET TO 19-5/8" A.F.F.

Sign Included

THIS SPACE FOR ARCHITECT/ENGINEER APPROVAL

Due to continuing product improvement, the information contained in this document is subject to change without notice. All dimensions are ± 1/4" (6mm). rev. 1014

Guardian Equipment
1140 N North Branch St
Chicago, IL 60642

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Tempering Valve

Guardian

SHOP DRAWING

This review is solely for the verification of general design quality and does not alleviate the responsibility of the contractor for insuring that all specification, space and installation requirements are met.

Reviewed By: M.M. Reviewed ☒
Reviewed as noted ☐
Date: 28 Apr 2015 Resubmit ☐

CHIARELLI ENGINEERING LTD.

☐ G3700LF Tempering Valve, 34 Gallon Capacity

Application: Tempering valve to blend hot and cold water to deliver tepid water. Valve has flow capacity of 3.0 to 34 gallons per minute (GPM). Valve can be used with emergency shower, safety station or multiple installations of eyewash, eye/face wash, dual purpose eyewash/drench hose and drench hose units.

Temperature Control: Valve has bimetallic thermostat that senses incoming water temperature and automatically blends water to 85°F (29°C). High temperature limit stop is set to 90°F (32°C). Valve has dial thermometer on outlet to monitor temperature of delivered water. *Note: Valve may need to be adjusted when installed based on incoming water temperature. Refer to "Installation Instructions" for further information.*

Fail Safe: In event of restriction or failure of hot water supply, internal bypass allows valve to deliver cold water to emergency unit. In bypass mode, valve will deliver 20 GPM of cold water at 30 PSI flow pressure. In event of loss of cold water supply, valve will close and not deliver water.

Flow Capacity: Refer to chart below for flow capacity of valve at specified pressure drops:

System Pressure Drop (PSI)	5	10	15	20	25	30	35	40
Flow Rate (GPM)	18	23	29	34	40	45	51	56

System Pressure Drop (Bar)	0.3	0.7	1.0	1.4	1.7	2.1	2.4	2.8
Flow Rate (Liters per Minute)	68	87	110	129	151	170	193	212

Shop Drawings
Contractor Approval
Approved by: M.A.G., G. F.
Date: Apr 23, 2015
SIFEC NORTH INC

Supply Temperature: Minimum hot water supply temperature is 140° F (60° C).

Supply Pressure: 30 PSI minimum supply pressure is required for proper operation of valve. Maximum supply pressure is 125 PSI. Maximum hot to cold water pressure differential is 5%.

Mounting: Furnished with heavy duty mounting bracket for securing valve to panel or wall.

Inlets: 3/4" NPT female hot and cold water inlets. Inlets can be rotated 360 degrees for top or bottom supply. Each inlet has integral water strainer, check valve and supply stop.

Outlet: 1" NPT female outlet.

Quality Assurance: Valve is completely assembled and water tested prior to shipment. Valve is certified to ASSE 1071. Valve is certified to meet low lead requirements of wetted surface area less than 0.25% lead by weight.

Additional Models

☐ **G3702LF** Same as above except valve is installed in surface mounted stainless steel cabinet.

☐ **G3707LF** Same as above except valve is installed in recess mounted stainless steel cabinet.

IMPORTANT: *Pursuant to ANSI Z358.1-2009, the water delivered by emergency equipment should be "tepid". Tepid is defined as moderately warm or lukewarm, and is generally considered to be between 60°F (15°C) and 90°F (32°C). However, in certain circumstances, a chemical reaction may be accelerated or otherwise affected by the water temperature. Please consult with a medical advisor to determine the optimum delivered water temperature prior to specifying, installing or using a tempering valve.*

Tempering valves will not deliver the appropriate water temperature if the system has not been sized correctly. Please refer to the flow capacities and supply pressure requirements listed above when designing the tempered water system and selecting tempering valves.

Tempering valves, like all emergency eyewash and shower equipment, must be installed in accordance with the manufacturer's instructions and maintained on a regular basis. Under ANSI Z358.1-2009, all emergency equipment should be activated weekly and inspected at least annually. Tempering valves should be treated the same and, in addition, must be regularly cleaned and cycled.

Guardian Equipment
1140 N North Branch St
Chicago, IL 60642

312 447 8100 TELEPHONE
312 447 8101 FACSIMILE
gesafety.com

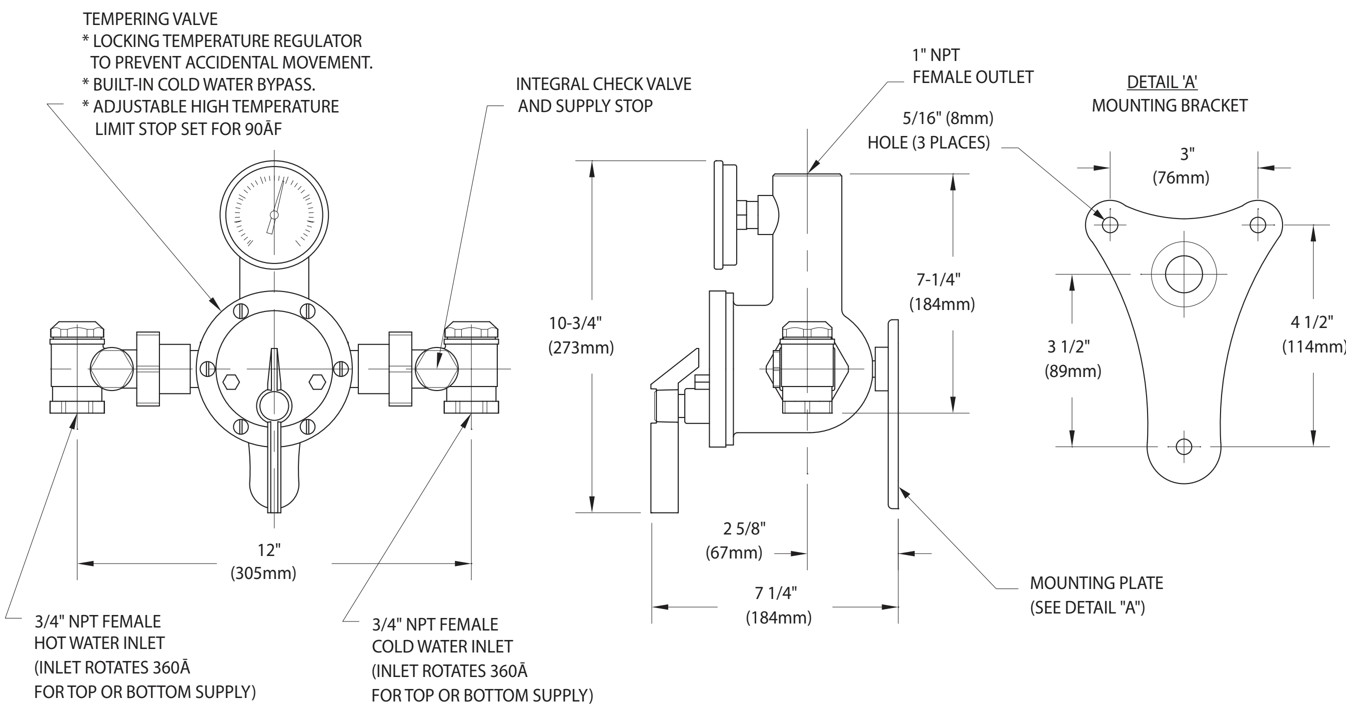
ASSE 1071 Certified

Meets low lead requirements

Tempering Valve

Guardian

☐ G3700LF Tempering Valve, 34 Gallon Capacity



1. As with all plumbing devices and emergency equipment, thoroughly flush supply lines prior to and after installation.

2. Install mounting bracket on panel or wall. Thread tempering valve securely onto mounting bracket. Valve must be installed in location where it is readily accessible for inspection, cleaning and maintenance.

3. Connect hot and cold water supply lines to valve. Connect outlet line to valve and then to inlet of emergency equipment.

4. Activate the water flow and check the temperature of the water delivered from the tempering valve and emergency equipment. Note that the temperature control knob on the tempering valve has been factory preset to deliver 85°F (29°C) tepid water and the high temperature limit stop has been factory preset at 90°F (32°C). These temperatures are based upon an incoming hot water supply at 140°F (60°C). If the incoming hot water temperature is higher than 140°F (60°C), the valve will deliver water that is warmer than 90°F (32°C). ***In this case, the high temperature limit stop must be reset by the installer.***

5. To reset the high temperature limit stop:
   - While the water is running, turn the adjusting knob counterclockwise to the maximum hot water position.
   - Remove the knob and retaining ring, loosen the set screw and remove the limit stop.
   - Replace the handle on the valve stem and rotate the valve stem until the desired outlet water temperature is reached. Confirm the outlet water temperature on the outlet thermometer.
   - Replace the limit stop on the valve stem, positioned so that the limit stop is against the web on the LEFT side of the valve cover (i.e. the valve stem cannot be turned any further counterclockwise).
   - Replace the retaining ring, tighten set screw and replace knob.

SHOP DRAWING

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Reviewed By: M.M. — ☒ Reviewed
☐ Reviewed as noted
Date: 28 Apr 2015 — ☐ Resubmit

CHIARELLI ENGINEERING LTD.

THIS SPACE FOR ARCHITECT/ENGINEER APPROVAL

Shop Drawings
Contractor Approval
Approved by: M.A.G., G. F.
Date: Apr 23, 2015
SIFEC NORTH INC

Due to continuing product improvement, the information contained in this document is subject to change without notice. All dimensions are ± 1/4" (6mm). rev. 1214

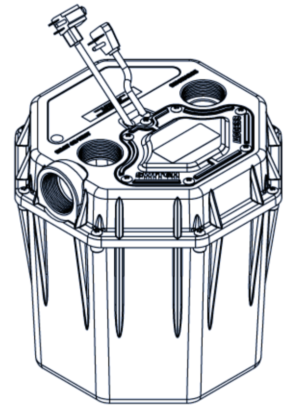
Guardian Equipment
1140 N North Branch St
Chicago, IL 60642
312 447 8100 TELEPHONE
312 447 8101 FACSIMILE
gesafety.com

ASSE 1071 Certified

Meets low lead requirements

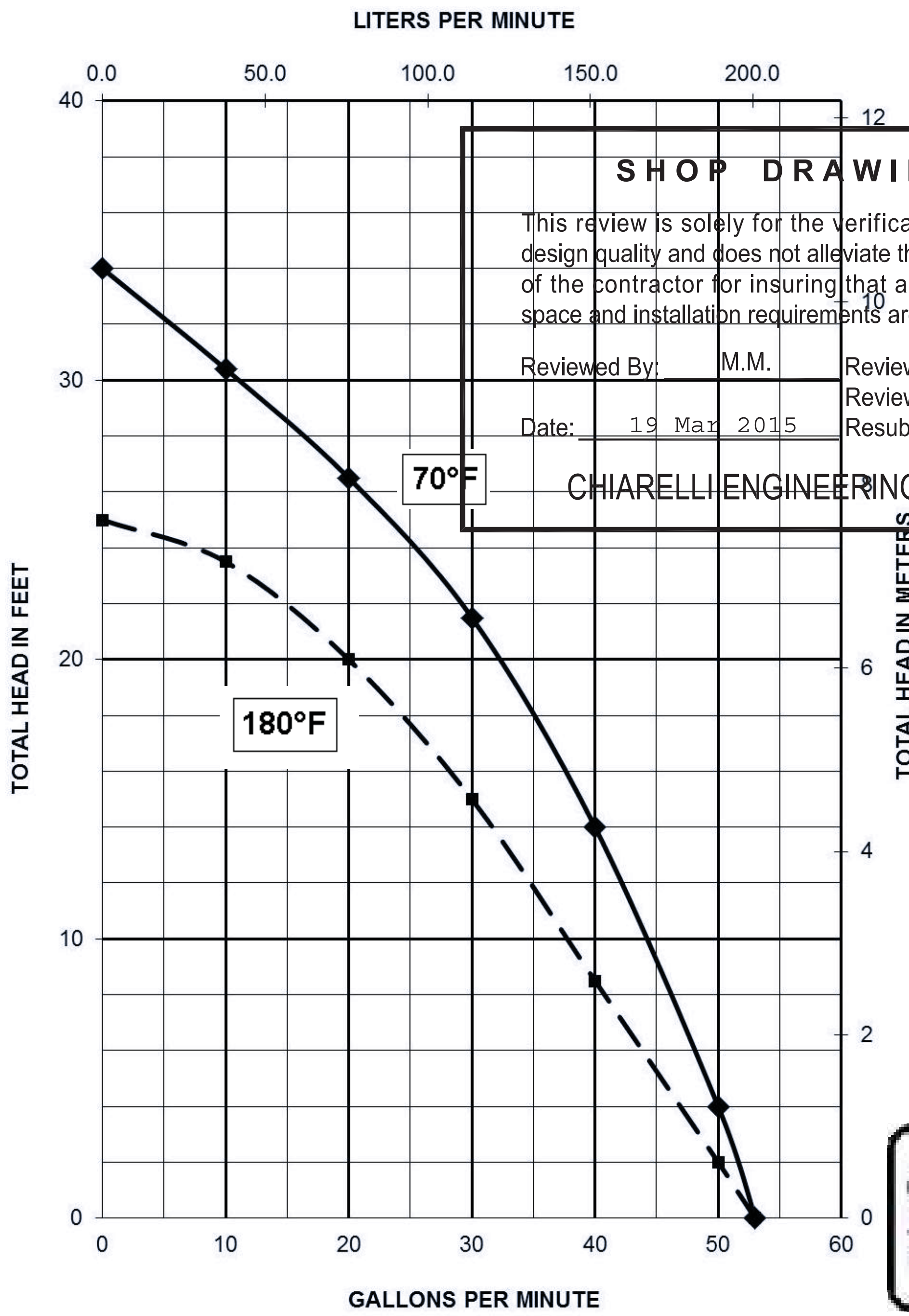
60/665

P-1/ SP-1



Pump Specifications

405 Series Commercial Drain Pump (High-Temp)



SHOP DRAWING

This review is solely for the verification of general design quality and does not alleviate the responsibility of the contractor for insuring that all specification, space and installation requirements are met.

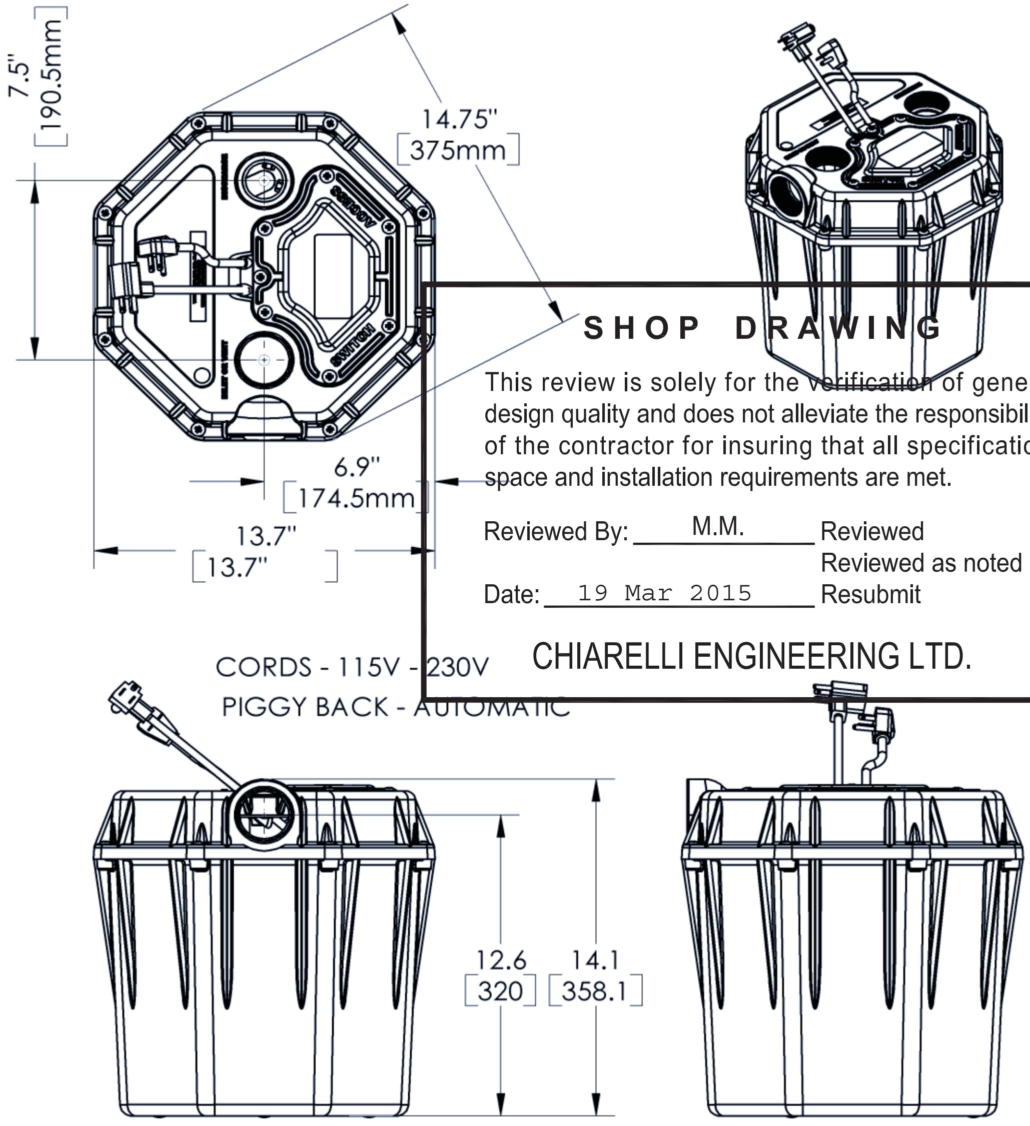
Reviewed By: M.M.
Date: 19 Mar 2015

- [x] Reviewed
- [ ] Reviewed as noted
- [ ] Resubmit

CHIARELLI ENGINEERING LTD.

Shop Drawings Contractor Approval
Approved by: M.A.G., G. F.
Date: Mar 03, 2015
SIFEC NORTH INC

P-1/ SP-1



SHOP DRAWING

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Reviewed By: M.M. — Reviewed ☒ / Reviewed as noted ☐

Date: 19 Mar 2015 — Resubmit ☐

CHIARELLI ENGINEERING LTD.

PROPRIETARY AND CONFIDENTIAL THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF LIBERTY PUMPS INC. ANY REPRODUCTION IN PART OR AS A WHOLE WITHOUT THE WRITTEN PERMISSION OF LIBERTY PUMPS INC. IS PROHIBITED.	405 SERIES DIMENSIONAL
APPLICATION / DO NOT SCALE DRAWING	SIZE A — JAN / 2007 — REV. A
	SCALE:1:4 — WEIGHT: 23 LBS — SHEET 1 OF 1

Liberty Pumps

P-1/ SP-1

405-Series Electrical Data

MODEL	HP	VOLTAGE	PHASE	FULL LOAD AMPS	LOCKED ROTOR AMPS	THERMAL OVERLOAD TEMP	STATOR WINDING CLASS	CORD LENGTH FT	DISCHARGE	AUTOMATIC
405	1/2	115	1	7.3	16	140˚C / 284˚F	F	10	2”	YES
405-HV	1/2	208/230	1	3.5	7	140˚C / 284˚F	F	10	2”	YES

405-Series Technical Data

IMPELLER	VORTEX HIGH TEMPERATUER ENGINEERED POLYMER
SOLIDS HANDLING	3/8”
PAINT (PUMP)	POWDER COAT
MAX LIQUID TEMP	82˚C / 180˚F
MAX STATOR TEMP	CLASS F 155˚C/ 311˚F
THERMAL OVERLOAD	140˚C/ 284˚F
POWER CORD TYPE	SJTOOW
MOTOR HOUSING	DEEP FINNED POWDER COATED ALUMINUM
VOLUTE	ENGINEERED POLYMER
SHAFT	STAINLESS
HARDWARE	STAINLESS
ORINGS	BUNA N
SHAFT SEAL	ENGINEERED DOUBLE LIP WITH STAINLESS SPRINGS
WEIGHT	23 LBS
TANK MATERIAL	POLYPROPYLENE
INLET SIZE	2” FEMALE NPT
DISCHARGE SIZE	2” FEMALE NPT
VENT SIZE	2” FEMALE NPT

SHOP DRAWING

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Reviewed By: M.M. — Reviewed ☒

Reviewed as noted ☐

Date: 19 Mar 2015 — Resubmit ☐

CHIARELLI ENGINEERING LTD.

Liberty Pumps

Installation Manual

7212000D

Model 404 and 405 Automatic Drain Pump

MODEL 404 Residential
115 volt

MODEL 405 Commercial 115 volt
MODEL 405HV Commercial 230 volt

Contents

IMPORTANT:

Prior to installation, record Model, Serial Number, and Code Number from pump nameplate for future reference.

MODEL ________________________

SERIAL ________________________

CODE ________________________

INSTALLATION DATE ________________________

Liberty Pumps

7000 Apple Tree Avenue
Bergen, NY 14416
Phone: (800) 543-2550
Fax: (585) 494-1839
www.libertypumps.com

C US
Contains Certified pump

SSPMA Certified PUMP MEMBER

1. General Information and Safety Guidelines

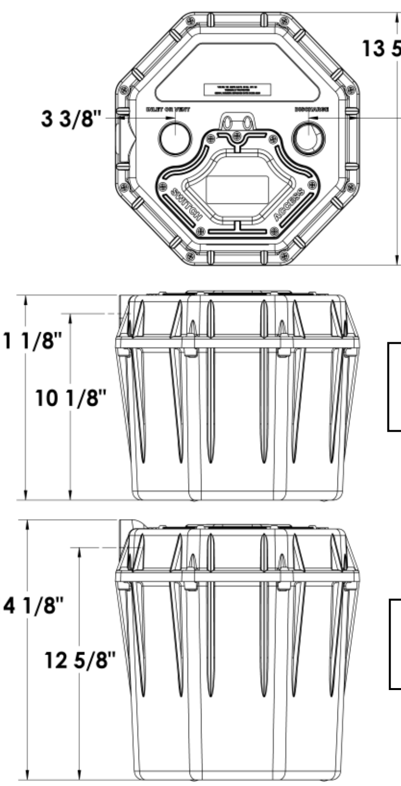
Before installation, read the following instructions carefully. Each Liberty pump is individually factory tested to insure proper performance. Closely following these instructions will eliminate potential operating problems, assuring years of trouble-free service.

⚠ WARNING

- **Risk of electric shock**. Always disconnect the pump from the power source before handling or making adjustments.
- The electrical connections and wiring for a pump installation should only be made by qualified personnel.
- **Explosion hazard during installation.** PVC cleaners, primers, and cements can release explosive vapors. These heavier than air vapors can accumulate in the tank. The heat of soldering or sweating copper or other metal pipe can ignite these vapors causing a violent explosion. If the unit is to be connected to copper discharge or vent piping, all solvent welded PVC joints must be allowed to cure a minimum of 24 hours. The access cover must be removed to allow the tank to be thoroughly ventilated prior to sweating copper pipe near the unit.
- This pump is supplied with a grounding conductor and grounding-type attachment plug. To reduce the risk of electric shock, be certain that it is connected to a Ground Fault Circuit Interrupter (GFCI) receptacle that meets the latest requirements per UL 943 including End of Life Provision and protection from Reverse Line-Load Miswire.
- Always wear rubber boots when water is on the floor and you must unplug the pump.
- DO NOT bypass grounding wires or remove ground prong from attachment plugs. DO NOT use an extension cord.
- This pump requires a separate, properly fused and grounded branch circuit. Make sure the power source is properly sized for the voltage and amperage requirements of the pump, as noted on the nameplate.
- The electrical outlet shall be within the length limitations of the pump power cord, and at least 4 feet above floor level to minimize possible hazards from flood conditions.
- The installation must be in accordance with the National Electric Code, Uniform Plumbing Code, International Plumbing Code, as well as all applicable local codes and ordinances.
- Keep clear of suction and discharge openings. To prevent injury, never insert fingers into pump while it is plugged in.
- DO NOT use this product for flammable or corrosive liquid.
- DO NOT use this product in applications where human contact with the pumped fluid is common (such as swimming pools, fountains, etc.)
- NEVER dispose of materials such as paint thinner or other chemicals down drains, as they can chemically attack and damage pump components, potentially causing product malfunction or failure.

⚠ CAUTION

- ***Model 404 Do not use this pump in water over 140° F.***
- ***Model 405 Do not use these pumps in water over 180°F***
- DO NOT DO NOT use pumps in mud, sand, cement, oil or chemicals.
- DO NOT modify the pump in any way.
- DO NOT lift or carry pump by power cord.
- DO NOT remove any tags from pump or cords.
- If pump is installed during construction before power is available, it must be protected from the environment to prevent water from entering through the cord plug end, etc.



Top view 404 and 405

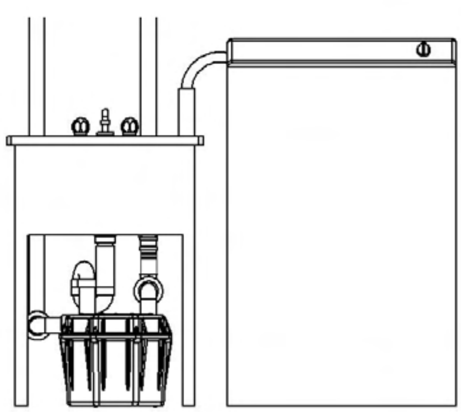
Side view 404

Side view 405

Dimensions are rounded to the nearest 1/8”

2. Installation

Fig. 1 – Typical Resident
Installation
This is a recommended installation only.



INLET: The pump has two ports: one on the top the other on the side, either can be used as a vent or inlet. Using the appropriate piping (1-1/2” on the model 404 and 2” on models 405, 405HV) connect the fixture to the pump. Note: a trap shall be used between the fixture and pump, a flange type is recommended. HAND-TIGHTEN TO PUMP. DO NOT OVERTIGHTEN OR CROSS-THREAD.

A. **DISCHARGE:** HAND-TIGHTEN ONLY. Install a union just above the pump to facilitate removal if necessary for cleaning or service. Install a check valve just above the union (as close to the pump as possible) to prevent the backflow of water after each pump cycle.

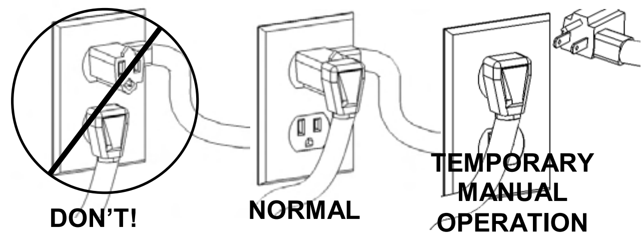
B. **VENT:** Provision is made for a vent stack to allow extra volume for high suds conditions, and to ensure proper drainage of the fixture. HAND-TIGHTEN ONLY. DO NOT CAP-OFF VENT. DO NOT use ONE-WAY QUICK-VENTS or AIR ADMITTENCE VALVES as they will not guarantee proper fixture performance. The vent pipe should have a union to facilitate removal if required and shall be connected directly to a building or house vent.

C. **POWER CORD:** The pump power cord is equipped with a grounding conductor and grounding-type 3-prong plug. It should be connected to a separately fused, grounded, 3-wire grounding-type receptacle of 15-amp capacity with the proper voltage for your model. Make sure all electrical wiring and connections are in accordance with the National Electric Code and all applicable local codes.
MODEL 404 - 115 volts
MODEL 405 - 115 volts
MODEL 405HV - 230 volts

⚠ WARNING

- **Risk of electric shock.** Always disconnect the pump from the power source before handling or making adjustments.
- DO NOT remove the plug or ground prong.
- DO NOT use an extension cord.

Fig. 1 Piggyback plug installation.



The 404 and 405-series pumps come factory-equipped with a float switch mounted within the tank. These models come with two cords - one to the float switch and the other to the pump motor. The switch cord has a series (piggyback) plug enabling the pump cord to be plugged into the back of it (see Fig. 4). The purpose of this design is to allow temporary manual operation of the pump.

For automatic operation using Liberty's supplied switch, the two cords should be interconnected and plugged into a separately fused, grounded outlet of proper amp capacity for your selected pump model. (See the pump’s nameplate for electrical specifications of your model.) Both cords are equipped with 3-prong plugs and must be plugged into a properly grounded 3-wire receptacle. DO NOT REMOVE THE GROUND PRONGS.

For manual operation, or in the event of switch failure, the pump cord can be separated and plugged into the electrical outlet, directly bypassing the switch. 208-230V single phase pumps should only be operated without the float switch by using the circuit breaker or panel disconnect. Do not let the pump run dry for extended periods.

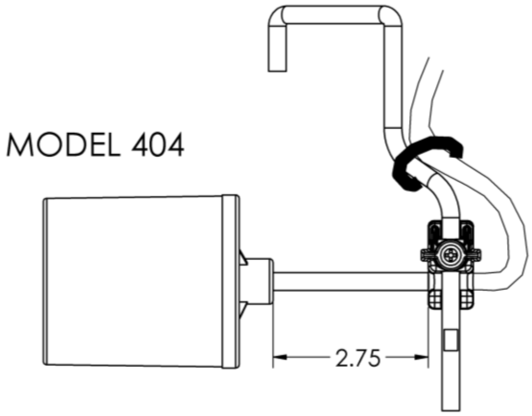
Application: The 404 and 405-series drain pumps are designed for use in gray wastewater applications. They will handle small debris and solids such as laundry lint (up to 3/8”) associated with normal gray water drainage from a sink. Larger solids should be kept out of the pump system. The 405-series is designed for commercial applications where higher temperature drain water (up to 180 degrees F.) may be used.

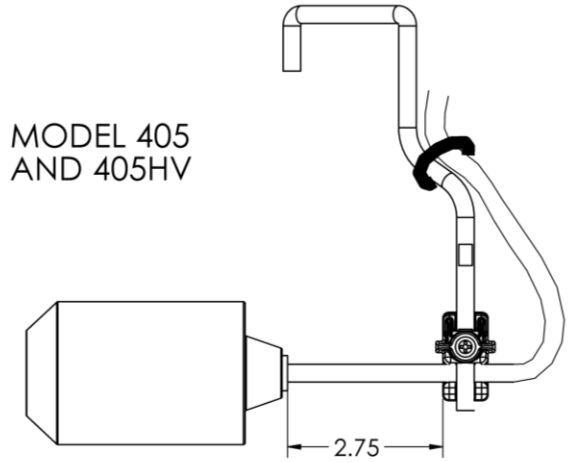
3. Maintenance and Troubleshooting

Each unit is individually factory tested to ensure proper adjustment and operation. If the unit fails to operate properly, carefully re-read the instructions to see that they have been followed correctly. Routine maintenance is not required on the pump itself, but associated connections may require occasional attention. Lint and foreign objects should be removed from the trap periodically. The check valve on the discharge should also be checked for freedom of operation at the same time.

The pump is automatically turned on and off by use of a float switch mounted within the tank. This switch can be easily removed and checked for operation by removing the access cover located on top of the unit. Once the access cover has been removed a rubber plug must be lifted to free up the switch cord. The switch is mounted to a rod which can be removed by lifting or pulling upward. **IMPORTANT: Do not adjust the tether length. If replacing the switch, make sure to maintain the correct tether length for your model per the following diagram. (Tether length is the distance of cord measured between the clamp and top of float switch.)**

*__NOTE:__ Liberty Pumps, Inc. assumes no responsibility for damage or injury due to disassembly beyond float removal in the field. Disassembly, other than at Liberty Pumps or its authorized service centers, automatically voids warranty.

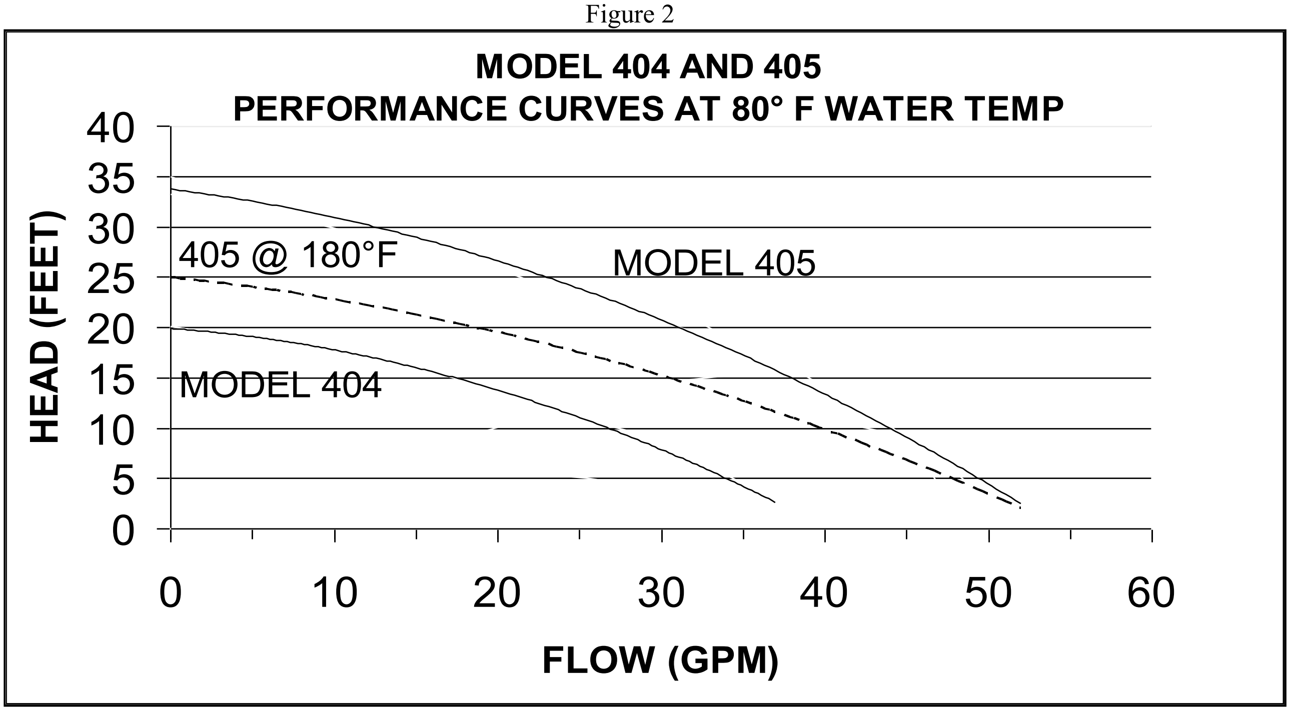




Problem	Cause	Correction
Pump will not turn on or shut off.	• Blown fuse or other interruption of power; improper voltage.	• Check that the unit is securely plugged in. Have an electrician check all wiring for proper connections and adequate capacity.
	• Plugged vent, or quick-vent in use.	• Be sure that an unrestricted vent at least 1-¼" in diameter is in use. Quick-vents shall not be used.
	• Defective switch or build-up on tank wall restricting free movement of float switch.	• *Remove access cover and check that float is free to move. If build-up restricts float, clean and reinstall. If defective, replace switch.
Pump runs or hums but does not pump.	• Discharge is blocked or restricted.	• Check the discharge line for blockage, including ice if the line passes through or into cold areas.
	• Check valve is stuck closed or installed wrong.	• Remove and examine for freedom of operation and proper installation.
	• Total lift height has been reached (see Fig. 2)	• Try routing pipe to a lower level. If not possible, another pumping station may be required at a level of roughly half the total lift.
	• Pump impeller is jammed.	• *Disassemble the receiver and bottom base of pump. Remove foreign material. Reassemble.
	• Trap or inlet piping is clogged.	• Check the trap and inlet piping for restrictions.
Pump short-cycles.	• Plugged vent, or quick-vent in use.	• Be sure that an unrestricted vent at least 1-¼" in diameter is in use. Quick-vents shall not be used.
	• Defective switch.	• *Remove access cover and check that float is free to move. If build-up restricts float, clean and reinstall. If defective, replace switch.
	• Check valve was not installed, is stuck open, or is leaking.	• Remove and examine for freedom of operation and proper installation.

Pump runs periodically when fixtures are not in use.	• Check valve was not installed, is stuck open, or is leaking.	• Remove and examine for freedom of operation and proper installation.
	• Faucets are dripping.	• Repair faucets to eliminate dripping.
Water or soap suds come out of vent pipe.	• Vent pipe is too short or too small in diameter.	• Be sure that an unrestricted vent at least 1-¼” in diameter is in use.
	• Defective switch.	• *Remove tank cover and check that float is free to move. If build-up restricts float, clean and reinstall. If defective, replace switch.
	• Rate of in-flow exceeds pump output.	• Use valve on the inlet to reduce rate of inflow.
Pump operates noisily.	• Foreign objects in impeller cavity.	• *Disassemble the receiver and bottom base of pump. Remove foreign material. Reassemble.
	• Piping to house structure is too rigid.	• Replace a portion of the discharge pipe with rubber hose to absorb noise.

Figure 2



3 Year Limited Warranty

Liberty Pumps, Inc. warrants that pumps of its manufacture are free from all factory defects in material and workmanship for a period of 3 years from the date of purchase. The date of purchase shall be determined by a dated sales receipt noting the model and serial number of the pump. The dated sales receipt must accompany the returned pump if the date of return is more than 3 years from the "CODE" (date of manufacture) number noted on the pump nameplate.

The manufacturer's obligation under this Warranty shall be limited to the repair or replacement of any parts found by the manufacturer to be defective, provided the part or assembly is returned freight prepaid to the manufacturer or its authorized service center, and provided that none of the following warranty-voiding characteristics are evident.

The manufacturer shall not be liable under this Warranty if the product has not been properly installed; if it has been disassembled, modified, abused or tampered with; if the electrical cord has been cut, damaged or spliced; if the pump discharge has been reduced in size; if the pump has been used in water temperatures above the advertised rating, or water containing sand, lime, cement, gravel or other abrasives; if the product has been used to pump chemicals or hydrocarbons; if a non-submersible motor has been subjected to excessive moisture; or if the label bearing the serial, model and code number has been removed. Liberty Pumps, Inc. shall not be liable for any loss, damage or expenses resulting from installation or use of its products, or for consequential damages, including costs of removal, reinstallation or transportation.

There is no other express warranty. All implied warranties, including those of merchantability and fitness for a particular purpose, are limited to three years from the date of purchase.

This Warranty contains the exclusive remedy of the purchaser, and, where permitted, liability for consequential or incidental damages under any and all warranties are excluded.

Chapter 12 GAUGES

MANUFACTURER/DISTRIBUTOR:

WOLSELEY Inc.
4200, Hickmore
St-Laurent, QC, H4T 1K2
Phone: (514) 344-9378
Fax : (514) 344-9341

Adjustable Angle

- 3", 5" Dial Size
- ± 1.0% Full Scale Accuracy
- Stainless Steel Case & Stem
- External Reset

SHOP DRAWING

This review is solely for the verification of general design quality and does not alleviate the responsibility of the contractor for insuring that all specification, space and installation requirements are met.

Reviewed By: M.M. Reviewed ☒
Reviewed as noted ☐
Date: 28 Apr 2015 Resubmit ☐

CHIARELLI ENGINEERING LTD.

B85606 shown

The Trerice **Adjustable Angle Bimetal Thermometer** can be configured to the most desirable viewing angle. This instrument has a hermetically sealed, stainless steel case designed to withstand the rigors of industrial environments, while producing an accurate, responsive measurement.

- Optional features available: Please consult the Options & Accessories Section for details.

Thermowell

- For corrosive or pressure applications, use of a thermowell is recommended to prevent damage to the thermometer and facilitate its removal from the process (refer to pages 155-161). For correct use and application of all Bimetallic thermometers, please refer to the Bimetallic Actuated Thermometer Standard ASME B40.3.

Specifications

Models	Dial Sizes
B836	3"
B856	5"

Case	300 stainless steel, hermetically sealed
Stem	300 stainless steel 1/4" diameter
Coil	Bimetallic, silicone dampened on ranges to 300˚F (148˚C), above 300˚F not dampened
Connection	Adjustable angle, 1/2 NPT
Window	Double strength glass
Pointer	Balanced, black finish
Dial Face	Aluminum, white background with black and blue graduations and markings
External Reset	Yes
Accuracy	±1.0 % Full Scale ASME B40.3 Grade A

Approximate Shipping Weight

B836: 1.1 lbs [0.5 kg]
B856: 1.5 lbs [0.68 kg]

HOW TO ORDER

Sample Order Number: **B856 06 05**

Model	Stem (Length)	Range Code
B836 B856	**02** 2 1/2" Stem **04** 4" Stem **06** 6" Stem **09** 9" Stem **12** 12" Stem **15** 15" Stem **18** 18" Stem **24** 24" Stem	See Standard Ranges

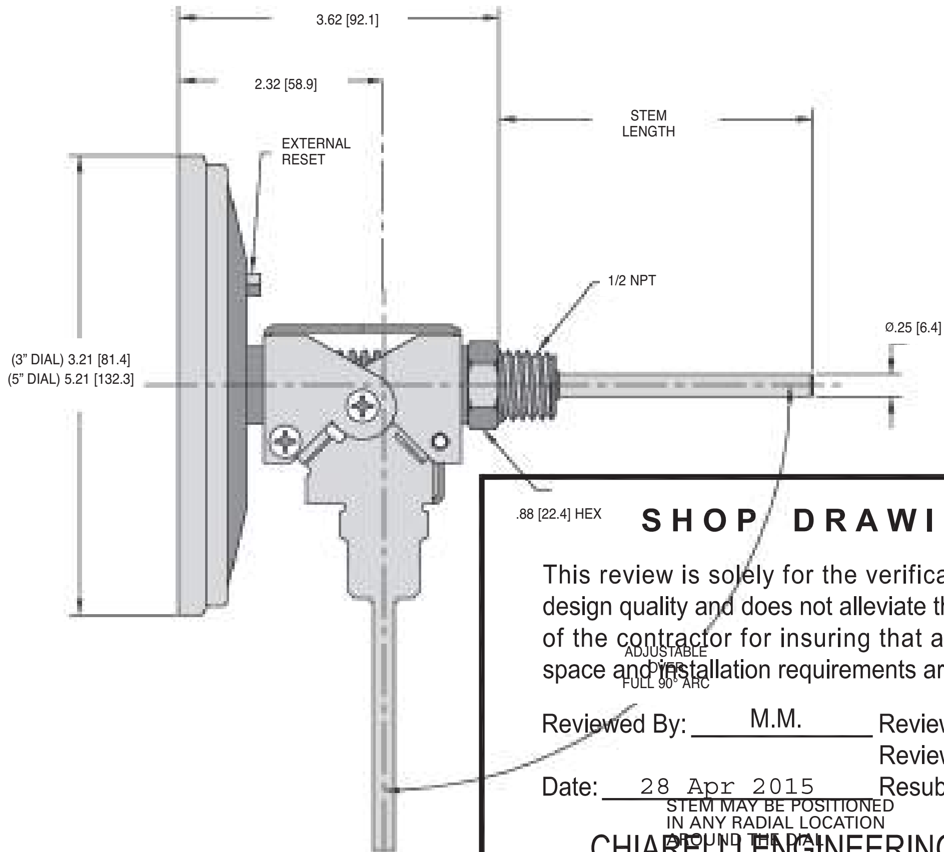
Other lengths available: Specify in inches (72" maximum)

Shop Drawings
Contractor Approval
Approved by: M.A.G., G. F.
Date: Apr 23, 2015
SIFEC NORTH INC

12950 W. Eight Mile Road • Oak Park, MI 48237-3288 • TEL:248/399-8000 • FAX: 248/399-7246 • www.TRERICE.com

Adjustable Angle

All dimensions are nominal. Dimensions in [ ] are in millimeters.



SHOP DRAWING

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Reviewed By: M.M. — Reviewed ☒ — Reviewed as noted ☐

Date: 28 Apr 2015 — Resubmit ☐

CHIARELLI ENGINEERING LTD.

Standard Ranges

Dual Scale (Fahrenheit & Celsius Range)		Fahrenheit only Range		Celsius only Range		Fahrenheit		Celsius	
Range Code	Range	Range Code	Range	Range Code	Range	Figure Intervals	Minor Divisions	Figure Intervals	Minor Divisions
01*†	-100° to 100°F & –75° to 40°C	01F*†	-100° to 100°F	01C*†	-75° to 40°C	20°	2°	10°	1°
02	-40° to 160°F & –40° to 70°C	02F	-40° to 160°F	02C	-40° to 70°C	20°	2°	10°	1°
12*†	0° to 100°F & -20° to 40°C	12F*†	0° to 100°F	12C*†	-20° to 40°C	10°	1°	10°	1°
03*†	25° to 125°F & –5° to 50°C	03F*†	25° to 125°F	03C*†	-5° to 50°C	10°	1°	5°	1/2°
04	0° to 200°F & –20° to 95°C	04F	0° to 200°F	04C	-20° to 95°C	20°	2°	10°	1°
05	20° to 240°F & –10° to 115°C	05F	20° to 240°F	05C	-10° to 115°C	20°	2°	10°	1°
27	0° to 250°F & –20° to 120°C	27F	0° to 250°F	27C	-20° to 120°C	50°	2°	20°	2°
06	50° to 300°F & 10° to 150°C	06F	50° to 300°F	06C	10° to 150°C	50°	2°	20°	2°
07	50° to 400°F & 10° to 200°C	07F	50° to 400°F	07C	10° to 200°C	50°	5°	50°	2°
08	50° to 500°F & 10° to 260°C	08F	50° to 500°F	08C	10° to 260°C	50°	5°	50°	2°
09*	150° to 750°F & 50° to 400°C	09F*	150° to 750°F	09C*	50° to 400°C	100°	10°	50°	5°
10*	200° to 1000°F & 100° to 550°C	10F*	200° to 1000°F	10C*	100° to 550°C	100°	10°	100°	5°

* Minimum stem length for these ranges is 4".
† Minimum insertion length for these ranges is 3".

Shop Drawings
Contractor Approval
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Date: Apr 23, 2015
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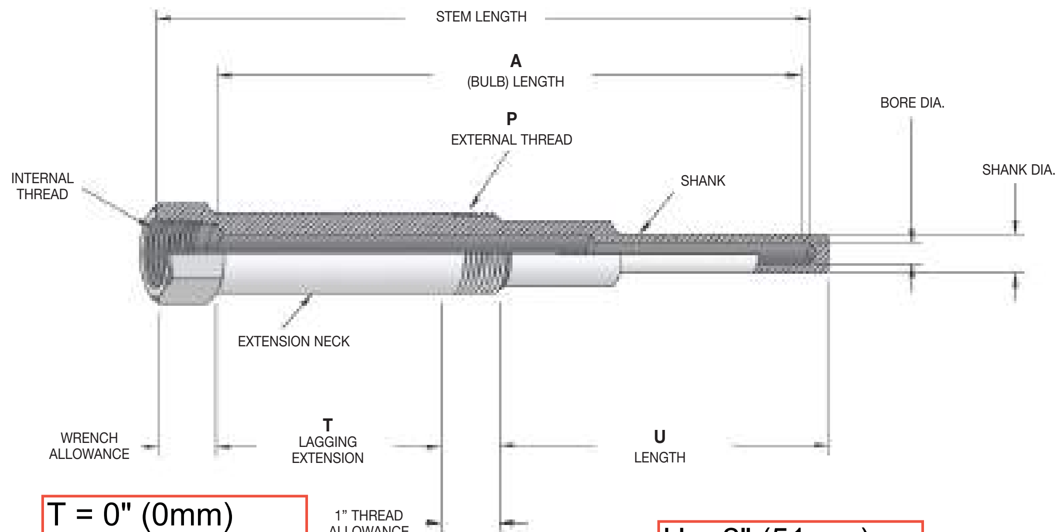
Thermowells

DESIGN & OPERATION

Description

A thermowell is a pressure tight receptacle designed to accept a temperature sensing element and provide a means to insert that element into a vessel or pipe.



Principles of Operation

A thermowell acts as a barrier between a process medium and the sensing element of a temperature measuring device. It protects against corrosive process media, media contained under pressure, or media flowing at a high velocity. A thermowell also allows the sensing element to be removed from the application while maintaining a closed system.

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Reviewed By: M.M. Reviewed ☒
Reviewed as noted ☐
Date: 28 Apr 2015 Resubmit ☐

CHIARELLI ENGINEERING LTD.

Shop Drawings Contractor Approval
Approved by: M.A.G., G. F.
Date: Apr 23, 2015
SIFEC NORTH INC

12950 W. Eight Mile Road • Oak Park, MI 48237-3288 • TEL:248/399-8000 • FAX: 248/399-7246 • www.TRERICE.com

Selecting a Thermowell

Temperature Instrumentation and Control Products, including: Thermometers, Thermocouples, RTDs, and Temperature Controllers.

All Trerice Thermowells should be carefully selected to meet the demands of the particular application. The information contained in this catalog is only offered as a guide to assist in making the proper selection. Improper application may cause failure of the thermowell, resulting in possible personal injury or property damage.

To ensure minimum response time, Trerice Heat Transfer Paste should be applied to the sensing portion of the instrument before installation into a thermowell. 1 oz. tube: Item No. 107-0001

Connection

Trerice Thermowells are available in a variety of process connection styles. Threaded connections in 1/2, 3/4 and 1 NPT are the most widely specified. Socket weld, weld-in, raised face flanged, Van Stone flanged, and sanitary (Tri-Clamp) connection styles are also available.

All Trerice Bimetal Thermowells are provided with a 1/2 NPSM instrument connection to allow for pressure relief within the thermowell.

U-Length

The U-length (insertion length) of a thermowell indicates its insertion depth into a process vessel or piping system and is measured from the tip of the thermowell to the underside of the threads. The U-length must equal or exceed the length of the sensitive portion of the temperature instrument's stem or bulb. Trerice Thermowells are available in U-lengths from 2" to 72".

Material

The material chosen must be compatible with the process medium to which it is exposed. In applications of high pressure or velocity, the material may be chosen for its strength or durability. Trerice offers thermowells in a variety of materials, including: brass, carbon steel, stainless steel, Monel, Carpenter 20, Hastelloy B or C, Inconel 600, Incoloy 800, Nickel and Titanium. Other alloys or compounds may also be available, please consult factory.

Threaded, welded and Van Stone flanged thermowells are made from forgings or bar stock. Raised face flanged and sanitary thermowells are of a two-piece welded construction.

Bore

The bore of each Trerice Thermowell is designed to fit the sensing element of a specific Trerice Temperature Instrument.

Shank

Trerice Thermowells are available in stepped, tapered, and straight shank configurations. Stepped shank thermowells are normally used on standard duty applications. Tapered shank thermowells are designed for use on heavy duty applications. Straight shank thermowells are designed for use with instruments that have wide stem diameters or short stem lengths.

Lagging Extension

Lagging extension thermowells are used on applications where insulation covers the vessel or piping system. The extension length (T-length) is the measurement between the instrument connection and process connection of the thermowell.

Shop Drawings
Contractor Approval
Approved by: M.A.G., G. F.
Date: Apr 23, 2015
SIFEC NORTH INC

Pressure gauge

620B

Stainless Steel Case

620B shown

- 4 1/2" Dial Size
- ±1.0% Accuracy
- Stainless Steel Case
- Recalibrator Screw

The **620B** Trerice Contractor Gauge is designed to service the general pressure measurement requirements of the construction industry. The 620B offers high reliability at an economic price. This gauge features a corrosion resistant, stainless steel case and acrylic window. Wetted parts are brass.

- For correct use and application of all pressure gauges, please refer to: Pressure Gauge Standard ASME B40.100.

Specifications

Model	**620B**
Dial Size	4 1/2"
Wetted Parts	Bronze tube, brass socket
Movement	Brass
Connection	Lower male, 1/4 NPT
Case	304 stainless steel, stem-mounted flangeless
Ring	Friction type, 304 stainless steel
Window	Acrylic
Pointer	Plain, black finished Adjustable via screw on dial face
Dial Face	Aluminum, white background with black graduations and markings
Accuracy	±1.0% Full Scale, ASME B40.100 Grade 1A
Maximum Temperature	**212°F (100° C)**
Approximate Shipping Weight	0.8 lbs [0.36 kg]

SHOP DRAWING

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Reviewed By: M.M. Reviewed ☒
Reviewed as noted ☐
Date: 28 Apr 2015 Resubmit ☐

CHIARELLI ENGINEERING LTD.

HOW TO ORDER

Sample Order Number: **620B 45 02 L D 140**

Model	Dial Size	Connection Size	Connection Location	Units of Measure	Range Code
620B	45 4 1/2"	02 1/4 NPT	L Lower	A psi D psi/kPa	See Standard Ranges

Shop Drawings
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Date: Apr 23, 2015
SIFEC NORTH INC

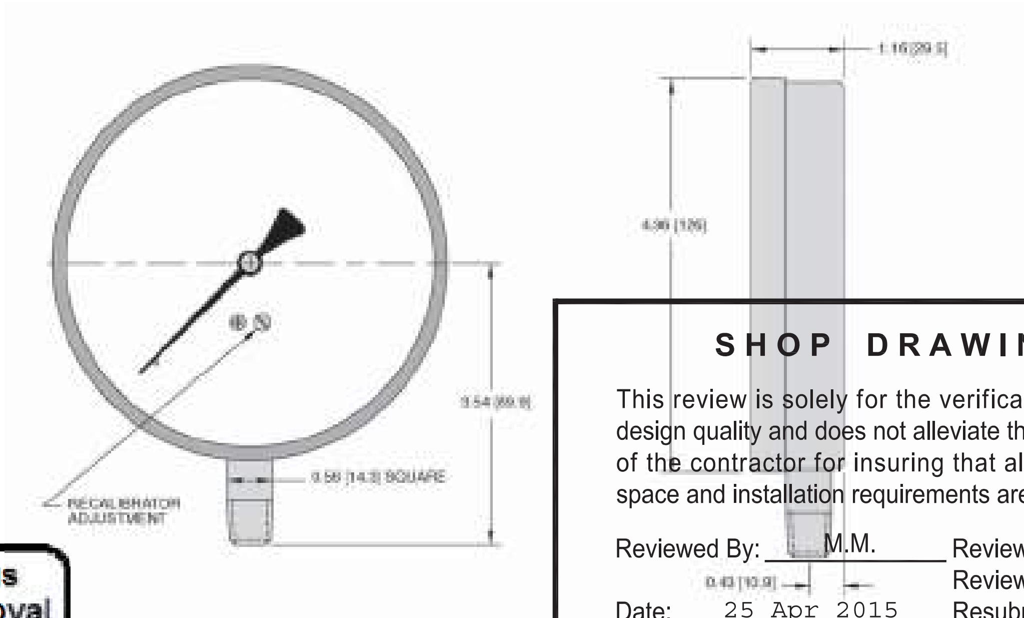
Pressure gauge

620B

Stainless Steel Case

All dimensions are nominal. Dimensions in [ ] are in millimeters.

COMMERCIAL • CONTRACTOR GAUGES



SHOP DRAWING

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Date: 25 Apr 2015

CHIARELLI ENGINEERING LTD.

Shop Drawings Contractor Approval

Approved by: M.A.G., G. F.

Date: Apr 23, 2015

SIFEC NORTH INC

Standard Ranges

psi Ranges (A)				psi/kPa Ranges (D)					
						psi		kPa	
Range Code	Specific Range (psi)	Figure Intervals	Minor Divisions	Range Code	Specific Range	Figure Intervals	Minor Divisions	Figure Intervals	Minor Divisions
010	30" Hg to 0	5	0.5	010	30" Hg to 0 / –100 to 0 kPa	5	0.5	10	1
020	30" Hg to 15 psi	10/5	1/0.5	020	30" Hg to 15 psi / –100 to 100 kPa	10/5	1/0.5	20	2
030	30" Hg to 30 psi	10/5	1/–	030	30" Hg to 30 psi / –100 to 200 kPa	10/5	1/–	50	2
040	30" Hg to 60 psi	10/10	2/1	040	30" Hg to 60 psi / –100 to 400 kPa	10/10	2/1	50	5
050	30" Hg to 100 psi	30/20	2/2	050	30" Hg to 100 psi / –100 to 700 kPa	30/20	2/2	100	5
060	30" Hg to 150 psi	30/30	5/2	060	30" Hg to 150 psi / –100 to 1000 kPa	30/30	5/2	100	10
070	30" Hg to 300 psi	30/50	5/5	070	30" Hg to 300 psi / –100 to 2000 kPa	30/50	5/5	200	20
080	0 to 15 psi	3	0.2	080	0 to 15 psi / 0 to 100 kPa	3	0.2	10	1
090	0 to 30 psi	5	0.5	090	0 to 30 psi / 0 to 200 kPa	5	0.5	20	2
100	0 to 60 psi	10	1	100	0 to 60 psi / 0 to 400 kPa	10	1	50	5
110	0 to 100 psi	10	1	110	0 to 100 psi / 0 to 700 kPa	10	1	100	5
120	0 to 160 psi	20	2	120	0 to 160 psi / 0 to 1100 kPa	20	2	200	10
130	0 to 200 psi	20	2	130	0 to 200 psi / 0 to 1400 kPa	20	2	300	10
140	0 to 300 psi	50	5	140	0 to 300 psi / 0 to 2000 kPa	50	5	200	20
150	0 to 400 psi	50	5	150	0 to 400 psi / 0 to 2800 kPa	50	5	300	50
160	0 to 600 psi	100	10	160	0 to 600 psi / 0 to 4000 kPa	100	10	500	50

DIFFERENTIAL
PRESSURE GAUGE

PISTON INSTRUMENTS

SHOP DRAWING

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Date: 28 Apr 2015 Resubmit ☐

CHIARELLI ENGINEERING LTD.

200 DPG

Piston Instruments

SALIENT FEATURES

- Cost effective and reliable.
- Simple and compact design.
- Easy to read dial instrument eliminates accumulated errors of two instrument installations.
- **High operating pressure up to 200 bar.**
- **Differential pressure range up to 10 bar.**
- Over pressure safe from either side to maximum working pressure.
- Adjustable reed contact switching.
- Indicating mechanism isolated from pressure chamber.
- Only switch is also available.
- Wide applications in air, gas and liquid media.
- Manufactured in ISO certified plant.

These piston instruments can indicate small values of differential pressure even when used at high line pressures. They provide instantaneous and continuous information regarding system conditions helping in eliminating premature servicing of equipment, avoid unscheduled down time of costly processes and detect abnormal system conditions.

Switching Facility : Instruments can be supplied with reed switches to initiate alarms, activate other equipment, or shut the system down. Two switches are used when high and low limits are desired. Gauge-switch models provide the user with both, gauge readout and switch operation.

APPLICATIONS :

Filters, Hydraulic systems, Water treatment plants, Chemical plants, Natural gas processing, Heat exchangers, Gasoline / Diesel engine filters, Pumps and Valves, Compressors.

Shop Drawings Contractor Approval
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Date: Apr 23, 2015
SIFEC NORTH INC

Differential Pressure Plus, Inc.
16 Carriage Hill Drive
Branford, CT 06405
Phone : 203-481-2545
Fax : 203-483-7169
Email : DPGauge@AOL.com
Website : www.differentialpressure.com

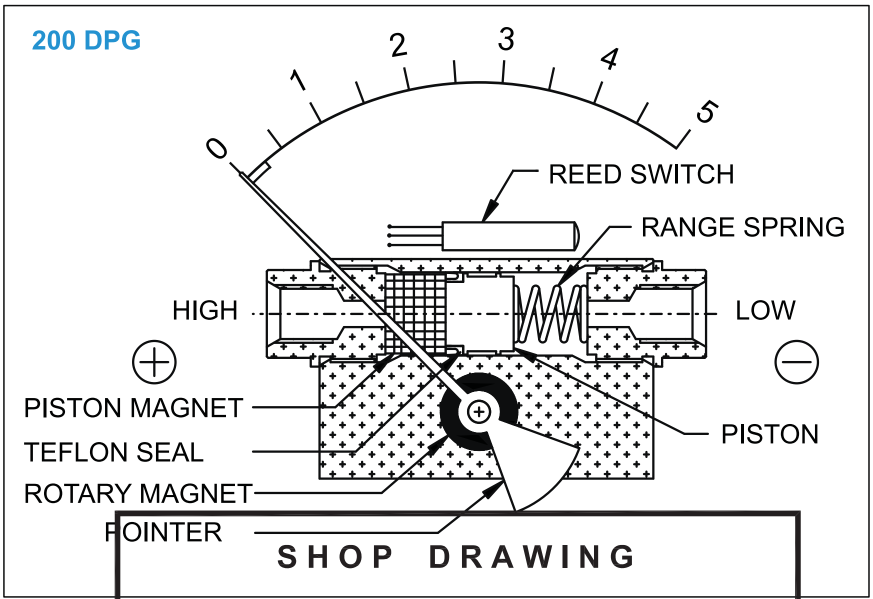
MAGNETIC PRINCIPLE

OPERATING PRINCIPLE

High and Low pressures are separated by a sensor assembly consisting of a magnet, piston, Teflon seal and a range spring. The difference in pressure causes the sensor assembly to move in proportion to the change against a range spring.

A rotary magnet, located in a separate body cavity and isolated from the acting pressures, is rotated by magnetic coupling as per the linear movement of the sensor assembly. A pointer attached to the rotary magnet indicates differential pressure on the dial.

Switch : Reed switches are located adjacent to the pressure chamber and are activated by the magnetic field of the sensor assembly.



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CHIARELLI ENGINEERING LTD.

TECHNICAL DATA

Specifications

Accuracy	: ±2% of the FSD (Ascending)
Migration	: Minor from high to low port
Range	: 0-0.25 to 0-70 bar or equivalent range in other units
First marking on the scale	: 20% of the FSD
Sensing element	: Piston
Wetted parts	: Body material, SS 302 spring, Teflon, & ceramic magnet
Case material	: Stainless steel (SS 304)
Dial size in inch /mm	: 2", 2.5", 3.5", 4", 4.5", 6"/ 50, 63, 80, 100, 115, 150
Mounting	: Direct, front flange & 2" pipe mounting
Max. working pressure	: 200/400 bar. 200 bar for Alu, Brass & 400 bar for SS body
Max. process temperature	: 80° C / 175° F
Body material	: Aluminum, Brass, SS 316 & Monel
Seals	: Buna-N, Viton & EPDM 'O' rings
Window	: Float glass(Std.), toughened glass & acrylic on request.
Connection	: 1/4" NPT(F) Std. optional 1/4" BSP(F)
Porting	: In-line, rear, bottom
Over range protection	: Up to the max. working pressure from high & low side
Protection for gauge & switch	: IP 65 / NEMA-4

Options

Glycerine filling
Red follower pointer (except 2" & 6")
Customer logo
Dual scale
Colour band
Filter mesh in (+) connection
Reverse port (Pointer moves from right to left)
Descending calibration

Switches (Adjustable in 20-100% of FSD)

1 or 2 SPSTs with a DIN plug
1 or 2 SPSTs with a terminal strip
1 or 2 SPSTs with a built in relay
1 or 2 SPDTs with a terminal strip
1 or 2 SPDTs with a DIN plug

Shop Drawings
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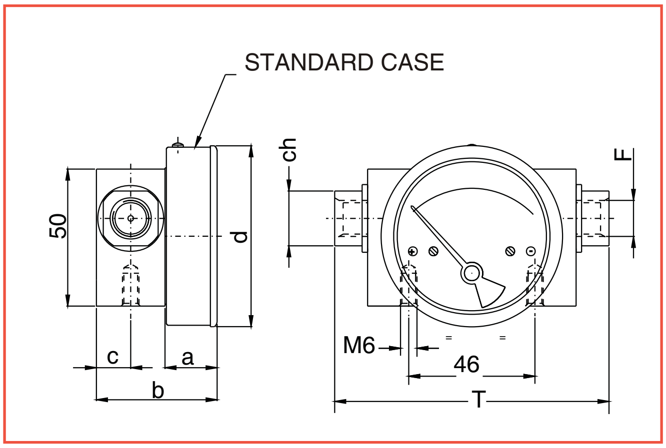
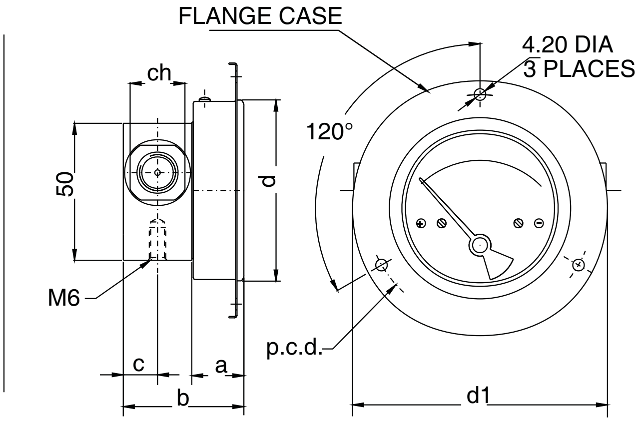
Date: Apr 23, 2015
SIFEC NORTH INC

STANDARD DIMENSIONS (MODEL 200 DPG)





DIAL Ø	F	a	b	c	d	d1	T	ch	p.c.d.
50 (2")	1/4"BSP - 1/4"NPT	18	43	12.5	53	79	100	20	69
63 (2.5")	1/4"BSP - 1/4"NPT	19	44	12.5	66	93	100	20	83
80 (3.5")	1/4"BSP - 1/4"NPT	19	44	12.5	83	109	100	20	99
100 (4")	1/4"BSP - 1/4"NPT	19	44	12.5	104.3	131	100	20	121
115 (4.5")	1/4"BSP - 1/4"NPT	19	44	12.5	119.7	146	100	20	136
150 (6")	1/4"BSP - 1/4"NPT	19	44	12.5	154.3	181	100	20	171

* PANEL CUT OUT = d+1

SHOP DRAWING

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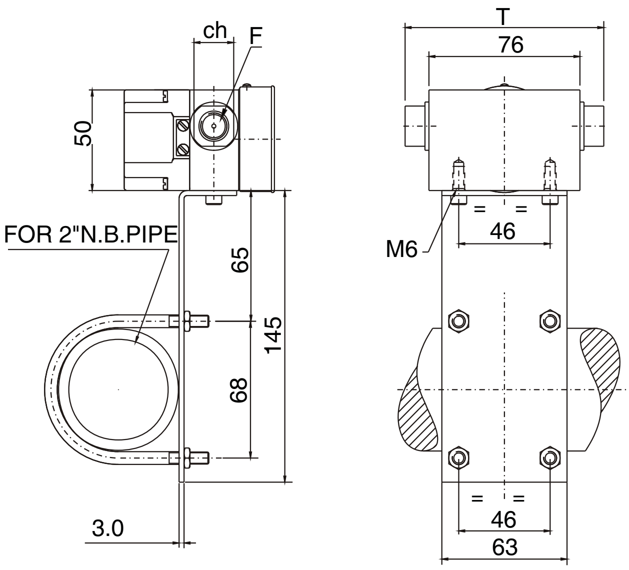
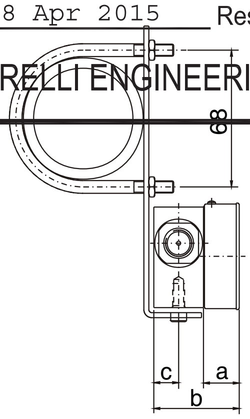
Reviewed as noted ☐
Date: 28 Apr 2015 — Resubmit ☐

CHIARELLI ENGINEERING LTD.

MOUNTING BRACKETS (MODEL 200 DPG)



BRACKET MOUNTING FOR GAUGE+ SWITCH



BRACKET MOUNTING FOR GAUGE

DIAL Ø	F	a	b	c	T	ch
50 (2")	1/4"BSP - 1/4"NPT	18	43	12.5	100	20
63 (2.5")	1/4"BSP - 1/4"NPT	19	44	12.5	100	20
80 (3.5")	1/4"BSP - 1/4"NPT	19	44	12.5	100	20
100 (4")	1/4"BSP - 1/4"NPT	19	44	12.5	100	20
115 (4.5")	1/4"BSP - 1/4"NPT	19	44	12.5	100	20
150 (6")	1/4"BSP - 1/4"NPT	19	44	12.5	100	20

Shop Drawings
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SIFEC NORTH INC

HOW TO ORDER A DIFFERENTIAL PRESSURE INSTRUMENT, MODEL 200 DPG

	Example	Code	Descriptions
Series	200 DPG		
Type	GS	G	Gauge
		S	Switch
		GS	Gauge + Switch
Body material	B	A	Aluminium *(anodized)*
		B	Brass
		S	SS-316
		H	Heavy duty Auminium. *(5000 psi) with 32mm thick body.*
		M	Monel
Dial size	3.5	2.0	2.0” (50 mm)
		2.5	2.5” (63 mm)
		3.5	3.5” (80 mm)
		4.0	4.0” (100 mm)
		4.5	4.5” (115 mm)
		6.0	6.0” (150 mm)
Connection	4N	4B	¼” BSP (Female)
		4N	¼” NPT (Female)
		ZZ	Special connection sizes using adaptor
Porting	1	1	In-line (Standard)
		2	Rear / Back
		3	Bottom
		6	In-line & Bottom
Case type	SS	SS	SS 304 with a rubber ring (standard)
		SF	SS 304 flange with a rubber ring (standard flange)
Window	A	F	Glass (standard)
		A	Acrylic
		T	Toughened glass
		L	Safety glass
Seal	B	B	Buna-N (standard)
		V	Viton
		E	EPDM
Switch	3	0	None
		1	One SPST, with a DIN plug*
		2	One SPST, with a terminal strip
		2A	One SPST, with built in relay
		3	Two SPSTs, with a DIN plug*
		4	Two SPSTs, with a terminal strip
		4A	Two SPSTs, with built in relay
		5	One SPDT, with a DIN plug*
		6	One SPDT, with a terminal strip
		7	Two SPDTs, with two DIN plugs*
		8	Two SPDTs, with a terminal strip

Shop Drawings Contractor Approval
Approved by: M.A.G., G. F.
Date: Apr 23, 2015
SIFEC NORTH INC

S H O P   D R A W I N G

This review is solely for the verification of general design quality and does not alleviate the responsibility of the contractor for insuring that all specification, space and installation requirements are met.

Reviewed By: M.M. — Reviewed ☒
Reviewed as noted ☐
Date: 28 Apr 2015 — Resubmit ☐

CHIARELLI ENGINEERING LTD.

SPST Specifications :
10 VA AC or DC (max)
100 V AC or DC (max)
0.5 Amp AC or DC (max)

Built in relay :
230 V AC, 1 Amps.

SPDT Specifications :
3 VA AC or DC (max)
30 V AC or DC (max)
0.30 Amp AC or DC (max)

* ***DIN plug :*** *we mount it on the top, on the plastic switch cover. However we can give it at the back as a request.)*

Switch applicable for “S” & “GS” types only. Switches operate from 20 to 100% of the range & mounted at the back. Switches are in a plastic enclosure, they are factory set, field adjustable.

Standard Ranges — Example: 0-100 psi

Kg/cm²	0.25	-	0.5	0.75	1	-	1.6	2	2.5	3	3.5	4	5	-	6	7	9	10
bar	0.25	-	0.5	0.75	1	-	1.6	2	2.5	3	3.5	4	5	-	6	7	9	10
Mbar	250	-	500	750	1000	-	-	-	-	-	-	-	-	-	-	-	-	-
psi	-	5	8	-	15	20	25	30	-	40	50	60	-	80	-	100	-	-
Kpa	25	-	50	75	100	-	160	200	250	300	350	400	500	-	600	700	900	1000

Other ranges on request.

	Example	Code	Descriptions
Options	BC	0	None
		A	Glycerine*
		B	Red follower pointer on acrylic window
		C	Customer Logo
		D	Dual scale
		E	Colour band
		F	Strainer in (+) connection
		G	Reverse port**
		H	Descending calibration *(longer delivery time)*
		N	NACE

* Affects accuracy
** Pointer moves from right to left

Ordering Sequence Code (Example)

Series
Type
Body material
Dial size
Connection
Porting
Case type
Window
Seal
Switch
Range
Options

200 DPG GS B 3.5 4N 1 SS A B 3 (0-100 psi) BC

Limitations for making combinations:

- Glycerine filling will not have follower pointer.
- For bottom or back porting no mounting holes are given and hence can not be mounted using a bracket.
- Gauge with back porting cannot have a switch. (However, only switch with back porting is available.)
- Toughened glass and follower pointer not available in 2" (50 mm) dial.
- No follower pointer available in 6” (150 mm).

Specifications and dimensions given in this leaflet represent the state of engineering at the time of printing, modifications may take place and materials specified may be replaced by others without prior notice.

74/665

Chapter 13 DRAINAGE PIPING

MANUFACTURER/DISTRIBUTOR:

WOLSELEY Inc.
4200, Hickmore
St-Laurent, QC, H4T 1K2
Phone: (514) 344-9378
Fax : (514) 344-9341

13.1 DRAINAGE PIPING XFR DWV

SYSTEM XFR® DWV

Drainage Systems for Noncombustible Buildings

THE WORLD'S FIRST PVC RATED FOR HIGH RISES & PLENUMS

Contractors installing DWV pipe in high-rises and plenums had few alternatives to heavy cast iron and copper. IPEX has changed that. System XFR® — the world's first PVC DWV system rated for high-rises and plenums where tighter fire and smoke regulations have previously limited the use of thermoplastic.

Suitable for use in noncombustible environments, System XFR's advanced material meets all fire-resistance and smoke development codes. Its revolutionary fire-retardant properties eliminate flame spread and reduce the volume of smoke generated.

And in addition to its reliable smoke and fire protection, System XFR delivers all the performance advantages you'd expect from thermoplastic piping.

FEATURES & BENEFITS

FLAME & SMOKE

System XFR possesses superior fire- and smoke- retardant capabilities. When tested to the CAN/ULC-102.2 Standard, System XFR achieved a Flame Spread Rating of not greater than 25 and a Smoke Developed Classification of not greater than 50.

CODE COMPLIANCE

Ideal for noncombustible applications, System XFR meets these national and provincial building codes:

- High-rise buildings as defined by NBC article 3.2.6
- Air plenums as defined by NBC article 3.6.4.3
- Noncombustible construction as defined by NBC article 3.1.5
- Penetrating a rated fire separation as defined by NBC article 3.1.9.4.(4)

RANGE OF SIZES

Sizes range from 1-1/2" to 12" in diameter.

HIGH IMPACT RESISTANCE

Thanks to its advanced materials, System XFR demonstrates a high impact strength in cold temperatures. Impact-tested at 0 ºC and 23 ºC, XFR is tough enough to exceed the CSA requirements.

IMPROVED FLOW

System XFR has a substantially lower roughness factor compared to metal systems, allowing for overall improved flow. It's also made with a larger inside diameter which provides a greater cross-sectional area for flow and raises both carrying capacity and flow rates. This feature gives engineers the versatility to design smaller, compact systems that can still handle the necessary flow rates.

LOWER THERMAL CONDUCTIVITY

System XFR sweats less than metal pipe due to its excellent insulating properties. As a result, XFR can reduce — and in many cases, eliminate — the need for insulation.

COMPARABLE NOISE ATTENUATION

In real world sound tests performed on constructed buildings, IPEX DWV systems have proven to provide comparable noise attenuation when compared to cast iron from drainage flow. Numerous installations from schools to hospitals and nursing homes have been plumbed with these IPEX drainage systems, all proving that in these critical installations the IPEX systems measure up in terms of sound transfer.

SYSTEM XFR® DWV

Contractors installing DWV pipe in high-rises and plenums had few alternatives to heavy cast iron and copper. IPEX has changed that. System XFR® — the world's first PVC DWV system rated for high-rises and plenums where tighter fire and smoke regulations have previously limited the use of thermoplastic.

Suitable for use in noncombustible environments, System XFR's advanced material meets all fire-resistance and smoke development codes. Its revolutionary fire-retardant properties eliminate flame spread and reduce the volume of smoke generated.

And in addition to its reliable smoke and fire protection, System XFR delivers all the performance advantages you'd expect from thermoplastic piping.

APPLICATIONS

Drain Waste and Vent Piping in:

- Commercial
- Industrial
- Residential
- Above ground or underground

STANDARDS

CSA B181.2
CAN/ULC S102.2

ADVANTAGES

1 Flame & Smoke

System XFR possesses superior fire- and smoke- retardant capabilities. When tested to the CAN/ULC S102.2 Standard, System XFR achieved a Flame Spread Rating of not greater than 25 and a Smoke Developed Classification of not greater than 50.

2 Code Compliance

Ideal for noncombustible applications, System XFR meets these national and provincial building codes:

- High-rise buildings as defined by NBC article 3.2.6
- Air plenums as defined by NBC article 3.6.4.3
- Noncombustible construction as defined by NBC article 3.1.5
- Penetrating a rated fire separation as defined by NBC article 3.1.9.4.(4)

3 High Impact Resistance

Thanks to its advanced materials, System XFR demonstrates a high impact strength in cold temperatures. Impact-tested at 0 °C and 23 °C, XFR is tough enough to exceed the CSA requirements.

4 Improved Flow

System XFR has a substantially lower roughness factor compared to metal systems, allowing for overall improved flow. It's also made with a larger inside diameter which provides a greater cross-sectional area for flow and raises both carrying capacity and flow rates. This feature gives engineers the versatility to design smaller, compact systems that can still handle the necessary flow rates.

5 Lower Thermal Conductivity

System XFR sweats less than metal pipe due to its excellent insulating properties. As a result, XFR can reduce — and in many cases, eliminate — the need for insulation.

6 Comparable Noise Attenuation

In real world sound tests performed on constructed buildings, IPEX DWV systems have proven to provide comparable noise attenuation when compared to cast iron from drainage flow. Numerous installations from schools to hospitals and nursing homes have been plumbed with these IPEX drainage systems, all proving that in these critical installations the IPEX systems measure up in terms of sound transfer.

DID YOU KNOW?

SYSTEM XFR — the world's first uncoated PVC rated for high-rises and plenums where tighter fire and smoke regulations have previously limited the use of thermoplastic.

Suitable for use in noncombustible environments, System XFR's advanced material meets all fire-resistance and smoke development codes. Its revolutionary fire-retardant properties virtually eliminate flame spread and reduce the volume of smoke generated.

SHORT FORM SPECIFICATIONS

SYSTEM XFR DWV PIPE AND FITTINGS
IPEX System XFR Drain, Waste and Vent pipe and fittings shall be certified to CSA B181.2 and when used in noncombustible construction, high-rise buildings and air plenums, they shall be tested and listed in accordance with CAN/ULC S102.2 and clearly marked with the certification logo indicating a Flame Spread Rating not more than 25 and a Smoke Developed Classification not exceeding 50.

System XFR® pipe and fittings have been tested and certified by CSA to the CSA B181.2 standard. System XFR pipe and fittings are listed with ITS (Warnock Hersey) to exhibit Flame and Smoke values as per CAN/ULC S102.2-10.

Test Results

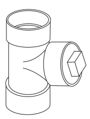
ITS (Warnock Hersey) conducted the testing in accordance with CAN/ULC S102.2 test standard. The following table summarizes the results of these tests.

Component	Flame Spread Rating	Smoke-Developed Classification
System XFR®		
Pipe	≤ 25	≤ 50
Fittings	≤ 25	≤ 50
Fabricated PVC fittings with XFR Coating	≤ 25	≤ 50

System XFR DWV Pipe

Dimension inches	Dimension mm	Product Code
1-1/2	40	110067
2	50	110068
3	75	110069
4	100	110070
6	150	110071
8	200	110072
10	250	110073
12	300	110074

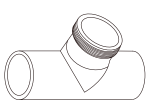
Line Cleanout H x H x Gasket Plug



Dimension inches	Dimension mm	Product Code
1-1/2	40	526040
2	50	526041
3	75	526103
4	100	526104
4 x 3 x 4	100 x 75 x 100	526105
6	150	526161
8	200	526162
10	250	526163
12	300	526164

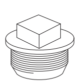
Line Cleanout Sp x Sp x Threaded Plug

FOR USE WITH *MJ GREY*™



Dimension inches	Dimension mm	Product Code
8	200	526766

Plug Cleanout MPT with gasket

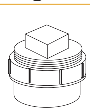


Dimension inches	Dimension mm	Product Code
1-1/2	40	526401
2	50	526402
3	75	526403
4	100	526404
6	150	526405

Fitting Cleanout Sp x FPT

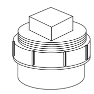
Dimension inches	Dimension mm	Product Code
1-1/2	40	526042
2	50	526046
3	75	526047
4	100	526048
6	150	426050

Fitting Cleanout Sp x Gasket Plug



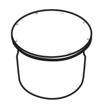
Dimension inches	Dimension mm	Product Code
1-1/2	40	526345
2	50	526346
3	75	526347
4	100	526348
6	150	526349

Tube End Cleanout H x Gasket Plug



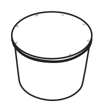
Dimension inches	Dimension mm	Product Code
1-1/2	40	526291
2	50	526298
3	75	526299
4	100	526300

Tube End Cleanout H x Bolted Cover



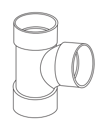
Dimension inches	Dimension mm	Product Code
8	200	526000
10	250	526001
12	300	526002

Fitting Cleanout Sp x Bolted Cover



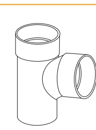
Dimension inches	Dimension mm	Product Code
8	200	526140
10	250	526141
12	300	526142

Sanitary Tee H x H x H



Dimension inches	Dimension mm	Product Code
1-1/2	40	526081
2	50	526082
2 x 1-1/2 x 1-1/2	50 x 40 x 40	526058
2 x 1-1/2 x 2	50 x 40 x 50	526057
2 x 1-1/2	50 x 40	526056
3	75	526083
3 x 1½	75 x 40	526061
3 x 2	75 x 50	526060
4	100	526084
4 x 2	100 x 50	526064
4 x 3	100 x 75	526066
6	150	526377
6 x 4	150 x 100	526385
8	200	526810
8 x 4	200 x 100	526808
8 x 6	200 x 150	526809
10	250	526814
10 x 4	250 x 100	526811
10 x 6	250 x 150	526812
10 x 8	250 x 200	526813
12	300	526819
12 x 4	300 x 100	526815
12 x 6	300 x 150	526816
12 x 8	300 x 200	526817
12 x 10	300 x 250	526818

Sanitary Tee Sp x H x H

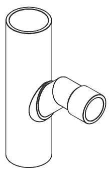


Dimension inches	Dimension mm	Product Code
1-1/2	40	526550
3 x 1-1/2	75 x 40	526552
4	100	426557

PRODUCT SELECTION CHART - SYSTEM XFR

Sanitary Tee Sp x Sp x H

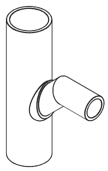
FOR USE WITH *MJ GREY*™



Dimension inches	Dimension mm	Product Code
8 x 4	200 x 100	526926
8 x 6	200 x 150	526998
10 x 4	250 x 100	526997
10 x 6	250 x 150	526758
12 x 4	300 x 100	526761
12 x 6	300 x 150	526762

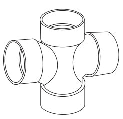
Sanitary Tee Sp x Sp x Sp

FOR USE WITH *MJ GREY*™



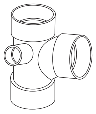
Dimension inches	Dimension mm	Product Code
8	200	526999
10 x 8	250 x 200	526759
10	250	526760
12 x 8	300 x 200	526763
12 x 10	300 x 250	526764
12	300	526765

Double Sanitary Tee H x H x H x H



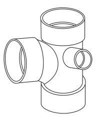
Dimension inches	Dimension mm	Product Code
1-1/2	40	526542
2	50	526543
2 x 1-1/2	50 x 40	526547
3	75	526544
3 x 1-1/2	75 x 40	526538
3 x 2	75 x 50	426539

Sanitary Tee Side Inlet (left hand) H x H x H x H SI



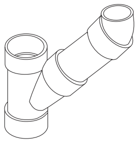
Dimension inches	Dimension mm	Product Code
3 x 3 x 3 x 1-1/2	75 x 75 x 75 x 40	526395
3 x 3 x 3 x 2	75 x 75 x 75 x 50	526396

Sanitary Tee Side Inlet (right hand) H x H x H SI x H



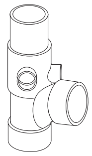
Dimension inches	Dimension mm	Product Code
3 x 3 x 3 x 1-1/2	75 x 75 x 75 x 40	526397
3 x 3 x 3 x 2	75 x 75 x 75 x 50	526398

Upright Extended Wye H x x H x Sp



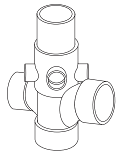
Dimension inches	Dimension mm	Product Code
3	75	526006

Single Apartment Fitting H x Sp x H



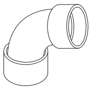
Dimension inches	Dimension mm	Product Code
3	75	526007

Double Apartment Fitting H x Sp x H x H



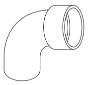
Dimension inches	Dimension mm	Product Code
3	75	526008

90º Elbow H x H



Dimension inches	Dimension mm	Product Code
1-1/2	40	526121
1-1/2 L	40 L	426024
2	50	526035
2 L	50 L	526122
3	75	526025
3 L	75 L	526123
4	100	526124
6	150	526125
8	200	526126
10	250	526127
12	300	526128

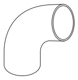
90º Elbow Sp x H



Dimension inches	Dimension mm	Product Code
1-1/2	40	526231
2	50	526232
3	75	526233
3 L	75 L	526230
4	100	526234
6	150	526235
8	200	526236
10	250	526237
12	300	526238

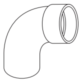
90º Elbow Sp x Sp

FOR USE WITH *MJ GREY*™



Dimension inches	Dimension mm	Product Code
8	200	526967
10	250	526968
12	300	526970

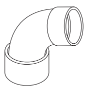
90º Reducing Elbow Closet Bend Reducing Sp x H



Dimension inches	Dimension mm	Product Code
4 x 3	100 x 75	426026

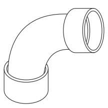
Dimension inches	Dimension mm	Product Code

90° Reducing Elbow H x H



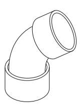
inches	mm	Product Code
4 x 3	100 x 75	526155

90° Elbow Extra Long Sweep H x H



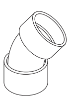
inches	mm	Product Code
2	50	426157

60° Elbow H x H



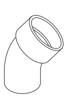
inches	mm	Product Code
1-1/2	40	526261
2	50	526262
3	75	526253
4	100	526264

45° Elbow Short Turn H x H



inches	mm	Product Code
1-1/2	40	526241
2	50	526242
3	75	526243
4	100	526244
6	150	526245
8	200	526246
10	250	526247
12	300	526248

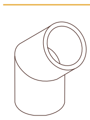
45° Elbow Short Turn Sp x H



inches	mm	Product Code
1-1/2	40	526221
2	50	526071
3	75	526223
4	100	526072
6	150	526073
8	200	526226
10	250	526270
12	300	526271

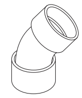
45° Elbow Short Turn Sp x Sp

FOR USE WITH *MJ GREY*™



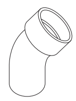
inches	mm	Product Code
8	200	526971
10	250	526770
12	300	526771

45° Elbow Long Turn H x H



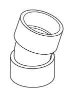
inches	mm	Product Code
6	150	426038

45° Elbow Long Turn Sp x H



inches	mm	Product Code
6	150	426225

22-1/2° Elbow H x H



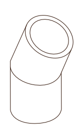
inches	mm	Product Code
1-1/2	40	526251
2	50	526252
3	75	526253
4	100	526254
6	150	526255
8	200	526256
10	250	526257
12	300	526258

22-1/2° Elbow Sp x H

inches	mm	Product Code
6	150	526651
8	200	526652
10	250	526653
12	300	526654

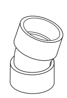
22-1/2° Elbow Sp x Sp

FOR USE WITH *MJ GREY*™



inches	mm	Product Code
8	200	526972
10	250	526973
12	300	526908

11-1/4° Elbow H x H

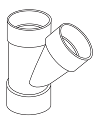


inches	mm	Product Code
6	150	526671
8	200	526672
10	250	526673
12	300	526674

11-1/4° Elbow Sp x H

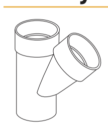
inches	mm	Product Code
6	150	526681
8	200	526682
10	250	526683
12	300	526684

45° Wye H x H x H



Dimension inches	Dimension mm	Product Code
1-1/2	40	526171
2	50	526172
2 x 1-1/2 x 1-1/2	50 x 40 x 40	526194
2 x 1-1/2	50 x 40	526195
3	75	526173
3 x 1-1/2	75 x 40	526201
3 x 2	75 x 50	526196
4	100	526174
4 x 2	100 x 50	526198
4 x 3	100 x 75	526197
6	150	526175
6 x 4	150 x 100	526199
8	200	526560
8 x 4	200 x 100	526606
8 x 6	200 x 150	526607
10	250	526706
10 x 4	250 x 100	526703
10 x 6	250 x 150	526704
10 x 8	250 x 200	526705
12	300	526711
12 x 4	300 x 100	526707
12 x 6	300 x 150	526708
12 x 8	300 x 200	526709
12 x 10	300 x 250	526710

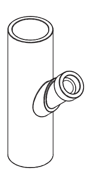
45° Wye Sp x H x H



Dimension inches	Dimension mm	Product Code
3	75	426635
3 x 1-1/2	75 x 40	426638

45° Wye Sp x Sp x H

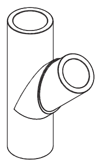
FOR USE WITH MJ GREY™



Dimension inches	Dimension mm	Product Code
8 x 4	200 x 100	526985
8 x 6	200 x 150	526986
10 x 4	250 x 100	526988
10 x 6	250 x 150	526989
12 x 4	300 x 100	526992
12 x 6	300 x 150	526993

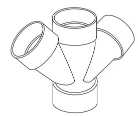
45° Wye Sp x Sp x Sp

FOR USE WITH MJ GREY™



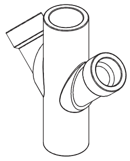
Dimension inches	Dimension mm	Product Code
8	200	526987
10 x 8	250 x 200	526990
10	250	526991
12 x 8	300 x 200	526994
12 x 10	300 x 250	526995
12	300	526996

Double 45° Wye H x H x H x H



Dimension inches	Dimension mm	Product Code
1-1/2	40	526637
2	50	526456
2 x 1-1/2	50 x 40	526642
3	75	526639
3 x 1-1/2	75 x 40	526643
3 x 2	75 x 50	526644
4 x 3	100 x 75	526457
6	150	426752
8	200	426755
8 x 4	200 x 100	426753
8 x 6	200 x 150	526754
10	250	426759
10 x 4	250 x 100	426756
10 x 6	250 x 150	426757
10 x 8	250 x 200	426758
12	300	426764
12 x 4	300 x 100	426760
12 x 6	300 x 150	426761
12 x 8	300 x 200	426762
12 x 10	300 x 250	426763

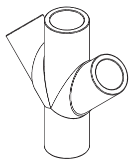
45° Double Wye Sp x Sp x H x H



Dimension inches	Dimension mm	Product Code
8 x 4	200 x 100	526769
8 x 6	200 x 150	526974
10 x 4	250 x 100	526976
10 x 6	250 x 150	526977
12 x 4	300 x 100	526980
12 x 6	300 x 150	526982

45° Double Wye Sp x Sp x Sp x Sp

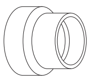
FOR USE WITH MJ GREY™



Dimension inches	Dimension mm	Product Code
8	200	526975
10	250	526979
10 x 8	250 x 200	526978
12 x 8	300 x 200	526983
12 x 10	300 x 250	526984

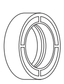
PRODUCT SELECTION CHART - SYSTEM XFR

Increaser Coupling H x H



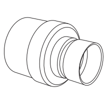
Dimension inches	Dimension mm	Product Code
2 x 1-1/2	50 x 40	526362
3 x 1-1/2	75 x 40	526363
3 x 2	75 x 50	526364
4 x 1-1/2	100 x 40	526369
4 x 2	100 x 50	526365
4 x 3	100 x 75	526366
5 x 3	125 x 75	526944
6 x 4	150 x 100	526860
8 x 4	200 x 100	526861
8 x 6	200 x 150	526867
10 x 4	250 x 100	526862
10 x 6	250 x 150	526868
10 x 8	250 x 200	526900
12 x 6	300 x 150	526869
12 x 8	300 x 200	526901
12 x 10	300 x 250	526907

Reducer Bushing Sp x H



Dimension inches	Dimension mm	Product Code
2 x 1-1/2	50 x 40	526282
3 x 1-1/2	75 x 40	526292
3 x 2	75 x 50	526284
4 x 2	100 x 50	526288
4 x 3	100 x 75	526286
6 x 4	150 x 100	526054
8 x 4	200 x 100	526446
8 x 6	200 x 150	526447

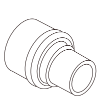
Reducer Bushing (Extended) Sp x H



Dimension inches	Dimension mm	Product Code
10 x 4	250 x 100	526296
10 x 6	250 x 150	526297
10 x 8	250 x 200	526962
12 x 4	300 x 100	526963
12 x 6	300 x 150	526964
12 x 8	300 x 200	526965
12 x 10	300 x 250	526966

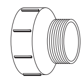
Reducer Bushing (Extended) Sp x Sp

FOR USE WITH *MJ GREY*™



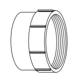
Dimension inches	Dimension mm	Product Code
10 x 8	250 x 200	526981
12 x 8	300 x 200	526767
12 x 10	300 x 250	526768

Male Adapter H x MPT



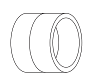
Dimension inches	Dimension mm	Product Code
1-1/2	40	526331
2	50	526332
3	75	526333
4	100	526334

Female Adapter H x FPT



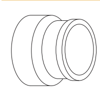
Dimension inches	Dimension mm	Product Code
1-1/2	40	526341
2	50	526342
3	75	526343
4	100	526344

Coupling H x H



Dimension inches	Dimension mm	Product Code
1-1/2	40	526351
2	50	526352
3	75	526353
4	100	526354
6	150	526356
8	200	526358
10	250	526359
12	300	526360

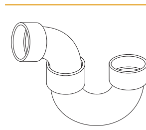
Plastic MJ Spigot MJ Sp x H



Dimension inches	Dimension mm	Product Code
2	50	526522
3	75	526523
4	100	526524

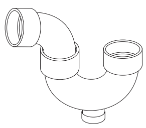
Adapts M-J Cast Iron Pipe to Plastic DWV Pipe

P Trap Solvent Weld H x H



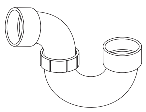
Dimension inches	Dimension mm	Product Code
1-1/2	40	526431
2	50	526432
3	75	526433
4	100	526434

P Trap — Solvent Weld with Cleanout H x H



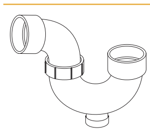
Dimension inches	Dimension mm	Product Code
1-1/2	40	526441
2	50	526442

P Trap — Union Connection H x H



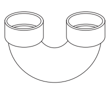
Dimension inches	Dimension mm	Product Code
1-1/2	40	526443
2	50	526444

P Trap — Union Connection with Cleanout H x H



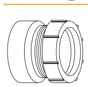
Dimension inches	Dimension mm	Product Code
1-1/2	40	526505

U Bend — H x H



Dimension inches	Dimension mm	Product Code
4	100	526499
6	150	426503

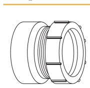
Fitting Trap Adapter — Sp x Slip Joint



Dimension inches	Dimension mm	Product Code
1-1/2	40	426304
2	50	426305

Plastic Nut & Washer

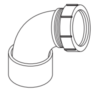
Pipe Trap Adapter — H x Slip Joint



Dimension inches	Dimension mm	Product Code
1-1/2	40	526321
1-1/2 x 1-1/4	40 x 32	526329

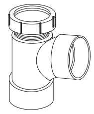
Plastic Nut & Washer

90° Pipe Trap Adapter — H x Slip Joint



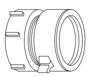
Dimension inches	Dimension mm	Product Code
1-1/2 x 1-1/2	40 x 40	526330

Sanitary Tee Trap Adapter — H x Slip Joint x H



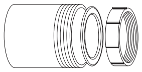
Dimension inches	Dimension mm	Product Code
1-1/2	40	426179

Copper to DWV Pipe Adapter — H x Slip Joint



Dimension inches	Dimension mm	Product Code
1-1/2	40	426320
1-1/2 x 1-1/4	40 x 32	426430
2	50	426510

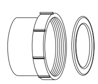
Tail Piece Adapter — Sp x Slip Joint



Dimension inches	Dimension mm	Product Code
1-1/2	40	526555
1-1/2 x 1-1/4	40 x 32	526556

Plastic Nut & Washer

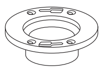
Swivel Strainer Adapter — H x Swivel Nut



Dimension inches	Dimension mm	Product Code
1-1/2	40	426894

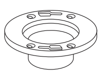
PRODUCT SELECTION CHART - SYSTEM XFR

Closet Flange One Piece Plastic Slip



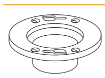
Dimension inches	Dimension mm	Product Code
4	100	526573
4 x 3	100 x 75	526584

Closet Flange One Piece Plastic Slip w Spigot End



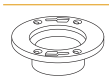
Dimension inches	Dimension mm	Product Code
4 x 3	100 x 75	526592

Closet Flange One Piece Plastic Slip w Molded Test Plate



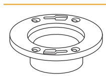
Dimension inches	Dimension mm	Product Code
4 x 3	100 x 75	526591

Closet Flange One Piece Plastic Slip Flush Kit



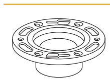
Dimension inches	Dimension mm	Product Code
4 x 3	100 x 75	426594

Closet Flange One Piece Plastic Slip Flush Kit w Molded Test Plate



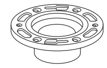
Dimension inches	Dimension mm	Product Code
4 x 3	100 x 75	526595

Adjustable Closet Flange with Plastic Ring Slip



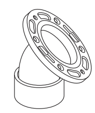
Dimension inches	Dimension mm	Product Code
4 x 3	100 x 75	526586

Adjustable Closet Flange w Plastic Ring Slip w Molded Test Plate



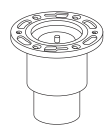
Dimension inches	Dimension mm	Product Code
4 x 3	100 x 75	526588

45º Discharge Closet Flange Adjustable w Plastic Ring



Dimension inches	Dimension mm	Product Code
4 x 3	100 x 75	426589

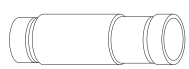
Closet Flange Kit for Concrete



Dimension inches	Dimension mm	Product Code
4 x 3	100 x 75	426593

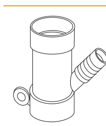
for use in Slab on Grade W.C. installations

Expansion Joint - Type 1 (Vertical & Horizontal Use) H x H



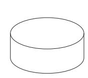
Dimension inches	Dimension mm	Product Code
1-1/2	40	526485
2	50	526486
3	75	526487
4	100	526489
6	150	426209
8	200	426210
10	250	426211
12	300	426212

Dishwasher Wye H x H x Hose Barb



Dimension inches	Dimension mm	Product Code
1-1/2 x 1-1/2 x 1/2	40 x 40 x 12	526495

Slip Cap H



Dimension inches	Dimension mm	Product Code
1-1/2	40	526411
2	50	526412
3	75	526413
4	100	526414
6	150	526415
8	200	526416
10	250	526417
12	300	526418

85/665

The **Modern Age** of **DWV** is here

Mechanical engineers and contractors are converting from metal piping to System XFR® and System 15®

SYSTEM XFR® DWV
SYSTEM 15® DWV

PROVEN BENEFITS

IMPROVED FLOW – Larger inside diameter and smoother interior walls for more efficient waste removal

THERMAL PROPERTIES – Storm drains can often be used without insulation

LONGEVITY – Extremely durable, will not rust or corrode

JOINING METHODS – Solvent welding or MJ Grey™ mechanical joint coupling options

PLENUM/HIGH-RISE – System XFR® carries 25/50 Flame/Smoke requirements

LABOUR SAVINGS – Easy to handle, cut and assemble

ENVIRONMENTAL EFFECTS – Local manufacturing minimizes transport and reduces carbon footprint

SYSTEM XFR® DWV

Proven in noncombustible environments, the advanced material meets all Flame and Smoke code requirements.

SYSTEM 15® DWV

A cost-effective "workhorse" designed for low-rise, light commercial and underground applications.

Chapter 14 WATER PIPING

MANUFACTURER/DISTRIBUTOR:

WOLSELEY Inc.
4200, Hickmore
St-Laurent, QC, H4T 1K2
Phone: (514) 344-9378
Fax : (514) 344-9341

14.1 **DRINKABLE WATER PIPING PVC SCH80**

14.2 **PROCESSING PIPINC CPVC SCH80**

NOTE: ALL PIPE & FITTINGS SCH. 80 SOCKET WELD

CORZAN®

Submittal Data Sheet

Job or Customer:

Engineer:

Contractor:

Submitted by:

Date

Approved by:

Date

Order No:

Date

Specification:

SHOP DRAWING

This review is solely for the verification of general design quality and does not alleviate the responsibility of the contractor for insuring that all specification, space and installation requirements are met.

Reviewed By: M.M. Reviewed ☒
Reviewed as noted ☐
Date: 19 Mar 2015 Resubmit ☐

CHIARELLI ENGINEERING LTD.

introduction

< STANDARDS >

ASTM D1784
ASTM F441
ASTM F439
ASTM F437
ASTM F1970

CAN/ULC
S102.2

CPVC has physical properties similar to those of PVC and chemical resistance similar to or generally better than that of PVC. The design stress of CPVC is also 2,000psi at 73°F (23°C). The maximum service temperature is 200°F (93°C) under pressure with occasional exposure to boiling water (212°F, 100°C). CPVC has proved to be an excellent piping material for hot corrosive liquids, hot and cold water distribution and similar applications above the temperature range of PVC.

NSF 14
NSF 61

CSA B137.6

Please see our listing on agency websites for NSF and CSA compliant fittings.

www.nsf.org
www.CSAgroup.org

Shop Drawings
Contractor Approval
Approved by: J.D., G.F.
Date: 12/03/15
SIFEC NORTH INC

IPEX

88/665

CORZAN®

Submittal Data Sheet

material properties

Properties	CPVC	CPVC (High Impact)	Standards
Cell classification	23447	24448	ASTM D1784
Specific gravity	1.5	1.51	ASTM D792
Tensile strength, psi at 73°F	7,500	7,320	ASTM D638
Modulus of elasticity tensile, psi at 73°F	380,000	423,000	ASTM D638
Flexural strength, psi	11,400	13,200	ASTM D790
Izod impact, ft.lbs./in. at 73°F, notched	2.0	10.0	ASTM D256
Compressive strength, psi	10,100	10,100	ASTM D695
Poisson's ratio	0.33	0.33	
Working stress, psi at 73°F	2,000	2,000	
Coefficient of thermal expansion in./in./°F (x 10^{-5})	3.8	3.4	ASTM D696
Linear expansion, in./10°F per 100' of pipe	0.44 - 0.46	0.41	
Maximum operating temperature under pressure	200ºF (93ºC)	200ºF (93ºC)	
Deflection temperature under load, °F at 66 psi	n/a	n/a	ASTM D648
Deflection temperature under load, °F at 264 psi	212	239	ASTM D648
Thermal conductivity, BTU.in./hr.ft^2.°F	0.95	0.95	ASTM C177
Burning rate	Self extinguish	Self extinguish	ASTM D635
Burning class	V-0	V-0	UL-94
Flash ignition, °F	900	900	
Limited oxygen index (%)	60	60	ASTM D2863-70
Water absorption, %, (24 hrs. at 73°F)	0.03	0.03	ASTM D570

pipe availability

Pipe Size

Schedule 40 Grey	Schedule 80 Grey
1/2" - 16"	1/2" - 16"

SHOP DRAWING

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Reviewed By: M.M. — Reviewed ☒

Reviewed as noted ☐

Date: 19 Mar 2015 — Resubmit ☐

CHIARELLI ENGINEERING LTD.

CORZAN®

Submittal Data Sheet

molded fittings availability

Fittings	Size (inches) Schedule 80
Tee (Soc)	1/4" - 12"
Reducing Tee (Soc)	3/4" - 10" x 3/4" - 10" x 1/2" - 6"
Tee (Soc x Soc x Fpt)	1/2" - 2"
Tee (Fpt)	1/4" - 4"
90° Elbow (Soc)	1/4" - 12"
90° Elbow (Soc x Fpt)	1/4" - 2"
90° Elbow (Fpt)	1/4" - 4"
45° Elbow (Soc)	1/4" - 12"
45° Elbow (Fpt)	1/4" - 4"
22-1/2° Elbow (Soc)	2" - 4"
11-1/4° Elbow (Soc)	2" - 4"
30° Elbow (Soc)	6"
Cross (Soc)	1/4" - 4"
Coupling (Fpt)	1/4" - 4"
Coupling (Soc)	1/4" - 8"
Reducer Coupling (Soc)	3/4" - 8' x 1/2" - 6"
Female Adapter (Soc x Fpt)	1/4" - 4"
Female Adapter (Soc x Fpt SS Reinforced)	1/2" - 4"
Female Adapter (Spig x Fpt SS Reinforced)	1/2" - 4"
Male Adapter (Soc x Mpt)	1/2" - 4"
Reducer Bushing (Spig x Soc)	3/8" - 8" x 1/4" - 6"
Reducer Bushing (Spig x Fpt)	3/8" - 6" x 1/4" - 4"
Reducer Bushing (Mpt x Fpt)	3/8" - 4" x 1/4" 3"
Cap (Soc)	1/4" - 8"
Cap (Fpt)	1/4" - 4"
Plug (Mpt)	1/4" - 4"
Wye (Soc)	1/2" - 2"

SHOP DRAWING

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Reviewed By: M.M. Reviewed ☒
Reviewed as noted ☐
Date: 19 Mar 2015 Resubmit ☐

CHIARELLI ENGINEERING LTD.

CORZAN®

Submittal Data Sheet

fabricated fittings availability

Fittings	Size (inches) Schedule 80
Fabricated Tee (Soc)	14" - 16"
Fabricated Reducing Tee (Soc)	12" x 12" x 8"
Fabricated 90° Elbow (Soc)	14" - 16"
Fabricated 45° Elbow (Soc)	14" - 16"
Fabricated Coupling (Soc)	10" - 16"
Fabricated Reducer Bushing (Spig x Soc)	10" - 12" x 6" - 10"
Fabricated Cap (Soc)	10" - 16"
Fabricated Vanstone Flange (Soc)	14" - 16"
Blind Flange	10" - 12"
Heavy Duty Vanstone Flange (Soc)	16"
Vanstone Flange (Spig)	10" - 12"
Nipples	1/4" - 4"
Expansion Joints	1/2" - 4"

ASTM F1970 fittings availability

Fittings	Size (inches) Schedule 80
One Piece Flange (Soc)	1/2" - 8"
One Piece Flange (Fpt)	1/2" - 4"
Blind Flange	1/2" - 8"
Heavy Duty Vanstone Flange (Soc)	1/2" - 12"
Vanstone Flange (Fpt)	1/2" - 4"
Vanstone Flange (Spig)	1/2" - 8"
Union (Soc)	1/4" - 4"
Union (Fpt)	1/4" - 4"

SHOP DRAWING

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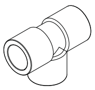
Reviewed By: M.M. Reviewed ☒
Reviewed as noted ☐
Date: 19 Mar 2015 Resubmit ☐

CHIARELLI ENGINEERING LTD.

IPEX 91/665

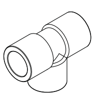
PRODUCT SELECTION CHART - XIRTEC 140 PVC SCH. 80 & CORZAN CPVC SCH. 80 FITTINGS

Tee Soc x Soc x Soc



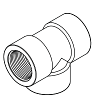
Dimension inches	Dimension mm	PVC Sch 80 Product Code	CPVC Sch 80 Product Code
1/4	6	036768	059479
3/8	9	036769	059480
1/2	12	036770	059481
3/4	20	036771	059482
1	25	036772	059483
1-1/4	32	036773	059484
1-1/2	40	036774	059485
2	50	036775	059486
2-1/2	65	036776	059487
3	75	036777	059488
4	100	036778	059489
6	150	036780	059490
8	200	036781	059491
10	250	036866 ▮	059062 ▮
12	300	036876 ▮	059084 ▮
10	250	036782 †	-
12	300	036783 †	-
14	350	036784 †	-
16	400	036785 †	-
18	450	036126 †	-

Tee Soc x Soc x Fpt



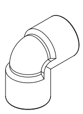
Dimension inches	Dimension mm	PVC Sch 80 Product Code	CPVC Sch 80 Product Code
1/2	12	036828	059942
3/4	20	036829	059943
1	25	036830	059518
2	50	036832	-

Tee Fpt x Fpt x Fpt



Dimension inches	Dimension mm	PVC Sch 80 Product Code	CPVC Sch 80 Product Code
1/4	6	036817	059507
3/8	9	036818	059508
1/2	12	036819	059509
3/4	20	036820	059510
1	25	036821	059511
1-1/4	32	036822	059512
1-1/2	40	036823	059513
2	50	036824	059514
2-1/2	65	036825	059515
3	75	036826	059516
4	100	036827	059517

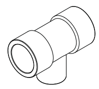
90° Elbow Fpt x Fpt



Dimension inches	Dimension mm	PVC Sch 80 Product Code	CPVC Sch 80 Product Code
1/4	6	036197	059206
3/8	9	036198	059207
1/2	12	036199	059208
3/4	20	036200	059209
1	25	036201	059210
1-1/4	32	036202	059211
1-1/2	40	036203	059212
2	50	036204	059213
2-1/2	65	036205	059214
3	75	036206	059215
4	100	036207	059216

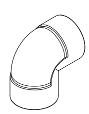
▮,†,◗ See page 5 for descriptions

Reducing Tee Soc x Soc x Soc



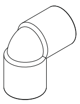
Dimension inches	Dimension mm	PVC Sch 80 Product Code	CPVC Sch 80 Product Code
3/4 x 3/4 x 1/2	20 x 20 x 12	036786	059492
1 x 3/4 x 3/4	25 x 20 x 20	036790	-
1 x 3/4 x 1	25 x 20 x 25	036791	059493
1 x 1 x 1/2	25 x 25 x 12	036788	059494
1 x 1 x 3/4	25 x 25 x 20	036789	-
1-1/4 x 1 x 3/4	32 x 25 x 20	036792	-
1-1/4 x 1 x 1-1/4	32 x 32 x 25	-	059495
1-1/4 x 1-1/4 x 3/4	32 x 32 x 20	036793	-
1-1/4 x 1-1/4 x 1	32 x 32 x 25	036794	-
1-1/2 x 1-1/2 x 3/4	40 x 40 x 20	036795	059496
1-1/2 x 1-1/2 x 1	40 x 40 x 25	036796	059497
2 x 2 x 1/2	50 x 50 x 12	036797	059498
2 x 2 x 3/4	50 x 50 x 20	036798	059499
2 x 2 x 1	50 x 50 x 25	036799	059500
2 x 2 x 1-1/2	50 x 50 x 40	036800	059501
3 x 3 x 2	75 x 75 x 50	036802	059502
3 x 3 x 2-1/2	75 x 75 x 65	036803	059504
4 x 4 x 2	100 x 100 x 50	036804	059505
4 x 4 x 3	150 x 100 x 75	036805	-
6 x 6 x 3	150 x 150 x 75	036807	-
6 x 6 x 4	150 x 150 x 100	036808 †	059506
8 x 8 x 4	200 x 200 x 100	036809	-
8 x 8 x 6	200 x 200 x 150	036810 †	059567
10 x 10 x 4	250 x 250 x 100	036919 †	-
10 x 10 x 6	250 x 250 x 150	036812 †	-
10 x 10 x 8	250 x 250 x 200	036813 †	-
12 x 12 x 8	300 x 300 x 200	036814 †	-
12 x 12 x 10	300 x 300 x 250	036815 †	-
14 x 14 x 10	350 x 350 x 250	036816 †	-
14 x 14 x 12	350 x 350 x 300	- †	-
16 x 16 x 12	400 x 400 x 300	- †	-
16 x 16 x 14	400 x 400 x 350	-	-

90° Elbow Soc x Soc



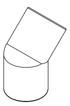
Dimension inches	Dimension mm	PVC Sch 80 Product Code	CPVC Sch 80 Product Code
1/4	6	036179	059192
3/8	9	036180	059193
1/2	12	036181	059194
3/4	20	036182	059195
1	25	036183	059196
1-1/4	32	036184	059197
1-1/2	40	036185	059198
2	50	036186	059199
2-1/2	65	036187	059200
3	75	036188	059201
4	100	036189	059202
6	150	036191	059203
8	200	036192	059204
10	250	036864 ▮	059085 ▮
12	300	036865 ▮	059086 ▮
10	250	036193 †	-
12	300	036194 †	-
14	350	036195 †	-
16	400	036196 †	-
18	450	036132 †	-

90° Elbow Soc x Fpt



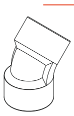
Dimension inches	mm	PVC Sch 80 Product Code	CPVC Sch 80 Product Code
1/2	12	036172	059187
3/4	20	036173	059941
1	25	036174	059188
1-1/4	32	036175	059189
1-1/2	40	036176	059190
2	50	036177	059191

45° Elbow Soc x Soc



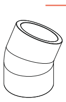
Dimension inches	mm	PVC Sch 80 Product Code	CPVC Sch 80 Product Code
1/4	6	036142	059162
3/8	9	036143	059163
1/2	12	036144	059164
3/4	20	036145	059165
1	25	036146	059166
1-1/4	32	036147	059167
1-1/2	40	036148	059168
2	50	036149	059169
2-1/2	65	036150	059170
3	75	036151	059171
4	100	036152	059172
6	150	036154	059173
8	200	036155	059174
10	250	036862 ▮	059087 ▮
12	300	036863 ▮	059088 ▮
10	250	036156 †	-
12	300	036157 †	-
14	350	036158 †	-
16	400	036159 †	-

45° Elbow Fpt x Fpt



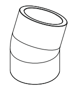
Dimension inches	mm	PVC Sch 80 Product Code	CPVC Sch 80 Product Code
1/4	6	036160	059176
3/8	9	036161	059177
1/2	12	036162	059178
3/4	20	036163	059179
1	25	036164	059180
1-1/4	32	036165	059181
1-1/2	40	036166	059182
2	50	036167	059183
2-1/2	65	036168	059184
3	75	036169	059185
4	100	036170	059186

30° Elbow Soc x Soc



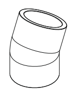
Dimension inches	mm	PVC Sch 80 Product Code	CPVC Sch 80 Product Code
6	150	236003	059022

22-1/2° Elbow Soc x Soc



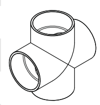
Dimension inches	mm	PVC Sch 80 Product Code	CPVC Sch 80 Product Code
2	50	036134	059614
3	75	036135	059615
4	100	036136	059616
6	150	036137 †	-
8	200	036138 †	-
10	250	036139 †	-
12	300	036140 †	-

11-1/4° Elbow Soc x Soc



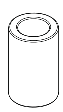
Dimension inches	mm	PVC Sch 80 Product Code	CPVC Sch 80 Product Code
2	50	-	059617
3	75	-	059618
4	100	-	059619

Cross Soc x Soc x Soc x Soc



Dimension inches	mm	PVC Sch 80 Product Code	CPVC Sch 80 Product Code
1/4	6	-	059620
1/2	12	036116	059154
3/4	20	036117	059155
1	25	036118	059156
1-1/4	32	036119	059157
1-1/2	40	036120	059158
2	50	036121	059159
2-1/2	65	036122	059018
3	75	036123	059160
4	100	036124	059161
6	150	036125 †	-

Coupling Soc x Soc

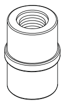


Dimension inches	mm	PVC Sch 80 Product Code	CPVC Sch 80 Product Code
1/4	6	036088	059130
3/8	9	036089	059131
1/2	12	036090	059132
3/4	20	036091	059133
1	25	036092	059134
1-1/4	32	036093	059135
1-1/2	40	036094	059136
2	50	036095	059137
2-1/2	65	036096	059138
3	75	036097	059139
4	100	036098	059140
6	150	036099	059141
8	200	036100	059142
10	250	036101 †	059033 †
12	300	036102 †	059043 †
14	350	036103 †	-
16	400	036889 †	-

▮,†,◗ See page 5 for descriptions

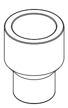
Dimension inches	Dimension mm	PVC Sch 80 Product Code	CPVC Sch 80 Product Code

Coupling Fpt x Fpt



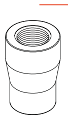
inches	mm	PVC Sch 80 Product Code	CPVC Sch 80 Product Code
1/4	6	036104	059143
3/8	9	036105	059144
1/2	12	036106	059145
3/4	20	036107	059146
1	25	036108	059147
1-1/4	32	036109	059148
1-1/2	40	036110	059149
2	50	036111	059150
2-1/2	65	036112	059151
3	75	036113	059152
4	100	036114	059153

Reducer Coupling Soc x Soc



inches	mm	PVC Sch 80 Product Code	CPVC Sch 80 Product Code
3/4 x 1/2	20 x 12	036719	059460
1 x 1/2	25 x 12	036720	059461
1 x 3/4	25 x 20	036721	059462
1-1/4 x 3/4	32 x 20	036723	-
1-1/4 x 1	32 x 25	036724	059463
1-1/2 x 1/2	40 x 12	036725	-
1-1/2 x 3/4	40 x 20	036726	059464
1-1/2 x 1	40 x 25	036727	059465
1-1/2 x 1-1/4	40 x 32	036728	059466
2 x 1/2	50 x 12	036897	-
2 x 1	50 x 25	036729	059467
2 x 1-1/2	50 x 40	036731	059458
3 x 2	75 x 50	036735	059470
4 x 2	100 x 50	036736	059459
4 x 3	100 x 75	036738	059472
6 x 4	150 x 100	036740	059471
8 x 6	200 x 150	036743	059473

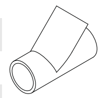
Reducer Coupling Fpt x Fpt



inches	mm	PVC Sch 80 Product Code	CPVC Sch 80 Product Code
1/2 x 1/4	12 x 6	036746	-
3/4 x 1/2	20 x 12	036748	-
1 x 1/2	25 x 12	036749	-
1 x 3/4	25 x 20	036750	-
1-1/4 x 3/4	32 x 20	036751	-
1-1/2 x 1	40 x 25	036754	-
2 x 1-1/2	50 x 40	036758	-

Dimension inches	Dimension mm	PVC Sch 80 Product Code	CPVC Sch 80 Product Code

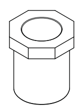
45° Wye Soc x Soc x Soc



inches	mm	PVC Sch 80 Product Code	CPVC Sch 80 Product Code
1-1/2	40	036854 ▮	059553. ▮
2	50	036855 ▮	059536 ▮
3	75	036856 ▮	059537 ▮
4	100	036857 ▮	059538 ▮
6	150	036858 ▮	059539 ▮
6 x 4	150 x 100	036861 ▮	059541 ▮
8	200	036859 †	-
8 x 6	200 x 150	036884 †	-

1/2" - 2" - 235 psi maximum internal pressure rating @ 73°F
(12 - 50mm - 1 620 kPa maximum internal pressure rating @ 23°C)
3" - 6" - 150 psi maximum internal pressure rating @ 73°F
(75 - 150mm - 1 034 kPa maximum internal pressure rating @ 23°C)

Reducer Bushing Spig x Soc (flushstyle)



inches	mm	PVC Sch 80 Product Code	CPVC Sch 80 Product Code
3/8 x 1/4	9 x 6	036599	-
1/2 x 1/4	12 x 6	036600	059373
1/2 x 3/8	12 x 9	036601	059374
3/4 x 1/2	20 x 12	036604	059375
1 x 1/2	25 x 12	036605	059376
1 x 3/4	25 x 20	036606	059377
1-1/4 x 1/2	32 x 12	036607	059378
1-1/4 x 3/4	32 x 20	036608	059379
1-1/4 x 1	32 x 25	036609	059380
1- 1/2 x 1/2	40 x 12	036610	059381
1- 1/2 x 3/4	40 x 20	036611	059382
1-1/2 x 1	40 x 25	036612	059383
1-1/2 x 1-1/4	40 x 32	036613	059384
2 x 1/2	50 x 12	036614	059385
2 x 3/4	50 x 20	036615	059386
2 x 1	50 x 25	036616	059387
2 x 1-1/4	50 x 32	036617	059388
2 x 1-1/2	50 x 40	036618	059389
2 -1/2 x 1-1/4	65 x 32	036620	-
2-1/2 x 1-1/2	65 x 40	036621	-
2-1/2 x 2	65 x 50	036622	059392
3 x 1	75 x 25	036623	-
3 x 1-1/2	75 x 40	036624	059393
3 x 2	75 x 50	036625	059394
3 x 2-1/2	75 x 65	036626	059395
4 x 2	100 x 50	036628	059396
4 x 3	100 x 75	036630	059397
6 x 2	150 x 50	036632	059398
6 x 3	150 x 75	036633	059399
6 x 4	150 x 100	036634	059400
8 x 6	200 x 150	036638	059401
10 x 6	250 x 150	036922 †	-
10 x 8	250 x 200	036270 †	-
12 x 10	300 x 250	036208 †	-
12 x 6	300 x 150	036908	-
12 x 8	300 x 200	036645	-

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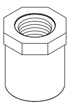
▮,†,◗ See page 5 for descriptions

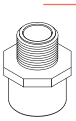
PRODUCT SELECTION CHART - XIRTEC 140 PVC SCH. 80 & CORZAN CPVC SCH. 80 FITTINGS

Reducer Bushing Spig x Fpt (flushstyle)



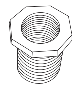
Dimension inches	mm	PVC Sch 80 Product Code	CPVC Sch 80 Product Code
3/8 x 1/4	9 x 6	036679	-
1/2 x 1/4	12 x 6	036681	059428
1/2 x 3/8	12 x 9	036682	059429
3/4 x 1/4	20 x 6	036683	059430
3/4 x 1/2	20 x 12	036684	059431
1 x 3/8	25 x 9	036685	-
1 x 1/2	25 x 12	036686	059432
1 x 3/4	25 x 20	036687	059433
1-1/4 x 1/2	32 x 12	036688	059434
1-1/4 x 3/4	32 x 20	036689	059435
1-1/4 x 1	32 x 25	036690	059436
1-1/2 x 1/2	40 x 12	036691	059437
1-1/2 x 3/4	40 x 20	036692	059438
1-1/2 x 1	40 x 25	036693	059439
1-1/2 x 1-1/4	40 x 32	036694	059440
2 x 1/2	50 x 12	036695	059441
2 x 3/4	50 x 20	036696	059442
2 x 1	50 x 25	036697	059443
2 x 1-1/4	50 x 32	036698	059444
2 x 1-1/2	50 x 40	036699	059445
2-1/2 x 3/4	65 x 20	036700	059446
2-1/2 x 1	65 x 25	036701	059447
2-1/2 x 1-1/4	65 x 32	036702	059448
2-1/2 x 1-1/2	65 x 40	036703	059449
2-1/2 x 2	65 x 50	036704	059450
3 x 3/4	75 x 20	036705	-
3 x 1	75 x 25	036706	059547
3 x 1-1/4	75 x 32	036707	-
3 x 1-1/2	75 x 40	036708	059451
3 x 2	75 x 50	036709	059452
3 x 2-1/2	75 x 65	036710	059453
4 x 2	100 x 50	036711	059454
4 x 2-1/2	100 x 65	036712	059640
4 x 3	100 x 75	036713	059455
6 x 2	150 x 50	036714	-
6 x 3	150 x 75	036715	059641
6 x 4	150 x 100	036716	059456

Male Adapter Soc x Mpt



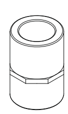
Dimension inches	mm	PVC Sch 80 Product Code	CPVC Sch 80 Product Code
1/2	12	036420	059286
3/4	20	036421	059287
1	25	036422	059288
1-1/4	32	036423	059289
1-1/2	40	036424	059290
2	50	036425	059291
2-1/2	65	036426	059292
3	75	036427	059293
4	100	036428	059294
6	150	036887 †	-

T T Bushing Mpt x Fpt (flushstyle)



Dimension inches	mm	PVC Sch 80 Product Code	CPVC Sch 80 Product Code
3/8 x 1/4	9 x 6	036647	059402
1/2 x 1/4	12 x 6	036648	059403
1/2 x 3/8	12 x 9	036649	059404
3/4 x 1/4	20 x 6	036651	059405
3/4 x 3/8	20 x 9	036652	059406
3/4 x 1/2	20 x 12	036653	059407
1 x 1/4	25 x 6	036654	059643
1 x 3/8	25 x 9	036655	-
1 x 1/2	25 x 12	036656	059408
1 x 3/4	25 x 20	036657	059409
1-1/4 x 1/2	32 x 12	036658	059410
1-1/4 x 3/4	32 x 20	036659	059411
1-1/4 x 1	32 x 25	036660	059412
1-1/2 x 1/2	40 x 12	036661	059413
1-1/2 x 3/4	40 x 20	036662	059414
1-1/2 x 1	40 x 25	036663	059415
1-1/2 x 1-1/4	40 x 32	036664	059416
2 x 1/2	50 x 12	036665	059417
2 x 3/4	50 x 20	036666	059418
2 x 1	50 x 25	036667	059419
2 x 1-1/4	50 x 32	036668	059420
2 x 1-1/2	50 x 40	036669	059421
2-1/2 x 2	65 x 50	036672	059422
3 x 1-1/2	75 x 40	036673	059423
3 x 2	75 x 50	036674	059424
3 x 2-1/2	75 x 65	036675	059425
4 x 2	100 x 50	036676	059426
4 x 3	100 x 75	036677	059427

Female Adapter Soc x Fpt

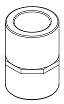


Dimension inches	mm	PVC Sch 80 Product Code	CPVC Sch 80 Product Code
1/4	6	036209	059217
3/8	9	036210	059218
1/2	12	036211	059219
3/4	20	036212	059220
1	25	036213	059221
1-1/4	32	036214	059222
1-1/2	40	036215	059223
2	50	036216	059224
2-1/2	65	036217	059225
3	75	036218	059226
4	100	036219	059227
6	150	036221 †	-

▮,†,◗ See page 5 for descriptions

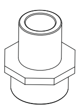
Dimension inches	mm	PVC Sch 80 Product Code	CPVC Sch 80 Product Code

Female Adapter Soc x Fpt (SS reinforced)



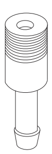
inches	mm	PVC Sch 80 Product Code	CPVC Sch 80 Product Code
1/2	12	036971	059951
3/4	20	036972	059952
1	25	036973	059953
1-1/4	32	036974	059954
1-1/2	40	036975	059955
2	50	036976	059956
2-1/2	65	036977	059646
3	75	036978	059957
4	100	036979	059958

Female Adapter Spig x Fpt (SS reinforced)



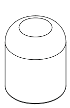
inches	mm	PVC Sch 80 Product Code	CPVC Sch 80 Product Code
1/2	12	036965	059945
3/4	20	036966	059946
1	25	036967	059947
1-1/4	32	036968	059948
1-1/2	40	036969	059949
2	50	036970	059950
3	75	236000	059647
4	100	236001	059648

Hose Adapter Hose x Mpt



inches	mm	PVC Sch 80 Product Code	CPVC Sch 80 Product Code
1/4	6	036394 †	-
3/8	9	036395 †	-
1/2	12	036396 †	-
3/4	20	036397 †	-
1	25	036398 †	-
1 1/4	32	036399 †	-
1 1/2	40	036400 †	-
2	50	036401 †	-
2 1/2	65	036402 †	-
3	75	036403 †	-
4	100	036404 †	-

Cap Soc

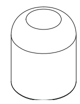


inches	mm	PVC Sch 80 Product Code	CPVC Sch 80 Product Code
1/4	6	036056	059107
3/8	9	.036057	059108
1/2	12	036058	059109
3/4	20	036059	059110
1	25	036060	059111
1-1/4	32	036061	059112
1-1/2	40	036062	059113
2	50	036063	059114
2-1/2	65	036064	059115
3	75	036065	059116
4	100	036066	059117
6	150	036067	059118
8	200	036068	059029
10	250	036069 †	-
12	300	036070 †	-
14	350	- †	-
16	400	036071 †	-

▮,†,◗ See page 5 for descriptions

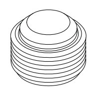
Dimension inches	mm	PVC Sch 80 Product Code	CPVC Sch 80 Product Code

Cap Fpt



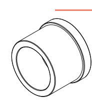
inches	mm	PVC Sch 80 Product Code	CPVC Sch 80 Product Code
1/4	6	036072	059119
3/8	9	036073	059120
1/2	12	036074	059121
3/4	20	036075	059122
1	25	036076	059123
1-1/4	32	036077	059124
1-1/2	40	036078	059125
2	50	036079	059126
2-1/2	65	036080	059127
3	75	036081	059128
4	100	036082	059129

Plug Mpt



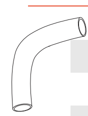
inches	mm	PVC Sch 80 Product Code	CPVC Sch 80 Product Code
1/4	6	036568	059361
3/8	9	036569	059362
1/2	12	036570	059363
3/4	20	036571	059364
1	25	036572	059365
1-1/4	32	036573	059366
1-1/2	40	036574	059367
2	50	036575	059368
2-1/2	65	036576	059369
3	75	036577	059370
4	100	036578	059371
6	150	036579	-

Plug Spig



inches	mm	PVC Sch 80 Product Code	CPVC Sch 80 Product Code
2	50	036585	-

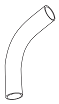
90° Radius Bends - 6D Spig x Spig



inches	mm	PVC Sch 80 Product Code	CPVC Sch 80 Product Code
1/2	12	- †	-
3/4	20	036027 †	-
1	25	036028 †	-
1-1/4	32	036029 †	-
1-1/2	40	036030 †	-
2	50	036031 †	-
2-1/2	65	036032 †	-
3	75	036033 †	-
4	100	036034 †	-
6	150	036035 †	-
8	200	036036 †	-
10	250	036868 †	-
12	300	- †	-

PRODUCT SELECTION CHART - XIRTEC 140 PVC SCH. 80 & CORZAN CPVC SCH. 80 FITTINGS

45° Radius Bends - 6D Spig x Spig

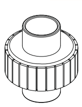


Dimension inches	mm	PVC Sch 80 Product Code	CPVC Sch 80 Product Code
1/2	12	- †	
3/4	20	036020 †	
1	25	036021 †	
1-1/4	32	- †	
1-1/2	40	036022 †	
2	50	036023 †	
2-1/2	65	036867 †	
3	75	036024 †	
4	100	036025 †	
6	150	036026 †	
8	200	- †	
10	250	- †	
12	300	- †	

22-1/2° Radius Bends - 6D Spig x Spig

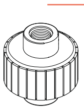
Dimension inches	mm	PVC Sch 80 Product Code	CPVC Sch 80 Product Code
1/2	12	036012 †	-
3/4	20	- †	-
1	25	036013 †	-
1-1/4	32	- †	-
1-1/2	40	- †	-
2	50	036014 †	-
2-1/2	65	036015 †	-
3	75	036016 †	-
4	100	036017 †	-
6	150	036018 †	-
8	200	036019 †	-
10	250	- †	-
12	300	- †	-

Union Soc x Soc (Viton® O-ring Seal)



Dimension inches	mm	PVC Sch 80 Product Code	CPVC Sch 80 Product Code
1/4	6	036833	059519
3/8	9	036834	-
1/2	12	036835	059520
3/4	20	036836	059521
1	25	036837	059522
1-1/4	32	036838	059523
1-1/2	40	036839	059524
2	50	036840	059525
3	75	036842	059526
4	100	036843	059550

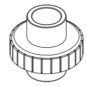
Union Fpt x Fpt (Viton® O-ring Seal)



Dimension inches	mm	PVC Sch 80 Product Code	CPVC Sch 80 Product Code
1/4	6	036844	059527
3/8	9	036845	-
1/2	12	036846	059529
3/4	20	036847	059530
1	25	036848	059531
1-1/4	32	036849	059532
1-1/2	40	036850	059533
2	50	036851	059534
3	75	036852	059535
4	100	036853	059651

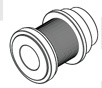
▮,†,◗ See page 5 for descriptions

Union Soc x Fpt (Viton® O-ring Seal)



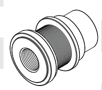
Dimension inches	mm	PVC Sch 80 Product Code	CPVC Sch 80 Product Code
1/2	12	036410	-
3/4	20	036411	-
1	25	036412	-
1-1/4	32	036413	-
1-1/2	40	036414	-
2	50	036415	-
3	75	236010	-
4	100	236011	-

Tank Adapter Soc x Fpt



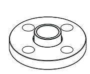
Dimension inches	mm	PVC Sch 80 Product Code	CPVC Sch 80 Product Code
1/2	12	036038	059100
3/4	20	036039	059101
1	25	036040	059102
1-1/4	32	036041	-
1-1/2	40	036042	059103
2	50	036043	059104
3	75	036045	059105
4	100	036046	059106
6	150	- †	-

Tank Adapter Fpt x Fpt



Dimension inches	mm	PVC Sch 80 Product Code	CPVC Sch 80 Product Code
1/2	12	036047	-
3/4	20	036048	-
1	25	036049	-
1-1/4	32	036050	-
1-1/2	40	036051	-
2	50	036052	-
3	75	036054	-
4	100	036055	-
6	150	- †	-

Flange Soc (solid style)



Dimension inches	mm	PVC Sch 80 Product Code	CPVC Sch 80 Product Code
1/2	12	036223	059228
3/4	20	036224	059229
1	25	036225	059230
1-1/4	32	036226	059231
1-1/2	40	036227	059232
2	50	036228	059233
2-1/2	65	036229	059234
3	75	036230	059235
4	100	036231	059236
5	125	036232	-
6	150	036233	059238
8	200	036234	059239
10	250	036235 †	-
12	300	036236 †	-
14	350	036237 †	-
16	400	036238 †	-
18	450	036870 †	-
20	500	- †	-
24	600	036239 †	

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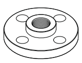
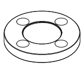
Flange Fpt (solid style)



Dimension inches	mm	PVC Sch 80 Product Code	CPVC Sch 80 Product Code
1/2	12	036240	059240
3/4	20	036241	059241
1	25	036242	059242
1-1/4	32	036243	059243
1-1/2	40	036244	059244
2	50	036245	059245
2-1/2	65	036246	059246
3	75	036247	059247
4	100	036248	059248
6	150	036249	059249

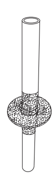
Flange Blind



Dimension inches	mm	PVC Sch 80 Product Code	CPVC Sch 80 Product Code
1/2	12	036250	059250
3/4	20	036251	059251
1	25	036252	059252
1-1/4	32	036253	059253
1-1/2	40	036254	059254
2	50	036255	059255
2-1/2	65	036256	059256
3	75	036257	059257
4	100	036258	059258
6	150	036259	059259
8	200	036260	059260
10	250	036261 †	-
12	300	036262 †	-
14	350	036263 † ◆	-
16	400	036264 † ◆	-
18	450	036265 † ◆	-
20	500	- † ◆	-
24	600	036266 † ◆	-

◆ Domed flange

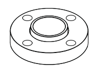
No-Leak Flange Spig x Spig



Dimension inches	mm	PVC Sch 80 Product Code	CPVC Sch 80 Product Code
1/2	12	036331 †	-
3/4	20	036332 †	-
1	25	036923 †	-
1-1/4	32	036333 †	-
1-1/2	40	036334 †	-
2	50	036335 †	-
2-1/2	65	036336 †	-
3	75	036337 †	-
4	100	036338 †	-
6	150	036339 †	-
8	200	036340 †	-
10	250	036341 †	-
12	300	036342 †	-
14	350	036915 †	-
16	400	036343 †	-
18	450	036871 †	-
20	500	- †	-
24	600	036924 †	-

▮,†,◗ See page 5 for descriptions

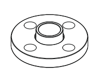
Heavy Duty Vanstone Flange Soc w Fibre-Loc Ring



Dimension inches	mm	PVC Sch 80 Product Code	CPVC Sch 80 Product Code
1/2	12	-	059262
3/4	20	-	059263
1	25	-	059264
1-1/4	32	-	059265
1-1/2	40	036323	059266
2	50	036324	059267
2-1/2	65	-	059268
3	75	036326	059269
4	100	036416	059270
6	150	036417	059271
8	200	036418	059272
10	250	036419 †	059273
12	300	036429 †	059569
14	350	036358 † ▼	-
16	400	036359 † ▼	-

▼ Molded hub, c/w coated metal rings

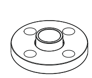
Vanstone Flange Soc w PVC Ring



Dimension inches	mm	PVC Sch 80 Product Code	CPVC Sch 80 Product Code
1/2	12	036344	-
3/4	20	036345	-
1	25	036346	-
1-1/4	32	036347	-
1-1/2	40	036348	-
2	50	036349	-
2-1/2	65	036350	-
3	75	036351	-
4	100	036352	-
5	125	036353	-
6	150	036354	-
8	200	036355	-
10	250	036356 ▼	-
12	300	036357 ▼	-

▼ Molded hub, c/w coated metal rings

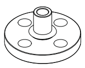
Vanstone Flange Soc w Steel Ring



Dimension inches	mm	PVC Sch 80 Product Code	CPVC Sch 80 Product Code
18	450	036947 †	-
20	500	036913 †	-
24	600	036914 †	-

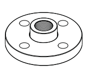
Note: these flanges are rated at 50 psi (345 kPa) maximum operating

Vanstone Flange Spig



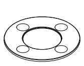
Dimension inches	mm	PVC Sch 80 Product Code	CPVC Sch 80 Product Code
1/2	12	036374	059274
3/4	20	036375	059275
1	25	036376	059276
1-1/4	32	036377	059277
1-1/2	40	036378	059278
2	50	036379	059279
2-1/2	65	036380	059280
3	75	036381	059281
4	100	036382	059282
6	150	036383	059283
8	200	036384	059570
10	250	036321 †	-
12	300	036406 †	-

Vanstone Flange Fpt



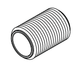
Dimension inches	mm	PVC Sch 80 Product Code	CPVC Sch 80 Product Code
1/2	12	036385	059656
3/4	20	036386	059657
1	25	036387	059658
1-1/4	32	036388	059284
1-1/2	40	036389	059659
2	50	036390	059660
2-1/2	65	036391	059661
3	75	036392	059285
4	100	036393	059662

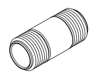
1/8" Flange Gasket Neoprene



Dimension inches	mm	PVC Sch 80 Product Code	CPVC Sch 80 Product Code
1/2	12	036296	-
3/4	20	036297	-
1	25	036298	-
1-1/4	32	036299	-
1-1/2	40	036300	-
2	50	036301	-
2-1/2	65	036302	-
3	75	036303	-
4	100	036304	-
5	125	036305	-
6	150	036306	-
8	200	036307	-
10	250	036308	-
12	300	036309	-
14	350	036310	-
16	400	036311	-
18	450	036312	-
20	500	036313	-
24	600	036314	-

Nipples





1/4" (6mm) diameter

Dimension inches	mm	PVC Sch 80 Product Code	CPVC Sch 80 Product Code
7/8 close	22	036434	059296
1-1/2	40	036445	059306
2	50	036456	059316
2-1/2	65	036457	-
3	75	036458	059317
3 1/2	90	036459	-
4	100	036460	059318
4-1/2	115	036461	-
5	125	036462	059319
6	150	036463	059320
8	200	036464	-
10	250	236012	-
12	300	236013	-

3/8" (9mm) diameter

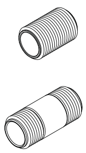
Dimension inches	mm	PVC Sch 80 Product Code	CPVC Sch 80 Product Code
1 close	25	036435	059551
1-1/2	40	036446	059307
2	50	036466	059552
2-1/2	65	036467	-
3	75	036468	059939
3-1/2	90	036469	-
4	100	036470	059554
4-1/2	115	036471	-
5	125	036472	-
6	150	036473	-
8	200	036474	-

1/2" (12mm) diameter

Dimension inches	mm	PVC Sch 80 Product Code	CPVC Sch 80 Product Code
1-1/8 close	28	036436	059297
1-1/2	40	036447	059308
2	50	036475	059322
2-1/2	65	036476	-
3	75	036477	059321
3-1/2	90	036478	-
4	100	036479	059324
4-1/2	115	036480	-
5	125	036481	059325
5-1/2	140	036482	-
6	150	036483	059326
8	200	036484	-
10	250	036485	-
12	300	036486	-

▮,†,◗ See page 5 for descriptions

Nipples



3/4" (20mm) diameter

Dimension inches	Dimension mm	PVC Sch 80 Product Code	CPVC Sch 80 Product Code
1-3/8 close	35	036437	059298
1-1/2	40	036448	059309
2	50	036490	059327
2-1/2	65	036491	-
3	75	036492	059328
3-1/2	90	036493	-
4	100	036494	059329
4-1/2	115	036495	-
5	125	036496	059331
5-1/2	140	036497	-
6	150	036498	059332
8	200	036500	-
10	250	036501	-
12	300	036502	-

1" (25mm) diameter

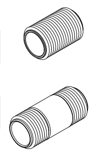
Dimension inches	Dimension mm	PVC Sch 80 Product Code	CPVC Sch 80 Product Code
1-1/2 close	40	036438	059299
2	50	036449	059310
2-1/2	65	036504	-
3	75	036505	059333
3-1/2	90	036506	-
4	100	036507	059334
4-1/2	115	036508	-
5	125	036509	059335
5-1/2	140	036510	-
6	150	036511	059336
8	200	036512	-
10	250	036514	-
12	300	036515	-

1-1/4" (32mm) diameter

Dimension inches	Dimension mm	PVC Sch 80 Product Code	CPVC Sch 80 Product Code
1-5/8 close	41	036439	059300
2	50	036450	059311
2-1/2	65	036516	-
3	75	036517	059338
3-1/2	90	036518	-
4	100	036519	059339
4-1/2	115	036520	-
5	125	036521	059340
6	150	036522	059341
8	200	036523	-
10	250	036524	-
12	300	036525	-

■,†,◗ See page 5 for descriptions

Nipples



1-1/2" (40mm) diameter

Dimension inches	Dimension mm	PVC Sch 80 Product Code	CPVC Sch 80 Product Code
1-3/4 close	45	036440	059301
2	50	036451	059312
2-1/2	65	036526	-
3	75	036527	059342
3-1/2	90	036528	-
4	100	036529	059343
4-1/2	115	036530	-
5	125	036531	059344
5-1/2	140	036532	-
6	150	036533	059345
8	200	036534	-
10	250	036535	-
12	300	036536	-

2" (50mm) diameter

Dimension inches	Dimension mm	PVC Sch 80 Product Code	CPVC Sch 80 Product Code
2 close	50	036441	059302
2-1/2	65	036452	-
3	75	036539	059346
3-1/2	90	036540	-
4	100	036541	059347
4-1/2	115	036542	-
5	125	036543	059348
5-1/2	140	036544	-
6	150	036545	059349
8	200	036546	-
10	250	036547	-
12	300	036548	-

2-1/2" (65mm) diameter

Dimension inches	Dimension mm	PVC Sch 80 Product Code	CPVC Sch 80 Product Code
2-1/2 close	65	036442	059303
3	75	036549	-
4	100	036550	059351
6	150	036551	059352
8	200	036552	-
12	300	036553	-

3" (75mm) diameter

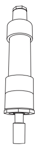
Dimension inches	Dimension mm	PVC Sch 80 Product Code	CPVC Sch 80 Product Code
2-5/8 close	67	036443	059304
3	75	036554	059353
4	100	036555	059354
5	125	036556	059355
6	150	036557	059356
8	200	036558	-
10	250	036559	-
12	300	036560	-

4" (100mm) diameter

Dimension inches	Dimension mm	PVC Sch 80 Product Code	CPVC Sch 80 Product Code
2-7/8 close	72	036444	059305
4	100	036562	-
5	125	036563	-
6	150	036564	059357
8	200	036565	-
10	250	036566	-
12	300	036567	

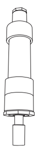
PRODUCT SELECTION CHART - XIRTEC 140 PVC SCH. 80 & CORZAN CPVC SCH. 80 FITTINGS

Expansion Joint 6" (150mm) Travel EPDM



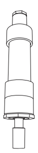
Dimension inches	Dimension mm	PVC Sch 80 Product Code	CPVC Sch 80 Product Code
1/2	12	136115	059973
3/4	20	136117	059975
1	25	136119	059977
1-1/2	40	136121	059979
2	50	136123	059981
3	75	136125	059983
4	100	136127	059985

Expansion Joint 12" (1300mm) Travel EPDM



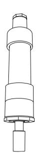
Dimension inches	Dimension mm	PVC Sch 80 Product Code	CPVC Sch 80 Product Code
1/2	12	136116	059959
3/4	20	136118	059961
1	25	136120	059963
1-1/2	40	136122	059965
2	50	136124	059967
3	75	136126	059969
4	100	136128	059971

Expansion Joint 6" (150mm) Travel Viton®



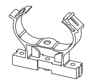
Dimension inches	Dimension mm	PVC Sch 80 Product Code	CPVC Sch 80 Product Code
1/2	12	136101	059974
3/4	20	136103	059976
1	25	136105	059978
1-1/2	40	136107	059980
2	50	136109	059982
3	75	136111	059984
4	100	136113	059986

Expansion Joint 12" (1300mm) Travel Viton®



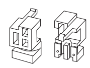
Dimension inches	Dimension mm	PVC Sch 80 Product Code	CPVC Sch 80 Product Code
1/2	12	136102	059960
3/4	20	136104	059962
1	25	136106	059964
1-1/2	40	136108	059966
2	50	136110	059968
3	75	136112	059970
4	100	136114	059972

Polypropylene Pipe Clamps



Dimension inches	Dimension mm	PVC Sch 80 Product Code	CPVC Sch 80 Product Code
1/2	12	035180	-
3/4	20	035181	-
1	25	035182	-
1-1/4	32	035183	-
1-1/2	40	035184	-
2	50	035185	-

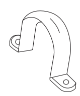
Strut Base



Dimension inches	Dimension mm	PVC Sch 80 Product Code	CPVC Sch 80 Product Code
-	-	035186	

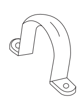
Note: Strut Bases are sold individually, two Strut Bases are required to create one Strut Base Unit.
Example: If you require 10 complete Strut Base Units you must order 20 strut bases.

Pipe Straps 2 holes



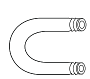
Dimension inches	Dimension mm	PVC Sch 80 Product Code	CPVC Sch 80 Product Code
1/2	12	036000	
3/4	20	036001	
1	25	036002	
1-1/4	32	036003	
1-1/2	40	036004	
2	50	036005	

Pipe Straps PVC Coated Steel 2 holes



Dimension inches	Dimension mm	PVC Sch 80 Product Code	CPVC Sch 80 Product Code
2-1/2	65	036006	
3	75	036007	
3-1/2	90	036008	
4	100	036009	
5	125	036010	
6	150	036011	

"U" Bend 4" (100mm) O.C. for Ice Rink Piping



Dimension inches	Dimension mm	PVC Sch 80 Product Code	CPVC Sch 80 Product Code
1	25	059019 Barbed end	
1	25	- Plain End (Spigot)	

Fits 1" (25mm) ID Poly Pipe

■,†,◗ See page 5 for descriptions

Chapter 15 DOMESTIC TANK

MANUFACTURER/DISTRIBUTOR:

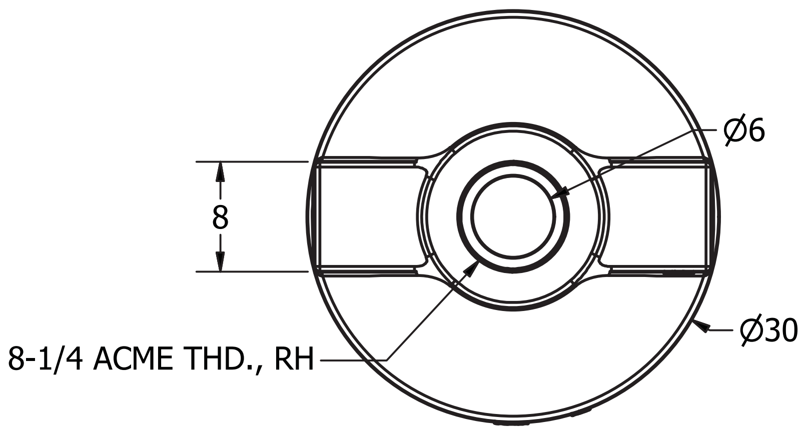
BRIMA
338, Grand Rang
La Présentation, QC, J0H 1B0
Phone: (450) 796-1818
Fax :(450) 796-2345
Email: admin@agbrima.com

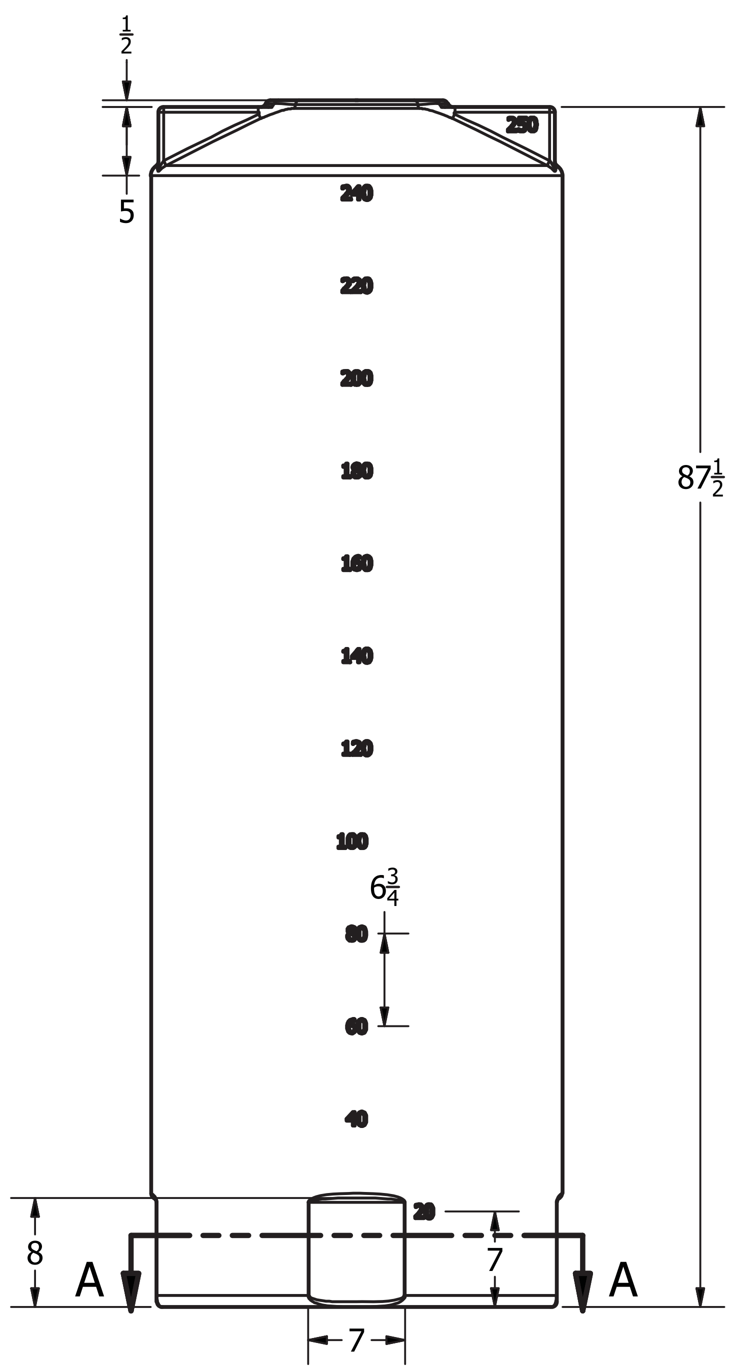
15.1 DOMESTIC COLD WATER TANKNORWESCO WATER TANK 41854 (DCWT)

15.2 WASTE WATER STORAGE TANK NORWESCO WATER TANK 41854 (WWST)

15.3 BURCAM EXPANSION TANK 503221S

DCWT/ WWST





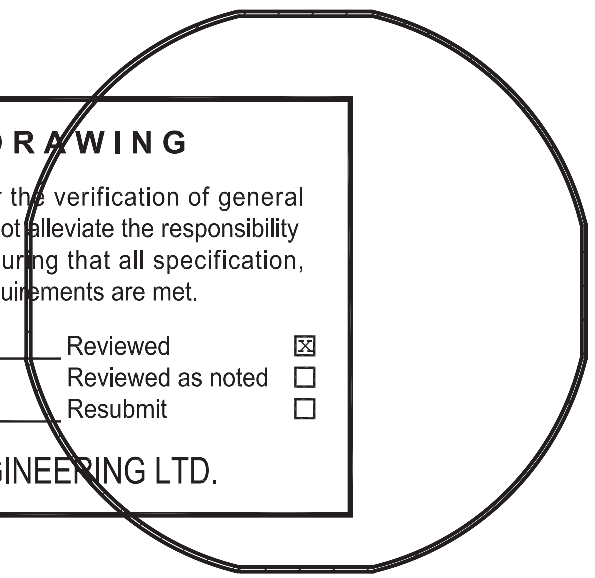
SHOP DRAWING

This review is solely for the verification of general design quality and does not alleviate the responsibility of the contractor for insuring that all specification, space and installation requirements are met.

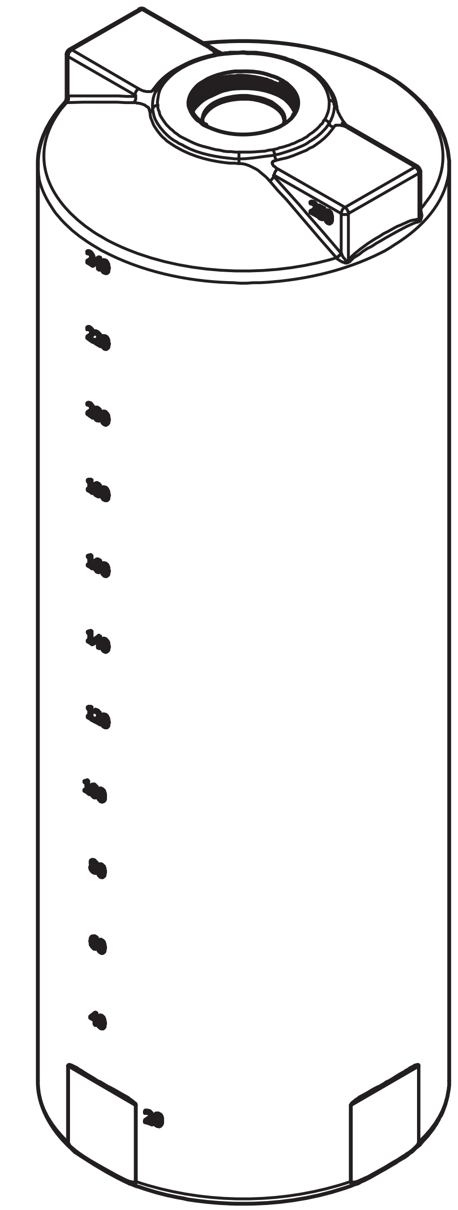
Reviewed By: M.M. — Reviewed ☒ / Reviewed as noted ☐ / Resubmit ☐

Date: 19 Mar 2015

CHIARELLI ENGINEERING LTD.



SECTION A-A
SCALE 1:10



Shop Drawings
Contractor Approval
Approved by: M.A.G., G. F.
Date: Mar 03, 2015
SIFEC NORTH INC

REVISION HISTORY

REV	DESCRIPTION	DATE	AUTHOR
A	REDRAWN	7/2/2013	Michael Holden

DRAWN Jerry Paulson	8/7/2003	NORWESCO, NORWESCO, INC. SAINT BONIFACIUS, MN
CHECKED		TITLE 250 GALLON VERTICAL TANK X 30 DIA
QA		
MFG		
APPROVED		SIZE B / DWG NO / REV A
		SCALE: 1/16 / SHEET 1 OF 1 103/665

»BURCAM»

DWP

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LAVAL (QUEBEC)
CANADA
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TÉL: 514.337.4415
FAX: 514.337.4029

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FIERS D'ÊTRE CANADIENS

INSTRUCTIONS D'INSTALATION MODÈLES 503121S/503221S

ET SOUS-PRODUITS 503127S, 503128S, 503228S, 503131S, 503231S, ETC.

POMPE À JET

S'il vous plaît, veuillez lire attentivement ces instructions. Le **défaut** de vous soumettre aux instructions et opérations **appropriées** à ce système peut annuler la garantie.

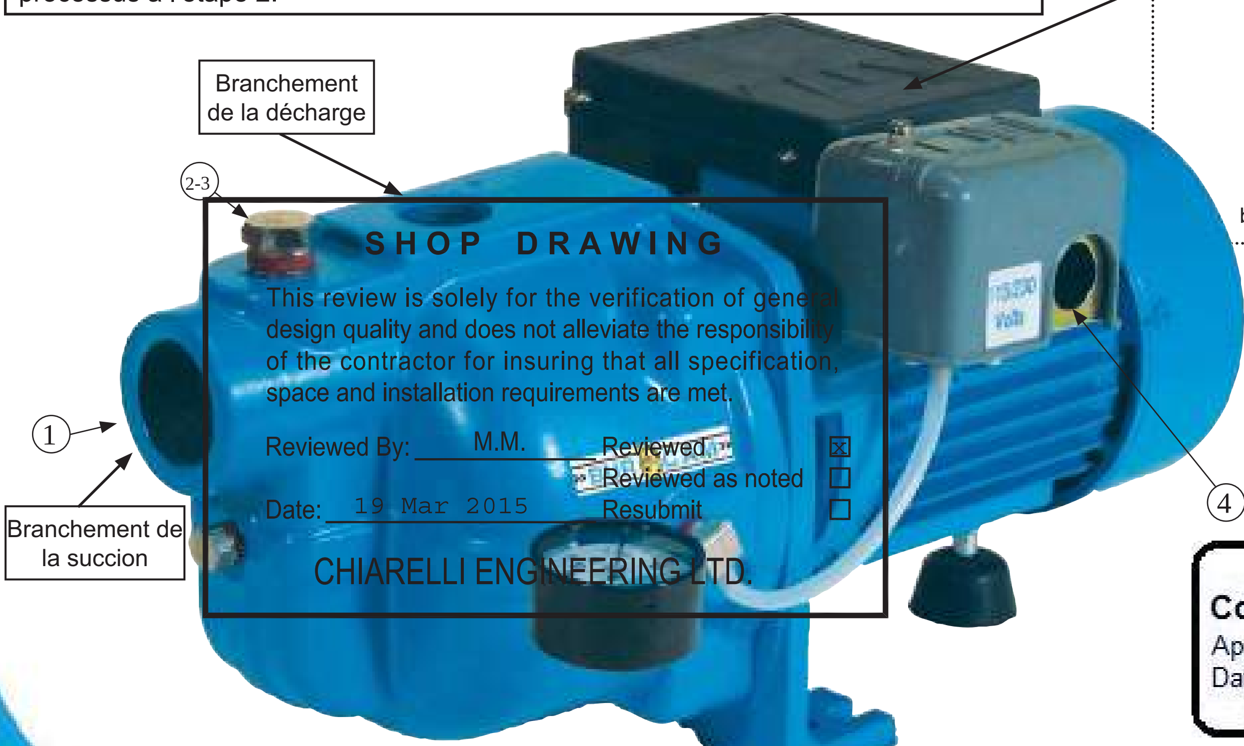
Votre pompe a été soigneusement emballée à l'usine, pour prévenir les dommages possibles lors du transport. Toutefois, des dommages occasionnels peuvent être encourus par une mauvaise manutention. **Vérifiez soigneusement votre pompe** afin de déceler tout dommage possible qui pourrait causer un bris de la pompe. Signalez tout dommage au transporteur ou à votre point de vente.

PROCESSUS D'AMORÇAGE

Suivre les instructions étape par étape, décrites à l'intérieur, pour installer votre pompe. Utiliser du ruban téflon sur tous les filetages. (1) Emplir d'eau le tuyau d'aspiration et le raccorder à l'entrée de la pompe. (2) Enlever le bouchon d'amorçage et emplir le boîtier de la pompe. (3) Revisser le bouchon d'amorçage. (4) Brancher la pompe. La pompe devrait commencer à propulser de l'eau dans le système de distribution à l'intérieur de 30 secondes. Sinon, débrancher la pompe et répéter le processus à l'étape 2.

TENSION PLACÉE EN USINE 115 V. CHANGEMENT DE TENSION DE RACCORDEMENT:

Avant de changer la tension de raccordement:
A) S'assurer que l'alimentation à la pompe est débranchée.
B) Ouvrir le couvercle de la boîte de jonction sur le moteur.
C) Veuillez glisser vers le bas le sélecteur de voltage pour obtenir du 115 V, ou vers le haut pour le 230 V.
D) Rebrancher à la source de voltage appropriée.
E) Refermer le couvercle de la boîte de jonction sur le moteur.



SHOP DRAWING
This review is solely for the verification of general design quality and does not alleviate the responsibility of the contractor for insuring that all specification, space and installation requirements are met.
Reviewed By: M.M. — Reviewed ☒ — Reviewed as noted ☐ — Resubmit ☐
Date: 19 Mar 2015
CHIARELLI ENGINEERING LTD.

Shop Drawings
Contractor Approval
Approved by: M.A.G., G. F.
Date: Mar 03, 2015
SIFEC NORTH INC

104/665

»BUR CAM»

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H7L 5X9

TEL: 514.337.4415
FAX: 514.337.4029

info@burcam.com

INSTALLATION INSTRUCTIONS

MODELS 503121S

AND OTHER PRODUCTS 503127S 503128S 503131S ETC.

JET PUMP

Please read these instructions carefully. **Failure** to comply to instructions and **designed** operation of this system, may **void** the warranty.

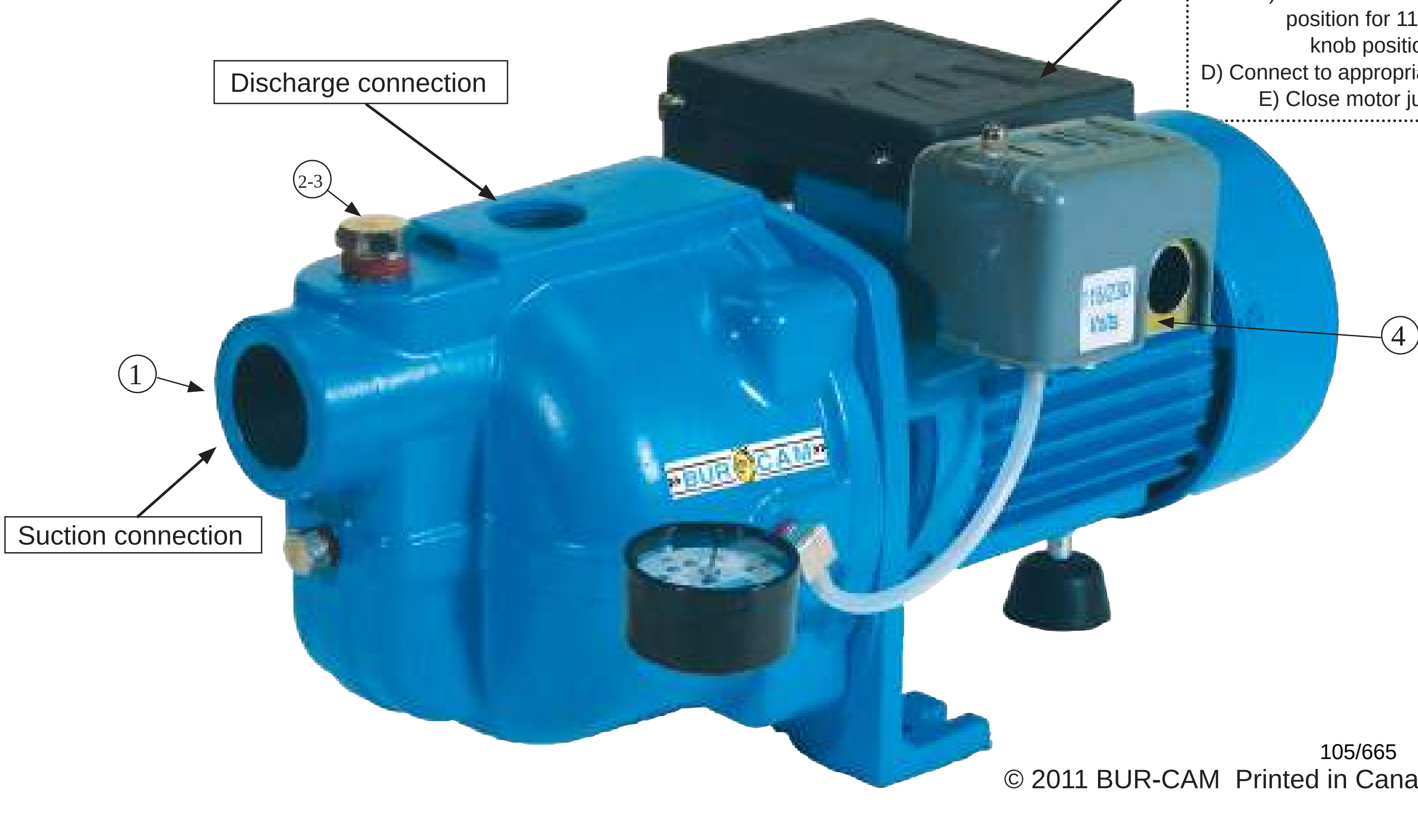
Your pump has been carefully packaged at the factory to prevent damage during shipping. However, occasional damage may occur due to rough handling. **Carefully inspect your pump** for damages that could cause failures. Report any damage to your carrier or your point of purchase.

PRIMING PROCESS

Follow all these inside step by step instructions to install your pump. Use teflon tape on all threads. (1) Fill the suction line with water and connect it to the suction inlet. (2) Remove the priming plug and fill the pump body with water. (3) Screw the plug to the priming inlet. (4) Turn the power on. The pump should deliver water to the plumbing line within 30 seconds. If not, unplug the pump and repeat the process at step 2.

FACTORY SET VOLTAGE 115 V CONNECTION VOLTAGE CHANGING:

Before changing the voltage connection:
A) Ensure the power to the pump is disconnected.
B) Open motor junction box cover.
C) Please select the up knob position for 115V or down knob position for 230V.
D) Connect to appropriate voltage.
E) Close motor junction box.



Safety Instructions:

This fine pump that you have just purchased is designed from the latest in material and workmanship. Before installation and operation, we recommend the following procedures:

A CHECK WITH YOUR LOCAL ELECTRICAL AND PLUMBING CODES TO ENSURE YOU COMPLY WITH THE REGULATIONS. THESE CODES HAVE BEEN DESIGNED WITH YOUR SAFETY IN MIND. BE SURE YOU COMPLY WITH THEM.

B WE RECOMMEND THAT A SEPARATE CIRCUIT BE LEAD FROM THE HOME ELECTRICAL DISTRIBUTION PANEL PROPERLY PROTECTED WITH A FUSE OR A CIRCUIT BREAKER. WE ALSO RECOMMEND THAT A GROUND FAULT CIRCUIT BE USED. CONSULT A LICENSED ELECTRICIAN FOR ALL WIRING.

C THE GROUND TERMINAL ON THE THREE PRONG PLUGS SHOULD NEVER BE REMOVED. THEY ARE SUPPLIED AND DESIGNED FOR YOUR PROTECTION.

D NEVER MAKE ADJUSTMENTS TO ANY ELECTRICAL APPLIANCE OR PRODUCT WITH THE POWER CONNECTED. DO NOT ONLY UNSCREW THE FUSE OR TRIP THE BREAKER, REMOVE THE POWER PLUG FROM THE RECEPTACLE.

Monthly Mandatory check-up:

1. Inspect the pump for any obvious condition that necessitates cleaning, correction, adjustement or repair.
2. Clear the surrounding of any paper, leaves or other debris.
3. Assure that the pump is secure for proper operation.
4. Assure that there is adequate clearance from any combustible materials or stucture. Stored materials must be kept away from the pump. Shelves or cabinet structures must not be in close proximity over the pump.
5. Assure that the motor is securely plugged into a proper GFCI electrical outlet.
6. Test the GFCI outlet by pressing its test switch. This should prove that the outlet is energized and will trip off to protect against a ground fault. Be sure to reset the GFCI by pressing its reset switch.
7. Observe that the plumbing can carry the water safely into the residence.

Material required for drilled well application (indoor use only)

Shallow well pump installation

- Desired length of polyethylene 1” pipe, 100 PSI, CSA or UL approved, to link up from pumping level to pump.
- 1 1” foot valve (750756 or 750752P).
- 1 well seal, as per well casing diameter (750929 6” x 1”).
- 1 1” well seal elbow (750860).
- 2 1” male adaptors (750865 or 750871).
- 8 1” stainless steel clamps (750885).
- Teflon tape.

Tank installation

- Desired length of 1” braided hose (750919) to link up from pump to tank. Keep tank as close as possible from pump.
- 1 tank T (650651).
- 1 drain valve (650659)
- 2 1” female adaptor.
- 1 1” male adaptor (750865 or 750871).
- 3 1” stainless steel clamps (750885).
- Teflon tape.

Tools

Screwdrivers, hacksaw to cut pipe, knife to assist in pipe cutting, round file to smooth pipe ends, pipe wrench, adjustable wrench to tighten fittings, propane torch and welding material.

APPLICATION

- This pump is designed for shallow well installation for water level up to 25 feet.
- CAPACITY AT 20 PSI:

5’	850	US GPH
10’	715	US GPH
15’	630	US GPH
20’	550	US GPH
25’	500	US GPH

FRICTION LOSS IN PIPE NOT INCLUDED

FEATURES

- Easy tu prime pump body.
- Totally enclosed, fan cooled motor, bearing to bearing. Built for a continuous use.
- Full time connected run capacitor, to eliminate starting wear vs regular motor.
- Thermal and overload protection.
- Noryl impeller, built-in injector
- 1/2 HP, 115 / 230 VAC, 60 Hz, 8.6 A / 4.3 A (at start :15 A / 7.5 A).

INSTALLATION STEPS

STEP 1

We recommend that you install your pump in a clean and dry location where there is adequate room for servicing at a later date. Protection from freezing temperatures and good ventilation should be considered as well, to provide the pump an environment for long life. Locating the pump as close as possible to the water source will reduce friction losses encountered in the suction pipe.

Friction losses in the suction pipe must be taken into consideration when the horizontal offset is greater than 50 feet. The suction pipes should be increased from 1” to 1 1/4”. This will reduce friction losses and allow the pump to give maximum performance.

A new well should be checked to determine that it is free from sand. Sand will damage the seal and the impeller. Have your well driller clean the well before your installation.

Never run the pump dry. Damage to the seal may occur. Fill pump body and suction pipe with water before turning on the power.

THE RUN OF HORIZONTAL PIPE FROM THE TOP OF YOUR WELL INTO THE HOUSE, WHERE YOUR PUMP WILL BE LOCATED, MUST BE INSTALLED IN A TRENCH, BELOW THE FROST LEVEL OF YOUR AREA.

SHALLOW WELL APPLICATION

SEE DIAGRAM ON PAGE 7

STEP 2

Cut the desired length of poly pipe to run from the top of the well to the pumping level. Smooth the pipe cuttings with your round file. (Check that no cut-out parts are left inside of pipe. This may block pump injector or impeller). Tape male adaptor threads with teflon tape and thread adaptor into the foot valve. Slide 2 stainless steel clamps over one end of pipe and use torch to soften pipe. Insert the male adaptor and foot valve into this pipe end. Tighten clamps with screwdriver when cool. **For security against leaks, we suggest to install 2 stainless steel clamps on each adaptor.**

STEP 3

Insert the well seal elbow thru the opening of the seal.
Slide 2 stainless steel clamps over the free end of the previously cut pipe and soften pipe with your torch. Attach pipe to the well seal elbow (end protruding at bottom of well seal). Tighten clamps with screwdriver when cool.

STEP 4

Install the well seal and piping assembly into your well casing. Tight down the well seal bolts using your adjustable wrench.

> To facilitate servicing at a later date, you may use a pitless adaptor and a sealed well cap instead of an elbow and a well seal as describe in steps 3 and 4.

STEP 5

Install your pump in the house, on a sound foundation, as close as possible to the basement wall. Locate the suction inlet in the front of the injector. Thread an adaptor into inlet using teflon tape. Do not over tighten.

STEP 6

Cut the desired length of pipe from pump location to the well seal and connect both ends using the previous way, with stainless steel clamps and torch. **Do not fill in your trench to the house until you have checked for any leaks in your connections or trouble in your water system.**

STEP 7
for sand or well points

Sand or well points are limited to areas where water bearing sand or gravel lies below the surface, and where there are no boulders or rocks to interfere with the driving into the ground of the point.
The amount of water any "one" well point will supply is usually rather limited. Sometimes, it is necessary to use more than one point to increase the supply of water, entering to the pump's suction.

THE IMPORTANT INSTALLATION STEP IN USING WELL POINTS IS THAT A CHECK VALVE MUST BE USED IN THE SUCTION PIPE LEADING TO THE SUCTION INLET, AS CLOSE TO THE PUMP AS POSSIBLE, TO KEEP SUCTION LINE AND PUMP WELL PRIMED.

CONTINUE ON PAGE 5 & 6 FOR TANKS AND ELECTRICAL INSTALLATION STEPS

TANKS INSTALLATION

SEE DIAGRAM ON PAGE 8

STEP 8
for captive air tanks

Packaged systems have the pump mounted directly to the tank. The pump to tank plumbing fittings are pre-assembled in factory. You only have to connect the discharge line of your system to your home's plumbing distribution line. When using a separate tank from your pump, we recommend to install a captive air tank as shown in our typical installation diagram, that is air injected into the tank at the factory. This air, which is in addition to atmospheric pressure, increase the ability of the tank to deliver more water between on/off cycles, thus increasing the efficiency of your water system. Connect the pump discharge to the tank T, using adaptors and braided hose, then, connect the other side of tank T to your home's plumbing distribution line.

Make sure that the precharged air pressure (before connecting the tank) is 2 PSI less than the starting pressure setted on the pressure switch of your pump. If you adjust the air pressure after the installation, follow these steps:

- Check the starting pressure of the pump on the pressure gauge;
- Disconnect the power to the pump;
- Open nearest fawcet to the tank and relieve all pressure in tank, then close the fawcet;
- Adjust the air pressure of the tank (by pumping or removing air at the snifter valve) 2 PSI below pressure switch "ON" setting;
- Turn power back on to pump.

Your tank is now well precharged. Run the pump through a few cycles to verify that it works properly.

STEP 8
for epoxy or glass lined tanks

Other types of tanks may be used, as galvanized standard tanks, epoxy or glass lined tanks. These products do not achieve the benefits of the captive air tanks.

Epoxy or glass lined tanks with float have to be precharged by the installer. Assuming tank is plumbed to pump and all connections are checked for leaks, follow these steps:

- Run pump thru one complete cycle, until pump shuts off;
- Disconnect the power to the pump;
- Open nearest fawcet to the tank and relieve all pressure in tank, then close the fawcet;
- Close service line gate valve;
- With a car tire pump, inject air into the snifter valve located in tank. Watch pump pressure gauge and stop pumping air when pressure reachs 2 PSI below pressure switch "ON" setting;
- Return power back on to pump;
- Run pump through one complete cycle;
- Open service line gate valve.

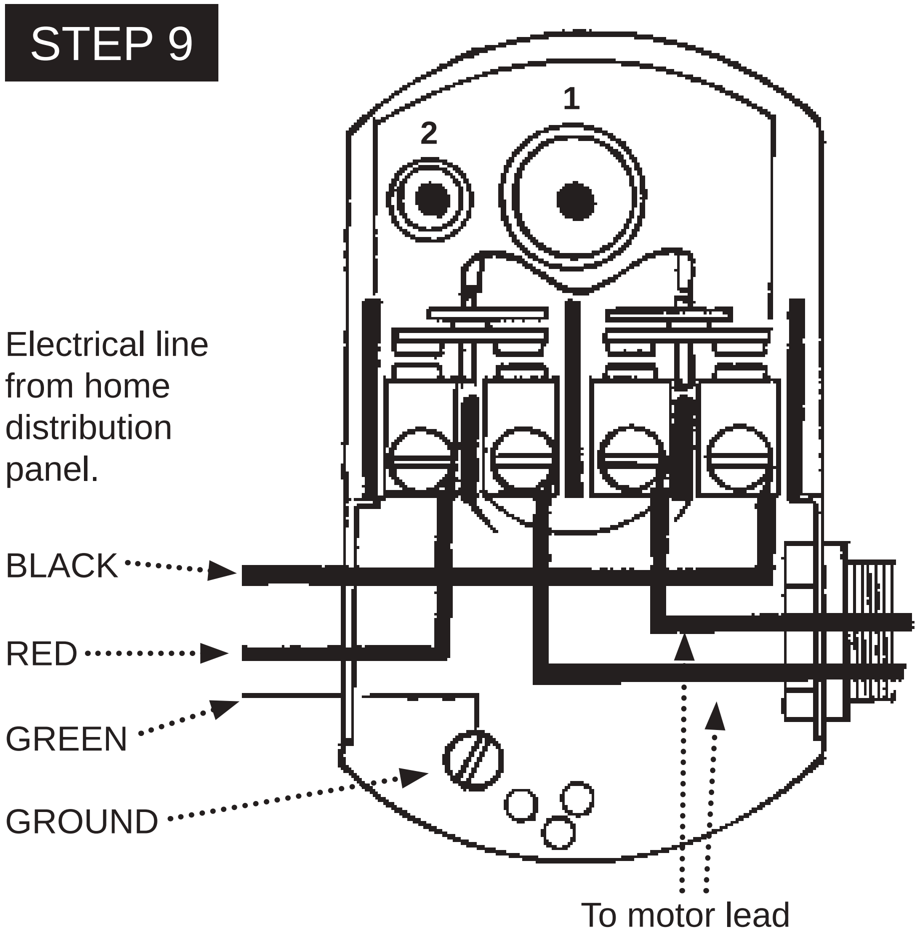
Your tank is now well precharged. Run the pump through a few cycles to verify that it works properly.

Not recommended for galvanized tanks

Galvanized standard tanks require an air volume control to be used with jet pump. We do not recommend the installation of this type of tank with your jet pump. This type of galvanized tank is recommended with piston pumps.

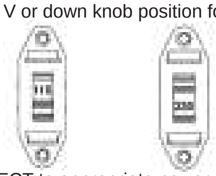
ELECTRICAL INSTALLATION

STEP 9



VOLTAGE SELECTION SWITCH

1. POWER off.
2. Please SELECT the up knob position for 115 V or down knob position for 230 V.



3. CONNECT to appropriate power source.

We recommend that a licensed electrician be employed to do the proper wiring to the pressure switch, and to permanently ground the motor in accordance to the electrical codes in your area.

Do not use an extension cord to connect your pump to the power source. From your distribution panel to the pressure switch, we recommend a wire gauge not smaller than 14 gauge.

This is a dual voltage 115/230 pump. The voltage selection switch is located inside the terminal box. The motor is factory wired on 115V. For 230V selection, please open the terminal cover and set the switch to the proper voltage. (See above drawing on right).

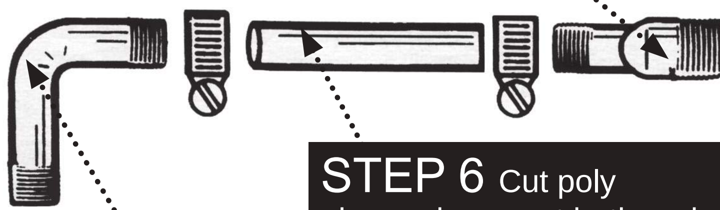
Pressure switch setting (start/stop 20/40 or 30/50) has been made at the factory. Adjustments may be done to give other operating pressures.

Adjustment or modification of start/stop setting of pressure switch have to be done carefully.
Turn adjustment nut half turn at a time.

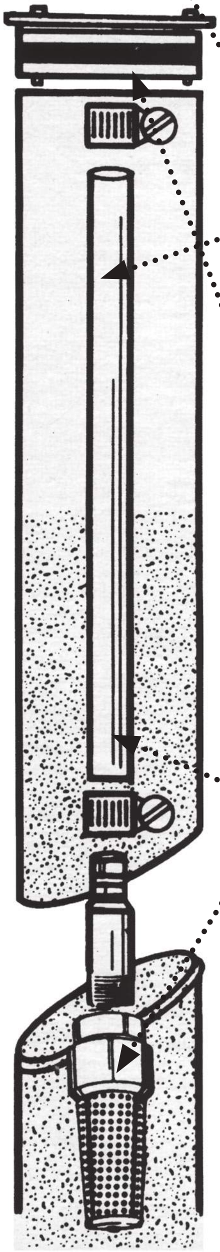
Turn nut 1 clockwise to raise start and stop pressure setting. **Never turn nut 2. This will change the 20 PSI range between start and stop presssure and may damage your tank's bladder or modify the efficiency of your water system.** Check system operation after each adjustment.

SHALLOW WELL APPLICATION

STEP 5 Install your pump and thread an adaptor into inlet.



STEP 6 Cut poly pipe and connect both ends.



STEP 3 Insert well seal elbow through the seal and attact to pipe.

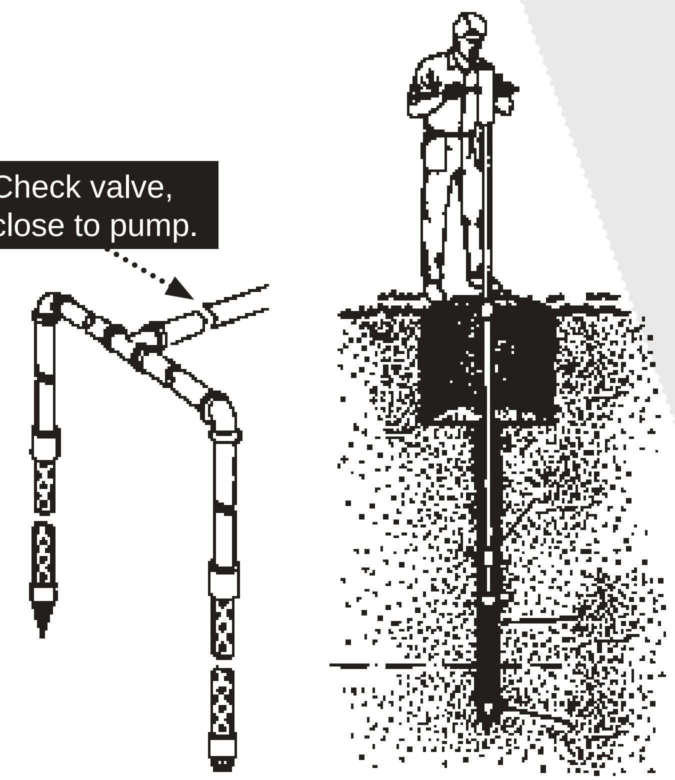
STEP 4 Install well seal and piping into well casing.

STEP 2 Cut poly pipe and install the check valve.

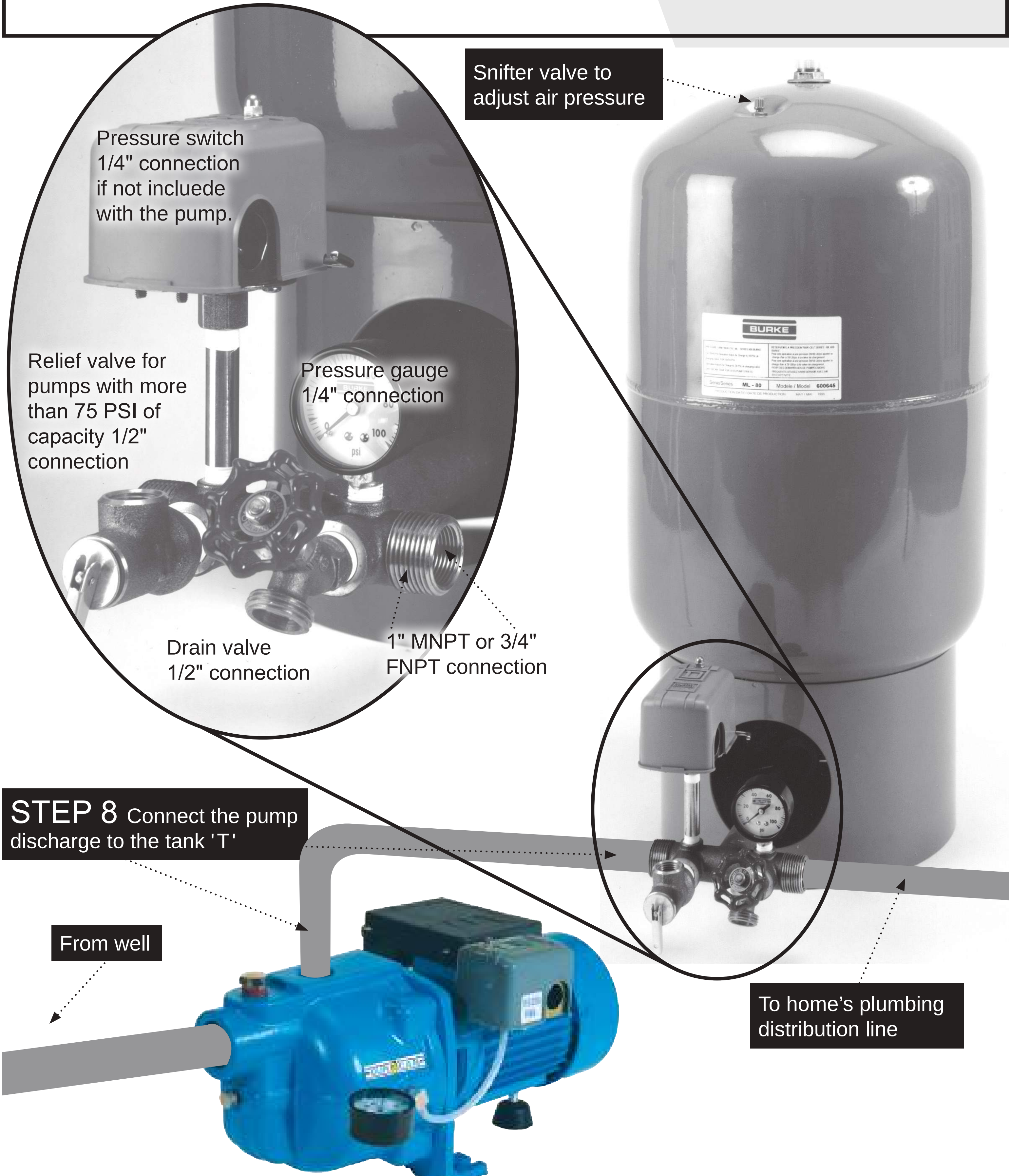
Well point optional installation

STEP 7 You may install one or more sand points to increase the supply of water.

Check valve, close to pump.

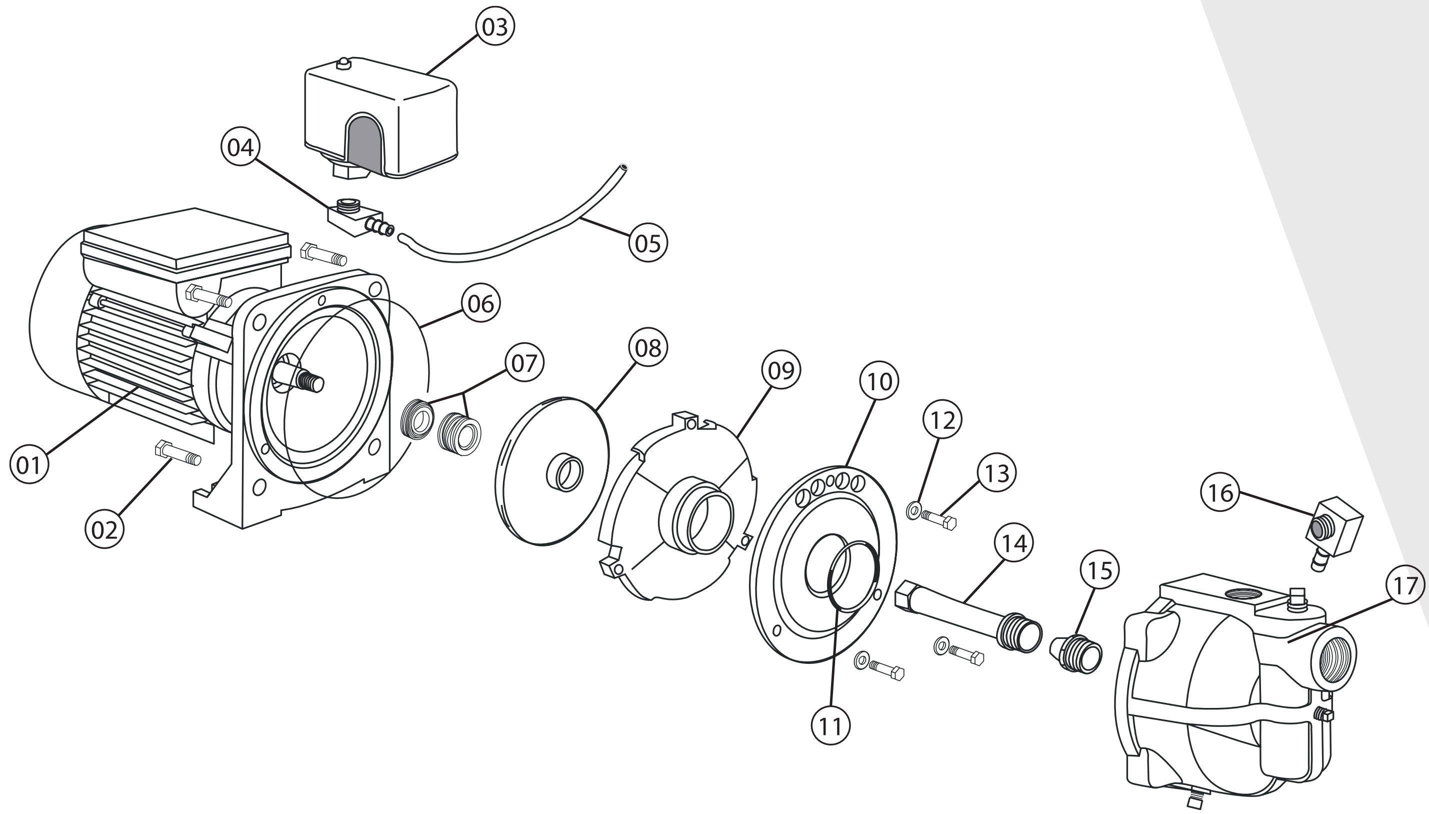


TANK INSTALLATION



REPAIR PARTS

Ref	Pieces	Descriptions
1	510054	Motor
2	510055	Motor Screws (4)
3	750957S	Pressure Switch
4	510056	1/4" NPT 1/4" Barb Elbow
5	750748	Hose
6	510053	Seal Plate O-Ring
7	510052	Macanical Seal
8	510048	Impeller
9	510047	Diffuser
10	510065	Diffuser Plate
11	510051	Diffuser Plate O-Ring
12	510050	Diffuser Plate Washers (3)
13	510049	Diffuser Plate Screws (3)
14	510069	Venturi
15	510046	Nozzle
16	510056	1/4" NPT 1/4" Barb Elbow
17	510045	Pump Body
18	750769	1/4" Pressure Gauge (not shown)



503121S 2011

Repair parts may be ordered from your autorized point of sale or from

BUR-CAM PUMPS

FOR INFORMATION TEL: 514.337.4415 FAX: 514.337.4029

TROUBLE SHOOTING GUIDE CHECKLIST

NEVER MAKE ADJUSTMENTS TO ANY ELECTRICAL APPLIANCE OR PRODUCT WITH THE POWER CONNECTED. DON'T JUST UNSCREW THE FUSE OR TRIP THE BREAKER, REMOVE THE POWER FROM THE RECEPTACLE.

TROUBLE	PROBABLE CAUSE	ACTION
Motor does not run.	Switch is off position	Turn switch to on position
	Blown fuse	Replace
	Tripped breaker	Reset
	Dirty pressure switch	Clean
	Defective pressure switch	Replace
	Defective motor	Replace
Motor runs but no water is delivered.	Pump not primed	Prime with clean water
	Leaky suction line	Check pipe and pipe connections
	Foot valve plugged	Clean
	Ejector nozzle clogged	Clean
	Water level below foot valve	Check foot valve level
	Suction lift to great	Water level lower than lift capacity
	Improper voltage	Check voltage
Pump does not deliver to full capacity.	Water level below foot valve	Check foot valve level
	Ejector nozzle clogged	Clean
	Excessive friction in pipe	Too small or dirty pipe
	Improper voltage	Check voltage
Pump does not shut off.	Leaky discharge line	Check all pipes for leak
	Motor not up to normal speed	Check power cable and voltage
	Improper setting of pressure switch	Reset or replace
	Ejector nozzle clogged	Clean
Pump starts and stop too often.	Pressure tank waterlogged	Drain tank and restart
	Leaky foot valve	Replace
	Leaky suction line	Check pipe and pipe connections
	Foot valve do not close properly	Clean or replace
	Pressure switch out of adjustment	Adjust on/off setting
	Leaky discharge line (toilet etc.)	Check all pipes for leak
Air spurts from fawcets.	Leaky suction line	Check pipe and pipe connections
	Gaz in water	Check and consult factory
	Airlogged tank (galvanized)	Replace air volume control

TO THE END CONSUMER

If you have any problems with the product, before advising the store, where you've purchased the pump, please contact us at 514 337-4415 , and ask for our sales department, and they will be pleased to help you with any questions you might have, concerning your installation.

Chapter 16 VALVES

MANUFACTURER/DISTRIBUTOR:

WOLSELEY Inc.
4200, Hickmore
St-Laurent, QC, H4T 1K2
Phone: (514) 344-9378
Fax :(514) 344-9341

16.1 **BUTTERFLY VALVE MAS L-D-4-A-E-LH 3” @ 6”**

16.2 **PVC CHECK VALVE IPEX 052289 & 052291**

16.3 **PVC CHECK VALVE SXE IPEX IPE052018**

16.4 **PVC BALL VALVE IPEX 353000 SERIE**

16.5 **BALL VALVE NPT STAINLESS STEEL G-2**

16.6 **BALL VALVE NPT MAS B3**

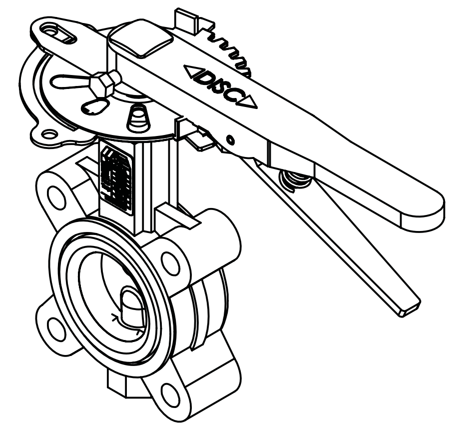
16.7 **NPT CHECK VALVE BRASS - Kitz#22**

16.8 **BALL VALVE CPVC**

16.9 **BALL VALVE JENKINS 4092J**

Size	L	∅D	n x M	h1	h2	A	B	Q	Assembly Weight
	in/mm								lbs/kgs
2"	1.69	4.75	4 x 5/8-11 UNC	2.60	5.12	8.7	1.3	1.13	6.5
DN50	42.9	121		66.0	130	221	33	28.7	3.0
2.5"	1.81	5.50	4 x 5/8-11 UNC	3.23	5.55	8.7	1.3	1.79	7.8
DN65	46.0	140		82.0	141	221	33	45.5	3.5
3"	1.81	6.00	4 x 5/8-11 UNC	3.54	5.83	8.7	1.3	2.45	8.6
DN75	46.0	152		89.9	148	221	33	62.2	3.9
4"	2.05	7.50	8 x 5/8-11 UNC	4.25	6.69	10.2	1.4	3.50	14.8
DN100	52.1	191		108	170	260	36	88.9	6.7
5"	2.20	8.50	8 x 3/4-10 UNC	4.84	7.36	10.2	1.4	4.55	19.2
DN125	55.9	216		123	187	260	36	116	8.7
6"	2.20	9.50	8 x 3/4-10 UNC	5.43	7.95	10.2	1.4	5.71	22.7
DN150	55.9	241		138	202	260	36	145	10.3
8"	2.36	11.75	8 x 3/4-10 UNC	6.69	9.37	14.2	1.7	7.77	36.6
DN200	59.9	299		170	238	360	43	197	16.6
10"	2.68	14.25	12 x 7/8-9 UNC	7.87	10.7	14.2	1.7	9.76	57.8
DN250	68.1	362		200	272	360	43	248	26.3
12"	3.07	17.00	12 x 7/8-9 UNC	9.29	12.0	14.2	1.7	11.7	79.5
DN300	78.0	432		236	305	360	43	298	36.1

#	MAS Part No.	Description
1	L-D-4-A-E-LH	Butterfly Valve
2	HANDLE XXX-XX	Lever - 10 pos throttle plate
3	MAS ID Plate	Identification tag w/ trim code
4	NSF-372 Tag	CSA/NSF-372 Compliance Tag



SHOP DRAWING

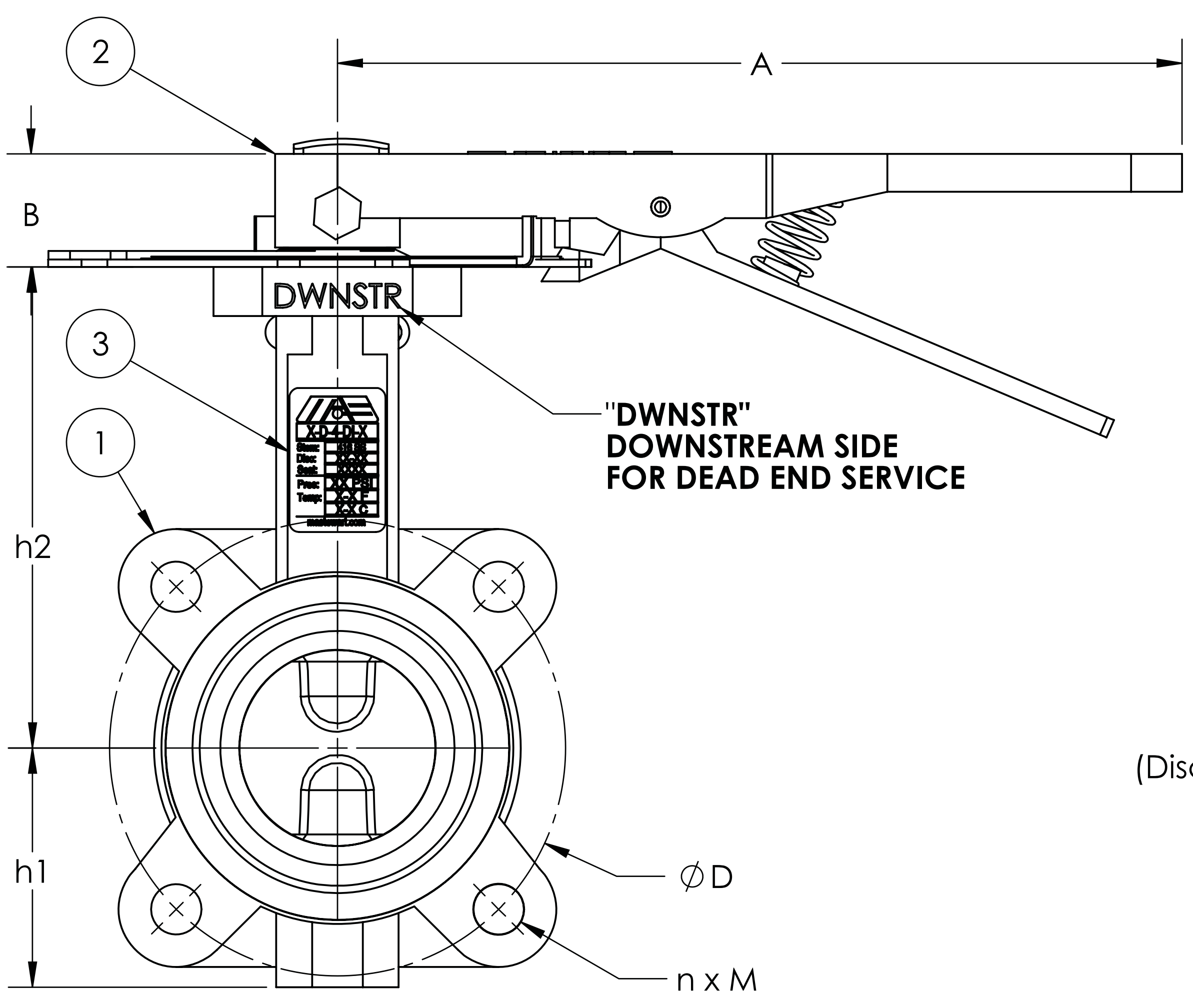
This review is solely for the verification of general design quality and does not alleviate the responsibility of the contractor for insuring that all specification, space and installation requirements are met.

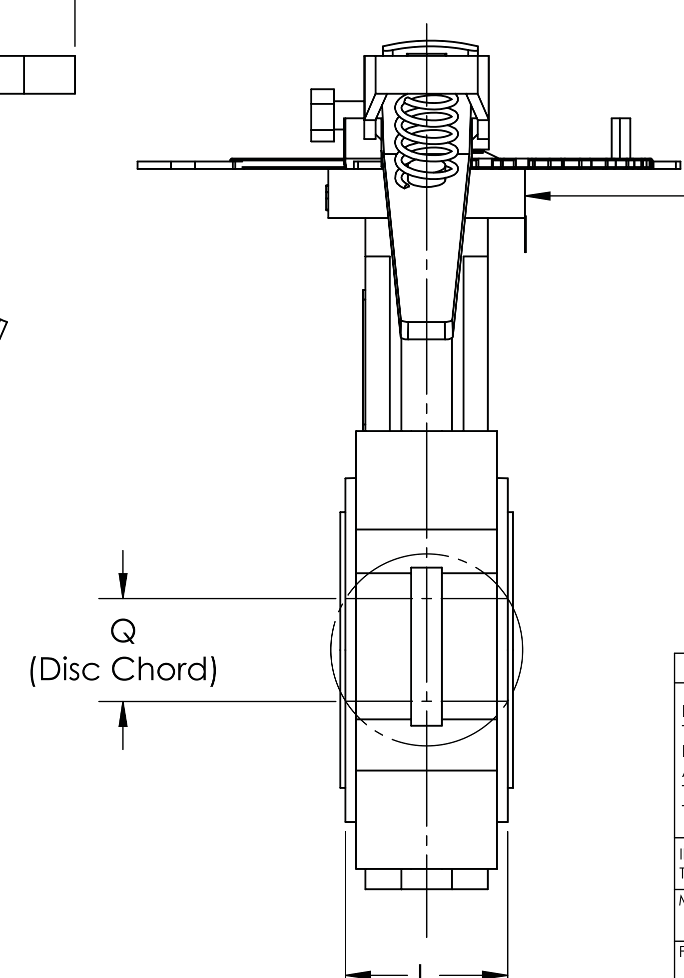
Reviewed By: M.M. Reviewed ☒
Reviewed as noted ☐
Date: 12 July 2016 Resubmit ☐

CHIARELLI ENGINEERING LTD.

4 CSA/NSF-372 Compliance Tag:

NSF/ANSI 372
LOW LEAD CONTENT ONLY
MC#218481





Specifications	
Temp. Rating	-4-275°F (-20-135°C)
Press. Rating	200 PSI
Design to: MSS-SP-67 & API-609	
Markings to: MSS-SP-25	
NSF-372 Compliance: Low Lead Content Only	

Materials		
Valve	Body	Ductile Iron ASTM A536
Valve	Stem	416 SS ASTM A582
Valve	Disc	Aluminum Bronze ASTM B148 alloy C95400
Valve	Seat	EPDM
Handle		Painted Malleable Iron w/ ABS Plug
Throttle plate		Zinc-Plated Steel

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES
TOLERANCES:
FRACTIONAL ±
ANGULAR: MACH ± BEND ±
TWO PLACE DECIMAL ±
THREE PLACE DECIMAL ±
INTERPRET GEOMETRIC TOLERANCING PER:
MATERIAL
FINISH
DO NOT SCALE DRAWING

	NAME	DATE
DRAWN	SE	5/3/13
CHECKED		
REVISIONS:	SE	11/18/13
	SE	5/13/14

PROJECT:

www.mastewart.com
M.A. Stewart & Sons Ltd.
12900 - 87th Avenue
Surrey, B.C. V3W 3H9
Toll-Free: (800) 594-8431
Fax: (604) 594-4335

TITLE: MAS D Series Lug BFV L-D-4-A-E-LH (2-12")

SIZE B | DWG. NO. 2-12in L-D-4-A-E-LH | REV 2

SCALE: 1:2 | WEIGHT: | SHEET 1 OF 1

SC SERIES SWING CHECK VALVES

The SC combines superior flow rate with maximum versatility. With stainless wetted parts and hardware, top entry design, and extremely low back pressure requirements, these flanged valves are the perfect choice for back-flow prevention in large diameter lines, both vertical and horizontal. The SC is available in PVC with either EPDM or Viton® seals.

Pressure: up to 100 psi at 73°F depending on the size
Sizes: 3" – 8"

End Connection	Size inches	EPDM Product	Viton® Product Code
PVC			
Flanged	3	052289	053875
Flanged	4	052290	053876
Flanged	6	052291	053877
Flanged	8	052292	053878

SHOP DRAWING

This review is solely for the verification of general design quality and does not alleviate the responsibility of the contractor for insuring that all specification, space and installation requirements are met.

Reviewed By: M.M. Reviewed ☒
Reviewed as noted ☐
Date: 15 Mar 2015 Resubmit ☐

CHIARELLI ENGINEERING LTD.

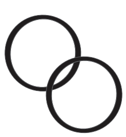
VA SERIES AIR RELEASE VALVES - SINGLE UNION

The VA is one of only two such plastic valves in the industry, and the only one controlled by media and not pressure. Designed for tanks, slurries, or start-ups, the VA valve will economically and efficiently eliminate air or gas pockets as well as break potentially dangerous vacuums. This no-spill valve is offered in PVC with EPDM seals. Viton® sealing kits are also available.

Pressure: 232 psi
Sizes: 3/4", 1-1/4" and 2"

Size inches	EPDM Product Code
PVC, Single Union	
3/4	053559
1-1/4	053560
2	053561

Note: Valves supplied with dual (socket & threaded) end connectors for the exhaust port



Size inches	Product Code
Viton® O-ring Set	
3/4	153845
1-1/4	153846
2	153847

Shop Drawings
Contractor Approval
Approved by: J.D., G.F.
Date: 12/03/15
SIFEC NORTH INC

VKD SERIES BALL VALVES - TRUE UNION

This next generation industrial valve features the patented Dual Block® system which allows locking of the union nuts in a preset position, assuring seal integrity under severe service conditions. A patented seat stop carrier, high quality stem and ball support system, integral mounting flange and bracketing, and a multifunctional locking handle (standard on sizes 2-1/2" to 4") set this valve apart from the rest. The VKD is available in PVC, CPVC, PP, and ABS with PTFE seats and either EPDM or FPM seals.

Pressure: up to 232 psi at 73°F depending on the material
Sizes: 3/8" – 4"

End Connection	Size inches	EPDM Product Code	FPM Product Code
PVC w/ PTFE Seats			
S/T	3/8	253067	253068
S/T	1/2	053461	053467
S/T	3/4	053462	053468
S/T	1	053463	053469
S/T	1-1/4	053464	053470
S/T	1-1/2	053465	053471
S/T	2	053466	053472
Socket	2-1/2	053539	053542
Socket	3	053540	053543
Socket	4	053541	053544
Corzan® CPVC w/ PTFE Seats			
S/T	1/2	053473	253008
S/T	3/4	053474	253009
S/T	1	053475	253010
S/T	1-1/4	053476	253011
S/T	1-1/2	053477	253012
S/T	2	053478	253013
Socket	2-1/2	053545	053548
Socket	3	053546	053549
Socket	4	053547	053550
PP w/ PTFE Seats			
Threaded	1/2	053525	253002
Threaded	3/4	053526	253003
Threaded	1	053527	253004
Threaded	1-1/4	053528	253005
Threaded	1-1/2	053529	253006
Threaded	2	053530	253007
PP w/ PTFE Seats			
Socket	20mm	053513	053519
Socket	25mm	053514	053520
Socket	32mm	053515	053521
Socket	40mm	053516	053522
Socket	50mm	053517	053523
Socket	63mm	053518	053524

VENTED VXD SERIES BALL VALVES – TRUE UNION

End Conn.	Size inches	PVC Product Code	Corzan CPVC Product Code
FPM w/ PTFE Seats			
S/T	3/8	353028	353000
S/T	1/2	353083	353021
S/T	3/4	353084	353022
S/T	1	353085	353023
S/T	1-1/4	053503	353024
S/T	1-1/2	053504	353025
S/T	2	053505	353026
Socket	2-1/2	053506	353027
Socket	3	353086	353029
Socket	4	053562	353030

Note: VKD vented ball valves to be used for Sodium Hypochlorite service. Please consult IPEX for other vented applications.

VXE/VX SERIES BALL VALVES – TRUE UNION

These ultra-compact valves feature a full-port, bi-directional double block design. The true union style allows the valve to be easily removed from the piping system and fully serviced. A threaded seat stop carrier provides improved seal integrity under tough service conditions while the removable handle also functions as a tool for ball seat adjustment.

The EasyFit VXE Series True Union Ball Valves represent the lastest innovation in thermoplastic ball valve manufacturing technology. The VXE Series is designed for industrial, general purpose and O.E.M applications. This valve features an ultra-compact double block design, and full port bi-directional operation. The true union design allows the valve to be easily removed from the piping system and fully serviced. A threaded seat stop carrier provides improved seal integrity under tough service conditions while the EasyFit multifunction handle doubles as a tool for ball seat adjustment, and for tightening union nuts precisely.

VXE

Pressure: up to 232 psi at 73°F depending on the size

Sizes 1/2" - 2"

VX

Pressure: up to 150 psi at 73°F depending on the size

Sizes: 2-1/2" - 6

The VX series is designed for industrial, general purpose and O.E.M. applications. The VX series is ideal for use in light industrial and water applications. These valves feature an ultra-compact double block design, and full port bi-directional operation. The true union design allows the valve to be easily removed from the piping system and fully serviced. A threaded seat stop carrier provides improved seal integrity under tough service conditions while the removable handle also functions as a tool for ball seat adjustment.

VXE & VX Series ball valves are part of our complete system of pipe, valves, and fittings, engineered and manufactured to our strict quality, performance, and dimensional standards.

SHOP DRAWING
This review is solely for the verification of general design quality and does not alleviate the responsibility of the contractor for insuring that all specification, space and installation requirements are met.
Reviewed By: M.M. Reviewed ☒
Reviewed as noted ☐
Date: 19 Mar 2015 Resubmit ☐
CHIARELLI ENGINEERING LTD.

EXAMPLE APPLICATIONS

- ✓ Plant water supply and distribution
- ✓ Wash-water and recovery systems
- ✓ Acid Products Handling for Refineries, Metal Works, etc.
- ✓ Alum and Ferric Chloride Handling
- ✓ Pulp and Chemical Recovery Systems
- ✓ Deionized Water
- ✓ Water treatment
- ✓ Swimming pools
- ✓ Chlorine Injection Systems Bleach, Dye and Acid Lines
- ✓ Aquariums
- ✓ Irrigation

Model	End Conn.	Size inches	EPDM Product Code	Viton® Product Code
PVC, w/ PTFE Seats				
VXE	S/T	1/2	053001	053002
	S/T	3/4	053003	053004
	S/T	1	053005	053006
	S/T	1-1/4	053007	053008
	~~S/T~~	~~1-1/2~~	~~053009~~	053010
	S/T	2	053011	053012
VX	Socket	2-1/2	053623	053624
	Socket	3	053013	053014
	Socket	4	053015	053016
	Threaded	3	053017	053018
	Threaded	4	053019	053020
	* Socket	6	053625	053626
PVC, w/ PTFE Seats				
VXE	Flanged	1/2	053627	053637
	Flanged	3/4	053628	053638
	Flanged	1	053629	053639
	Flanged	1-1/4	053630	053640
	Flanged	1-1/2	053631	053641
	Flanged	2	053632	053642
VX	Flanged	2-1/2	053633	053643
	Flanged	3	053634	053644
	Flanged	4	053635	053645
	* Flanged	6	053636	053646
Corzan® CPVC, w/ PTFE Seats				
VXE	S/T	1/2	053041	053042
	S/T	3/4	053043	053044
	S/T	1	053045	053046
	S/T	1-1/4	053047	053048
	S/T	1-1/2	053049	053050
	S/T	2	053051	053052
VX	Socket	2-1/2	053647	053648
	Socket	3	053053	053054
	Socket	4	053055	053056
	Threaded	3	053057	053058
	Threaded	4	053059	053060
	* Socket	6	053649	053650
Corzan® CPVC, w/ PTFE Seats				
VXE	Flanged	1/2	053651	053661
	Flanged	3/4	053652	053662
	Flanged	1	053653	053663
	Flanged	1-1/4	053654	053664
	Flanged	1-1/2	[illegible]	[illegible]
	Flanged	2	[illegible]	[illegible]
VX	Flanged	2-1/2	[illegible]	[illegible]
	Flanged	3	[illegible]	[illegible]
	Flanged	4	[illegible]	[illegible]
	* Flanged	6	053660	053670

Shop Drawings
Contractor Approval
Approved by: J.D., G.F.
Date: 12/03/15
SIFEC NORTH INC

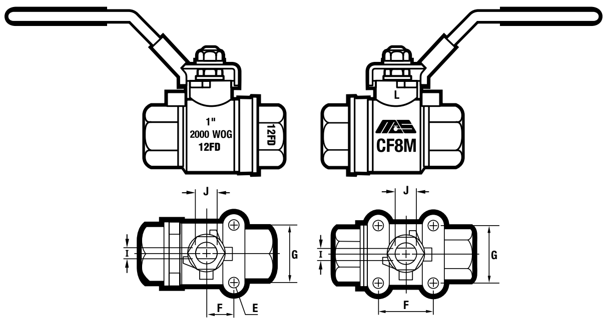
* Note: The 6" valve is a 4" with Venturied ends.

G Series Investment Cast Stainless Steel 2000 WOG Ball Valves

M. A. Stewart & Sons Ltd.
VALVES AND FITTINGS

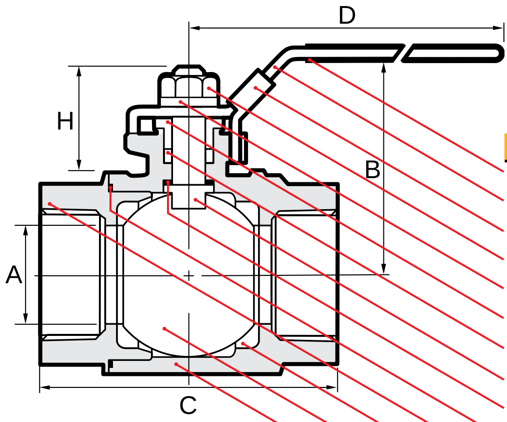
2.3

G2



Sizes 1/4" to 2" Sizes 2 1/2" to 3"

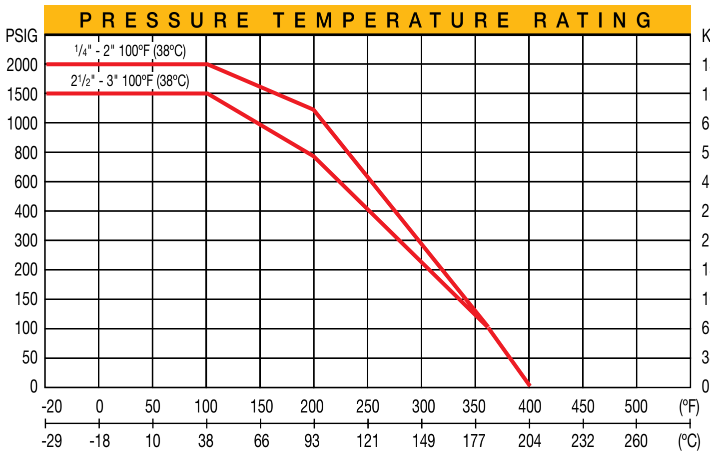
- Full port
- NPT threads to ANSI B1.20.1
- Two piece body
- Blowout proof system
- Adjustable packing nut
- Locking lever handle
- Actuator mounting pad
- Floating ball
- 2000 PSI, WOG 1/4" to 2"
- 1500 PSI, WOG 2 1/2" to 3"



NAME / MATERIAL
1. Handle Grip / Vinyl
2. Handle / Stainless Steel A276 Type 304
3. Locking Device / Stainless Steel A276 Type 304
4. Handle Nut / Stainless Steel A 276 Type 304
5. Stem Washer / Stainless Steel A276 Type 304
6. Gland Nut / Stainless Steel A276 Type 304
7. Packing / PTFE
8. Stem / Stainless Steel A276 Type 316
9. Thrust Washer / R-PTFE 15% Glass-Filled
10. Gasket / PTFE
11. Cap / Stainless Steel A351 CF8M (316)
12. Seat / R-PTFE 15% Glass-Filled
13. Ball / Stainless Steel A351 CF8M (316)
14. Body / Stainless Steel A351 CF8M (316)

- *Available with Oval handle for size range: 1/4"-2"*
- *1/4" and 3/8" have non-tapped reserve holes cast in*
- *1/2" to 2" mounting pads are tapped, 2 1/2" and 3" are dimpled.*

PRESSURE TEMPERATURE RATING



DIMENSIONS

size	8	10	15	20	25	32	40	50	65	80
mm/in	1/4	3/8	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3
A	9.60	9.60	12.50	20.00	24.70	32.00	38.10	50.00	63.50	76.00
mm/in	0.378	0.378	0.492	0.787	0.972	1.260	1.500	1.969	2.500	2.992
B	50.28	50.28	52.60	59.25	62.35	79.90	84.80	94.60	122.05	131.55
mm/in	1.980	1.980	2.071	2.333	2.455	3.146	3.339	3.724	4.805	5.179
C	55.80	55.80	60.50	72.50	85.50	93.00	110.50	128.00	153.80	175.50
mm/in	2.197	2.197	2.382	2.854	3.366	3.661	4.350	5.039	6.055	6.909
D	96.00	96.00	96.00	119.00	119.00	149.00	149.00	174.00	244.00	244.00
mm/in	3.780	3.780	3.780	4.685	4.685	5.866	5.866	6.850	9.606	9.606
E	*	*	M5	M6	M6	M8	M8	M8	†	†
F	12.70	12.70	12.70	15.80	15.80	17.68	25.00	23.60	72.10	70.00
mm/in	0.500	0.500	0.500	0.622	0.622	0.696	0.984	0.929	2.839	2.756
G	25.40	25.40	25.40	29.40	29.40	35.35	49.50	50.00	72.10	73.00
mm/in	1.000	1.000	1.000	1.157	1.157	1.392	1.949	1.969	2.839	2.874
H	20.78	20.78	23.10	28.75	27.85	36.20	37.30	36.10	45.35	44.85
mm/in	0.818	0.818	0.909	1.132	1.096	1.425	1.469	1.421	1.785	1.766
I	5.52	5.52	5.55	6.50	6.50	8.07	8.07	10.00	12.00	12.00
mm/in	0.217	0.217	0.219	0.256	0.256	0.317	0.317	0.394	0.472	0.472
J	8.00	8.00	8.00	10.00	10.00	12.00	12.00	14.00	16.00	16.00
mm/in	0.315	0.315	0.315	0.394	0.394	0.480	0.480	0.551	0.630	0.630
CV	7.0	7.0	15.0	45.0	65.0	125.0	175.0	380.0	500.0	900.0
weights	0.230	0.225	0.280	0.520	0.765	1.292	1.864	3.170	5.796	8.285
kg/lb	0.506	0.495	0.616	1.144	1.683	2.842	4.101	6.974	12.751	18.227

* Untapped
† dimpled at drilling location

 Technical data, dimensions, materials & specifications are subject to change without notice.

M. A. Stewart & Sons Ltd.
VALVES AND FITTINGS

B Series Forged Brass Ball Valves

B-3

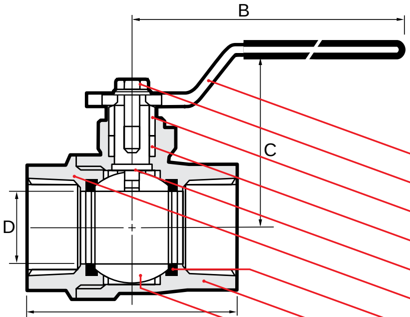
LISTED 5SAO
Trim & Drain
C US
FM

Forged 2 piece construction, Full port
ANSI B1.20.1 NPT ends
Blowout-proof stem, Chrome plated ball
Adjustable packing gland
Class 150 WSP, 600 WOG

Certified to:
ANSI Z21.15/CSA 9.1 (1/2 PSIG)
ASME B16.44/CGA-CR91-002 (2 & 5 PSIG)
ASME B16.33/CGA-3.16 (125 PSIG)
-40° to 120°F

** Suitable for use with natural gas, manufactured gas and liquefied petroleum gases (distributed as vapour with or without the admixture of air), or mixtures thereof. Not for use on Sour Gas.

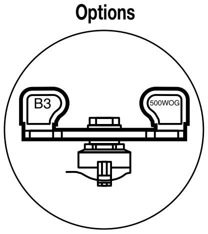
B3SS-LL (SS Trim) is available for 1/4" to 2"



PART / MATERIAL B-3	B-3SS-LL
1. Lever / Steel ASTM A36	**(AISI 430SS)**
2. Lever Screw / Steel ASTM A36	**(AISI 430SS)**
3. Packing Nut / Brass ASTM B124-C37700	
4. Packing / PTFE	
5. Stem / Brass ASTM B124-C37700	**(ASTM A276 Type 316SS)**
6. Cap / Brass ASTM B283-C37700	
7. Seats / PTFE	
8. Body / Brass ASTM B283-C37700	
9. Ball / Brass ASTM B124-C37700 Chrome Plated	**(ASTM A276 Type 316SS)**
10. Wing and Latch lock handles / Steel A36 Zinc Plated	

Options

(1/4 to 2")

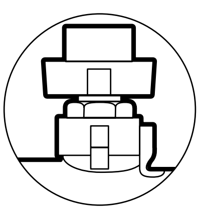


B3W
(wing handle)

(1/4 to 2")

B3LL
(Latch lock handle)

(1" to 2")



B3SH
(Square head operator)

DIMENSIONS

size (in.)	1/4	3/8	1/2	3/4	1	1 1/4	1 1/2	2	*2 1/2	*3	*4
A	44	44	54	62.2	72.4	83.2	96.4	110.3	150	173.2	192
mm/in	1.73	1.73	2.12	2.44	2.84	3.27	3.79	4.34	5.90	6.81	7.55
B	81	81	91.5	91.5	126.5	126.5	141.5	141.5	281	281	281
mm/in	3.18	3.18	3.60	3.60	4.98	4.98	5.57	5.57	11.06	11.06	11.06
C	39	39	53.4	57	65.3	70	83	90.5	118	130	143
mm/in	1.55	1.54	2.12	2.26	2.57	2.76	3.28	3.58	4.65	5.20	5.62
D	10	10	15	20	25	32	40	50	65	80	100
mm/in	0.39	0.39	0.59	0.78	0.98	1.25	1.57	1.96	2.55	3.14	3.93
CV	8	8	15	30	60	110	130	360	450	620	1200
Weight	0.25	0.25	0.50	0.75	1.2	1.8	2.7	3.9	8.4	11	16.5
lb/kg	0.12	0.12	0.23	0.34	0.55	0.82	1.23	1.8	3.8	5.0	9.5

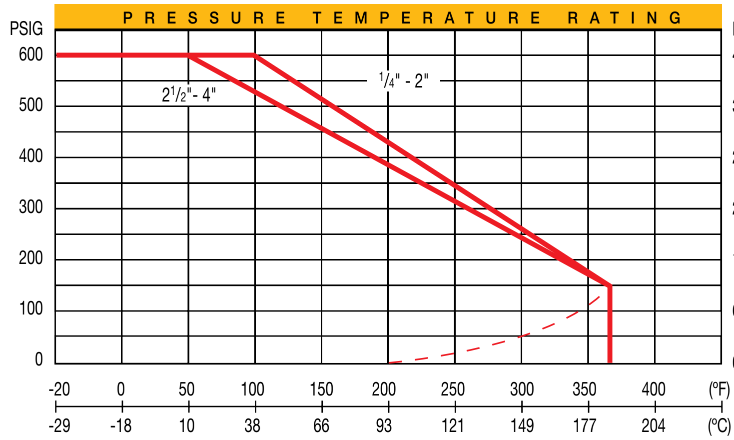
***NOTES:**

1) 2 1/2" and 3" sizes are certified for 1/2 to 5 PSIG gas services only

2) Gas certifications listed are not applicable to 4" size.

3) UL listings are not applicable to 2 1/2" – 4"

PRESSURE TEMPERATURE RATING



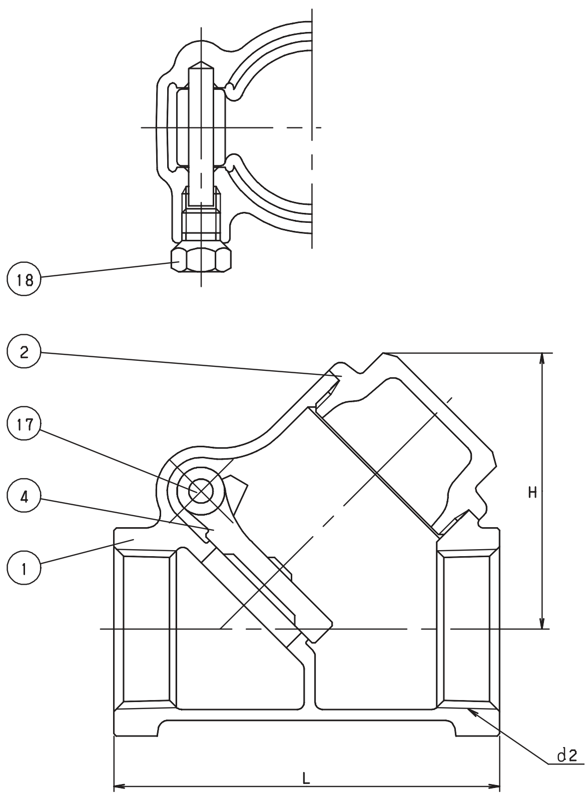
Max limit for saturated steam applications: 150 PSIG 366°F
121/665

CHECK
CLASS 125 BRONZE

Screw Cap • Integral Seat
Y-Pattern Swing Type Disc

BRONZE CHECK

CODE # 22 (AKYR)
THREADED



STANDARDS	
END TO END	KITZ
THREADED ENDS	ANSI B1.20.1
SOLDER JOINT ENDS	ANSI B16.18
DESIGN	MSS SP-80, TYPE 3
MILITARY	MSS SP-80, TYPE 3

PRESSURE/TEMPERATURE

125 PSI - SATURATED STEAM TO 353ºF
- FLUID TO 406ºF
200 PSI NON-SHOCK COLD WATER, OIL OR GAS

**SEE PRESSURE/TEMPERATURE LIMITATIONS FOR SOLDER JOINT VALVES - PAGE BIV-53.*

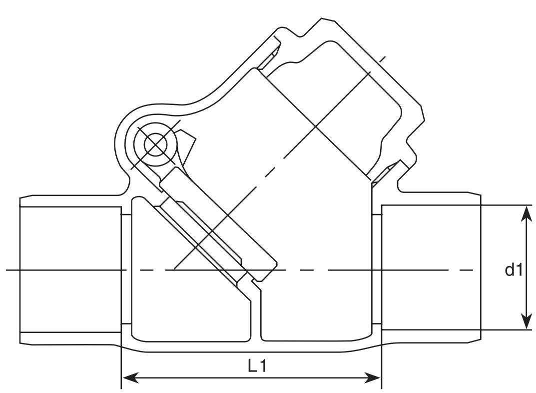
MATERIAL LIST

NO.	NAME OF PART	SPECIFICATION
1	BODY	CAST BRONZE (ASTM B62)
2	CAP	FORGED BRASS (B283, C37700)
4	DISC	CAST BRONZE (ASTM B62)
17	HINGE PIN	COPPER
18	PLUG	BRASS ROD (B16)

DIMENSIONS • WEIGHTS • QUANTITIES

	d2 SIZE	H	L	L1	d1 Max.	d1 Min.	APPROX. NET WT.	CARTON QTY
in.	1/2	1.57	2.20	1.64	.631	.627	0.52	96
mm.		39.9	55.9	41.7	16.0	15.9	0.2	
in.	3/4	1.93	2.76	1.88	.881	.877	0.88	60
mm.		49.0	70.1	47.8	22.4	22.3	0.4	
in.	1	2.28	3.15	2.31	1.132	1.128	1.33	48
mm.		57.9	80.0	58.7	28.8	28.7	0.6	
in.	1 1/4	2.8	3.74	2.83	1.382	1.378	2.04	24
mm.		71.1	94.0	71.9	35.1	35.0	0.9	
in.	1 1/2	3.15	4.33	3.21	1.633	1.628	2.78	18
mm.		80.0	80.01	81.5	41.5	41.4	1.3	
in.	2	3.74	5.04	4.02	2.133	2.128	4.58	12
mm.		94.0	128.0	102.1	54.2	54.1	2.1	
in.	2 1/2	4.49	6.14	4.69	2.633	2.628	7.67	6
mm.		114.0	155.0	119.1	66.9	66.8	3.5	
in.	3	5.16	7.24	5.42	3.133	3.128	11	4
mm.		131.1	183.9	137.7	79.6	79.5	5.0	

CODE # 23 (CYR)
SOLDER*



Bronze Swing Check Valve

Figure 4092J

Class 150 • Threaded Cap • Brass/Bronze Disc • Threaded Ends

Features

- Two piece disc hinge assembly, with regrindable seating, and rotating disc.
- Easy access cap permits quick regrinding.
- Free to rotate disc design allows the disc to close in a different position on the integral seat each time it operates.
- Always install with pressure under the disc in vertical or horizontal position. An arrow cast on the body indicates the correct direction of flow.
- Y-Pattern Body
- Screwed Cap
- MSS Specification SP-80

For more detailed features,
refer to Page 29.

Figure 4092J

Size Range:

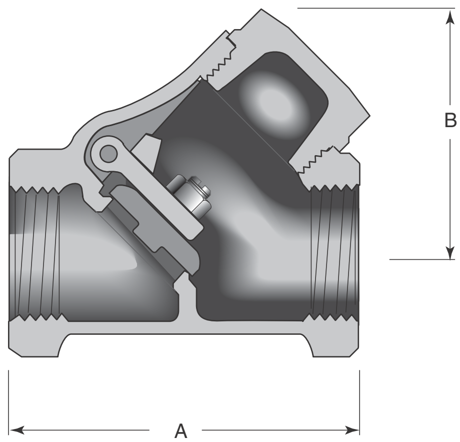
¼ through 3 inches

Working Pressures

Non-Shock:

150 psi Steam, Basic Rating

300 psi Cold Working Pressure



Principal Parts & Materials

Part	Sizes	Material	ASTM
Body & cap	All	Bronze	B62 alloy C83600
Hinge	All	Bronze	B584 alloy C87600
Disc	¼" - ¾"	Brass	B16 H02
Disc	1" - 3"	Bronze	B62 alloy C83600
Hinge Pin	All	Bronze	B150 alloy 64200

Dimensions and Weights

Inches (millimeters) - pounds (kilograms)

	¼ (6)	3/8 (10)	½ (15)	¾ (20)	1 (25)	1 ¼ (32)	1 ½ (40)	2 (50)	2 ½ (65)	3 (80)
A	1.94 (49)	1.94 (49)	2.15 (55)	2.71 (69)	3.18 (81)	3.81 (97)	4.34 (110)	5.13 (130)	6.12 (155)	7.25 (184)
B	1.50 (38)	1.50 (38)	1.59 (40)	1.97 (50)	2.43 (62)	3.00 (76)	3.50 (89)	4.00 (102)	4.76 (121)	5.57 (142)
WTS.	0.50 (0.23)	0.50 (0.23)	0.60 (0.27)	1.00 (0.45)	1.50 (0.68)	2.20 (1.00)	3.40 (1.54)	5.40 (2.44)	9.00 (4.09)	14.50 (6.59)

Chapter 17 SUBMERSIBLE PUMP

MANUFACTURER/DISTRIBUTOR:

Real-Jean
A/S Hugo Porier
8165-75 Lafrenaie
Montréal, Qc, H1P 2B1
Email: hpoirier@real-jean.com
Tel:(514)279-8592
Fax: (514)279-8595

WP-1 & WP-2

DIMENSIONS AND WEIGHTS

MODEL NO.	FIG.	HP	MOTOR SIZE	DISCH. SIZE	DIMENSIONS IN INCHES A	B	C	D	E	APPROX. SHIP WT.
300S30-1B	A	3	4"	3" NPT	38.1	23.6	14.5	3.8	5.7	65
300S50-1	A	5	4"	3" NPT	44.1	29.6	14.5	3.8	5.7	82
300S50-2BB	A	5	4"	3" NPT	49.1	29.6	19.5	3.8	5.7	87
300S75-2	A	7 1/2	4"	3" NPT	43.5	24.0	19.5	3.8	5.7	113
300S75-2*	A	7 1/2	6"	3" NPT	49.1	29.6	19.5	5.4	5.7	104
300S100-3A	A	10	4"	3" NPT	67.8	43.9	23.9	3.8	5.7	154
300S100-3A	A	10	6"	3" NPT	49.3	25.4	23.9	5.4	5.7	130
300S150-3	A	15	6"	3" NPT	51.9	28.0	23.9	5.4	5.7	146
300S150-4AA	A	15	6"	3" NPT	56.4	28.0	28.4	5.4	5.7	161
300S150-4	A	15	6"	3" NPT	56.4	28.0	28.4	5.4	5.7	161
300S200-5AA	A	20	6"	3" NPT	63.4	30.6	32.8	5.4	5.7	172
300S200-5	A	20	6"	3" NPT	63.4	30.6	32.8	5.4	5.7	172
300S200-6B	A	20	6"	3" NPT	67.9	30.6	37.3	5.4	5.7	177
300S250-6	A	25	6"	3" NPT	70.4	33.1	37.3	5.4	5.7	192
300S250-7AA	A	25	6"	3" NPT	74.8	33.1	41.7	5.4	5.7	201
300S300-7	A	30	6"	4" NPT	74.8	33.1	41.7	5.4	5.7	220
300S300-8	A	30	6"	4" NPT	81.9	35.7	46.2	5.4	5.7	241
300S300-9B	A	30	6"	4" NPT	81.9	35.7	46.2	5.4	5.7	246
300S400-9*	A	40	6"	4" NPT	91.4	40.8	50.6	5.4	5.7	281
300S400-10*	A	40	6"	4" NPT	95.9	40.8	55.1	5.4	5.7	286
300S500-11*	A	50	6"	4" NPT	117.3	57.8	59.5	5.4	5.7	292
300S500-12*	A	50	6"	4" NPT	116.8	57.8	63.9	5.4	5.7	396
300S500-13*	A	50	6"	4" NPT	126.2	57.8	68.4	5.4	5.7	402
300S600-14*	A	60	6"	4" NPT	135.3	61.3	74.0	5.4	7.1	447
300S600-15*	A	60	8"	4" NPT	120.3	41.8	78.5	7.5	7.1	484
300S750-16	A	75	8"	4" NPT	130.3	47.4	82.9	7.5	7.1	540
300S750-17	A	75	8"	4" NPT	134.8	47.4	87.4	7.5	7.1	544
300S750-18	A	75	8"	4" NPT	139.2	47.4	91.8	7.5	7.1	626

NOTES: Models 2-15 Stgs. are suitable for use in 6" wells, 16-18 Stgs. are suitable for use in 8" wells.
Weights include pump end with motor in lbs.
* Alternate motor sizes available.

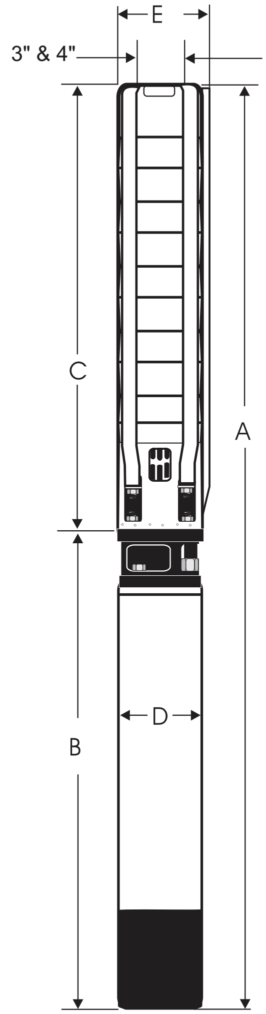


Fig. A

SHOP DRAWING

This review is solely for the verification of general design quality and does not alleviate the responsibility of the contractor for insuring that all specification, space and installation requirements are met.

Reviewed By: M.M. — Reviewed ☒ — Reviewed as noted ☐ — Resubmit ☐

Date: 19 Mar 2015

CHIARELLI ENGINEERING LTD.

Shop Drawings Contractor Approval
Approved by: M.A.G., G. F.
Date: Mar 03, 2015
SIFEC NORTH INC

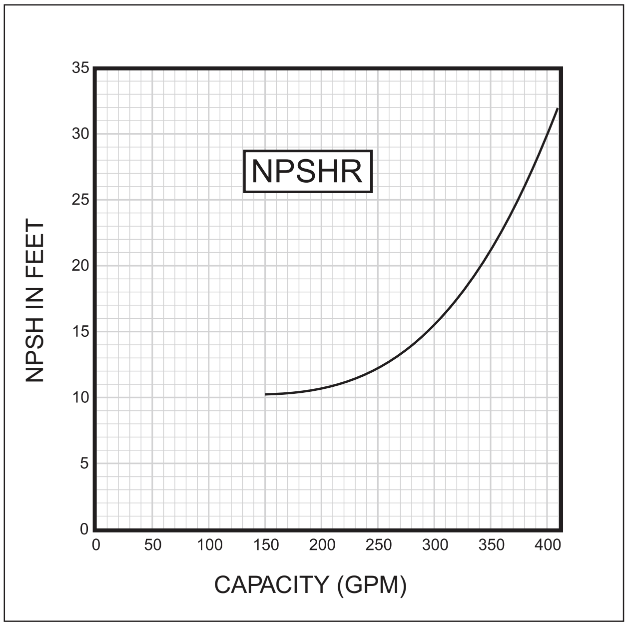
125/665

WP-1 & WP-2

MATERIALS OF CONSTRUCTION

COMPONENT	CYLINDRICAL SHAFT (2-18 Stgs.)
Check Valve Housing	304 Stainless Steel
Check Valve	304 Stainless Steel
Diffuser Chamber	304 Stainless Steel
Split Cone Nut	304 Stainless Steel
Split Cone	304 Stainless Steel
Impeller	304 Stainless Steel
Suction Interconnector	304 Stainless Steel
Inlet Screen	304 Stainless Steel
Straps	304 Stainless Steel
Cable Guard	304 Stainless Steel
Coupling	316/329 Stainless Steel**
Pump Shaft	431 Stainless Steel
Intermediate Bearings	NBR
Impeller Seal Ring	NBR/304 Stainless Steel
Check Valve Seat	NBR/316 Stainless Steel
Top/Lower Bearing	NBR/316 Stainless Steel
8" Motor Adaptor Plate	304 Stainless Steel
Upthrust Washer	Carbon/Graphite HY22
Upthrust stop ring	304 S.S./Tungsten Carbide

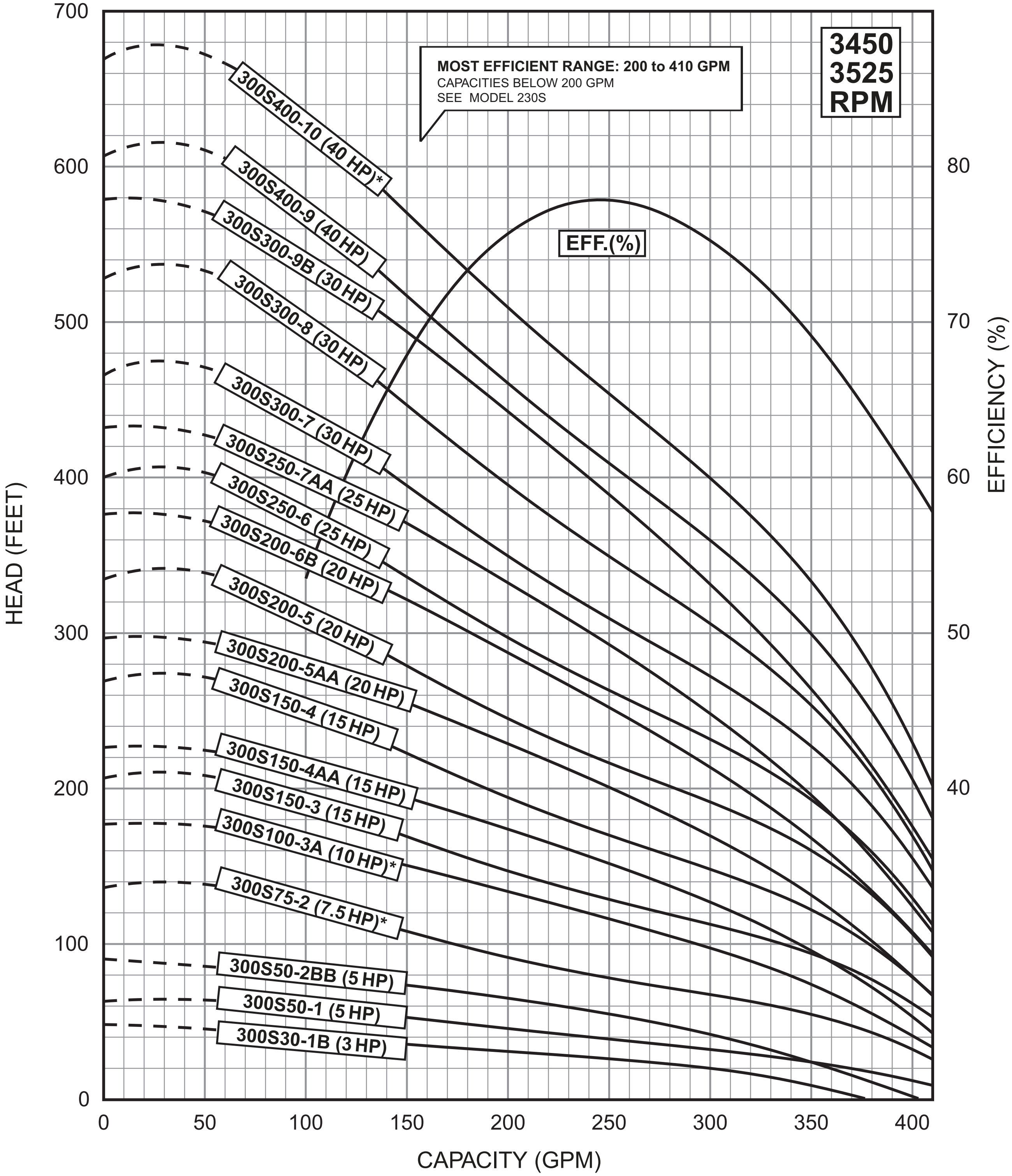
NOTES: Specifications are subject to change without notice.
***Stainless Steel options available.**
** 4" Coupling made of 316 Stainless Steel.



PERFORMANCE CURVES 300 GPM MODEL 300S

WP-1 & WP-2

FLOW RANGE: 60 -410 GPM **OUTLET SIZE: 3"& 4" NPT*** **NOMINAL DIA. 6"**

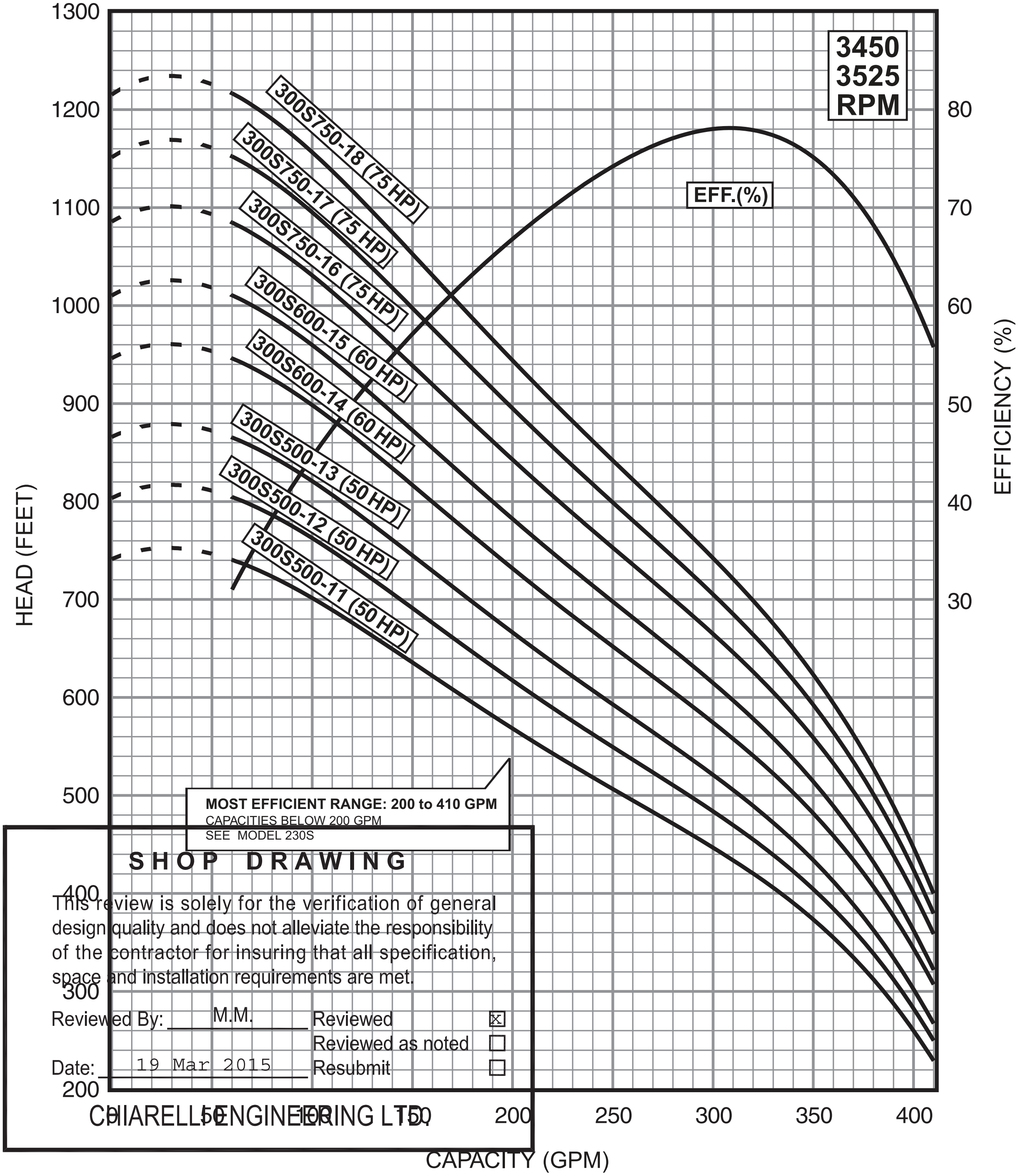


SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.
4" MOTOR STANDARD, 7.5 HP/3450 RPM.
6" MOTOR STANDARD,15-60 HP/3450 RPM.
8" MOTOR STANDARD, 75 HP/3525 RPM.
* 3" NPT 2-6 STAGES, 4" NPT 7-18 STAGES.

Performance conforms to ISO 9906 Annex A
@ 8 ft. min. submergence.

WP-1 & WP-2

FLOW RANGE: 60 -410 GPM **OUTLET SIZE: 3"& 4" NPT*** **NOMINAL DIA. 6"**



SHOP DRAWING

This review is solely for the verification of general design quality and does not alleviate the responsibility of the contractor for insuring that all specification, space and installation requirements are met.

Reviewed By: M.M. Reviewed ☒ Reviewed as noted ☐
Date: 19 Mar 2015 Resubmit ☐

CHIARELLI ENGINEERING LTD.

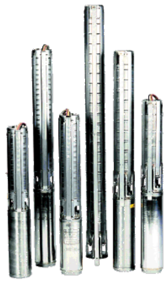
SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.
4" MOTOR STANDARD, 7.5 HP/3450 RPM.
6" MOTOR STANDARD,15-60 HP/3450 RPM.
8" MOTOR STANDARD, 75 HP/3525 RPM.
* 3" NPT 2-6 STAGES, 4" NPT 7-18 STAGES.

Performance conforms to ISO 9906 Annex A @ 8 ft. min. submergence.

Company name:
Created by:
Phone:

Date: 25/08/2016

Tender Text



Note! Product picture may differ from actual product

Product No.: 14B735C6
300S200-6-B
Multi-stage submersible pump for raw water supply, groundwater lowering and pressure boosting. The pump is suitable for pumping clean, thin, non-agressive liquids without solid particles or fibres.

The pump is made entirely of Stainless steel DIN W.-Nr. EN 1.4301.

The motor is a 3-phase motor with sand shield, liquid-lubricated bearings and pressure equalizing diaphragm.

Liquid:

Pumped liquid:	Water
Maximum liquid temperature:	40 °C
Max liquid t at 0.15 m/sec:	40 °C
Liquid temp:	20 °C
Density:	998.2 kg/m³

Technical:

Speed for pump data:	3450 rpm
Rated flow:	72 m³/h
Rated head:	60 m
Shaft seal for motor:	SIC/SICNBR
Curve tolerance:	ISO9906:2012 3B
Motor version:	T40

Materials:

Pump:	Stainless steel EN 1.4301 AISI 304
Impeller:	Stainless steel EN 1.4301 AISI 304
Motor:	Stainless steel DIN W.-Nr. 1.4301 AISI 304

Installation:

Maximum ambient pressure:	60 bar
Pump outlet:	3"NPT
Motor diameter:	6 inch

Electrical data:

Motor type:	MS6000
Rated power - P2:	15 kW 15 kW
Mains frequency:	60 Hz
Rated voltage:	3 x 440-460-480 V

Service factor:	1.15
Rated current:	33.5-32.5-32.0 A
Starting current:	520-570-610 %
Cos phi - power factor:	0.85-0.84-0.81
Rated speed:	3450-3470-3480 rpm
Start. method:	direct-on-line
Enclosure class (IEC 34-5):	IP68
Insulation class (IEC 85):	F
Built-in temp. transmitter:	yes

Others:

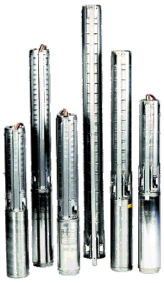
ErP status:	EuP Standalone/Prod.
Net weight:	75.1 kg
Gross weight:	105 kg
Shipping volume:	0.236 m³

GRUNDFOS

Company name:
Created by:
Phone:

Date: 25/08/2016

Position	Qty.	Description
	1	**300S200-6-B**



Note! Product picture may differ from actual product

Product No.: 14B735C6

Multi-stage submersible pump for raw water supply, groundwater lowering and pressure boosting. The pump is suitable for pumping clean, thin, non-agressive liquids without solid particles or fibres.

The pump is made entirely of Stainless steel DIN W.-Nr. EN 1.4301.

The motor is a 3-phase motor with sand shield, liquid-lubricated bearings and pressure equalizing diaphragm.

Liquid:

Pumped liquid:	Water
Maximum liquid temperature:	40 °C
Max liquid t at 0.15 m/sec:	40 °C
Liquid temp:	20 °C
Density:	998.2 kg/m³

Technical:

Speed for pump data:	3450 rpm
Rated flow:	72 m³/h
Rated head:	60 m
Shaft seal for motor:	SIC/SICNBR
Curve tolerance:	ISO9906:2012 3B
Motor version:	T40

Materials:

Pump:	Stainless steel EN 1.4301 AISI 304
Impeller:	Stainless steel EN 1.4301 AISI 304
Motor:	Stainless steel DIN W.-Nr. 1.4301 AISI 304

Installation:

Maximum ambient pressure:	60 bar
Pump outlet:	3"NPT
Motor diameter:	6 inch

Electrical data:

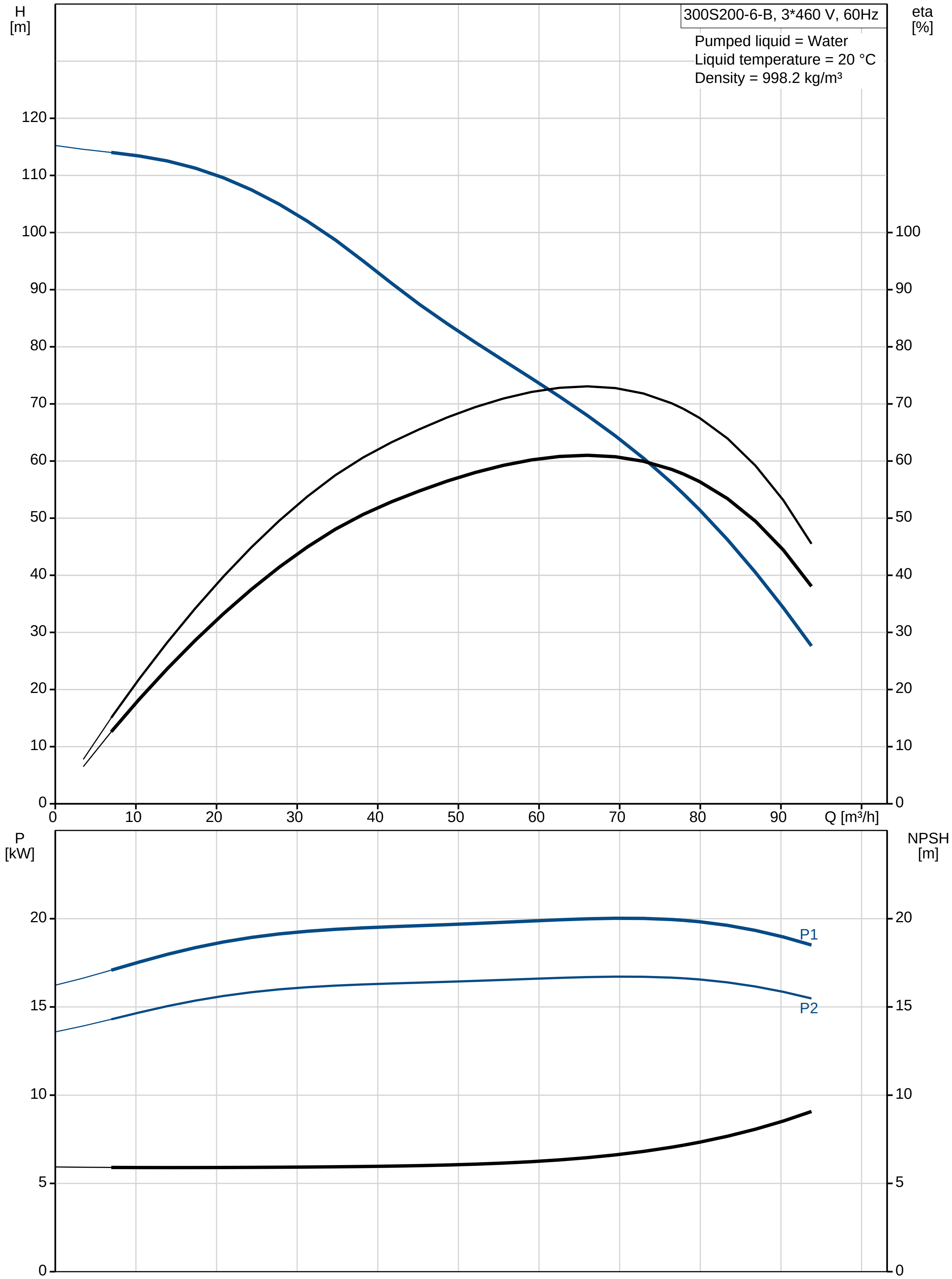
Motor type:	MS6000
Rated power - P2:	15 kW 15 kW
Mains frequency:	60 Hz
Rated voltage:	3 x 440-460-480 V
Service factor:	1.15

Position	Qty.	Description	
		Rated current:	33.5-32.5-32.0 A
		Starting current:	520-570-610 %
		Cos phi - power factor:	0.85-0.84-0.81
		Rated speed:	3450-3470-3480 rpm
		Start. method:	direct-on-line
		Enclosure class (IEC 34-5):	IP68
		Insulation class (IEC 85):	F
		Built-in temp. transmitter:	yes
		Others:	
		ErP status:	EuP Standalone/Prod.
		Net weight:	75.1 kg
		Gross weight:	105 kg
		Shipping volume:	$0.236\ m^3$

Company name:
Created by:
Phone:

Date: 25/08/2016

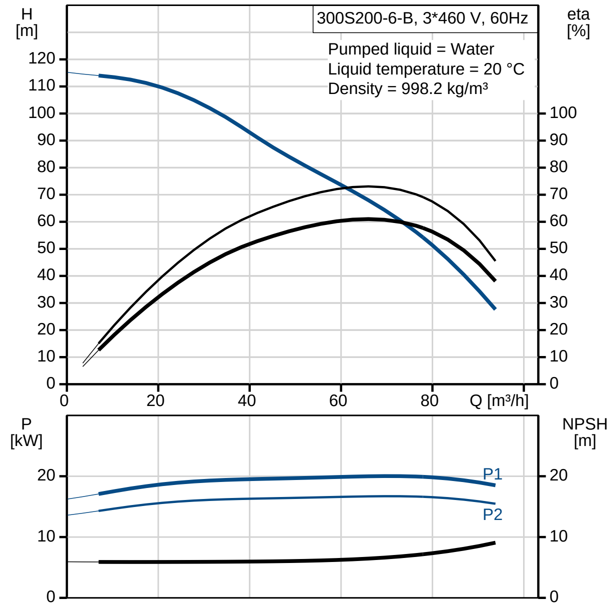
14B735C6 300S200-6-B 60 Hz

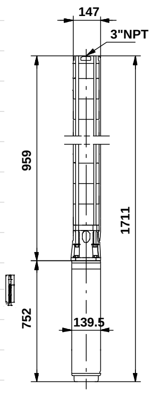


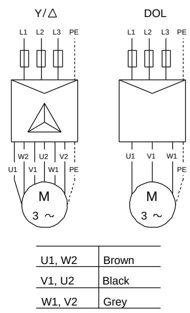
Company name:
Created by:
Phone:

Date: 25/08/2016

Description	Value
General information:	
Product name:	300S200-6-B
Product No:	14B735C6
EAN number:	5700393985872
Price:	On request
Technical:	
Speed for pump data:	3450 rpm
Rated flow:	72 m³/h
Rated head:	60 m
Impeller reduc.:	B
Shaft seal for motor:	SIC/SICNBR
Curve tolerance:	ISO9906:2012 3B
Stages:	6
Model:	B
Valve:	YES
Motor version:	T40
Materials:	
Pump:	Stainless steel
	EN 1.4301
	AISI 304
Impeller:	Stainless steel
	EN 1.4301
	AISI 304
Motor:	Stainless steel
	DIN W.-Nr. 1.4301
	AISI 304
Installation:	
Maximum ambient pressure:	60 bar
Pump outlet:	3"NPT
Motor diameter:	6 inch
Liquid:	
Pumped liquid:	Water
Maximum liquid temperature:	40 °C
Max liquid t at 0.15 m/sec:	40 °C
Liquid temp:	20 °C
Density:	998.2 kg/m³
Electrical data:	
Motor type:	MS6000
Applic. motor:	GRUNDFOS
Rated power - P2:	15 kW
	15 kW
KVA code:	J
Mains frequency:	60 Hz
Rated voltage:	3 x 440-460-480 V
Service factor:	1.15
Rated current:	33.5-32.5-32.0 A
Starting current:	520-570-610 %
Cos phi - power factor:	0.85-0.84-0.81
Rated speed:	3450-3470-3480 rpm
Axial load max:	27 kg
Start. method:	direct-on-line
Enclosure class (IEC 34-5):	IP68
Insulation class (IEC 85):	F
Motor protec:	NONE





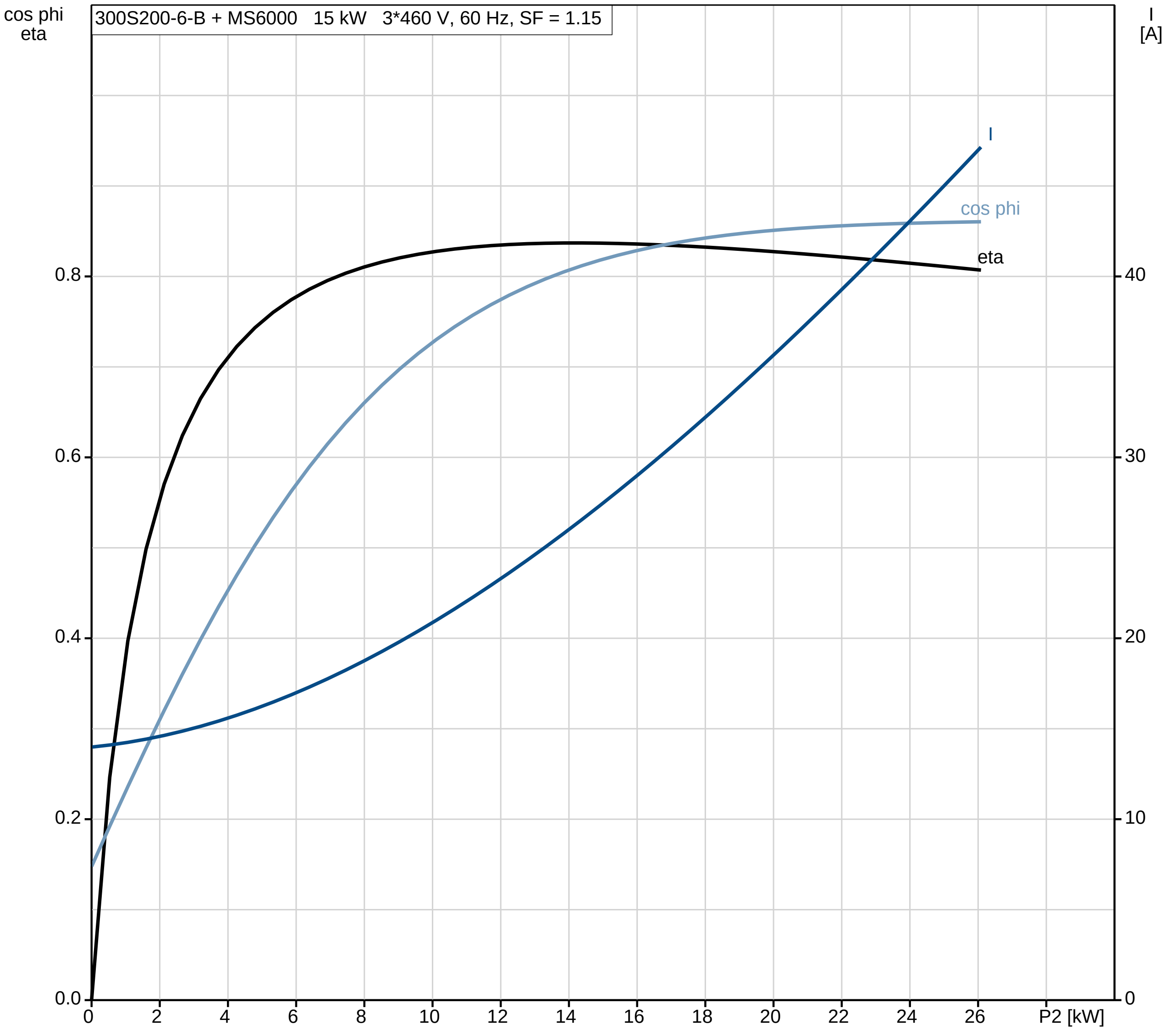


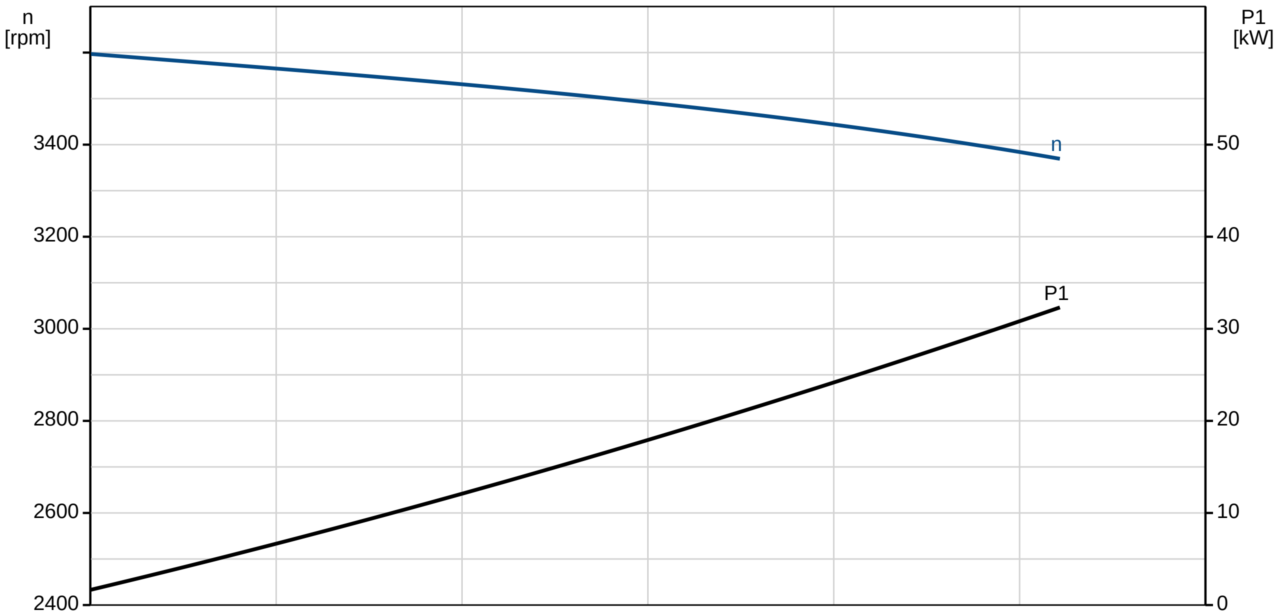
Description	Value
Thermal protec:	external
Built-in temp. transmitter:	yes
Motor No:	96166166
Cable number:	96163476
Others:	
ErP status:	EuP Standalone/Prod.
Net weight:	75.1 kg
Gross weight:	105 kg
Shipping volume:	0.236 m³
Sales region:	Namreg

Company name:
Created by:
Phone:

Date: 25/08/2016

14B735C6 300S200-6-B 60 Hz

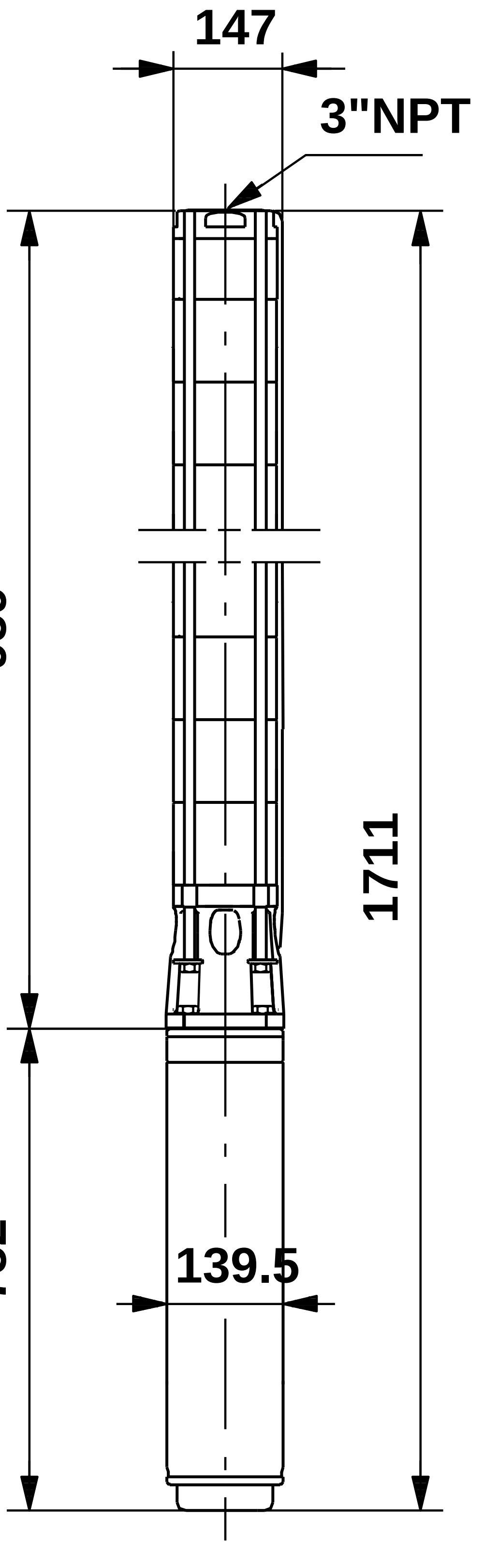




Company name:
Created by:
Phone:

Date: 25/08/2016

14B735C6 300S200-6-B 60 Hz



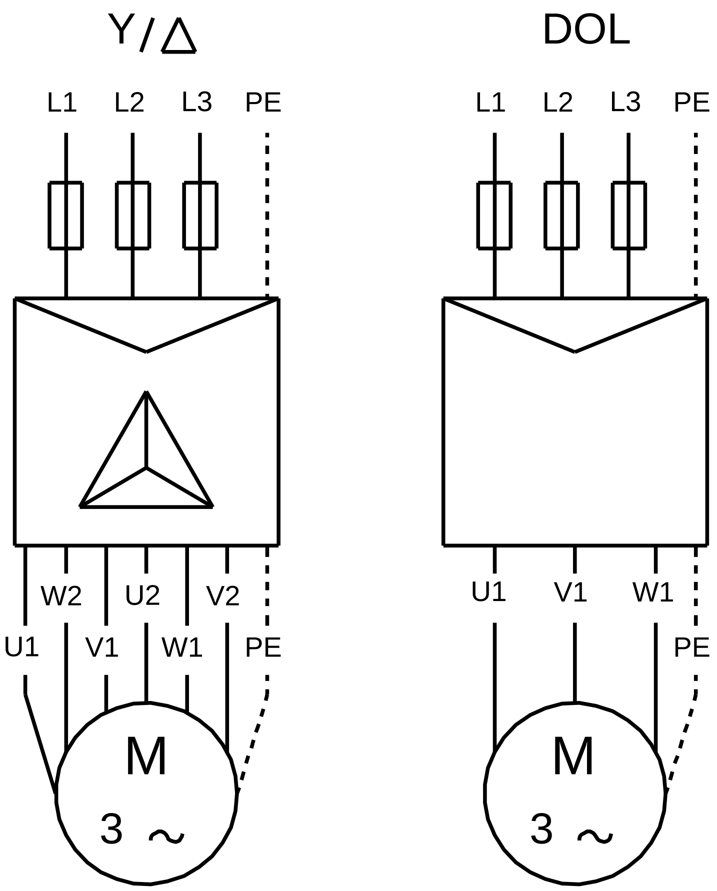
Note! All units are in [mm] unless others are stated.
Disclaimer: This simplified dimensional drawing does not show all details.

GRUNDFOS

Company name:
Created by:
Phone:

Date: 25/08/2016

14B735C6 300S200-6-B 60 Hz



U1, W2	Brown
V1, U2	Black
W1, V2	Grey

Note! All units are in [mm] unless others are stated.

GRUNDFOS

Company name:
Created by:
Phone:

Date: 25/08/2016

Order Data:

Product name:	300S200-6-B
Amount:	1
Product No:	14B735C6
Price:	On request

Total: Price on request

GRUNDFOS

Company name:
Created by:
Phone:

Date: 25/08/2016

Parts list 300S200-6-B, Product No. 14B735C6
Valid from 1.12.2006 (0649)

	Pos	Description	Annotation	Classification Data	Part no.	Qty.	Unit
-		Pump w/o motor				1	pcs
-		Shaft, cableg.,strap				1	
	16	Shaft cpl.					
	26	Strap cpl.					
	181a	Cable guard cpl.					
	1	Valve casing				1	
	2	Valve cone				1	
-	3	Chamber cpl.				1	
		Chamber					
-	6	Bearing, top					
	6b	Bearing					
	6b	Cup					
	45	Valve seat					
	8a	Washer				1	
-	9	Chamber cpl.				4	
		Chamber					
	7	Seal ring					
	8	Bearing					
+	10	Chamber cpl.				1	
-	13	Impeller, reduced diameter		Type: B-TRIM		1	
	72	Wear ring					
-	13	Impeller cpl.				1	
	11	Split cone nut					
	12	Split cone					
	72	Wear ring					
	14	Suction interconnector				1	
	15	Strainer				1	
	19	Nut				4	
	23	Rubber guard				1	
-	49	Impeller cpl.				5	
	72	Wear ring					
	68	Seal ring				1	
	74	Hex head screw				4	
	76	Nameplate				2	
-		Motor				1	pcs
		Motor liquid				2	
		Filter				1	
		Welding material				3	
	101b	Helical compression spring				1	
	202	Shaft w/rotor				1	
	203	Thrust ring support cpl.				1	
	205	Bearing retainer				1	
	207	Strainer				1	
	208	Thrust ring support				1	
	209	Pin				1	
	210	Thrust bearing support				1	
	212	Diaphragm				1	
	212	Diaphragm				1	
	213	End cover				1	
	215	Socket set screw				2	
	216	Washer				1	
	216b	Nut				1	
	217	Spring retainer				1	

GRUNDFOS

Company name:
Created by:
Phone:

Date: 25/08/2016

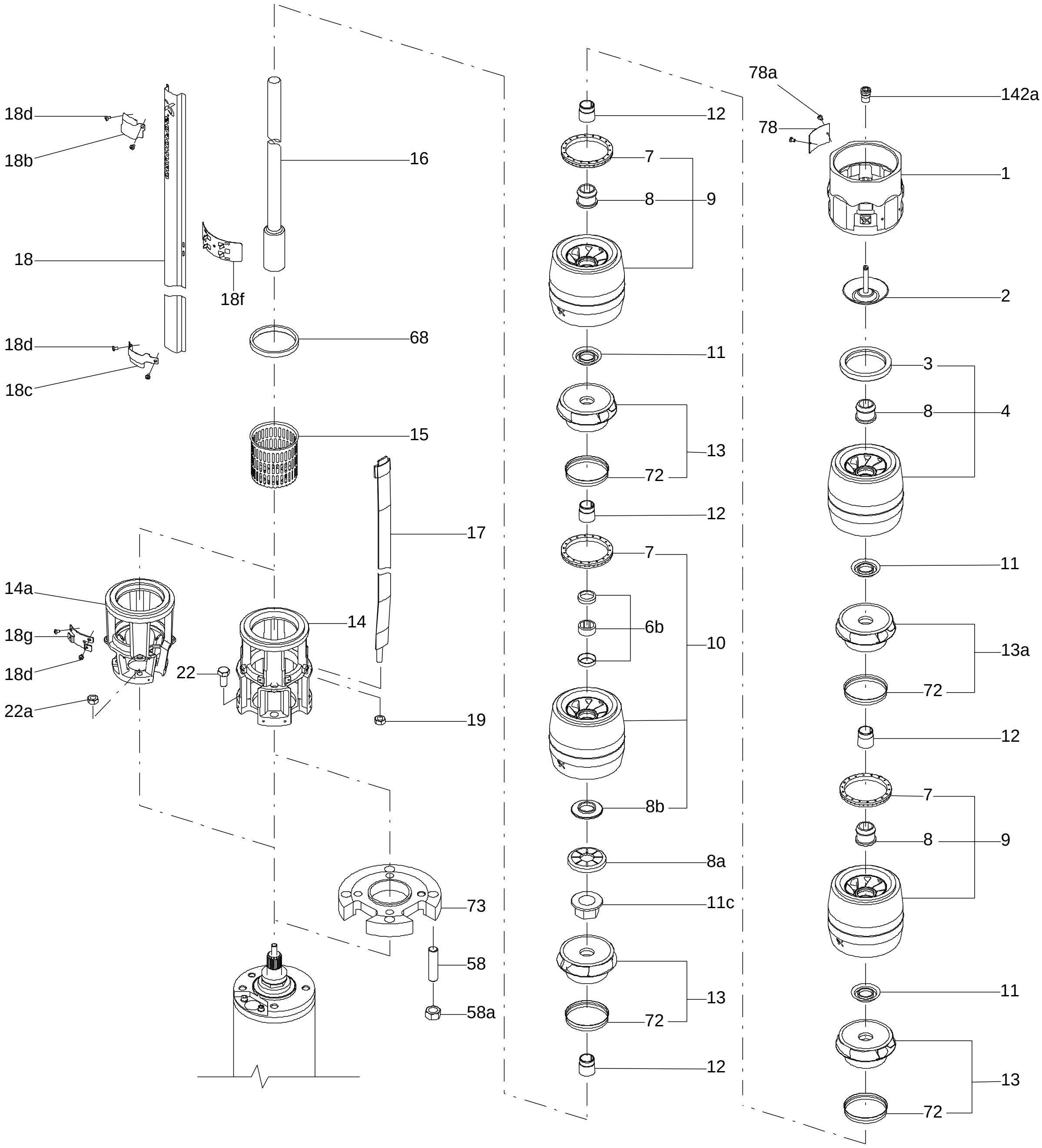
	Pos	Description	Annotation	Classification Data	Part no.	Qty.	Unit
	219	Thrust bearing housing				1	
	222	Valve				1	
	224	O-ring				2	
	226	Shaft seal housing				1	
	226a	Shaft seal, stationary part				1	
	226b	Shaft seal, rotating part				1	
+	229	Sand shield				1	
	231	O-ring				1	
	232	Lip seal ring				1	
	236	Bearing retainer				1	
	236a	Socket set screw				2	
	242	Upthrust spacer				1	
	220	Cable w/plug				1	pcs

GRUNDFOS

Company name:
Created by:
Phone:

Date: 25/08/2016

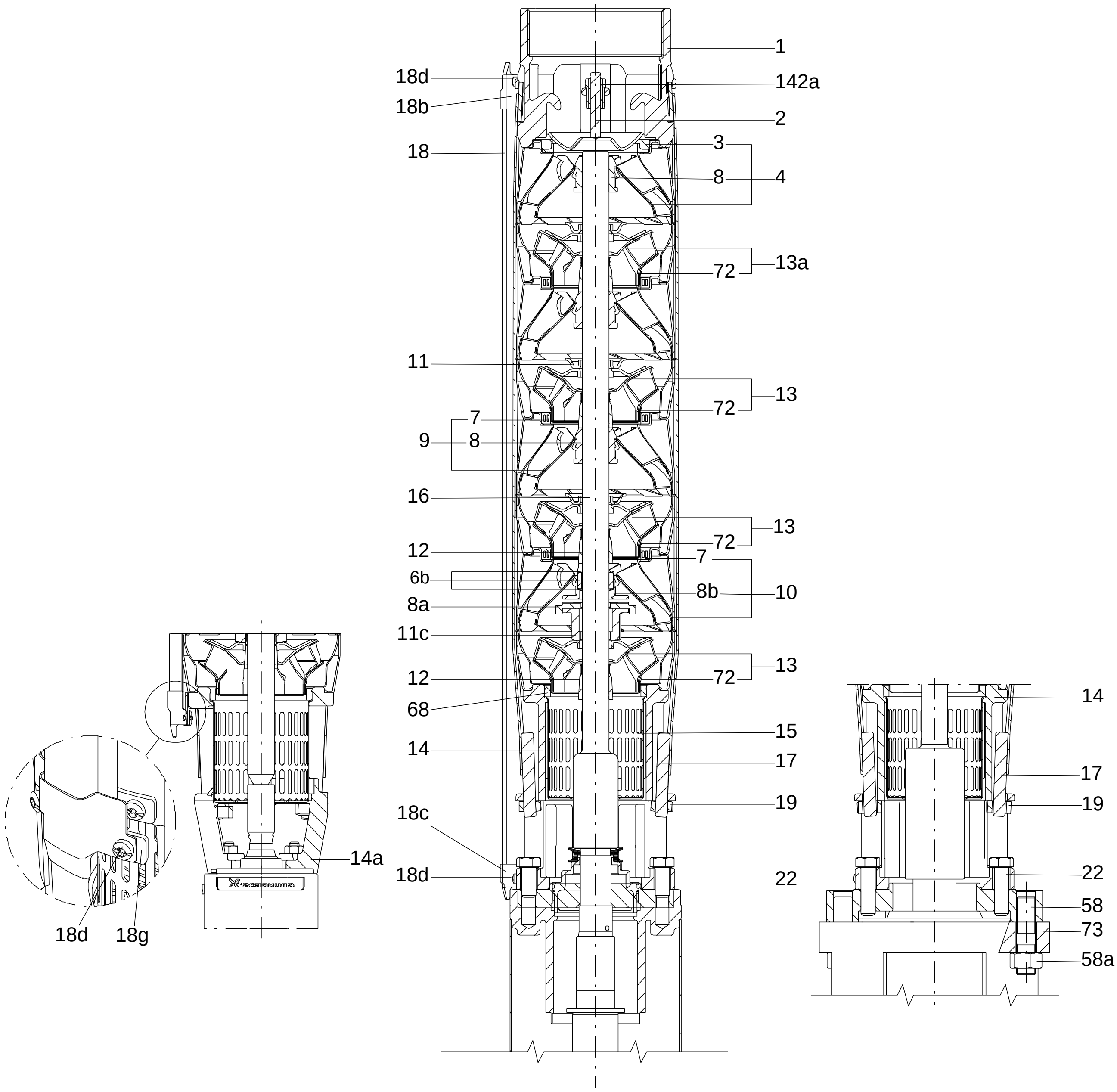
Exploded view (TM054015 SP(LDC) w/1 red. impel(XXA))



Company name:
Created by:
Phone:

Date: 25/08/2016

Sectional drawing (TM054154 SP(LDC) XXA Stage w/1 red.impeller)



Chapter 18 MODULATING VALVES

MANUFACTURER/DISTRIBUTOR:

WOLSELEY Inc.
4200, Hickmore
St-Laurent, QC, H4T 1K2
Phone: (514) 344-9378
Fax :(514) 344-9341

18.1 **BALL VALVE IPEX 053137 MV-1, MV-2, MV-3, MV-4**

18.2 **SOLENOID VALVE SV-01, SV-02**

18.3 **FLOW SWITCH FS4-3 MCDONNELL & MILLER**

FK Series Automated Butterfly Valves

Product Data Sheet

SHOP DRAWING

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Reviewed By: M.M. — Reviewed ☒ / Reviewed as noted ☐ / Resubmit ☐

Date: 19 Mar 2015

CHIARELLI ENGINEERING LTD.

introduction

< STANDARDS >

ASTM D1784
ASTM D3222
ASTM D4101

ANSI B16.5

IPEX FK Series Automated Butterfly Valves offer superior strength and chemical resistance in highly corrosive environments and process flow conditions. This versatile industrial valve features double self-lubricating seals, and a special shaped liner and body cavity guaranteeing a bubble tight seal while keeping break-away torque at an absolute minimum. An integral stainless steel lug version provides for full bi-directional operation allowing disassembly of the downstream flange connection without weakening the integrity of the upstream connection to the pressurized line. FK Series Automated Butterfly Valves are part of our complete systems of pipe, valves, and fittings, engineered and manufactured to our strict quality, performance, and dimensional standards.

Valve Availability

Body Material:	Glass reinforced PP (GFPP)
Disc Material:	PP, PVC, CPVC, ABS, PVDF
Size Range:	1-1/2" through 12"
Pressure:	232psi (1-1/2" to 2"), 150psi (2-1/2" to 10"), 120psi (12")
Seats:	EPDM or FPM
Seals:	EPDM or FPM
Body Style:	Wafer or Lugged
End Connections:	Flanged (ANSI 150)
Actuator Control:	Double Acting Pneumatic, Spring Return Pneumatic, Electric

Shop Drawings
Contractor Approval
Approved by: J.D., G.F.
Date: 12/03/15
SIFEC NORTH INC

www.ipexinc.com
Toll Free: 866 473-9462

145/665

MV-1, MV-2, MV-3, MV-4

FK Series Automated Butterfly Valves

Sample Specification

1.0 Butterfly Valves - FK

1.1 Material

- The valve body shall be made of glass reinforced polypropylene (GRPP) obtained from homopolymer polypropylene (PPH).
- The valve disc shall be made of stabilized PP homopolymer compound, also containing a RAL 7032 pigment, which shall meet or exceed the requirements of Type I Polypropylene according to ASTM D4101.
- The valve disc shall be made of PVC compound which shall meet or exceed the requirements of cell classification 12454 according to ASTM D1784.
- The valve disc shall be made of Corzan® CPVC compound which shall meet or exceed the requirements of cell classification 23447 according to ASTM D1784.
- The valve disc shall be made of virgin, non-regrind PVDF compound which shall meet or exceed the requirements of Table 1 according to ASTM D3222.
- The valve disc shall be made of Duraplus® ABS compound which shall meet or exceed the requirements of cell classification 43234 according to ASTM D3965.
- The valve shaft shall be made of 420 stainless steel.

1.2 Seats

- The disc liner shall be made of EPDM.
- The disc liner shall be made of FPM.

1.3 Seals

- The o-ring seals shall be made of EPDM.
- The o-ring seals shall be made of FPM.

1.4 All wetted parts of the valves shall comply with standards that are equivalent to NSF Standard 61 for potable water.

2.0 Connections

2.1 Flanged style

- The ANSI 150 flanged connections shall conform to the dimensional standard ANSI B16.5.

S H O P   D R A W I N G

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Reviewed By: M.M. — Reviewed ☒ / Reviewed as noted ☐ / Resubmit ☐

Date: 19 Mar 2015

CHIARELLI ENGINEERING LTD.

www.ipexinc.com
Toll Free: 866 473-9462

146/665

FK Series Automated Butterfly Valves

Sample Specification (cont'd)

3.0 Design Features

- The valve shall be of either wafer or lugged design (specifier must select one).
- The lugged style shall feature permanently integrated stainless steel lugs. No field inserted lugs allowed.
- The shaft shall have standard ISO square dimensions for direct mounting of actuators.
- The disc seat shall be a trapezoidal elastomeric liner and provide a bubble tight seal.
- The liner shall completely isolate the valve body from the process flow.
- The liner shall function as a flange gasket on both sides of the valve.
- The body cavity shall feature special channeling to prevent liner slippage and compression.
- The disc, seats, and seals shall be the only wetted parts.
- Teflon® seated o-ring seals shall prevent the stainless steel shaft from becoming wetted.

3.1 Pressure Rating

- All valves sizes 1-1/2" through 2" shall be rated at 232psi at 73ºF.
- All valves sizes 2-1/2" through 10" shall be rated at 150psi at 73ºF.
- All valves sizes 12" shall be rated at 120psi at 73ºF.

3.2 Markings

- All valves shall be marked to indicate size, material designation, and manufacturers name or trade mark.

3.3 Color Coding

- All valves shall be color-coded beige gray.

4.0 All valves shall be by IPEX or approved equal.

SHOP DRAWING

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Reviewed By: M.M. — Reviewed ☒ / Reviewed as noted ☐ / Resubmit ☐

Date: 19 Mar 2015

CHIARELLI ENGINEERING LTD.

MV-1, MV-2, MV-3, MV-4

FK Series Automated Butterfly Valves

Sample Specification (cont'd)

5.0 Actuators

- All Actuators shall be factory installed by IPEX

Pneumatic Actuator:

- Shall be sized for 80 psi control air pressure
- Shall be dual piston rack and pinion design with linear torque output.
- Body shall be Technopolymer UT series or Anodized Aluminum MT series with standard position indicator and NAMUR VDI/VDE 3845 and ISO 5211 mounting dimensions.
- All models shall be operable using air, water, nitrogen or compatible hydraulic fluids from 40 – 120psi.
- Aluminum body models shall feature dual travel stops that provide +/- 10° stroke rotation on both the opening and closing phases.
- All external fasteners shall be stainless steel.

Electric Actuator:

- Shall have 100VAC – 240VAC reversing motors with torque limiters, thermal protection, auxiliary limit switches, NEMA 4X enclosure*, manual override, and position indicator as standard.

or Shall have 24VDC reversing motors with torque limiters, thermal protection, auxiliary limit switches, NEMA 4X enclosure*, manual override, and position indicator as standard.

- 4-20mA positioner, battery backup, and 180° rotation models shall be available in 100 – 240VAC and 24VDC
- All models shall have ISO 5211 mounting dimensions

* Type 4X Indoor Use Only Enclosure

SHOP DRAWING

This review is solely for the verification of general design quality and does not alleviate the responsibility of the contractor for insuring that all specification, space and installation requirements are met.

Reviewed By: M.M. — Reviewed ☒ — Reviewed as noted ☐

Date: 19 Mar 2015 — Resubmit ☐

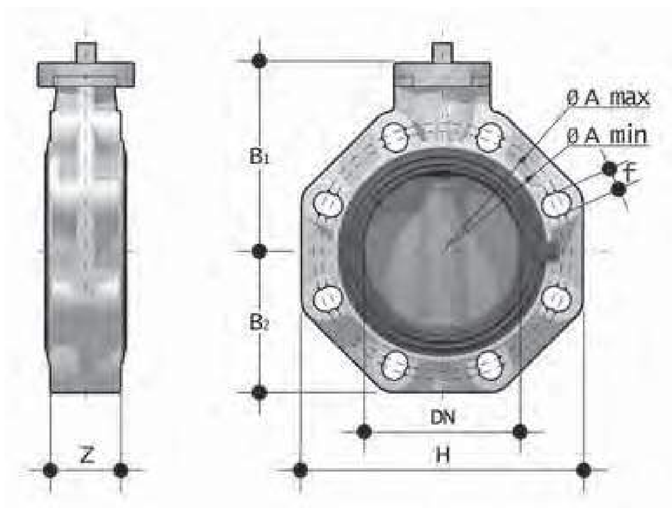
CHIARELLI ENGINEERING LTD.

FK Series Automated Butterfly Valves

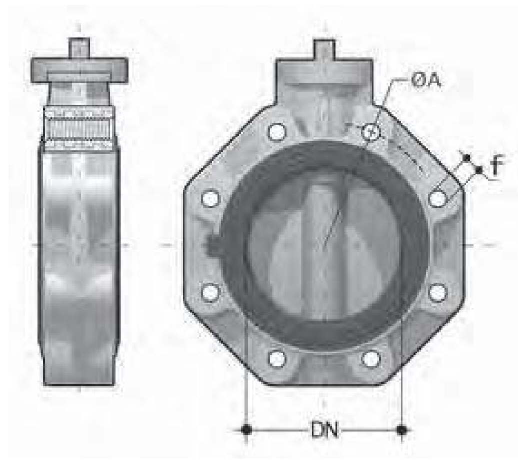
Technical Data

dimensions

wafer style



lugged style



Dimensions (inches)

Size	DN	Z	B_1	B_2	H	A_{min}	A_{max}	f	A_{lug}	f_{lug}	# holes
1-1/2	1.57	1.30	4.17	2.36	5.20	3.90	4.29	0.75	3.87	1/2-UNC	4
2	1.97	1.69	4.41	2.76	5.79	4.53	4.94	0.75	4.75	5/8-UNC	4
2-1/2	2.56	1.81	4.69	3.15	6.50	5.04	5.67	0.75	5.50	5/8-UNC	4
3	3.15	1.93	5.24	3.66	7.28	5.71	6.30	0.75	6.00	5/8-UNC	8
4	3.94	2.20	5.79	4.21	8.31	6.50	7.48	0.75	7.50	5/8-UNC	8
5	4.92	2.52	6.57	4.72	9.45	8.03	8.46	0.91	8.50	3/4-UNC	8
6	5.91	2.76	7.09	5.28	10.55	9.06	9.53	0.91	9.50	3/4-UNC	8
8	7.87	2.80	8.94	6.34	12.72	11.02	11.73	0.91	11.75	3/4-UNC	8
10	9.84	4.49	9.76	8.27	15.94	13.19	14.25	1.00	14.25	7/8-UNC	12
12	11.81	4.49	12.01	9.65	18.70	15.35	17.01	1.14	17.00	7/8-UNC	12

SHOP DRAWING

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Reviewed By: M.M. Reviewed ☒
Reviewed as noted ☐
Date: 19 Mar 2015 Resubmit ☐

CHIARELLI ENGINEERING LTD.

IPEX

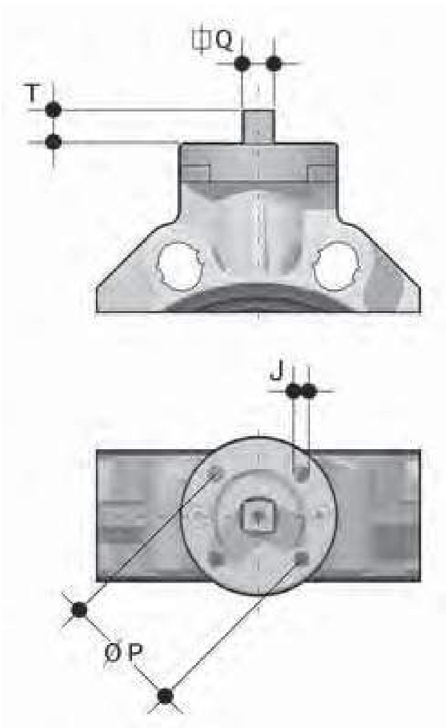
149/665

FK Series Automated Butterfly Valves

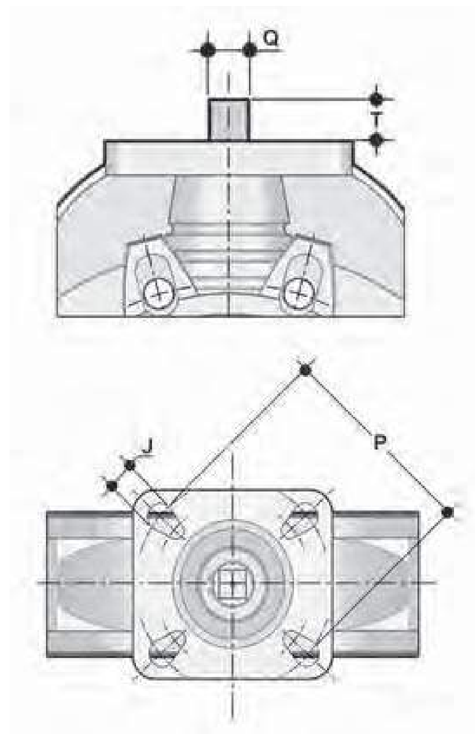
Technical Data (cont'd)

dimensions (cont'd)

sizes 1-1/2" to 8"



sizes 10" to 12"



Dimensions (inches)

Size	T	Q	ISO	P	J
1-1/2	0.47	0.43	F05	1.97	0.28
2	0.47	0.43	F05	1.97	0.28
2-1/2	0.47	0.43	F05 / F07	1.97 / 2.76	0.28 / 0.35
3	0.63	0.55	F07	2.76	0.35
4	0.63	0.55	F07	2.76	0.35
5	0.75	0.67	F07	2.76	0.35
6	0.75	0.67	F07	2.76	0.35
8	0.94	0.87	F10	4.02	0.43
10	1.14	1.06	F10 / F12 / F14	4.02 / 4.92 / 5.51	0.43 / 0.51 / 0.67
12	1.14	1.06	F10 / F12 / F14	4.02 / 4.92 / 5.51	0.43 / 0.51 / 0.67

SHOP DRAWING

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Reviewed By: M.M. — Reviewed ☒
Reviewed as noted ☐
Date: 19 Mar 2015 — Resubmit ☐

CHIARELLI ENGINEERING LTD.

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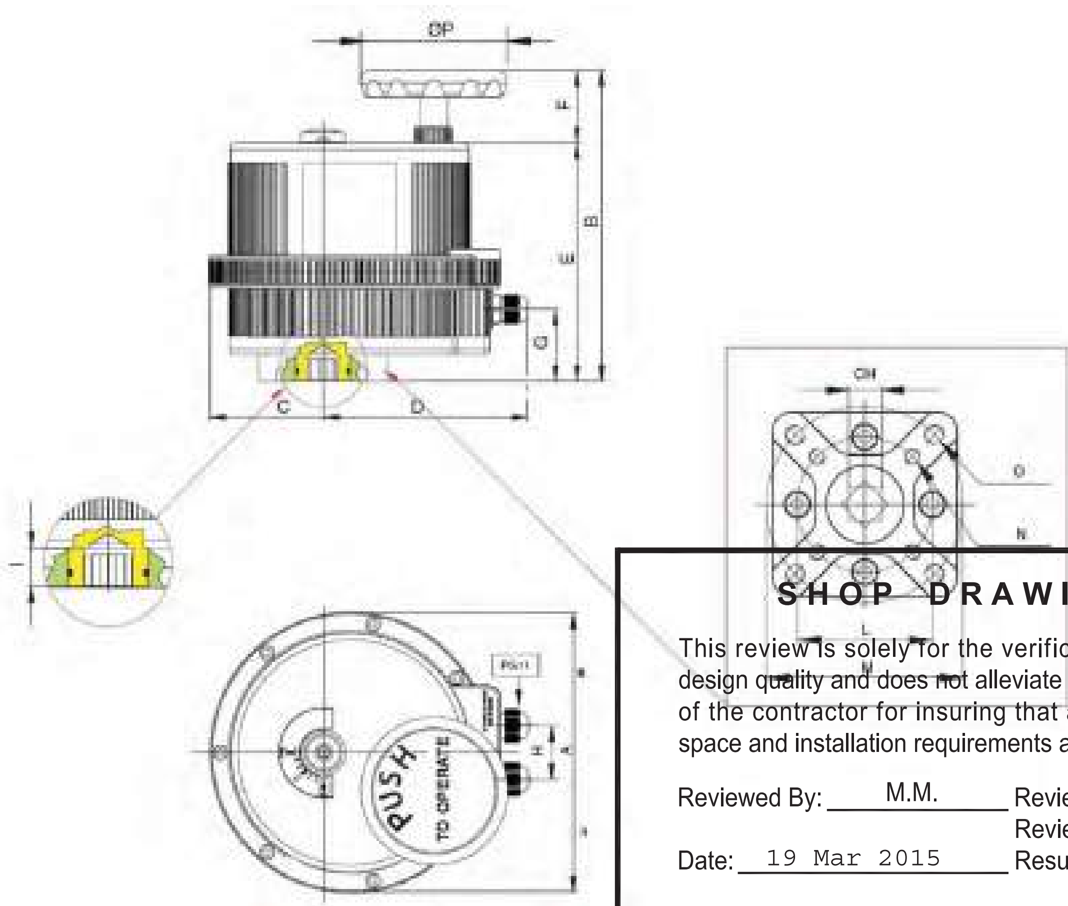
IPEX

150/665

FK Series Automated Butterfly Valves

Technical Data (cont'd)

electric actuator dimensions



SHOP DRAWING

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Reviewed By: M.M. — Reviewed ☒ / Reviewed as noted ☐

Date: 19 Mar 2015 — Resubmit ☐

CHIARELLI ENGINEERING LTD.

Dimensions (inches)

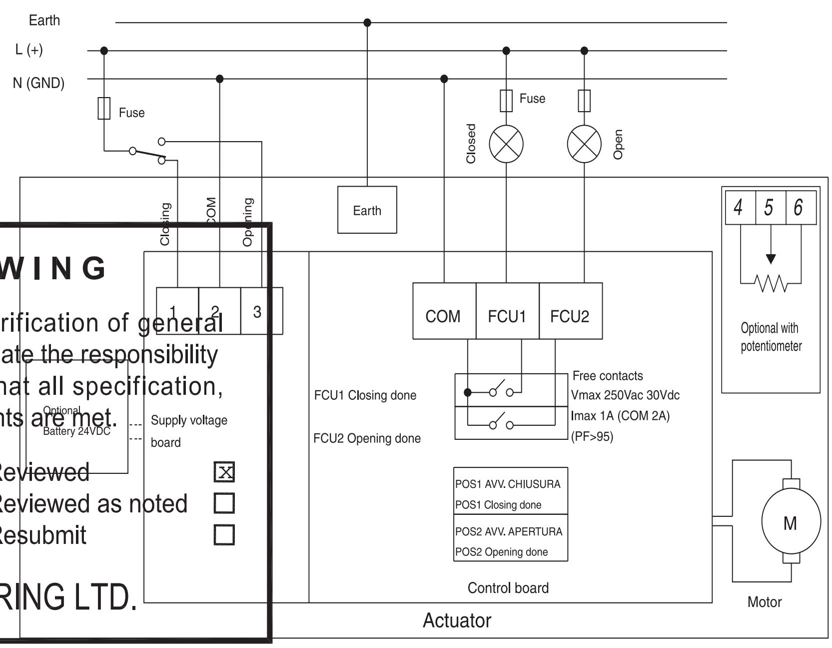
Valve Size	Actuator Model	ISO	CH	A	B	C	D	E	F	G	H	I	L	M	N	O	ØP
1-1/2	VB015	F03/F05	0.43	4.84	5.57	1.67	4.74	4.96	0.61	4.06	1.26	0.55	1.42	1.97	10-24 UNC 2BX0.47	1/4-20 UNC 2BX0.55	2.68
2	VB030	F03/F05	0.43	6.18	7.40	2.38	5.12	5.75	1.65	1.30	1.42	0.47	1.42	1.97	10-24 UNC 2BX0.47	1/4-20 UNC 2BX0.55	2.56
2-1/2	VB030	F03/F05	0.43	6.18	7.40	2.38	5.12	5.75	1.65	1.30	1.42	0.47	1.42	1.97	10-24 UNC 2BX0.47	1/4-20 UNC 2BX0.55	2.56
3	VB060	F05/F07	0.55	7.28	8.46	2.66	5.77	6.81	1.65	2.01	1.42	0.63	1.97	2.76	1/4-20 UNC 2BX0.59	5/16-18 UNC 2BX0.67	2.56
4	VB060	F05/F07	0.67	7.28	8.46	2.66	5.77	6.81	1.65	2.01	1.42	0.63	1.97	2.76	1/4-20 UNC 2BX0.59	5/16-18 UNC 2BX0.67	2.56
5	VB110	F07/F10	0.67	8.31	9.14	3.31	6.02	7.01	2.13	2.13	1.58	0.75	2.76	4.02	5/16-18 UNC 2BX0.79	3/8-16 UNC 2BX0.79	4.33
6	VB110	F07/F10	0.67	8.31	9.14	3.31	6.02	7.01	2.13	2.13	1.58	0.75	2.76	4.02	5/16-18 UNC 2BX0.79	3/8-16 UNC 2BX0.79	4.33
8	VB270	F07/F10	0.87	8.74	9.19	3.03	6.69	7.17	2.03	2.13	1.58	0.95	2.76	4.02	5/16-18 UNC 2BX0.79	3/8-16 UNC 2BX0.79	4.33

FK Series Automated Butterfly Valves

Technical Data (cont'd)

electrical actuator

model VB30 to VB350 24V AC/DC, 110 – 240V AC



SHOP DRAWING

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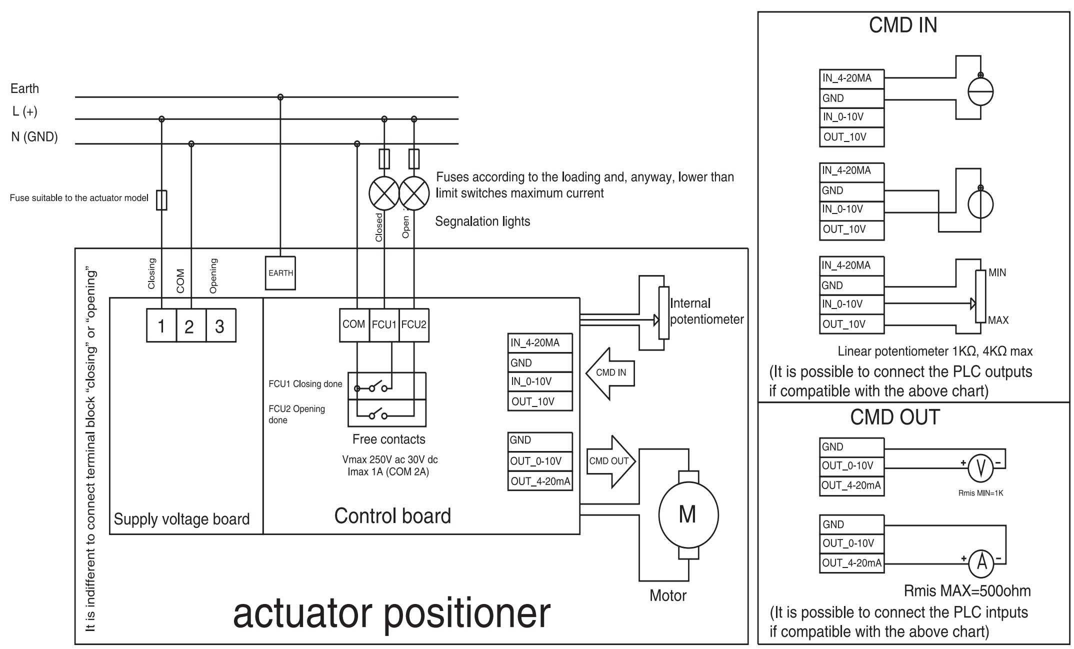
Reviewed By: M.M. — Reviewed ☒

Reviewed as noted ☐

Date: 19 Mar 2015 — Resubmit ☐

CHIARELLI ENGINEERING LTD.

VB30 to VB350 24V AC/DC, 110 – 240V AC with Positioner



FK Series Automated Butterfly Valves

Technical Data (cont'd)

MODEL		VB015	VB030	VB060	VB110	VB270
Max Working Torque (in-Lbs)		133	266	530	975	2390
Voltage (V)	**Low Voltage**	24V AC/DC	24V AC/DC	24V AC/DC	24V AC/DC	24V AC/DC
	High Voltage Multitension	100-240V AC	100-240V AC	100-240V AC	100-240V AC	100-240V AC
Working Time (sec)		10	8	9	27	50
Torque Limiter		STD	STD	STD	STD	STD
Duty Rating		50%	75%	75%	75%	75%
Protection		IP65 ** NEMA 4X*	IP65-67 NEMA 4X*	IP65-67 NEMA 4X*	IP65-67 NEMA 4X*	IP65-67 NEMA 4X*
Rotation		90°	90°	90°	90°	90°
Upon Request		180°	180° or 270°	180° or 270°	180° or 270°	180° or 270°
Manual Intervention		STD	STD	STD	STD	STD
Position Indicator		STD	STD	STD	STD	STD
Working Temperature		-4F +131F	-4F +131F	-4F +131F	-4F +131F	-4F +131F
Heater		STD	STD	STD	STD	STD
Additional Free Limit Switches		2 STD	2 STD	2 STD	2 STD	2 STD
Drilling ISO 5211 PAD		F03 – F05	F03 – F05	F05 – F07	F07 – F10	F07 – F10
Square Drive		0.43	0.43	0.55	0.67	0.87
Positioner (4~20mA or 0~10 VDC)		Not Available	Upon Request	Upon Request	Upon Request	Upon Request
Electrical Connections		PG11	PG11	PG11	PG11	PG 11
Weight (LBS)		3.09	5.07	7.28	10.80	13.23

* Type 4X Indoor Use Only Enclosure
** UL pending

Electric Actuator Power Consumption

MODEL		VB015		VB030	VB060	VB110	VB270
VERSION H	Nominal Voltage	100V AC	240V AC	100 – 240V AC			
	Absorbed Current	75mA	25mA	0.3 – 0.2A	0.6 – 0.3A		
	Absorbed Power	6.6 VA	6 VA	30 – 48VA	60 – 72 VA		
VERSION L	Nominal Voltage	24V AC/DC		24V AC/DC	24V AC/DC	24V AC/DC	24V AC/DC
	Absorbed Current	0.6A		1.0A	1.8A	1.0A	1.8A
	Absorbed Power	15 VA		24 VA	44 VA	24 VA	44 VA
Frequency		50/60 HZ					

SHOP DRAWING

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Reviewed By: M.M. Reviewed ☒
Reviewed as noted ☐
Date: 19 Mar 2015 Resubmit ☐

CHIARELLI ENGINEERING LTD.

www.ipexinc.com
Toll Free: 866 473-9462

IPEX

MV-1, MV-2, MV-3, MV-4

FK Series Automated Butterfly Valves

About the IPEX Group of Companies

As leading suppliers of thermoplastic piping systems, the IPEX Group of Companies provides our customers with some of the world's largest and most comprehensive product lines. All IPEX products are backed by more than 50 years of experience. With state-of-the-art manufacturing facilities and distribution centers across North America, we have established a reputation for product innovation, quality, end-user focus and performance.

Markets served by IPEX group products are:

- Electrical systems
- Telecommunications and utility piping systems
- Industrial process piping systems
- Municipal pressure and gravity piping systems
- Plumbing and mechanical piping systems
- PE Electrofusion systems for gas and water
- Industrial, plumbing and electrical cements
- Irrigation systems
- PVC, CPVC, PP, PVCO, ABS, PEX, FR-PVDF, NFRPP, FRPP, HDPE, PVDF and PE pipe and fittings (1/2" – 48")

SHOP DRAWING

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Reviewed By: M.M. Reviewed ☒
Reviewed as noted ☐
Date: 19 Mar 2015 Resubmit ☐

CHIARELLI ENGINEERING LTD.

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A policy of ongoing product improvement is maintained. This may result in modifications of features and/or specifications without notice.

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IPEX

VKD SERIES BALL VALVES - TRUE UNION

The next generation industrial valve features the patented Dual Block® system which allows locking of the union nuts in a preset position, assuring seal integrity under severe service conditions. A patented seat stop carrier, high quality stem and ball support system, integral mounting flange and bracketing, and a multifunctional locking handle (standard on sizes 2-1/2" to 4") set this valve apart from the rest. The VKD is available in PVC, CPVC, PP, and ABS with PTFE seats and either EPDM or Viton® seals.

Pressure: up to 232 psi at 73°F depending on the material
Sizes: 3/8" – 4"

End Connection	Size inches	EPDM Product Code	Viton® Product Code
PVC, w/ PTFE Seats			
S/T	3/8	253067	253068
S/T	1/2	053461	053467
S/T	3/4	053462	053468
S/T	1	053463	053469
S/T	1-1/4	053464	053470
S/T	1-1/2	053465	053471
S/T	2	053466	053472
Socket	2-1/2	053539	053542
Socket	3	053540	053543
Socket	4	053541	053544
Corzan® CPVC, w/ PTFE Seats			
S/T	3/8	253069	253070
S/T	1/2	053473	253008
S/T	3/4	053474	253009
S/T	1	053475	253010
S/T	1-1/4	053476	253011
S/T	1-1/2	053477	253012
S/T	2	053478	253013
Socket	2-1/2	053545	053548
Socket	3	053546	053549
Socket	4	053547	053550
PP, w/ PTFE Seats			
Threaded	1/2	053525	253002
Threaded	3/4	053526	253003
Threaded	1	053527	253004
Threaded	1-1/4	053528	253005
Threaded	1-1/2	053529	253006
Threaded	2	053530	253007
PP, w/ PTFE Seats			
Socket	20mm	053513	053519
Socket	25mm	053514	053520
Socket	32mm	053515	053521
Socket	40mm	053516	053522
Socket	50mm	053517	053523
Socket	63mm	053518	053524

SHOP DRAWING

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Reviewed By: M.M. Reviewed ☒
Reviewed as noted ☐
Date: 19 Mar 2015 Resubmit ☐

CHIARELLI ENGINEERING LTD.

Shop Drawings
Contractor Approval
Approved by: J.D., G.F.
Date: 12/03/15
SIFEC NORTH INC

SV-1, SV-2

PNEUMATIC ACTUATOR ACCESSORIES

Pilot Solenoids - 110 VAC, 3/4-Way

Component Style	Product Code
NEMA 4/4X	253055
NEMA 7/9	253056

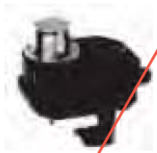
Note: Pilot solenoids meet NAMUR mounting specifications. Other voltages available.

Limit Switches - NEMA 4/4X

Component Style	Product Code
Mechanical	253057
Proximity	253058

Note: Limit switches include universal mounting brackets (ISO 5211)

Positioners

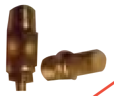


Component Style	Product Code
3-15 psi	253061
4 - 20 mA	253059
4 - 20 mA, w/ limit switch (LS)	253816
4 - 20 mA, w/ position transmitter (PT)	253817
4 - 20 mA, w/ LS & PT	253818
4 - 20 mA, I-safe	253062

Note: All positioners include universal mounting brackets (ISO 5211) and gages.

Several other positioners available, including Intrinsically Safe, Explosion proof, Smart, Stainless Steel and High Vibration models, with limit switch and position transmitter options. Please contact IPEX for more information.

Other



Component Style	Product Code
Sandwich Declutch. Gearbox ISO 5211	253819
Muffler - Brass/Bronze	253065
Speed Control - Brass/Bronze	253066

Note: Declutchable gearbox has MAXIMUM torque rating of 2600 in-lbs. For higher torque values, please contact IPEX for larger size gearbox models.

MOUNTING ACCESSORIES

VKD & TKD Series Ball Valve Mounting Kit

Size Inches	Mounting Detail	Product Code
1/2	F03 / F04 / 11mm	154048
3/4	F04 / 11mm	154049
3/4	F03 / F05 / 11mm	154050
1	F04 / 11mm	154051
1	F03 / F05 / 11mm	154052
1-1/4	F05 / F07 / 11mm	154182
1-1/4	F05 / F07 / 14mm	154053
1-1/2	F05 / F07 / 11mm	154183
1-1/2	F05 / F07 / 14mm	154054
2	F05 / F07 / 11mm	154174
2	F05 / F07 / 14mm	154055
2-1/2 - 4 (VKD)	F05 / F07	153001

VX Series Ball Valve Mounting Kit

Size Inches	Mounting Detail	Product Code
1/2	F04 / F05 / 11mm	154042
3/4	F04 / F05 / 11mm	154043
1	F04 / F05 / 11mm	154044
1-1/4	F04 / F05 / 11mm	154045
1-1/2	F05 / F07 / 14mm	154046
2	F05 / F07 / 14mm	154047

Spacer Plate for FK Series Butterfly Valves

Size Inches	Mounting Detail	Product Code
1-1/2 - 6	F05 / F07	153001
8	F10	153002

Square Stem Adapter

Size Inches	Mounting Detail	Product Code
0.43 x 0.35	11mm x 9mm	253048
0.55 x 0.43	14mm x 11mm	253049
0.67 x 0.43	17mm x 11mm	253050
0.67 x 0.55	17mm x 14mm	253051
0.87 x 0.67	22mm x 17mm	253052
1.06 x 0.87	27mm x 22mm	253053
1.42 x 1.06	36mm x 27mm	253054

SHOP DRAWING

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Reviewed By: M.M. — Reviewed ☒ — Reviewed as noted ☐

Date: 19 Mar 2015 — Resubmit ☐

CHIARELLI ENGINEERING LTD.

SV-1, SV-2

VKD SERIES BALL VALVE - TRUE UNION, PNEUMATIC - DOUBLE ACTING

End Connection	Size inches	EPDM Product Code	Viton® Product Code
PVC w PTFE Seats			
S/T	1/2	253296	253305
S/T	3/4	253297	253306
S/T	1	253298	253307
S/T	1-1/4	253299	253308
S/T	1-1/2	253300	253309
S/T	2	253301	253310
Socket	2-1/2	253302	253311
Socket	3	253303	253312
Socket	4	253304	253313

End Connection	Size inches	EPDM Product Code	Viton® Product Code
Corzan® CPVC w PTFE Seats			
S/T	1/2	253314	253323
S/T	3/4	253315	253324
S/T	1	253316	253325
S/T	1-1/4	253317	253326
S/T	1-1/2	253318	253327
S/T	2	253319	253328
Socket	2-1/2	253320	253329
Socket	3	253321	253330
Socket	4	253322	253331

Pneumatic - Spring Return, Normally Open

PVC w PTFE Seats

S/T	1/2	253368	253377
S/T	3/4	253369	253378
S/T	1	253370	253379
S/T	1-1/4	253371	253380
S/T	1-1/2	253372	253381
S/T	2	253373	253382
Socket	2-1/2	253374	253383
Socket	3	253375	253384
Socket	4	253376	253385

Pneumatic - Spring Return, Normally Open

Corzan® CPVC w PTFE Seats

S/T	1/2	253386	253395
S/T	3/4	253387	253396
S/T	1	253388	253397
S/T	1-1/4	253389	253398
S/T	1-1/2	253390	253399
S/T	2	253391	253400
Socket	2-1/2	253392	253401
Socket	3	253393	253402
Socket	4	253394	253403

Pneumatic - Spring Return, Normally Closed

PVC w PTFE Seats

S/T	1/2	253332	253341
S/T	3/4	253333	253342
S/T	1	253334	253343
S/T	1-1/4	253335	253344
S/T	1-1/2	253336	253345
S/T	2	253337	253346
Socket	2-1/2	253338	253347
Socket	3	253339	253348
Socket	4	253340	253349

Pneumatic - Spring Return, Normally Closed

Corzan® CPVC w PTFE Seats

S/T	1/2	253350	253359
S/T	3/4	253351	253360
S/T	1	253352	253361
S/T	1-1/4	253353	253362
S/T	1-1/2	253354	253363
S/T	2	253355	253364
Socket	2-1/2	253356	253365
Socket	3	253357	253366
Socket	4	253358	253367

VKD SERIES BALL VALVE - ELECTRIC - DOUBLE ACTING, 110 VAC

End Connection	Size inches
PVC w PTFE Seats	
S/T	1/2
S/T	3/4
S/T	1
S/T	1-1/4
S/T	1-1/2
S/T	2
Socket	2-1/2
Socket	3
Socket	4

End Connection	Size inches
Corzan® CPVC w PTFE Seats	
S/T	1/2
S/T	3/4
S/T	1
S/T	1-1/4
S/T	1-1/2
S/T	2
Socket	2-1/2
Socket	3
Socket	4

For electric valve actuation, you must order three separate components. Contact IPEX Sales for assistance.

SHOP DRAWING

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Reviewed By: M.M. Reviewed ☒

Reviewed as noted ☐

Date: 19 Mar 2015 Resubmit ☐

CHIARELLI ENGINEERING LTD.

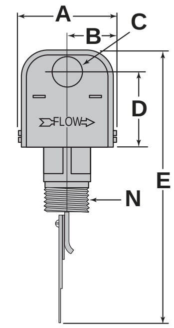
Flow Switches – Liquid

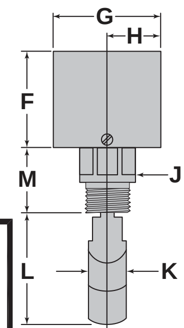
Series FS4-3
General Purpose Liquid Flow Switches

(for specified models)

- Universal design serves the widest variety of applications
- For starting or stopping electrically operated equipment such as signal lights, alarms, motors, automatic burners, metering devices and others
- Replacement for common flow switches from Johnson/Penn, Potter/Taco, Watts, Hydrolevel and other manufacturers
- 1" NPT
- Two electrical knock-outs allows connection from either end
- Sensitivity adjusting screw makes flow adjustment easy
- Single pole, double throw snap switch
- Hardened stainless steel bearings minimize friction
- Sealed Monel bellows
- Four stainless steel paddles included - 1", 2", 3" & 6" (25, 50, 80, & 150mm)
- Optional features
  – Two SPDT switches to make or break two separate circuits
  – Materials of construction suitable for corrosive liquids
  – BSPT threads
- Minimum temperature (fluid or ambient) 32°F (0°C)
- Maximum temperature 300°F (149°C)
- Maximum pressure 160 psi (11.3 kg/cm²)

Series FS4-3





SHOP DRAWING

This review is solely for the verification of general design quality and does not alleviate the responsibility of the contractor for insuring that all specification, space and installation requirements are met.

Reviewed By: M.M. Reviewed ☒
Reviewed as noted ☐
Date: 19 Mar 2015 Resubmit ☐

CHIARELLI ENGINEERING LTD.

Shop Drawings
Contractor Approval
Approved by: J.D., G.F.
Date: 12/03/15
SIFEC NORTH INC

Electrical Ratings

Voltage	Motor Switch Rating (Amperes)		Pilot Duty
	Full Load	Locked Rotor	
120 VAC	7.4	44.4	125 VA at 120 or 240 VAC 50 or 60 cycles
240 VAC	3.7	22.2	

Dimensions, in. (mm)

A	B	C	D	E	F	G
3 (76)	1½ (38)	⅞ (22)	2 7/32 (56)	8 7/16 (211)	2 15/16 (75)	3⅜ (86)

H	J	K	L	M	N NPT
1 11/16 (43)	1 7/16 (37)	1⅛ (29)	3 7/16 (87)	2 1/16 (52)	1

Flow Switches – Liquid

Series FS4-3 (continued)
General Purpose Liquid Flow Switches

Flow Rates

Pipe Size NPT in.	Settings	Mode of Operation Flow gpm (lpm)	No Flow gpm (lpm)	Max. Flow Rate gpm (lpm) w/o Paddle Damage
1	Factory or Minimum	6 (22.7)	3.6 (13.6)	27
	Maximum	10.2 (38.6)	9.2 (34.8)	(102.2)
1¼	Factory or Minimum	9.8 (37.1)	5.6 (21.2)	47
	Maximum	16.8 (63.6)	15 (56.8)	(177.9)
1½	Factory or Minimum	12.7 (48.1)	7 (26.5)	63
	Maximum	23 (87.1)	19.5 (73.8)	(238.5)
2	Factory or Minimum	18.8 (71.2)	9.4 (35.6)	105
	Maximum	32.8 (124.1)	24 (90.8)	(397.4)
2½	Factory or Minimum	24.3 (92)	11.6 (43.9)	149
	Maximum	42.4 (160.5)	37.5 (141.9)	(564)
3	Factory or Minimum	30 (113.6)	12 (45.4)	230
	Maximum	52.1 (197.2)	46.1 (174.5)	(870.6)
4	Factory or Minimum	39.7 (150.3)	19.8 (74.9)	397
	Maximum	73.5 (278.2)	64.2 (242)	(1502.7)
5	Factory or Minimum	58.7 (222.2)	29.3 (110.9)	654
	Maximum	115 (435.3)	92 (348.2)	(2415.4)
6	Factory or Minimum	79.2 (300)	39.6 (150)	900
	Maximum	166 (628.3)	123 (465.6)	(3406.5)

Values are ± 10%

NOTE: DO NOT USE LIQUID FLOW SWITCHES ON SYSTEMS WITH FLOW GREATER THAN 10 FEET (3M) PER SECOND.

Ordering Information

Model Number	Part Number	Description	Weight lbs. (kg)
FS4-3	114400	General purpose flow switch	1.9 (0.9)
FS4-3J	114610	FS4-3 w/BSPT connections	1.9 (0.9)
FS4-3-RPT	114639	FS4-3 w/test button	1.9 (0.9)
FS4-3Z	114410	FS4-3 w/ANSI terminal connections	1.9 (0.86)
FS4-3D	114550	FS4-3 w/2 SPDT switches	2.3 (1.0)
FS4-3S	114641	FS4-3 w/SS body, monel bellows	1.9 (0.9)
FS4-3SJ	176216	FS4-3S w/BSPT connections	1.9 (0.9)
FS4-3DS	114642	FS4-3S w/2 SPDT switches	3.3 (1.5)
FS4-3J-E	114611	FS4-3J-CE conformance rated	1.9 (0.9)
FS4-3D-E	114552	FS4-3D-CE conformance rated	1.9 (0.9)
FS4-3S-E	114646	FS4-3S-CE conformance rated	1.9 (0.9)

See page 120 for CE Conformance information

SHOP DRAWING

This review is solely for the verification of general design quality and does not alleviate the responsibility of the contractor for insuring that all specification, space and installation requirements are met.

Reviewed By: M.M. — Reviewed ☒ / Reviewed as noted ☐
Date: 19 Mar 2015 — Resubmit ☐

CHIARELLI ENGINEERING LTD.

Chapter 19 INSULATION

MANUFACTURER/DISTRIBUTOR:

CrossRoads C&I Inc.
c/o Liette Larose
5760 Côte de Liesse
Ville Mont-Royal, Quebec H4T 1B1
Phone: 514-738-1916 Ext.2706
Fax: (514) 738-2058
800-738-2058
llarose@glasscellisofab.com

19.1 **PLUMBING INSULATION**

19.2 **VENTILATION INSULATION**

Foamglas

Used on the 3" intake pipe inside the building

FOAMGLAS®

SHOP DRAWING

Reviewed by: Samuel Charbonneau

Date: 21 juin 2016

Reviewed [X]

Reviewed as noted [ ]

Resubmit [ ]

Out for approval

SIFEC NORTH INC.

Pittsburgh Corning

Protecting Companies and Their People Worldwide

INDUSTRIAL PIPING, DUCTS AND EQUIPMENT

FOAMGLAS® insulation is a lightweight, rigid material composed of millions of completely sealed glass cells. Each cell is an insulating entity. FOAMGLAS® insulation's all-glass, closed-cell structure provides the following benefits:

- Constant Insulating Efficiency
- Zero Water Vapor Permeability
- Moisture Resistance
- Fire Protection
- Corrosion Resistance
- Long-Term Dimensional Stability
- Vermin Resistance
- CFC and HCFC Free

These benefits result in FOAMGLAS® Insulation Systems that are long-lasting, require little maintenance and are ideal for:

- Low temperature pipe, equipment, tanks and vessels
- Medium and high temperature pipes and equipment
- Hot oil and hot asphalt storage tanks
- Heat transfer fluid systems
- Hydrocarbon processing systems
- Chemical processing systems
- Above ground and underground steam and chilled water piping
- Commercial piping and ductwork

Manufactured to comply with ASTM C552-07.

FOAMGLAS® insulation is manufactured by Pittsburgh Corning in a basic block form. Blocks are fabricated into a wide range of shapes, thicknesses and sizes to satisfy industrial insulation requirements.

PHYSICAL AND THERMAL PROPERTIES OF FOAMGLAS® ONE™ INSULATION

PHYSICAL PROPERTIES	SI	ENGLISH	ASTM STANDARD	EUROPEAN STANDARD
Absorption of Moisture (% by Volume)	0.2%	0.2%	C 240	EN 1609
	Only moisture retained is that adhering to surface cells after immersion			
Water-Vapor Permeability	0.00 perm-cm	0.00 perm-cm	E96 Wet Cup, Procedure B	EN ISO 10456
Acid Resistance	Impervious to common acids and their fumes except hydrofluoric acid			
Capillarity	None	None		EN 1609
Combustibility	Noncombustible, will not burn.		E 136	EN ISO 1182 (Class A1)
Composition	Soda-lime silicate glass — inorganic with no fibers or binders.			
Compressive Strength Average for Standard Material (+/-10%)	600 kPA	90 psi	C 165 C 240 C 552	EN 826
	Strength for flat surfaces capped with hot asphalt. For curved surfaces and pipe supports, contact PCC.			
Density, Average	120 kg/m^3	7.5 lb/ft^3	C 303	
Dimensional Stability	Excellent — does not shrink, swell or warp.			EN 1604
Flexural Strength, Block Average	480 kPa	70 psi	C 203 C 240	
Hygroscopicity	No increase in weight at 90% relative humidity.			EN 12089
Linear Coefficient of Thermal Expansion 25°C to 300°C (75°F to 575°F)	9.0×10^{-6}/°K	5.0×10^{-6}/°F	E 228	EN 13571
Maximum Service Temperature	480°C	+900°F		EN 14706
Modulus of Elasticity, Approx.	900 MPa	1.3×10^5 psi	C 623	
Thermal Conductivity	W/mK 0.039 @ 0°C 0.040 @ 10°C	Btu-in/hr•ft²•°F 0.29 @ 75 °F 0.28 @ 50 °F	C 177 C 518	EN 12667 EN 12939
Specific Heat	0.84 kJ/kg•°K	0.20 Btu/lb•°F		
Thermal Diffusivity	4.2 x 10-7m^2/sec	0.016 ft^2/hr		

Notes: Measurements were collected using ASTM guidelines and, unless otherwise specified, properties were collected at 24°C (75°F). Properties may vary with temperature. The measurements listed in the table are average or typical values recommended for design purposes, and are not intended as specification or limit values.

FOAMGLAS® ONE™ INSULATION SYSTEMS FOR INDUSTRIAL APPLICATIONS

Pittsburgh Corning has developed insulation systems for a wide range of piping and equipment applications—above ground or underground, indoors or outdoors—at operating temperatures from -450°F to +900°F (-268°C to +482°C).

With the patented StrataFab® System, blocks of FOAMGLAS® insulation are laminated into billets using a special high temperature adhesive. These billets are fabricated into the desired shapes and sizes for pipe, tank, vessels, flanges and valves—practically any industrial insulation application.

Totally Impermeable

Long Term Performance

Because it consists of closed glass cells, FOAMGLAS® insulation resists moisture in both liquid and vapor forms. When tested in accordance with ASTM E96, it has a permeability rating of 0.00 perm-in.

Noncombustible

FOAMGLAS® insulation is 100% glass and contains no binders or fillers—it cannot burn. FOAMGLAS® insulation will not absorb flammable liquids or vapors. If a fire does occur, FOAMGLAS® insulation will help contain it.

Corrosion-Resistant

All-glass FOAMGLAS® insulation is unaffected by common chemicals and by most corrosive plant atmospheres. It does not promote metal corrosion and its moisture resistance will help keep water from reaching equipment and piping.

Dimensionally Stable

FOAMGLAS® insulation is unaffected by temperature differentials and humidity. It will not swell, warp, shrink or otherwise distort. The insulation system's integrity remains intact.

High Compressive Strength

FOAMGLAS® insulation can withstand loads which crush most other insulating materials. In a properly designed piping system, FOAMGLAS® insulation eliminates the need for special treatment at pipe cradles. It also provides a firm base for roof membranes, jacketing or vapor retarders, prolonging their life.

Technical Service

Pittsburgh Corning's Technical Service Staff provides product, application and materials testing—standardized and customized specifications—on-site customer assistance and installation guidance.

For complete data on FOAMGLAS® Insulation Systems, please visit our Web site at www.foamglas.com, or contact Pittsburgh Corning at any of the following locations:

Pittsburgh Corning USA
(Corporate Headquarters)
800 Presque Isle Drive
Pittsburgh, PA 15239
Tel: 1-724-327-6100
Fax: 1-724-387-3807

Pittsburgh Corning Corporation Asia
(Asia Headquarters)
Pittsburgh Corning Corporation
3-7-4-304 Hikarigaoka
Nerima-ku, Tokyo, Japan 179-0072
Tel & Fax: 011 81-3-5997-0248

Pittsburgh Corning Europe NV
(Europe / Middle East Africa Headquarters)
Albertkade, 1
B-3980 Tessenderlo
Belgium
Tel: +32-13-66-17-21
Fax: +32-13-66-78-54

GreenSpec® LISTED
www.GreenSpec.com

ISO 9001:2000
KEMA CERTIFICATE

BCCA ISO 9001:2000

STANDARDS, CERTIFICATIONS* AND APPROVALS

FOAMGLAS® insulation can be certified to conform to the requirements of:

- ASTM C 552 "Specification for Cellular Glass Thermal Insulation"
- Military Specification MIL-I-24244C, "Insulation Materials, Thermal, with Special Corrosion and Chloride Requirement"
- Nuclear Regulatory Guide 1.36, ASTM C 795, C 692, C 871
- Flame Spread 5, Smoke Developed 0 (UL 723, ASTM E 84), R2844; also classified by UL of Canada, CR1957
- ISO 9001:2000
- UL 1709
- For a listing of UL Through Penetration Fire Stop Approved Systems please search the UL Database at http://www.ul.com/ Once on this page click on CERTIFICATIONS on the left hand side. Under General Search click on UL FILE NUMBER and type in R15207 and then SEARCH
- Board of Steamship Inspection (Canada) Certificate of Approval No. 100/F1-98
- General Services Administration,PBS (PCD): 15250, Public Building Service Guide Specification, "Thermal Insulation (Mechanical)"
- New York City Dept. of Bldgs., MEA #138-81-M FOAMGLAS® insulation for piping, equipment, walls and ceilings
- New York State Uniform Fire Prevention and Building Code Dept. of State (DOS) 07200-890201-2013
- City of Los Angeles General Approval RR22534

FOAMGLAS insulation is identified by Federal Supply Code for Manufacturers (FSCM 08869)

***Written request for certificate of compliance must accompany order.**

FOAMGLAS®

Printed in U.S.A.
FG-3 Rev. 1/09 (Replaces Rev. 11/05)

Used on the 3" intake pipe inside the building

SHOP DRAWING
Reviewed by: Samuel Charbonneau
Date: 21 juin 2016

Reviewed X
Reviewed as noted
Resubmit

Out for approval

SIFEC NORTH INC.

GCI
GLASSCELL ISOFAB INC.

TECHNICAL DATA

FABRICATED METAL PRODUCTS

ALUMACLAD ROLLS AND CUT AND ROLLED

0.16

DESCRIPTION	GCI's Alumaclad Roll Jacketing is manufactured from Series 3000 alloys to meet the requirements of ASTM B-209. The BLUE coated interior offers moisture protection while the acrylic exterior finish offers better resistance in corrosive environments than a mill finish type. This combination has provided excellent protection for over 25 years. Rolled Jacketing is supplied in rolls that allow the installer to cut desired lengths to suit a particular application. Standard rolls are supplied in either 36" or 48" (918 mm or 1218 mm) widths and are available with or without a factory applied moisture barrier. The rolls are supplied in cardboard cartons for easy identification and storage. To increase job site efficiency, jackets are also offered pre-cut and rolled to fit standard insulated pipes.
AVAILABLE TYPES	Aluminum (Alumaclad) rolled jacketing and cut and rolled jacketing are pre-painted and available in smooth (SM), stucco embossed (SE) or cross crimped (CC. Thicknesses range from .006" to .050" in aluminum. Standard rolll lengths are 100 ft. in aluminum. These rolls are available with a clear epoxy coating for corrosion protectionand with or without factory applied moisture barrier. Moisture barriers are available as Polykraft, Painted acrylic "Blue Barrier" or Polysurlyn film. * Non standard roll lengths are available upon request.
ADVANTAGES	Rolled Jacketing in standard length rolls allows the installer the convenience of cutting desired length pieces as required in the field. Rolls may be inventoried for convenience and quick response times. They may be used to cover insulated piping, tanks and other mechanical equipment. Cut and rolled jackets are pre-cut to length and are economical to use on most job sites as the premium paid for the service is significantly less than the labor involved in cutting the jacket on site and the additional handling of large rolls.
APPLICATIONS	Rolled Jacketing may be fastened with either bands, screws or pop rivets depending on the application. Rolled Jacketing looks good and provides a neat finish to any insulated system. All laps should be arranged to shed water and edges caulked with an approved sealant where required

TORONTO – HAMILTON – KITCHENER - LONDON – SARNIA – MONTREAL – QUEBEC

CONTINUED

SHOP DRAWING
Reviewed by: Samuel Charbonneau
Date: 21 juin 2016

Reviewed [X]
Reviewed as noted [ ]
Resubmit [ ]

Out for approval

SIFEC NORTH INC.

GCI
GLASSCELL ISOFAB INC.

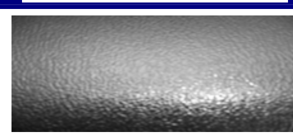
TECHNICAL DATA

FABRICATED METAL PRODUCTS

FABRICATED METALS ROLLS AND CUT AND ROLLED - 2

WIDTHS :	LENGTHS :
36" Standard, 48" on Special order.	100' Standard or Cut & Rolled to Length.

THICKNESSES:	USAGE:
.016”	Use in areas subject to traffic and abuse. Use on insulated lines up to 36” O.D.
.020”	Use on larger lines and large equipment up to 8’ in diameter.
.024”	Use in applications where extra thickness and protection is required.
.032”	Use where severe mechanical abuse or special fabricating requirements such as flat ducts or precipitators. Also in very windy areas.
.040” (Special Order)	

	PLAIN	PEBBLED (STUCCO)	CORRUGATED 3/16”:
FINISHES:			
	Use where minimum abuse is expected.	Use where some abuse is expected.	Use where maximum abuse is expected.

FEATURES	BENEFITS
Recycled content	Produced from 99% scrap. 80% of the scrap is from post-consumer sources.
Excellent emittance	Contributes to lower heat losses and personnel protection.
Coated Moisture Barrier	Eliminates possibility of delaminating in Lock formers. Coverage is full roll width.
Fire Protection	Coatings contribute less to a fire than Kraft or poly films.
Tensile & yield	Conforms to Aluminum Association standards for tensile & yield properties for each temper.
Bending	Meets Aluminum Association specifications for bending.

TORONTO – HAMILTON – KITCHENER - LONDON – SARNIA – MONTREAL – QUEBEC

DUCT insulation

sustainable insulation.

Specification Sheet

SHOP DRAWING
Reviewed by: Samuel Charbonneau
Date: 21 juin 2016

Reviewed ☒
Reviewed as noted ☐
Resubmit ☐

Out for approval

SIFEC NORTH INC.

CertainTeed
SAINT-GOBAIN

SoftTouch™ Duct Wrap Insulation

Product Name	CertainTeed SoftTouch™ Duct Wrap Insulation
Manufacturer	CertainTeed Corporation
Address	P.O. Box 860 Valley Forge, PA 19482-0105
Phone	610-341-7000 • 800-233-8990
Fax	610-341-7571
Website	www.certainteed.com/insulation

PRODUCT DESCRIPTION

Basic Use: SoftTouch™ Duct Wrap Insulation is used to insulate rectangular and round heating, ventilating and air conditioning ductwork.

Benefits: SoftTouch Duct Wrap Insulation provides thermal efficiency that reduces unwanted heat loss or gain from equipment and ductwork. When properly installed in the correct thickness, this product virtually eliminates condensation problems on cold duct surfaces.

Composition and Materials: SoftTouch Duct Wrap is a blanket-type insulation composed of tan, uniformly textured, inorganic fibrous glass formed with a formaldehyde-free plant-based binding agent. It is available unfaced or with FSK, gray PSK or white PSK vapor retarder facing. On faced products, a stapling/taping tab is provided on one edge.

Limitations: The product should be kept clean and dry from the time of manufacture through job site installation and system operation.

SoftTouch Duct Wrap is suitable for use with most heating, ventilating and air conditioning ductwork operating at temperatures from 35°F to 250°F (1.7°C to 121°C) for faced SoftTouch Duct Wrap, and from 35°F to 450°F (1.7°C to 232°C) for unfaced SoftTouch Duct Wrap.

Sizes: See table on back for available sizes. Contact CertainTeed for other sizes and minimum order quantities.

INSTALLATION

Sheet metal ducts must be clean, dry and sealed tightly prior to insulating with CertainTeed SoftTouch Duct Wrap.

To ensure installed thermal performance, CertainTeed SoftTouch Duct Wrap must be cut to "stretch-out" dimensions. This requires measurement of the duct perimeter, then cutting the duct wrap to the dimensions (perimeter + add-on) indicated in the stretch-out table on the other side. A 2" piece of insulation is removed from the facing at the end of the piece of insulation to form an overlapping stapling and taping flap.

CertainTeed SoftTouch Duct Wrap is installed by wrapping the insulation around the perimeter of the duct with the facing out. Adjacent sections of duct wrap are tightly butted with the 2" taping flap overlapping. Seams must be stapled with outward-clinching staples on approximately 6" centers. When a vapor retarder is required, all seams, joints, tears, punctures and/or other penetrations of the duct wrap must be sealed with a pressure sensitive vapor retarder tape that matches the facing, or a suitable mastic system.

Where rectangular ducts are 24" in width or greater, CertainTeed SoftTouch Duct Wrap must be additionally secured to the bottom of the duct with mechanical fasteners spaced 18" on center to prevent sagging.

For additional installation details, consult the National Commercial and Industrial Insulation Standards (current edition) published by the Midwest Insulation Contractors Association (MICA).

AVAILABILITY AND COST

Manufactured in U.S.A. Available in select Western U.S./Canada regions. For availability and cost contact your local distributor, or call CertainTeed Sales Support Group in Valley Forge, PA at 800-233-8990.

WARRANTY

Refer to CertainTeed's Limited One-Year Warranty for Fiber Glass Duct Wraps (30-29-047).

MAINTENANCE

An inspection and preventative maintenance program for the HVAC system is recommended to ensure optimum performance.

TECHNICAL DATA

Applicable Standards

- Model Building Codes:
  – ICC
- Material Standards:
  – ASTM C1290
    Type I, Unfaced
    Type II, PSK – Grey
    Type III, FSK & PSK – White
  – ASTM C553
    Type I, Type 75 Duct Wrap
    Type II, Type 100 & 150 Duct Wrap
    Type III, Type 150 Duct Wrap
  – CAN/CGSB-51.11-92
  – ASTM C1136: FSK & White PSK, Type II, Gray PSK, Type IV
- Fire Safety Standards:
  – NFPA 90A, NFPA 90B

Fire Resistance

- Fire Hazard Classification:
  – UL 723, ASTM E84, CAN/ULC-S102
    Max. Flame Spread Index: 25
    Max. Smoke Developed Index: 50
- Non-Combustible: ASTM E136 / Meets test requirements

Physical/Chemical Properties

- Thermal Performance: See table on other side
- Operating Limits:
  – Temperature: ASTM C411
    Faced: Max. 250°F / 121°C
    Unfaced: Max. 450°F / 232°C
- Water Vapor Sorption: ASTM C1104 / < 5% by weight
- Water Vapor Transmission – Facing:
  – ASTM E96, Desiccant Method
    FSK and white PSK: Max. 0.02 perms (1.15×10^{-9} g/Pa•s•m^2)
    Gray PSK: Max. 0.09 perms (5.17×10^{-9} g/Pa•s•m^2)
- Corrosiveness: ASTM C665
  – Pass test requirements
- Fungi Resistance: ASTM C1338
  – Pass test requirements
- Odor Emission: ASTM C1304
  – Pass test requirements

Quality Assurance

CertainTeed's commitment to quality and environmental management has ensured the registration of the Athens, Chowchilla and Kansas City plants to ISO 9001:2000 and ISO 14001:2004 standards. The GREENGUARD® Environmental Institute has certified SoftTouch Duct Wrap Insulation for low emissions of total particle, formaldehyde and other Volatile Organic Compounds (VOCs).

DUCT insulation

SHOP DRAWING
Reviewed by: Samuel Charbonneau
Date: 21 juin 2016
Reviewed [X]
Reviewed as noted [ ]
Resubmit [ ]
Out for approval
SIFEC NORTH INC.

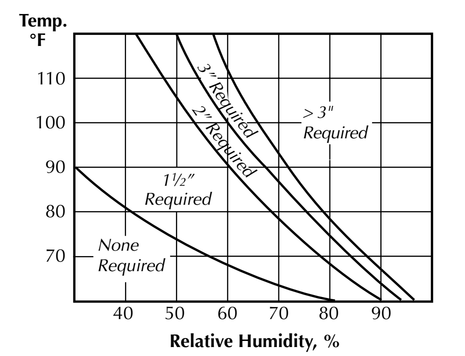
TECHNICAL SERVICES

Technical assistance can be obtained either from your local CertainTeed sales representative, or by calling CertainTeed Sales Support Group in Valley Forge, PA at 800-233-8990.

FILING SYSTEMS

- CertainTeed Pub. No. 30-36-081
- Sweet's Catalog Files, 230700
- Additional product information available upon request.

CONDENSATION CONTROL



This chart is based on indoor conditions so far as wind and other factors are concerned.

To determine thickness to prevent condensation, based on installed thickness at 75% of nominal (out-of-package) thickness and a duct internal air temperature of 55˚F, refer to the condensation control chart.

To use: 1) Select maximum relative humidity (%) on lower axis; 2) Read up vertically until that line intersects the maximum ambient air temperature; 3) Select the thickness indicated at the point of intersection.

THERMAL PERFORMANCE

Product			R-Value		Installed R-Value		K-Value		Installed K-Value	
Type	Thickness		h•ft²•°F/Btu	m²•°C/W	h•ft²•°F/Btu	m²•°C/W	Btu•in/h•ft²•°F	W/m²•°C	Btu•in/h•ft²•°F	W/m²•°C
	in.	mm								
75 (0.75 pcf*)	1	25	3.8	0.67	3.0	0.53	0.26	0.038	0.25	0.036
	1½	38	5.2	0.92	4.2	0.74	0.29	0.042	0.27	0.039
	2	51	6.9	1.22	5.7	1.00	0.29	0.042	0.26	0.038
	2⅛	54	7.3	1.29	6.0	1.06	0.29	0.042	0.27	0.038
	2½	64	8.6	1.51	7.1	1.25	0.29	0.042	0.26	0.037
	3	76	10.2	1.80	8.3	1.46	0.29	0.42	0.27	0.039
	4	102	13.5	2.38	11.0	1.94	0.30	0.043	0.27	0.039
100 (1.0 pcf*)	1	25	3.8	0.67	3.0	0.53	0.26	0.038	0.25	0.036
	1½	38	5.7	1.00	4.5	0.79	0.26	0.038	0.25	0.036
	2	51	7.6	1.34	6.1	1.07	0.26	0.038	0.25	0.035
150 (1.5 pcf*)	1	25	4.1	0.72	3.2	0.56	0.24	0.035	0.23	0.034
	1½	38	6.2	1.09	4.8	0.85	0.24	0.035	0.23	0.034
	2	51	8.3	1.46	6.4	1.13	0.24	0.035	0.23	0.034

Tested in accordance with ASTM C518 and/or ASTM C177 at 75°F (24°C) mean temperature. R means resistance to heat flow. The higher the R-value, the greater the insulating power. The installed R-value and K-value based upon 25% compression of the product thickness during installation. To get the installed R-value, it is essential that this insulation be installed properly. If you do it yourself, follow the installation instructions carefully.

*pcf. is pounds per square foot

INSTALLATION STRETCH-OUT DIMENSIONS

Product Label Thickness		Average Installed Thickness		Stretch-Out Dimensions[1]						
					Round Duct		Square Duct		Rectangular Duct	
in.	mm	in.	mm	perim.	in.	mm	in.	mm	in.	mm
1	25	0.75	19	P+	7.0	178	6.0	152	5.0	127
1.5	38	1.13	29	P+	9.5	241	8	203	7	178
2	51	1.50	38	P+	12	305	10	254	8	203
2.125	54	1.59	40	P+	12.6	321	10.4	270	8.4	213
2.5	64	1.875	48	P+	14.5	368	12.5	318	9.5	241
3	76	2.25	57	P+	17	432	14.5	368	11.5	292
4	106	3.00	76	P+	22.0	559	18.5	470	14.5	368

[1] The stretch-out dimension is equal to the duct perimeter (P) plus the add-on factor for the type of duct being installed.

AVAILABLE SIZES

Product Type	Facing	Thickness		Length		Width	
		in.	mm	in.	m	in.	mm
75 (0.75 pcf)	UNFACED	1	25	150	45.7	9 - 72	229 - 1829
		1½	38	150	45.7		
		2	51	75	22.9		
		2½	64	75	22.9		
		3	76	50	15.2		
	FSK/PSK	1½	38	100	30.5	48	1219
		2	51	75	22.9		
		2⅛	54	75	22.9		
		2½	64	75	22.9		
		3	76	50	15.2		
		4	102	50	15.2		
100 (1.0 pcf)	Unfaced	1	25	150	45.7	9 - 72	229 - 1829
	FSK/PSK	1	25	100	30.5	48	1219
		1½	38	100	30.5		
		2	38	75	22.9		
150 (1.5 pcf)	FSK/PSK	1½	38	75	22.9	48	1219
		2	51	50	15.2		

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Code No. 30-35-016

SAINT-GOBAIN

Chapter 20 OLSEN FURNACE

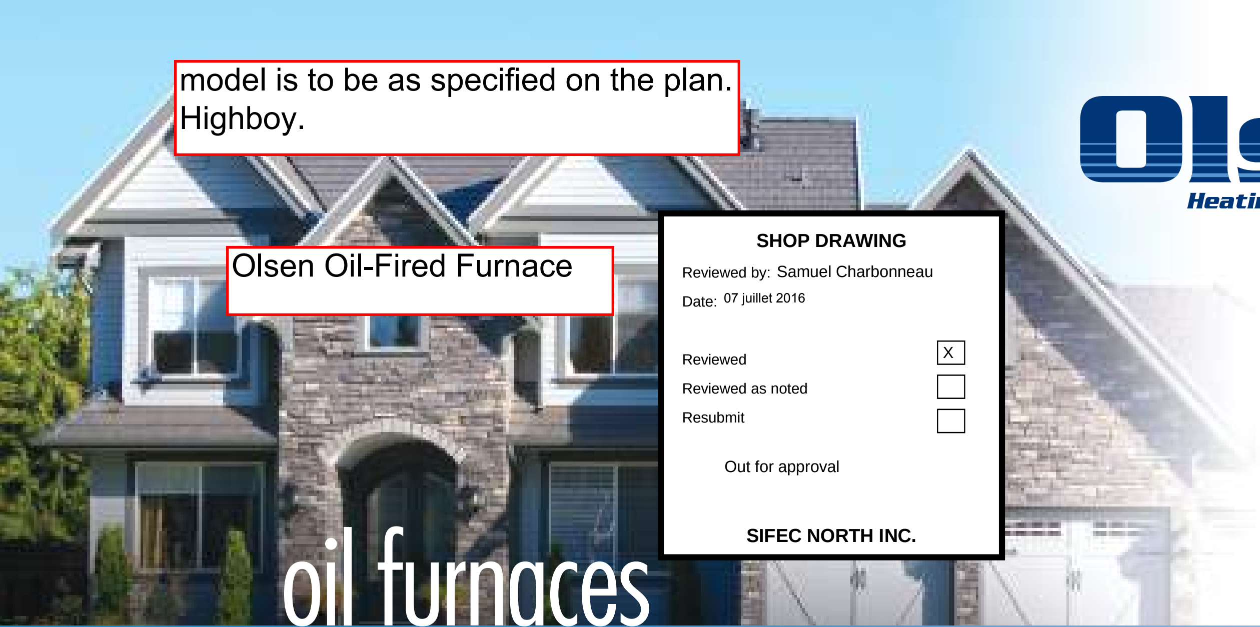
MANUFACTURER/DISTRIBUTOR:

WOLSELEY Inc.
4200, Hickmore
St-Laurent, QC, H4T 1K2
Phone: (514) 344-9378
Fax :(514) 344-9341

20.1 OLSEN FURNACE HML80CNX2

model is to be as specified on the plan.
Highboy.

Olsen Oil-Fired Furnace



Olsen
Heating & Cooling Products

SHOP DRAWING

Reviewed by: Samuel Charbonneau

Date: 07 juillet 2016

- [x] Reviewed
- [ ] Reviewed as noted
- [ ] Resubmit

Out for approval

SIFEC NORTH INC.

oil furnaces

keeping families warm for more than 60 years

Reliable, Efficient Home Heating:

– Variable Speed Technology
– Easy Installation & Maintenance
– Optional Cooling Up to 5 Tons

Lowboy
BCL, BFL, BML, BMLV
59,000 - 237,000 BTU

Highboy
HML, HMLV, HTL, HTLV
59,000 - 113,000 BTU

Multiposition
WML, WMLV, MPL
59,000 - 128,000 BTU

Olsen Home Heating Economics 101

Olsen Oil-Fired Furnace

An oil furnace uses two energy sources, oil to produce heat and electricity to power the fan motor but there's more to consider than just that.

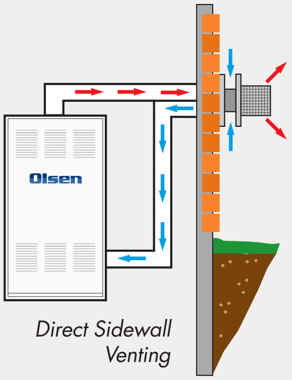
Calculate Your Savings

FEATURE:	BENEFIT:	ADDITIONAL BENEFITS:
OIL COSTS		
Higher Olsen AFUE Ratings (Annual Fuel Utilization Efficiency)	**= Lower Fuel Costs**	**+ Bonus Cash Back** (Through energy efficiency rebates).*
ELECTRICITY COSTS		
Olsen Variable Speed Technology An oil furnace with an ECM (Electronically Commutated Motor) can reduce electricity consumption up to †80%.	**= Lower Electric Costs**	**+ Bonus Cash Back** (Through energy efficiency rebates).*

ECM Fan Motor

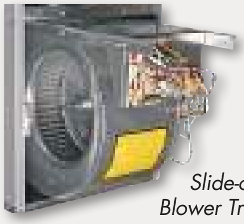
OTHER COSTS AND CONSIDERATIONS

FEATURE:	BENEFIT:	ADDITIONAL BENEFITS:
DIRECTVENT SIDEWALL **Olsen Direct Sidewall Venting** As homes age, the chimney can become costly to maintain or repair.	**– Eliminates Chimney Costs** **+ Increases Combustion Efficiency**	Requires only one wall opening, an Olsen Direct Sidewall Vent Kit (includes all connections from the furnace) and an Olsen concentric vent. (The Olsen vent terminal utilizes a two-pipe combustion air/exhaust gas configuration. Outside air is used for combustion resulting in greater efficiency and safety. The burner provides the necessary pressure for venting of flue products – no additional motors or controls are needed).
Superior Heat Exchanger Design	**+ Delivers Higher AFUE**	Double Pass Heat Exchanger (Heavy-gauge construction and large surface area maximize heat transfer) Dual Clean Outs (Provide easy access for quick, efficient routine maintenance)
Service & Maintenance Equipped for easy service and maintenance.	**= Lower Costs of Good Design**	Features like the slide out blower tray on high-boy models provide technicians easy access to critical components. Full length rails eliminate annoying/time consuming remounting of blower and motor housings, saving time and money on service.
Quiet Operation	**= Better Quality Comfort**	Most high-boy and low-boy Olsen furnaces come standard with a vestibule which provides sound attenuation, reducing operating noise. The vestibule also provides added protection for the burner.
Warranty & Peace of Mind Olsen furnaces are designed to provide years of trouble-free operation.	**+ Limited Lifetime Warranty (Heat Exchanger), 5 Years Parts**	



Direct Sidewall Venting

Superior Heat Exchanger



Slide-out Blower Tray

*(Check with your local government agencies and/or utilities regarding the availability of rebates and incentives).
†Individual savings may vary.*

169/665

HIGHBOY MODELS

Olsen Oil-Fired Furnace

BREECH	FURNACE DIMENSIONS (INCHES) HEIGHT	WIDTH	DEPTH	MODEL	FIRING RATE GPH	INPUT/ OUTPUT MBH[1]	AFUE EFFICIENCY % RATING — CHIMNEY VENT: BECKETT	BECKETT NX	RIELLO F	DIRECT VENT: BECKETT AFII	RIELLO BF
FRONT FLUE MODEL	49 5/8	22	30 3/4	HML60C2 HMLV60C2	0.50	70/59	83.1%				
				HML80C2 **HMLV80C2**	0.65	91/76	83.3%				
				HML90C2 HMLV90C2	0.75	105/85	81.5%				
				HML100C2 HMLV100C2	0.85	119/96	79.1%				
				HML60CNX2 HMLV60CNX2	0.50	70/60	Chimney Vented with Beckett NX	86.4%			
				HML80CNX2 **HMLV80CNX2**	0.65	91/76		85.7%			
				HML90CNX2 HMLV90CNX2	0.75	105/88		84.3%			
				HML100CNX2 HMLV100CNX2	0.85	119/98		83.4%			
				HML60CRF2 HMLV60CRF2	0.50	70/60	Chimney Vented with Riello F		86.3%		
				HML80CRF2 **HMLV80CRF2**	0.65	91/77			85.2%		
				HML90CRF2 HMLV90CRF2	0.75	105/87			83.2%		
				HML60CB2U2 HMLV60CB2U2	0.55	77/65	Direct Vented with Beckett AF II			84.6%	
				HML80CB2U2 **HMLV80CB2U2**	0.65	91/77				83.9%	
				HML90CB2U2 HMLV90CB2U2	0.75	105/88				83.3%	
				HML60CRBU2 HMLV60CRBU2	0.50	70/61	Direct Vented with Riello BF				86.7%
				HML80CRBU2 **HMLV80CRBU2**	0.65	91/77					85.4%
				HML90CRBU2 HMLV90CRBU2	0.75	105/88					84.5%
	58	22	30 3/4	HTL90D2	0.75	105/84	83.4%				
				HTL100D2	0.85	119/101	84.0%				
				HTL120D2	1.00	140/117	83.0%				
				HTL90DRF2 HTLV90DRF2	0.75	105/91	Chimney Vented with Riello F		86.5%		
				HTL100DRF2 HTLV100DRF2	0.85	119/102			85.3%		
				HTL115DRF2 **HTLV115DRF2**	0.95	133/113			84.1%		

GREEN TINTED AREA indicates models sold in Canada only. **BOLD TYPE** indicates factory equipped firing rate. Other firing rates shown utilize field supplied nozzles.

170/665

AVAILABLE MOTOR DRIVES			AC RANGE IN TONS BASED ON 400 CFM PER TON AIR FLOW @ 0.50" W.C. (CFM RANGE)	COOLING COILS SELECTION
ECM (V) VARIBLE FAN SPEED	PSC DIRECT DRIVE	PSC BELT DRIVE		
(V) 1/2 HP ECM motor 600 – 1200 cfm @ 0.5" w.c.	½ HP		2 to 3.5 Tons (690-1500)	**HML& HMLV Cased Cooling Coils** 2 ton CC24A3G-220R-066 2.5 ton CC30C3G-220R-066 3 ton CC36B3G-220R-066 3.5 ton CC42C3G-220R-066
(V) 1/2 HP ECM motor 600 – 1200 cfm @ 0.5" w.c.	½ HP		2 to 3.5 Tons (650-1400)	**HTL & HTLV Cased Cooling Coils** 2 ton CC24A3G-220R-066 2.5 ton CC30C3G-220R-066 3 ton CC36B3G-220R-066 3.5 ton CC42C3G-220R-066

Ratings and specifications are subject to change without notice.

Common Features:

All Olsen Oil Furnaces:

- **Heat Exchanger –** Proven heat exchanger design featuring 100% welded construction for maximum performance. Large accessible clean out ports.
- **Radiator –** "Wrap-around" style for maximum heat transfer.
- **Insulation –** Spun glass and aluminum foil for "hand-cool" cabinet.
- **Burner –** Equipped with industry leading Beckett or Riello oil burners which include oil solenoid valve, PSC motor and solid state controls. Factory assembled, wired and tested. Ready to connect to fuel line.
- **Barometric Draft Control –** Included with all chimney vent models.
- **Blower –** Direct drive or belt drive type. Permanently lubricated, resilient mounted.
- **Blower Assembly –** Entire unit can be easily removed for servicing.
- **Filter Racks & Washable Air Filters –** Included with all models.
- **Alternate firing rates** to fit a wide variety of applications (alternate nozzles are field supplied).

Made in North America, Dunkirk, NY Plant.

Additional Features:

BCL/BCL-S/BFL Lowboy Models

- **Cabinet construction –** 22 gauge steel cabinet ensures strength and quiet operation. Access door easily removed to access enclosed burner & controls.
- **PSC Blower Motor –** Designed for heavy duty continuous operation. Thermally protected. Four-speed is standard with 1/2 HP direct drive models. Three-speed is standard with 1 HP direct drive models. Single speed with adjustable motor pulley is standard with belt drive models.
- **Controls –** (UTEC) Electronic fan timer is standard on all 1/3 HP and 1/2 HP models. (Honeywell or White Rodgers) Fan and limit control is standard on all 3/4 HP and 1 HP models.
- **Air conditioning –** Fan timer control is AC ready. Prewired fan center relay is standard on fan and limit equipped models with 1 HP direct drive blower.
- **Direct Vent Models –** Include Beckett AFII-150 oil burner with pressure switch system for proving airflow, intake air collar and vent adapter. Vent pipe kits sold separately.

BML/BMLV Compact Lowboy Models

- **Cabinet construction –** 22 gauge steel cabinet ensures strength and quiet operation. Access door easily removed to access enclosed burner & controls.
- **PSC Blower Motor (BML Models) –** Designed for heavy duty continuous operation. Thermally protected. Four-speed is standard with ½ HP direct drive models. Single speed with adjustable motor pulley is standard with belt drive models.
- **ECM Variable Speed Blower Motor (BMLV Models) –** Maximizes air conditioner efficiencies, reduces electrical operating costs and enhances comfort with programmed ramp up and ramp down operation. Available on 1/2 HP direct drive models.
- **Controls –** (UTEC) Electronic fan timer control is standard on all models.
- **Air conditioning –** Fan timer control is AC ready.
- **Direct Vent Models –** Include Beckett AFII-85 or Riello 40BF3 oil burner with pressure switch system for proving airflow, intake air collar and vent adapter. Vent pipe kits sold separately.

HML/HMLV/HTL/HTLV Highboy Upflow Models

- **Cabinet construction –** 22 gauge steel cabinet ensures strength and quiet operation. Access door easily removed to access enclosed burner & controls.
- **PSC Blower Motor (HML/HTL Models) –** Designed for heavy duty continuous operation. Thermally protected. Four-speed is standard with 1/2 HP direct drive models.
- **ECM Variable Speed Blower Motor (HMLV/HTLV Models) –** Maximizes air conditioner efficiencies, reduces electrical operating costs and enhances comfort with programmed ramp up and ramp down operation. Available on 1/2 HP direct drive models.
- **Controls –** (UTEC) Electronic fan timer control is standard on all models.
- **Air conditioning –** Fan timer control is AC ready.
- **Direct Vent Models –** Include Beckett AFII-85 or Riello 40BF3 oil burner with pressure switch system for proving airflow, intake air collar and vent adapter. Vent pipe kits sold separately.

WML/WMLV/MPL Highboy Downflow/Horizontal Models

- **Cabinet construction –** 22 gauge steel cabinet ensures strength and quiet operation. WML/WMLV models may be factory equipped with vestibule compartment to enclose burner & controls. Vestibule compartment for WML/WMLV also available as an after-market kit for non-factory equipped units.
- **PSC Blower Motor (WML/MPL Models) –** Designed for heavy duty continuous operation. Thermally protected. Four-speed is standard with 1/2 HP (WML) and 3/4 HP (MPL) direct drive models.
- **ECM Variable Speed Blower Motor (WMLV Models) –** Maximizes air conditioner efficiencies, reduces electrical operating costs and enhances comfort with programmed ramp up and ramp down operation. Available on 1/2 HP direct drive models.
- **Controls –** (UTEC) Electronic fan timer control is standard on all models.
- **Air conditioning –** Fan timer control is AC ready.
- **Direct Vent Models –** Include Beckett AFII-85 (WML/WMLV) or Beckett AFII-150 (MPL) or Riello 40BF3 (WML) oil burner with pressure switch system for proving airflow, intake air collar and vent adapter. Vent pipe kits sold separately.

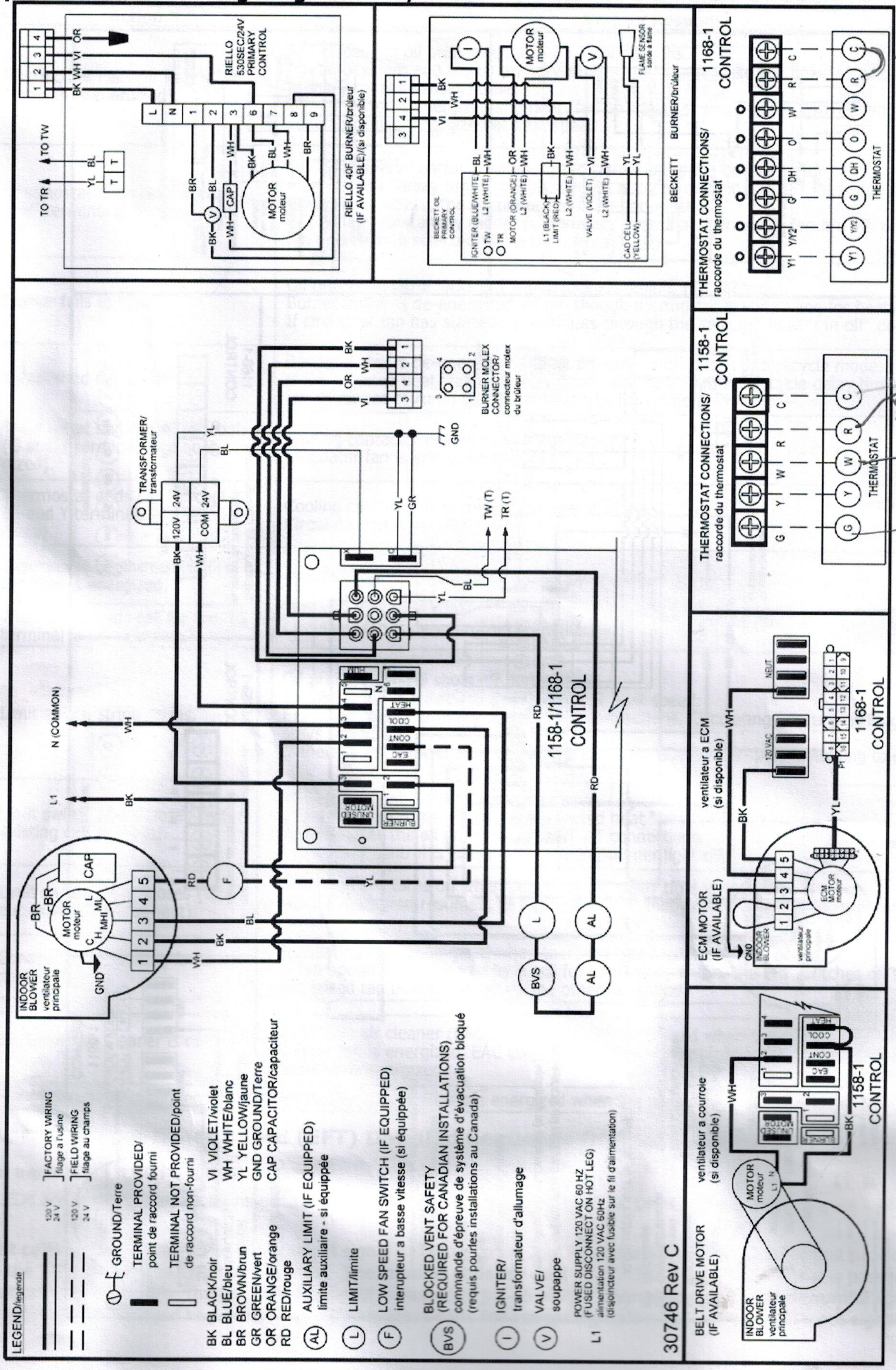
Olsen Oil-Fired Furnace

ECR International
2201 Dwyer Ave., Utica, NY 13504
Phone: (315) 797-1310 or
(800) 325-5479
Fax: (315) 724-9319
Web: www.olsenhvac.com

In Canada:
Contact ECR Master Representative:
Morden National Sales
Phone: 519-627-0791
Fax: 866-835-6667

PN 240009878 Rev. 4/14

Chimney Vent Furnace Wiring Diagram HML/HMLV



Olsen Oil-Fired Furnace

HML
(Up-Flow Model)
HMLV
(Up-Flow Model with ECM)
Series C
Oil Fired Warm Air Furnaces

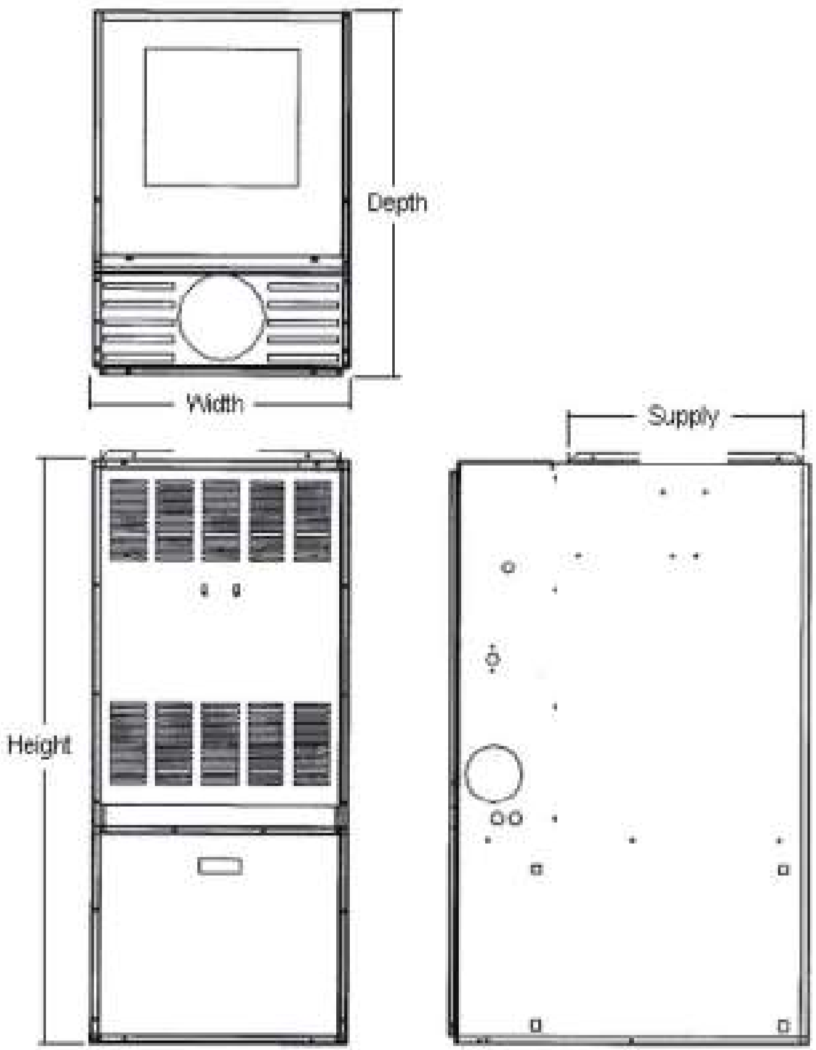
INSTALLATION, OPERATION & MAINTENANCE MANUAL

C US

ECR International
2210 Dwyer Avenue, Utica NY 13501
web site: www.ecrinternational.com

P/N# 301743, Rev. E [06/2013]

Dimensions



Furnace Model	Cabinet			Plenum Openings			Flue Diameter	Filter		Shipping Weight (LB)
	Width	Depth	Height	Supply	Return			Type	Size	
					Side	Bottom				
HML HMLV	22"	30¾"	49⅝"	20½"W x 20"D	14" x 22"	14" x 22"	5"	Permanent	16" x 25" x 1"	210 LB
	55.9 cm	78.1 cm	126.7 cm	52 cm x 52.8 cm	35.6 cm x 55.9 cm	35.6 cm x 55.9 cm	12.7 cm		40.6 cm x 63.5 cm x 2.5 cm	95.3 Kg

Check our website frequently for updates: www.ecrinternational.com

Information and specifications outlined in this manual in effect at the time of printing of this manual. Manufacturer reserves the right to discontinue, change specifications or system design at any time without notice and without incurring any obligation, whatsoever.

1. General

Furnace installation shall be completed by qualified agency. See glossary for additional information.

⚠ WARNING

Fire, explosion, asphyxiation and electrical shock hazard. Improper installation could result in death or serious injury. Read this manual and understand all requirements before beginning installation.

⚠ WARNING

Fire, burn, asphyxiation hazard. Do not use gasoline, crank case oil, or any oil containing gasoline. Failure to follow these instructions could result in death or serious injury.

2. Safety Symbols

Become familiar with symbols identifying potential hazards.

This is the safety alert symbol. Symbol alerts you to potential personal injury hazards. Obey all safety messages following this symbol to avoid possible injury or death.

⚠ DANGER

Indicates a hazardous situation which, if not avoided, WILL result in death or serious injury

⚠ WARNING

Indicates a hazardous situation which, if not avoided, could result in death or serious injury.

⚠ CAUTION

Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

NOTICE

Used to address practices not related to personal injury.

3. Introduction Models HML And HMLV

Models HML and HMLV are oil fired forced air up-flow furnaces with an output capacity range of 59,000 btu/hr. To 96,000 btu/hr.

- HML models are equipped with 1/2 HP PSC 4 speed blower motor.
- HMLV models are equipped with 1/2 HP ECM variable speed blower motor.

Furnace models are either factory equipped for chimney venting or factory equipped for direct venting.

Chimney vent models and direct vent models are not field convertible. Direct vent installation instructions are included with the direct vent models.

Installation shall conform to requirements of authority having jurisdiction or in absence of such requirements:

- Canada - CAN/CSA - B139, Installation Code for Oil-Burning Equipment.
- United States - National Electrical Code, NFPA31, Standard for the Installation of Oil-Burning Equipment.

Models are CSA listed, (NRTL/C) for use with No. 1 (Stove) and No. 2 (Furnace) Oil.

Refer to tables in Appendix A for performance data.

4. Heat Loss

Maximum hourly heat loss for each heated space shall be calculated in accordance with the procedures described in the manuals of:

- Canada - The Heating, Refrigeration and Air Conditioning Institute of Canada (HRAI), or by other means prescribed, or approved by the local authority having jurisdiction.
- United States - Manual J. titled, "Load Calculation" published by the Air Conditioning Contractors of America, describes a suitable procedure for calculating maximum hourly heat loss.

5. Locating the Unit - [See Figure 1 and Table 1]

- Locate furnace so flue connection to chimney is short, direct and consists of as few elbows as possible.
- Centralize furnace location with respect to supply and return air ductwork. Central location minimizes trunk duct sizing.
- All models may be installed on combustible floors.

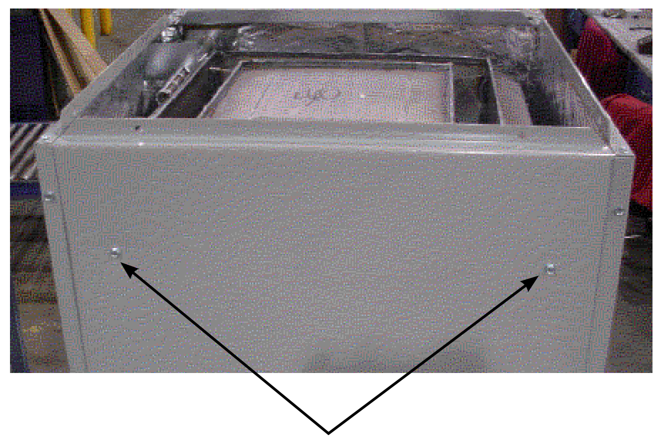
6. Furnace Used In Conjunction With Air Conditioning

- Install furnace in parallel with or upstream from evaporator coil to avoid condensation in heat exchanger.
- When installed in parallel, prevent chilled air from entering furnace by use of dampers or air controlling.
- Manually operated dampers must have a control to prevent operation of either system unless dampers are in full heat or full cool position.
- Air heated by the furnace shall not pass through evaporator coil unless coil is specifically approved for such service.
- Check and adjust blower speed to compensate for pressure drop caused by evaporator coil.

Table 1: Minimum Installation Clearances

Location	Clearance to Combustibles
	HML and HMLV
	Up flow
Top	1" (26 mm)
Bottom	0"
S/A Plenum	1" (26 mm)
Rear	1" (26 mm)
Sides	1" (26 mm)
Front	1"** (26 mm)
Flue Pipe	9"* (229 mm)
Enclosure	Closet
*18 in. (458 mm) USA ** 24 in. (610 mm) Service Clearance	

Figure 1 - Heat Exchanger Support Screw Location



Heat Exchanger Support Screws

- Remove heat exchanger support screws before final placement of the furnace.
- Preferable if furnace rear panel is inaccessible after installation.
- Screws must be removed if heat exchanger is to be removed from the cabinet.

7. Combustion Air

- Furnace installed in a closet or utility room, provide two openings connecting to well-ventilated space (full basement, living room or other room opening, not a bedroom or bathroom).
  A. One opening shall be located above level of upper vent opening.
  B. One opening below combustion air inlet opening in front of furnace.

  Each opening shall have a minimum free area of 1½ square inches per 1,000 Btu/h of total input rating of all appliances installed in the room.
- For furnaces located in buildings of unusually tight construction, such as those with high quality weather stripping, caulking, windows and doors, or storm sashed windows, or where basement windows are well sealed, a permanent opening communicating with a well ventilated attic or with the outdoors shall be provided, using a duct if necessary. The duct opening shall have a free area of 1½ square inches per 1,000 Btu/h of total input rating of all appliances to be installed.
- Furnace installed in a full basement, infiltration is normally adequate to provide air for combustion and draft operation.
- Furnace rooms under 65m³ (700 ft³) should automatically be treated as confined space.

8. Chimney Venting

- Flue pipe should be as short as possible with horizontal pipes sloping upward toward the chimney at a rate of one-quarter inch per foot.
- Flue pipe should not be smaller in cross sectional area than flue collar on the furnace.
- Flue pipe should connect to chimney so the flue pipe extends into, and terminates flush with the inside surface of chimney liner. Seal the joint between pipe and lining.
- Chimney outlet should be at least two feet above highest point of peaked roof.
- All unused chimney openings should be closed.
- Chimneys must conform to local, provincial or state codes, or in the absence of local regulations, to the requirements of the National Building Code.

NOTICE

This furnace is approved for use with Type L vent or equivalent.

⚠ WARNING

Asphyxiation hazard. Chimney vented versions of furnace must be connected to flue having sufficient draft at all times. Failure to follow these instructions could result in death or serious injury.

Manufacturer recommends overfire draft of -0.02 in. w.c. See figure 2.

Flue pipe must not pass through any floor or ceiling, may pass through a wall where suitable fire protection provisions have been installed.

- Refer to CAN/CSA B-139 for rules governing the installation of oil burning equipment.
- United States, refer to NFPA 31 for regulations governing the installation of oil burning equipment.

See appendix A for burner set-up.

Figure 2 - Check Over-Fire Draft

Over-fire draft access port.

9. Barometric Damper Control

Barometric damper control, also known as draft regulator, is used on conventional chimney venting only. Control automatically maintains constant negative pressure. Ensures proper pressures are not exceeded. If chimney does not develop sufficient draft, draft control does not function properly.

- Install draft regulator in same room or enclosure as furnace. Draft regulator should not interfere with combustion air supplied to the burner.
- Locate control near furnace flue outlet.
- Install per instructions supplied with regulator.
- Set overfire draft, measured at oil burner mounting plate over-fire draft access port, to -0.02 in. w.c. See Figure 2 page 6.

10. Optional Side Wall Venting

Certain HML and HMLV furnace models are manufactured as sidewall vented units. Refer to Direct Venting Instructions, P/N 240006979 included with Vent Kit for details.

Sidewall Venting (*Direct Venting*) requires use of specific oil burners; Beckett AFII, or Riello 40BF.

Refer to Appendix A, Tables A2, and A4.

11a. Fan Timer Board And Limit Control (HML) See Figure 3, page 15.

Electronic Fan Timer integrates control of burner and circulator fan operations. Control is central wiring point for most of furnace electrical components.

- United Technologies 1158-120 (HML) has an adjustable fan on time set by selecting dipswitch combination displayed in Chart 1. Fan on delay can be set at 30, 60, 90 or 120 seconds. Provides a delay between burner ignition and blower start-up to eliminate excessive flow of cold air when blower comes on.
- United Technologies 1158-120 (HML) has an adjustable fan off time of 2, 3, 4 or 6 minutes as displayed in Chart 1. Fan off delay time starts when burner motor is de-energized at end of call for heat. Blower shutdown is delayed to remove any residual heat from heat exchanger.
- Electronic fan timer board works in conjunction with snap disc limit controls, performing a safety function, and breaks power to oil burner primary control, shutting off burner if furnace over-heats.
- Limit control is thermally operated and automatically resets. Limit control is factory installed, pre-set and is not adjustable.
- If limit control opens with United Technologies 1158-120 (HML) electronic fan control**,** circulating fan will energize. When limit closes, fan off timer begins. At the end of fan off time cycle burner is energized, initiating normal burner cycle.

Chart 1- United Technologies 1158-120 (HML)

Dip Switch Position				Blower Delay Times	
1	**2**	**3**	**4**	**On Seconds**	**Off Minutes**
Off	Off			30	
On	Off			60	
Off	On			90	
On	On			120	
		Off	Off		2
		On	Off		3
		Off	On		4
		On	On		6

11b. Fan Timer Board And Limit Control (HMLV) [See Figure 4, page 15]

United Technologies 1168-1 ECM (HMLV) tap board has an adjustable fan on/off delay and airflow settings that must be adjusted in accordance with furnace input rating (nozzle size). Refer to Table A-9, page 17 for ECM blower set-up.

12. Electrical Connections

- Furnace is listed by Canadian Standards Association under NRTL (North American) Standard.
- All field wiring shall conform to CAN/CSA C22.1 Canadian Electrical Code, Part 1, and by local codes, where they prevail.
- United States, wiring shall conform to National Fire Protection Association NFPA-70, National Electrical Code, and with local codes and regulations.
- Wire furnace to separate dedicated circuit in main electrical panel.
- Suitably located circuit breaker can be used as service switch, separate service switch is advisable.
- Service switch is necessary if circuit breaker is close to the furnace, or furnace is located between circuit breaker and entry to furnace room.
- Clearly mark service switch. Install in accessible area between furnace and furnace room entry. Locate so as to reduce possibility it can be mistaken as light switch or similar device.
- Power requirement for HML and HMLV models is: 120 VAC, 1 Ø, 60 Hz., 12A.
- Accessory equipment such as electronic air cleaners and humidifiers may be included on furnace circuit.
- Accessories requiring 120 VAC power sources such as electronic air cleaners and humidifier transformers may be powered from electronic fan timer board where provisions have been made for connections, but should have their own controls.
- Do not use direct drive motor connections as a power source, there is risk of damaging accessories.

- Thermostat wiring connections are shown in wiring diagrams in Appendix B. Some micro-electronic thermostats require additional controls and wiring. Refer to thermostat manufacturer's instructions.
- Locate thermostat approximately 5 feet above floor, on inside wall, and where thermostat is exposed to average room temperatures. Avoid locations where thermostat is exposed to cold drafts, heat from nearby lamps and appliances, exposure to sunlight, heat from inside wall stacks, etc.
- Adjust thermostat heat anticipator to amperage draw of heating control circuit as measured at "R" and "W" terminals of thermostat. Do not measure current with thermostat connected to the circuit. Measure amperage by connecting ammeter between two wires which connect to thermostat "R" and "W" terminals.

13. Humidifier

- Humidifier is optional accessory available through most heating supplies outlets.
- Follow humidifier manufacturer's installation instructions
- Protect furnace heat exchanger from water or water droplets from humidifier.
- Do not use direct drive motor connections as source of power for 120 VAC humidifiers and humidifier transformers.

14. Piping Installation

- Install fuel system in accordance with requirements of CAN/CSA B-139, and local regulations.
- United States installation shall conform to NFPA No. 31 and local codes and authorities.
- Use only approved fuel oil tanks, piping, fittings and oil filter.
- Install oil filter as close to burner as possible.
- Refer to instructions and illustrations in oil burner and oil pump instructions shipped with the furnace.

15. Oil Filter

Install oil filter between fuel oil storage tank and oil burner. When using oil burner nozzle smaller than 0.65 U.S. Gallons Per Hour, install additional 7 to 10 micron filter as close as possible to oil burner.

16. Oil Burner Nozzles

Furnaces are certified for multiple firing rates. Furnace may be fired at ideal rate for wide range of structures by manipulating oil burner nozzle, flame retention head, and temperature rise. Refer to Table A-1 thru A-5, and furnace rating plate to determine proper combinations.

17. Oil Burner Adjustment

- Adjust burner air supply to maintain fuel to air ratio to obtain ideal combustion conditions.
- Lack of air causes "soft" and "sooty" flames, resulting in soot build-up throughout heat exchanger passages.
- Excess combustion air causes bright roaring fire and high stack temperatures resulting in poor fuel efficiency.
- HML and HMLV operate most efficiently with No. 1 smoke spot on Bacharach Scale. Dust will eventually build up on air moving components of oil burner assembly resulting in decreased air supply with potential soot build up in flue gas passageways of heat exchanger. Soot behaves as insulator and impairs good heat transfer. Stack temperature increases, and efficiency decreases. To avoid this problem, adjust the air supply to provide no more than trace smoke spot on Bacharach Scale.
- See Venting Instructions included in Vent Kits for set-up details for sidewall vented furnaces.

NOTICE

Set up sidewall vented models to deliver zero (0) smoke.

NOTICE

Before operating furnace check burner alignment with combustion chamber. End cone of air tube must be centred to accommodating ring of combustion chamber. Adjust as necessary.

18. Burner Electrodes

Correct positioning of electrode tips with respect to each other, fuel oil nozzle, and burners is essential for smooth light ups and proper operation.

Refer to oil burner instructions provided with furnace and Appendix A Section A.2 in this manual for electrode specifications.

NOTICE

Do not tamper with furnace controls they are sensitive. If problems persist, call your service contractor.

19. Burner Primary (Safety) Control

Furnace is equipped with primary combustion control, also referred to as burner relay or burner protector relay, which uses a cad cell located in burner housing, to monitor and control combustion.

Dust or combustion residuals can build up on lens of cad cell impairing its response to flame. Check cad cell for cleanliness and proper alignment if primary control frequently shuts down combustion.

20. Combustion Chamber

Furnace is equipped with cerafelt combustion chamber, held in place by a retaining bracket.

Check the alignment of the combustion chamber and oil burner before firing. It is possible for the combustion chamber to shift if subjected to rough handling during transit.

Inspect combustion chamber for damage or carbon build up whenever oil burner is removed for repairs or routine maintenance.

⚠WARNING

Fire, burn, asphyxiation hazard. Do not start the burner unless blower access door is secured in place. Failure to follow these instructions could result in death or serious injury.

21a. CIRCULATING AIR BLOWER (HML)

- HML and HMLV furnace models are equipped with direct drive blower systems.
- HML models are equipped with PSC motors.
- HMLV models are equipped with electronically commutated motors (ECM).
- Direct drive blower speed adjustments are not normally required in properly sized extended plenum duct systems. Motor RPM and air CFM delivery will vary automatically to accommodate conditions within usual range of external static pressures typical of residential duct systems.
- Under-sized duct systems may require higher blower speed to obtain system temperature rise.
- Some older duct systems were not designed to provide static pressure. They typically feature special reducing fittings at each branch run and lack block ends on the trunk ducts. These systems may require modification to provide some resistance to the airflow to prevent over-amping of direct drive blower motor. Selecting a lower blower speed may correct this problem.
- Direct drive blower speeds are adjusted by changing "hot" wires to motor winding connections. Refer to wiring diagrams in Appendix B or wiring diagram label affixed to furnace.
- ***Do not move neutral wire (normally white wire) to adjust blower speed.***
- Single blower speed for both heating and cooling modes may be used. Use a "piggy-back connector" accommodating both wires on a single motor tap.
- It is also acceptable to connect selected motor speed with a pigtail joined to both heating and cooling speed wires with a wire nut.
- Safety precaution against accidental disconnection of wires by vibration, secure wire nut and wires with few wraps of electricians tape.
- ***Do not connect power leads between motor speeds. Always connect neutral wire to motor's designated neutral terminal.***
- If joining blower speed wiring is done in furnace junction box, tape off both ends of unused wire.
- ***Do not use blower speed wires as source of power to accessories as electronic air cleaners and humidifier transformers. Unused motor taps auto-generate sufficiently high voltages to damage accessory equipment.***

⚠WARNING

Electrical shock hazard. Turn OFF electrical power supply at service panel before opening blower access door. Failure to do so could result in death or serious injury.

21b. Circulating Air Blower (HMLV)

HMLV furnace models are equipped with electronically commutated motors (ECM).

Setting Blower Speed and "ON" and "OFF" Timings

Blower speed and on/off time delays are handled by ECM motor programming and are set via dipswitches per Table A-9 on page 17. Heating airflow rate is SW1 and on/off delay is SW4, both are set according to firing rate. Cooling airflow rate is SW2 and if used is set according to installed cooling capacity. SW3 can be used to adjust airflow rate by (+) or (-) 15%. Features of this ECM variable speed motor are that it will deliver a constant airflow within a wide range of external static pressures, and also includes:

- **Soft Start:** ECM will slowly ramp up to required operating speed. In heating cycle allows heat exchanger to reach operating temperature before set heat speed, minimizes noise and increases comfort.
- **Soft Stop:** At end of heating cycle, ECM will slowly ramp down. Allows increased energy efficiency and reduced noise levels.
- **Dehumidification:** Dehumidification feature is programmed into the variable speed motor. At start of each cooling cycle, variable speed motor will run at 82% of rated airflow for 7.5 minutes. After 7.5 minutes has elapsed, motor will increase to 100% of rated airflow. Used to provide dehumidification and improve system efficiency.
- **Continuous Fan Operation:** When thermostat continuous fan (G) switch is on without call for heating or cooling, indoor fan is immediately energized up to 50% of cooling speed. Allows continuous circulation of air between calls for heating or cooling. If call for heat (W) or cool (Y) occurs during continuous fan, blower remains energized.

22. Maintenance And Service

Routine Maintenance By Home Owner

- Arrange for professional servicing of furnace by the service or installation contractor annually.
- Homeowner is to maintain air filter or filters. A dirty filter can cause furnace to over-heat, fail to maintain indoor temperature during cold weather, increase fuel consumption and cause component failure.
- Inspect, clean or replace filter monthly.
- Furnace is supplied with semi-permanent type filter. If filter is damaged, replace with filters of same size and type.
- During monthly filter inspection, inspect general condition of furnace. Watch for signs of oil leaks in vicinity of oil burner, soot forming on any external part of furnace, soot forming around joints in vent pipe, etc. If any of these conditions are present, please advise your service or installation contractor.

Annual Service By Contractor

NOTICE

Combustion chamber (firepot) is fragile. Use care when inspecting and cleaning this area

- Inspect heat exchanger periodically and clean if necessary.

⚠WARNING

Electrical shock hazard. Turn OFF electrical power supply at service panel before service or maintenance Failure to do so could result in death or serious injury.

- If cleaning is necessary, shut off oil supply, shut off power to the furnace and remove burner.
- Use stiff brush with wire handle, brush off scale and soot from inside drum and flue pipe.
- Clean radiator, remove clean-out cap screws. Remove caps carefully to avoid tearing gaskets.
- Wire brush can be used to loosen dirt and debris on the inside surfaces of radiator. Clean out all accumulated dirt, soot and debris with a wire handled brush and an industrial vacuum cleaner.
- Before replacing clean-out caps, inspect gaskets. If gaskets are broken, remove remnants and replace with new gaskets.
- Blower motor is factory oiled and permanently sealed. ***Do not lubricate.*** Excess oil causes premature electric motor failure.
- Inspect blower fan. Clean if necessary.
- Oil Burner Maintenance: Follow oil burner manufacturer instructions.
- Change oil burner nozzle and oil filter annually.
- Clean and inspect venting system for signs of deterioration. Replace pitted or perforated vent pipe and fittings.
- Barometric damper should open and close freely.
- Check electrical connections to ensure tight connections. Safety controls such as the high limit controls should be tested for functionality.
- Check fan control to ensure fan on and off delay function continues to start and stop blower fan at optimal settings.

WARNING

Fire, burn, explosion, asphyxiation hazard.

- Do not start burner when excess oil has accumulated, furnace is full of vapor, or combustion chamber is very hot.
- Do not burn garbage or paper in furnace.
- Do not leave paper or rags around furnace.

Failure to follow these instructions could result in death or serious injury.

23. OPERATING INSTRUCTIONS (HML)

Before Lighting

1. Open all supply and return air registers and grilles.
2. Open all valves in oil pipes.
3. Turn on electric power supply

To Light Unit

1. Set thermostat above room temperature to call for heat. Burner should start. It may be necessary to press RESET button on primary combustion control relay.
2. There is a fan on time delay before circulating fan is energized. United Technologies 1158-120 has adjustable fan on time set by selecting dipswitch combination displayed in Chart 1. Fan on delay can be set at 30, 60, 90 or 120 seconds.
3. Set the thermostat below room temperature. Oil burner stops.
4. Air circulation blower continues to operate until time off setting selected on electronic fan timer control times out. United Technologies 1158-120 has adjustable fan off time of 2, 3, 4 or 6 minutes. Fan timer control adjustments may be altered if air at room registers is high upon blower start up or shutdown.
5. Restore thermostat setting to comfortable temperature.

To Shut Down Unit

1. Set thermostat to lowest possible setting.
2. Set manual switch (if installed) in electrical power supply line to "OFF".

24. Operating Instructions (HMLV)

Before Lighting

1. Open all supply and return air registers and grilles.
2. Open all valves in oil pipes.
3. Turn on electric power supply.

To Light Unit

1. Set thermostat above room temperature to call for heat. Burner should start. It may be necessary to press RESET button on primary combustion control relay.
2. There is a fan on time delay before circulating fan is energized. United Technologies 1168-1 has adjustable fan on/off time delay programmed into ECM motor, and is set by selecting SW4 DIP switch combination displayed in Table A-9 page 17. Adjust Fan on/off delay according to input (nozzle size).
3. Set thermostat below room temperature. Oil burner stops.
4. Air circulation blower continues to operate until blower off delay setting programmed into ECM motor times out.
5. Restore thermostat setting to comfortable temperature.

NOTICE

If furnace is to be shut down for extended period of time, close oil supply valve to burner.

Check out and adjustments

HML and HMLV furnaces may be used with following oil burners.

Beckett AF, Beckett NX and Riello 40F oil burners are for applications using indoor air for combustion only.

Sidewall venting applications utilizing outdoor air for combustion, use Beckett AFII or Riello 40BF (Balanced Flue) oil burners only.

Table A-1 Beckett AF Oil Burner Set-Up

Beckett AF Series Oil Burners (For use with chimney vented units only)							
Furnace Model	Output BTU/Hr	Burner Model	Delavan Nozzle	Pump Pressure	Flow Rate	Head [1]	Static Plate
HML60C2 [2] HMLV60C2[2]	59,000	AF76BNHS	0.50 / 80°A	100 PSIG	0.50 USGPH	F3	3- ⅜ in.
HML80C2 HMLV80C2	76,000	AF76BNHS	0.65 / 80°A	100 PSIG	0.65 USGPH	F3	3- ⅜ in.
HML90C2[3] HMLV90C2[3]	85,000	AF76BNHS	0.75 / 80°A	100 PSIG	0.75 USGPH	F3	3- ⅜ in.
HML100C2[3] HMLV100C2[3]	96,000	AF76BNHS	0.85 / 70°A	100 PSIG	0.85 USGPH	F3	3- ⅜ in.

[1] Head is shielded by ceramic insulator.

[2] Low Firing Rate Baffle required when using 0.50-gallon nozzle.

[3] These models do not meet U.S. government requirements for minimum efficiency. They are intended for Canada only.

Table A-2 Beckett AFII Oil Burner Set-Up

Beckett AFII Series Oil Burners (For use with sidewall vented units with outdoor combustion air)						
Furnace Model	Output BTU/Hr	Burner Model	Delavan Nozzle	Pump Pressure	Flow Rate	Head
HML60CB2U2 HMLV60CB2U2	65,000	AFII-85	0.50 / 60°A	145 PSIG	0.55 USGPH	FB0
HML80CB2U2 HMLV-80CB2U2	77,000	AFII-85	0.60 / 60°A	115 PSIG	0.65 USGPH	FB3
HML90CB2U2 HMLV90CB2U2	88,000	AFII-85	0.70 / 60°A	115 PSIG	0.75 USGPH	FB3

Table A-3 Riello 40F Series Oil Burner Set-Up

Riello 40F Series Oil Burners (For use with chimney vented units)							
Furnace Model	Output BTU/Hr	Burner Model	Delavan Nozzle	Pump Pressure	Flow Rate	Air Gate	Turbulator Setting
HML60CRF2 HMLV60CRF2	60,000	40F3	0.50 / 60°W	105 PSIG	0.50 USGPH	2.6	1.0
HML80CRF2 HMLV80CRF2	77,000	40F3	0.60 / 60°W	115 PSIG	0.65 USGPH	2.6	1.5
HML90CRF2 HMLV90CRF2	87,000	40F3	0.65 / 60°W	135 PSIG	0.75 USGPH	3.6	2.0

Table A-4 Riello Balanced Flue (40BF) Burner Set-Up

Riello 40BF Balanced Flue Series Oil Burners (For use with sidewall vented units using outdoor combustion air)						
Furnace Model	Output BTU/Hr	Burner Model	Delavan Nozzle	Pump Pressure	Flow Rate	Turbulator Setting
HML60CRBU2 HMLV60CRBU2	61,000	40BF3	0.50 / 60°W	105 PSIG	0.50 USGPH	1.0
HML80CRBU2 HMLV80CRBU2	77,000	40BF3	0.60 / 60°W	115 PSIG	0.65 USGPH	1.5
HML90CRBU2 HMLV90CRBU2	88,000	40BF3	0.65 / 60°W	135 PSIG	0.75 USGPH	2.0

NOTE: Air gate setting may vary for sidewall vented units where air gate must be adjusted to achieve zero smoke.

Table A-5 Beckett NX Oil Burner Set-Up

Beckett NX Series Oil Burners (For use with chimney vented units)							
Furnace Model	Output BTU/Hr	Burner Model	Delavan Nozzle	Pump Pressure	Flow Rate	Retention Head	Air Setting
HML60CNX2 HMLV60CNX2	60,000	NX70LHSS	0.40 / 70°W	150 PSIG	0.50 USGPH	6-Slot	2.00
HML80CNX2 HMLV80CNX2	76,000	NX70LHSS	0.55 / 60°W	140 PSIG	0.65 USGPH	6-Slot	3.50
HML90CNX2 HMLV90CNX2	88,000	NX70LHSS	0.65 / 60°W	140 PSIG	0.75 USGPH	6-Slot	4.00
HML100CNX2 HMLV100CNX2	98,000	NX70LHSS	0.75 / 60°W	140 PSIG	0.85 USGPH	6-Slot	4.25

A.1 OIL BURNER AIR ADJUSTMENT

Consult oil burner instructions provided in furnace documents envelope for specific information concerning burner adjustments, operation and troubleshooting.

Beckett AF Burner (Chimney Vent)

Adjust air shutter by loosening locking screws. Moving air shutter, and if necessary, bulk air band.

Beckett AFII Burner (Direct Vent)

Adjust burner air supply. Loosen locking screw located on black dial to right of burner. Turn black dial clockwise to increase combustion air and counter-clockwise to decrease combustion air. Re-tighten locking screw after obtaining proper setting.

Beckett NX Burner (Chimney Vent)

Turn adjusting screw to setting 1/2 number higher than proper set point, turn adjusting screw counter clockwise to proper setting.

Riello 40F3 Burner (Chimney Vent)

Combustion air is adjusted by removing burner cover. Loosen screws that secure air adjustment plate. Move adjusting plate to either increase or decrease combustion air. When proper air setting is achieved, retighten fixing screws.

Riello 40BF3 Burner (Direct Vent)

Combustion air can be adjusted with burner cover on. Remove plastic cover on top right hand side of burner cover. With phillips head screw driver, turn adjustment screw clockwise to increase combustion air or counter-clockwise to decrease combustion air. When combustion air is set, re-insert plastic cover.

A.2 Burner Electrodes

Adjustment of electrode tips with respect to each other, nozzle, burner head is very important to ensure smooth start-ups and to permit efficient combustion.

Beckett AF and AFII Burners

- Electrode gap: 5/32 inch.
- Distance above horizontal center-line: 5/16 inch. Older instruction sheets specify 7/16 inch. Current specification is 5/16 inch.
- Distance ahead of nozzle: 1/16 inch.
- “Z” dimension, distance from front of end cone (head) to face of nozzle should be 1-1/8 inches. If ceramic head is used, distance from end cone to nozzle face is increased to 1-3/8 inches.

Beckett NX Burners

- Electrode gap: 5/32 inch
- Distance above horizontal centerline: 1/4 inch
- Distance ahead of nozzle: 3/32 inch
- Check /adjust zero calibration per Beckett NX Oil Burner Manual supplied with furnace.

Riello 40F, & BF Burners

- Electrode gap: 5/32 inch.
- Distance above horizontal center-line: 13/64 inch.
- Distance ahead of nozzle: 5/64 to 7/64 inch.

A.3 Start Up

Use following instructions to set the burner:

1. Shut off electrical power to the furnace.
2. Install oil pressure gauge to pressure port on oil pump. (Refer to oil pump specification sheet included with burner instructions).
3. Restore electrical power to furnace.
4. Start furnace and bleed all air from fuel oil lines.
5. Close purge valve and fire the unit.
6. Allow furnace to warm up to normal operating temperatures. During this time, set pump pressure in accordance with data provided in Appendix A, Table A-1 thru A-4.
7. ***Chimney vented units*** - Drill 1/4" test port in venting between furnace flue outlet and draft regulator (barometric damper) to take smoke readings.
8. ***Sidewall vented units*** - Do not drill. Use test port in the supplied appliance connector to take smoke readings.
9. When furnace has reached "*steady state*" (after approximately 10 minutes). Set combustion air damper to get TRACE of smoke for chimney vented units and ZERO smoke for sidewall vented units.
10. Check system temperature rise. *Temperature rise is the difference between return air temperature measured at a point near return air inlet, and supply air temperature measured near furnace outlet*.

    System temperature rise is listed on furnace rating plate. If temperature rise is too high, airflow must be increased. If temperature rise is too low, slow fan down.
11. After air adjustments have been completed, recheck the overfire draft at test port on burner mounting plate shown in Figure 2. Overfire draft should be adjusted to -0.02 inches w.c.
12. Turn burner off. Observe duct thermometer in supply air stream, note temperature blower fan stops. Fan adjustments can be made by moving dipswitch settings on timer control board for fan off delay.

13. Check operation of limit switch.
   A. Shut off power to furnace.
   B. Temporarily remove neutral wire from PSC blower motor or remove 5 pin power connector from ECM blower motor. Isolate AC line voltage pins on 5 pin power connector with electrical tape to prevent electric shock hazard.
   C. Restore electrical power to furnace.
   D. Set thermostat above room temperature.
   E. After three or four minutes of burner operation, limit control should turn burner off.
   F. When limit function test is complete, shut off electrical power to furnace, replace neutral wire to PSC blower motor or 5 pin power connector to ECM blower motor. Restore power.
   G. Blower fan will start up immediately. Once temperature has dropped and limit control has reset, fan will operate until fan off time is reached.
   H. Oil burner will resume operation and continue until thermostat is satisfied.
   I. Restore thermostat setting to comfortable temperature.

14. Set heat anticipator adjustment in thermostat (if so equipped), by removing "R" or "W" wire to thermostat. Read amperage draw between the two wires. Failure to remove one of the wires from thermostat while performing this test could burn out heat anticipator. Set heat anticipator to amperage measured.

15. Run furnace through at least three full cycles before leaving the installation, to ensure all controls are operating properly.

16. Check all joints in any positive pressure venting system for leaks before leaving the installation site

A.4 Special Instructions For Units Equipped With Riello Burners

Riello specifications are listed in Tables A-3 and A-4. Consult Riello Installation Instructions supplied with Burner for specific information concerning burner adjustments, operation, and trouble-shooting.

A.5 Final Check Out

Verify all safety devices and electrical components have been set for normal operation.

Verify all electrical connections are tight and wiring is secure.

Verify homeowner is informed and understands:

Where circuit breaker or fuse is located in main electrical panel.

Where furnace switch is located, and switch "on" and "off" positions if not obvious.

Where oil shut-off valve from oil storage tank is located.

Thermostat operation, and other related accessories.

How to operate manual reset button on primary control, and when not to push the reset button.

How and where to visually inspect venting system for leaks or other problems.

How to inspect, clean and replace air filter, and other homeowner maintenance procedures.

Who to call for emergency service and routine annual service.

FIGURE 3: UNITED TECHNOLOGIES 1158-120 FAN TIMER BOARD (HML)

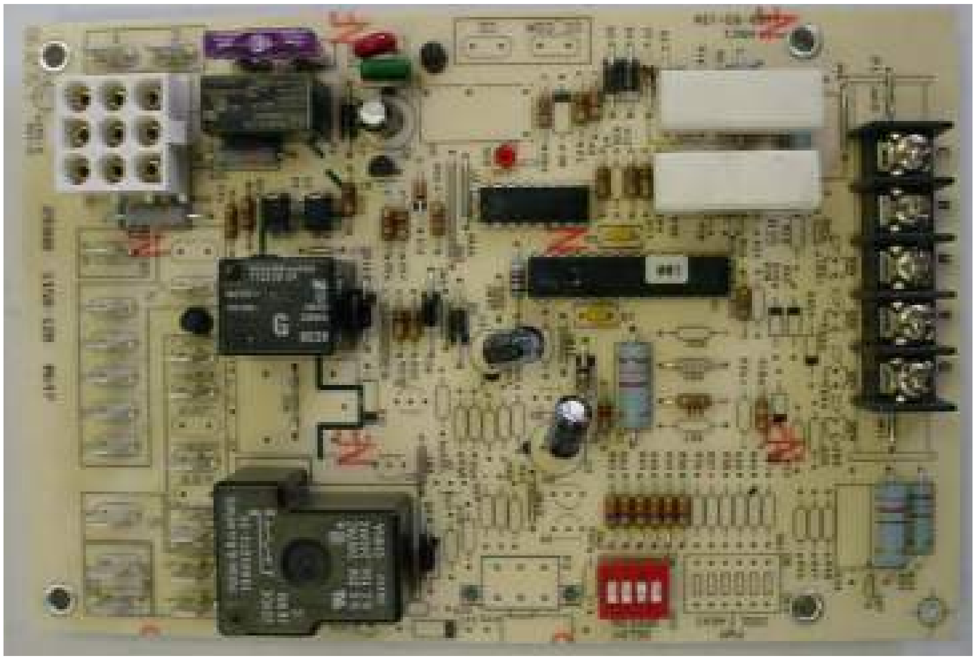


FIGURE 4: UNITED TECHNOLOGIES 1168-1 ECM TAP BOARD (HMLV)

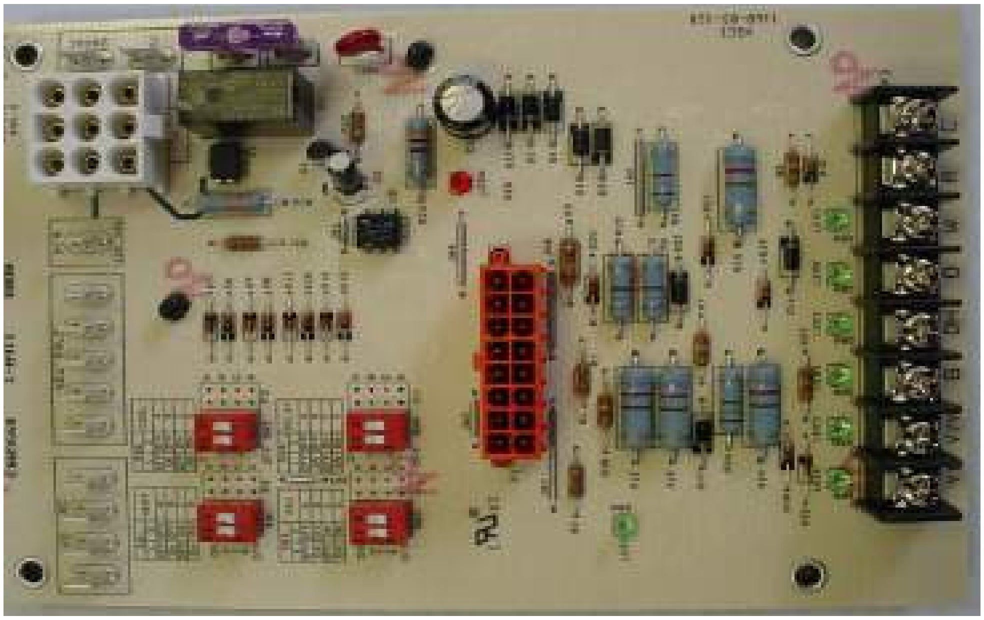


Table A-6 Direct Drive Blower Set-Up PSC Motor

Furnace Model	Blower	Blower Set-Up				Cooling Capacity		
		0.20 in. w.c.		0.50 in. w.c.		Tons	Power	CFM Range
		Speed	Motor	Speed	Motor			
HML-60	100-10T DD	Low	1/2 HP	Med-Low	1/2 HP	3	1/2 HP	690 – 1500
HML-80	100-10T DD	Med-Low	1/2 HP	Med-High	1/2 HP	3	1/2 HP	690 – 1500
HML-90	100-10T DD	Med-High	1/2 HP	High	1/2 HP	3	1/2 HP	690 – 1500
HML-100	100-10T DD	Med-High	1/2 HP	High	1/2 HP	3	1/2 HP	690 – 1500

Table A-7 Direct Drive Blower Characteristics PSC Motor

Furnace Model	Blower	Motor HP	Motor FLA	ΔT	Speed	CFM				
						External Static Pressure – Inches w.c.				
						0.20	0.30	0.40	0.50	0.60
HML 60 – 100	100-10T DD	1/2 HP	7.0	60°F	High	1741	1651	1556	1476	1369
					Med-High	1557	1497	1434	1369	1278
					Med-Low	1063	1051	1037	1037	1011
					Low	697	697	687	672	646

Table A-8 Direct Drive Blower Characteristics ECM Motor

Furnace Model	Blower	Motor HP	Motor FLA	ΔT	CFM RANGE		
					Continuous Fan	Heating	Cooling
						0.38 - 0.48 inches w.c.	0.5 inches w.c.
HMLV 60 – 100	100-10T DD	1/2 HP ECM	7.7	60°F	445 - 605	625 - 1500	600 - 1200

TIP

Formulas will assist with design of duct-work and determination of air flow delivery.

CFM = Bonnet Output / (1.085 x System Temperature Rise (ΔT)

System Temperature Rise (ΔT) = Bonnet Output / (1.085 x CFM)

Table A-9 ECM Blower Set-Up (HMLV)

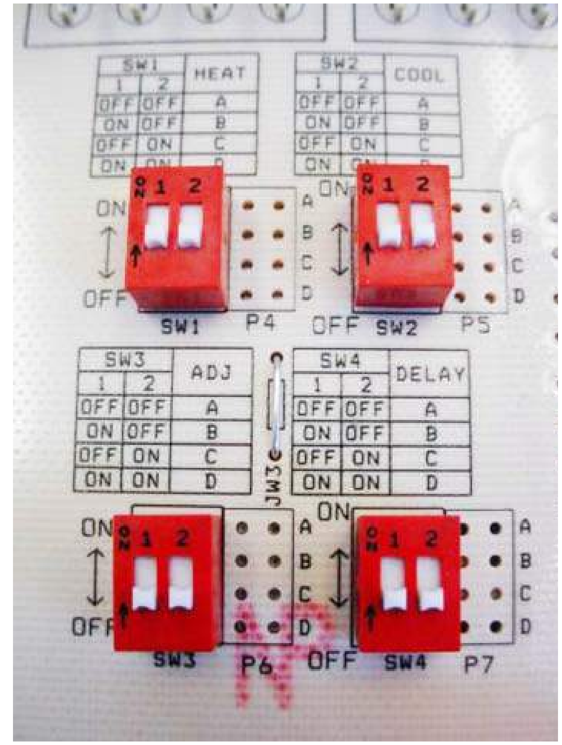
Dip Switch Adjustment Chart
For Input 0.50 USGPH TO 0.85 USGPH

SW1 - HEAT DIP Switch Position 1	2	POS.	INPUT USGPH
OFF	OFF	A	0.65
ON	OFF	B	0.85
OFF	ON	C	0.75
ON	ON	D	0.50

SW2 - COOL DIP Switch Position 1	2	POS.	AC Size (TON)
OFF	OFF	A	3
ON	OFF	B	2.5
OFF	ON	C	2
ON	ON	D	1.5

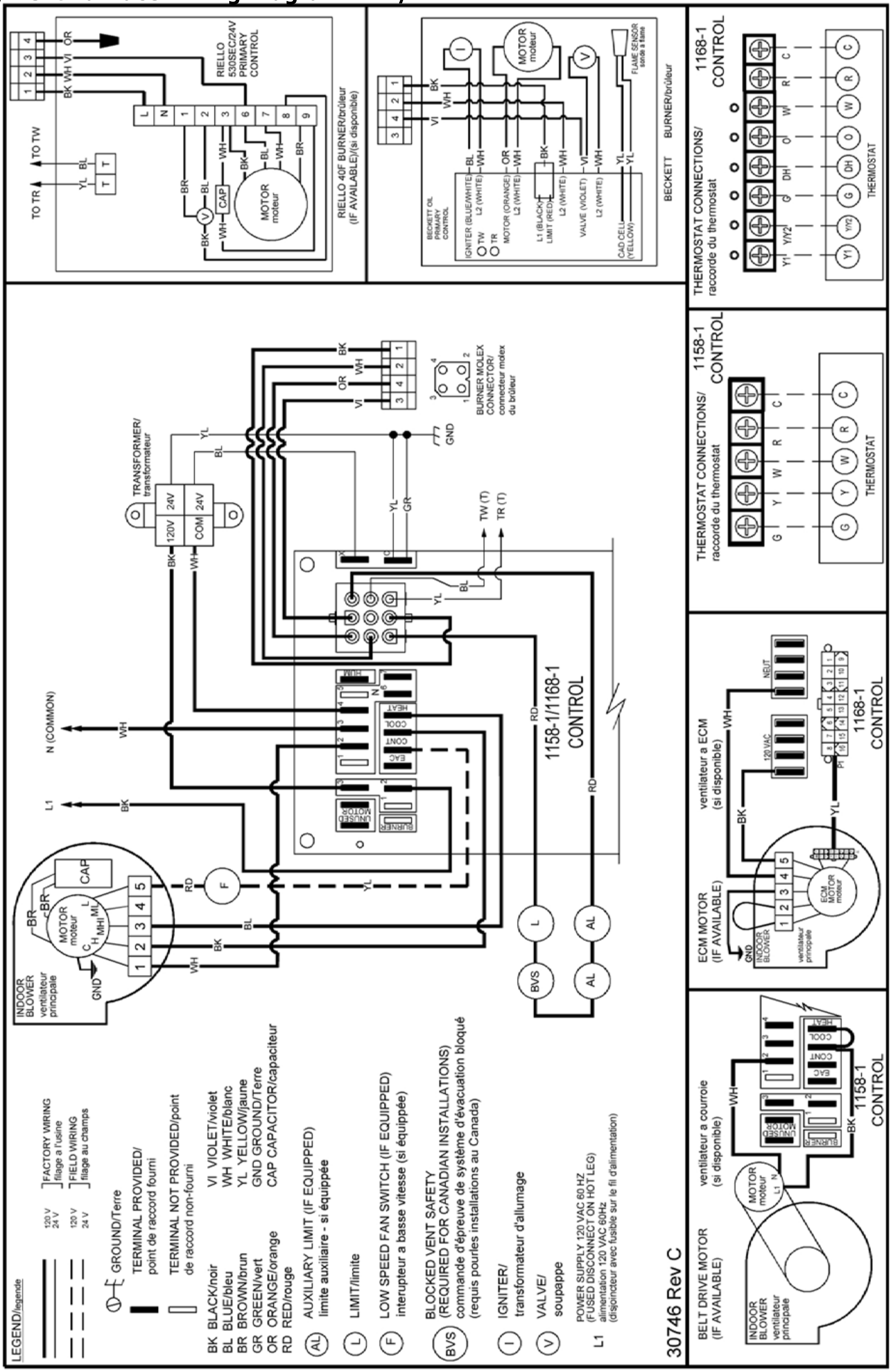
SW3 - ADJUST DIP Switch Position 1	2	POS.	CFM
OFF	OFF	A	0%
ON	OFF	B	(+)15%
OFF	ON	C	(-)15%
ON	ON	D	N/A

SW4 - DELAY DIP Switch Position 1	2	POS.	INPUT USGPH
OFF	OFF	A	0.65
ON	OFF	B	0.85
OFF	ON	C	0.75
ON	ON	D	0.50



NOTE:
SW1 (HEAT) AND SW4 (DELAY) DIP SWITCHES MUST BOTH BE ADJUSTED ACCORDING TO INPUT (NOZZLE SIZE).
SW2 (COOL): 1 TON is approximately equal to 400 CFM
SW3 (ADJUST): (Heating Mode) Increase OR decrease temperature rise respectively
(Cooling Mode) Increase OR decrease CFM respectively

Chimney Vent Furnace Wiring Diagram HML/HMLV



Direct Vent Furnace Wiring Diagram HML/HMLV

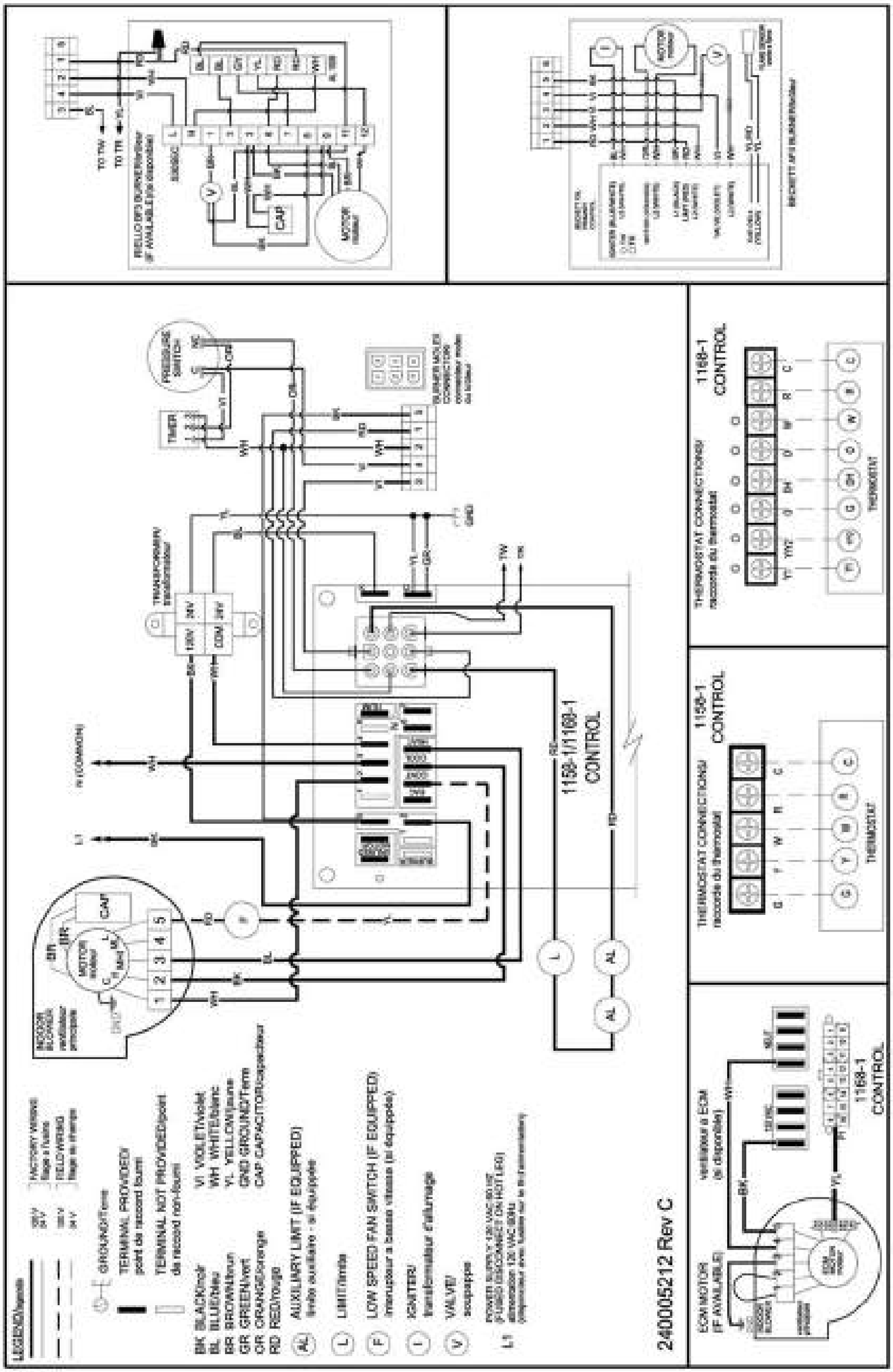


Table C-1: 1158-120 Electronic Fan Timer Board (EFT) Detailed Sequence Of Operation (HML)

Mode	Action	System Response
HEAT	Thermostat calls for heat. ("W" terminal is energized).	EFT closes the oil primary control T - T connections. Ignition system and the oil primary control start the furnace. Oil flows as long as the oil primary control senses flame. Burner motor is energized and heat "fan on" delay timing begins. When timing is complete, the circulator fan is energized at heat speed.
	Thermostat ends call for heat. ("W" terminal is de-energized).	The oil primary control is de-energized, terminating the burner cycle. Heat "fan off" delay timing begins. Length of delay depends on EFT dipswitch settings. When timing is complete, the circulator fan is de-energized. EFT returns to standby mode, (Oil primary control and circulator fan are off, unless continuous fan operation is selected at the thermostat).
	Burner fails to light.	Oil primary control locks out within lockout timing, (15 seconds). Burner motor is de-energized. (Even though thermostat is still calling for heat). If circulator fan has started, it continues through the selected heat "fan off" delay period.
	Established flame fails.	Burner motor is de-energized and oil primary control goes into recycle mode. If the selected heat "fan off" delay timing is longer than the recycle delay timing, the circulator fan continues to run through the next trial for ignition.
COOL	Thermostat begins call for cool. (G and Y terminals are energized).	Cooling contactor is energized immediately. Circulator fan is energized at cool speed.
	Thermostat ends call for cool. (G and Y terminals are de-energized).	Cooling contactor is de-energized immediately. Circulator fan turns off immediately.
FAN	Thermostat begins call for fan. (G terminal is energized).	Circulator fan is energized immediately at cooling speed.
	Thermostat ends call for fan. (G terminal is de-energized).	Circulator fan is de-energized immediately.
LIMIT	Limit switch string opens.	Oil primary control shuts off burner. Circulator fan is energized immediately at heat speed. EFT opens the oil primary control T - T connections. Circulating fan runs as long as limit string stays open. If there is a call for cooling or fan, the circulating fan switches from heating to cooling speed.
	Limit switch string closes (with existing call for heat).	EFT begins heat "fan off" delay sequence. Circulating fan turns off after the selected heat "fan off" timing. EFT re-closes the oil primary control T - T connections. Oil primary control is energized, initiating burner light off.
	Limit switch string closes (without existing call for heat).	Circulator fan turns off when heat "fan off" delay time is complete. Normal operation resumes; EFT control is in standby mode awaiting next thermostat command.
FAN	Continuous circulating fan is connected.	Circulating fan is energized when there is no call for heat, cool, or fan. If fan operation is required by a call for heat, cool, or fan, the EFT switches off the continuous fan speed tap before energizing the other fan speed.

EAC	Electronic Air Cleaner is connected.	Electronic air cleaner (EAC) connections are energized when the heat or cool speed of the circulator fan is energized. EAC connections are not energized when the optional continuous fan terminal is energized.
HUM	Humidity control is connected.	Humidifier connections are energized when the oil burner motor is energized.

1168-1 Electronic Fan Timer Board (EFT) Detailed Sequence Of Operation (HMLV)

Thermostat Input LEDs (LED1-5, LED8)

Six green LEDs are placed behind their respective thermostat connections (Y1, Y/Y2, G, DH, O, and W) and operate whenever a call is present.

Thermostat calls for heat "W". The 24VAC input signal is passed to pin 2 of P1 and will drive the K1 relay that provides dedicated contacts to the T-T input of the Oil Primary Control. **Thermostat calls for cool "Y1"**. The 24VAC input signal is passed to pin 6 of P1. **Thermostat calls for fan "G"**. The 24VAC input signal is passed to pin 15 of P1. **Thermostat calls for dehumidification "DH"**. The 24VAC input signal is passed to pin 10 of P1. **Thermostat calls for reversing valve "O"**. The 24VAC input signal is passed to pin 9 of P1.

C.1 Troubleshooting

⚠WARNING

Electrical shock hazard. Only a trained, experienced service technician should perform troubleshooting procedure. Failure to do so could result in death or serious injury.

C.2 Preliminary Steps:

Consult Beckett or Riello instruction manuals provided with oil burner for specific information regarding oil burner primary control sequence of operation, diagnostics and troubleshooting.

Check diagnostic light for indications of burner condition.

NOTICE

When simulating call for heat at oil primary control, disconnect at least one thermostat lead wire from T - T terminals to prevent damage to thermostat. Neglecting this procedure may burn out heat anticipator of standard 24 vac thermostat, or cause harm to components within micro-electronic thermostat.

Before checking oil primary control, perform these preliminary checks, repair or replace controls as necessary:

- Check power supply, fuse box or breaker, any service switches, all wiring connections, and burner motor reset button (if equipped).
- Check limit switches to ensure switch contacts are closed.
- Check electrode gap and position.
- Check contacts between oil primary control and electrodes.
- Check oil supply (tank gauge).
- Check oil nozzle, oil filter, and oil valves.
- Check piping or tubing to oil tank.
- Check oil pump pressure.

C.3 Check Oil Primary Control

If the trouble does not appear to be in the burner or ignition hardware, check the oil primary control per manufacturer's instructions inlcuded with oil burner.

⚠WARNING

Electrical shock hazard. Only a trained, experienced service technician should perform troubleshooting procedure. Failure to do so could result in death or serious injury.

Table C2: System and General Troubleshooting

Problem	Possible Cause	Remedy
Furnace will not start.	Thermostat not calling for heat	Check thermostat and adjust. Check thermostat for accuracy; if mercury switch type, it might be off level.
	No power to furnace	Check furnace switch, main electrical panel furnace fuse or circuit breaker. Look for any other hand operated switch, such as old poorly located furnace switch, which was not removed during furnace replacement.
	Thermostat faulty	Remove thermostat wires from oil primary control terminals T-T. Place a jumper across T-T. If furnace starts, replace thermostat, thermostat sub-base (if equipped), or both.
	Oil primary control faulty	Check reset button on oil primary control. Remove thermostat wires from oil primary control terminals T - T. Check for 24V across T -T. If no voltage is present, check for 115V to oil primary control. If 115V is present, refer to oil primary control documentation provided with oil burner.
	Photo Cell wiring shorted or room light leaking into photo cell compartment	Check photo cell (cad cell) wiring for short circuits. Check for room light leaking into cad cell compartment. Repair light leak if necessary.
	Open safety switch	Check for open limit or auxiliary limit. Check internal wiring connections; loose connectors, etc.
Furnace will not start without first pushing oil primary control reset button. (Happens on frequent basis)	No fuel oil	Check fuel oil supply. Check all hand operated fuel oil valves are in open position. Fill oil storage tank if necessary.
	Clogged nozzle	Replace nozzle with high quality replacement. Use rating plate or Tables in Appendix A as a guide.
	Clogged oil filter	Replace oil tank filter or in-line filter if used.
	Low oil pump pressure	Connect pressure gauge to oil pump. Adjust pump pressure, or replace oil pump if necessary. Verify erratic pressure readings are not caused by defective fuel oil line.
	Air getting into fuel oil lines, or fuel oil line dirty, clogged, or in some manner defective	Check fuel oil lines. Replace any compression fittings found with high quality flared fittings. Check for signs of oil leaks. Any oil leak is potential source of air or contaminants.
	Defective burner motor	Check burner motor. If burner motor is cutting out on over-load, determine why. Replace if neces-sary.

Table C-2: System and General Troubleshooting continued

Problem	Possible Cause	Remedy
Furnace starts, but cuts out requiring manually re-setting oil protector reset button.	Photo Cell (Cad Cell) defective.	If cad cell is dirty, clean it. Determine why cad cell is getting dirty. If cad cell is poorly aimed, realign it. NOTE: Photocell should have resistance of 100 KΩ in absence of light; maximum of 1500 Ω in presence of light. Verify room light is not leaking into the cad cell compartment. (See diagnostic light section).
Furnace starts, but cuts out requiring manually re-setting oil protector reset button.	No fuel oil.	Check fuel oil supply. Check that all hand operated fuel oil valves are in the open position. Fill oil storage tank if necessary.
	Clogged nozzle.	Replace nozzle with high quality replacement. Use rating plate or Tables in Appendix A as a guide.
	Clogged oil filter.	Replace oil tank filter or in-line filter if used.
	Low oil pump pressure.	Connect pressure gauge to oil pump. Adjust pump pressure, or replace oil pump if necessary. Verify erratic pressure readings are not caused by defective fuel oil line.
	Air getting into fuel oil lines, or fuel oil line dirty, clogged, or in some manner defective.	Check fuel oil lines. Replace any compression fittings found with high quality flared fittings. Check for any signs of oil leaks. Any oil leak is a potential source of air or contaminants.
	Defective burner motor.	Check burner motor. If burner motor is cutting out on over-load, determine why. Replace if necessary.
	Water or contaminants in oil.	Drain fuel oil storage tank; replace fuel oil. (Consult with fuel oil supplier).
	Frozen oil line.	Gently warm oil line. Insulate oil line. (Outdoor piping size may require increased diameter).
Oil burner sputtering at nozzle	Electrodes out of adjustment or defective.	Check electrode settings. Check electrodes for dirt build-up or cracks in porcelain.
	Poor igniter connections or defective igniter.	Check contacts between the igniter and electrodes. If OK, replace the igniter
	Fuel oil filter clogged.	Replace fuel oil storage tank filter and / or fuel oil in-line filter.
	Defective oil pump.	Check burner motor and / or fuel oil pump coupling. Check oil pump pressure. Replace fuel oil pump if necessary.
	Fuel oil line partially clogged or contains air.	Bleed air from oil line. If problem persists, replace oil line.
Excessive fuel oil consumption.	System temperature rise too high.	System temperature rise should not exceed 75°F. Check for clogged air filters. Check blower fan for excess dirt build-up or debris. Speed up blower fan if necessary.
	Poor "fan off" delay timing selection, (fan stops too soon).	Check "fan off" delay timing setting. Use duct thermometer in supply air plenum take-off or first few inches of supply air trunk duct. Fan should shut off at 90° - 100°F. Manipulate dip switch settings to come as close as possible to this "fan off" temperature.
	Fuel oil leak.	Check fuel oil line for leaks. Repair or replace if necessary.
	Stack temperature too high.	Check stack temperature. Stack temperatures will normally range from 400° to 500°F. Check draft regulator. Draft should be set to -0.02 in. w.c.
	Thermostat improperly adjusted or in poor location.	Check thermostat heat anticipator setting against measured amperage draw. Increase heat anticipator setting if necessary. If thermostat is being influenced by drafts, sunlight, duct work, etc., relocate to suitable location.

Table C-2: System and General Troubleshooting continued

Problem	Possible Cause	Remedy
Too much smoke.	Insufficient combustion air adjustment at oil burner, or improper draft pressure.	Adjust oil burner combustion air band and draft regulator to gain highest practical CO2 or lowest practical O2 content in flue gases. See Burner Set Up.
	Heat exchanger partially clogged.	Check for soot build-up in heat exchanger flue passages, especially in outer radiator.
Soot building up on blast tube (end coning).	Poor alignment between oil burner blast tube and fire pot.	Check alignment. Blast tube should be centered with fire pot burner opening. Oil burner head should be ¼ inch back from inside surface of fire pot.
	Flame impingement caused by Incorrect nozzle angle.	Check nozzle size and angle. (See Appendix A). Check distance from head to inside surface of fire pot.
	Defective fire-pot	Check fire-pot. Repair or replace.
Furnace will not warm home to desired temperature.	Airflow blocked or dirty air filter.	Clean or replace air filter.
	Thermostat adjustments or location.	Check thermostat heat anticipator setting against measured amperage draw. Increase heat anticipator setting if necessary. If thermostat is being influenced by drafts, sunlight, duct work, etc., relocate to suitable location.
	Insufficient airflow.	Check all dampers. Open closed dampers including registers in unused rooms. Check system temperature rise. If temperature rise is too high, speed up blower fan.
	Defective high limit control.	Test high limit function of all limit switches. Use duct thermometer to verify accuracy of limit control. Check for obstructions to airflow around limit switch bimetal elements. Replace control if necessary.
	Under-sized nozzle.	Check nozzle. If problem is not caused by air flow problems, use larger nozzle, if permitted by rating plate.
	Blower fan motor stopping intermittently on overload.	Check blower fan motor amperage draw. Check motor ventilation ports, clean if necessary. Replace motor if necessary.
	Burner motor stopping intermittently on overload.	Check burner motor. Replace if necessary.
Home does not heat evenly	Improper distribution of heat.	This is not likely to be a furnace problem. Balance duct system.
Supply air temperature too hot.	Airflow blocked or dirty air filter.	Clean or replace air filter.
	Insufficient airflow.	Check all dampers. Open closed dampers including registers in unused rooms. Check system temperature rise. If temperature rise is too high, speed up blower fan.
Supply air temperature too cool.	Excess airflow.	Check system temperature rise. Slow down blower fan if necessary.
	Excessive duct losses.	Check supply air ductwork. Seal leaky joints and seams. Insulate ductwork if necessary.
Supply air temperature too cool during first moments of furnace cycle.	Fan control "fan on" setting too low.	Increase "fan on" dipswitch settings on EFT if control has this option. Register air deflectors may help.
	Excessive duct losses.	Check supply air ductwork. Seal leaky joints and seams. Insulate ductwork if necessary.

APPENDIX D - HOMEOWNER'S REFERENCE TABLE

Model No.	
Serial No.	
Date Installed	
Contractor	
Contact	
Address	
Postal Code	
Telephone No.	
After Hours No.	

Fuel Supplier

Fuel Oil Supplier	
Contact	
Telephone No.	
After Hours No.	

Parts Listing: Chimney Vent Models HML80(C2,CRF2, CNX2) and HMLV80(C2,CRF2, CNX2)

Ref. No.	Description	Part No.
1	Left Side Panel Assembly	29130AD
2	Right Side Panel Assembly	29129AD
3	Rear Panel	29131AD
4	Blower Division Assembly	29189
5	Base Panel	26216
6	Inner Front Panel	30066
7	Blower Access Panel	27721AD
8	Top Panel	21437AD
9	Heat Exchanger Assembly	550001636
10	Combustion Chamber Retainer Bracket	27068
11	Replacement Combustion Chamber	27000WP
12	Oil Burner Mounting Plate Assembly	109007674
	Sight Glass Cover Plate	29850
	Sight Glass Gasket (2 per unit)	29870
	Sight Glass	29876
13	Flue Connector	29005
14	Pouch Gasket	2080175
15	Flue Collar Gasket	21994
16	Insulation Retainer	20602
17	Radiator Clean-out Cover (2 per unit)	240007841
	Radiator Clean-out Cover Gasket (2 per unit)	240006333
18	Clean-out Gasket Retainer	29161
	Clean-out Tube Gasket	29163
19	Filter Frame 16” X 25”	18020
20	Filter Frame End Support	5592B2
21	Filter 16” X 25” X 1” Permanent	2180023
24	Control Box	29362
25	Upper Door Panel	30164AD
	Logo Bezel	28479
	Logo Label	28563
26	Limit Disc 60T11 BOF 155°F	30071
27	Fan Timer Control 1158-120 UTEC Fan Timer Control 1168-1 ECM UTEC	29388 240007048
28	Wire Harness, Controls Fan Timer	29364
29	Wire Harness PSC, Blower	29365
30	Wire Harness, Fan Timer Board, Transformer	29751
31	Wire Harness, ECM Blower Control	240006438
	Wire Harness, ECM Blower Supply	240005742
32	Transformer	240005330
33	Draft Regulator	27494 (5”)
34	Oil Burner Assembly, Beckett AF76BNHS	30067
	Oil Burner Assembly, Beckett NX70LHSS	240010182
	Burner Motor 1/7 HP 3450 RPM PSC	29689
	Beckett Clean-Cut Oil Pump A2EA6520	29688
	Solid State Ignitor	29522
	Oil Primary Combustion Control 7505P1515	240008818
	Flame Retention Head (F3 for AF burner)	1050002
	Low Fire Kit (0.50 GPH for AF burner)	29880
	Low Firing Rate Baffle (for AF burner)	25521101
34	Oil Burner, Riello 40F3	29568

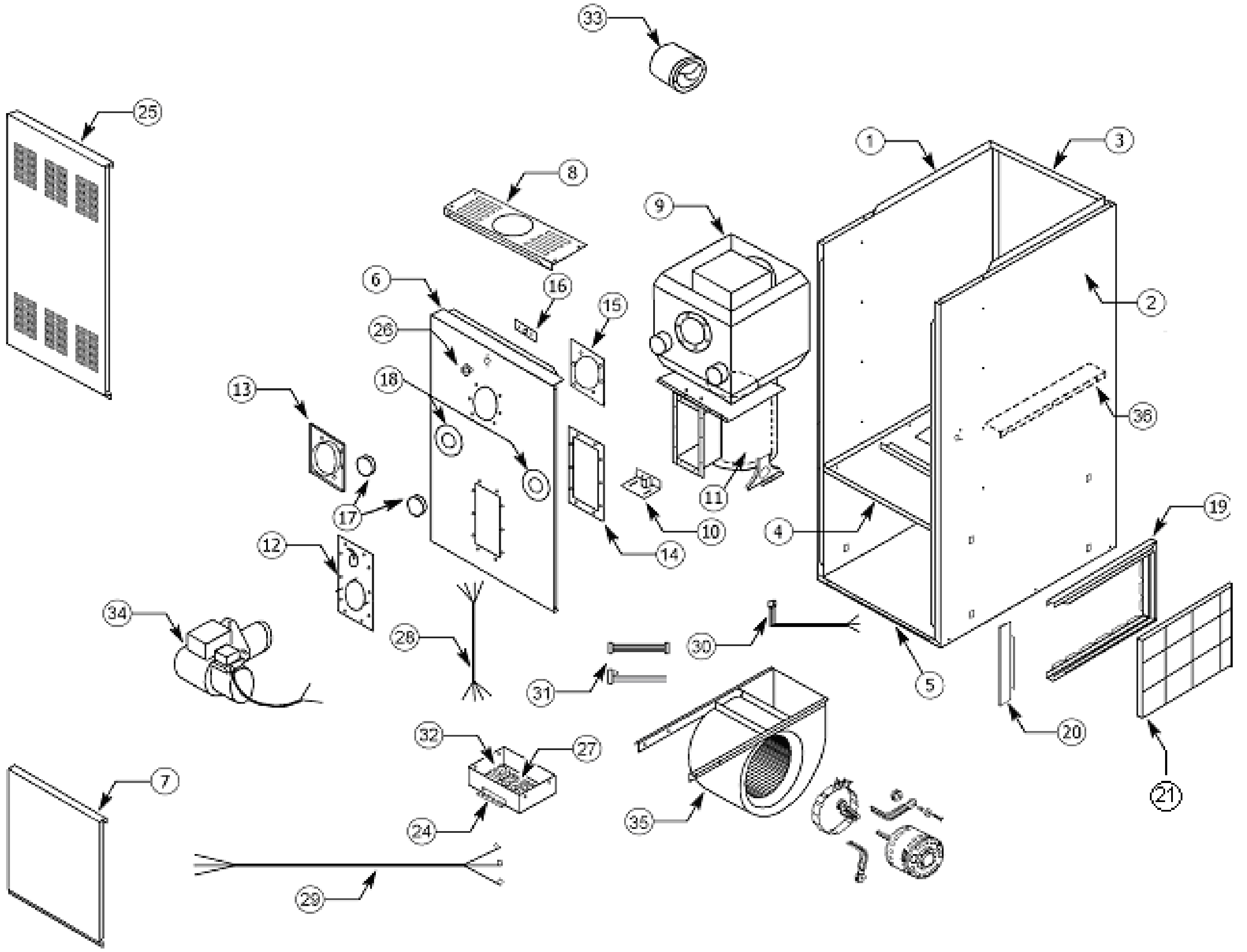
Parts Listing: Chimney Vent Models HML80(C2,CRF2,CNX2) and HMLV80(C2,CRF2,CNX2)

Ref. No.	Description	Part No.
35	Blower Assembly Direct Drive	30146
	Blower Assembly Direct Drive ECM	109007271
	Blower Housing and Wheel, 100-10T DD (HML and HMLV)	30626
	Blower Motor, 1/2 hp, 4-Speed	102000131
	Blower Motor, 1/2 hp, ECM Programmed	109007272
	Motor Mounting Band TR5868	17811
	Motor Mount Arms – 10-10 DD Blower (3 per unit)	26251
	Motor Run Capacitor, 10 mfd @ 370 Vac	27743
	Capacitor Strap	27761
	Blower Slide Rail 2 Per	27733
36	Right Side Panel, Air Baffle HML- 80C and HMLV-80C	27731
*	Blocked Vent Safety Switch Kit Complete	30693
*	Blocked Vent Safety Switch - Replacement Switch Only	30660

Parts Listing: Direct Vent Models HML80(CB2U2,CRBU2) and HMLV80(CB2U2,CRBU2)

Ref. No.	Description	Part No.
All parts are the same as listed on previous pages for chimney vent except where noted below.		
13	Flue Connector Assembly 6” to 4” 90º Elbow	240008224
14	Pouch Gasket (Second gasket required for Direct Vent)	2080175
15	Flue Collar Gasket (Second gasket required for Direct Vent)	21994
28	Wire Harness, Controls, Fan timer, Direct Vent	30745
34	Beckett Oil Burner AFII 85	30069
	Burner Motor 1/7 HP 3450 RPM PSC	28907
	Beckett Clean-cut Oil Pump A2EA6520	29688
	Solid State Ignitor	28558
	Oil Primary Combustion Control 7505P1530	
	Air Tube Combination FBX80HGXS	28561
	Flame Retention Head (FB3)	28533
34	Riello Oil Burner 40BF3	30427
*	Pressure Switch -0.28" WC	30700
*	10 Second Bypass Timer GPS00C9X10 (Use with Beckett AFII)	30699
*	25 Second Bypass Timer GPS00C9X25 (Use with Riello 40BF3))	240005182

Model HML and HMLV Diagram



ECR International
2210 Dwyer Avenue, Utica NY 13501
web site: www.ecrinternational.com

Chapter 21 CHIMNEYS

MANUFACTURER/DISTRIBUTOR:

CHEMINEE LINING
Denis Caron & Simon Champagne
Technical Representative
T (450) 625-6060 # 6226
F (450) 625-8170
C 514-946-1770
dcaron@chemineelining.com

21.1 IPPL2 STAINLESS STEEL 304 CHEMINEE LINING INSIDE INSULATED 2” WITH MINERAL WOOL

21.2 EXHAUST THIMBLE 3MDC-20-C-450-29 type C

Chimney

CHEMINÉE Lining

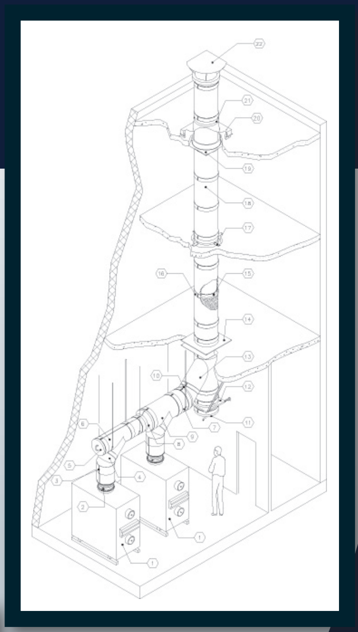
BOILER AND ENGINE EXHAUST

Industrial Positive Pressure Piping Systems

Complete Guide for Parts Identification and Selection

MODELS

IPPL • IPPL2 • IPPL2F • IPPL4F



SHOP DRAWING

Reviewed by: Samuel Charbonneau

Date: 07 juillet 2016

Reviewed	X
Reviewed as noted	
Resubmit	

Out for approval

SIFEC NORTH INC.

Our mission is to become the supplier of choice for gas venting products and solutions.

Company Profile

Cheminée Lining started out as a sales company that provided customers with quality products and installation. Our manufacturing arose from the certitude that we could supply superior products and services at a reasonable price.
With more than 15 years experience, our principles based on business integrity, first class customer service, reliable delivery and engineering services have established our reputation as a market leader for the supply of chimneys, grease duct and gas venting products.

Personnel

Cheminée Lining can count on qualified and highly professional employees. We are continually seeking to develop superior quality products at a competitive price.
Our engineering department will supply the answers you need – either for a project involving our standard line of products or a uniquely designed response to a specific requirement. We have developed specialized design systems for highly efficient results on sizing analysis and CAD design.
Our capabilities not only encompass the design and manufacturing of gas venting products, but also include full range engineering expertise to assist you in your projects, from specification to installation.
Cheminée Lining sales personnel work in an environment that promotes entrepreneurship. Their experience in the field allows them to utilize their resources to provide our clients with the best technical and economical solutions.

Manufacturing

Cheminée Lining combines the craftsmanship of a seasoned labor force with state of the art fabrication, delivering the highest quality products in the industry.
Our stainless steel precision cut using state of the art equipment for quality, speed and accuracy resulting in reduced manufacturing lead times.
An innovative engineering staff ensures continuing research and design, so that Cheminée Lining can offer the latest in gas venting products.

CONTENTS

LISTING AND APPLICATIONS

LISTINGS

CHEMINEE LINING.E inc. venting systems models IPPL, IPPL2, IPPL2F and IPPL4f are listed by Underwriters Laboratories, inc. (UL) under file MH26661 and tested in accordance with UL 103 Standard for Factory-Built Chimneys for Residential Type and Building Heating Appliances and the Canadian Standard for 540°C (1000°F) and 760°C (1400°F) industrial Chimneys CAN/ULC-C959. These models are also suitable for use in positive pressure applications up to 60" water column. Listings include the following chimney product categories and diameters.

C UL US LISTED

UL 103

MODELS IPPL, IPPL2, IPPL2F AND IPPL4F	TEMPERATURE	SIZE
Building Heating Appliance Type Chimney	1000°F continuous	6'' to 48'' I.D.
1400°F Chimney (IPPL, IPPL2, IPPL2F et IPPL4F)	1400°F continuous	6'' to 48'' I.D.

CAN/ULC C-959

MODELS IPPL, IPPL2, IPPL2F AND IPPL4F	TEMPERATURE	SIZE
Building Heating Appliance Type Chimney	1000°F continuous	6'' to 48'' I.D.
1400°F Chimney (IPPL, IPPL2, IPPL2F et IPPL4F)	1400°F continuous	6'' to 48'' I.D.

APPLICATIONS

1. Building Heating Appliance Chimney Listing (1000°F Chimney Listing) – under this category, models IPPL, IPPL2, IPPL2F and IPPL4F, have been determined suitable for venting flue gases at a temperature not exceeding 540°C (1000°F) under continuous operating conditions, from gas, liquid, oil or solid fuel fired appliances.
2. Building Heating Appliance Chimneys are suitable for use with Building Heating Appliances and Low Heat Appliances as described in the Chimney Selection Chart of National Fire Protection Association (NFPA) Standard No. 211.
3. 1400°F Chimney Listing – under this category, models IPPL, IPPL2F and IPPL4F, have been determined suitable for venting flue gases at a temperature not exceeding 760°C (1400°F) under continuous operating conditions. As such, they are suitable for use with ovens and furnaces as described in the Chimney Selection Chart of NFPA No. 211, in addition to other applications.

Other products and applications

CRITERIA	GREASE DUCT	BHA CHIMNEY	1400°F CHIMNEY
Application	Cooking appliances ventilation hoods restaurant grease ducts pizza oven exhausts.	• Low and high pressure steam boilers • Diesel and turbine exhausts • Building heating equipment	• Industrial furnaces • Processing equipment • Kilns and ovens • Diesel and turbine exhausts
Continuous operating temperature	500°F	1000°F	1400°F
IPPL, GDPL	Yes	Yes	Yes
IPPL2	Yes	Yes	N/A
IPPL2F, GDPL2F	N/A	Yes	Yes
IPPL4F, GDPL4F	Yes	Yes	N/A

DESIGN AND SPECIFICATION

DESIGN

All our double wall chimney systems are part of a large family of IPP (Industrial Positive Pressure) products for industrial and commercial applications. The components of each model are made using the same continuous laser welding stainless steel inner wall. Since all components have the same small and large ends, the parts of all models fit into one another, thus eliminating the need for all kinds of adapters and providing an incomparable flexibility in selecting models of flues and chimneys.

IPP, GDP: Single wall
(see Chimney Breechings and Liners Catalogue)

IPPL, GDPL : Double wall
with 2" air space

IPPL2: Double wall
with 2" mineral fiber insul.

IPPL2F, GDPL2F: Double wall
with 2" ceramic fiber insul.

IPPL4F, GDPL4F: Double wall
with 4" ceramic fiber insul.

This unique method for jointing components together is very efficient either in horizontal or in vertical installations. Our simple jointing concept along with the wide variety of components and accessories allows for a quick and simple installation, thus permitting you to save both time and money.

Cheminée Lining is proud of their industrial positive pressure piping systems. Recognized for being high quality products, they are also the easiest to install on the market!

These chimney systems are designed for exhaust of combustion gases, under positive, negative or neutral pressure, emanating from a variety of appliances including but not limited to:

- Diesel Engine and Gas Turbine Exhaust
- Restaurant Grease Duct
- Incinerator
- Coffee Roaster
- Air and Product containment
- Industrial Oven Exhaust
- Boiler Negative and Positive Pressure
- Unit Heater
- Heat Recovery

Models IPPL, IPPL2, IPPL2F and IPPL4F provide a wide variety of components and accessories, suitable for all kinds of site conditions, thus allowing for quick and simple installation. Each component is packed and shipped complete, with (1) one assembly band and (1) one finishing band for those having large ends. Sufficient tubes of appropriate sealant are also included in the shipment for completing the assembly.

SAMPLE SPECIFICATION (boiler Exhaust)

The chimney and flue must meet ULC (Underwriters Laboratories of Canada) and UL-103 (Underwriters Laboratories Inc.) section 22A for positive pressure exhaust system up to 60" water column and carry the appropriate approval labels. The chimney shall be listed by UL as a "B.H.A." (Building heating appliance) chimney for continuous operation up to 1000°F (540°C) maximum. For applications above 1000°F (540°C), the chimney shall be listed by UL as a "1400°F chimney" for continuous operation up to 1400°F (760°C) maximum.

The chimney and flue components must be of double wall construction and properly designed for positive pressure exhaust. The inner wall must be of 20 gauge (18 gauge – 42" to 48" diameter) 304 stainless steel, with continuous laser welding. The outer wall must be of 24 gauge (20 gauge – 42" to 48" diameter) 304 stainless steel. A high temperature insulation must be installed between walls. The jointing must be made using an assembly band, a finishing band and an appropriate sealing material, as supplied by the manufacturer. Quality required : Model IPPL2.

All components must be installed according to the manufacturer recommendations and must meet the NFPA and local safety code requirements.

MATERIALS

MODEL IPPL

Inner wall: 316L or 304 2B stainless steel (20 ga - 6" (152mm) to 40" (1016mm) diameter; 18 ga - 42" (1067mm) to 48" (1219mm) diameter)
Outer wall: 301,316L, 304 2B stainless steel, 430 or galvalume(24 ga - 6" (152mm) to 40" (1016mm) diameter; 20 ga - 42" (1067mm) to 48" (1219mm) diameter)
Insulation: 2" (51mm) air space

MODEL IPPL2

Inner wall: 316L or 304 2B stainless steel (20 ga - 6" (152mm) to 40" (1016mm) diameter; 18 ga - 42" (1067mm) to 48" (1219mm) diameter)
Outer wall: 301,316L, 304 2B stainless steel, 430 or galvalume(24 ga - 6" (152mm) to 40" (1016mm) diameter; 20 ga - 42" (1067mm) to 48" (1219mm) diameter)
Insulation: 2" (51mm) high temperature mineral fiber

MODEL IPPL2F

Inner wall: 316L or 304 2B stainless steel (20 ga - 6" (152mm) to 40" (1016mm) diameter; 18 ga - 42" (1067mm) to 48" (1219mm) diameter)
Outer wall: 301,316L, 304 2B stainless steel, 430 or galvalume (24 ga - 6" (152mm) to 40" (1016mm) diameter; 20 ga - 42" (1067mm) to 48" (1219mm) diameter)
Insulation: 2" (51mm) high temperature ceramic fiber

MODEL IPPL4F

Inner wall: 316L or 304 2B stainless steel (20 ga - 6" (152mm) to 40" (1016mm) diameter; 18 ga - 42" (1067mm) to 48" (1219mm) diameter)
Outer wall: 301,316L, 304 2B stainless steel, 430 or galvalume (24 ga - 6" (152mm) to 40" (1016mm) diameter; 20 ga - 42" (1067mm) to 48" (1219mm) diameter)
Insulation: 4" (51mm) high temperature ceramic fiber

SUPPORTS & ACCESSORIES

Galvanized steel, hot-galvanized steel, 316 L or 304 2B stainless steel

COMPONENTS	Internal walls		external walls		materials	
	STANDARD	AVAILABLE	STANDARD	AVAILABLE	STANDARD	AVAILABLE
ANCHOR PLATE	2	1	2	1	3	1, 2 and 4
ASSEMBLY BAND	2	1	---	---	--	---
COLLARS, FLASHING	---	---	---	---	--	1 and 2
DRAIN SECTION	2	1	2	1	--	---
ELBOWS	2	1	2	1	--	---
EXHAUST CONE, MITER SECTION	2	1	2	1	--	---
EXPANSION JOINT	2	1	2	1	--	---
FAN ADAPTER	2	1	2	1	---	---
FINISHING BAND	---	---	2	1	--	---
FIRESTOP, WALL FIRESTOP	---	---	---	---	3	1 and 2
HANGER BRACKET	---	---	---	---	3	1, 2 and 4
INCREASER / REDUCER	2	1	2	1	---	---
INSULATED SLEEVE, INSULATED WALL FIRESTOP	---	---	---	---	3	1 and 2
LENGTH, ADJUSTABLE LENGTH, VARIABLE LENGTH	2	1	2	1	---	---
RADIANT FIRESTOP	---	---	---	---	3	1 and 2
RAIN CAP, RAINSHEILD, CLOSURE SECTION	2	1	2	1	---	---
ROOF BAND, GUYWIRE BAND	---	--	---	--	2	1, 3 and 4
ROOF SUPPORT, GUIDING SPACER	---	--	---	--	3	1, 2 and 4
STARTING ADAPTER, DRAIN ADAPTER	2	1	---	--	3	1, 2 and 4
STARTING SLEEVE	2	1	---	--	3	1, 2 and 4
TEES	2	1	2	1	--	---
TEE CAPS	2	1	2	1	--	---
WALLS BAND, SUSPENSION BAND	---	---	---	---	3	1, 2 and 4
WALL / FLOOR GUIDES	--	---	---	---	3	--
WALL / HORIZONTAL SUPPORTS	2	1	2	1	3	1, 2 and 4

1: 316 L stainless steel **2:** 304 2B stainless steel **3:** Galvanized steel **4:** Hot-galvanized steel

WEIGTHS AND CLEARANCES

IPPL ● IPPL2 ● IPPL2F ● IPPL4F				LINEAR WEIGHT							
I.D.		AREA		IPPL		IPPL2		IPPL2F		IPPL4F	
in	mm	in^2	$1000mm^2$	lb/ft	kg/m	lb/ft	kg/m	lb/ft	kg/m	lb/ft	kg/m
6	152	28	18.2	5.7	8.5	8.8	13.1	8.8	13.1	14.6	21.8
8	203	50	32.4	7.2	10.8	11.1	16.5	11.1	16.5	17.7	26.3
10	254	79	50.7	8.8	13.0	13.4	19.9	13.4	19.9	20.7	30.8
12	302	113	73.0	10.3	15.3	15.6	23.3	15.6	23.3	23.8	35.4
14	356	154	99.3	11.8	17.5	17.9	26.7	17.9	26.7	26.8	39.9
16	406	201	129.7	13.3	19.8	20.2	30.1	20.2	30.1	29.9	44.4
18	457	254	164.2	14.8	22.0	22.5	33.4	22.5	33.4	32.9	49.0
20	508	314	202.7	16.3	24.3	24.7	36.8	24.7	36.8	35.9	53.5
22	559	380	245.2	17.8	26.5	27.0	40.2	27.0	40.2	39.0	58.0
24	610	452	291.9	19.3	28.7	29.3	43.6	29.3	43.6	42.0	62.5
26	660	531	342.5	20.8	31.0	31.6	47.0	31.6	47.0	45.1	67.1
28	711	616	397.3	22.3	33.2	33.9	50.4	33.9	50.4	48.1	71.6
30	762	707	456.0	23.8	35.5	36.1	53.8	36.1	53.8	51.6	76.1
32	813	804	518.9	25.4	37.7	38.4	57.2	38.4	57.2	54.2	80.7
34	864	908	585.8	26.9	40.0	40.7	60.5	40.7	60.5	57.3	85.2
36	914	1018	656.7	28.4	42.2	43.0	64.9	43.0	64.9	60.3	89.7
38	965	1134	731.7	29.9	44.5	45.2	67.3	45.2	67.3	63.3	94.3
40	1016	1257	810.7	31.4	46.7	47.5	70.7	47.5	70.7	66.3	98.8
42	1067	1385	893.8	46.2	68.7	63.1	93.9	63.1	93.9	83.3	124.0
44	1118	1521	981.0	48.3	71.9	66.0	98.2	66.0	98.2	87.0	129.4
46	1067	1662	1072.2	50.4	75.0	68.9	102.5	68.9	102.5	90.6	134.9
48	1219	1810	1167.5	52.5	78.2	71.7	106.8	71.7	106.8	94.3	140.3

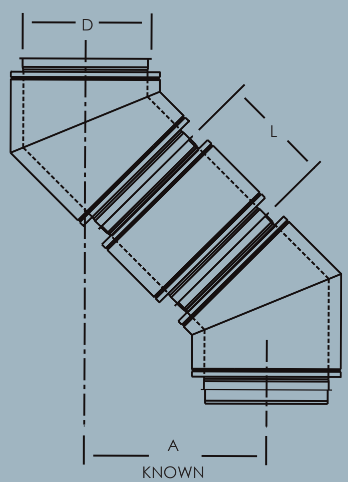
Minimum clearance air space to combustible construction									
Model IPPL						Model IPPL2		Model IPPL2F & IPPL4F	
Inside diameter		Clearance (1000°F to 1400°F)		Inside diameter		Clearance (1000°F)		Clearance (1000°F to 1400°F)	
in	mm	in	mm	in	mm	in	mm	in	mm
6'' to 12''	152-305	4''	102	6'' to 12''	152-305	1''	25	1''	25
14''	355	5''	127	14''	355	1.5''	38	1.5''	38
16'' to 18''	406-457	6''	152	16'' to 18''	406-457	2''	51	2''	51
20'' to 24''	508-610	7''	178	20'' to 22''	508-610	3''	76	3''	76
30'' to 34''	762-864	9''	229	28'' to 32''	762-864	5''	127	5''	127
36'' to 38''	914-965	10''	254	34'' to 36''	864-914	6''	152	6''	152
40'' to 48''	1016-1219	11''	279	38'' to 40''	965-1016	7''	178	7''	178
				42'' to 48''	1067-1219	8''	203	8''	203

Minimum opening when installing a chimney through a floor or wall made of combustible construction.
O.D. + 2 X (min. clearance air space) Ex. : IPPL2, B.H.A., I.D. = 8" ⇨ 12" + (2 X 1") = 14"

Minimum opening when installing a chimney through a floor or wall made of non combustible construction.
O.D. + 1" Ex. : IPPL2, B.H.A., O.D. = 12" ⇨ 12" + 1" = 13"

OFFSETS

OFFSET CALCULATIONS



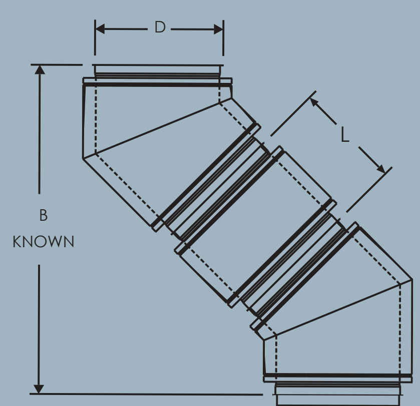
EFFECTIVE LENGTH CALCULATIONS

- OFFSET dimension is known
- Effective length is to be determined using equation 1, 2 or 3 depending on elbows used

1.	L(A) = 3.864(A) - 0.132D - 13"	15° elbows
2.	L(A) = 2(A) - 0.268D - 13"	30° elbows
3.	L(A) = 1.414(A) - 0.414D - 13"	45° elbows

EXAMPLE: An 8" ID IPPL2 chimney with a known offset width of 44.75"(A)using 2-45° elbows.

3. L(A) = 1.414(A) - 0.414D - 13''
L(A) = 1.414(44.75'') - 0.414(8'') - 13''
L(A) = 47'' in effective length choose a 48'' length (48L)



EFFECTIVE LENGTH CALCULATIONS

- HEIGTH dimesnion is known
- Effective length is to be determined using equation 4, 5 or 6 depending on elbows used

4.	L(B) = 1.035(B) - 0.268D - 26.459"	15° elbows
5.	L(B) = 1.155(B) - 0.577D - 28.011"	30° elbows
6.	L(B) = 1.414(B) - D - 31.385"	45° elbows

EXAMPLE: A 10" ID chimney with a known offset height of 55"(B) using 2- 45° elbows

6. L(B) = 1.414(B) - D - 31.385''
L(B) = 1.414(55'') - 10'' - 31.385''
L(B) = 36.385'' in effective length choose a 24'' length (24L) + adjustable length (AL)

Refer to the elbows specific table for minimum offsets and heights of two matched elbows. For special conditions, we can manufacture one piece offset.

LENGTHS

STRAIGHT LENGTHS • 48L • 36L • 24L • 12L

Available in 22 diameters from 6 to 48" (152 to 1219mm). Standard lengths: 48" (1219mm), 36" (914mm), 24" (610mm) and 12" (305mm).

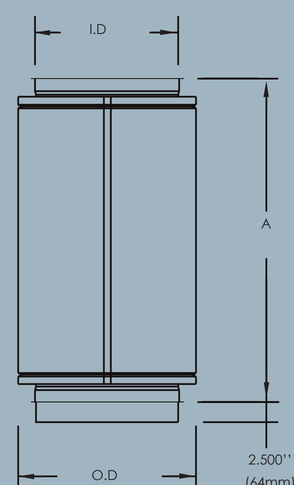
Includes:
1 Assembly band (AB)
1 Finishing band (FB)

K = 0.30 L/D

Where L = Pipe length in feet
D = Pipe diameter in inches

IPPL ● IPPL2 ● IPPL2F			
I.D.		O.D.	
in	mm	in	mm
6	152	10	254
8	203	12	305
10	254	14	356
12	305	16	406
14	356	18	457
16	406	20	508
18	457	22	559
20	508	24	610
22	559	26	660
24	610	28	711
26	660	30	762
28	711	32	813
30	762	34	864
32	813	36	914
34	864	38	965
36	914	40	1016
38	965	42	1067
40	1016	44	1118
42	1067	46	1168
44	1118	48	1219
46	1168	50	1270
48	1219	52	1321

IPPL4F			
I.D.		O.D.	
in	mm	in	mm
6	152	14	356
8	203	16	406
10	254	18	457
12	305	20	508
14	356	22	559
16	406	24	610
18	457	26	660
20	508	28	711
22	559	30	762
24	610	32	813
26	660	34	864
28	711	36	914
30	762	38	965
32	813	40	1016
34	864	42	1067
36	914	44	1118
38	965	46	1168
40	1016	48	1219
42	1067	50	1270
44	1118	52	1321
46	1168	54	1372
48	1219	56	1422



LENGTHS	EFFECTIVE LENGTHS "A"	
	in	mm
12'' (305 mm)	11.000	279
24'' (610 mm)	23.000	584
36'' (914 mm)	35.000	889
48'' (1219 mm)	47.000	1194

INSTALLATION GUIDE

Guide to Component Parts

MATERIALS	CODE	PAGE
ADJUSTMENT / EXPANSION		
Adjustable Length	AL	10
Expansion Joint	EJ	10
Increaser	I	19
Reducer	R	19
Variable Length	VL	10
COMPONENT		
Drain Section	DS	10
Drain -Tee Cap	DC	20
Tee Cap	TC	20
CONNECTING THE FLUE		
Drain Starting Adapter	SAD	21
Starting Adapter	SA	21
Starting Sleeve	SS	21
CONNECTION / OFFSET		
5° Elbow	E5	14
15° Elbow	E15	15
30° Elbow	E30	16
45° Elbow	E45	17
90° Elbow	2 x E45	18
90° Short Radius Elbow	E90	18
45° Tee	T45	12
90° Tee	T90	13
FIRE PROTECTION		
Firestop	FS	25
Insulated Sleeve	IS	26
Insulated Wall Firestop	IFS	27
Radiant Firestop	RFS	25
Wall Firestop	WFS	25
JOINTING		
Assembly Band	AB	20
Finishing Band	FB	20

MATERIALS	CODE	PAGE
LENGTH		
12" Length	12L	9
24" Length	24L	9
36" Length	36L	9
48" Length	48L	9
RELIEF VALVE	RV	34
SEALING AT ROOF		
Adjustable Flashing	AF	29
Flashing for Flat Roof	F	32
Ventilated Flashing	VF	33
SIDE STABILITY		
Guy Wire Band	GWB	28
Roof Band	RB	28
Wall Band	WB	28
SUPPORT / GUIDE		
Anchor Plate	AP	23
Floor Guide	FG	23
Guiding Spacer	GS	25
Hanger Bracket	HB	21
Horizontal Support	HS	22
Roof Support	RS	23
Suspension Band	SB	28
Wall Guide	WG	24
Wall Support	WS	22
TERMINATIONS		
Closure Section	CS	30
Exhaust Cone	EC	31
Fan Adapter	FA	29
Miter Section	MS	30
Rain Cap	RC	30
Rainshield	RSH	30

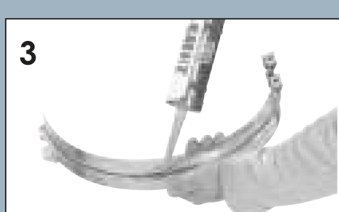
PIPE AND FITTING JOINT ASSEMBLY, STEP BY STEP

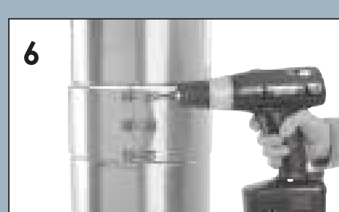
1


4


2


5


3


6


1. All components have a male and a female end. The orientation is indicated on the labelling of each section with an arrow. The arrow indicates the direction of the flue.
2. Before fitting the large and small ends into one another, a sealant (LTS or HTS) is applied on the male end, at the gap between the inner flange and the inner pipe.
3. Assemble both sections by sliding one section into the other until the flanges meet. A layer of sealant is applied inside the V-Groove of the Assembly band (AB) prior to it's installation over the joint.
4. The Assembly Band (AB) is installed and clamped in place with 4 nuts and bolts (supplied).
5. Insert the insulation strip around the inner joint assembly of insulated models IPPL2, IPPL2F and IPPL4F.
6. The Finishing Band (FB) is installed by slipping the edges of the band into the outer pipe edges and clamping them with 3 nuts and bolts (supplied).

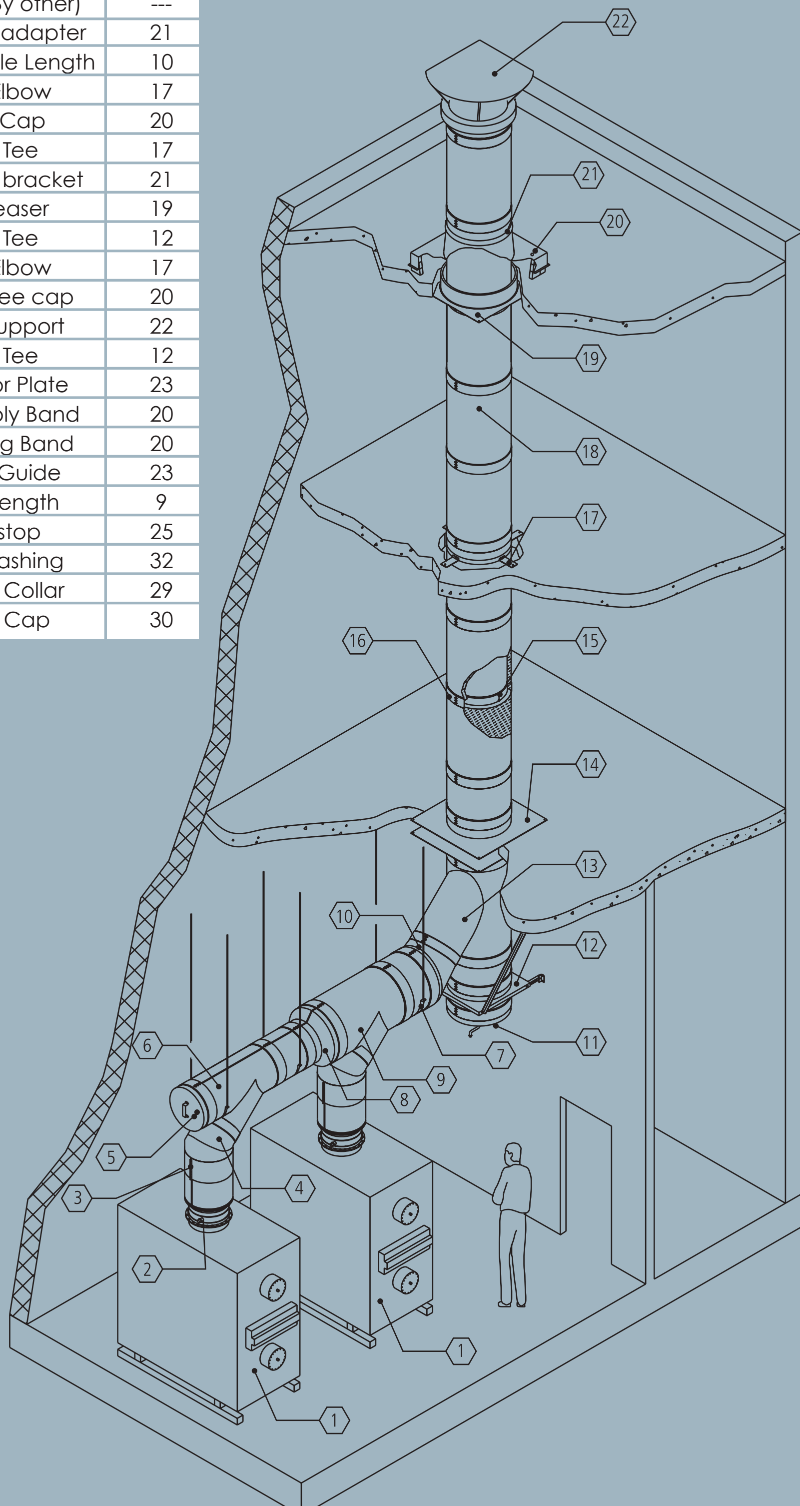
LTS: Low Temperature Sealant. 600˚F maximum flue gas temperature
HTS: High Temperature Sealant. Up to 2000˚F flue gas temperature
ES: Exterior Sealant. Outer sealant weather proof

7. FOR OUTDOOR INSTALLATION AND BAD WEATHER PROTECTION, AN EXTERIOR SEALANT (ES) IS APPLIED AT THE JOINT BETWEEN THE FINISHING BAND (FB) AND THE OUTER WALL OF THE CHIMNEY.

SAMPLE DRAWINGS

Sample Drawings

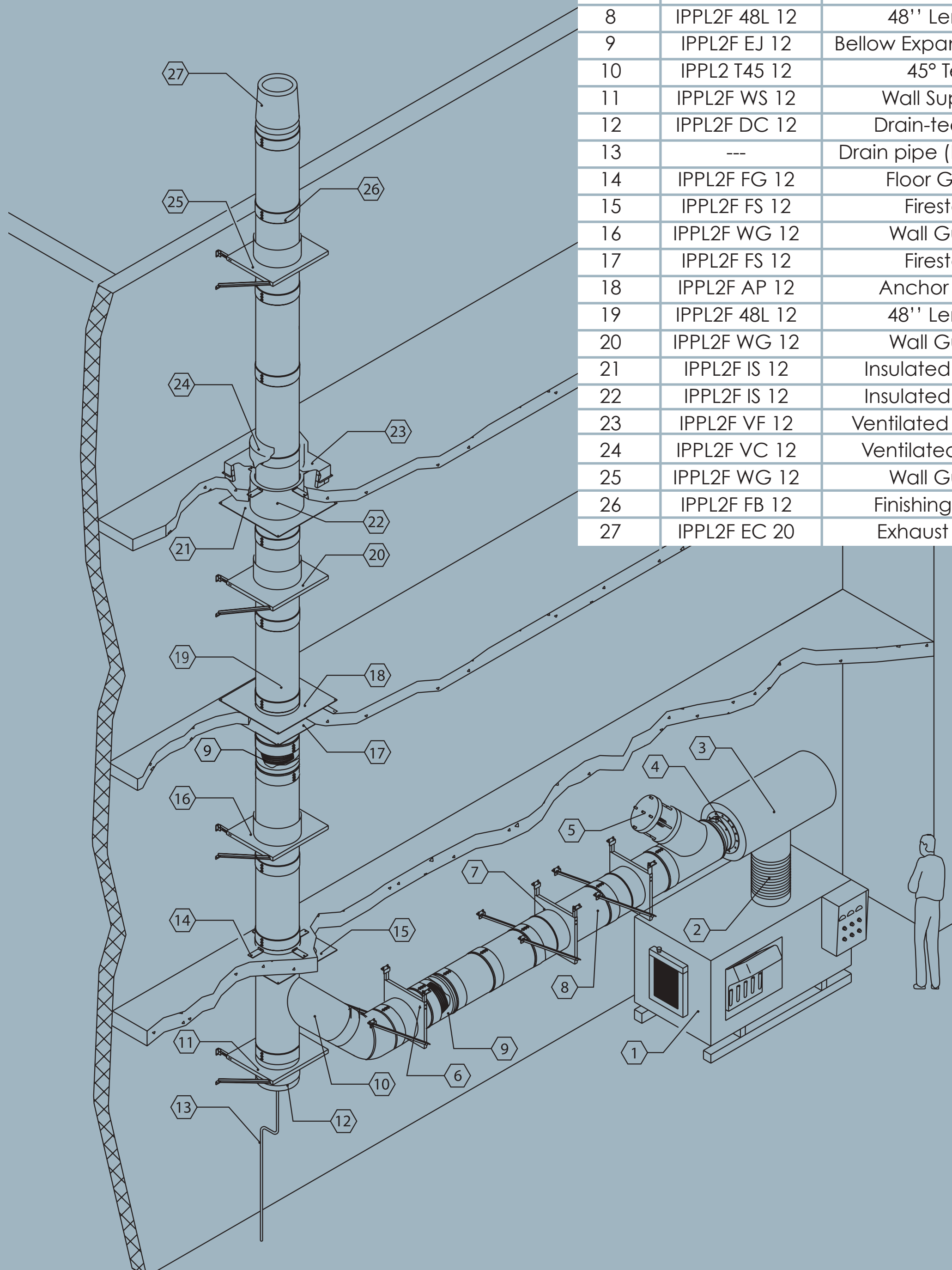
No.	Part No.	Descrption	Page
1	---	Boiler (By other)	---
2	IPPL2 SA 16	Starting adapter	21
3	IPPL2 AL 16	Adjustable Length	10
4	IPPL2 E45 16	45° Elbow	17
5	IPPL2 TC 16	Tee Cap	20
6	IPPL2 T45 16	45° Tee	17
7	IPPL2 HB 16	Hanger bracket	21
8	IPPL2 I 16	Increaser	19
9	IPPL2 T45 20	45° Tee	12
10	IPPL2 E45 20	45° Elbow	17
11	IPPL2 DC 20	Drain-tee cap	20
12	IPPL2 WS 20	Wall support	22
13	IPPL2 T45	45° Tee	12
14	IPPL2 AP 20	Anchor Plate	23
15	IPPL2 AB	Assembly Band	20
16	IPPL2 FB 20	Finishing Band	20
17	IPPL2 FG 20	Floor Guide	23
18	IPPL2 48L 20	48'' Length	9
19	IPPL2 FS 20	Firestop	25
20	IPPL2 F 20	Flat Flashing	32
21	IPPL2 SC 20	Storm Collar	29
22	IPPL2 RC 20	Rain Cap	30



ENGINE EXHAUST

Sample Drawings

No.	Part No.	Descrption	Page
1	---	Boiler (By other)	---
2	---	Adapter (By others)	---
3	---	Muffler (By others)	---
4	IPPL2F SA 12	Starting adapter	21
5	IPPL2F RV 12	Relief Valve	24
6	IPPL2F HS 12	Horizontal Support	22
7	IPPL2F WG 12	Wall Guide	22
8	IPPL2F 48L 12	48'' Length	9
9	IPPL2F EJ 12	Bellow Expansion Joint	17
10	IPPL2 T45 12	45° Tee	17
11	IPPL2F WS 12	Wall Support	22
12	IPPL2F DC 12	Drain-tee cap	20
13	---	Drain pipe (By others)	---
14	IPPL2F FG 12	Floor Guide	23
15	IPPL2F FS 12	Firestop	25
16	IPPL2F WG 12	Wall Guide	22
17	IPPL2F FS 12	Firestop	25
18	IPPL2F AP 12	Anchor Plate	23
19	IPPL2F 48L 12	48'' Length	9
20	IPPL2F WG 12	Wall Guide	22
21	IPPL2F IS 12	Insulated sleeve	25
22	IPPL2F IS 12	Insulated sleeve	25
23	IPPL2F VF 12	Ventilated Flashing	33
24	IPPL2F VC 12	Ventilated Collar	29
25	IPPL2F WG 12	Wall Guide	22
26	IPPL2F FB 12	Finishing Band	20
27	IPPL2F EC 20	Exhaust cone	31



1-YEAR STANDARD WARRANTY

Models IPPL, IPPL2, IPPL2F and IPPL4F

All components of our models IPPL, IPPL2, IPPL2F and IPPL4F chimney system have been inspected in our workshop in accordance with our quality standards. Cheminée Lining.e inc. warrants the chimney/exhaust system and components against defects in material and workmanship for a period of (1) one year from date of delivery to the purchaser. During this period, any system or component supplied by Cheminée Lining.e inc. failing to perform its intended function of exhausting, without adverse leakage, combustion by-products from engine or heating appliance will be repaired or replaced at the manufacturer option.

This warranty is limited to repair or replacement of any component which has been proven defective by a factory-authorized inspector by Cheminée Lining.e inc. This warranty does not cover any labour cost or freight charge for removal or replacement of the defective product, nor does this warranty cover any system component not furnished by Cheminée Lining.e inc. and installed as part of the system. The warranty on any repaired or replacement component shall be for a duration no longer than the remaining or unexpired term of the original warranty.

This standard warranty is subject to the following conditions:

a) Generally accepted engineering practices have been followed to determine that sizing and material specifications are suitable for the application and environment involved.
b) The undamaged components have been correctly installed in accordance with the installation instructions published by Cheminée Lining.e inc. at the time of shipment.

The standard warranty is extended to a **15-YEAR LIMITED WARRANTY** provided the following conditions are satisfied:

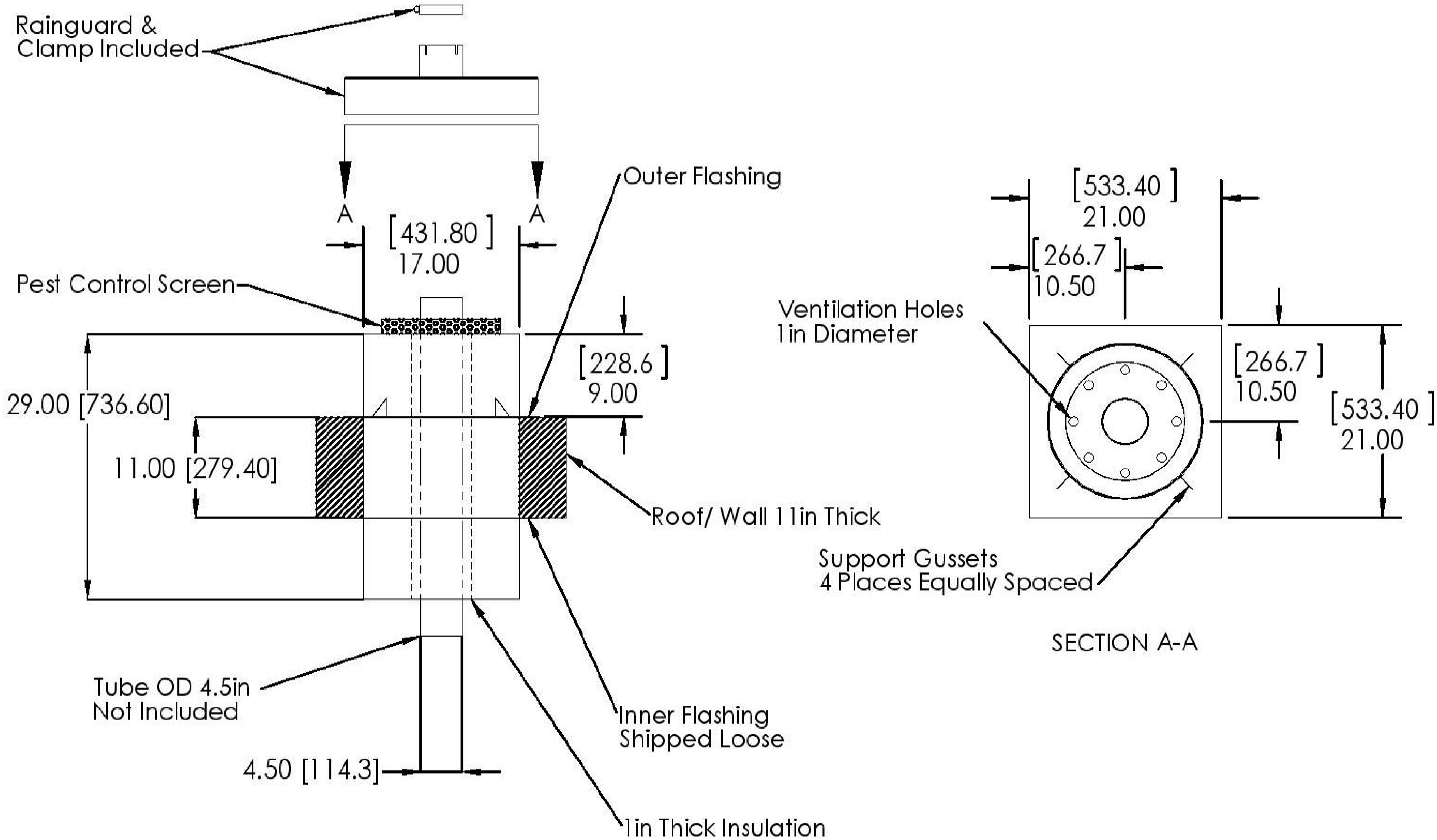
a) The chimney must have been connected to an appliance listed by a testing authority recognized by the federal government. Also, this warranty is void if the appliance was not installed, used and maintained according to the manufacturer instructions.
b) The chimney system must have been designed and sized by the engineering department of Cheminée Lining.e inc. All design and operating parameters provided to Cheminée Lining.e inc. must meet the standards of Cheminée Lining.e inc. and must be accurately representative of the operating conditions.
c) The undamaged components must have been correctly installed, used and maintained in accordance with the instructions published by Cheminée Lining.e inc. at the time of shipment.
d) Air used in combustion must be free from any solvent or refrigerant vapor and from any halogenated compound which might generate acid condensate within the flue or chimney.
e) Cheminée Lining.e inc. has supplied the entire chimney or exhaust system from the appliance outlet to the stack termination.
f) Prior to start-up and thereafter, exposed galvanized and aluminized steel surfaces are at all times protected with a minimum of one base coat primer and one finish coat of heat and corrosion resistant paint.

In no event shall Cheminée Lining.e inc. be liable for any incidental or consequential damages of any kind or for any damage resulting in whole or in part from misuse, improper installation, removal and/or reuse of components or inadequate maintenance of the system or any component part thereof. In no event shall Cheminée Lining.e inc. be liable for any cost of installation, removal and reinstallation. Cheminée Lining.e inc. assumes no liability in case of fire, chimney fire, lightning or act of God. This warranty is in lieu of all other express warranties or guarantees of any kind. All implied warranties, including merchantability and fitness, are limited to the duration of the express warranty contained herein. Cheminée Lining.e inc. neither assumes nor authorizes any other person to assume on its behalf any other liability in connection with products sold. No agent is authorized to make any modification to this warranty or additional warranties, even if in writing, binding Cheminée Lining.e inc.

The purchaser or complainant must send all claims under this warranty in writing to Cheminée Lining.e inc. Customer Service Department.

CHEMINÉE Lining

warranty


Rainguard &
Clamp Included
Outer Flashing
A
A
[431.80]
17.00
Pest Control Screen
[228.6]
9.00
29.00 [736.60]
11.00 [279.40]
Roof/ Wall 11in Thick
Inner Flashing
Shipped Loose
Tube OD 4.5in
Not Included
4.50 [114.3]
1in Thick Insulation
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21.00
[266.7]
10.50
Ventilation Holes
1in Diameter
[266.7]
10.50
[533.40]
21.00
Support Gussets
4 Places Equally Spaced
SECTION A-A

Chapter 22 GRILLES & DIFFUSERS

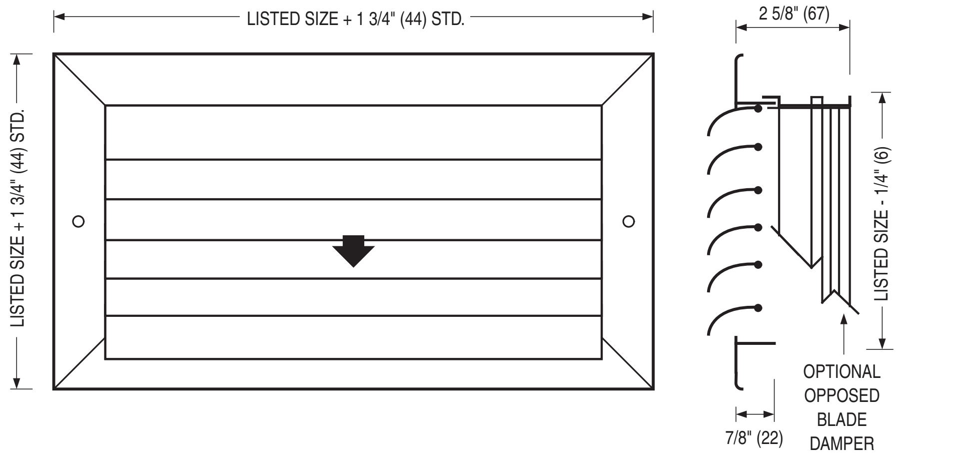
MANUFACTURER/DISTRIBUTOR:

VENTIL-X-PERT
Jean-Paul Jobin
9855 Boul, L,- H. Lafontaine
Anjou, QC, H1J 2A3
Email: jpjobin@ventil-x-pert.com
Tel: 514-355-4540

TYPE A

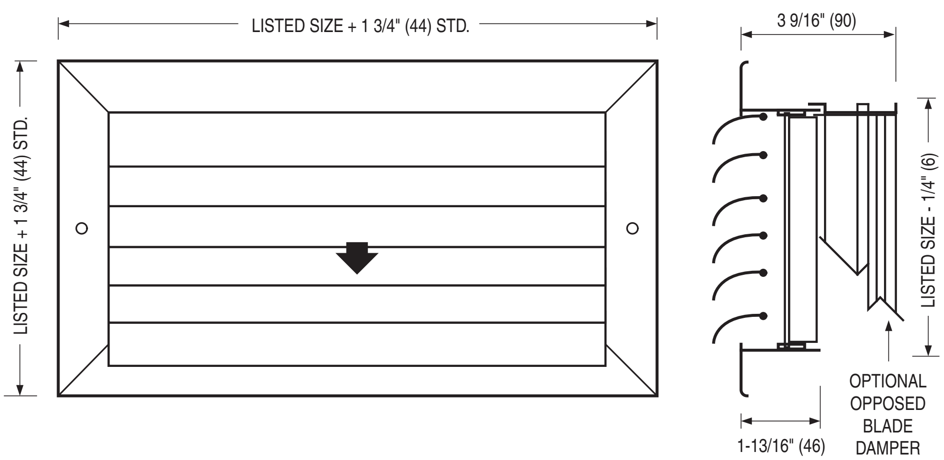
Nailor® Industries Inc.

STEEL CURVED BLADE GRILLES & REGISTERS
ONE-WAY DISCHARGE PATTERN
MODELS: 61C(-O) AND 61CD(-O) TYPE S



❑ **MODEL 61C**
Curved Blade Grille
1-Way Discharge Pattern

❑ **MODEL 61C-O**
Curved Blade Register
1-Way Discharge Pattern
(Includes O. B. Damper)

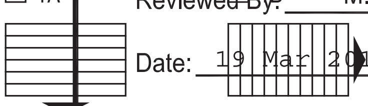


❑ **MODEL 61CD**
Curved Blade Grille with rear directional vanes
1-Way Discharge Pattern

❑ **MODEL 61CD-O**
Curved Blade Register with rear directional vanes
1-Way Discharge Pattern
(Includes O. B. Damper)

DESCRIPTION:

1. Construction: Corrosion-resistant steel. Curved vanes on 1" (25) centers. Frame is mechanically inter-locked for strength with hairline miters. Rear adjustable equalizing vanes on 61CD models are "teardrop" on 3/4" (19) centers. Roll-formed steel opposed blade damper on registers has screwdriver slot operator.
2. The min. size is 6" x 4" (152 x 102). The maximum size is 36" x 36" (914 x 914).
3. **Discharge Pattern Selection:**
   ☐ 1A ☐ 1B



4. Type S Surface mount frame has a 1 1/4" (32) face border and a 1" (25) overlap margin.
5. Curved blades are individually adjustable and regulate angle of discharge.
6. Standard fastening is Type A countersunk screwholes.
7. Standard finish is AW Appliance White.

SHOP DRAWING
This review is solely for the verification of general design quality and does not alleviate the responsibility of the contractor for insuring that all specification, space and installation requirements are met.
Reviewed By: M.M. — Reviewed ☒ Reviewed as noted ☐ Resubmit ☐
Date: 19 Mar 2015
CHIARELLI ENGINEERING LTD.

OPTIONS:

1. Finish:
   ❑ SP — Special ___________ .
2. Fastening:
   ❑ Type C — Concealed mounting straps
   ❑ Type D — Concealed screwholes in neck
   ❑ Type N — None
3. ❑ Type FB — Fixed Curved Blades
4. ❑ PF — Plaster sub-frame
5. ❑ IS — Insect screen
6. ❑ Other ________________ .

Shop Drawings
Contractor Approval
Approved by: J.D., G.F.
Date: 12/03/15
SIFEC NORTH INC

Dimensions are in inches (mm).

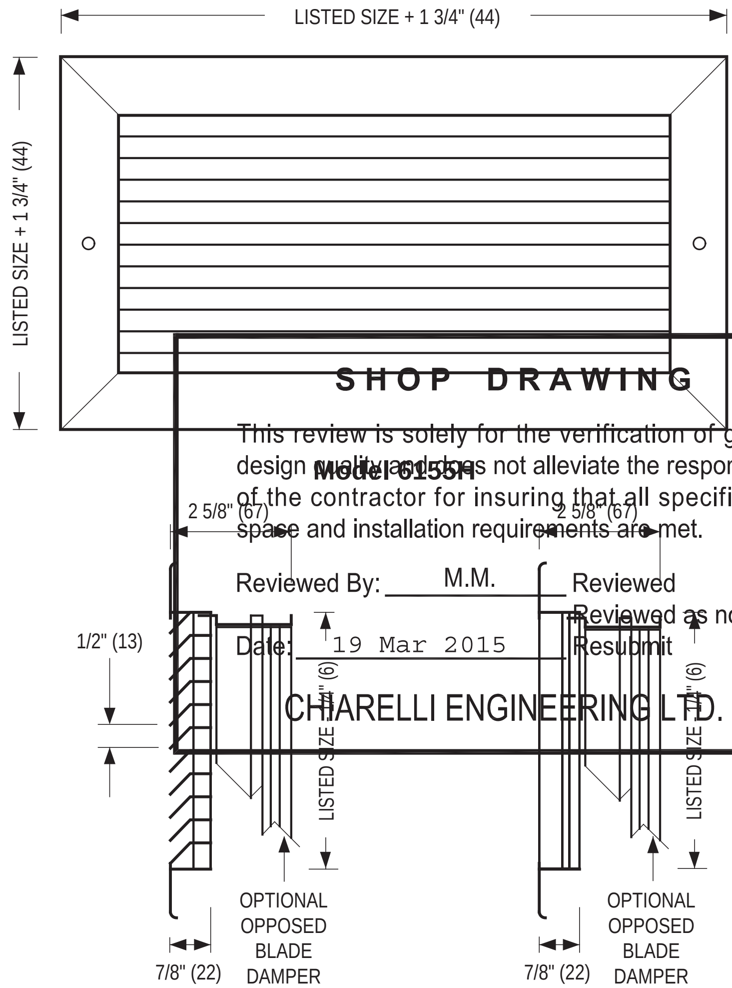
SCHEDULE TYPE:				
PROJECT:				
ENGINEER:	**DATE**	**B SERIES**	**SUPERSEDES**	**DRAWING NO.**
CONTRACTOR:	2 - 1 - 11	6100	6100-6/13-10-00R	61C-1

220/665

TYPE B

STEEL RETURN GRILLES & REGISTERS
FIXED BLADES • 1/2" (13) CENTERS
MODELS: 6155H(-O) AND 6155V(-O) TYPE S

Nailor® Industries Inc.



SHOP DRAWING

This review is solely for the verification of general design quality and does not alleviate the responsibility of the contractor for insuring that all specification, space and installation requirements are met.

Reviewed By: M.M.
Date: 19 Mar 2015

☒ Reviewed
☐ Reviewed as noted
☐ Resubmit

CHIARELLI ENGINEERING LTD.

Model 6155H

MODEL 6155H
Horizontal Blades

MODEL 6155V
Vertical Blades

❑ **MODEL 6155H**
Single Deflection Grille
Fixed 45° Horizontal Blades

❑ **MODEL 6155H-O**
Single Deflection Register
Fixed 45° Horizontal Blades
(Includes O. B. Damper)

❑ **MODEL 6155V**
Single Deflection Grille
Fixed 45° Vertical Blades

❑ **MODEL 6155V-O**
Single Deflection Register
Fixed 45° Vertical Blades
(Includes O. B. Damper)

DESCRIPTION:

1. Construction: Corrosion resistant steel. Roll-formed frame mechanically interlocked with reinforced mitered corners for strength. Streamlined shaped blades on 1/2" (13) centers are fixed at 45 degrees. Concealed reinforcing mullions on maximum 16" (406) centers. No see through when viewed from straight ahead.
2. Optional roll-formed steel opposed blade damper has a concealed lever operator.
3. Minimum size is 4" x 4" (102 x 102). Maximum size is 48" x 36" (1219 x 914).
4. Type S surface mount frame has a 1 1/4" (32) face border and a 1" (25) overlap margin.
5. Standard fastening is Type A countersunk screw holes.
6. Standard finish is AW Appliance White.

OPTIONS:

1. Finish:
   ❑ SP Special ______________ .
2. Fastening:
   ❑ Type N None.
3. ❑ PF Plaster frame
4. ❑ IS Insect screen
5. ❑ Other ________________ .

Shop Drawings
Contractor Approval
Approved by: J.D., G.F.
Date: 12/03/15
SIFEC NORTH INC

Dimensions are in inches (mm).

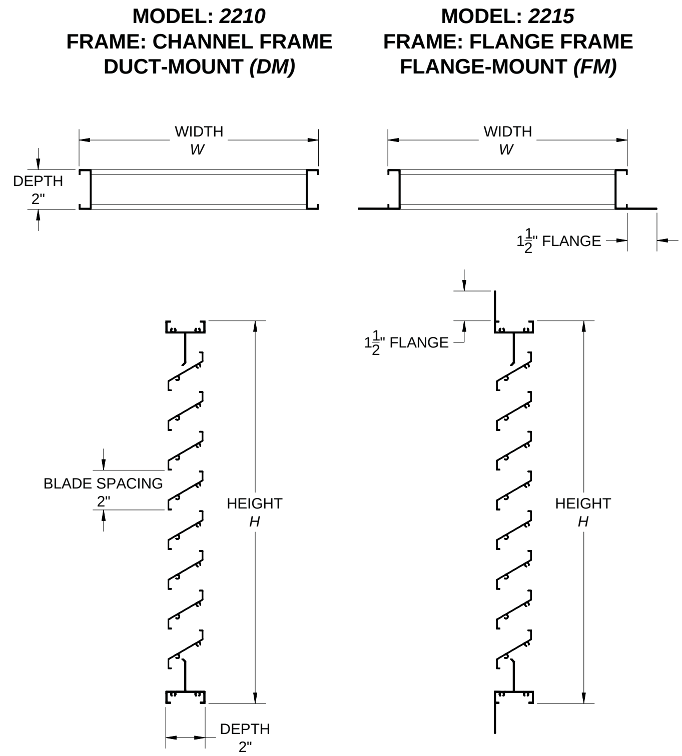
SCHEDULE TYPE:				
PROJECT:				
ENGINEER:	**DATE**	**B SERIES**	**SUPERSEDES**	**DRAWING NO.**
CONTRACTOR:	2 - 7 - 11	6100	6100-3B/17-10-00	6100-8

L1

LOUVERS & BACK DRAFT DAMPERS

2210 / 2215

2" DEEP EXHAUST LOUVER



PERFORMANCE			
LOUVER UNIT SIZE	TOTAL AREA	FREE AREA	FREE AREA
48" x 48"	16 ft^2	8.51 ft^2	**53.2%**
(1219 x 1219 mm)	*(1.49 m^2)*	*(0.79 m^2)*	
BEGINNING POINT OF WATER PENETRATION AT 0.01 oz./ft^2 FREE AREA			**478 FPM**

STANDARD CONSTRUCTION

DEPTH:	2" *(51 mm)*
MATERIAL:	EXTRUDED ALUMINUM - 6063-T5 ALLOY
FRAME THICKNESS:	0.062" *(1.57 mm)*
BLADE THICKNESS:	0.062" *(1.57 mm)*
BLADE ANGLE:	30°
BLADE CENTRES:	2" *(51 mm)*
BIRDSCREEN:	19 GA. GALVANIZED BIRDSCREEN - ½" x ½" OPENINGS
FINISH:	MILL

SIZE LIMITATIONS: SINGLE SECTION LOUVER

	MINIMUM	MAXIMUM
WIDTH	12" *(305 mm)*	72" *(1829 mm)*
HEIGHT	8" *(203 mm)*	72" *(1829 mm)*
AREA	0.67 ft^2 *(0.06 m^2)*	36 ft^2 *(3.34 m^2)*

*LOUVER WILL BE MANUFACTURED 1/4" *(6.4 mm)* SMALLER (SINGLE SECTION) AND 1/2" *(12.7 mm)* SMALLER (MULTIPLE SECTION) THAN GIVEN OPENING DIMENSIONS UNLESS OTHERWISE SPECIFIED

AVAILABLE ACCESSORIES

FINISH:
- BAKED ENAMEL FINISH
- DURANAR FINISH
- ANODIZED FINISH
  - *CLEAR ANODIZED*
  - *LIGHT BRONZE*
  - *MEDIUM BRONZE*
  - *DARK BRONZE*
  - *BLACK ANODIZED*

- EXTENDED SILLS
- SECURITY BARS
- FILTER RACKS
- STAINLESS STEEL FASTENERS
- HINGED ACCESS DOORS
- ALL WELDED CONSTRUCTION
- CUSTOM GEOMETRIC SHAPES
- CONTINUOUS LINE CONSTRUCTION WITH HIDDEN MULLIONS TO PROVIDE AN UNINTERRUPTED APPEARANCE

SCREENS:
- BIRDSCREEN
  - *1/2" x 1/2" INTER CRIMPED ALUMINUM*
  - *ALUMINUM BIRDSCREEN WITH FRAME*
- INSECT SCREEN
  - *18 X 14 MESH*

BLANK-OFF PANELS (ALUMINUM): VARIOUS GAUGES
- NON-INSULATED BLANK-OFF PANELS
- INSULATED BLANK-OFF PANELS
  - *1" (25.4 mm) INSULATION*
  - *2" (50.8 mm) INSULATION*

SHOP DRAWING

This review is solely for the verification of general design quality and does not alleviate the responsibility of the contractor for insuring that all specification, space and installation requirements are met.

Reviewed By: M.M. — Reviewed ☒

Reviewed as noted ☐

Date: 19 Mar 2015 — Resubmit ☐

CHIARELLI ENGINEERING LTD.

Shop Drawings Contractor Approval
Approved by: J.D., G.F.
Date: 12/03/15
SIFEC NORTH INC

DWG. 2210 / 2215 *MARCH 2010*

195 HEALEY ROAD | BOLTON, ON. L7E 5B2 | TEL (905) 857-4700 | FAX (905) 857-4730 | 1-800-668-7214 | *www.ventexinc.com*

L1

LOUVERS & BACK DRAFT DAMPERS

2210 / 2215
2” DEEP EXHAUST LOUVER

FREE AREA (Sq. Ft.)

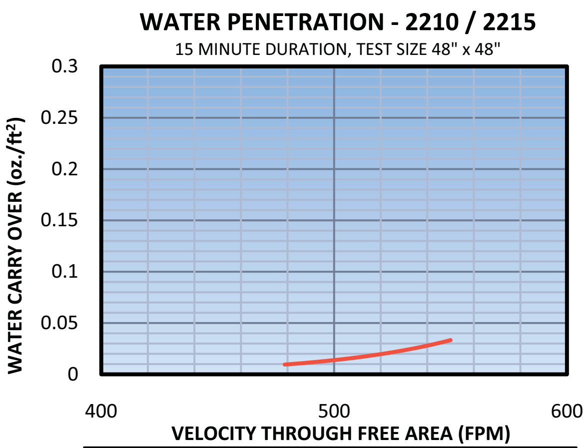
WIDTH (INCHES) / HEIGHT (INCHES)

	12	16	20	24	28	32	36	40	44	48	52	56	60	64	68	72
8	0.17	0.23	0.29	0.36	0.42	0.48	0.54	0.61	0.67	0.73	0.79	0.86	0.92	0.98	1.05	1.11
12	0.35	0.48	0.61	0.73	0.86	0.99	1.12	1.25	1.38	1.51	1.64	1.77	1.90	2.03	2.16	2.29
16	0.53	0.72	0.92	1.11	1.31	1.50	1.70	1.90	2.09	2.29	2.48	2.68	2.88	3.07	3.27	3.46
20	0.70	0.97	1.23	1.49	1.75	2.02	2.28	2.54	2.80	3.07	3.33	3.59	3.85	4.11	4.38	4.64
24	0.88	1.21	1.54	1.87	2.20	2.53	2.86	3.19	3.51	3.84	4.17	4.50	4.83	5.16	5.49	5.82
28	1.06	1.46	1.85	2.25	2.64	3.04	3.44	3.83	4.23	4.62	5.02	5.41	5.81	6.20	6.60	6.99
32	1.24	1.70	2.17	2.63	3.09	3.55	4.01	4.48	4.94	5.40	5.86	6.32	6.79	7.25	7.71	8.17
36	1.42	1.95	2.48	3.01	3.53	4.06	4.59	5.12	5.65	6.18	6.71	7.23	7.76	8.29	8.82	9.35
40	1.60	2.19	2.79	3.38	3.98	4.57	5.17	5.76	6.36	6.96	7.55	8.15	8.74	9.34	9.93	10.53
44	1.78	2.44	3.10	3.76	4.42	5.09	5.75	6.41	7.07	7.73	8.39	9.06	9.72	10.38	11.04	11.70
48	1.96	2.69	3.41	4.14	4.87	5.60	6.33	7.05	7.78	8.51	9.24	9.97	10.70	11.42	12.15	12.88
52	2.14	2.93	3.73	4.52	5.31	6.11	6.90	7.70	8.49	9.29	10.08	10.88	11.67	12.47	13.26	14.06
56	2.31	3.18	4.04	4.90	5.76	6.62	7.48	8.34	9.21	10.07	10.93	11.79	12.65	13.51	14.37	15.23
60	2.49	3.42	4.35	5.28	6.21	7.13	8.06	8.99	9.92	10.84	11.77	12.70	13.63	14.56	15.48	16.41
64	2.67	3.67	4.66	5.66	6.65	7.64	8.64	9.63	10.63	11.62	12.62	13.61	14.61	15.60	16.59	17.59
68	2.85	3.91	4.97	6.03	7.10	8.16	9.22	10.28	11.34	12.40	13.46	14.52	15.58	16.64	17.70	18.77
72	3.03	4.16	5.29	6.41	7.54	8.67	9.80	10.92	12.05	13.18	14.31	15.43	16.56	17.69	18.82	19.94

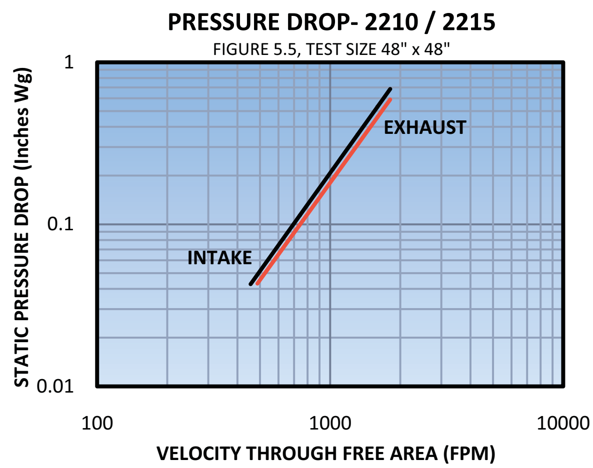
FREE AREA (%)

WIDTH (INCHES) / HEIGHT (INCHES)

	12	16	20	24	28	32	36	40	44	48	52	56	60	64	68	72
8	25.3%	26.0%	26.4%	26.7%	26.9%	27.1%	27.2%	27.3%	27.4%	27.5%	27.5%	27.6%	27.6%	27.6%	27.7%	27.7%
12	34.7%	35.7%	36.3%	36.7%	37.0%	37.2%	37.4%	37.5%	37.7%	37.7%	37.8%	37.9%	38.0%	38.0%	38.0%	38.1%
16	39.5%	40.6%	41.3%	41.7%	42.1%	42.3%	42.5%	42.7%	42.8%	42.9%	43.0%	43.1%	43.1%	43.2%	43.2%	43.3%
20	42.3%	43.5%	44.3%	44.8%	45.1%	45.4%	45.6%	45.7%	45.9%	46.0%	46.1%	46.2%	46.2%	46.3%	46.3%	46.4%
24	44.2%	45.5%	46.2%	46.8%	47.1%	47.4%	47.6%	47.8%	47.9%	48.0%	48.1%	48.2%	48.3%	48.4%	48.4%	48.5%
28	45.5%	46.9%	47.7%	48.2%	48.6%	48.9%	49.1%	49.3%	49.4%	49.5%	49.6%	49.7%	49.8%	49.8%	49.9%	50.0%
32	46.6%	47.9%	48.7%	49.3%	49.7%	49.9%	50.2%	50.3%	50.5%	50.6%	50.7%	50.8%	50.9%	51.0%	51.0%	51.1%
36	47.3%	48.7%	49.5%	50.1%	50.5%	50.8%	51.0%	51.2%	51.4%	51.5%	51.6%	51.7%	51.8%	51.8%	51.9%	51.9%
40	48.0%	49.4%	50.2%	50.8%	51.2%	51.5%	51.7%	51.9%	52.0%	52.2%	52.3%	52.4%	52.4%	52.5%	52.6%	52.6%
44	48.5%	49.9%	50.8%	51.3%	51.7%	52.0%	52.3%	52.4%	52.6%	52.7%	52.8%	52.9%	53.0%	53.1%	53.1%	53.2%
48	48.9%	50.3%	51.2%	51.8%	52.2%	52.5%	52.7%	52.9%	53.1%	53.2%	53.3%	53.4%	53.5%	53.5%	53.6%	53.7%
52	49.3%	50.7%	51.6%	52.2%	52.6%	52.9%	53.1%	53.3%	53.5%	53.6%	53.7%	53.8%	53.9%	53.9%	54.0%	54.1%
56	49.6%	51.0%	51.9%	52.5%	52.9%	53.2%	53.4%	53.6%	53.8%	53.9%	54.0%	54.1%	54.2%	54.3%	54.4%	54.4%
60	49.9%	51.3%	52.2%	52.8%	53.2%	53.5%	53.7%	53.9%	54.1%	54.2%	54.3%	54.4%	54.5%	54.6%	54.6%	54.7%
64	50.1%	51.6%	52.4%	53.0%	53.4%	53.8%	54.0%	54.2%	54.3%	54.5%	54.6%	54.7%	54.8%	54.8%	54.9%	55.0%
68	50.3%	51.8%	52.7%	53.2%	53.7%	54.0%	54.2%	54.4%	54.6%	54.7%	54.8%	54.9%	55.0%	55.1%	55.1%	55.2%
72	50.5%	52.0%	52.9%	53.4%	53.9%	54.2%	54.4%	54.6%	54.8%	54.9%	55.0%	55.1%	55.2%	55.3%	55.3%	55.4%



BEGINNING POINT OF WATER PENETRATION AT 0.01 oz./ft² FREE AREA IS 478 FPM



**TEST RESULTS DO NOT INCLUDE THE EFFECTS OF BIRDSCREEN*

RECOMMENDED SPECIFICATION

Furnish and install stationary louver models 2210 / 2215 as manufactured by Ventex Inc, Bolton, Ontario. Louvers must be licensed to bear the AMCA seal. Louvers shall be 2” *(51 mm)* deep. Blades shall be 0.062” *(1.57 mm)* extruded 6063-T5 aluminum alloy and frame shall be 0.062” *(1.57 mm)* extruded 6063-T5 aluminum alloy. Louvers shall have 19 gauge galvanized ½” x ½” birdscreen. All materials shall be factory finished after assembly with Polyester Powder Coat in a color selected from the Ventex Color Chart.

CERTIFIED RATINGS

Ventex Inc. certifies that the models 2210 / 2215 shown here are licensed to bear the AMCA Seal. The ratings shown are based on tests and procedures performed in accordance with AMCA Publication 511 and comply with the requirements of the AMCA Certified Ratings Program. The Certified Ratings Seal applies to air performance and water penetration ratings.

DWG. 2210 / 2215 *MARCH 2010*

D1

CONTROL DAMPERS & FIRE DAMPERS

3100 SERIES

NON-INSULATED CONTROL DAMPERS

3160 | 3161 | 3165

3160
Duct-Mount

3161 Quick 'N' Stall
Duct-Mount

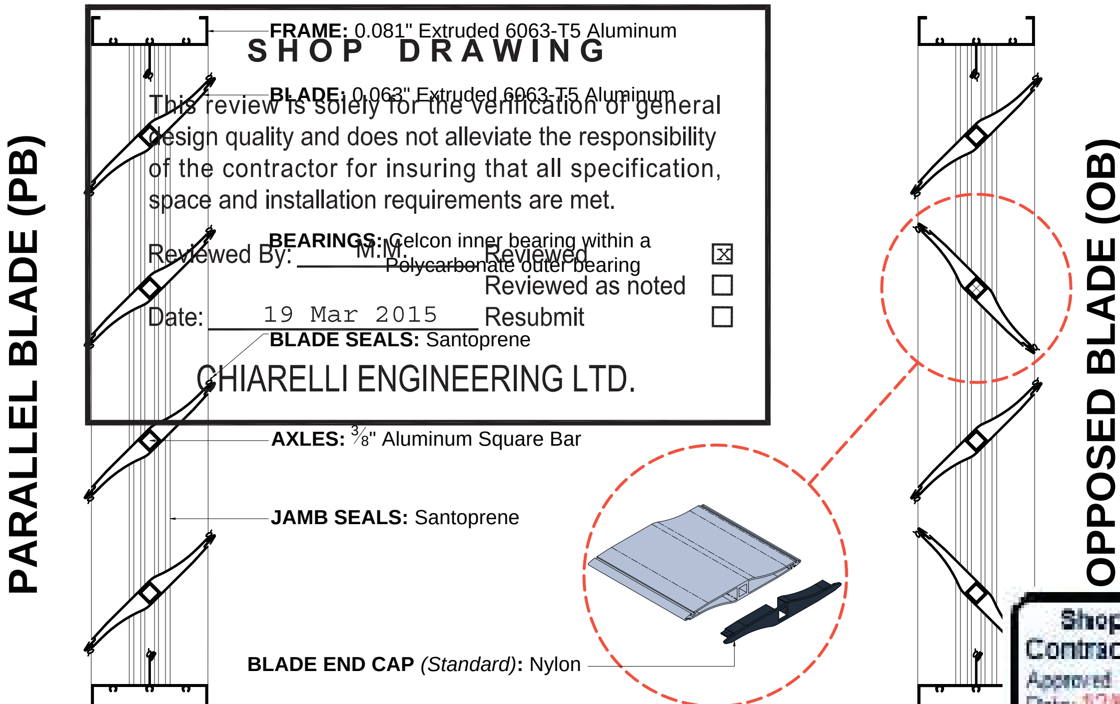
3165
Flanged-to-Duct

STANDARD CONSTRUCTION

Depth: 4" *(101 mm)* – 3160/3165
5.25" *(133 mm)* – 3161
Depth with Blades Open: 6.125" *(156 mm)*
Minimum Height: 8" *(203 mm)* - Single Blade
15" *(381 mm)* - Multiple Blade
Maximum Panel Width: 48" *(1219 mm)*
Maximum Panel Height: 60" *(1524 mm)*
Maximum Panel Size: 20 Sq.Ft.
Maximum System Pressure: 4" w.g. *(1 kPa)*
Operating Temperature Range: -40°to +180°F
Standard Finish: Mill
Standard Motor Installation: 6" Side Shaft Direct Drive
Linkage: Concealed in Frame (3160/3161)
Outside of Frame (3165)
Blade End Cap: Nylon

AVAILABLE ACCESSORIES

- **Actuators [Honeywell, Belimo]**
- **End Switch for signaling peripheral devices**
- **Jack Shaft**
- **Hand Quadrants**
- **Chain Operation for manual operation spring closed**
- **Silicone Blade and Jamb Seals – Specify 3100 *SS***
- **Salt Water Construction – Specify 3100 *SW***
- **Available finish: Clear Anodized**
- **4" Blade Construction**



SHOP DRAWING
This review is solely for the verification of general design quality and does not alleviate the responsibility of the contractor for insuring that all specification, space and installation requirements are met.
Reviewed By: M.M. Reviewed ☒
Reviewed as noted ☐
Date: 19 Mar 2015 Resubmit ☐
CHIARELLI ENGINEERING LTD.

Shop Drawings
Contractor Approval
Approved by: J.D., G.F.
Date: 12/03/15
SIFEC NORTH INC

DWG. 3160-3161-3165 *MARCH 2011*

D1

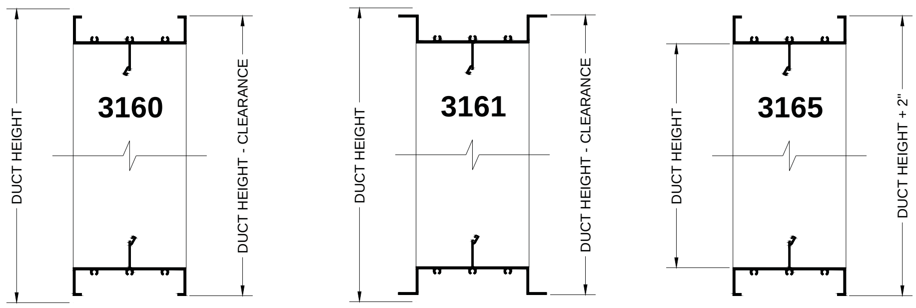
ALUMAVENT
CONTROL DAMPERS & FIRE DAMPERS

3100 SERIES
NON-INSULATED CONTROL DAMPERS
3160 | 3161 | 3165

3160 – Duct-Mount

3161 – Duct-Mount

3165 – Flanged-to-Duct



For Duct-Mount Frame specify: *3160 / 3161*
For Flanged-to-Duct Frame specify: *3165*

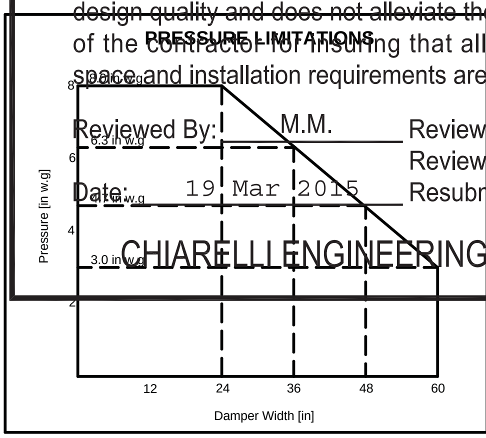
**For Models 3160 and 3161:*
Clearance = 1/4" Overall for Single Panel Construction
Clearance = 1/2" Overall for Multiple Panel Construction

SHOP DRAWING

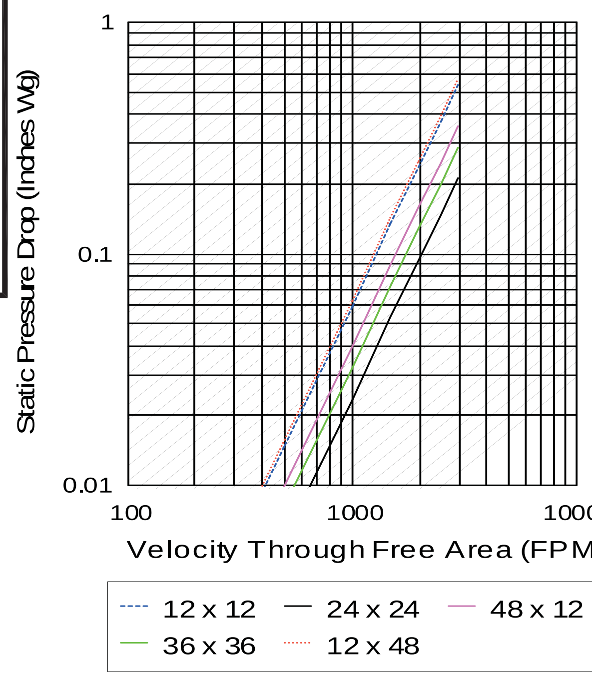
This review is solely for the verification of general design quality and does not alleviate the responsibility of the contractor for insuring that all specification, space and installation requirements are met.

Reviewed By: M.M. Reviewed ☒
Reviewed as noted ☐
Date: 19 Mar 2015 Resubmit ☐

CHIARELLI ENGINEERING LTD.



Pressure Drop



RECOMMENDED SPECIFICATION

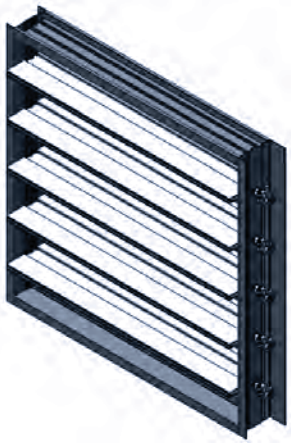
Furnish and install control damper models 3160 / 3161 / 3165 as manufactured by Alumavent, Bolton Ontario. Dampers shall be 4” *(101 mm)* deep. Blades shall be 0.063” *(1.60 mm)* thick, hollow airfoil shape. Frames shall be 0.081” *(2.06 mm)* thick. Axles shall be 0.375” *(9.53 mm)* thick, Aluminum square bar. Blade and Jamb seals shall be Santoprene. Linkage is concealed in frame for models 3160 / 3161 and outside of frame for model 3165. Air leakage through a 48”x48” damper shall not exceed 8 CFM/ ft^2 *(40.6 L/s/m^2)* against 4” w.g *(1 kPa)* static pressure at standard air. Operating temperature range shall be -40°to +180°F.

DWG. 3160-3161-3165 *MARCH 2011*

D2

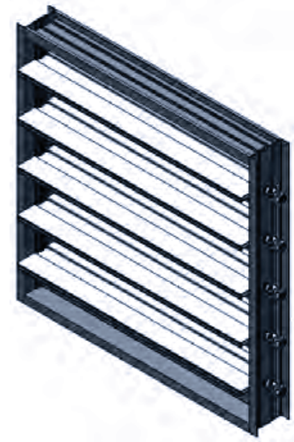
ALUMAVENT
CONTROL DAMPERS & FIRE DAMPERS

3900 SERIES
INSULATED CONTROL DAMPERS
3960 | 3961 | 3965



3960
Duct-Mount

3961 Quick 'N' Stall
Duct-Mount



3965
Flanged-to-Duct

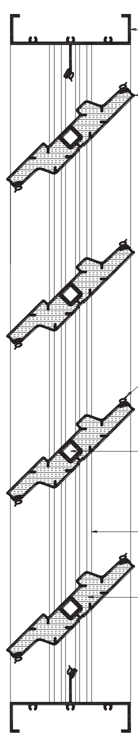
STANDARD CONSTRUCTION

Depth: 4" *(102 mm)* – 3960/3965
5.25" *(133 mm)* – 3961
Depth with Blades Open: 6.125" *(156 mm)*
Minimum Height: 8" *(203 mm)* - Single Blade
15" *(381 mm)* - Multiple Blade
Maximum Panel Width: 48" *(1219 mm)*
Maximum Panel Height: 60" *(1524 mm)*
Maximum Panel Size: 20 Sq. Ft.
Operating Temperature Range: -40° to +180° F
Standard Finish: Mill
Standard Motor Installation: 6" Side Shaft Direct Drive
Linkage: Concealed in Frame (3960/3961)
Outside of Frame (3965)

AVAILABLE ACCESSORIES

- **Actuators [Honeywell, Belimo]**
- **End Switch for signaling peripheral devices**
- **Jack Shaft**
- **Hand Quadrants**
- **Chain Operation for manual operation spring closed**
- **Silicone Blade and Jamb Seals – Specify 3900 *SS***
- **Salt Water Construction – Specify 3900 *SW***
- **Available finish: Clear Anodized**
- **Frame Insulation: Polystyrene Insulation**

PARALLEL BLADE (PB)



FRAME: 0.081" Extruded 6063-T5 Aluminum

BLADE: 0.063" Extruded 6063-T5 Aluminum

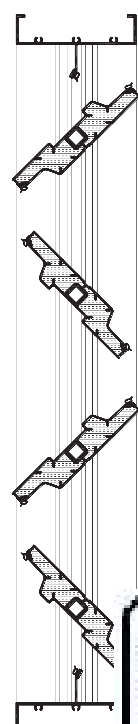
BEARINGS: Celcon inner bearing within a Polycarbonate outer bearing

BLADE SEALS: Santoprene

AXLES: ⅜" Aluminum Square Bar

JAMB SEALS: Santoprene

BLADE INSULATION: High density polyurethane non-CFC foam (R-2.25) - Blades are thermally broken



OPPOSED BLADE (OB)

SHOP DRAWING

This review is solely for the verification of general design quality and does not alleviate the responsibility of the contractor for insuring that all specification, space and installation requirements are met.

Reviewed By: M.M. Reviewed ☒
Reviewed as noted ☐
Date: 19 Mar 2015 Resubmit ☐

CHIARELLI ENGINEERING LTD.

Shop Drawings
Contractor Approval
Approved by: J.D., G.F.
Date: 12/03/15
SIFEC NORTH INC

DWG. 3960-3961-3965 *AUGUST 2010*

D2

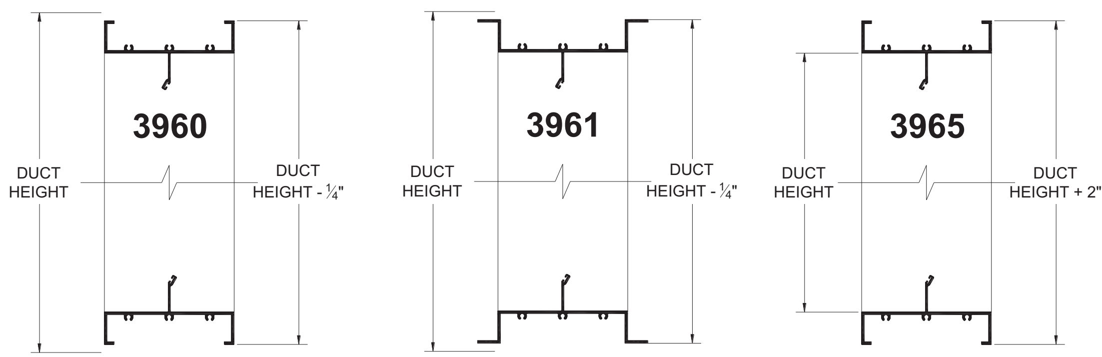
ALUMAVENT
CONTROL DAMPERS & FIRE DAMPERS

3900 SERIES
INSULATED CONTROL DAMPERS
3960 | 3961 | 3965

3960 – Duct-Mount

3961 – Duct-Mount

3965 – Flanged-to-Duct



For Duct-Mount Frame specify: *3960 / 3961*
For Flanged-to-Duct Frame specify: *3965*

SHOP DRAWING

This review is solely for the verification of general design quality and does not alleviate the responsibility of the contractor for insuring that all specification, space and installation requirements are met.

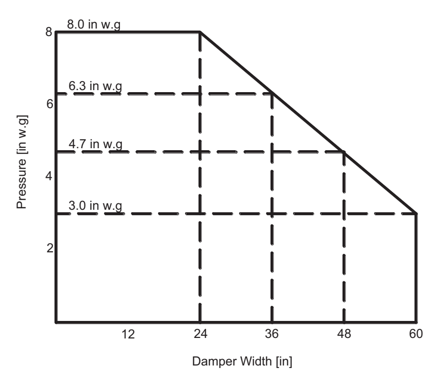
Reviewed By: M.M. — Reviewed ☒
Reviewed as noted ☐
Date: 19 Mar 2015 — Resubmit ☐

CHIARELLI ENGINEERING LTD.

RECOMMENDED SPECIFICATION

Furnish and install control damper models 3960 / 3961 / 3965 as manufactured by Alumavent, Bolton Ontario. Dampers must be licensed to bear the AMCA seal. Dampers shall be 4" *(102 mm)* deep. Blades shall be 0.063" *(1.60 mm)* thick, thermally broken with high density Polyurethane non-CFC injected foam insulation. Frame shall be 0.081" *(2.06 mm)* thick, with polystyrene insulation. Axles shall be 0.375" *(9.53 mm)* thick, aluminum square bar. Blade and jamb seals shall be Santoprene. Linkage is concealed in frame for models 3960 / 3961 and outside of frame for model 3965. Air leakage through a 36"x36" *(914 mm x 914 mm)* damper shall not exceed 3 CFM/ft^2 *(15.2 L/s/m^2)* against 1" w.g. *(0.25 kPa)* static pressure at standard air (as per AMCA testing). Operating temperature range shall be -40° to +180° F.

PRESSURE LIMITATIONS



D2

ALUMAVENT

CONTROL DAMPERS & FIRE DAMPERS

3900 SERIES

INSULATED CONTROL DAMPERS

3960 | 3961 | 3965

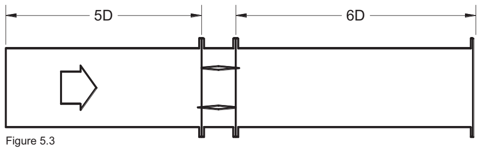


Figure 5.3

CERTIFIED RATINGS

Alumavent Inc. certifies that the 3900 Series Insulated Control Dampers shown here are licensed to bear the AMCA Seal. The ratings shown are based on tests and procedures performed in accordance with AMCA Publication 511 and comply with the requirements of the AMCA Certified Ratings Program. The AMCA Certified Ratings Seal applies to air performance ratings and air leakage ratings.

3900 SERIES CONTROL DAMPER PRESSURE DROP	
Velocity [FPM]	**Pressure Drop [in. w.g.]**
12x12 (inches)	
553.6	0.044
891.4	0.119
1051.9	0.161
2021.4	0.554
2221.7	0.740
24x24 (inches)	
536.8	0.014
776.9	0.025
1101.1	0.056
2066.3	0.182
2530.1	0.272
36x36 (inches)	
500.4	0.011
750.6	0.021
1006.1	0.036
2019.5	0.161
2526.6	0.249
12x48 (inches)	
545	0.008
772.8	0.018
1095.3	0.035
2055.5	0.126
2519.2	0.187
48x12 (inches)	
544.6	0.029
772.2	0.064
1094.4	0.1228
2053.1	0.439
2516	0.661

SHOP DRAWING

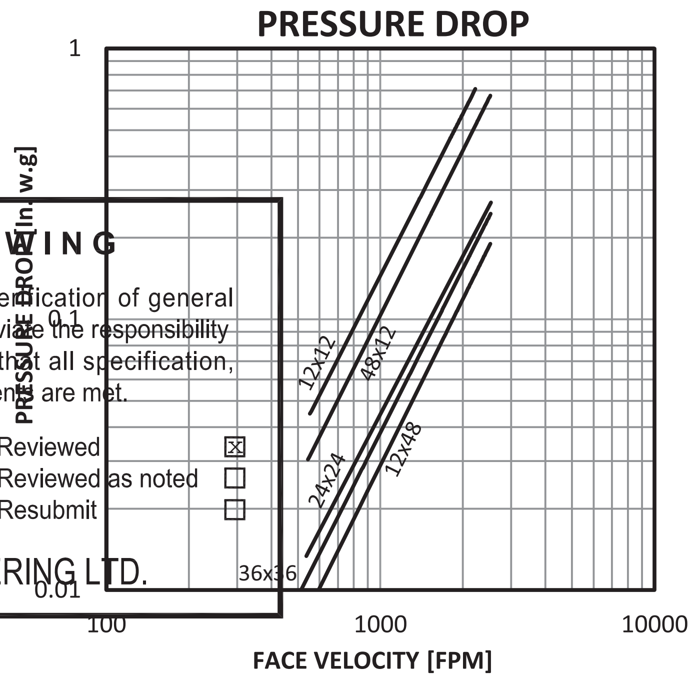
This review is solely for the verification of general design quality and does not alleviate the responsibility of the contractor for insuring that all specification, space and installation requirements are met.

Reviewed By: M.M.   ☒ Reviewed

☐ Reviewed as noted

Date: 19 Mar 2015   ☐ Resubmit

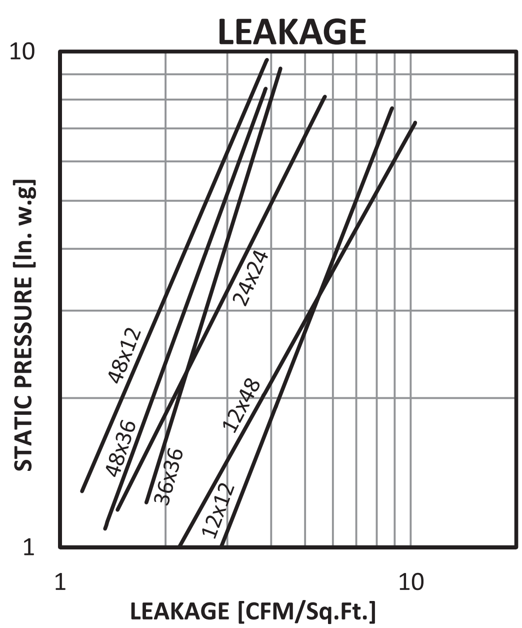
CHIARELLI ENGINEERING LTD.



Ratings Based on: AMCA Standard 500-D   Intake Ducted Test   Figure 5.3 Setup

DEFINITION OF LEAKAGE CLASSIFICATION				
CLASS	**LEAKAGE ft³/min/ft² *(L/s/m²)***			
	1" *(0.25 kPa)*	**4" *(1.0 kPa)***	**8" *(2.0 kPa)***	**12" *(3.0 kPa)***
1A	3 *(15.2)*	N/A	N/A	N/A
1	4 *(20.3)*	8 *(40.6)*	11 *(55.9)*	14 *(71.1)*
2	10 *(50.8)*	20 *(102)*	28 *(142)*	35 *(178)*
3	40 *(203)*	80 *(406)*	112 *(569)*	140 *(711)*

3900 SERIES CONTROL DAMPER LEAKAGE RATING			
DAMPER SIZE Width x Height	**PRESSURE in. w.g. (kPa)**		
	1" *(0.25 kPa)*	**4" *(1.0 kPa)***	**8" *(2.0 kPa)***
12"x12" *(305x305 mm)*	1A	1	1
24"x24" *(610x610 mm)*	1A	1	1
36"x36" *(914x914 mm)*	1A	1	1
12"x48" *(305x1219 mm)*	1A	1	1
48"x12" *(1219x305 mm)*	1A	1	1
48"x36" *(1219x914 mm)*	1A	1	1



Leakage test was conducted in accordance with AMCA Standard 500-D-98. Holding torque applied was 6 in.-lbs./sq. ft. on parallel blade dampers. Air leakage is based on operation between 0°C – 49°C *(32°F – 120°F)*.

DWG. 3960-3961-3965   *AUGUST 2010*

Chapter 23 DAMPER ACTUATOR

MANUFACTURER/DISTRIBUTOR:

S.C.I. Montréal Inc.
3311, boul. Industriel
Laval Qc H7L 4S3
T : 450-668-8866
T : 514-990-8866
1-800-667-8866
info@scimtl.ca

23.1 BELIMO NFB24-SR MODULING ACTUATOR

23.2 BELIMO LF24 MODULING ACTUATOR

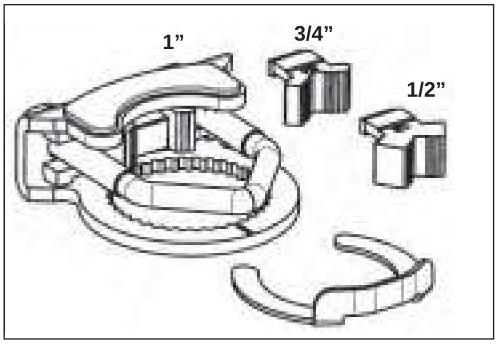
BELIMO

DAMPER
ACTUATOR

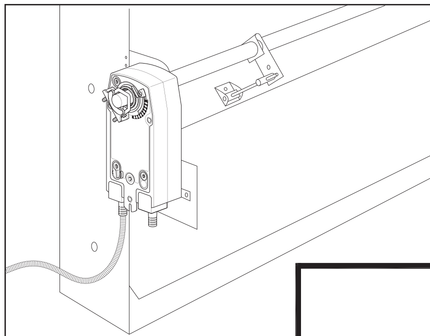
Minimum 90 in-lb Torque

- **For damper areas up to 22 sq-ft***

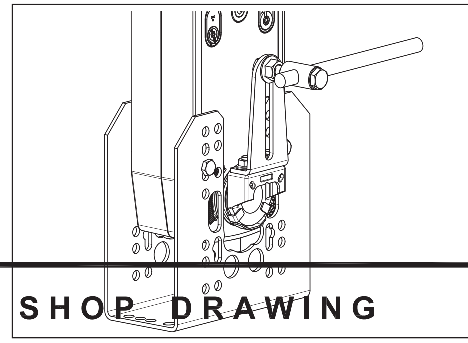
Applications



New standard clamp fits standard 1/2” shafts to 1.05” jackshafts.



Mount directly to 1.05” jackshafts.



Linkage solutions are available when direct coupling is not possible.

SHOP DRAWING

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Reviewed By: M.M.
Date:

☐ Reviewed
☐ Reviewed as noted
☐ Resubmit

CHIARELLI ENGINEERING LTD.

Actuators in bold have BDCM

NFB, NFX Series – At A Glance

		NFB24, NFX24 (p. 105)	NFB24 N4(H), NFX24 N4 (p. 107)	NFB24-S, NFX24-S (p. 105)	NFB24-S N4(H), NFX24-S N4 (p. 107)	NFBUP, NFXUP (p. 109)	NFBUP N4(H), NFXUP N4 (p. 111)	NFBUP-S, NFXUP-S (p. 109)	NFBUP-S N4(H), NFXUP-S N4 (p. 111)	NFB24-SR, NFX24-SR (p. 113)	NFB24-SR N4(H), NFX24-SR N4 (p. 115)	NFB24-SR-S, NFX24-SR-S (p. 113)	NFB24-SR-S N4(H), NFX24-SR-S N4 (p. 115)	NFB24-MFT, NFX24-MFT (p. 117)	NFB24-MFT N4(H), NFX24-MFT N4 (p. 119)	NFB24-MFT-S, NFX24-MFT-S (p. 117)	NFB24-MFT-S N4(H), NFX24-MFT-S N4 (p. 119)
Torque:	90 in-lb	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Power supply:	24 VAC/DC	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
	120 VAC					●	●	●	●								
	230 VAC					●	●	●	●								
Control signal:	On/Off	●	●	●	●	●	●	●	●								
	Proportional 2 to 10 VDC									●	●	●	●				
	Multi-function**													●	●	●	●
Feedback signal:	2 to 10 VDC									●	●	●	●				
	VDC variable**													●	●	●	●
Running time motor:	<75 seconds	●	●	●	●	●	●	●	●								
	95 seconds constant									●	●	●	●				
	Adj. 40 to 220 seconds***													●	●	●	●
	spring: <20 seconds	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Brushless DC Motor										●	●	●	●	●	●	●	●
External direction of rotation switch										●	●	●	●	●	●	●	●
Manual override		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Appliance rated cable, 18 GA (default)		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Plenum rated cable, 18 GA (optional)		●								●				●			
Built-in auxiliary switch, Two SPDT				●	●			●	●			●	●			●	
NEMA 4 rated housing			●		●		●		●		●		●		●		

Installation instructions......(p. 121-127) General wiring......(p. 129) Start-up and checkout......(p. 130) Electrical operations..

*Based on 4 in-lb/ft² damper torque loading. Parallel blade. No edge seals. **Default 2 to 10 VDC. ***Default 150 seconds.

Shop Drawings
Contractor Approval
Approved by: J.D., G.F.
Date: 12/03/15
SIFEC NORTH INC

BELIMO

DAMPER
ACTUATOR

A CLOSER LOOK...

- Cut labor costs with simple direct coupling.
- True mechanical spring return – the most reliable fail-safe.
- Mount for clockwise or counterclockwise fail-safe.
- Check damper position easily with clear position indicator.
- Don't worry about actuator burn-out.
  Belimo is overload-proof throughout rotation.
- Built-in mechanical stop to adjust angle of rotation.
- Manual override crank speeds installation
- Need to change control direction?
  Do it easily with a simple switch (modulating actuators).
- Incorporated breather membrane optimizes performance in harsh airstream environments.
- Built-in auxiliary switches are easy to use, offers feedback or signal for additional device (-S models).
- Microprocessor-controlled brushless DC motor increases actuator life span and reliability, provides constant running time (modulating actuators).
- Rugged metal on plastic housing withstands rough handling in the mechanical room.
- Standard 3 ft. appliance rated cable and conduit connector eases installation.
- Added flexibility to select clamp, electrical connection, and running time to fit your specific application with Belimo's customized line of actuators (NFX).

SHOP DRAWING

This review is solely for the verification of general design quality and does not alleviate the responsibility of the contractor for insuring that all specification, space and installation requirements are met.

Reviewed By: M.M. ☒ Reviewed

☐ Reviewed as noted

Date: 19 Mar 2015 ☐ Resubmit

CHIARELLI ENGINEERING LTD.

ISO 9001

5 YEAR WARRANTY

The Belimo Difference

- *Customer Commitment.*
  Extensive product range. Application assistance.
  Same-day shipments. Free technical support. Five year warranty.
- *Low Installation and Life-Cycle Cost.*
  Easy installation. Accuracy and repeatability.
  Low power consumption. No maintenance.
- *Long Service Life.*
  Components tested before assembly. Every product tested before shipment.
  30+ years direct coupled actuator design.

CE LISTED 94 D5 TEMP. IND. & REG. EQUIP. c UL us

BRUSHLESS dc motor ©

NFB24, NFB24-S, NFX24, NFX24-S

On/Off, Spring Return, 24 V

DAMPER
ACTUATOR

BELIMO

- **Torque min. 90 in-lb, for control of air dampers**

Application

For On/Off, fail-safe control of dampers in HVAC systems. Actuator sizing should be done in accordance with the damper manufacturer's specifications. Control is On/Off from an auxiliary contact, or a manual switch.

The actuator is mounted directly to a damper shaft up to 1.05" in diameter by means of its universal clamp. A crank arm and several mounting brackets are available for applications where the actuator cannot be direct coupled to the damper shaft.

Operation

The NFB and NFX series actuators provide true spring return operation for reliable fail-safe application and positive close off on air tight dampers. The spring return system provides constant torque to the damper with, and without, power applied to the actuator.

The NFB and NFX series provides 95° of rotation and is provided with a graduated position indicator showing 0° to 95°.

The actuator may be stalled anywhere in its normal rotation without the need of mechanical end switches.

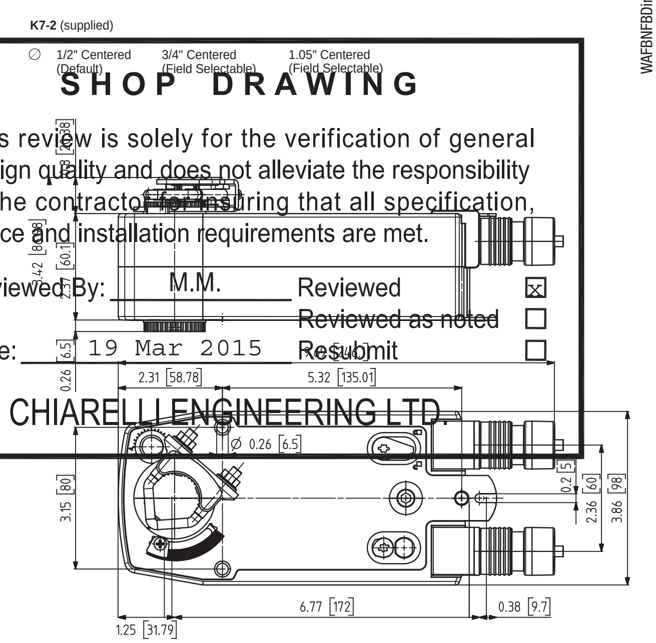
The NFB24-S and NFX24-S versions are provided with two built-in auxiliary switches. These SPDT switches are provided for safety interfacing or signaling, for example, for fan start-up. The switching function at the fail-safe position is fixed at +10°, the other switch function is adjustable between +10° to +90°. The NFB24, NFB24-S, NFX24 and NFX24-S actuator is shipped at +5° (5° from full fail-safe) to provide automatic compression against damper gaskets for tight shut-off.

Technical Data	NFB24, NFB24-S, NFX24, NFX24-S
Power supply	24 VAC ± 20% 50/60 Hz 24 VDC +20% / -10%
Power consumption running	6 W
holding	2.5 W
Transformer sizing	8.5 VA (class 2 power source)
Electrical connection	
NFB24...	3 ft, 18 GA appliance cable, 1/2" conduit connector **-S models:** two 3 ft, 18 gauge appliance cables with 1/2" conduit connectors
NFX24...	3 ft [1m], 10 ft [3m] or 16 ft [5m] 18 GA appliance or plenum cables, with or without 1/2" conduit connector **-S models:** two 3 ft [1m], 10 ft [3m] or 16 ft [5m] appliance cables, with or without 1/2" conduit connectors
Overload protection	electronic throughout 0 to 95° rotation
Control	on/off
Torque	90 in-lb [10 Nm] minimum
Direction of rotation spring	reversible with CW/CCW mounting
Mechanical angle of rotation	95° (adjustable with mechanical end stop, 35° to 95°)
Running time motor	< 75 seconds
spring	20 seconds @ -4°F to 122°F [-20°C to 50°C]; < 60 seconds @ -22°F [-30°C]
Position indication	visual indicator, 0° to 95° (0° is full spring return position)
Manual override	5 mm hex crank (3/16" Allen), supplied
Humidity	max. 95% RH non-condensing
Ambient temperature	-22°F to 122°F [-30°C to 50°C]
Storage temperature	-40°F to 176°F [-40°C to 80°C]
Housing	Nema 2, IP54, Enclosure Type2
Housing material	zinc coated metal and plastic casing
Agency listings †	cULus acc. to UL60730-1A/-2-14, CAN/CSA E60730-1:02, CE acc. to 2004/108/EC & 2006/95/EC
Noise level	<50dB(A) motor @ 75 seconds ≤62dB(A) spring return
Servicing	maintenance free
Quality standard	ISO 9001
Weight	4.15 lbs (1.9 kg); 4.4 lbs (2.0 kg) with switches

† Rated Impulse Voltage 800V, Type of action 1.AA (1.AA.B for -S version), Control Pollution Degree 3.

NFB24-S, NFX24-S	
Auxiliary switches	2 x SPDT 3A (0.5A) @ 250 VAC, UL approved one set at +10°, one adjustable 10° to 90°

Dimensions (Inches [mm])



SHOP DRAWING

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Reviewed By: M.M. ☒ Reviewed
☐ Reviewed as noted
Date: 19 Mar 2015 ☐ Resubmit

CHIARELLI ENGINEERING LTD.

DAMPER ACTUATOR

Accessories

AV 8-25	Shaft extension
IND-AFB	Damper position indicator
KH-AFB	Crank arm
K7-2	Universal clamp for up to 1.05” dia jackshafts
TF-CC US	Conduit fitting
Tool-06	8mm and 10 mm wrench
ZG-100	Universal mounting bracket
ZG-101	Universal mounting bracket
ZG-118	Mounting bracket for Barber Colman® MA 3../4.., Honeywell® Mod III or IV or Johnson® Series 100 replacement or new crank arm type installations
ZG-AFB	Crank arm adaptor kit
ZG-AFB118	Crank arm adaptor kit
ZS-100	Weather shield (metal)
ZS-150	Weather shield (polycarbonate)
ZS-260	Explosion-proof housing
ZS-300	NEMA 4X housing

Note: When using NFB24, NFB24-S, NFX24, NFX24-S actuators, only use accessories listed on this page.

For actuator wiring information and diagrams, refer to Belimo Wiring Guide.

Typical Specification

On/Off spring return damper actuators shall be direct coupled type which require no crank arm and linkage and be capable of direct mounting to a jackshaft up to a 1.05” diameter. The actuators must be designed so that they may be used for either clockwise or counterclockwise fail-safe operation. Actuators shall be protected from overload at all angles of rotation. If required, two SPDT auxiliary switch shall be provided having the capability of one being adjustable. Actuators with auxiliary switches must be constructed to meet the requirements for Double Insulation so an electrical ground is not required to meet agency listings. Actuators shall be cULus Approved and have a 5 year warranty, and be manufactured under ISO 9001 International Quality Control Standards. Actuators shall be as manufactured by Belimo.

SHOP DRAWING

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Reviewed By: M.M. — Reviewed ☒ / Reviewed as noted ☐

Date: 19 Mar 2015 — Resubmit ☐

CHIARELLI ENGINEERING LTD.

Wiring Diagrams

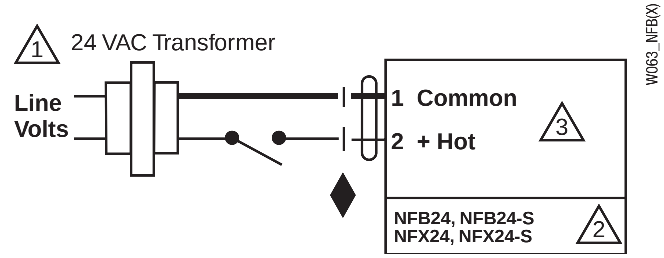
INSTALLATION NOTES

1. Provide overload protection and disconnect as required.
2. ***CAUTION*** *Equipment Damage!* Actuators may be connected in parallel. Power consumption and input impedance must be observed.
3. Actuators may also be powered by 24 VDC.
4. For end position indication, interlock control, fan startup, etc., NFB24-S and NFX24-S incorporates two built-in auxiliary switches: 2 x SPDT, 3A (0.5A) @250 VAC, UL Approved, one switch is fixed at +10°, one is adjustable 10° to 90°.

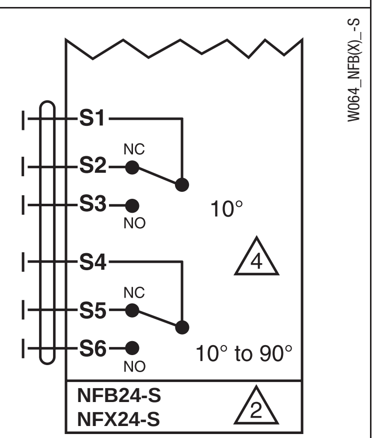
APPLICATION NOTES

◆ Meets cULus requirements without the need of an electrical ground connection.

WARNING *Live Electrical Components!* During installation, testing, servicing and troubleshooting of this product, it may be necessary to work with live electrical components. Have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks. Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.



On/Off wiring for NFB24, NFX24



Auxiliary Switches for NFB24-S, NFX24-S

Chapter 24 HVAC FANS

MANUFACTURER/DISTRIBUTOR:

E.H. Price
Montreal - Samuel Thomas
4645 rue Louis-B-Mayer
Laval
T: 514-334-9804 etx.235
F: 514-745-3159

24.1 **GREENHECK EXHAUST FAN SP-A250**

24.2 **FIRE DAMPER FD-A-S -- 3 HR RATING, 14" LG SLEEVE 20 GA., VERTICAL**

Inline, Ceiling and Sidewall Exhaust

GREENHECK
Building Value in Air.

Ceiling Exhaust - SP

Model SP ceiling exhaust fans are designed for clean air applications where low sound levels are desired. Low sound levels are achieved through quiet running forward-curved wheels.

SP-A

SP-B

SP-C

SP FANS A	SP FANS B	SP FANS C	STANDARD FEATURES
✓	✓	✓	Backdraft Damper - Prevents unwanted backdrafts.
✓			Spring Loaded Aluminum Backdraft Damper - Eliminates rattling or unwanted backdrafts (sizes 110 and up).
✓			Outlet - Both square and round outlets are field rotatable from horizontal to vertical discharge.
✓	✓	✓	Round Outlet (4 or 6 in.) - up to size A90. Versatile for quick, easy connections.
✓	✓		Power Assembly - Removes quickly for maintenance.
✓			External Electrical Access - Eliminates removing motor pack, saving installation time.
✓	✓		Electrical Knockout - Eliminates drilling holes.
✓	✓	✓	Disconnect (Plug Type) - Servicing is quick and safe.
✓	✓		Electrical Junction Box - Large for easy wiring.
✓	✓		Attractive Designer Grille - Concealed attachment screws securely to fasten grille to housing for quiet, rattle free operation.
✓	✓	✓	Mounting Brackets - Fully adjustable for multiple installation types.
✓	✓		Housing - Embossed galvanized steel for rigidity and low-profile for height restricted areas.
✓	✓	✓	PSC Compatible Motors - 50 cycle, 220v, and 240v options. 60 cycle, 115v, 208v, 220v, 230v, and 277v options. (Check factory for availability)
✓	✓	✓	3 Year Warranty
✓	✓	✓	UL listed for above showers w/ GFCI branch protected circuit

SERVICE CHART	IN STOCK	3 DAY	10 DAY
Standard Construction	✓	✓	✓
Speed Control, Mounted & Wired		✓	✓
Light, SP-A50, 70, 90, 110, 125 SP-B50, 80, 150		✓	✓
Light, SP-B70, 90, 110		✓	✓
Fan/CRD UL Listed Assembly		✓	✓
277 volt SP-A 110, 125, 190		✓	✓
277 volt SP-B 110, 150, 200		✓	✓
Contractor 4-Packs		✓	✓
Contractor Packs-Housings (sizes B70-B110) - Miami	✓	✓	✓
Motion Sensor - Grille Mounted			✓

PERFORMANCE

Models SP-A, SP-B, and SP-C are compact exhaust fans with performance capabilities of 29 cfm to 1600 cfm and up to 1 in. wg.

OPTIONS AND ACCESSORIES

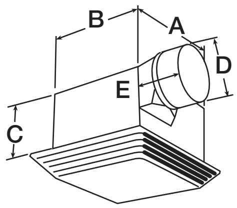
- Grilles
- Lights
- Ceiling radiation dampers (CRD)
- Vibration isolation kits
- Speed controls
- Motion detectors
- Time delays
- Roof discharge accessories
- Wall discharge accessories
- Transitions
- Filters
- Contractor paks

Note: *See pages 44-47 for full stock accessory listing*

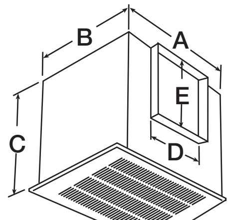
Shop Drawings
Contractor Approval
Approved by: J.D., G.F.
Date: 12/03/15
SIFEC NORTH INC

GREENHECK
Building Value in Air.

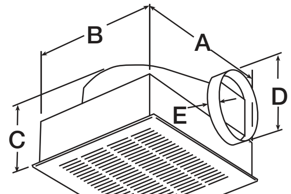
Ceiling Exhaust - SP



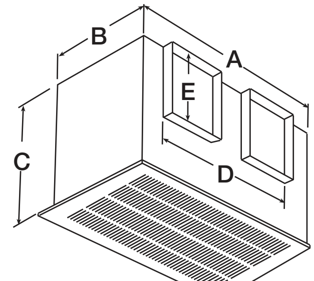
SP-C50



SP-A110 through SP-A510
and SP-A710 & SP-A780



SP-B50 through SP-B200



SP-A700, SP-A900
& SP-A1550

SP PERFORMANCE & DIMENSIONAL DATA - IN STOCK

MODEL	A	B	C	OUTLET		RPM	AMPS	WATTS	SONES @ 0 IN.	GRILLE SIZE	PERFORMANCE IN INCHES WG								
				D	E						0.00	.100	.125	.250	.375	.500	.625	.750	1.00
SP-C50-QD	7½	7½	3⅝	3 dia. x 1⅝		1680	0.80	46	2.9	9¼ x 9	52	49	48	47	44	38	29		
SP-B50-QD	13⅞	11½	6¹⁵⁄₁₆	4 dia. x ¾		625	0.50	38	1.7	14⅞ x 13¼	67	54	51	41	30				
SP-B70-QD	13⅞	11½	6¹⁵⁄₁₆	4 dia. x ¾		675	0.53	45	1.7	14⅞ x 13¼	77	71	68	57	50	40			
SP-B80-QD	13⅞	11½	6¹⁵⁄₁₆	4 dia. x ¾		900	0.60	54	2.9	14⅞ x 13¼	87	80	78	69	61	54	44	30	
SP-B90-QD	13⅞	11½	7¹⁵⁄₁₆	6 dia. x 1¼		700	0.65	50	1.9	14⅞ x 13¼	102	93	89	75	59	45	30		
SP-B110-QD	13⅞	11½	7¹⁵⁄₁₆	6 dia. x 1¼		950	1.14	80	2.0	14⅞ x 13¼	133	114	111	98	96	94	92	85	51
SP-B150-QD	13⅞	11½	7¹⁵⁄₁₆	6 dia. x 1¼		1050	1.70	129	3.0	14⅞ x 13¼	160	156	156	154	152	150	147	139	92
SP-B200-QD	13⅞	11½	7¹⁵⁄₁₆	6 dia. x 1¼		1100	2.20	173	4.4	14⅞ x 13¼	197	195	195	191	188	184	181	166	128
SP-A50-QD	13¼	10⅝	11⅝	6	6	700	0.31	18	0.7	14⅞ x 13¼	76	51	48	30					
SP-A70-QD	13¼	10⅝	11⅝	6	6	850	0.27	20	1.1	14⅞ x 13¼	83	70	67	42					
SP-A90-QD	13¼	10⅝	11⅝	6	6	900	0.34	29	1.1	14⅞ x 13¼	99	88	85	62	25				
SP-A110-QD	13¼	10⅝	10½	8	6	950	0.58	49	1.3	14⅞ x 13¼	119	110	106	89					
SP-A125-QD	13¼	10⅝	10½	8	6	1100	0.62	53	1.4	14⅞ x 13¼	135	123	121	105					
SP-A190-QD	13¼	10⅝	10½	8	6	1400	1.30	113	3.2	14⅞ x 13¼	216	197	192	167	134				
~~SP-A200-QD~~	~~14~~	~~11⅞~~	~~11¼~~	~~8~~	~~8~~	~~900~~	~~0.43~~	~~48~~	~~2.0~~	~~14⅞ x 13¼~~	~~247~~	~~226~~	~~220~~	~~197~~	~~172~~	~~142~~	~~105~~	~~68~~	
SP-A250-QD	14	11⅞	11¼	8	8	1000	0.77	83	2.9	14⅞ x 13¼	272	252	246	228	211	186	158	119	
~~SP-A290-QD~~	~~14~~	~~11⅞~~	~~11¼~~	~~8~~	~~8~~	~~1050~~	~~0.72~~	~~81~~	~~3.2~~	~~14⅞ x 13¼~~	~~315~~	~~293~~	~~287~~	~~258~~	~~232~~	~~207~~	~~176~~	~~125~~	
SP-A390-QD	14	11⅞	11¼	8	8	1350	1.34	135	5.4	14⅞ x 13¼	410	395	392	369	345	325	308	280	
SP-A410-QD	18	14⅜	14½	8	8	1000	1.74	121	4.1	19⅜ x 16⅜	443	413	405	351	306				
SP-A510-QD	18	14⅜	14½	8	8	1070	3.30	224	6.0	19⅜ x 16⅜	557	512	501	439	392	325			
SP-A700-QD	23⅝	11⅝	11⅝	19½	8	1100	3.20	350	6.1	25⅛ x 13½	757	730	723	700	680	650	613	560	397
SP-A710-QD	18	14⅜	14½	10	8	1080	4.40	285	7.4	19⅜ x 16⅜	752	714	701	653	588	486	320		
SP-A780-QD	18	14⅜	14½	10	8	1600	3.30	348	10.2	19⅜ x 16⅜	812	783	776	741	704	665	625	582	
SP-A900-QD	23¾	14⅜	14½	18¾	8	950	4.00	285	5.2	25 x 16⅜	955	907	897	842	774	701			
SP-A1050-QD	23¾	14⅜	14½	18¾	8	1095	6.30	420	7.2	25 x 16⅜	1125	1059	1043	964	886	797	663		
SP-A1410-QD	23¾	14⅜	14½	18¾	8	1450	7.40	786	11.6	25 x 16⅜	1455	1415	1404	1354	1308	1263	1219	1174	
SP-A1550-QD	23¾	14⅜	14½	18¾	8	1610	8.60	818	12.4	25 x 16⅜	1607	1568	1558	1507	1449	1408	1369	1323	

SHOP DRAWING
This review is solely for the verification of general design quality and does not alleviate the responsibility of the contractor for insuring that all specification, space and installation requirements are met.
Reviewed By: M.M.
Date: 19 Mar 2015
☒ Reviewed
☐ Reviewed as noted
☐ Resubmit
CHIARELLI ENGINEERING LTD.

All dimensions in inches. Grille dimensions are for the designer grille except on model SP-C50 where the dimensions are shown for the decorative grille. Performance certified is for installation type B: Free inlet, Ducted outlet. Performance ratings include the effects of an inlet grille and backdraft damper. Speed (RPM) shown is nominal. Performance is based on actual speed of test. The sound ratings shown are loudness values in fan sones at 5 ft. (1.5 m) in a hemispherical free field calculated per AMCA Standard 301. Values are for installation type B: free inlet sone levels. The AMCA Certified Ratings Sound Seal applies to sone ratings only.

UL/cUL 507
E33599
Ceiling Exhaust Fans are also UL Listed for sizes 50 through 390 for above bathtub/shower with GFCI branch protected circuit. File No. E33599

c UL US LISTED

Tub & Shower

PLUG-IN

amca CERTIFIED RATINGS SOUND and AIR PERFORMANCE
AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL, INC.

Greenheck Fan Corporation certifies that the SP models shown herein are licensed to bear the AMCA seal. The ratings shown are based on tests and procedures performed in accordance with AMCA Publication 211 and AMCA Publication 311 and comply with the requirements of the AMCA Certified Ratings Program.

For complete product information refer to catalog Models SP and CSP, or contact your local representative.

236/665

Building Value in Air.

Document 474680
Model SP
Model CSP
Ceiling Exhaust and Inline Fans

Installation, Operation and Maintenance Manual

Please read and save these instructions for future reference. Read carefully before attempting to assemble, install, operate or maintain the product described. Protect yourself and others by observing all safety information. Failure to comply with instructions could result in personal injury and/or property damage!

Model SP

Model SP is a direct drive ceiling exhaust fan designed for clean air applications where low sound levels are required. Many options and accessories are available such as lights, motion detectors, ceiling radiation dampers and speed controls. Capacities range from 25 to 1,600 cfm (42 to 2,718 m^3/hr) and 1 in. wg (248 Pa). AMCA Licensed for Sound and Air Performance.

ENERGY STAR® Certified models include:
SP-A, 50, 70, 90, 200, 250, 290 and 410;
SP-B, 50, 70, 80 and 90.

WARNING!

To reduce the risk of fire, electric shock, or injury to persons, observe the following:

- Suitable for use with solid state speed controls.
- Use this unit only in the manner intended by the manufacturer. If you have questions, contact the manufacturer.
- Before servicing or cleaning unit, switch power off at service panel and lock service disconnecting means to prevent power from being switched on accidentally. When the service disconnecting means cannot be locked, securely fasten a prominent warning device, such as a tag, to the service panel.
- Installation work and electrical wiring must be done by qualified person(s) in accordance with all applicable codes and standards, including fire-rated construction.
- Sufficient air is needed for proper combustion and exhausting of gases through the flue (chimney) of fuel burning equipment to prevent back drafting. Follow the heating equipment manufacturer's guideline and safety standards such as those published by the National Fire Protection Association (NFPA), and the American Society for Heating, Refrigeration and Air Conditioning Engineers (ASHRAE) and the local code authorities.
- When cutting or drilling into wall or ceiling, do not damage electrical wiring or other hidden utilities.
- Acceptable for use over a bathtub or shower when installed in a GFCI protected branch circuit. (Up through size SP-A390)
- Never place a switch where it can be reached from a tub or shower.
- Ducted fans must always be vented to the outdoors.
- These fans are not recommended for cooking exhaust applications. They are designed primarily for low temperature, clean air applications only. The diagram shows the minimum distance these fans should be placed in relation to cooking equipment.
- Fan/Light combination not to be installed in a ceiling thermally insulated to a value greater than R40.

CAUTION!

- For general ventilating use only. Do not use to exhaust hazardous or explosive materials and vapors.

Model CSP

Model CSP is a direct drive inline exhaust fan designed for clean air applications where low sound levels are required. Capacities range from 70 to 3,800 cfm (119 to 6,456 m^3/hr) and 1 in. wg (248 Pa). AMCA Licensed for Air Performance.

AVERTISSEMENT!

Pour réduire le risque d'incendie, de choc électrique ou de blessure corporelle, respecter cd qui suit:

- Appareil pouvant être utilisé avec un régulateur de vitesse à semi-conducteurs.
- Utiliser cet appareil exclusivement comme prévu par le fabricant. En cas de questions, communiquer avec le fabricant à l'adresse ou au numéro de téléphone figurant dans la garantie.
- Avant tout entretien ou nettoyage de l'appareil, couper l'alimentation sur le tableau électrique et verrouiller le dispositif de sectionnement pour empêcher toute mise sous tension accidentelle. Si le dispositif de sectionnement ne peut pas être verrouillé, attacher un moyen de mise en garde bien visible, tel qu'un panonceau, au tableau électrique.
- La pose et le câblage électrique doivent être effectués par des personnes qualifiées en conformité avec les codes et normes en vigueur, y compris pour la résistance au feu du bâtiment.
- Une quantité d'air suffisante est nécessaire pour la bonne combustion et l'extraction des gaz brûlés par le conduit d'évacuation (cheminée) d'appareils à combustible afin d'éviter le refoulement. Veiller à suivre les indications du fabricant du matériel de chauffe, les normes de sécurité telles que celles publiées par la National Fire Protection Association (NFPA) et l'American Society for Heating, Refrigeration and Air Conditioning Engineers (ASHRAE) et la réglementation en vigueur.
- Lors de la découpe ou du perçage de murs ou plafonds, ne pas endommager les câbles électriques et autres conduites masquées.
- Pose admissible au-dessus d'une baignoire ou d'une douche sous réserve de raccordement à un circuit de dérivation à protection GFCI (disjoncteur différentiel). (Jusqu'à la taille SP-A390 incluse)
- Ne jamais placer d'interrupteur à un emplacement à portée d'une baignoire ou d'une douche.
- Les caissons d'extraction à gaine doivent toujours être évacués vers l'extérieur.
- Ces caissons ne sont pas conseillés pour les applications d'aspiration de vapeurs de cuisson. Ils sont conçus essentiellement pour l'aspiration d'air propre à basse température. Le schéma indique la distance minimale de placement de ces caissons par rapport à l'équipement de cuisson.
- Le combiné ventilateur/luminaire ne devra pas être installé dans un plafond ayant une isolation thermique d'une valeur supérieure à R40.

ATTENTION!

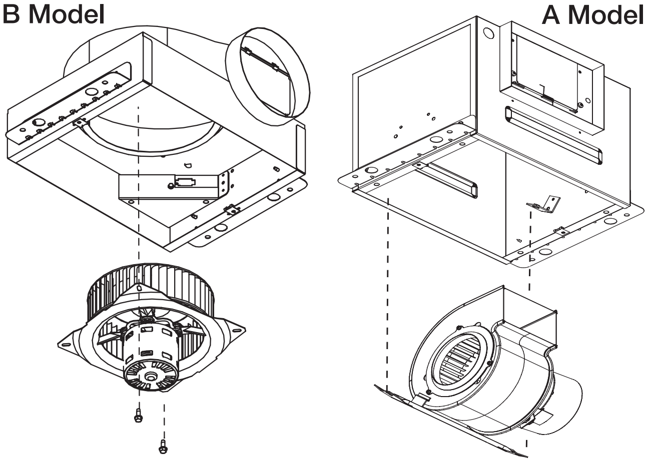
- À utiliser pour la ventilation générale uniquement. Ne pas utiliser pour l'aspiration de matières et vapeurs dangereuses ou explosives.

Prepare the fan

Power Assembly

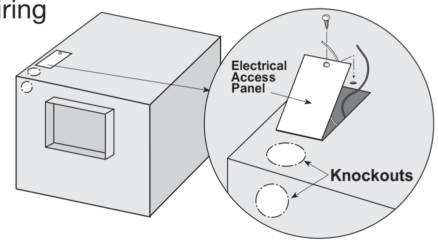
If power assembly (motor, wheel, and scroll) is not installed in housing, insert the electrical plug into fan socket, then slide scroll end of power assembly into fan housing. Attach by using two sheet metal screws provided.

B Model A Model



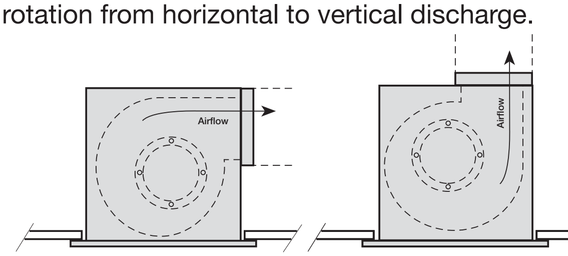
Remove Wiring Knockout

Remove either top or side wiring knockout, depending on wiring direction, by bending it back and forth to break tabs.



Ductwork

Check ductwork to see if the fan's discharge requires rotation from horizontal to vertical discharge.

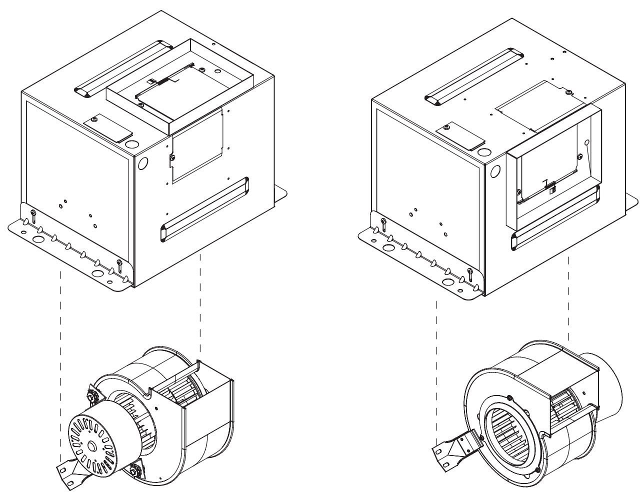


Fan Rotation

To rotate from horizontal to vertical discharge
A-Models Only

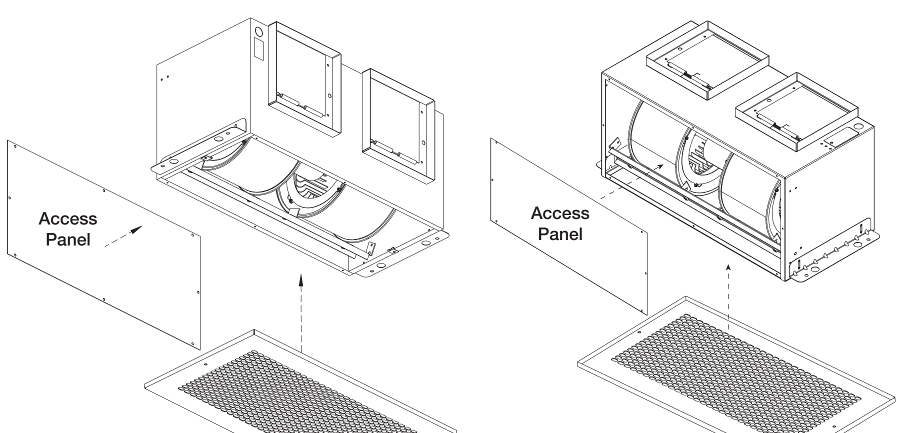
A-50-500, 710, 780 Models

Remove the two screws holding the power assembly in and pull power assembly out. Rotate power assembly 180 degrees and put back into fan. Use the same screws to reattach power assembly to fan housing. Flip fan over and remove the four screws holding the discharge duct and damper assembly. Exchange the assembly with plate mounted on top of fan, as shown in these illustrations.



A-700, 900-1500 Models

Remove the eight screws holding the access panel or collar as shown in picture. Rotate the fan housing so the discharge is facing up. Replace access panel or collar and screws.

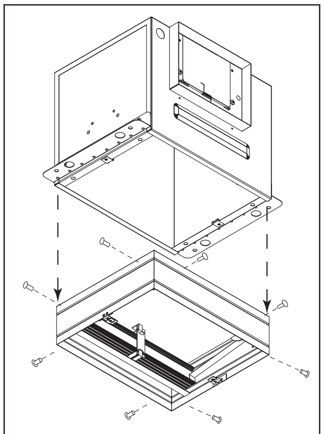


Ceiling Radiation Damper (CRD)

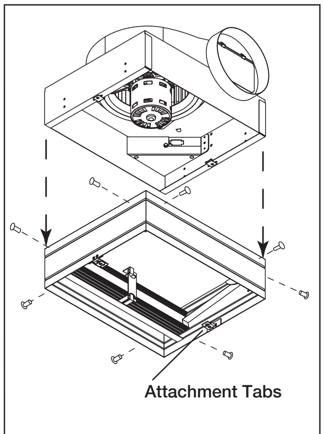
If fan is to be used in a fire resistive membrane ceiling, a ceiling radiation damper must be used.

If the ceiling radiation damper is already mounted to the fan from the factory, proceed to Install the Fan.

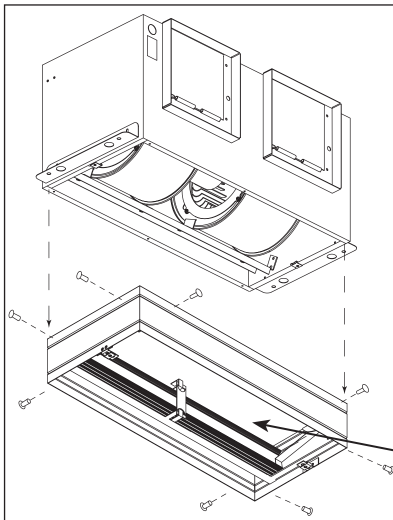
To mount the ceiling radiation damper to fan, make sure grille attachment tabs are facing down. Then place the inlet part of the fan into the ceiling radiation damper collar, and use self-tapping sheet metal screws (by others) to screw through the damper collar and into the fan housing. If the fan/light combination is being used, make sure ceiling radiation damper has an electrical plug in it. The electrical plug must be inserted into the fan. Make sure the electrical wire will not interfere with damper operation as shown in figure below.



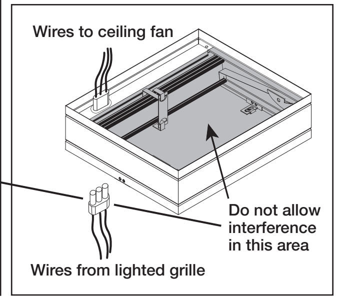
A-50-510, 710, 780 Models



B-Models

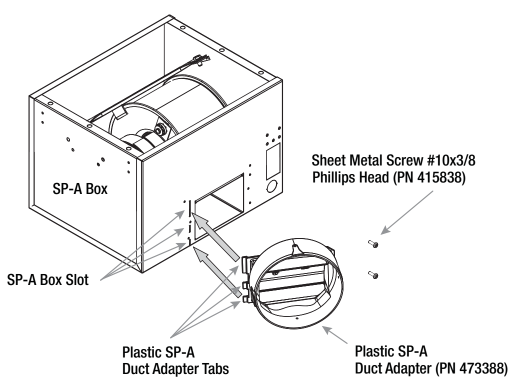


A-700, 900-1550 Models

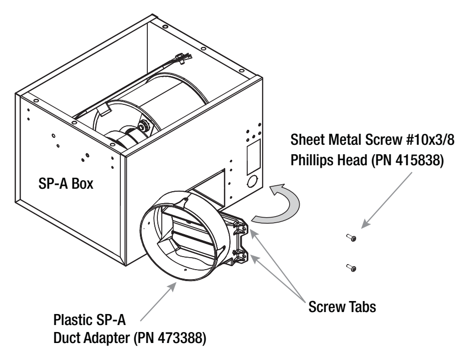


Discharge Installation SP-A 50-90 Models

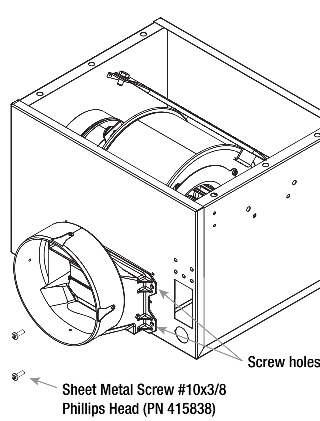
1 Insert plastic duct tab into SP-A box slots.



2 Rotate plastic SP-A duct adapter (PN 473388) until the screw tabs meets SP-A box.

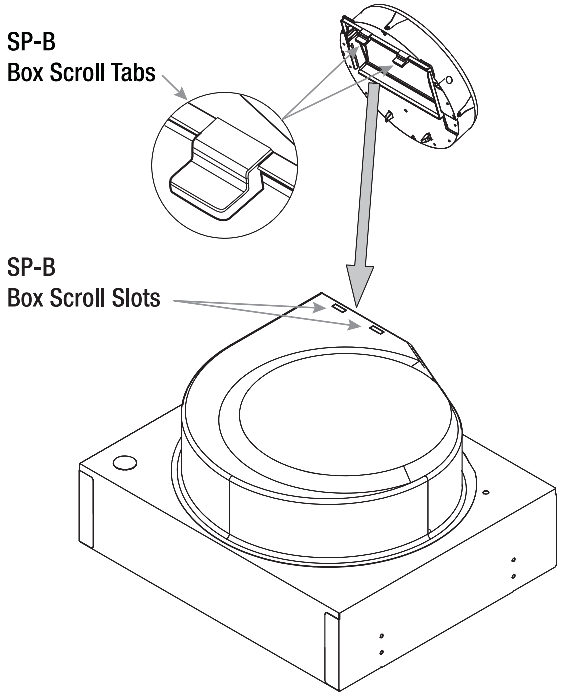


3 Install screws provided to secure discharge.

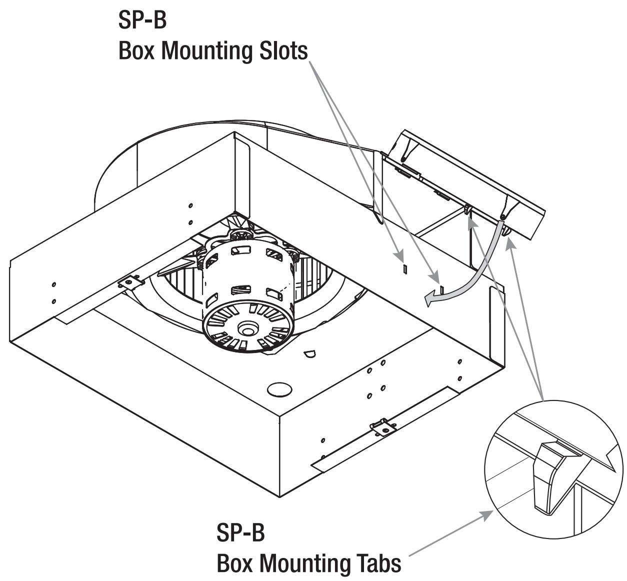


Discharge Installation SP/CSP-B 50-200 Models

1 Insert SP-B box scroll tab into SP-B box scroll slots.

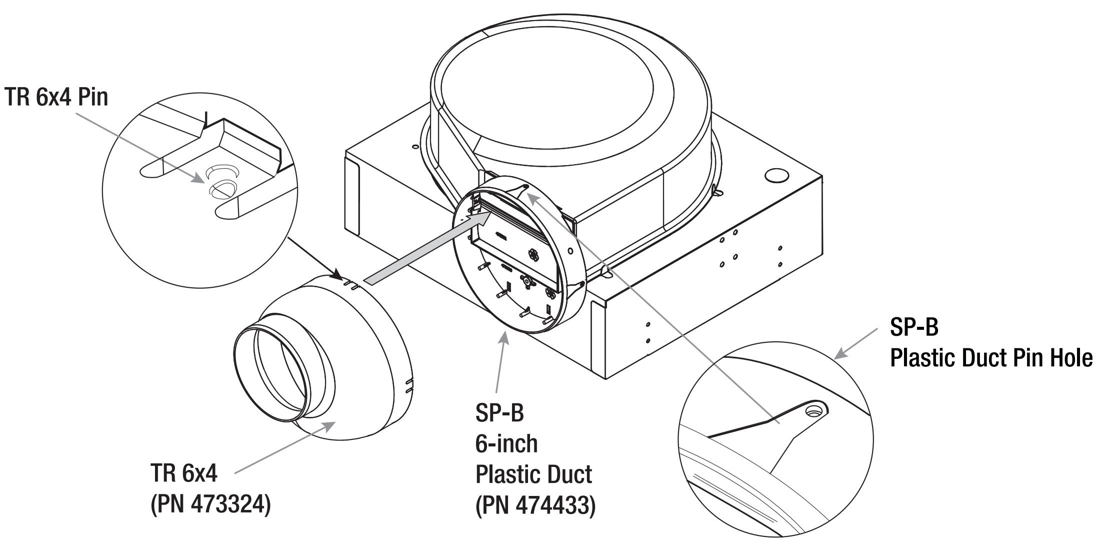


2 Rotate plastic SP-B duct adapter (PN 474433) until the two SP-B mounting tabs fully engage into the two SP-B box mounting slots.



3 **OPTIONAL**

Align the pins on the TR 6x4 adaptor to the duct pin hole on the SP-B 6-inch duct. Push until the adaptor snaps into place.



Install the Fan

1. For best performance, choose a location with the shortest possible duct run and minimum number of elbows. Do not mount near cooking equipment, as shown in Fig. 1.

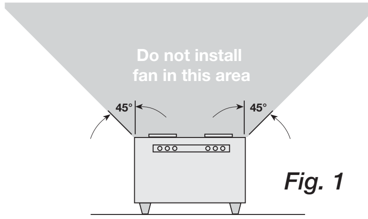


Fig. 1

2. Attach adjustable mounting brackets to fan, but leave the screws loose until proper height is determined, shown in Fig. 2. Cut hole to dimensions shown in table below:

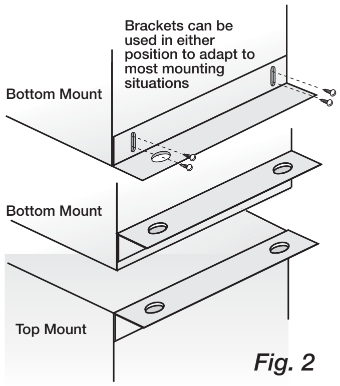


Fig. 2

Ceiling Openings		
Sizes	Fan or Fan/Light	Fan/CRD
SP-A50, A70, A90 SP-A110, A125, A190	10⅞ x 13⅜	11⅛ x 13 7/16
SP-A200, A250, A290, A390	12⅛ x 14¼	12¼ x 14⅜
SP-A700	23¾ x 11¾	24⅛ x 12¼
SP-A410, A510, A710, A780	14¾ x 18⅜	14⅞ x 18 7/16
SP-A900, A1050, A1410, A1550	14¾ x 24	14⅞ x 24⅛
SP-B 50 - 200	14⅛ x 11¾	14⅜ x 12¼

NOTE

Model SP-A 50-90 are standard with a round duct. Should Model SP-A 110-190 require a round duct, Model RDC (Round Duct Connector) may be ordered from Greenheck for field installation.

For Frame Construction:
Position unit between joists. Position brackets such that bottom edge of housing will be flush with finished ceiling, and tighten the adjustable mounting brackets, shown in Fig. 3.

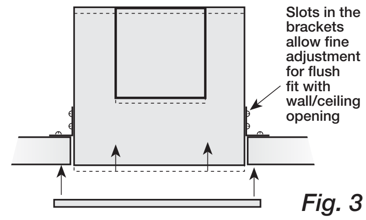


Fig. 3

For Hanging Installations:
Use Greenheck's optional vibration isolator kit Part Number VI Kit. Using the fan's standard adjustable mounting brackets and 10 by 32 threaded rod (by others), hang unit as shown in Fig. 4.

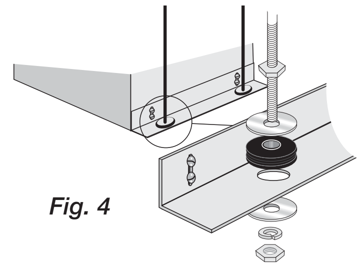
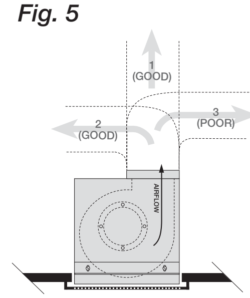


Fig. 4

3. Installation of ductwork is critical to the performance of the fan, shown in Fig. 5. Straight ductwork (1) or ductwork that turns in the same direction as the wheel (2) is recommended. Ductwork turning opposite the wheel direction (3) will cause turbulence and back pressure resulting in poor performance.

Fig. 5



4. Slide ductwork over the fan's discharge collar and securely attach it with sheet metal screws.

Make sure the screws do not interfere with damper operation. Check damper to make sure it opens freely.

Wire the Fan

1. If installed, remove wiring cover. If fan/light combination is being used, make sure the fan plug is connected to the fan receptacle and the light plug is connected to the light receptacle, shown in Fig. 6. Using proper wire connectors, wire the fan as shown in Fig. 7a. For wiring of light proceed to Fig. 7b.

2. Push all wiring into the unit's cover and replace wiring cover.

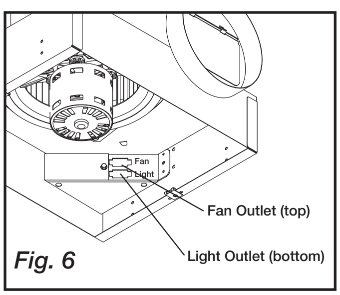


Fig. 6

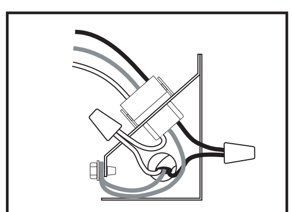


Fig. 7a

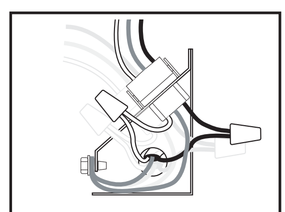


Fig. 7b

115 & 277 Volt
Black wire is "Hot"
White wire is "Neutral"
Green wire is "Ground"

220 - 240 Volt
Black wire is "Hot"
White wire is "Hot"
Green wire is "Neutral/Ground"

Attach the Grille

1. If lighted grille is being used, plug wire into fan socket.

   If lighted grille and ceiling radiation damper are being used, plug wire from lighted grille into ceiling radiation damper socket. Do not plug wire directly into the fan socket. Make sure the wire does not interfere with the ceiling radiation damper operation.
2. Attach grille with two screws provided. Make sure not to over tighten; over tightening will damage grille.
3. Slide attachment screw covers over the attachment screws, shown in Figure 8 and 9.
4. If lighted grille is being used, install light bulb(s) into light socket(s). For incandescent lights, use maximum 100 watt bulb (by others). For fluorescent lights, use 27W GU24 bulbs. Greenheck has replacement 27W GU24 bulbs call 1-800-355-5354 to order.
5. If lighted grille is being used, snap lens into place, by pushing on the outside edges of lens, shown in Fig. 9. To remove lens, use small screw driver and pry on one side of lens.
6. Turn on power and check fan and light operation.

Fig. 8

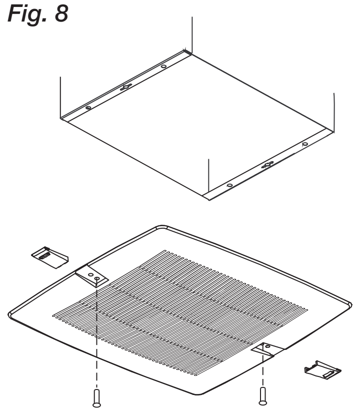
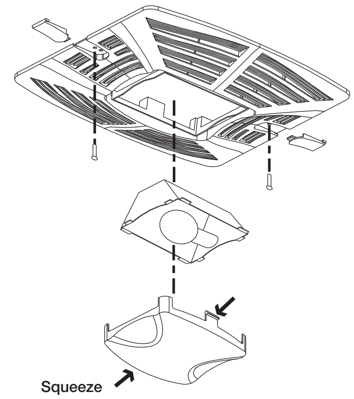


Fig. 9



Converting from ceiling to cabinet design for Model SP fans

All SP convertible sizes will be shipped with grille and duct collar cover.

Conversion Kit Parts List

- Qty. of 1 Blower Box Cover

Tools Required

- Phillips Head Screwdriver

Step 1: Remove grille (A) by removing the two grille screws (B).

Step 2: Remove duct collar cover (C) by removing the four duct collar screws (D).

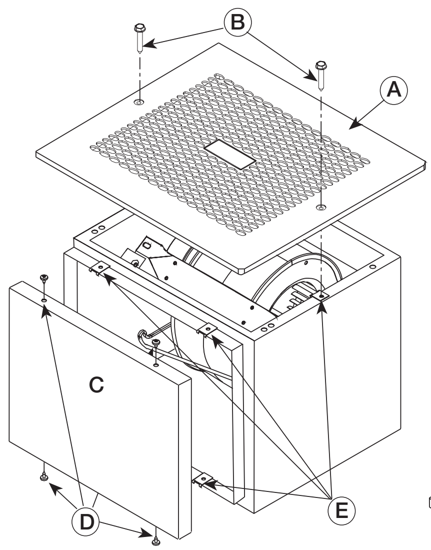
Step 3: Discard grille (A), two grille screws (B), and duct collar cover (C).

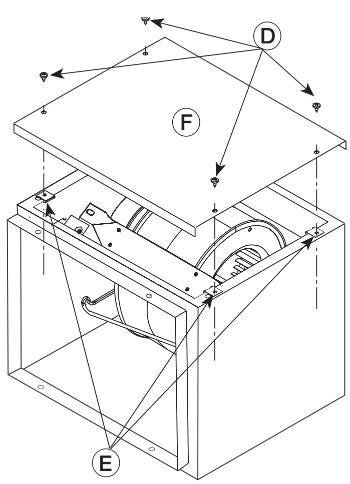
Step 4: Remove the six (6) tinnerman clips (E) by twisting them to one side and pulling straight out. Discard two of the six tinnerman clips.

Step 5: Insert the remaining four tinnerman clips (E) on grille opening side.

Step 6: Place blower box cover (F) over tinnerman clips (E), which were inserted in step 5.

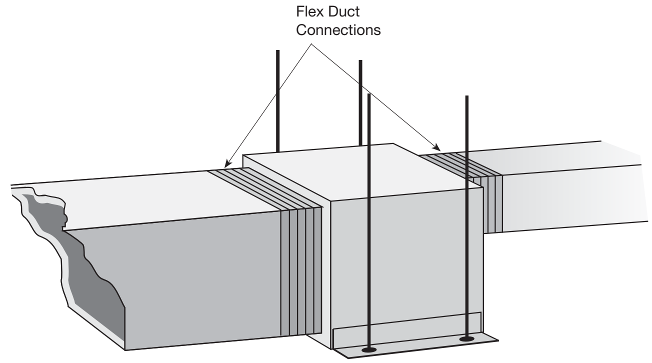
Step 7: Screw the blower box cover (F) into place with four blower box cover screws (D).





SP/CSP models shown are UL and cUL listed E 33599

Other Installation Considerations



Ductwork and Noise

Fiberglass ductboard is a better choice than metal ductwork for reducing fan noise and is highly recommended for low sound applications. Where metal duct is used, sound transmission can be reduced with flexible duct connections between the fan and the duct.

Sound and Location

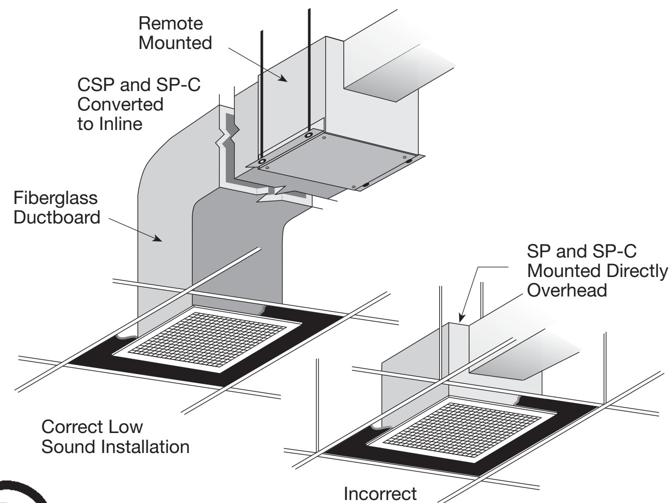
The location of these fans must be taken into consideration before installation. In critical sound installations, insulated ductwork, flexible duct connections or placing the fan in a remote section of ductwork are solutions to meeting the required fan sound levels.

Filters

The addition of an intake filter is highly recommended for these fans, even in clean air environments excess dirt can accumulate on wheels and motors causing reduced performance and imbalance.

Filters, once installed, should be checked and cleaned periodically to maintain performance.

Greenheck offers washable aluminum mesh filters specifically designed for these fans. Please consult our SP/CSP catalog for more information.



SP/CSP models shown are UL and cUL listed E 33599

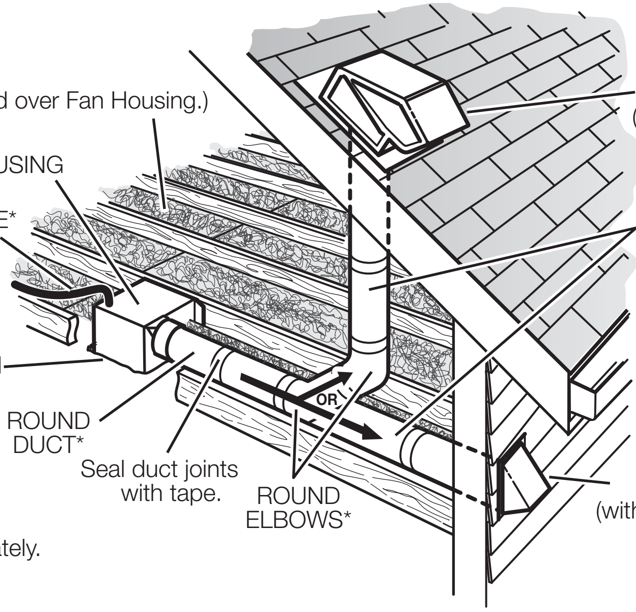
General Maintenance Suggestions

Model SP/CSP ceiling exhaust fans require very little maintenance. But since small problems over time left unchecked could lead to loss of performance or early motor failure, we do recommend that the unit be inspected periodically (once or twice a year).

The fan motor and wheel should be checked for dust and dirt accumulations. Dirt buildup can lead to loss of performance and motor overheating. Cleaning can be accomplished by brushing off any dust that may have accumulated. Even filtered units can accumulate build-up and should be checked when cleaning filters.

The motor should be checked for lubrication at this time. Lubricate only those motors which have an oil hole provided. A few drops of all purpose oil (SAE 20) will be sufficient.

Typical Installation



Our Commitment

As a result of our commitment to continuous improvement, Greenheck reserves the right to change specifications without notice.

Specific Greenheck product warranties are located on greenheck.com within the product area tabs and in the Library under Warranties.

Greenheck's Centrifugal Ceiling and Cabinet Exhaust Fans catalog provides additional information describing the equipment, fan performance, available accessories, and specification data.

AMCA Publication 410-96, Safety Practices for Users and Installers of Industrial and Commercial Fans, provides additional safety information. This publication can be obtained from AMCA International, Inc. at www.amca.org.

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Building Value in Air.

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Model FD-A-S c/w Sleeve

$1^1/_2$, 3 Hour Rated
"A" Style

Static Fire Damper c/w Sleeve, Horizontal and Vertical

Model

Static Fire Damper **FD-A-S c/w Sleeve**

Standard Construction:
Frame: Roll Formed Galvanized Steel.

Blades: Roll Formed Galvanized Steel, Curtain-Type

Springs: Stainless Steel.

Fusible Link: U.L. Listed 165°F.

$1^1/_2$ Hr. Vertical
Min. Size: 4"w x 4"h (102mm x 102mm)
Single Section Max:
60"w x 60"h (1524mm x 1524mm)
Max. Size:
120"w x 120"h (3048mm x 3048mm)

$1^1/_2$ Hr. Horizontal
Min. Size: 4"w x 4"h (102 mm x 102 mm)
Single Section Max:
40"w x 40"h (1016 mm x 1016 mm)
or 48"w x 48"h (1219 mm x 1219 mm)
Max. Size:
120"w x 40"h (3048 mm x 1016 mm)
or 96"w x 48"h (2438 mm x 1219 mm)

3 Hr. Vertical
Min. Size: 4"w x 4"h (102mm x 102mm)
Single Section Max:
40"w x 40"h (1016mm x 1016mm)
Max. Size:
80"w x 40"h (2032mm x 1016mm)

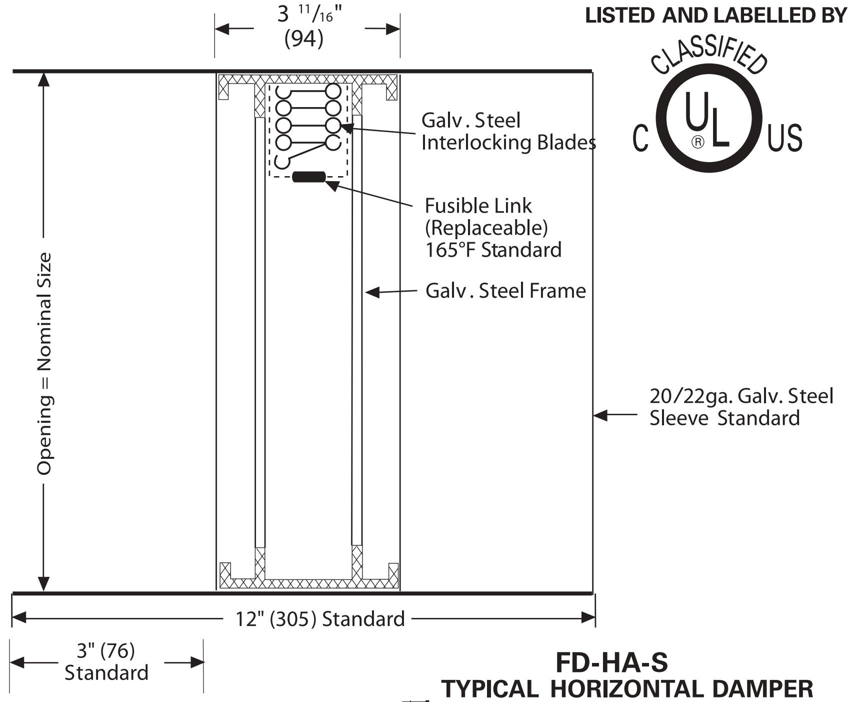
3 Hr. Horizontal
Min. Size: 4"w x 4"h (102mm x 102mm)
Single Section Max:
40"w x 40"h (1016mm x 1016mm)
Max. Size:
80"w x 40"h (2032mm x 1016mm)

Optional Construction:
- ❑ Sleeve Gauge
  - ❑ 18 Gauge
  - ❑ 16 Gauge
  - ❑ 14 Gauge
  - ❑ 10 Gauge
  - ❑ Sleeve Length (Required) ________
- ❑ Fuse Link 212°F
- ❑ $^3/_4$" (19) Flange (Sidewall Termination)

Notes: Dampers are furnished approximately $^1/_4$" (6mm) smaller than given duct dimensions.

UL/ULC Approved For Use in Static Systems Where The Fan Shuts Down in the Event of a Fire.

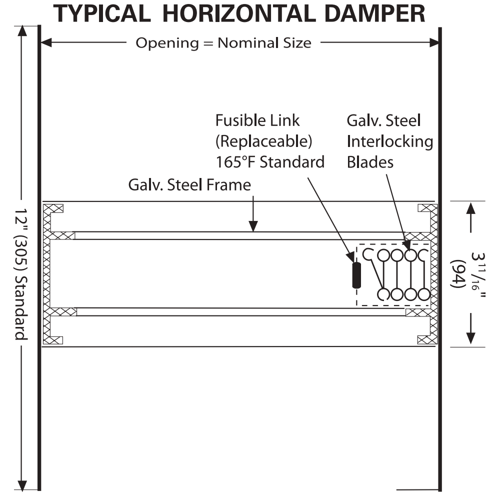
FD-VA-S
TYPICAL VERTICAL DAMPER



DESIGNED AND TESTED IN ACCORDANCE WITH UL-555 AND ULC-S112. MEETS ALL NFPA-90A REQUIREMENTS FOR FIRE DAMPERS.

LISTED AND LABELLED BY :

FD-HA-S
TYPICAL HORIZONTAL DAMPER



Manufacturer's Recommendations
All moving parts of the damper must be inspected and cycled at intervals not greater than every six months and in accordance with the latest edition of NFPA 90A, 92A, local codes and the actuator manufacturer. In addition, fuse links shall be removed and inspected for corrosion. Dry lubricants are recommended.

Specifications are correct at time of printing. However, as part of our 'continuous improvement program,' we reserve the right to make further improvements without notice.

PROJECT:		price®
ENGINEER:		
CUSTOMER:		Jul / 06
SUBMITTAL DATE:	**SPEC. SYMBOL:**	244984

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All Metric dimensions ( ) are soft conversion.
Imperial dimensions are converted to metric and rounded to the nearest millimetre.

Chapter 25 FUEL-OIL SYSTEM

MANUFACTURER/DISTRIBUTOR:

Wolseley Canada Inc
A/S M. Lacasse
4200 Hickmore
Saint-Laurent, Qc
Email: Mario.Lacasse@wolseleyinc.ca
Tel:(514) 344 9378
Fax:(514) 344 9341

25.1 FUEL PUMPS VIKING DUPLEX SYSTEM SG-0510X-DUP-O

VIKING PUMP

A Unit of IDEX Corporation

Viking® Duplex Fuel Oil Systems and Control Panels

Factory Built and Tested Solutions for Simple Installation Startup and Operation

DFO

- 25 Years experience
- Single source responsibility
- Compact integrated system
- Mounting flexibility
- Ease of Selection
- Factory-Built / Local Support

Capacity to 284 LPM (75 GPM)
Pressure to 3,448 kPa (500 PSI)
Viscosity 1 to 500 cSt (38 to 2,500 SSU)
Temperature -20°C to +82°C (-4°F to +180°F)

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Duplex Fuel Oil Systems Applications

The Viking Advantages

Viking Duplex Fuel Oil systems:

Factory engineered and built to order Duplex Fuel Oil systems and control panels for oil transfer applications like:

- Fueling diesel generators for backup electrical power generation
- Boosting low pressure fuel oil on oil-fired boilers and oil-fired furnaces
- Oil filtration/recirculation to ensure clean and / or water-free oil
- Fuel oil transfer from storage to day tank.

Viking Advantages

- Experience – Viking Pump have been worldwide leaders of PD pumping solutions since 1911 and have over 25 years of engineering and manufacturing DFO systems.
- One Source-One Responsibility – With a Viking DFO set we pre-engineer, pre-plumb, and with available pre-wiring give you a complete “plug-n-play” system so you don’t have to worry about sourcing and assembling the components.
- Compact – The Viking DFO set provides you with a compact integrated system that allows you mounting flexibility.
- Ease of Selection – With Viking’s easy select software, you can design, specify, and order standard and custom DFO systems to suit your application.
- Factory-Built / Local Support – With Viking’s extensive Distributor network we can provide you with local support and start-up assistance for you Viking DFO set.

Customer Benefits:

- Reliable fuel delivery with plumbed-and-wired standby pump
- Alternate pumps automatically minimize run time on any one pump
- Proven, factory manufactured sets built custom to your order
- UL-CSA electrical control panels
- Available with standard or UL rated pumps
- Quick access comparison sheets, specification sheets and illustration drawings
- Easily requested CAD submittal drawings
- Over 25 years experience engineering and manufacturing duplex fuel oil systems
- Easy sizing with 8-Step Selection Program
  (CD available, through your local authorized Viking Distributor)

Typical Applications:

Emergency Generators

Turbine Generators

Boilers

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Standard Equipment - Pump Sets

Standard Equipment

Viking Heavy Duty Positive Displacement Rotary Gear or Spur Gear Pumps (2)

Flexible couplings with Orange Peel OSHA guards (2)

Motors - Totally Enclosed Fan Cooled, foot mounted, NEMA, UL, CSA (2)

Common steel baseplate shall be made of heavy gauge steel plate with 1 1/2” high drip-lip and 1/2” NPT drain (1)

Suction Line Equipment

- Viking Lid-Ease Basket Strainers, cast iron body, 40 mesh stainless steel basket (2)
- Ball valves, 600 PSI pressure rated, full port, two piece bronze body, PTFE seat (2)
- Compound Gauges, 30” Hg-0-30 PSI 2.5” dial, bronze internals, stainless steel case, liquid filled (2)
- Gauge Valves - bronze ball valves, 600 PSI rated (2)

Discharge Line Equipment

- Spring Check Valves, 400 PSI pressure rated, bronze body, PTFE poppet (3)
- Ball valves, 600 PSI pressure rated, full port, two piece bronze body, PTFE seat (2)
- Relief Valves - continuous bypass type, cast iron body, stainless steel spring (2)
- Pressure Gauges, 0-200 PSI, 2.5” dial, bronze internals, stainless steel case, liquid filled (2)
- Gauge Valves - bronze ball valves, 600 PSI rated (2)

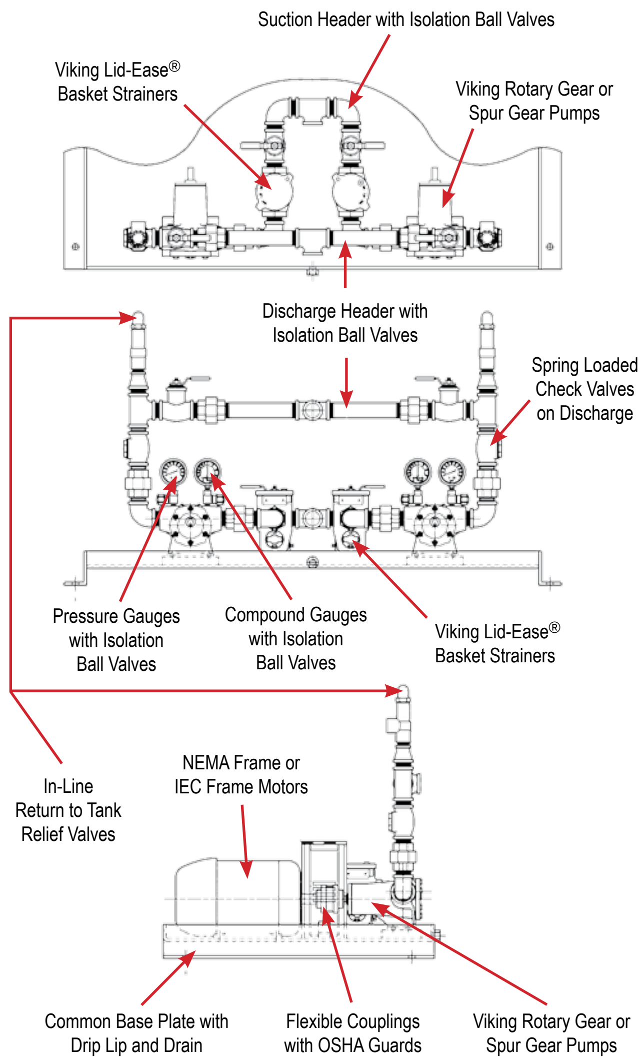
Suction and Discharge Piping

- Schedule 40 carbon steel piping and nipples, 150 PSI malleable iron screwed fittings

Unit to be coated with Vinyl Toluene Alkyd, quick dry enamel.

Duplex pump set to be leak tested with 100 PSI air and soap water.

Typical Standard Equipment Example



Suction Strainers

Viking Lid-Ease® Simplex Basket Strainer (2)
Duplex Basket Strainer (1)
Y-Strainers (2)
UL-Listed Simplex Basket Strainer (2)
UL-Listed Duplex Basket Strainer (1)

Standard equipment is Viking Lid-Ease Strainer w/40 mesh.
All strainers offerred in 20, 40 or 60 mesh.

Phase-Cycle-Voltage

1 ph 60 Hz 115 Volt
1 ph 60 Hz 230-240 Volt
3 ph 60 Hz 208-230-460 Volt
3 ph 60 Hz 575 Volt
3 ph 50 Hz 380-415 Volt

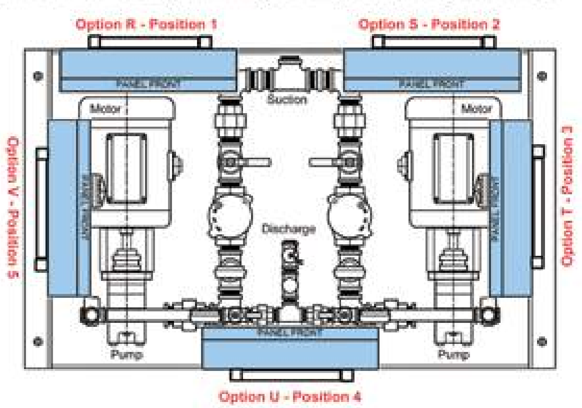
Optional Equipment - Pump Sets

DFO

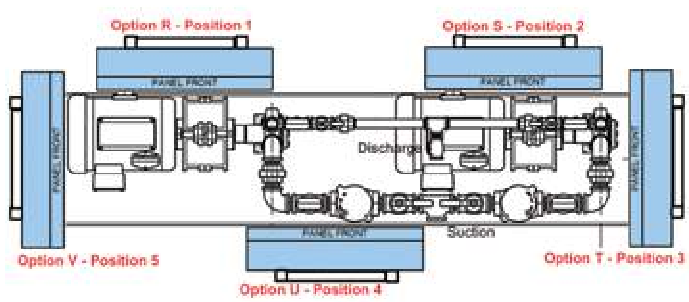
“A” or “B”	A	Pressure Switch - Single Stage, 20-200 PSI (41.4 to 1379.3 kPa) in EEMAC1 enclosure, installed
	B	Pressure Switch - Dual Stage - High and Low, 6-200 PSI (41.4 to 1379.3 kPa) in EEMAC1 enclosure, installed
	C	Pressure Control Valve Bronze body, Buna-N diaphragm, 0 to 75 PSI (0 to 517.2 kPa) c/w two shut off and one by-pass valve, installed
“D” or “E”	D	Flow Switch - Low Pressure to 100 PSI , NEMA 1, brass housing, SS vane, with junction box, c/w 120VAC, SPDT switch, installed
	E	Flow Switch - High Pressure to 1450 PSI , NEMA 7, brass housing, SS vane, less junction box, c/w 120VAC, SPDT switch, installed
“F” or “G”	F	Thermometer, industrial , bi-metal type, 3” round dial, 1/2”NPT mount -5° to 115°C (20° to 240°F), installed
	G	Thermometer, 91T100 industrial , 9” long Valox case with glass lens, 3/4”NPT mount, 0° to 115°C (30° to 240°F), installed
	H	Flexible Connectors: (1) suction header, (1) discharge header, (1) return-to-tank Relief Valve, SS hose, steel nipples, supplied loose
	J	Water Removal Filter, spin-on type cartridge filter, 200 PSI, c/w disposable 10 micron element and visual indicator, installed
	K	Galvanized Base Plate
	L	4” Dial Guages - (2) Compound 30”Hg-0-30PSI & (2) Pressure 0-200 PSI
“M” or “N”	M	UL-Listed Ball Valves, Strainer(s), and Relief Valves
	N	Stainless Steel Ball Valves and Check Valves (instead of standard bronze)
	O	Turbine Flow Meter - installed
	P	Viton® Seals in Pumps (instead of Buna-N)
	Q	High Efficiency Motors (Available for 3 phase 1 HP and larger)
“R” or “S” or “T” or “U” or “V”	R	Control Panel Mounted & Wired on Pump Set - Position 1
	S	Control Panel Mounted & Wired on Pump Set - Position 2
	T	Control Panel Mounted & Wired on Pump Set - Position 3
	U	Control Panel Mounted & Wired on Pump Set - Position 4
	V	Control Panel Mounted & Wired on Pump Set - Position 5
	W	Hand Priming Pump - Piped c/w isolation valves
	X	Magnetic Float Switch w/Alarm for Drip Tray Leak Detection
	Y	Header for Return-to-Tank Relief Valves

UL Listed Pumps
Cast Steel Pumps (4193 Series)
Consult factory for other options not listed

Control Panel Mounting and Wiring to Pump Set - (Side-by-Side Units)



Control Panel Mounting and Wiring to Pump Set - (F & FH In-Line Units Only)



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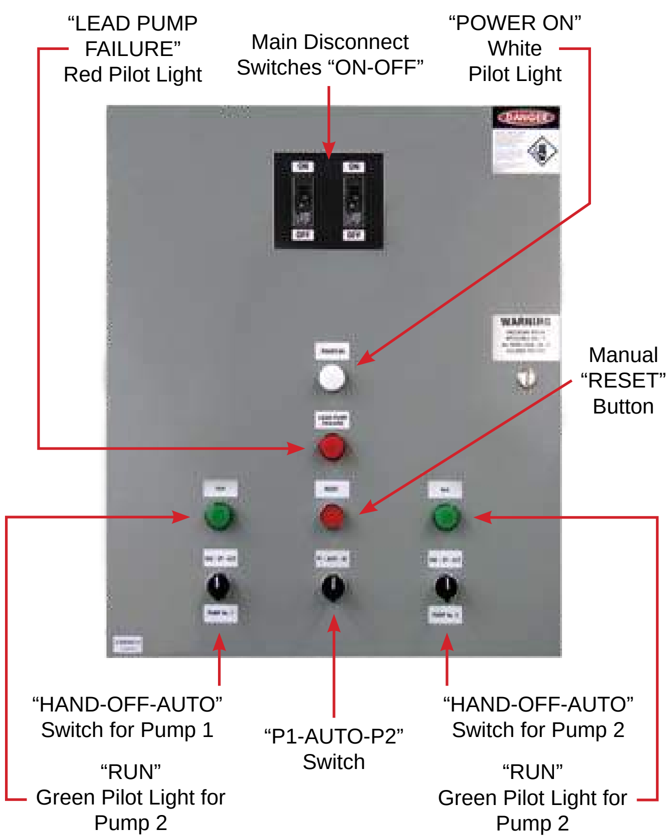
Standard Equipment - Control Panels

Standard Equipment:

- NEMA/CSA 1 enclosure
- Single pole circuit breaker (2) c/w through the door operation (120 volt) or individual disconnect switches, motor protectors and transformer (208-575 volt)
- Magnetic motor starters (2)
- Hand-Off-Auto selector switches (2)
- Power on pilot light (white)
- Run pilot light (green) (2)
- Terminal Strip
- Provision to connect 3 float switches (normally closed)
- Control circuit fuse
- Lead pump failure pilot light & manual reset, lag pump start
- P1 - Auto - P2 alternating selector switch



Standard control panel for Duplex Fuel Oil Pump Set is NEMA1 enclosure / CSA Listed. For USA customers, the panel is standard with UL508 Listing (see option Q in optional equipment)

Customized Packages to Your Specifications

Consult our Factory Applications Engineers to help us build the fuel oil system to meet your applications needs, with specific brands or specifications of:

- Motors
- Special Painting
- Filtration
- Valves
- Custom Nameplates
- Gauges
- Piping and Fittings
- Solenoid Valves
- Controls

Optional Equipment: Control Panel Chart

A	Motor run signal NO/NC - 1 per pump
B	Motor tripped red lights (2)
C	Motor tripped NO/NC signals (2)
D	High pressure cut out - red pilot light and manual reset
E	Low pressure cut out - red pilot light and override timers (2) (manual reset)
F	High pressure alarm signal
G	Low pressure alarm signal
H	Type ADB - 2 float switches, signal from generator and high level red light
I	Buzzer and silence push button
J	NEMA / CSA 2 enclosure - drip proof
K	NEMA / CSA 12 enclosure - oil & dust tight
L	NEMA / CSA 4 enclosure - water tight
M	Low flow signal to start lag pump c/w timers (2), red pilot lights and reset push button
N	Low level alarm signal and red pilot light
O	High level alarm signal and red pilot light
P	Low flow alarm signals (2)
Q	UL508 Listed Panel (Standard on USA Panel - Optional for Canadian panel)
R	Stop pump level main tank alarm signal and red pilot light
S	Low-level alarm signal and red pilot light (specify function)
T	High-level alarm signal and red pilot light (specify function)
U	Momentary test button
V	Key lock
W	Provision to connect valve (each)
X	Main disconnect for single phase controller
Y	Overload reset push-button (or handle)
Z	No alternator
1	NEMA 3R double door enclosure
2	Emergency push button shut-off switch
3	Time delay on Magnetrol contact (each, specify contact)
4	Main disconnect for three phase controller in lieu of pump disconnect

Consult Factory for other control panel options.

Worldwide Leader Since 1911 for Positive Displacement Pumping Solutions for Industrial, OEM, and Sanitary Applications.

VIKING PUMP
A Unit of IDEX Corporation

Innovation and Experience

Viking Pump has been a pump industry leader and innovator since its founding in 1911. We continue to build on our ever growing experience delivering innovative new pumping solutions, including custom designs, to many thousands of customers who use millions of Viking® pumps in some of the world's toughest applications.

Broad Performance Range

Capacity:
0.5 to 360 M³/Hr (0.1 to 1600 GPM)
Pressure:
0 to 172 Bar (0 to 2500 PSI)
Temperature:
-40°C to 370°C (-40°F to 700°F)
Viscosity:
0.5 to 1,000,000 cSt (28 to 4,500,000 SSU)

Ultimate in Sealing Solutions

Viking's offering of packing, component mechanical seals, cartridge seals, and sealless Mag Drive technology provides the best choices for sealing flexibility needed to provide your application a customized sealing solution every time - saving you money, time, and unplanned downtime.

Material Options Matched to Application

Viking's dedicated iron and alloys foundries provide pump construction materials from cast iron to Alloy C. Application-specific materials of construction extend pump life significantly, while reducing maintenance and unplanned downtime, which enables increased production and a better bottom line.

Liquid Integrity Protection

Viking has developed multiple positive displacement pump principles to protect shear-sensitive liquids, and low-shear options to prevent damage to fibers, polymers, and solids. Full-jacketing options provide precise temperature control throughout the pump. The Viking Mag Drive® and other seal options prevent fluid contact with air, assuring liquid integrity.

Local Applications and Engineering Support

Over 245 Authorized Viking Pump Distributors in 68 countries provide local application support and service, backed by Viking Application Engineers and Viking Region Managers strategically located around the world.

Quality Manufacturing

Viking uses ISO9001-2000, ISO14001, Six-Sigma, and Lean/Kaizen in its worldwide manufacturing and assembly processes to remove waste, reduce development costs, and deliver superior products on schedule. Dedicated Viking foundries and manufacturing facilities utilize state-of-the-art CNC equipment to assure unmatched quality is built into every pump.

Custom Designed Solutions

Viking has provided custom designed pumps to end-users and OEMs since its first pump in 1911, when Viking invented the gear-within-a-gear pumping principle to remove water from a rock quarry. Today, enabled by Viking's engineering staff, extensive applications experience, and in-house foundries, more than 20% of Viking's sales are new Viking designs, or pumps designs derived from more than 1000 Viking catalog pumps with more than 40,000 active configurations. So, whether you are an end-user or an OEM, Viking can provide custom designed pumping solutions to meet your specific needs.

IDEX CORPORATION

For more information, contact your local authorized Viking Pump Distributor or contact Viking at:

VIKING PUMP, INC.
A Unit of IDEX Corporation
406 State Street
Cedar Falls, Iowa 50613-0008 U.S.A.
Telephone: (319) 266-1741
Fax: (319) 273-8157
Email: info.viking@idexcorp.com
Web site: www.vikingpump.com

VIKING PUMP OF CANADA INC.
A Unit of IDEX Corporation
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Windsor, Ontario N9A 6M3 Canada
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Fax: (519) 256-5070
E-mail: cinfo@idexcorp.com
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VIKING
PUMP
CANADA

Viking Pump of Canada Inc.
A Unit of IDEX Corporation
661 Grove Avenue, P.O. Box 398
Windsor, Ontario N9A 6M3

Wolseley Canada

4200 Hickmore

St-Laurent, Quebec

H4T 1K2

December 15, 2014

Our quotation # 142848

Attention: Mario Lacasse

Reference: Pangnirtung, NU

Thank you for considering Viking Pump Canada for your pumping requirements

Attached please find our quotation for your review.

We are confident that you will be very satisfied with the products and services that we offer

If you have any questions, comments, or require any additional information, please do not hesitate to contact us

Sincerely,

Jerome Bouchard

IDEX
FLUID & METERING

VIKING PUMP CANADA

Viking Duplex Fuel Oil Pump Package - Quotation

Company:	Wolseley Canada	Reference	Pangnirtung, NU
Address:	4250 Hickmore	Quote #	142049
City & Province:	St-Laurent, Quebec	Item number	one
Postal Code	H4T 1K2	Date	12/15/2014
Contact:	Mario Lacasse	Project Reference	13-073
Phone	(514) 344-9378 ext. 152	FCA	Viking Pump, Windsor, Ontario
Fax:	(514) 344-8639	Terms:	1% 10 days, net 30 days O.A.C
Email address:	mario.lacasse@wolseleyinc.ca	Delivery	4 - 6 weeks

Required Conditions	Capacity			Pressure			Liquid	Viscosity		Temperature	
	0.167	10.00	0.63	10	0.69	68.97	No. 2 Fuel Oil	38		76	24
	USGPM	GPH	LPM	PSIG	Bar	kPa	SG 0.85	SSU	cPs	°F	°C

We are pleased to offer the following.

Viking Duplex Fuel Oil Pump Package Selection:

Quantity: 1

Consisting of

Quantity 1 Viking DFO part number SG-0510X-DUP-O

Quantity : 2 Motors Part Number: 350E-60-60-333TC

0.5 hp 3 ph 60 Hz 575 Volt 1150 rpm 56C Frame size

• Motors shall be Totally Enclosed Fan Cooled, C-Faced, NEMA Frame, CSA, UL, CE

Control Panel for Viking Duplex Fuel Oil Pump Package

Quantity 1

Viking Control Panel part number CPD05-DUP-STC

Please see the attached Specification sheets for complete details on our proposal

Best Regards

Jerome Bouchard
Applications Team
519-259-4250

VIKING PUMP

Specifications
Viking Duplex Fuel Oil Pump Package

The Duplex Fuel Oil Pump Set shall be Viking part # **SG-0510X-DUP-D** complete with the following equipment:

- Pumps shall be Viking® Pump Model
  SG-0510X Spur Gear Pump in [illegible] construction, UL-Listed, heat treated steel gears, case hardened shafts, carbon graphite bushings, Viton® lip seal, plain head, 1/2" NPT ports.

Pump 1 P/N: **L-0510-3852-004** Pump 2 P/N: **L-0510-3852-009** Bracket P/N: **8-05-756-51-0005**

The pumps shall deliver:

Capacity	Liquid	Differential Pressure	Viscosity/Sp. Gr.
2.5 USGPM	No. 2 Fuel Oil	10 PSIG	38 SSU
9.4 l/min		0.7 Bar	3 cPs
0.15 m³/hr		69.0 kPa	0.85 Sp. Gravity

- Motors shall be Totally Enclosed Fan Cooled, C-Faced, NEMA Frame, CSA, UL, CE
  0.5 HP 3 ph 60 Hz 575 Volt 1150 RPM 56C Frame
  Motor P/N: **350E.60-60-333TC**
- **Common Base** shall be made of heavy gauge steel plate with 1 1/2" high drip-lip and 1/2" NPT drain.
- **Suction Line Equipment** shall consist of the following components in 1" Header Size
  - (2) Lo-Ease Basket Strainers w/40 mesh
  - (2) Ball valves, 600 PSI pressure rated, full port, two piece brass body, PTFE seat, UL-Listed
  - (2) 30"Hg-0-30 PSI Compound gauges, 2.5" face, brass internals, liquid filled
  - (2) Gage Valves - 1/4" Ball valves, 600 PSI, full port, two piece brass body, PTFE seat, UL Listed
  - Sch. 40 black steel piping and nipples,150 PSI malleable iron screwed fittings; Class 125/150 Flanges where applicable. N-American fittings std
- Discharge Line Equipment shall consist of the following components in 1/2" Header Size
  - (2) Swing Check Valves, 400 PSI pressure rated, bronze body, PTFE poppet
  - (2) Ball valves, 600 PSI pressure rated, full port, two piece brass body, PTFE seat, UL-Listed
  - (2) In-Line Relief Valves - continuous bypass type, cast iron body, stainless steel spring
  - (2) Pressure Gauges, 2.5" dial, brass internals, liquid filled, 0-60 Range
  - (2) Gage Valves - 1/4" Ball valves, 600 PSI, full port, two piece brass body, PTFE seat, UL Listed
  - Sch. 40 black steel piping and nipples,150 PSI malleable iron screwed fittings, Class 125/150 Flanges where applicable. N-American fittings std
  - Pump Set to be leak tested with 100 PSI air and soapy water
  - Unit to be coated with Vinyl Toluene Alkyd, Quick Dry Enamel
  - Magnetic Float Switch with Alarm for Drip Tray Leak Detection
  - Viton Seals in the Pumps instead of standard Buna-N
  - Pressure Switch - Dual Stage - High and Low, 6-200 PSI (41.4 to 1379.0 kPa) in CEMA [illegible] enclosure, installed

IDEX IDEX CORPORATION

Viking Pump, Inc., A Unit of IDEX Corporation • Cedar Falls, IA 50613

[illegible]

[illegible]

VIKING PUMP

Specifications

Control Panel for Viking Duplex Fuel Oil Pump Package

The Control Panel for the Viking Duplex Fuel Oil Pump Set shall be Viking part number **CPD05-DUP-STD**

Complete with the following components:

- Enclosure - NEMA / CSA 1 enclosure
- Individual disconnect switches, motor protectors and transformer c/w through the door operation and control circuit fuse (3 phase - 208 Volt to 575 Volt)
- Magnetic motor starters - 2
- Hand-Off-Auto selector switches (2)
- Power on pilot light (white) (1)
- Run pilot lights (green) (2)
- Terminal Strip
- Provision to connect 4 float switches, and 1 redundant contactor (normally closed)
- Control circuit fuse
- P1 - Auto - P2 alternating selector switch
- Lead pump failure pilot light & manual reset, lag pump start (automatic transfer to non operating pump in case of motor overload or short circuit)
- High pressure cut out - red pilot light & manual reset
- Low pressure cut out - red pilot light & override timers (2) (manual reset)
- High pressure alarm signal
- Low pressure alarm signal
- Low level alarm signal & red pilot light
- High level alarm signal & red pilot light
- Critical High Level Alarm Signal & red pilot light
- Provision to connect valve (each)
- Redundant Contactors (Back-up to Primary Contactors)
- Drip tray leak detection alarm signal & red pilot light

Important Notes: When quoting an electrical control panel for the DFO set, please check any Federal, State, or Local requirements under the electrical code. Consult our Applications Engineering Department at 1-866-VIK-PUMP for options not listed above.

Disclaimer: Any onsite modification needed to meet Federal, State, or Local electrical codes not specified on the order will be the responsibility of the Distributor or End-User and not Viking Pump, Inc. or Viking Pump of Canada Inc.

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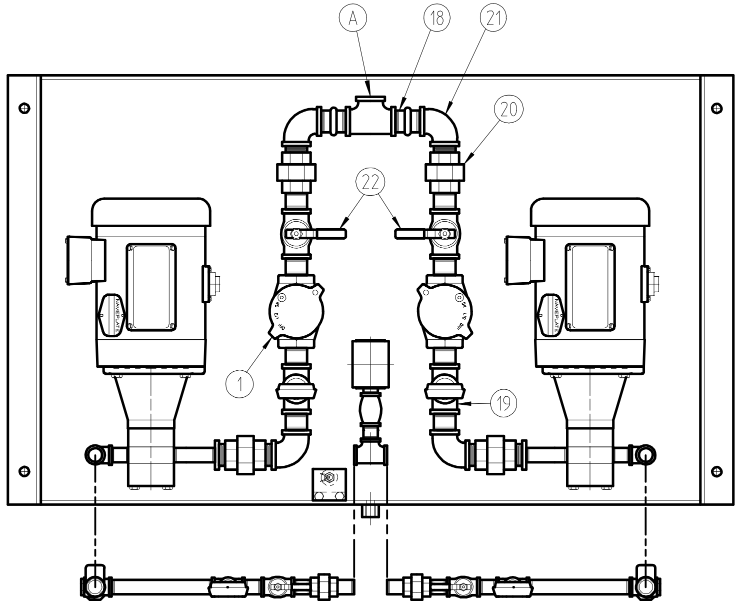
Note: Specifications subject to change without notice.

DIMENSIONAL DRAWING SG0510X-DUP-O DUPLEX UNIT

ITEM	DESCRIPTION
1	F1010 1.0" NPT LID EASE SIMPLEX BASKET STRAINER c/w 40 MESH S.S. BASKET
2	COMPOUND GUAGE 30"-0-30 PSI LIQUID FILLED 2.5" FACE X .25" NPT
3	PRESSURE GUAGE 0-100 PSI LIQUID FILLED 2.5" FACE X .25" NPT
4	FULFLO R.V. .50" NPT c/w GREEN-WS SPRING 30 - 100 PSI
5	.25" NPT X 1.5" PIPE NIPPLE
6	.25" NPT BALL VALVE
7	.50" NPT X 1.5" PIPE NIPPLE TBE
8	.50" NPT X 3.0" LONG NIPPLE
9	.50" NPT X 6.0" LONG NIPPLE
10	.50" NPT UNION
11	.50" NPT TEE
12	.50" NPT 90 DEG STREET ELBOW
13	.50" NPT CHECK VALVE
14	.50" NPT BALL VALVE
15	.50" MALE X .25" FEMALE NPT HEX REDUCING BUSHING
16	1.0" MALE X .25" FEMALE NPT HEX REDUCING BUSHING
17	1.0" MALE X .50" FEMALE NPT HEX REDUCING BUSHING
18	1.0" NPT X 2" PIPE NIPPLE
19	1.0" NPT TEE
20	1.0" NPT UNION
21	1.0" NPT 90 DEG STREET ELBOW
22	1.0" NPT BALL VALVE
23	PRESSURE SWITCH - DUAL STAGE
24	MAGNETIC FLOAT SWITCH

A	1.0" NPT COMMON SUCTION
B	.50" NPT COMMON DISCHARGE
C	.50" NPT DRAIN CONNECTION
D	9/16" DIA. 4-HOLES

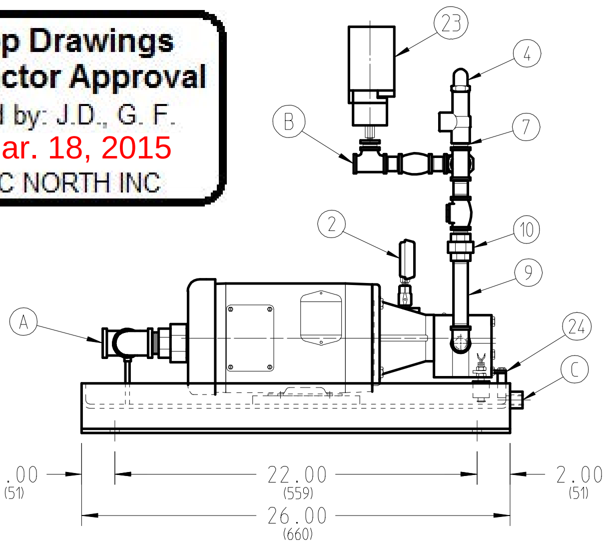
NOTES
1) PIPES AND NIPPLES ARE CARBON STEEL SCH.40
2) ALL MALLEABLE IRON FITTINGS AND STEEL PIPING ARE MANUFACTURED IN USA/CANADA
3) PUMP SET IS LEAK TESTED WITH 100 PSI AIR AND SOAPY WATER

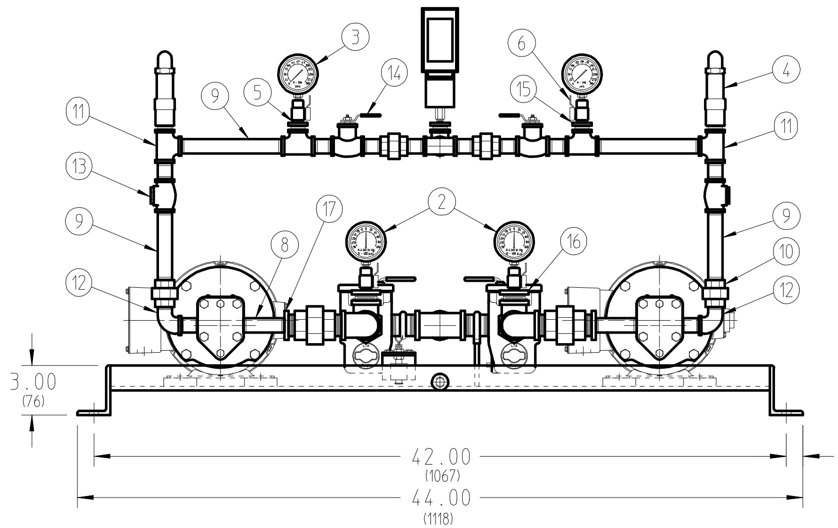


0.50 hp	1 ph 60 Hz 115 Volt	1150 rpm	56C Frame size

- Moteurs fermés et ventilés ("TEFC"), montés sur pieds, CSA, NEMA, moteur fractionel

Shop Drawings
Contractor Approval
Approved by: J.D., G. F.
Date: Mar. 18, 2015
SIFEC NORTH INC





Conditions de service:	Capacité			Pression:			Produit:	Viscosité	Température	
	2.5	9.4	0.16	10	0.69	68.9	No. 2 Fuel Oil	38	76	24
	USGPM	LPM	L/s	PSIG	Bar	kPa	SG 0.85	SSU	°F	°C

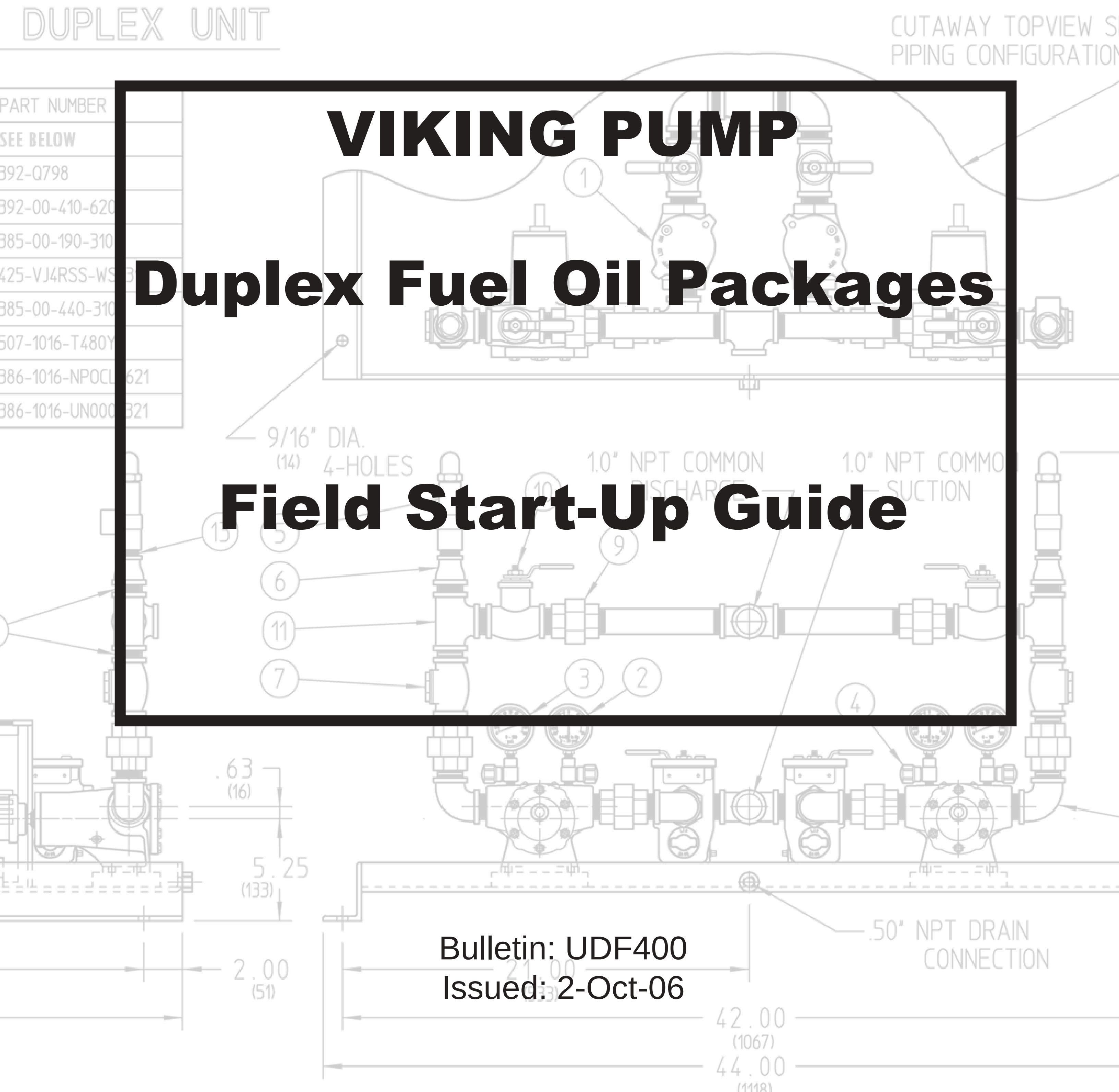
DIMENSIONAL DRAWING FOR VIKING DUPLEX FUEL OIL PACKAGE MODEL SG-0510X-DUP-O WITH SG-0510X PUMPS AND M DRIVE BRACKETS TO SUIT 56C FRAME MOTORS.

VIKING PUMP OF CANADA INC.
A Unit of IDEX Corporation
Windsor, Ontario N9A 6M3
CANADA

ARR. DRAWING | DRG. SIZE B

DRAWING NUMBER 800-SG-0510X-DUPLEX-O

VIKING PUMP



VIKING PUMP

Duplex Fuel Oil Packages

Field Start-Up Guide

Bulletin: UDF400
Issued: 2-Oct-06

IDEX CORPORATION

Before arriving on job site, make sure you have:

- ☐ A copy of the approved drawing or certified print of the Duplex Fuel Oil Pump Package
- ☐ A copy of the approved drawing of the Control Panel.
- ☐ Read all of the instructions, notes, and suggestions in this bulletin to become familiar with the start-up procedures. If you have any questions or require clarification please contact our systems specialist, Humberto Da Silva, P.Eng. at (905) 542-8906 ext. 204 (or North America toll free at 1-888-845-7867 ext. 0 and asked to be transferred)

When you arrive at the site confirm the following:

- ☐ Check the name plate rating on the Control Panel and compare with the incoming voltage and motor ratings.
- ☐ The compound gauge should be located on the pump suction or in the suction header (depending on pump size and duplex package configuration layout).
- ☐ The pressure gauge should be on the discharge of the pump or in the discharge header (depending on pump size and duplex package configuration layout).
- ☐ Examine the suction header and confirm that the arrow cast into suction strainer points toward the pump suction.
- ☐ Confirm the sales order number stamped on the serial number plate matches the packing slip. The serial number plate is typically located on the base plate of the unit.
- ☐ On the control panel confirm the voltage, phase, horsepower, certifications and part number stamped on the serial number plate located on the door of the panel match the specifications. Do not open the panel door.

Observations to be made on site:

General Installation

- ☐ The package should be anchor to the ground to prevent movement. If the unit is mounted on a shelf it should be properly bolted.
- ☐ All piping (suction, discharge and relief return lines) should be externally supported to prevent pipe stresses being transferred to the unit. Ideally flexible connections should be used.

Suction Piping

- ☐ If possible follow the suction pipe to the supply tank. The suction line should go around obstacles instead of over them. This is to prevent air lock (the system will not prime if the suction line is air locked).
- ☐ If there are any valves on the suction line they should be in the open position.
- ☐ With long suction pipe there should be a hand operated pump to evacuate the air from the suction line. This pump should be piped parallel to the duplex package.
- ☐ The relief valves piping can not be piped back into the suction piping. Both valves can be piped to a common pipe. But that pipe has to be piped back to the supply tank. There should not be any other valves in this line. If there is any they should be always in the open position.

Discharge Piping

- ☐ The discharge will be piped into a day tank or directly into the diesel generator or boiler depending on the installation.
- ☐ If possible follow the discharge pipe. If there are any valves on the discharge line they should be in the open position.
- ☐ Take a look at the day tank. There should be the line from the duplex pump unit, overflow and floats.

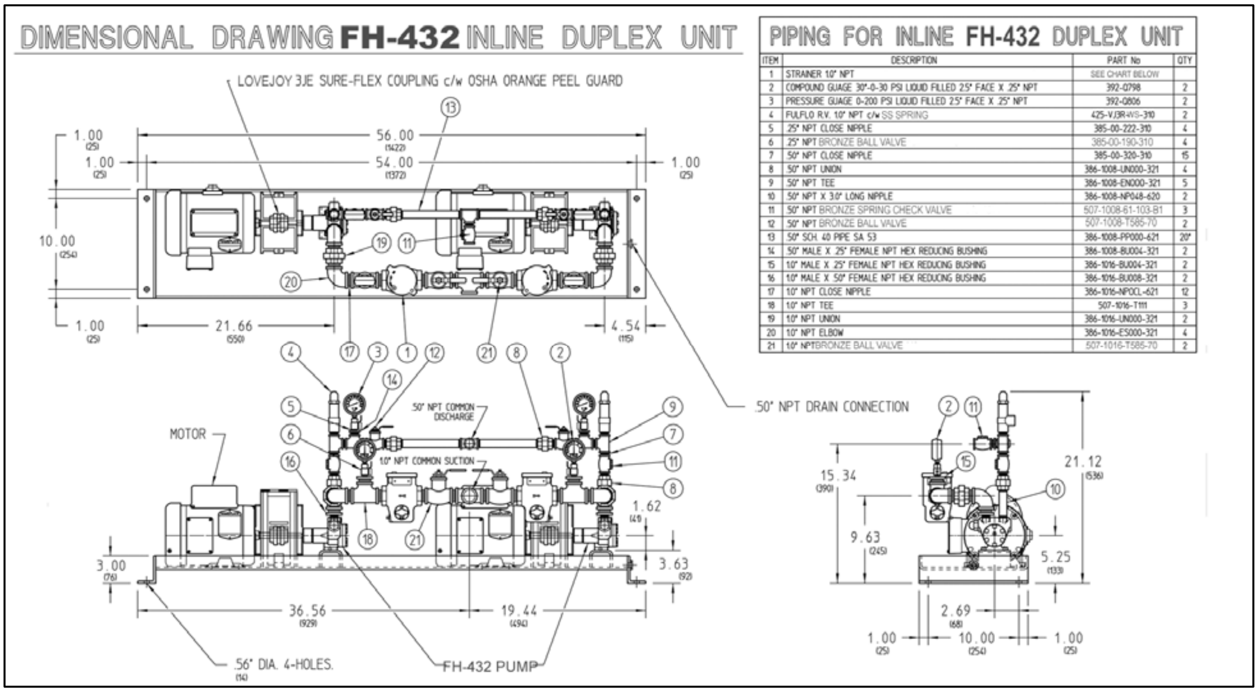


Fig. 1 – Typical F-432 & FH-432 Layout

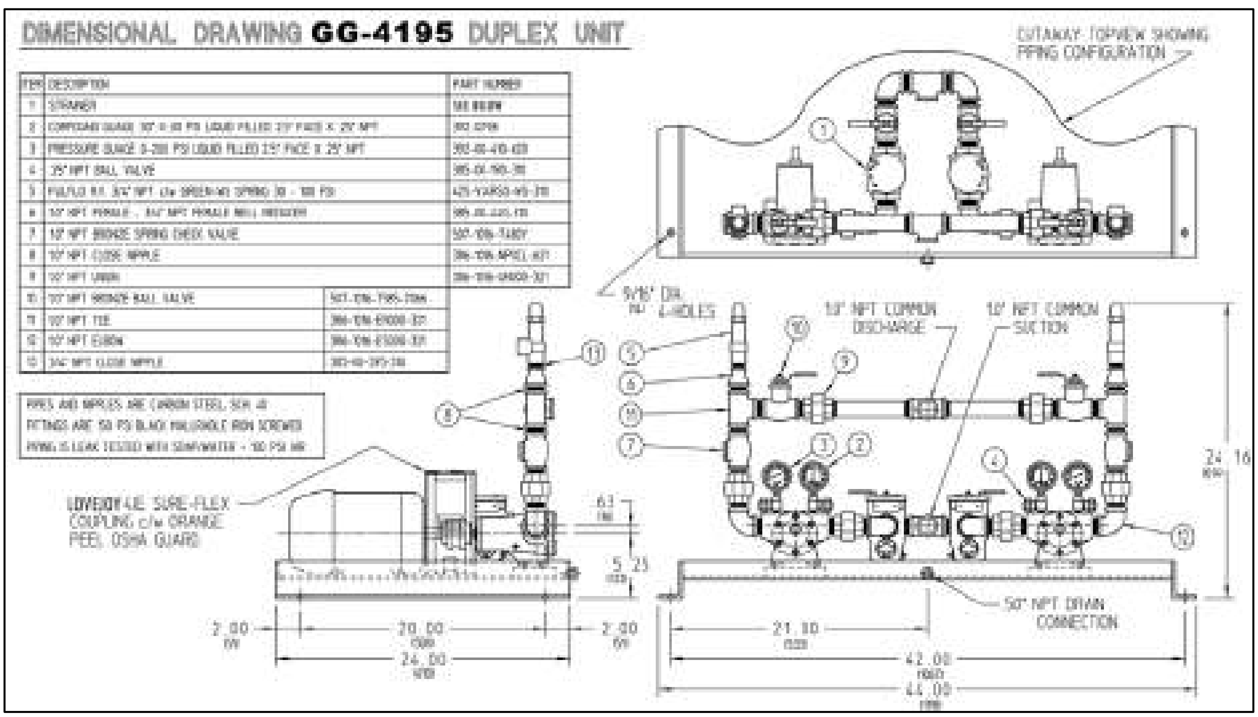


Fig. 2 – Typical Series 4195 & Spur Gear Layout

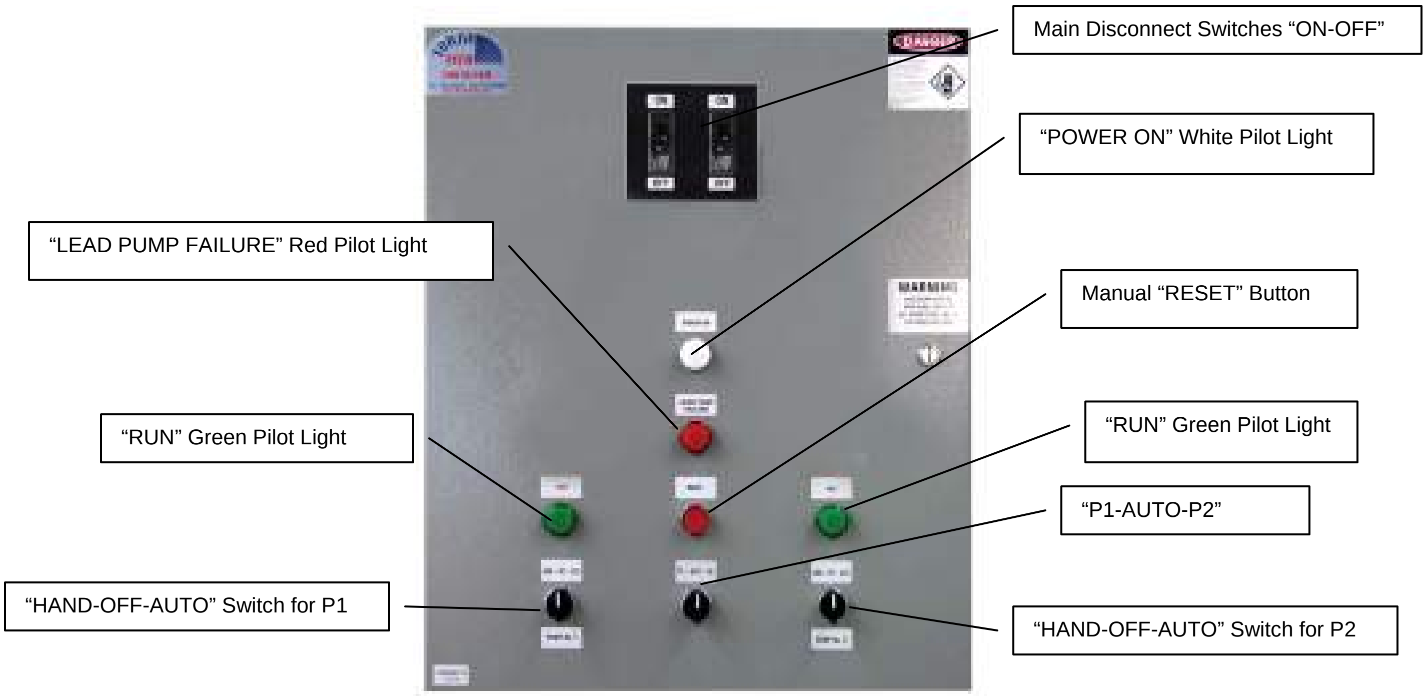


Fig. 3 – Typical Control Panel Cover

Priming the Duplex Fuel Oil Package:

1. On the Control Panel make sure both the Main Disconnect “ON-OFF” switches are in the “OFF” position (power off).

2. Take a look at the suction gauge to see if there is any pressure on the suction line. If there is pressure and the application is not a flooded suction the suction line is pressurized. Carefully remove the drain plug from the basket strainer to release the compressed air.

3. Turn the four ball valves connected to the pressure gauges (suction & discharge gauges) to closed position.

4. Remove the thumbscrew from top of the lid of the basket strainers, rotate the lid counter clockwise until the pin hits and stops, and then remove lid.

5. Open the suction valves.

6. Fill the strainers with diesel (the suction valves should be in open position, as you fill one strainer the liquid level will flow in the other strainer).

7. Reinstall the lid with the tab of the lid just to the left of the boss with the body, rotate the lid clockwise until the holes line up, and reinsert the thumbscrew.

8. Both the suction and discharge ball valves should be in open position.

9. On the Control Panel, turn the “Hand-Off-Auto” selector switches to “Off” position for both P1 and P2.

10. Turn both the Main Disconnect “On-Off” switches to “ON” position (power on).

11. Turn the “P1-Auto-P2” switch to “P1” position.

12. Have some one observe the motor fan for the next operation.

13. For P1 turn “Hand-Off-Auto” selector switch to “Hand” position and P1 will start.

14. After approximate 3 seconds turn the “Hand-Off-Auto” selector switch for P1 back to “Off” position.

15. Confirm that the motor fan had spun in the proper rotation. If the motors are not rotating properly have an electrician switch the motor leads and check again the rotation of the motors.

16. Repeat steps 11 to 15 for P2.

17. Turn the four ball valves connected to the pressure gauges (suction & discharge gauges) to the open position.

18. For P1 turn “Hand-Off-Auto” selector switch to “Hand” position and P1 will start.

19. Observe the suction compound gauge; it should start pulling a vacuum. The discharge gauge will read 0 psi. Run P1 for no more than 2 minutes then turn it off. Place you hand on the pump (around the seal area) and if it starts heating up, turn off the pump to prevent mechanical seal failure.

20. When the pumps are primed and pumping the discharge gauge will show a positive pressure.

NOTE: If the suction line is long you may have to refill the basket strainer again. Before this is done the suction valves will have to be in the closed position, other wise the vacuum will be lost. Then alternate running P1 and P2 in manual mode.

NOTE: Some local codes specify a anti-siphon valve to be installed on the suction line. It is usually installed close to the main supply tank. In some cases this valve will prevent the pumps from priming. If the pumps don’t prime after a few attempts ask the contractor to loosen the spring in the anti-siphon valve and then after the pumps are primed the spring can be set in order to meet local codes.

NOTE: If the installation has a flooded suction, turn the suction and discharge valves to the open position. The suction pressure gauge should show a positive pressure. If it doesn’t follow the suction line to the supply tank and see if all the valves are open. If all the valves are open and the pressure gauges don’t read a positive pressure there a blockage in the line. The blockage will have to be cleaned before running the pumps.

CONTROL PANEL

- Check the name plate rating of the Control Panel and compare with the incoming line voltage and the motors ratings.
- Adjust overload relay setting to full current rating
- Check that motor protector push actuator(s) is (are) in start position.
- Check that float switches are adjusted to the desired levels
- Check that the controller is properly connected to the pump motors
- If motors are rotating in the proper direction (as checked in steps 10 to 16 under Priming section), and all the above checks out correctly, turn the “Hand-Off-Auto” switches for both P1 and P2 to the “Auto” position.
- Activate float switches manually and test if the pumps start and stop at desired levels.
- Once the level falls below the start lead pump level float switch FL2 (as shown in diagram under Float Controls), the pump motor is energized and the lead pump starts pumping fuel into the tank.
- If the lead pump has failed and the level falls below FL2 start lead pump level float switch, the “Lead Pump Failure” red pilot light is turned on and the lag pump motor is energized so that the lag pump keeps pumping fuel into the fuel tank.
- In order to turn off the “Lead Pump Failure” red pilot light, the manual “Reset” red pushbutton must be pressed.
- Once the level reaches the stop all pumps level float switch FL3, the pump motors are de-energized and the pumps stop.
- If the alternation selector switch “P1-Auto-P2” is in the “Auto” position, the stop all pumps float switch FL3 triggers the alternator and reverses the order of the lead and lag pumps. For example, if P1 was the lead pump before the trigger, P2 will become the lead pump after the trigger.

RELIEF VALVES

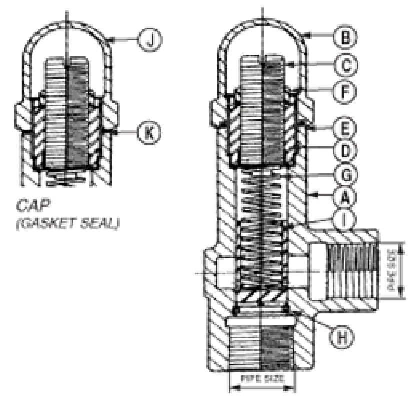
Checking Relief Valves Current Setting

1. With the pump running notice the reading on the discharge pressure gauge.
2. Slowly close the discharge ball valve.
3. Operate only one pump at a time in manual mode.
4. The reading on the discharge pressure gauge will increase.
5. Make a note of the pressure reading when the valve is fully closed; this value is the pressure relief valve setting. It should be approximate 15 to 20 psi greater than the specified pump discharge pressure.
6. Open the discharge valve and turn the pump off.
7. If the pressure relief setting in satisfactory, repeat for the other pump.

Setting the Pressure Relief Valves

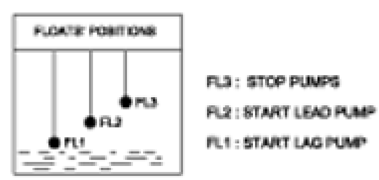
1. Turn the “Hand-Off-Auto” switches to “OFF” for both P1 and P2.
2. Remove the cap (item J) of the pressure relief valve for pump P1.
3. Loosen the lock nut (item F)
4. Turn the adjusting screw (item C) clockwise to increase the pressure setting or counterclockwise to decrease the pressure setting
5. Tighten the lock nut (item J)
6. Reinstall the cap (item B) onto the valve.
7. Turn the “Hand-Off-Auto” switch for P1 to “HAND” position.
8. Slowly close the discharge ball valve for P1. If the pressure relief setting is not satisfactory repeat the operation to adjust the adjusting screw.
9. Repeat steps 1 to 8 for pump P2.

SYM.	NAME
A	BODY
B	CAP (O-RING SEAL)
C	ADJUSTING SCREW
D	RETAINER
E	O-RING †
F	LOCK NUT
G	SPRING †
H	STOP RING
I	PISTON †
J	CAP (GASKET SEAL)
K	GASKET †



FLOAT CONTROLS

The standard duplex control panel contains NC relays to operate three float switches (switches supplied by others) for the day tank. If more than three floats are required, the control panel would have to be ordered with optional NC relays.



The top float (FL3) stops both pumps, the middle float (FL2) starts the lead pump and the bottom float (FL1) starts the lag pump.

It may not be practical to fill the day tank to test the operation of the panel. A simpler way is to have the electrician simulate the open and closing contacts of the floats to check the operation sequence. This procedure can be used to check the high and low level alarms (if supplied) in the panel. The electrician can check the conductivity of the float (normally open or normally closed) to see if they are the same as specified. In some cases there is no day tank and the pump duplex unit pumps directly into the diesel generator or boiler. The panel will receive the signal from the generator and start the lead pump.

PRESSURE SWITCHES

If the duplex unit is supplied with pressure switches (either single or dual stage) they will be installed on the discharge line. The pressure setting will be factory set, but they are field adjustable.

To simulate a low pressure condition on the discharge line, have the control panel on automatic mode and then close the discharge valve of the pump running. The relief valve will open and the pumping liquid will return to the supply tank. The pump will shut down and a red light will come on the panel, the time will be that is set on the timer.

It is difficult to simulate an actual high pressure shut down. Have the electrician simulate by open or closing the contacts in the control panel.

Field adjustment of the pressure setting can be done by the following:

Single Stage Pressure Switch – Square D – 9012-GNG2
- See UDF400-1 Single Stage Pressure Switch.pdf

Dual Stage Pressure Switch – ASCO – SC10D-TG10A21
- See UDF400-2 Dual Stage Pressure Switch.pdf

FLOW SWITCHES

If the duplex unit is supplied with a flow switch it will be installed on the discharge line. To simulate a low flow condition on the discharge line, have the control panel on automatic mode and then close the discharge valve of the pump running (either P1 or P2). The relief valve will open and the pumping liquid will return to the supply tank. Within a few minutes (usually 1 to 3 minutes) based on the time set on the timer, the control panel will start the other pump and the “Low Flow” Signal red lights (optional equipment required for installation of low flow switch) will light up on the panel.

SQUARE D Instruction Bulletin

UDF400-1 Single Stage Pressure Switch

Industrial Pressure Switches
Type/Tipo/Typ
Class/Classe/Klasse 9012

Adjustable Differential: GNO, GNG, GPO, GPG, GQO, GQG
Non-adjustable Differential: GRO, GRG, GSO, GSG, GTO, GTG
Series B

USE LIMITATIONS

Pressure Ratings

NOTE

If the pressure actuators are exposed to system or surge pressures greater than the maximum pressure rating printed on the device nameplate, leakage from the actuator and/or a change of operating set points may result.

Maximum Allowable Pressure is the maximum pressure, including surges, to which an actuator of the pressure switch may be exposed for brief or extended periods of time without altering the performance characteristics of the switch. For types GNO, GNG, GRO, GRG periodic retorquing of actuator mounting screws to 8-10 in-lb is recommended.

NOTE

Pressure on a switch during use should be within the stated range of the switch. For maximum mechanical life, maximum system pressure applied on a continual basis, including surges, should not exceed maximum stated range. The mechanical life of any diaphragm actuated switch will be decreased if pressure exceeds the stated maximum range value. The more frequent the application and the greater the value of excessive pressure, the more diaphragm life will be decreased.

Temperature Ratings

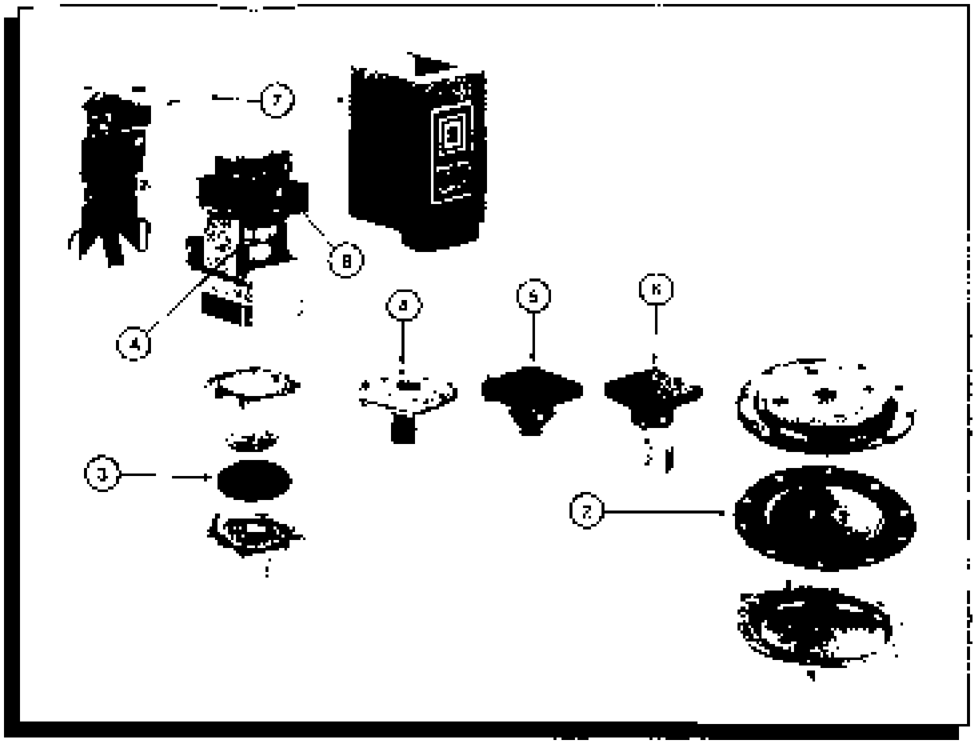
These devices are continuous use rated as below, provided that the media fluid does not freeze and the conditions of application do not give rise to the formation of frost or ice inside the pressure switch.

Table 1

	Ambient C	Ambient F	Pressure Media C	Pressure Media F
Minimum	-25	-10	-25	-10
Maximum	+85	+185	+120	+250

Use on Steam

Do not use directly on steam in excess of 15 psig (1 bar). Indirect use may be accomplished by attaching a minimum of 10 feet of capillary tubing between the steam source and the actuator. Class 9049 A7 is recommended. This permits use on steam up to 250 psig (17 bars) subject to maximum allowable pressure and temperature ratings of the switch.



⚠ WARNING

HAZARDOUS VOLTAGE
CAN CAUSE SEVERE INJURY OR DEATH

To reduce the hazard of electrical shock always disconnect power from the circuit before installing the pressure switch or exposing the electrical terminals for maintenance.

Per ridurre il pericolo di infortuni da shock elettrico, prima di installare l'interuttore a pressione o primi di accedere ai terminali per manutenzione togliere sempre tensione dal circuito.

Um die Gefahr von Stromschlägen zu mindern, vor Einbau das Druckwächters oder Offnen das Klemmendeckels zu Wartungszwecken die Versorgungspannung abschalten.

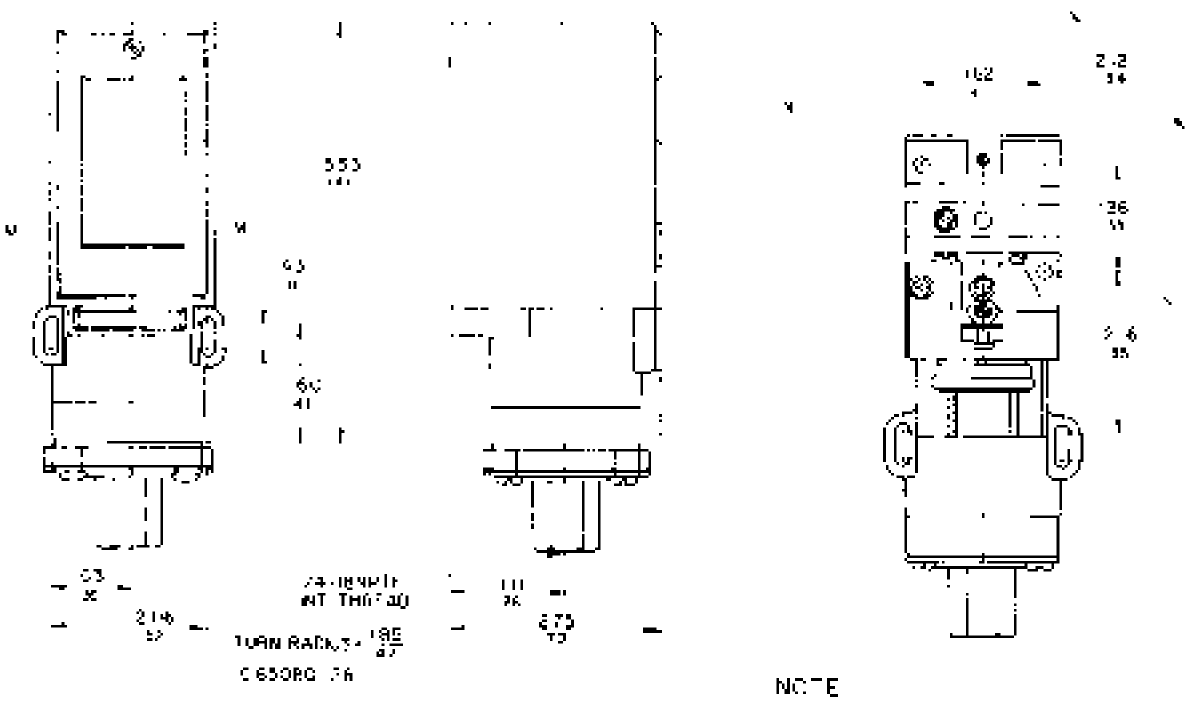
Avant toute intervention sur ce material, couper l'alimentation electrique de l'appareil afin d'eviter tout risque d'electrocution.

ANTES de instalar el interruptor a presion o ANTES de exponer las terminales electricas para daries maintenimiento, DESCONECTE LA ENERTIA y reduzea el peligro de una sobrecarga electrica.

MOUNTING

It is not recommended to mount the switch by its pressure connection only. The holes and slots identified as "M" or "N" are for surface mounting the switch. When connecting the switch to the pressure system piping, turn the switch onto the pipe using a wrench on the hexagonal body of the actuator. Do not apply leverage through the switch housing.

For type GNO, GNG the standard pressure connection is 1/4-18 NPTF; the dry seal thread should seal against a new external 1/4 NPT thread without the use of sealing tape or compounds. Alternate pressure connections include: Form Z for GNO, GNG, GRO, GRG only which is 1/4-18 NPT external thread, Form Z16 for GNO, GNG, GRO, GRG only is 1/2-14 NPT external and 1/4-18 NPTF internal thread. Form Z18 for all GNG, GRG is 7/16-20 UNF-2A.



NOTE

Do not plug the 1/4 inch diameter holes on types GPO, GPG, GSO, GSG.

WIRING

Class 9012 Type G pressure switches are suitable for #12, 14, 16 AWG or 1.0-2.5mm solid or stranded copper wire. Tighten terminal screws to 6-9 in-lbf (0.7-1 Nm). They are not suitable for use with aluminum wire. For enclosed types GxG grounding (earthing) provision is located above the snap switch on the enclosure backplate and is marked (⏚).

The single pole, double throw snap switch contains single break contacts offering one normally open circuit and one normally closed circuit. These circuits are electrically separate but are not for use on circuits of opposite polarity. For proper wiring, refer to the wiring diagram on the snap switch or the terminal identification on the snap switch.

SET POINT ADJUSTMENTS

The pressure switch is set at the factory to the operating point(s) marked on the outside of the mechanism housing. It is good practice to cycle the switch to determine actual operating points before proceeding with readjustment. Refer to the illustration on page 2 for location of adjustment.

Range Adjustment

For non-adjustable differential types GRO, GRG, GSO, GSG, GTO, GTG
The range adjustment may be used to set either set point and completes the adjustment sequence. To increase the operating points, with the switch mounted as shown in the illustration on page 2 and facing the switch, place a flat bladed screwdriver in the slots of range adjustment nut (A) and rotate from right to left.

For adjustable differential types GNO, GNG, GPO, GPG, GQO, GQG
The range adjustment is used to set the decreasing set point and must be made first. This adjustment is made in the same manner as for non adjustable differential types.

Differential Adjustment

For types GNO, GNG, GPO, GPG, GQO, GQG

An independent adjustment of the set point on increasing pressure is available. This adjustment must be performed after the decreasing pressure set point has been adjusted. Turn adjusting screw (B) clockwise to raise the set point on increasing pressure. The decreasing pressure set point is not affected by this adjustment.

REPLACEMENT PARTS

Note: When ordering any of these replacement parts, Class, Type, and Form of switch on which the replacement is to be used must be specified with the order.

Table 2

Item	Description	Class	Order Type	Form	Used On
2	Diaphragm Assembly	9998	PC 265		GNO, GNG, GRO, GRG-1
3	Diaphragm Assembly	9998	PC 266		GNO, GNG, GRO, GRG-3
		9998	PC 267		GNO, GNG, GRO, GRG-4
4	Diaphragm Assembly	9998	PC 268		GNO, GNG, GRO, GRG-5
		9998	PC 269		GNO, GNG, GRO, GRG-6
5	Diaphragm Actuator Assy	9998	PC 177		GPO, GPG, GSO, GSG-1
		9998	PC 176		GPO, GPG, GSO, GSG-2
6	Piston Actuator Assy	9998	PC 270		GQO, GQG, GTO, GTG-1
		9998	PC 271		GQO, GQG, GTO, GTG-2
		9998	PC 272		GQO, GQG, GTO, GTG-3
		9998	PC 273		GQO, GQG, GTO, GTG-4
7	Enclosure Assembly	9049	DE-1		Converts Type GTO to GTG

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PLEASE NOTE:

Electrical equipment should be serviced only by qualified electrical maintenance personnel, and this document should not be viewed as sufficient instruction for those who are not otherwise qualified to operate, service or maintain the equipment discussed. Although reasonable care has been taken to provide accurate and authoritative information in this document, no responsibility is assumed by Square D for any consequences arising out of the use of this material.

UDF400-2
Dual Stage Pressure Switch

Installation & Maintenance Instructions

ASCO® TRIPOINT® SWITCH UNITS

TWO-STAGE DUAL ADJUSTMENT SWITCH UNIT WITH GENERAL PURPOSE, WATERTIGHT, OR EXPLOSIONPROOF SWITCH ENCLOSURE

SC-SERIES

Form No.V5736R2

DESCRIPTION

The SC-Series Two-Stage Dual Adjustment Switch Units are used with transducer units to make Tripoint Pressure Switches or Temperature Switches. The switch units are made of aluminum alloy and designed for rugged industrial use. The switch units have a general purpose, watertight, or explosionproof enclosure. All wiring terminals, adjustments, and visual scales are accessible from the front of the switch.

The switch may be supplied as a complete unit or with the switch unit and transducer completely assembled. The components may be separate units to be assembled upon installation. There are two electrical snap switches with independently adjustable actuation (set)points, adjustable over the full range of the switch. The reactuation(reset) point of each electrical snap switch is fixed with respect to the actuating point setting for that switch. The switch assembly can be mated with a wide selection of pressure or temperature transducers to cover a broad range of pressures, fluids, or temperatures. The switch will control electrical circuits in response to changes in pressure or temperature.

IMPORTANT: These instructions cover the installation and use of this switch on pressure and temperature transducers. Select the paragraphs that apply to your particular installation and application. The word *signal* is used in place of pressure or temperature changes.

INSTALLATION

Check the nameplate for the correct catalog number, pressure range, temperature range, media, and proof pressure or temperature. Never apply incompatible fluids or exceed the pressure or temperature rating of the switch. Installation and inspection to be performed by qualified personnel.

Nameplates are located on cover and on the bottom of the transducer. Check to be sure the third digit in each number is the same. If not, the unit should not be used. (Refer to Figure 3).

IMPORTANT: All internal adjustments have been made at the factory. Any adjustment, alteration or repair to the internal parts of the switch other than stated herein voids all warranties. The signal setting adjustments required are made by the adjusting nut on the outside of the switch

Temperature Limitations

Ambient temperature limits are $-4°F(-20°C)$ to $140°F$ $(60°C)$. To determine fluid temperature limitations, see form No.V5794 for Pressure Transducer catalog numbers and construction materials, then refer to chart below.

TRANSDUCER CONSTRUCTION MATERIALS	RATINGS FLUID TEMPERATURE
Buna N or Neoprene	-4°F(-20°C) to 179°F(82°C)
VITON*	-4°F(-20°C) to 250°F(121°C)
316 Stainless Steel	-50°F(-45°C) to 300°F(149°C)

For steam service, the fluid temperature with a pigtail (siphon tube or condensate loop) installed directly into the transducer will be below 179°F (82°C).

Assembly of Switch and Transducer Units

IMPORTANT: The switch unit and transducer unit may be provided as a complete assembly or as separate units. If separate units are provided refer to Form No. V5794 for a complete listing of switch unit and transducer unit combinations. Form No.V5794 is provided to ensure that the proper switch unit is assembled to the proper transducer unit. Pay careful attention to exploded views provided in Figure 3 for assembly of switch unit and transducer unit. Proceed in the following manner:

⚠ **CAUTION: The third digit in the catalog number on both the switch unit and transducer unit must be identical. If not, do not assemble to each other. If the same proceed.**

1. Remove special instructions label and switch range scales from transducer unit.
2. For watertight and explosionproof construction place gasket on base of switch unit.
3. Place transducer unit on base of switch unit and assemble. Insert four bolts and torque bolts in a crisscross manner to 80 ± 10 in-lbs [9.0 ± 1,1 Nm].
4. Remove backing paper from range scale and install scale on the switch body behind adjusting nut. The scale is slotted to fit over a raised boss on the body. See Figure 1.

Positioning

Switch may be mounted in any position.

Mounting

Figure 1 shows partial view of switch body for mounting dimensions.

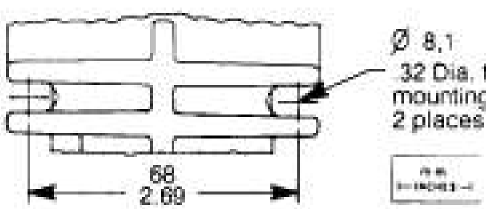


Figure 1. Mounting locations

Piping/Tubing (Pressure Transducer)

Adequate support of piping and proper mounting of switch should be made to avoid excessive shock or vibration. To minimize the effect of vibration on a switch, mount perpendicular to vibration. Connect piping or tubing to switch at base of transducer. It is recommended that flexible tubing be used whenever possible. Apply pipe compound sparingly to male pipe threads only. If applied to female threads, it may enter the transducer and cause operational difficulty. Avoid pipe strain on switch by properly supporting and aligning piping. When tightening pipe, do not use switch as a lever. Wrenches applied to transducer body or piping are to be located as close as possible to connection point.

IMPORTANT: For steam service, install a condensate loop (pigtail or steam syphon tube) directly into the pressure transducer.

⚠ **CAUTION: To avoid damage to the transducer body, DO NOT OVERTIGHTEN PIPE CONNECTIONS. If TEFLON* tape, paste or similar lubricant is used, use extra care due to reduced friction.**

IMPORTANT: To eliminate undesirable pressure fluctuations in the system, install a surge suppressor.

*DuPont's Registered Trademark

Wiring

Wiring must comply with local codes and the National Electrical Code. All switch enclosures are provided with two 3/4" NPT conduit hubs with one plugged when not in use. It is recommended that a flexible conduit connection be used. If rigid conduit is used, do not consider it or use it as a means of support (mounting). For general purpose and watertight construction, the switch cover is removed by loosening two screws then twisting slightly and lifting. For explosionproof construction, the cover unscrews. When explosionproof cover is replaced, torque cover to 135 ± 10 in-lbs [15,3 ± 1,1 Nm]. Use No. 14 AWG copper wire rated for 60°C minimum. All switches have a grounding screw and clamp in the enclosure. For factory wired switch, black lead is common, red lead is normally open, blue lead is normally closed, and the green lead wire is a ground.

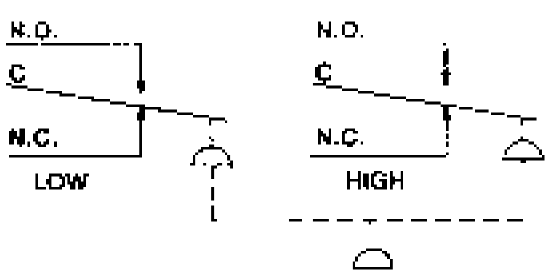
IMPORTANT: Electrical load must be within range stated on nameplate. Failure to stay within the electrical range of the switch rating may result in damage to or premature failure of electrical switch.

CAUTION: Do not exert excessive screw driver force on snap switch when making terminal connections. When connections are made, be sure there is no stress on the wire leads. Either condition may cause malfunction of switch.

ELECTRICAL RATINGS		
Switch Unit	Ratings for Limit Controls and Pressure Operated Switches	Ratings for Industrial Controls and [illegible] and Regulating Equipment
Standard Switch Rating	5 Amps Res. 125/250 VAC 1/8 HP 125 VAC 1/4 HP 250 VAC 0.4 Amp Res. 125 VDC	10 Amps Res. 125 VAC 10 Amps Res. 250 VAC 1/8 HP 125 VAC 1/4 HP 250 VAC 0.5 Amp Res. 125 VDC 0.4 Amp Res. 250 VDC

Schematic

SPDT



INSTALLATION OF TEMPERATURE TRANSDUCERS

Direct Probe

The direct probe type temperature transducer is provided with 1/2" NPT connection. When installing, do not use switch unit as a lever for tightening. Use wrenching flats provided at base of transducer for tightening.

Capillary and Bulb

The capillary and bulb or remote temperature transducers are provided with a length of capillary and a 3/8" diameter sensing bulb.

CAUTION: Do not bend capillary at sharp angles. For proper operation, be sure sensing bulb is completely immersed in fluid and not in contact with heating element or anything that would directly affect the temperature of the fluid being sensed.

Thermal Well (Optional Feature)

A thermal well may be used for capillary and bulb (remote) or direct probe (local) temperature transducers. The thermal well affords protection for the sensing bulb and allows removal of the sensing bulb while maintaining a pressure tight vessel. When installing sensing bulb in thermal well, be sure that it is fully inserted. Where a thermal well already exists, gland nuts may be obtained to adapt the capillary and bulb to the existing thermal well. The existing thermal well must be for a 3/8" diameter sensing bulb.

Union Connector (Optional Feature)

A union connector will allow direct mounting of the sensing bulb in the fluid being controlled. It will allow into piping connection for line tightening [illegible]. For maximum performance, the bulb should be inserted in the union connection so that the end of the sensing bulb is even with the end of the union connector nut. Do not apply excessive torque when tightening union connector nut.

Adjustment (Signal Setting) of Two–Stage Dual Adjustment Switch

To make adjustments (signal settings) a 7/16" wrench and a pressure or temperature gage (within scale ranges) are required. If electrical connection (in line of final application) of the switch is not desirable, a battery powered test lamp or ohm meter may be used. Pressure or temperature range scales should be used for initial signal setting. These will be accurate within 5%. Loosen lock ring and turn adjusting nut until red line is even with the desired range. For exact signal setting, proceed as follows:

WARNING: To prevent the possibility of personal injury or property damage, turn off electrical power when making permanent electrical connections to switch.

Adjustment (Signal Setting) of Normally Closed or Normally Open Switch, *Increasing Signal* (Refer to Figure 2)

1. If the switch is in the line of final application when adjustment (signal setting) is made, be sure switch can be test operated without affecting other equipment.
2. Loosen lock ring on adjusting nut and turn low signal adjustment nut full upwards and high signal adjustment full down using a 7/16" wrench.

CAUTION: Adjusting nut will turn easily until it hits a stop. Do not over torque; over torqueing may cause internal damage resulting in malfunction.

3. Remove switch cover to gain access to snap switch. See section on Wiring for cover removal.
4. Follow the steps in the chart below to make signal setting:

Adjustment Procedure	NORMALLY CLOSED		NORMALLY OPEN	
	Switch Terminal	Test Lamp On-Off	Switch Terminal	Test Lamp On-Off
1. Starting at zero signal, connect test lamp to [illegible]	NC	On (Closed Circuit)	NO	Off (Open Circuit)
2. Apply desired actuation signal. Then [illegible] off [illegible] adjusting nut until switch actuates	NC	Off (Open Circuit)	NO	On (Closed Circuit)
[illegible] desired deactuation signal	NC	On (Closed Circuit)	NO	Off (Open Circuit)

5. Cycle between signal settings and make minor adjustments to adjusting nuts as required to achieve the exact signal setting.
6. After setting has been made, make permanent electrical connections.

ASCO Valves ASCO
ASCOLECTRIC Limited [illegible]

Adjustment (Signal Setting) of Normally Closed or Normally Open Switch, *Decreasing Signal*
(Refer to Figure 2)

1. If the switch is in the line of final application when adjustment (signal setting) is made, be sure switch can be test operated without affecting other equipment.

2. Loosen lock ring on adjustment nuts and turn low signal adjustment nut full upwards and high signal adjustment nut slightly beyond desired actuation setting using a 7/16" wrench.

⚠ CAUTION: Adjustment nut will turn easily until it hits a stop. Do not over torque; over torquing may cause internal damage resulting in malfunction.

3. [illegible] wiring for cover removal.

4. Follow steps in chart below to make signal setting.

Adjustment Procedure	Normally Closed		Normally Open	
	Switch Terminal	Test Lamp On-Off	Switch Terminal	Test Lamp On-Off
1. Start signal [illegible] above desired actuation setting, connect test lamp to common.	NC	Off Open Circuit	NO	On Closed Circuit
2. Decrease signal to desired actuation signal. Then advance adjusting nut until switch actuates.	NC	On Closed Circuit	NO	Off Open Circuit
3. Increase signal to check deactuation signal.	NC	Off Open Circuit	NO	On Closed Circuit

5. Cycle between actuation and deactuation signals and make minor adjustment to adjusting nuts as required to achieve the exact signal settings.

6. After settings have been made, tighten lock rings and make permanent electrical connections.

Testing of Installation

If the adjustment of the switch has been made outside of the line of final application, the switch should be re-tested when installed in the line of final application. Follow adjustment instructions. Be sure switch can be test operated without affecting other equipment.

MAINTENANCE

⚠ **WARNING: To prevent the possibility of personal injury or property damage, turn off electrical power and depressurize switch unit before inspection or removal.**

IMPORTANT: Switch is not field repairable. The switch must be returned to the factory (Automatic Switch Company, Florham Park, New Jersey) or serviced only by an authorized factory representative. Address all service inquiries to Automatic Switch Company, 50-60 Hanover Road, Florham Park, New Jersey 07932, Valve Service Department. The only maintenance which may be performed on the two stage dual adjustment switch is changing the setting of the adjusting nut and replacement of the transducer unit. Replacement of transducer should be done only if external leakage is evident.

Preventive Maintenance

- While in service, operate the switch (cycle between desired signals) at least once a month to insure proper operation. If necessary, electrical wiring and pipe connection should be made so that switch can be test operated without affecting other equipment.

- Periodic inspection of the switch external surfaces only should be carried out. Switch should be kept clean and free from paint, foreign matter, corrosion, icing, and freezing conditions.

- Keep the medium entering the transducer as free as possible from dirt and foreign material.

Causes of Improper Operation

Switch will not actuate or actuates and [illegible].

- **Incorrect Electrical Connection:** Check leads to switch. Be sure they are properly connected. Switch is marked NO for Normally Open, NC for Normally Closed and C for Common.

- **Faulty Control Circuit:** Check electrical power supply to switch. Check for loose or blown fuses, open-circuited or grounded wires, [illegible].

- **Incorrect Pressure:** Check pressure in system with suitable pressure gage. Pressure must be within range specified on nameplate.

- **Incorrect Adjustment:** Check adjustment nut for correct setting. Refer to adjustment instructions.

- **External Leakage:** Check to see that [illegible] pressure switch are properly torqued [illegible] is properly tight and leakage [illegible]. Refer to paragraph on *Assembly of Switch Case and Transducer Unit*.

- **Excessive Vibration or Surges Causing Switch to Actuate and Deactuate.** Check for pressure surges in system and install pressure surge suppressor. Check switch mounting and be sure there is no excessive vibration.

- **Incorrect Temperature:** Check temperature of system with suitable thermometer. Temperature must be within range specified on nameplate. Check location of capillary and bulb for incorrect mounting. Refer to paragraph on *Installation Of Temperature Transducer*.

If the operation of the switch cannot be corrected by the above means, the entire switch unit should be replaced or an authorized factory representative consulted.

Color Code Identification

[illegible] the color of the sealant used on the locknuts of the snap switch. The color of the sealant will correspond directly to the third digit of the switch catalog number.

Third Digit In Catalog Number	Sealant Color Used In Snap Switch Locknuts
1	Yellow
2	Green
3	Red
4	Blue

Example: If the sealant color on the snap switch was red, this would mean that the third digit in the pressure switch catalog number would be 3, possibly SC[illegible]. It would not be, for example: SC[illegible], SC[illegible], or SC[illegible].

FOR SERVICE, REPLACEMENT, OR NEW TRANSDUCER
Consult Factory or Authorized Factory Representative or Distributor

ORDERING INFORMATION

For Two-Stage Dual Adjustment Switch or New Transducer
When Ordering, Specify Catalog Numbers, Fluid, Pressure Range,
Temperature Range, Serial Numbers, and Proof
Pressure or Rated Overrange Temperature

NAMEPLATES ARE LOCATED ON SWITCH COVER AND BOTTOM OF TRANSDUCER.

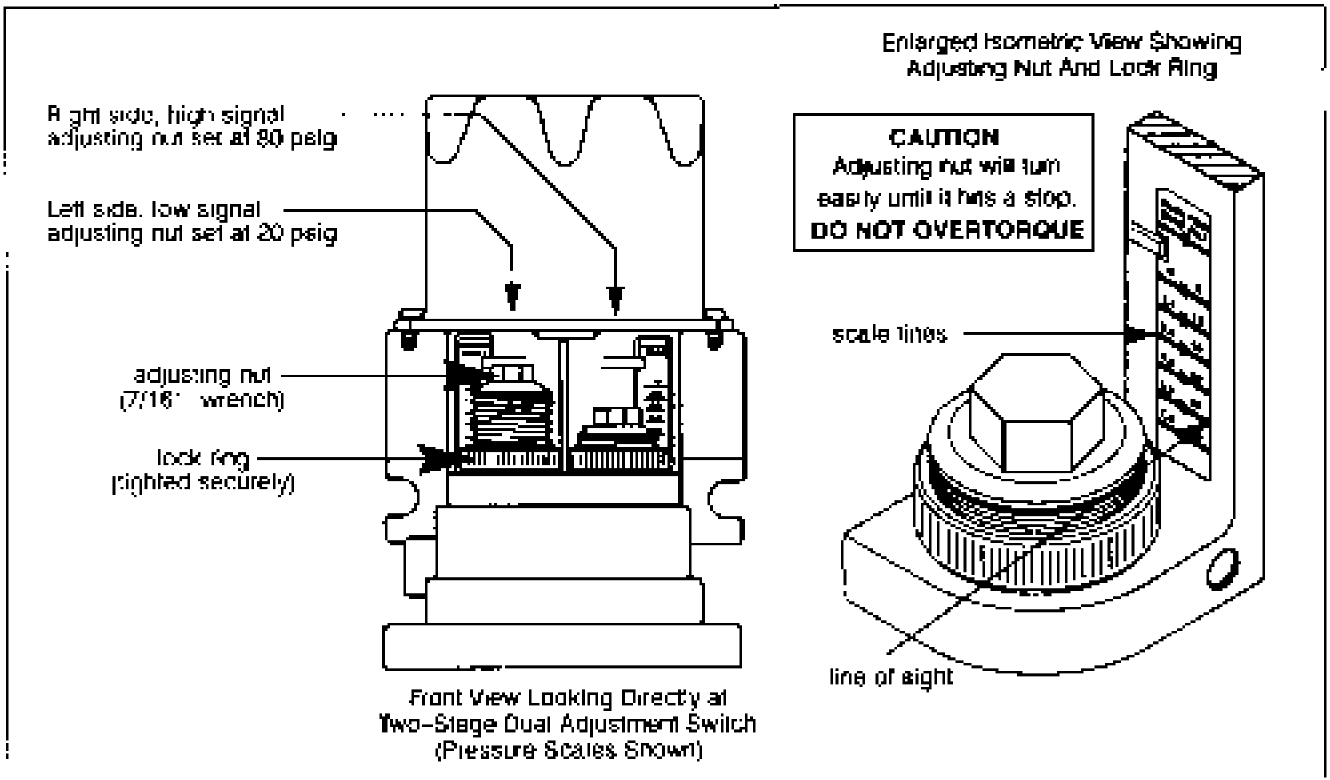


Figure 2. Adjustment (Signal Setting) of Two-Stage Dual Adjustment Switch.

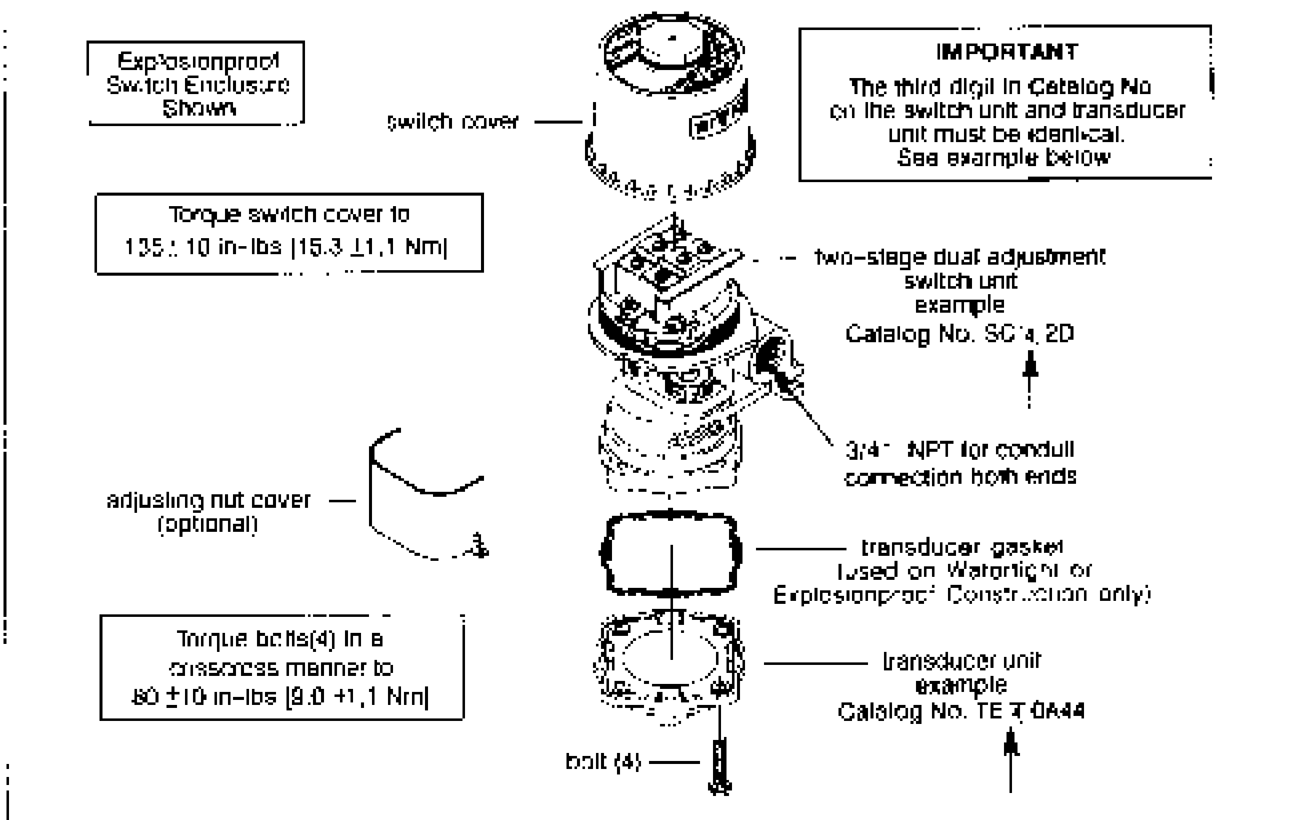


Figure 3. Switch Unit and Transducer Unit to be Assembled.

Chapter 26 FACILITY FUEL-OIL

MANUFACTURER/DISTRIBUTOR:

WOLSELEY Inc.
4200, Hickmore
St-Laurent, QC, H4T 1K2
Phone: (514) 344-9378
Fax :(514) 344-9341

26.1 **OUTSIDE GREY DOUBLE WALL TANK 1000 GALL 30464222-08**

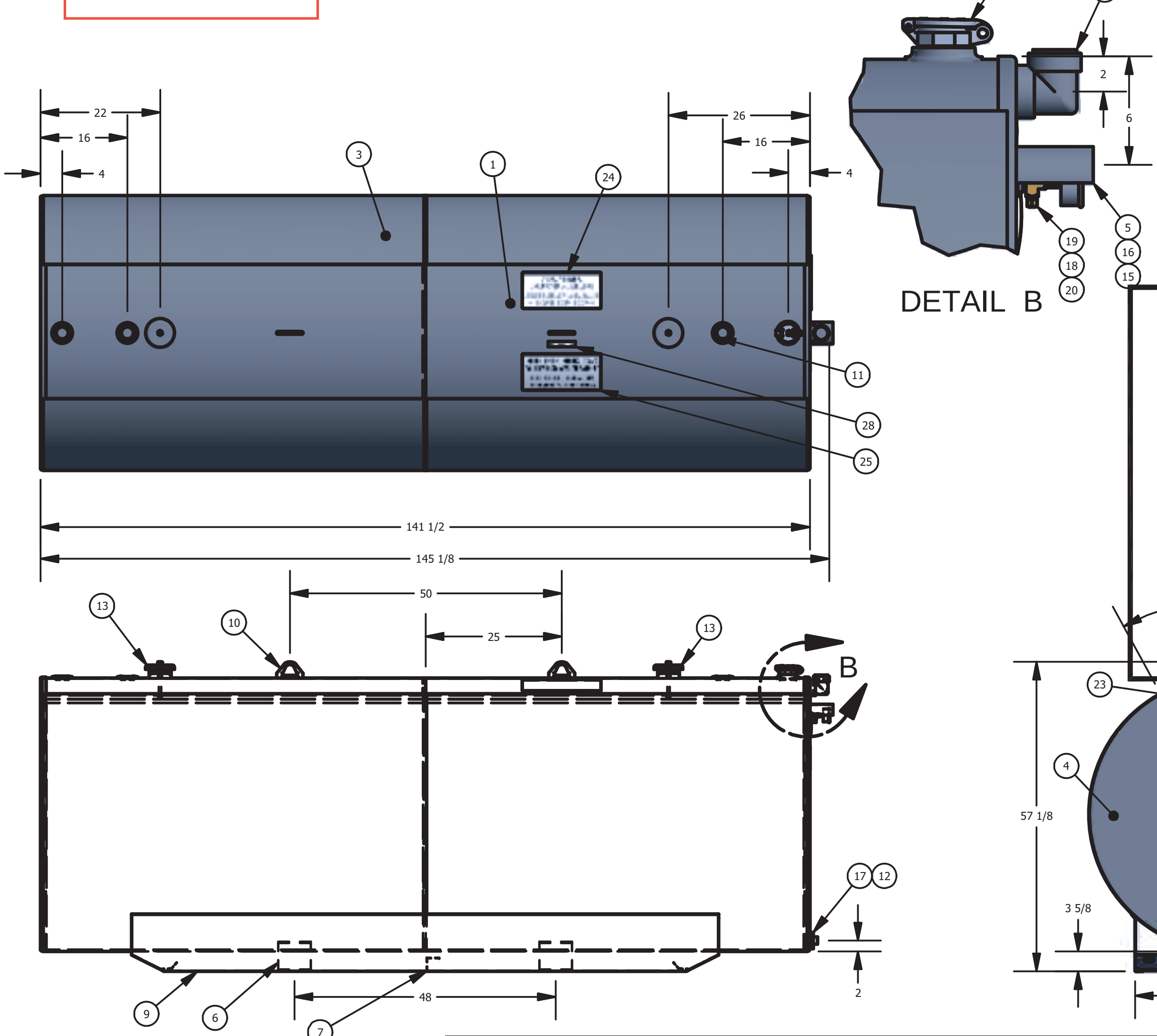
26.2 **DAILY FUEL TANK ATS Fuel Tank 602-V-P – 50 Gal**

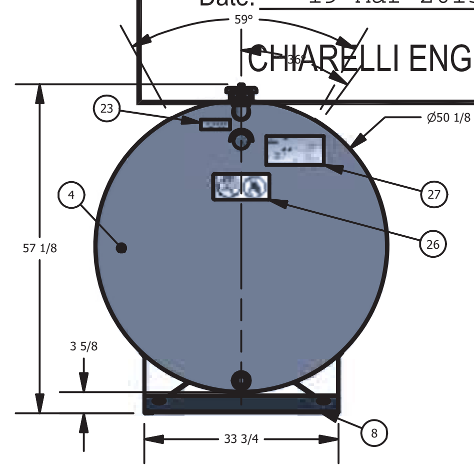
26.3 **K-TECH FLOAT SWITCH FS301E-1**

26.4 **K-TECH FLOAT SWITCH FS301E-1**

26.5 **MIDGET 277 LEVEL-O-METER (4550L – 50"D X 140")**

Oil storage tank





Parts List

ITEM	QTY	PART NUMBER	DESCRIPTION
1	2	FA27184403	HR STEEL 0.093"min x 70½" x 158½"
2	2	CR27128	COUVERCLE ROND - 12ga 50" DIA - ROUND TANK HEAD
3	2	FA27184338	HR STEEL 0.093" min x 70½" x 133"
4	2	CR34130	COUVERCLE ROND - 10ga 50½" DIA. - ROUND TANK HEAD
5	1	AS0025	PROTECTEUR DE CADRAN DE SURVEILLANCE VAC.- GAUGE PROTECTOR FOR VAC. MONITOR
6	4	AS07003	RENFORT DE LISSE RÉS. D./-P ULC-S601 - SKID STRENGTHENER FOR D./W. ULC-S601 TANKS
7	1	AS07004	RENFORT DE LISSE - 11Ga 2 3/8" x 33½" LONG - SKID STRENGTHENER
8	2	AS07014	RENFORT DE LISSE - 11Ga X 33½"LRG - SKID STRENGTHENER
9	2	AS07274	LISSE - 11Ga x 108" LONG - SKID
10	2	AS1101	OEILLET DE MANUTENTION RHC - LIFTING LUG
11	3	BE00051CAP	BRIDE EMBOUTIE COURBÉE CAPÉE - 2" NPT- CURVED STAMPED FLANGE CAPPED
12	1	BO00051	BOUCHON FILETÉ - 2" NPT - PIPE PLUG
13	2	CA02010G	EVENT D'URGENCE - 4" DIA x 2.25 LNG - EMERGENCY VENT
14	1	CA02005	ELFENT 2" INTERSTITIAL VENT ELBOW (ULC LISTED)
15	1	BF00006	BRIDE FORGÉE - ¼" NPT - FORGED FLANGE
16	1	CP02006	2½" DIA GLYCERIN FILLED SS VACUUM GAUGE (30" Hg)
17	1	MD02051	DEMI-MANCHON - 2" NPT - HALF COUPLING
18	1	RL01006	RACORD LAITON - F,F,M ¼" NPT - BRASS TEE
19	1	VD01006	VALVE DIRECTIONELLE LAITON - 1/4" M x 1/8" F - BRASS CHECK VALVE
20	1	BO01003	BOUCHONS À PANS CREUX - 1/8" NPT - BRASS HEX SOCKET PLUG
21	1	BF00064	BRIDE FORGÉE COURBE - 2½" NPT - FORGED & CURVED FLANGE
22	1	CA01004	BOUCHON DE REMPLISSAGE EN ALU. - 2 ½" NPT - ALUMINUM FILL CAP
23	1	EP0126	VACUUM MONITORING & INSTERTITIAL VENT STICKER
24	1	EP0245	COLLANT NE PAS SOULEVER - DO NOT LIFT TANK STICKER
25	1	EP0246	COLLANT DISTANCE DU BÂTIMENT - DISTANCE FROM BUILDING STICKER
26	1	EP0247	COLLANT - NO SMOKING OR OPEN FLAME - STICKER
27	1	EP0314-1	AUTOCOLLANT ULC-S601 - LISTING MARK
28	1	EP0314-2	AUTOCOLLANT PIÈCE - PART NUMBER STICKER

SHOP DRAWING

This review is solely for the verification of general design quality and does not alleviate the responsibility of the contractor for insuring that all specification, space and installation requirements are met.

Reviewed By: M.M. — Reviewed ☒ — Reviewed as noted ☐ — Resubmit ☐

Date: 19 Mar 2015

CHIARELLI ENGINEERING LTD.

Shop Drawings Contractor Approval

Approved by: M.A.G., G. F.

Date: Mar 03, 2015

SIFEC NORTH INC

NOTES:

1. AIR / SOAP TEST TO 35 KPa (5 PSI) MAX.
2. INTERIOR FINISH: CLEAN OF DEBRIS ETC.
3. EXTERIOR FINISH: PHOSPHATE CLEAN AND APPLY GRAY URETHANE ENAMEL 300 (PE0059ET AND PE0062ET)

TOLÉRANCES LINÉAIRES, LINEAR STD TOLERANCES
0 OR FRAC. (X/X) -> ±0.5" — 0.00 -> ±0.125"
0.0 -> ±0.25" — 0.000 -> ±0.0625"

TOLÉRANCES ANGULAIRES, ANGULAR STD TOLERANCES
0 -> ± 2 DEG. — 0.00 -> ± 0.1 DEG.
0.0 -> ± 0.5 DEG.

Les soudures doivent respecter la spécification SI-0039.
Tank welds must respect SI-0039 specifications.

Matériau / Material :

Description de la révision / Revision description

Dessiné par / Drawn by: E Bourassa — 2013-09-25

Approuvé par / Approved by : E Bourassa — 2013-10-04

Unités / Units: INCHES — Échelle / Scale — Feuille Sheet 1 / 1

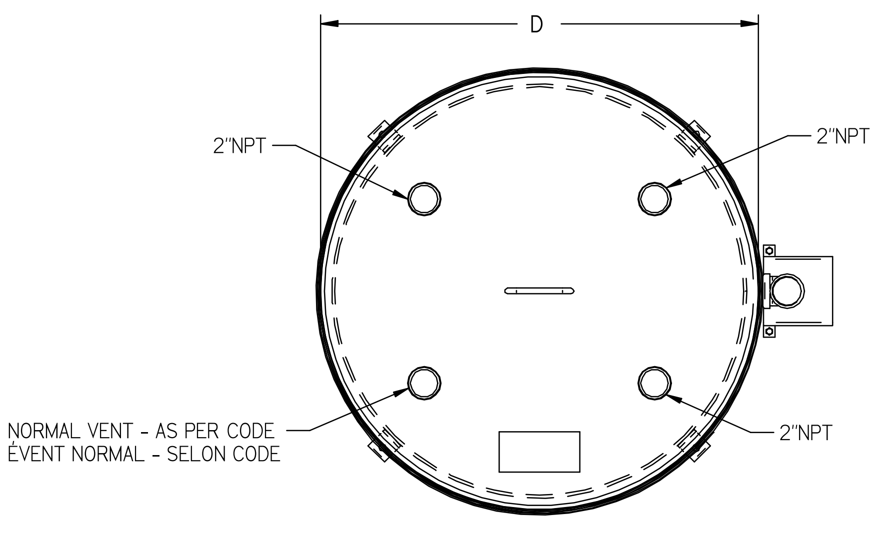
Réservoirs d'Acier Granby, Granby Steel Tanks

Format / Size: A — No de la pièce / Part no.: 30464222-08 — REV: A

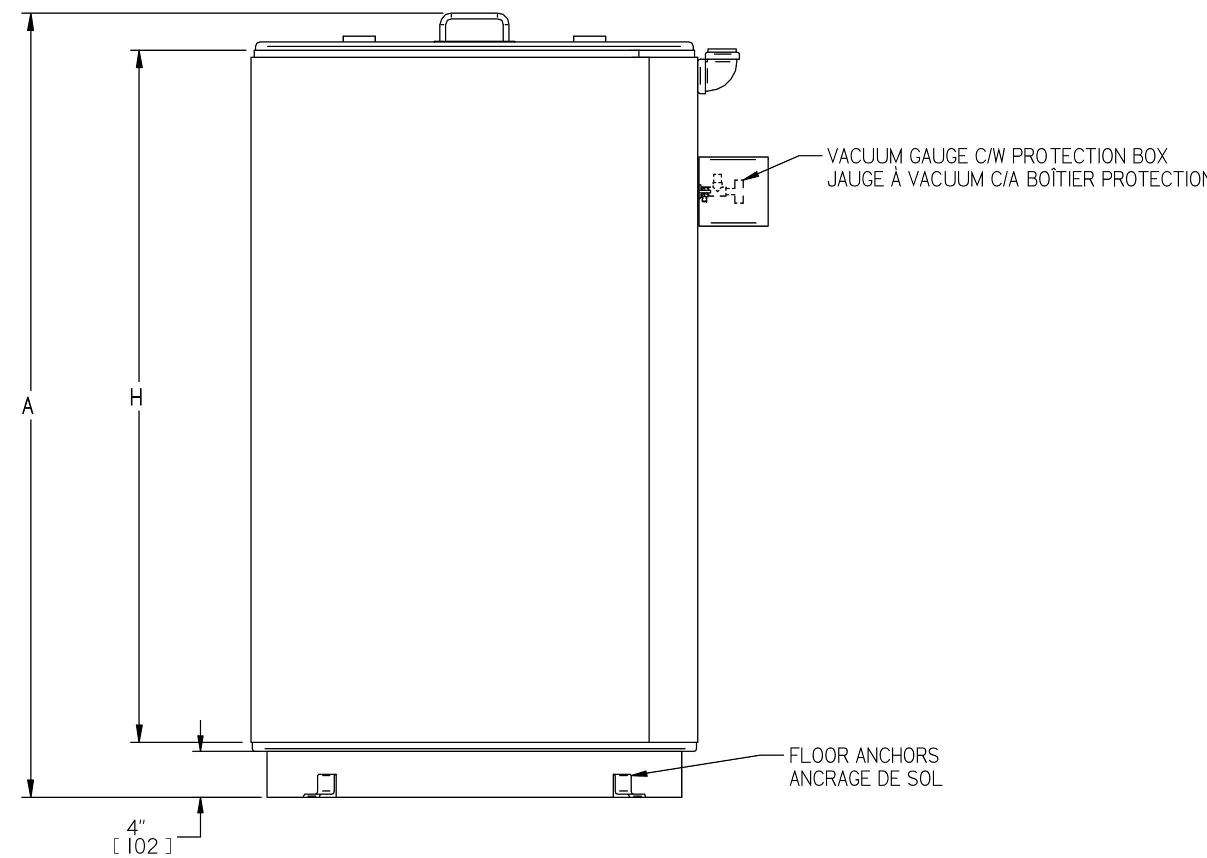
Description / Title: RES. SUR LISSE GRIS - 4550L 2.5mm D/W V/M ULC-S601 - TANK ON SKID GREY

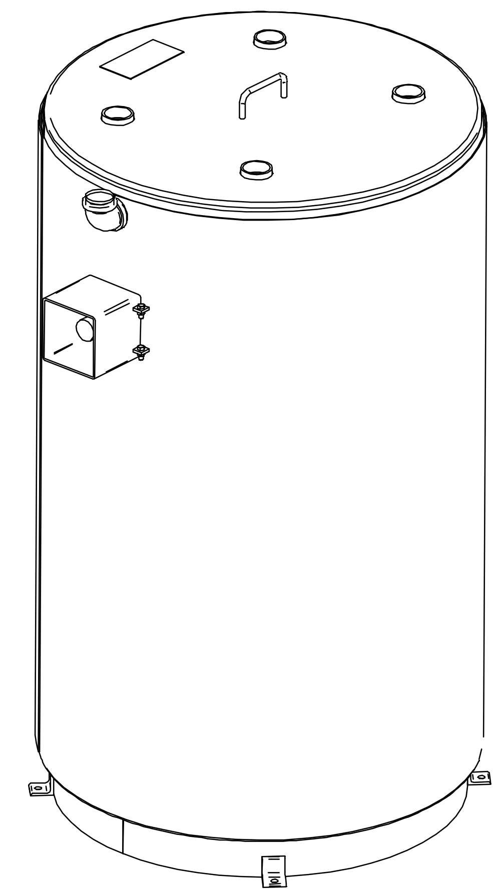
D-TANK_TMPLT-C

VERTICAL DOUBLE WALL DAY TANK ULC-S602
RÉSERVOIR VERTICAL DOUBLE PAROI ULC-S602



TOP VIEW
VUE DE DESSUS





REAL CAPACITY / CAPACITÉ RÉELLE	*SPECIFICATIONS / SPÉCIFICATIONS D	H	A	WEIGHT / POIDS
I.G. (G.I.) / LITRES	IN (PO) / mm	IN (PO) / mm	IN (PO) / mm	LBS / Kg
50 / 227	22 / 559	35 / 889	43 / 1092	188 / 86
101 / 458	30 / 762	38 / 965	46 / 1168	296 / 135
152 / 689	30 / 762	58 / 1220	66 / 1676	408 / 185
201 / 916	32 / 812	68 / 1727	76 / 1930	501 / 228
251 / 1143	38 / 965	60 / 1524	68 / 1727	559 / 254
300 / 1366	38 / 965	72 / 1829	80 / 2032	644 / 293
435 / 1979	50 / 1270	60 / 1524	68 / 1727	791 / 360
520 / 2365	50 / 1270	72 / 1829	80 / 2032	903 / 411

* THESE MODELS ARE PRESENTED FOR ILLUSTRATIVE PURPOSE ONLY - OUR TANKS ARE CUSTOM-MADE BASED ON YOUR NEEDS AND SPECIFICATIONS.
CES MODÈLES SONT PRÉSENTÉS À TITRE INDICATIF SEULEMENT; NOUS FABRIQUONS NOS RÉSERVOIRS SUR MESURE, EN FONCTION DE VOS BESOINS ET SPÉCIFICATIONS.

No	DATE	REVISION	PAR	APPR.

AT&S DIVISION GIL-FAB
1429, avenue de la gare
Mascouche Qc J7K 3G6
CANADA
T 450 474.7400
F 450 474.7404

TITLE / TITRE:
VERTICAL DOUBLE WALL DAY TANK
RÉSERVOIR VERTICAL DOUBLE PAROI

JOB No:	DRAWN BY / DESSINÉ PAR: JEAN LEPAGE	
DATE: 2013-01-21	VERIFY BY / VERIFIÉ PAR: S.G.	APPR. BY / APPR. PAR: P.L.
FORMAT: B	DRAWING / DESSIN No: 602-V-DP	REV: 0

Ktech INDUSTRIAL PRODUCTS INC.

Model FS301 Overfill Protection Device Installation Instructions
Part No.: FS301E-1

CAUTION: REFER TO INSTRUCTIONS BEFORE OPERATING OR SERVICING SWITCH.
Construction: ½” O.D. Brass stem, Buna-N float, 2” NPT bushing, explosion proof J-box. Switch set-point distances are measured from the underside of the 2” NPT bushing to the center of the float at the level where the switch is activated. Switch set-point distances are not field adjustable. They are factory-set as specified on the purchase order. The contact arrangement may be changed from normally open (NO) to normally closed (NC) and vice versa. Turn over the float and return the stop collars to their original positions. If the contact arrangement is altered, use an ohmmeter to test that the switch operates correctly. Screw the float switch into the 2” NPT opening on top of the tank. The conductors are colour coded to identify each switch. The switch must be connected in series with a load.

DO NOT CONNECT THE SWITCH DIRECTLY ACROSS THE POWER SUPPLY.
The voltage / current product must not exceed the power rating.

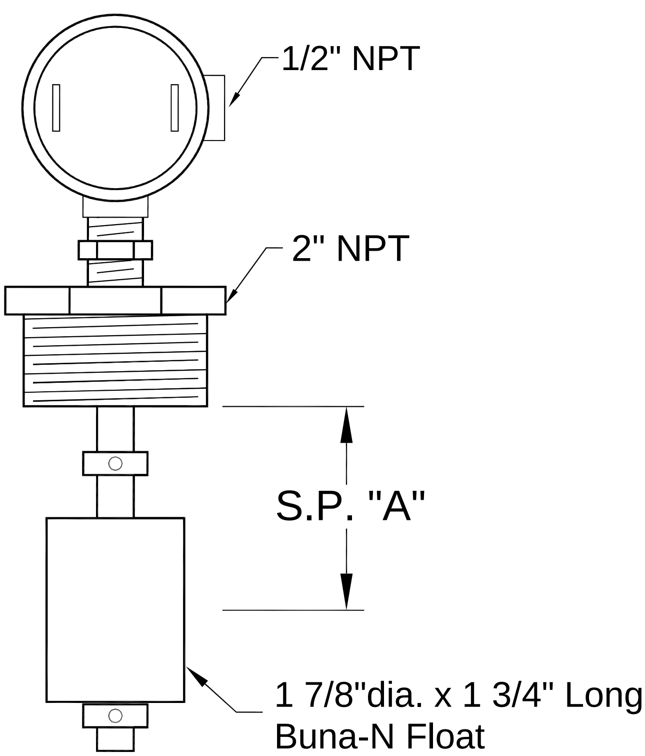
Electrical Specifications

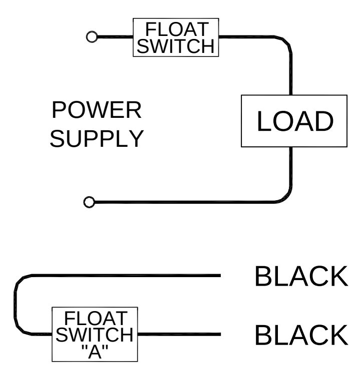
Maximum Switching Voltage Volts DC/AC	120
Maximum Switching Current Amps DC/AC	1.0
Maximum Switching Power Volt/Amps DC/AC	100
Operating Temperature Range	-25˚C to 90˚C -13˚F to 194˚F

Intertek 9700099

Meets Standards:
Class 1 Division 1, Groups B,C,D
CSA C22.2 No. 1010-1 and ANSI/I SA S82-03
CSA C22.2 No. 30 and UL1203
Factory Sealed

MINIMUM SETPOINT DISTANCE FROM TOP IS 2"
MINIMUM SETPOINT DISTANCE BETWEEN CONTACTS IS 3'
MINIMUM SETPOINT DISTANCE FROM BOTTOM IS 2 1/2"





"A" = ______ " ☐ N.O. ☐ N.C.

Ktech Industrial Products, 20 Regan Road, Unit 11, Brampton, Ontario. L7A 1C3 Phone (905) 840-7106, Fax (905) 840-6172

Ktech INDUSTRIAL PRODUCTS INC.

Model FS301 Overfill Protection Device Installation Instructions
Part No.: FS301-3

CAUTION: REFER TO INSTRUCTIONS BEFORE OPERATING OR SERVICING SWITCH.
Construction: ½” O.D. Brass stem, Buna-N float, 2” NPT bushing.
Switch set-point distances are measured from the underside of the 2” NPT bushing to the center of the float at the level where the switch is activated. Switch set-point distances are not field adjustable. They are factory-set as specified on the purchase order. The contact arrangement may be changed from normally open (NO) to normally closed (NC) and vice versa. Turn over the float and return the stop collars to their original positions. If the contact arrangement is altered, use an ohmmeter to test that the switch operates correctly. Screw the float switch into the 2” NPT opening on top of the tank. The conductors are colour coded to identify each switch. The switch must be connected in series with a load.

DO NOT CONNECT THE SWITCH DIRECTLY ACROSS THE POWER SUPPLY.
The voltage / current product must not exceed the power rating.

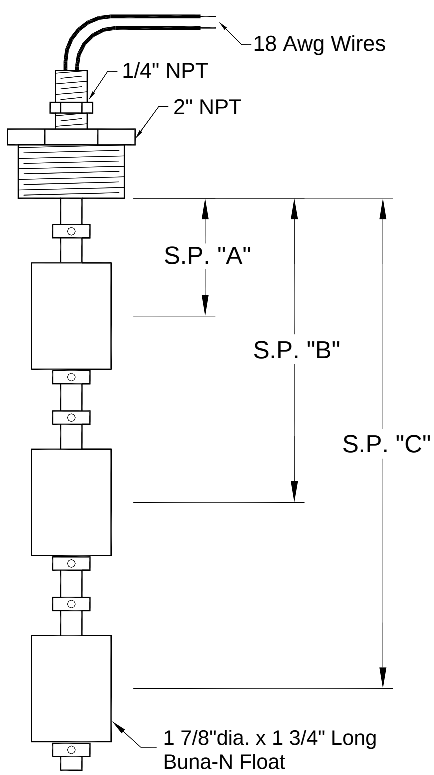
Electrical Specifications

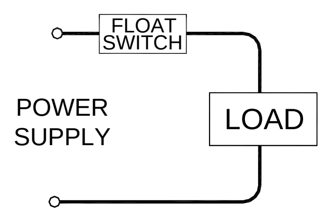
Maximum Switching Voltage Volts DC/AC	120
Maximum Switching Current Amps DC/AC	1.0
Maximum Switching Power Volt/Amps DC/AC	100
Operating Temperature Range	-25˚C to 90˚C -13˚F to 194˚F

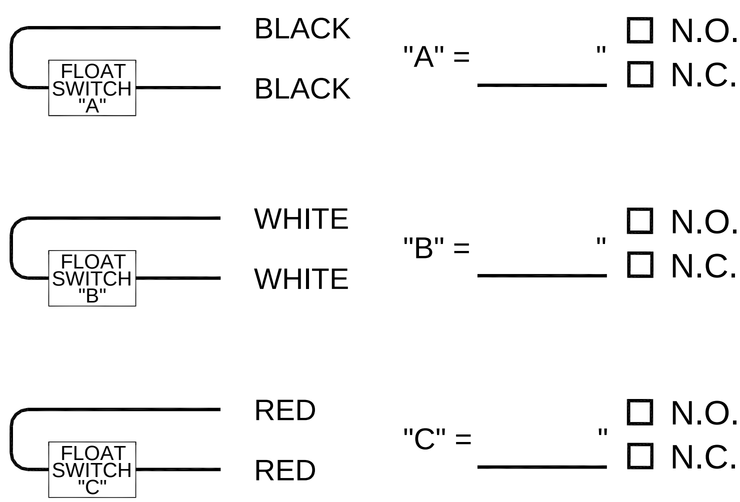
c ETL us Listed
Intertek
9700099

Meets Standards:
Class 1 Division 1, Groups B,C,D
CSA C22.2 No. 1010-1 and ANSI/I SA S82-03
CSA C22.2 No. 30 and UL1203
Factory Sealed

MINIMUM SETPOINT DISTANCE FROM TOP IS 2"
MINIMUM SETPOINT DISTANCE BETWEEN CONTACTS IS 3'
MINIMUM SETPOINT DISTANCE FROM BOTTOM IS 2 1/2"

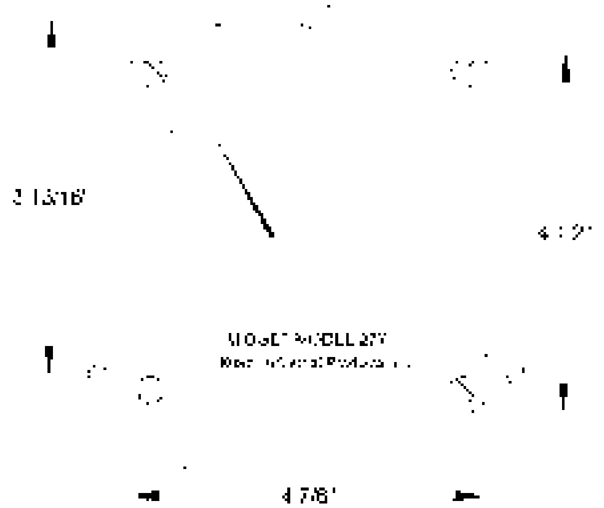




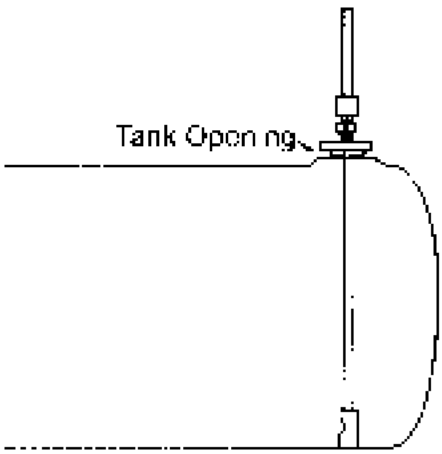


Ktech INDUSTRIAL PRODUCTS INC.

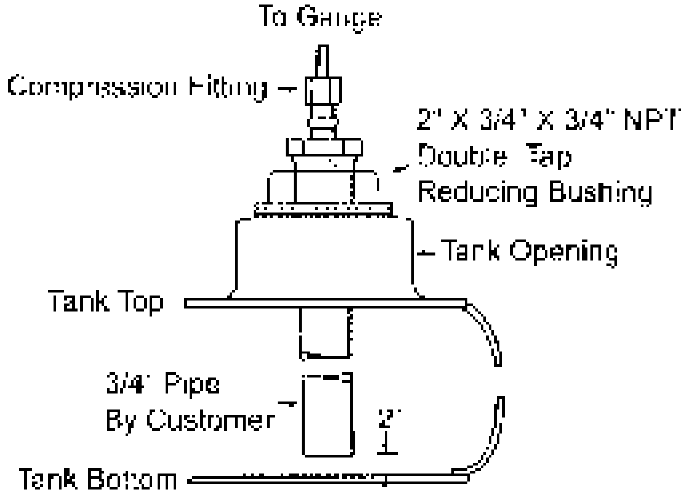
MIDGET 277 LEVELOMETER



Company Name: S.Pe
Address: 545 bv Airport
Contact Name: Samuel Cimbeanu
Phone #: 1 855 437 4100
email: S.cimbeanu @s.be.ca
P.O. #: ________
Quantity: 1 (Please use separate form for each tank specification)



#1 STANDARD INSTALLATION
for Tanks up to 10 feet in Diameter or Height



#2 RECOMMENDED INSTALLATION
for Marine Applications

1. If horizontal cyl. tank is used specify tank diameter (I.D.) ________
2. If vertical cyl. tank is used specify tank inside height 50"
3. If vertical oval tank is used specify tank inside Height ________
4. If rectangular tank is used specify tank inside height ________
5. If tank opening is not 2" specify ✓
6. If #1 installation length of tubing required (measured from bottom of tank to gauge) 25 ☐ 50' ☐ 75' ☒ 100' ☐
7. If #2 installation length of tubing required (measured from tank entrance to gauge) 25 ☐ 50' ☐ 75' ☐ 100' ☐
8. Name of liquid to be measured Fuel n°2 diesel oil Specific Gravity 0,83 - 0.95
9. Tank Capacity 4550 L 1000 Gal
10. Units of Dial Indication: Litres ☒ Imp. Gallons ☒ US Gallons ☐ Dual Scale ☒ Custom (Call)
Liter + Imp. Gallons

Chapter 27 BACKUP UNIT HEATER

MANUFACTURER/DISTRIBUTOR:

Provan
A/S Mathieu Labranche
2315 Rue Halpern
Ville St-Laurent, Quebec H4S 1S3
Phone: 514.332.3230
Email: mlabranche@provan.ca

27.1 CHROMOLOX UNIT HEATER LUH-04-83-34-40-1

UH1-5
Chromolox Model
LUH-04-83-34-40-1

LUH

Horizontal Blower Heater

- **2.6 - 45 kW**
- **8,900 - 153,000 Btuh**
- **208, 240, 277, 480 and 600 Volt**
- **1 or 3 Phase**
- **Wall or Ceiling Mounted Configurations**

Description

Type LUH self-contained heater provides quiet, reliable fan-forced heating in all types of commercial and industrial applications.

Applications

- Shipping and Receiving Areas
- Pump Houses
- Power Generating Stations
- Aircraft Hangers
- Factories
- Warehouses
- Garages

Construction

Die Formed Cabinet — Heavy 18 gauge steel, phosphate undercoated for corrosion resistance and finished in almond polyester powder coat.

Louvers — Individually adjustable louvers direct air flow up or down as needed.

Fintube Heating Elements have corrosion resistant steel fins that are furnace brazed to the tubular element to assure long life and superior heat transfer.

Refer to WR-80, RTC, WR-90 in the Controls section.

Fan Motor — Totally enclosed fan motor is rated for continuous duty with built-in thermal cutout and operates on same voltage as the heating circuit.

Dynamically Balanced Fan is attached with rubber vibration insulators for smooth, quiet operation. Blade pitch is carefully selected so that the volume of air moved results in the optimum discharge air temperature.

Features

- **Sub-divided Circuits with Individual Fuse Protection —** Standard on all heaters with a total current draw of 48 Amps or greater. The fuse compartment is conveniently located for easy access.
- **Integral 120V Control Transformer —** Standard on 480V models, eliminates the need for an external control source (24V optional).
- **Heavy Duty Magnetic Contactors** are standard on all models.
- **Thermal Cutouts** open the control circuit and disconnect power to the heating elements if overheating occurs. **Automatic Reset** allows the control circuit to reclose and restore power when temperature returns to normal.
- **Field Convertible —** Combination 208/240V and 1 or 3 phase operation through 10 kW.
- **Mounting Configurations —** Recessed welded fasteners on top of the heater cabinet are internally threaded for suspension of unit with threaded rods. Ceiling and Universal Wall Swivel brackets are optional. The ceiling bracket lets you mount heater directly to ceiling or over-head member, simply and easily. The swivel mounting allows you to readily adjust the direction of warm air flow for maximum comfort up to 180 degrees.

Optional Features (Factory Installed or Field Installation Kits)

- **Summer Fan Switch Kit —** Field installable for circulating warm stratified air. Available for all models.
- **Thermostat Kit —** Field installable on all models. Range 40°F - 100°F.
- **Power Disconnect Kit —** Field installable switch enables power to be disconnected while servicing heater. 40, 80 and 100 Amp models available. Mounts in the back of the heater.
- **Ceiling Bracket** (shown above)
- **Wall Mounting Bracket**

Advantages

- Self Contained
- Versatile, Flexible and High Performance
- Easy Installation
- Minimum Maintenance
- Long Life
- Attractive Appearance

Because it has individually adjustable discharge louvers to direct air flow, and can be wall or ceiling (plus swivel) mounted, the LUH heater may be used in a variety of heating applications:

- Primary Heating
- Supplementary Heating
- Dual System Heating
- Spot Heating
- Entryway Air-Curt

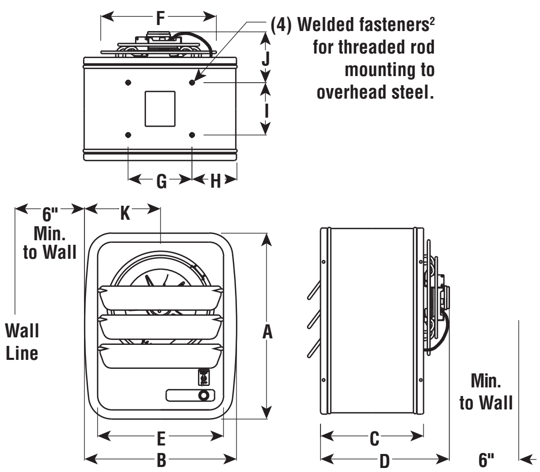
Shop Drawings Contractor Approval
Approved by: S.B.S., G. F.
Date: Mar 03, 2015 275/605
SIFEC NORTH INC

INDUSTRIAL

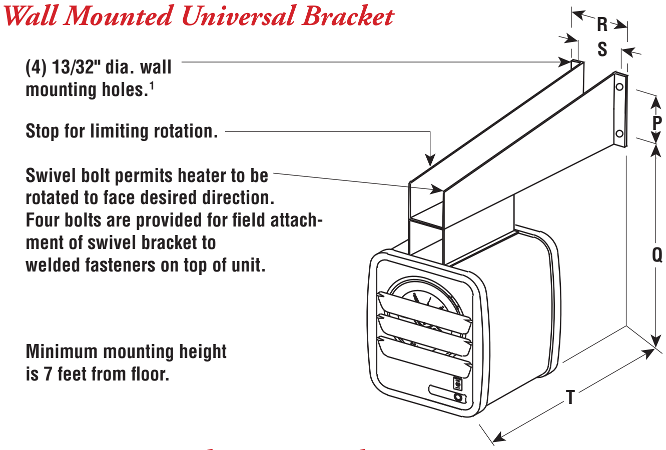
LUH

Horizontal Blower Heater *(cont'd.)*

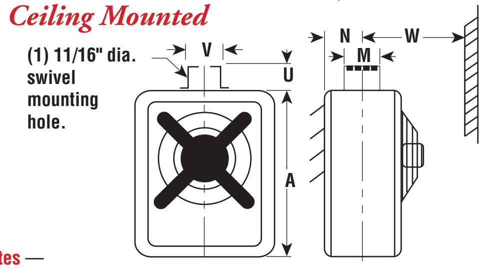
Dimensions (Inches)



Wall Mounted Universal Bracket



Ceiling Mounted



Wall Mounted Heaters

Heater	Dimensions (In.) P	Q	R	S	T	Wall Bracket	PCN	Stock	Wt. (Lbs.)
LUH-02 to -05	1-3/4	21-1/2	6-3/4	5-1/2	14-15/16	**WUH-01A**	**303474**	S	3
LUH-07, 10, 12, 15	2	28-7/16	9-1/2	8-3/8	22-1/4	**WUH-02**	**300484**	S	5
LUH-20, 25	2	32	9-1/2	8-3/8	22-1/4	**WUH-02**	**300484**	S	7
LUH-30, 35, 40, 45	5-1/2	28-11/16	5	3-1/2	33-1/4	**WUH-03**	**300492**	S	10

Notes —
1. Wall mounting fasteners to be supplied by customer.
2. Threaded rod to be supplied by customer.

Ceiling Mounted Heaters

Heater	Dimensions (In.) A	B	C	D	E	F	G	H	I	J	K	M	N	U	V	W	Ceiling Bracket	PCN	Stock	Wt. (Lbs.)
LUH-02 to -05	16	13-1/8	8-7/8	11-5/8	10-3/4	9-3/4	5-1/2	3-13/16	4-1/2	4-15/16	6-5/8	6	4-7/16	4	4-1/2	10-1/2	WUH-04A	303466	NS	1
LUH-07, 10, 12, 15	20-1/2	17-1/4	11-1/2	16-3/8	14-3/8	12-3/8	8-1/4	4-1/2	6-1/4	7-7/16	8-5/8	8	6-1/4	6	7-1/4	16	WUH-05	300513	NS	2
LUH-20, 25	24	20-1/8	11-1/2	20-1/2	16-3/4	16	8-1/4	6	6-1/4	12	10-1/16	8	6-1/4	6	7-1/4	16	WUH-05	300513	NS	3
LUH-30, 35, 40, 45	24	20-1/8	17	26	16-3/4	16	8-1/4	6	11-3/4	12	10-1/16	13-3/4	9-5/16	6	7-1/4	21	WUH-06	300521	NS	3

Optional Control Accessories & Remote Thermostats

Fan Only Operation Kits

Summer Fan Switch

Thermostat Kit

Note — A fan only operation (optional) is available by means of a built-in switch or by external control.

Summer Fan Switch	2 - 15 kW Model	PCN	20 - 45 kW Model	PCN	Stock	Wt. (Lbs.)
Internal 208 - 277V	ISFS-02[2]	305007	ISFS-02	305007	NS	0.25
External[1] with Relay (24V control)	ESFS-40	305015	ESFS-40A	305058	NS	0.5
External[1] with Relay (120V control)	ESFS-41	305023	ESFS-41A	305066	NS	0.5
External[1] with Relay (240V control)	ESFS-42	305031	ESFS-42A	305074	NS	0.5
External[1] with Relay (277V control)	ESFS-47	305040	—	—	NS	0.5

1. Kit includes wall plate (discard plate if switch is to be installed on heater).
2. Do not use for 480V rated heaters. 480V heaters require fan relay option with proper control voltage relay coil.

Thermostat Kits

Model	PCN	Stock	Wt. (Lbs.)
LUH-TK1 (SPST)	**301129**	S	0.25

Power Disconnect Kits

3 Pole, 600V Rating

Model	Rating	PCN	Stock	Wt. (Lbs.)
EDS-1	40 Amp*	**303431**	S	0.5
EDS-2	80 Amp	**303440**	S	0.5
EDS-3	100 Amp	303458	NS	1

* EDS-1 Rating for 480V or less is 50 Amp.

Mounting Limitations

Hazardous Atmosphere — Unit heaters should not be used in potentially explosive atmospheres. **Corrosive Atmosphere** —The finish is not intended for direct salt spray exposure in marine applications or the highly corrosive atmospheres of greenhouses, swimming pools, chemical storage bins, etc. **Mounting Height** — Do not install unit heaters above recommended maximum mounting height. **Obstructions** must not block unit heater air inlet or discharge.

LUH Horizontal Blower Heater *(cont'd.)*

Specifications and Ordering Information

Electrical (60 Hz)				Motor					Air Delivery				Ordering			
kW	Volts	Ckt & Phase	Amps[4]	Volts	Phase	HP	RPM	CFM	FPM	Temp. Rise (°F)	Horiz. Throw (Ft.)	Mtg.[5] Height (Ft.)	Model	Stock	PCN	Wt. (Lbs.)
2.6	208	1 - 1	13.1	208	1	1/40	1,650	410	880	21	12	8	**LUH-02-81-34**	S	**303001**	32
2.0/2.6	208/240	1 - 1	11.4[2]	240	1	1/40	1,650	410	880	21	12	8	**LUH-02-21-34**	S	**303010**	32
2.6	277	1 - 1	9.6	277	1	1/30	1,550	360	770	24	12	8	**LUH-02-71-35**	S	**303028**	32
4	208	1 - 1	19.8	208	1	1/40	1,650	410	880	31	12	8	**LUH-04-81-34**	S	**303036**	32
4	208	1 - 3[3]	11.7	208	1	1/40	1,650	410	880	31	12	8	**LUH-04-83-34**	S	**303044**	32
3/4	208/240	1 - 1	17.2[2]	240	1	1/40	1,650	410	880	31	12	8	**LUH-04-21-34**	S	**303052**	32
3/4	208/240	1 - 3[3]	10.2[2]	240	1	1/40	1,650	410	880	31	12	8	**LUH-04-23-34**	S	**303060**	32
4	277	1 - 1	14.6	277	1	1/30	1,550	360	770	35	12	8	**LUH-04-71-35**	S	**303079**	32
4	480	1 - 3	5.1	480	1	1/35	1,550	380	815	33	12	8	**LUH-04-43-32**	S	**303087**	32
5	208	1 - 1	24.6	208	1	1/40	1,650	410	880	39	12	8	**LUH-05-81-34**	S	**303095**	32
5	208	1 - 3[3]	14.5	208	1	1/40	1,650	410	880	39	12	8	**LUH-05-83-34**	S	**303108**	32
3.75/5	208/240	1 - 1	21.4	240	1	1/40	1,650	410	880	39	12	8	**LUH-05-21-34**	S	**303116**	32
3.75/5	208/240	1 - 3[3]	12.6	240	1	1/40	1,650	410	880	39	12	8	LUH-05-23-34	NS	303124	32
5	277	1 - 1	18.3	277	1	1/30	1,550	360	770	44	12	8	LUH-05-71-35	NS	303132	32
5	480	1 - 3	6.3	480	1	1/35	1,550	380	815	42	12	8	**LUH-05-43-32**	S	**303140**	32
7.5	208	1 - 1[3]	36.5	208	1	1/15	1,725	850	1,040	28	27	8	LUH-07-81-34	NS	303159	50
7.5	208	1 - 3	21.3	208	1	1/15	1,275	850	1,040	28	27	8	**LUH-07-83-34**	S	**303167**	50
5.6/7.5	208/240	1 - 1[3]	31.7[2]	240	1	1/15	1,725	850	1,040	28	27	8	**LUH-07-21-34**	S	**303175**	50
5.6/7.5	208/240	1 - 3	18.5[2]	240	1	1/15	1,725	850	1,040	28	27	8	LUH-07-23-34	NS	303183	50
7.5	277	1 - 1	27.7	277	1	1/15	1,550	750	920	32	27	8	LUH-07-71-35	NS	303191	50
7.5	480	1 - 3	9.9	480	3	1/15	1,725	850	1,040	28	27	8	**LUH-07-43-32**	S	**303204**	50
7.5	600	1 - 3	7.6	575	3	1/3	1,725	850	1,040	28	27	8	LUH-07-63-32	NS	—	50
9.7	208	1 - 1[3]	47.1	208	1	1/15	1,725	850	1,040	37	27	9	LUH-10-81-34	NS	303212	50
9.7	208	1 - 3	27.4	208	1	1/15	1,725	850	1,040	37	27	9	**LUH-10-83-34**	S	**303220**	50
7.5/10	208/240	1 - 1[3]	42.1[2]	240	1	1/15	1,725	850	1,040	37	27	9	**LUH-10-21-34**	S	**303239**	50
7.5/10	208/240	1 - 3	24.5[2]	240	1	1/15	1,725	850	1,040	37	27	9	LUH-10-23-34	NS	303247	50
10	480	1 - 3	12.9	480	3	1/15	1,725	850	1,040	37	27	9	**LUH-10-43-32**	S	**303255**	50
10	600	1 - 3	10.6	575	3	1/3	1,725	850	1,040	37	27	9	LUH-10-63-32	NS	—	50
12.5	208	1 - 3	35.2	208	1	1/15	1,725	850	1,040	47	27	9	**LUH-12-83-34**	S	**303263**	50
9.3/12.5	208/240	1 - 3	30.6	240	1	1/15	1,725	850	1,040	47	27	9	LUH-12-23-34	NS	303271	50
12.5	480	1 - 3	15.9	480	3	1/15	1,725	850	1,040	47	27	9	**LUH-12-43-32**	S	**303280**	50
12.5	600	1 - 3	12.6	575	3	1/3	1,725	850	1,040	47	27	9	LUH-12-63-32	NS	—	50
15	208	1 - 3	42.1	208	1	1/15	1,725	850	1,040	56	27	10	LUH-15-83-34	NS	303298	50
11.25/15	208/240	1 - 3	36.6[2]	240	1	1/15	1,725	850	1,040	56	27	10	LUH-15-23-34	NS	303300	50
15	480	1 - 3	19.0	480	3	1/15	1,725	850	1,040	56	27	10	**LUH-15-43-32**	S	**303319**	50
15	600	1 - 3	15.6	575	3	1/3	1,725	850	1,040	56	27	10	LUH-15-63-32	NS	—	50
14.5/19.4	208/240	1 - 3	48.0[2]	240	3	1/3	1,725	1,240	1,160	53	31	11	LUH-20-23-34	NS	303327	73
20	480	1 - 3	25.0	480	3	1/3	1,725	1,240	1,160	53	31	11	**LUH-20-43-32**	S	**303335**	73
20	600	1 - 3	19.6	575	3	1/3	1,725	1,240	1,160	53	31	11	LUH-20-63-32	NS	—	73
25	480	1 - 3	31.0	480	3	1/3	1,725	1,350	1,260	60	31	12	**LUH-25-43-32**	S	**303343**	73
25	600	1 - 3	24.6	575	3	1/3	1,725	1,350	1,260	60	31	12	LUH-25-63-32	NS	—	73
30	208	2 - 3	85.2	240	3	1/3	1,725	1,555	1,450	64	46	13	LUH-30-83-34	NS	303351	106
22.5/30	208/240	2 - 3	74.0[2]	240	3	1/3	1,725	1,555	1,450	64	46	13	LUH-30-23-34	NS	303360	106
30	480	2 - 3	37.1	480	3	1/3	1,725	1,555	1,450	64	46	13	**LUH-30-43-32**	S	**303378**	106
30	600	2 - 3	29.6	575	3	1/3	1,725	1,555	1,450	64	46	13	LUH-30-63-32	NS	—	106
26.25/35	208/240	2 - 3	86.0[2]	240	3	1/3	1,725	1,555	1,450	71	45	14	LUH-35-23-34	NS	303386	106
35	480	2 - 3	43.1	480	3	1/3	1,725	1,555	1,450	71	45	14	**LUH-35-43-32**	S	**303394**	106
35	600	2 - 3	34.7	575	3	1/3	1,725	1,555	1,450	71	45	14	LUH-35-63-32	NS	—	106
28.5/38	208/240	2 - 3	93.3	240	3	1/3	1,725	1,555	1,450	84	44	15	LUH-40-23-34	NS	303407	106
39	480	2 - 3	47.9	480	3	1/3	1,725	1,555	1,450	84	44	15	**LUH-40-43-32**	S	**303415**	106
40	600	2 - 3	39.7	575	3	1/3	1,725	1,555	1,450	84	44	15	LUH-40-63-32	NS	—	106
45	480	2 - 3	55.1	480	3	1/3	1,725	1,555	1,450	94	42	17	**LUH-45-43-32**	S	**303423**	106
45	600	2 - 3	43.7	575	3	1/3	1,725	1,555	1,450	94	42	17	LUH-45-63-32	NS	—	106

Stock Status: S = stock NS = non-stock
To Order—Specify model, PCN, kW, volts, phase and quantity.

1. For motor data, see table.
2. 208V amperage is 86% of 240V value.
3. Models can be field wired for 1 or 3 phase.
4. Includes motor Amps.
5. Maximum mounting height for effective heat distribution. Minimum height is 7 feet.

Other Notes —

A. All heaters have built-in contactors and stock 480V models have built-in control transformers and contactor with 120V holding coils. All stock 208 and 240V models have 208/240V holding coils. All stock 277V models have 277V holding coils.
B. Optional contactors available with 120 or 24V holding coils on made-to-order models, contact your Local Chromalox Sales office.
C. When total heater capacity exceeds 48 Amps, built-in fusing is provided behind a hinged and latched door in the side which allows easy access.

INDUSTRIAL

LUH Horizontal Blower Heater *(cont'd.)*

Recommended Control Options

PCN	Description	Kits: Thermostat	Kits: Fan Only	Kits: Remote Fan	Kits: Dis-connect
303001	LUH-02-81-34-00 208V 1P 2.6kW	LUH-TK1	ISFS-02	ESFS-42	EDS-1
303010	LUH-02-21-34-00 240V 1P 2.6kW	LUH-TK1	ISFS-02	ESFS-42	EDS-1
303028	LUH-02-71-35-00 277V 1P 2.6kW	LUH-TK1	ISFS-02	ESFS-47	EDS-1
303036	LUH-04-81-34-00 208V 1P 4kW	LUH-TK1	ISFS-02	ESFS-42	EDS-1
303044	LUH-04-83-34-00 208V 3P 4kW	LUH-TK1	ISFS-02	ESFS-42	EDS-1
303052	LUH-04-21-34-00 240V 1P 4kW	LUH-TK1	ISFS-02	ESFS-42	EDS-1
303060	LUH-04-23-34-00 240V 3P 4kW	LUH-TK1	ISFS-02	ESFS-42	EDS-1
303079	LUH-04-71-35-00 277V 1P 4kW	LUH-TK1	ISFS-02	ESFS-47	EDS-1
303087	LUH-04-43-32-00 480V 3P 4kW	LUH-TK1	ESFS-41	ESFS-41	EDS-1
303095	LUH-05-81-34-00 208V 1P 5kW	LUH-TK1	ISFS-02	ESFS-42	EDS-1
303108	LUH-05-83-34-00 208V 3P 5kW	LUH-TK1	ISFS-02	ESFS-42	EDS-1
303116	LUH-05-21-34-00 240V 1P 5kW	LUH-TK1	ISFS-02	ESFS-42	EDS-1
303124	LUH-05-23-34-00 240V 3P 5kW	LUH-TK1	ISFS-02	ESFS-42	EDS-1
303132	LUH-05-71-35-00 277V 1P 5kW	LUH-TK1	ISFS-02	ESFS-47	EDS-1
303140	LUH-05-43-32-00 480V 3P 5kW	LUH-TK1	ESFS-41	ESFS-41	EDS-1
303159	LUH-07-81-34-00 208V 1P 7.5kW	LUH-TK1	ISFS-02	ESFS-42	EDS-1
303167	LUH-07-83-34-00 208V 3P 7.5kW	LUH-TK1	ISFS-02	ESFS-42	EDS-1
303175	LUH-07-21-34-00 240V 1P 7.5kW	LUH-TK1	ISFS-02	ESFS-42	EDS-1
303183	LUH-07-23-34-00 240V 3P 7.5kW	LUH-TK1	ISFS-02	ESFS-42	EDS-1
303191	LUH-07-71-35-00 277V 1P 7.5kW	LUH-TK1	ISFS-02	ESFS-47	EDS-1
303204	LUH-07-43-32-00 480V 3P 7.5kW	LUH-TK1	ESFS-41	ESFS-41	EDS-1
303212	LUH-10-81-34-00 208V 1P 10kW	LUH-TK1	ISFS-02	ESFS-42	EDS-2

PCN	Description	Kits: Thermostat	Kits: Fan Only	Kits: Remote Fan	Kits: Dis-connect
303220	LUH-10-83-34-00 208V 3P 10kW	LUH-TK1	ISFS-02	ESFS-42	EDS-1
303239	LUH-10-21-34-00 240V 1P 10kW	LUH-TK1	ISFS-02	ESFS-42	EDS-2
303247	LUH-10-23-34-00 240V 3P 10kW	LUH-TK1	ISFS-02	ESFS-42	EDS-1
303255	LUH-10-43-32-00 480V 3P 10kW	LUH-TK1	ESFS-41	ESFS-41	EDS-1
303263	LUH-12-83-34-00 208V 3P 12.5kW	LUH-TK1	ISFS-02	ESFS-42	EDS-1
303271	LUH-12-23-34-00 240V 3P 12.5kW	LUH-TK1	ISFS-02	ESFS-42	EDS-1
303280	LUH-12-43-32-00 480V 3P 12.5kW	LUH-TK1	ESFS-41	ESFS-41	EDS-1
303298	LUH-15-83-34-00 208V 3P 15kW	LUH-TK1	ISFS-02	ESFS-42	EDS-2
303300	LUH-15-23-34-00 240V 3P 15kW	LUH-TK1	ISFS-02	ESFS-42	EDS-1
303319	LUH-15-43-32-00 480V 3P 15kW	LUH-TK1	ESFS-41	ESFS-41	EDS-1
303327	LUH-20-23-34-00 240V 3P 20kW	LUH-TK1	ISFS-02	ESFS-42A	EDS-2
303335	LUH-20-43-32-00 480V 3P 20kW	LUH-TK1	ESFS-41A	ESFS-41A	EDS-1
303343	LUH-25-43-32-00 480V 3P 25kW	LUH-TK1	ESFS-41A	ESFS-41A	EDS-1
303351	LUH-30-83-34-00 208V 3P 30kW	LUH-TK1	ISFS-02	ESFS-42A	EDS-3
303360	LUH-30-23-34-00 240V 3P 30kW	LUH-TK1	ISFS-02	ESFS-42A	EDS-2
303378	LUH-30-43-32-00 480V 3P 30kW	LUH-TK1	ESFS-41A	ESFS-41A	EDS-1
303386	LUH-35-23-34-00 240V 3P 35kW	LUH-TK1	ISFS-02	ESFS-42A	EDS-3
303394	LUH-35-43-32-00 480V 3P 35kW	LUH-TK1	ESFS-41A	ESFS-41A	EDS-2
303407	LUH-40-23-34-00 240V 3P 40kW	LUH-TK1	ISFS-02	ESFS-42A	EDS-3
303415	LUH-40-43-32-00 480V 3P 40kW	LUH-TK1	ESFS-41A	ESFS-41A	EDS-2
303423	LUH-45-43-32-00 480V 3P 45kW	LUH-TK1	ESFS-41A	ESFS-41A	EDS-2

When ordering LUH heaters, specify the model number and corresponding PCN (Product Code Number). If controls or thermostat/fan options are required, designate these options in the model number when ordering, as shown below. Always specify voltage, phase and kW by listing them on the purchase order product specifications.

Model Numbers

Chromalox Horizontal Unit Heater

Heating Elements

02 = 2.6 kW
04 = 4.0 k W
05 = 5.0 kW
07 = 7.5 kW
10 = 10.0 kW
12 = 12.5 kW
15 = 15.0 kW
20 = 20.0 kW
25 = 25.0 kW
30 = 30.0 kW
35 = 35.0 kW
40 = 40.0 kW
45 = 45.0 kW

Heater Voltage and Phase

81 = 208V, 1 Phase
83 = 208V, 3 Phase
21 = 240V, 1 Phase
23 = 240V, 3 Phase
71 = 277V, 1 Phase
43 = 480V, 3 Phase
63 = 600V, 3 Phase

Control

0 0 No Contactor(s)
3 0 24V Control Internal Transformer
3 1 24V Control Externally Supplied
3 2 120V Control Internal Transformer
3 3 120V Control Externally Supplied
3 4 208/240V Control Internally Supplied, No Transformer
3 5 277V Control Internally Supplied

Control

0 0 No Thermostat, No Summer Fan Switch
4 0 Internal Thermostat Only
4 1 Internal Therm. and Internal Sum. Fan Sw.
4 2 External Sum. Fan Sw. Only (Not 480V)
4 3 External Sum. Fan Sw. and Fan Relay (All Volts)
4 4 Rem. Fan Sw. and Internal Therm. (Not 480V)
4 5 Rem. Fan Sw., Fan Relay and Int. Therm. (All Volts)D, E, F, G
4 6 Internal Sum. Fan Sw. (Not 480 V)
4 7 Internal Sum. Fan Sw., Fan Relay (All Volts)

Disconnect Switch

1 40 Amp
2 80 Amp
3 100 Amp

LUH 04 83 34 40 1 — **Typical Model Number**

Chromalox®

Installation
and
RENEWAL PARTS IDENTIFICATION

Type LUH
Horizontal Unit Heater

SERVICE REFERENCE	
DIVISION 4	SECTION LUH
SALES REFERENCE (Supersedes PF479-5)	PF479-6
	161-303474-001
DATE JANUARY, 2003	

Specifications — Table 1

Model	Electrical Data (60 Hz)					Dimensions (In.)			Standard Contactor Rating (Qty.)
	Volts	Watts	Phase	Amps	BTU	Height	Width	Depth	
LUH-D-02-81	208	2,667	1	12.8	8,850	16	13-1/8	8-7/8	30A (1)
LUH-D-02-21	208/240	2,000/2,667	1	11.1 *					30A (1)
LUH-D-02-71	277	2,667	1	9.6					30A (1)
LUH-D-04-81 †	208	4,000	1	19.2	13,661	16	13-1/8	8-7/8	30A (1)
LUH-D-04-83 †			3	11.2					30A (1)
LUH-D-04-21 †	208/240	3,000/4,000	1	16.7 *					30A (1)
LUH-D-04-23 †			3	9.6 *					30A (1)
LUH-D-04-71	277	4,000	1	14.5					30A (1)
LUH-D-04-43	480	4,000	3	4.8					30A (1)
LUH-D-05-81 †	208	5,000	1	24.0	17,076	16	13-1/8	8-7/8	30A (1)
LUH-D-05-83 †			3	13.8					30A (1)
LUH-D-05-21 †	208/240	3,750/5,000	1	20.8 *					30A (1)
LUH-D-05-23 †			3	12.1 *					30A (1)
LUH-D-05-71	277	5,000	1	18.2					30A (1)
LUH-D-05-43	480	5,000	3	6.0					30A (1)
LUH-D-07-81 †	208	7,500	1	36.1	25,598	20-1/2	17-1/4	11-1/2	50A (1)
LUH-D-07-83			3	20.9					30A (1)
LUH-D-07-21 †	208/240	5,625/7,500	1	31.1 *					30A (1)
LUH-D-07-23			3	18.1 *					30A (1)
LUH-D-07-71	277	7,500	1	27.2					30A (1)
LUH-D-07-43	480	7,500	3	9.0					30A (1)
LUH-D-10-81 †	208	10,000	1	48.0	34,130	20-1/2	17-1/4	11-1/2	50A (1)
LUH-D-10-83			3	27.8					30A (1)
LUH-D-10-21 †	208/240	7,500/10,000	1	41.7 *					30A (1)
LUH-D-10-23			3	24.0 *					30A (1)
LUH-D-10-43	480	10,000	3	12.0					30A (1)
LUH-D-12-83	208	12,500	3	34.8	42,663	20-1/2	17-1/4	11-1/2	50A (1)
LUH-D-12-23	208/240	9,375/12,500	3	30.1 *					50A (1)
LUH-D-12-43	480	12,500	3	15.1					30A (1)
LUH-D-15-83	208	15,000	3	41.8	51,195	20-1/2	17-1/4	11-1/2	50A (1)
LUH-D-15-23	208/240	11,250/15,000	3	36.2 *					50A (1)
LUH-D-15-43	480	15,000	3	18.1					30A (1)
LUH-D-20-23	208/240	15,000/20,000	3	48.0 *	68,460	24	20-1/8	11-1/2	50A (1)
LUH-D-20-43	480	20,000	3	24.0					30A (1)
LUH-D-25-43	480	25,000	3	30.0	85,525	24	20-1/8	11-1/2	50A (1)
LUH-D-30-83	208	30,000	3	83.4	102,390	24	20-1/8	17-1/4	50A (2)
LUH-D-30-23	208/240	22,500/30,000	3	72.2 *					50A (2)
LUH-D-30-43	480	30,000	3	36.1					30A (2)
LUH-D-35-23	208/240	26,250/35,000	3	84.3 *	119,455	24	20-1/8	17-1/4	50A (2)
LUH-D-35-43	480	35,000	3	42.1					30A (2)
LUH-D-40-23	208/240	30,000/40,000	3	96.0 *	136,520	24	20-1/8	17-1/4	50A (2)
LUH-D-40-43	480	40,000	3	48.0					30A (2)
LUH-D-45-43	480	45,000	3	54.1	153,585	24	20-1/.8	17-1/4	30A (2)

***Note:** 208V amperage is 86% of 240V value.

† These models can be field changed from single phase to three phase or three phase to single phase.

IMPORTANT

Failure to understand and follow these installation instructions and the "WARNING" notes therein may result in serious personal injury from electrical shock, or from the heater failing due to faulty installation.

⚠WARNING

FIRE/EXPLOSION HAZARD. This heater is not intended for use in hazardous atmospheres where flammable vapors, gases, liquids or other combustible atmospheres are present as defined in the National Electrical Code. Failure to comply can result in personal injury, explosion or fire. For these applications see PDS CXH-A-EP (PF490).

⚠WARNING

Users should install adequate back-up controls and safety devices with their electric heating equipment. Where the consequenses of failure may be severe, back-up controls are essential.

Do not mount mercury type thermostat directly on unit. Vibration could cause heater to malfunction.

The heater must be mounted at least 7' above the floor to prevent accidental contact with the heating elements or fan blade which could cause injury.

Keep at least 5' clearance in front of the heater. Refer to Table 2 for side, top and back clearance requirements.

The ceiling mounting structure and the anchoring provisions must be of sufficient strength to support the combined weight of the heater and mounting bracket. (Refer to Table 3 for weights of heater and bracket.)

The wall or mounting surface, and the anchoring provisions must be capable of supporting the combined weight of the heater and mounting brackets cantilevered from the mounting surface. (Refer to Table 3 for weights of heater and brackets and for cantilevered force expressed in foot-pounds.)

Fan blade rotation must be checked. If airflow is not moving out through the louvers, interchange any two of the three customer power leads on three-phase units only.

GENERAL

Heater Location Instructions:
Arrange units so their discharge air streams:

A. are subjected to a minimum of interference from columns, machinery and partitions.
B. wipe exposed walls without blowing directly at them.
C. are directed away from room occupants in comfort heating.
D. are directed along the windward side when installed in a building exposed to a prevailing wind.

Locate thermostat on interior partition walls or posts away from cold drafts, internal heat sources and away from heater discharge air streams.

Small rooms can be heated by one unit heater. Where two walls are exposed, the heater should be mounted as shown in Figure 1.

Large rooms require multi-unit installation. Number and capacity of units will be determined by volume of building and square feet of floor area to be heated. Arrange units to provide perimeter air circulation where each unit supports the air stream from another.

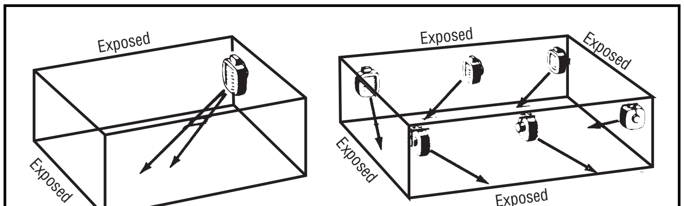


Figure 1

INSTALLATION

⚠WARNING

Please read all of the following instructions: Failure to observe these precautions could result in personal injury or equipment damage.

1. The heater must be mounted at least 7' above the floor to prevent accidental contact with the heating elements or fan blade which could cause injury.
2. Keep at least 5' clearance in front of heater. Refer to Table 2 for side, top and back clearance requirements.

Clearance Requirements — Table 2

Basic Model	Mounting Limitations (In.) Back to Wall	Side to Wall	Top to Ceiling
LUH-02 through LUH-05	6	6	4
LUH-07 through LUH-15	6	6	6
LUH-20 and LUH-25	6	6	6
LUH-30 through LUH-45	6	6	6

3. The ceiling mounting structure and the anchoring provisions must be sufficient to support the combined weight of the heater and mounting bracket. (Refer to Table 3 for weights of heater and bracket.)
4. The wall or mounting surface and the anchoring provisions must be capable of supporting the combined weight of the heater and mounting brackets cantilevered from the mounting surface. (Refer to Table 3 for weights of heater and brackets and for cantilevered force expressed in foot-pounds.)

The heater may be mounted either on the ceiling or on the wall as follows:

A. CEILING. The ceiling mounting bracket is fastened to the top of the heater using the four bolts supplied with the mounting bracket. The bracket is then mounted to the ceiling using a 5/8" bolt (supplied by others).

CEILING (Alternate)
1. The heater can be rod mounted to the ceiling by installing four threaded mounting rods in the threaded holes located on the top of the heater as shown in Figure 2. (Refer to Table 4 for mounting rod thread size.)
2. Securely attach the four mounting rods to the ceiling. (Refer to Table 2 for wall and ceiling clearances, and Figure 3 for mounting spacing specifications).

B. WALL. Wall mounting kits include both a ceiling mounting bracket and a wall mounting bracket. First, attach the ceiling mounting bracket to the heater as described in step 4A. Then attach the wall mounting bracket to the wall using four 3/8" bolts (supplied by others). Attach the ceiling mounting bracket on the heater to the wall mounting bracket using the 5/8" bolt provided.

The heater may be rotated to discharge in the desired direction. Open and adjust louvers to desired position. See Figure 4 and 5 for additional mounting details.

Heater & Bracket Weights Combined — Table 3

Heater Model	Weight (Lbs.) Heater and Brackets: Ceiling Weight	Wall Weight	Wall Ft./Lbs.
LUH-02 through LUH-05	33-3/4	38-1/4	48
LUH-07 through LUH-15	55	67-1/4	112
LUH-20 through LUH-25	78	90-1/4	150
LUH-30 through LUH-45	117	141-1/4	400

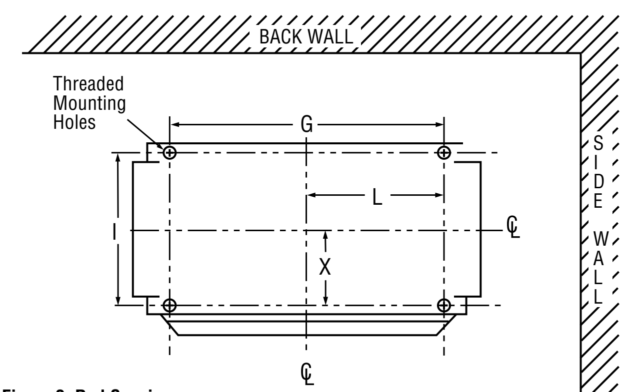


Figure 2 Rod Spacing

Table 4 — Rod Thread Type and Spacing Dimensions (In.) for Horizontal Discharge

Unit	Rod Thread Type	Dimensions (In.)			
		I	G	L	X
2 - 5kW	5/16 - 18	4-1/2	5-1/2	2-3/4	2-1/4
7-1/2 - 15kW	3/8 - 16	6-1/4	8-1/4	4-1/8	3-1/8
20 - 25kW	3/8 - 16	6-1/4	8-1/4	4-1/8	3-1/8
30 - 45kW	3/8 - 16	11-3/4	8-1/4	4-1/8	5-7/8

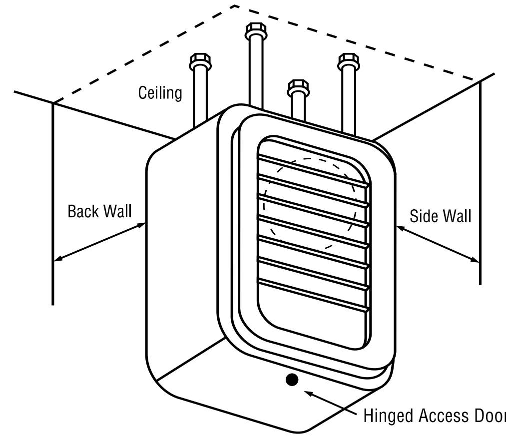


Figure 3 Wall and Ceiling Clearance (Table 2)

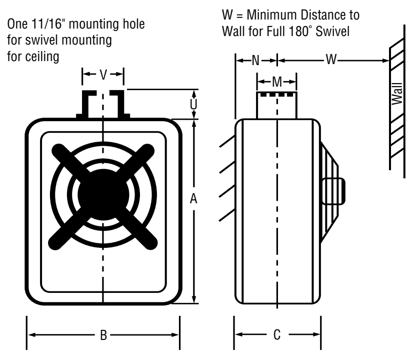


Figure 4
Optional Ceiling Swivel Mounting Bracket

Bracket Model No.	Dimensions (In.)								Wt. (Lbs.)	Use With
	A	B	C	M	N	U	V	W		
WUH-04A	16	13-1/8	8-7/8	6	4-7/16	4	4-1/2	10-1/2	3	LUH-02 04, 05
WUH-05	20-1/2	17-1/4	11-1/2	8	6-1/4	6	7-1/4	16	5-1/2	LUH-07 10, 12, 15
WUH-05	24	20-1/8	11-1/2	8	6-1/4	6	7-1/4	16	5-1/2	LUH-20, 25
WUH-06	24	20-1/8	17	13-3/4	10	6	7-1/4	21	11	LUH-30 35, 40, 45

Note: Wall mounting hardware to be supplied by customer.

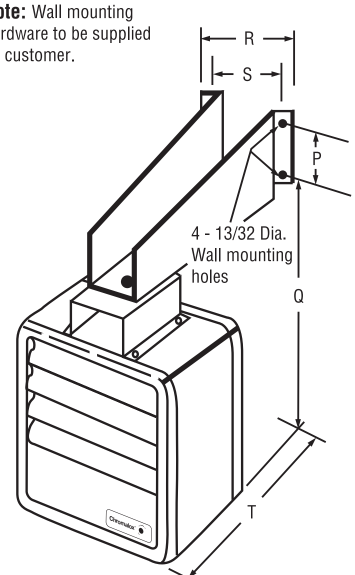


Figure 5
Optional Wall Swivel Mounting Bracket

Bracket Model Number	Dimensions - (In.)					Bracket Weight (Lbs.)	Use With
	P	Q	R	S	T		
WUH-01A	1-3/4	21-1/2	6-3/4	5-1/2	14-15/16	4-1/2	LUH-02 04, 05
WUH-02	2	28-7/16	9-1/2	8-3/8	22-1/4	12-1/4	LUH-07 10, 12, 15
WUH-02	2	28-7/16	9-1/2	8-3/8	22-1/4	12-1/4	LUH-20, 25
WUH-03	5-1/2	28-11/16	5	3-1/2	33-1/4	24-1/4	LUH-30, 35, 40, 45

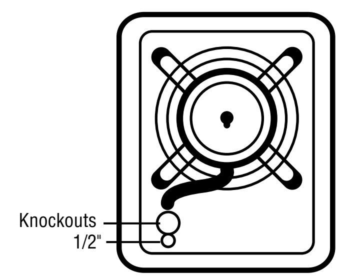


Figure 6
Heater Back View

Knockout Sizes	
LUH-02 - LUH-05	3/4” (1)
LUH-07 - LUH-15	1” (1)
LUH-20 - LUH-25	3/4”, 1”, 1-1/4”(1)
LUH-30 - LUH-45	3/4”, 1”, 1-1/4”(1)

⚠WARNING

ELECTRIC SHOCK HAZARD. Disconnect all power before installing or servicing heater. Failure to do so could result in personal injury or property damage. Heater must be installed by a qualified person in accordance with the National Electrical Code, NFPA 70.

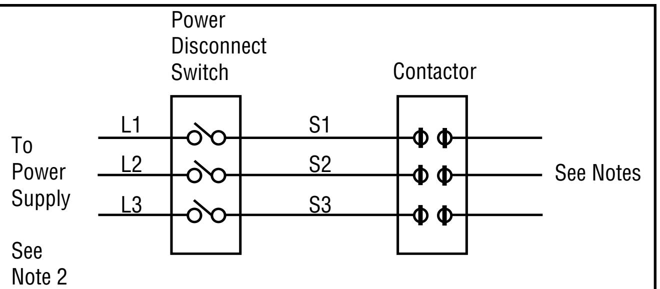
⚠WARNING

ELECTRIC SHOCK HAZARD. Any installation involving electric heaters must be performed by a qualified person and must be effectively grounded in accordance with the National Electrical Code to eliminate shock hazard.

1. Use heater only on the voltage and frequency specified on the nameplate.
2. All wiring should be done in accordance with local codes and the National Electrical Code by a qualified person as defined in the NEC.
3. Two knockouts are provided on the back of the heater for wire entry. See Figure 6 for location of knockouts.
4. Branch circuit wire for connection to heater must be at least 60°C wire.
5. The bottom access door is hinged. There is one screw that must be loosened to gain access (Figure 3). This screw is the captive type; do not try to remove it.
6. A ground terminal is provided near the power terminal board. The ground wire should be connected before other connections are made.
7. Stripped wire leads are supplied to be connected to accept the correct size power supply wire. Copper wire rated at 600V and 60°C is satisfactory for the heater branch circuit.
8. Electrical accessories, either kits or factory-installed options, are shown connected by a dash line on the heater wiring diagram.
9. Wiring connections are to be made on designated wire leads as shown in the wiring diagrams located inside the access door.

POWER DISCONNECT SWITCH (Available as a kit or factory installed option.) This switch (Figure 7) disconnects the power to the power leads when the handle is placed in its off position.

1. Use copper conductor supply wire only when connecting to the power line.
2. Connection to the switch pigtails should be made with compression connectors and the joint should be then well insulated.



Notes:

1. This illustration shows wiring hook up for three phase service. Remove lead wires marked L2 and S2 when using single phase power service.
2. For units without contactors, disconnect switch is to be wired to lead wires on heater power.
3. Use copper supply wire only with this switch.

Figure 7
Power Disconnect Switch Wiring Diagram

3. Consult the local wiring code in your area.

SUMMER FAN SWITCH (MOUNTED ON FRONT OF HEATER). When the switch handle is pointing toward the "SUMMER" position, the fan will run continuously. When the switch handle is pointing toward the "WINTER" position, the fan will run only when the heating elements are hot.

REMOTE FAN SWITCH (MANUAL SWITCH-LINE VOLTAGE). 480V requires an additional relay. The wall switch is packed in the wiring compartment.

The remote fan switch is mounted external and remote from the LUH unit heater. The voltage of the remote fan switch is the same as the supply voltage to the LUH heater.

1. Use 14 gauge copper, NEC Class 1, 600V rated insulated wire. Wiring must meet all Local and NEC requirements for 480V service.
2. Install the remote fan switch in standard wall box in any convenient location that is protected from traffic or other accidental damage.
3. Connect the 14 gauge copper field wire to the switch lead wires with suitable connectors.

REMOTE FAN SWITCH (USED WITH 24 or 120-VOLT RELAY) (Available as a kit or factory installed option). The wall switch is packed in the wiring compartment.

1. Use 18 gauge (min.) NEC Class 1, 600V wiring that meets all Local and NEC requirements.
2. Install the wall switch in a standard wall box in any convenient location that is protected from traffic or other accidental damage.
3. Connect the field wire to the switch lead wires with suitable connectors.

Figure 8 — Thermostat Location, Front View

OPTIONAL THERMOSTAT (LUH-TK)

Heaters can be equipped with an optional thermostat of the Bulb and Capillary type for automatic temperature control (Figure 8). The thermostat controls the heating elements and fan simultaneously to achieve set temperature.

The "Lo" setting of the thermostat is approximately 40°F, and the "Hi" setting is approximately 90°F.

CONTROL VOLTAGE WIRING - EXTERNAL REMOTE THERMOSTATS AND FAN SWITCHES

⚠WARNING

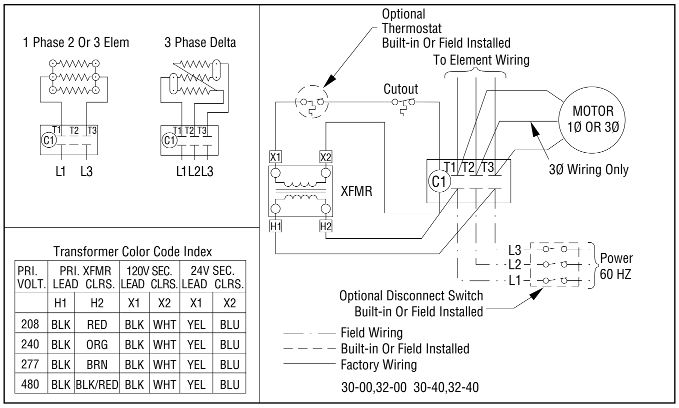
ELECTRIC SHOCK HAZARD. Line voltage is present on some of the terminals. Always disconnect the power from the heater before making any connections.

1. Use 600V, NEC Class 1 insulated wiring with a minimum gauge of 18 for thermostats and a minimum gauge of 14 for line voltage motor switch (remote fan switch without relay).
2. The thermostat should be located in the area to be heated on an inside wall. The thermostat should not be exposed to drafts, sunlight, radiation from hot objects, or in a direct line with the discharge from the unit heater.
3. Install the thermostat approximately 5 feet above the floor line.
4. Install the remote fan switch in any convenient location that is protected from traffic or likely accidental damage.
5. Internal optional controls are shown on the unit heater wiring diagrams by a dash line.

Use wiring diagrams as listed for model number on (A through X), pages 5, 6 and 9.

For installation and optional control kits, refer to instruction sheets listed on page 8.

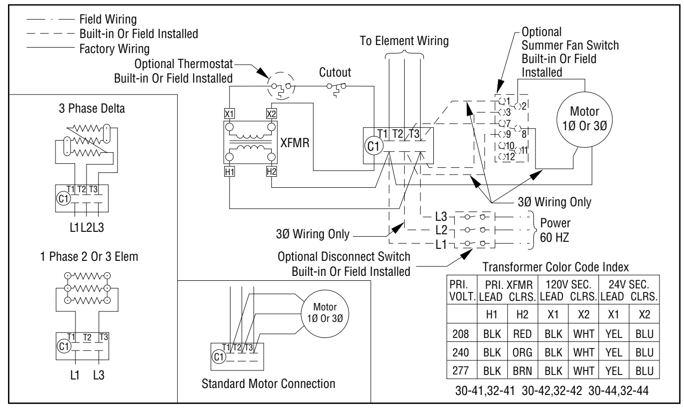
WIRING DIAGRAMS



Transformer Color Code Index

PRI. VOLT.	PRI. XFMR LEAD	CLRS.	120V SEC. LEAD	CLRS.	24V SEC. LEAD	CLRS.
	H1	H2	X1	X2	X1	X2
208	BLK	RED	BLK	WHT	YEL	BLU
240	BLK	ORG	BLK	WHT	YEL	BLU
277	BLK	BRN	BLK	WHT	YEL	BLU
480	BLK	BLK/RED	BLK	WHT	YEL	BLU

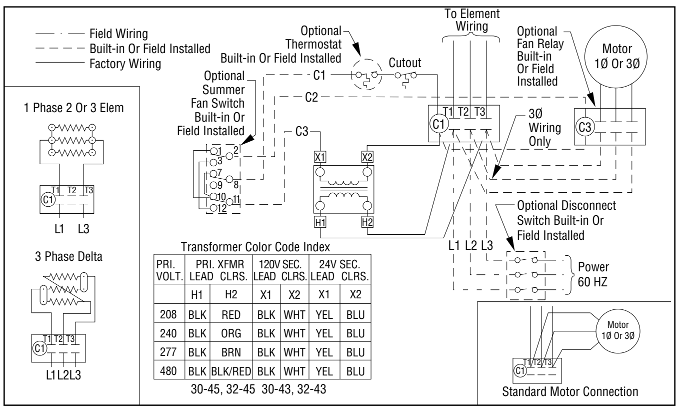
Figure A



Transformer Color Code Index

PRI. VOLT.	PRI. XFMR LEAD	CLRS.	120V SEC. LEAD	CLRS.	24V SEC. LEAD	CLRS.
	H1	H2	X1	X2	X1	X2
208	BLK	RED	BLK	WHT	YEL	BLU
240	BLK	ORG	BLK	WHT	YEL	BLU
277	BLK	BRN	BLK	WHT	YEL	BLU

Figure B



Transformer Color Code Index

PRI. VOLT.	PRI. XFMR LEAD	CLRS.	120V SEC. LEAD	CLRS.	24V SEC. LEAD	CLRS.
	H1	H2	X1	X2	X1	X2
208	BLK	RED	BLK	WHT	YEL	BLU
240	BLK	ORG	BLK	WHT	YEL	BLU
277	BLK	BRN	BLK	WHT	YEL	BLU
480	BLK	BLK/RED	BLK	WHT	YEL	BLU

Figure C

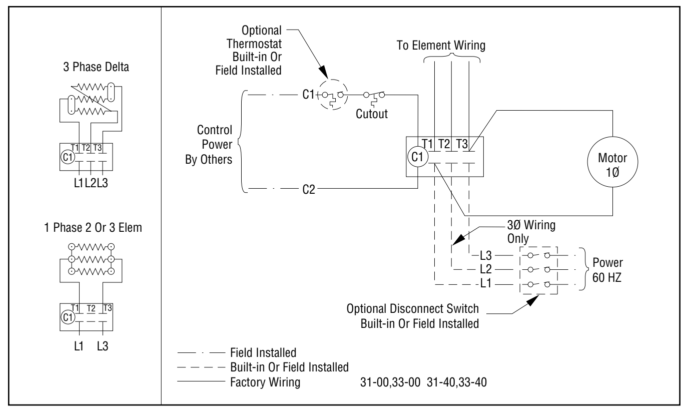


Figure D

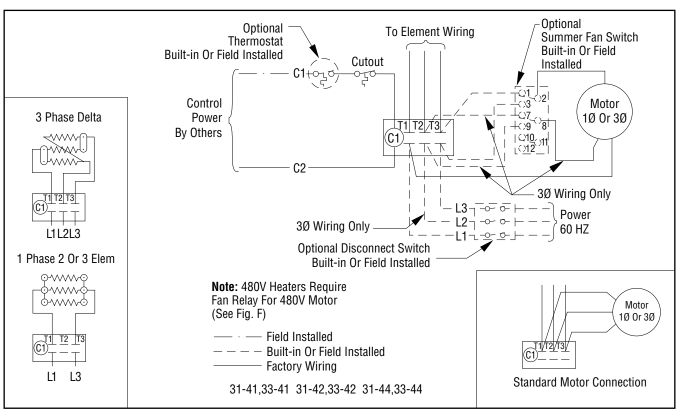


Figure E

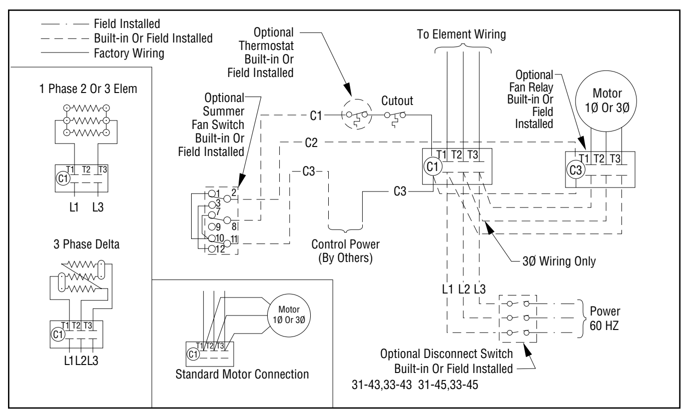


Figure F

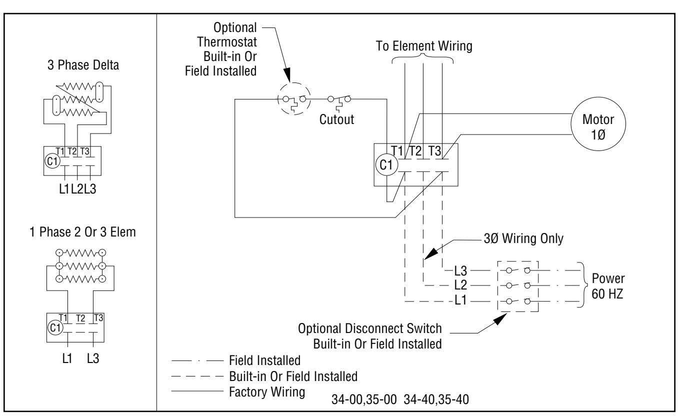


Figure G

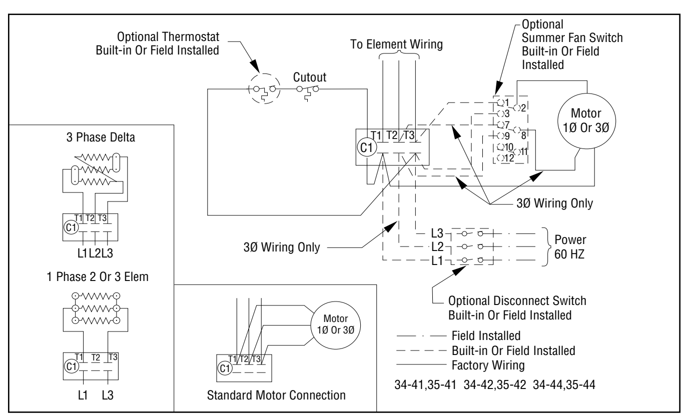


Figure H

WIRING DIAGRAMS

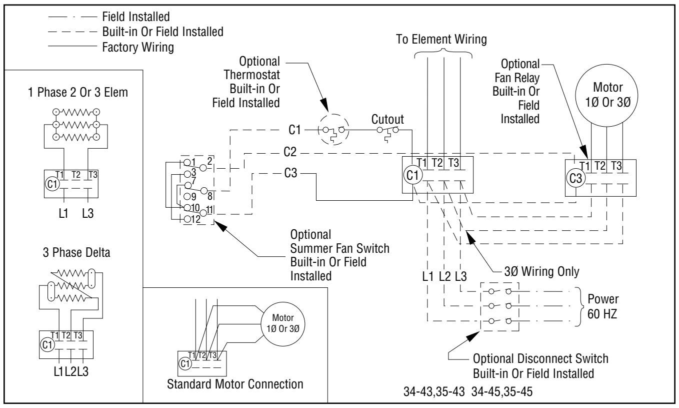
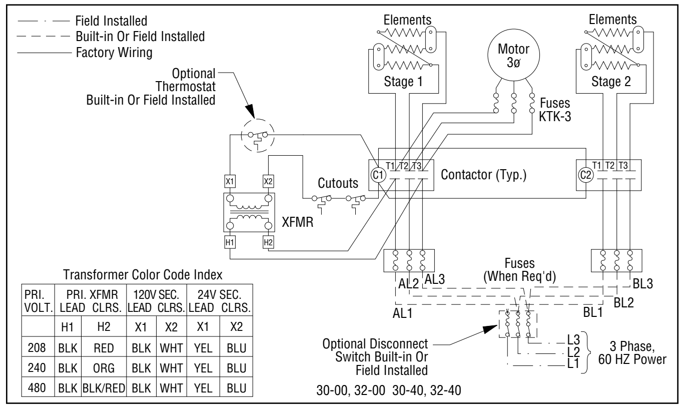


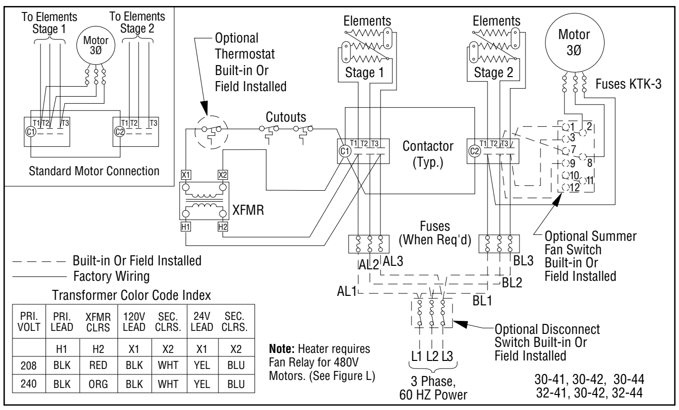
Figure I



Transformer Color Code Index

PRI. VOLT.	PRI. XFMR LEAD	CLRS.	120V SEC. LEAD	CLRS.	24V SEC. LEAD	CLRS.
	H1	H2	X1	X2	X1	X2
208	BLK	RED	BLK	WHT	YEL	BLU
240	BLK	ORG	BLK	WHT	YEL	BLU
480	BLK	BLK/RED	BLK	WHT	YEL	BLU

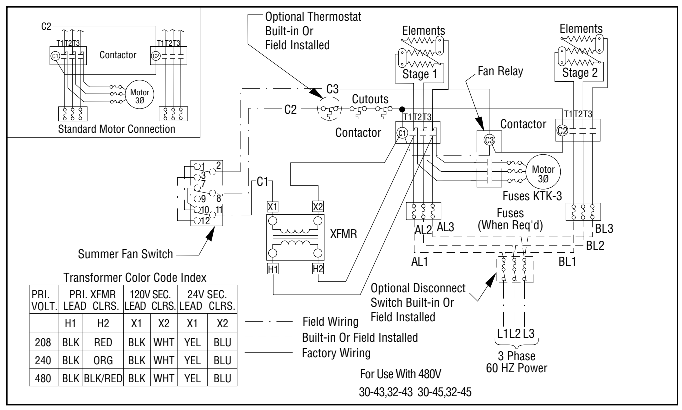
Figure J



Transformer Color Code Index

PRI. VOLT	PRI. LEAD	XFMR CLRS	120V LEAD	SEC. CLRS.	24V LEAD	SEC. CLRS.
	H1	H2	X1	X2	X1	X2
208	BLK	RED	BLK	WHT	YEL	BLU
240	BLK	ORG	BLK	WHT	YEL	BLU

Figure K



Transformer Color Code Index

PRI. VOLT.	PRI. XFMR LEAD	CLRS.	120V SEC. LEAD	CLRS.	24V SEC. LEAD	CLRS.
	H1	H2	X1	X2	X1	X2
208	BLK	RED	BLK	WHT	YEL	BLU
240	BLK	ORG	BLK	WHT	YEL	BLU
480	BLK	BLK/RED	BLK	WHT	YEL	BLU

Figure L

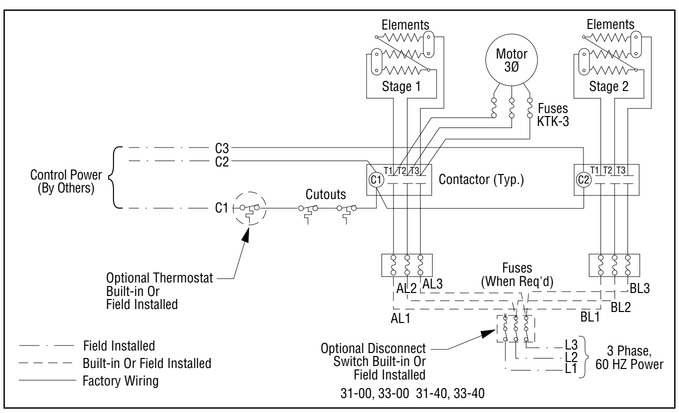


Figure M

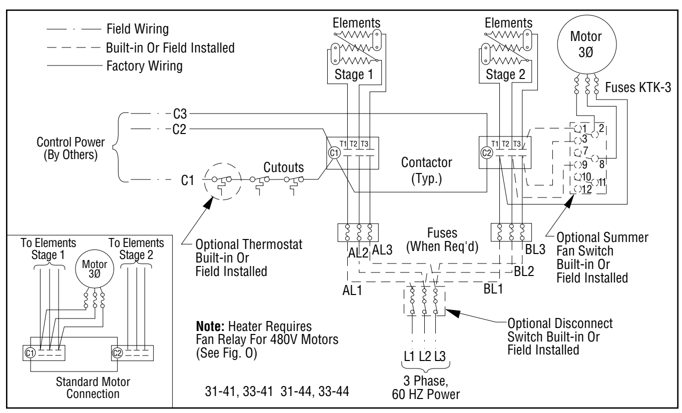


Figure N

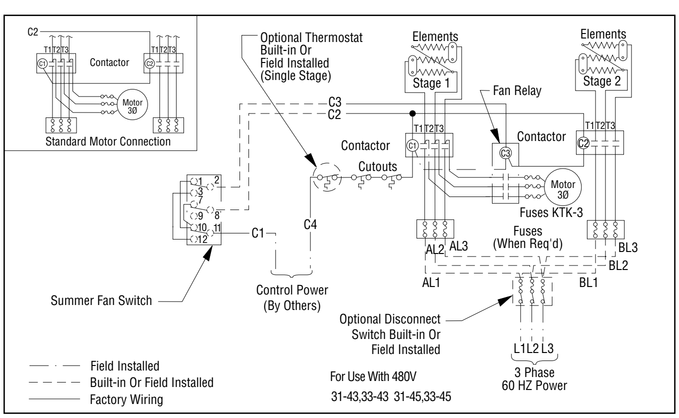


Figure O

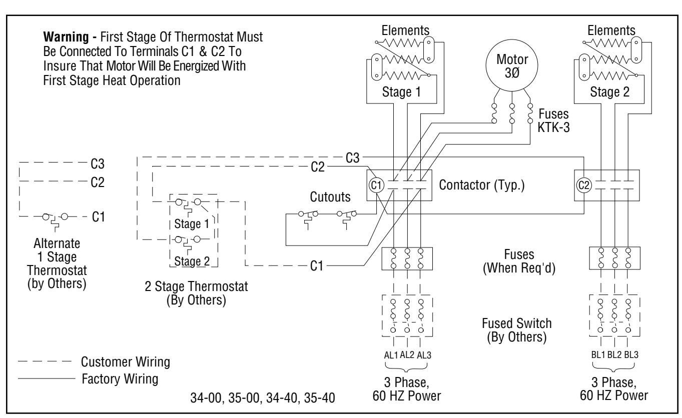


Figure P

RENEWAL PARTS IDENTIFICATION

MANUFACTURER PART NUMBER BREAKDOWN
FOR MADE TO ORDER UNITS
(LOCATED ON UNIT NAMEPLATE)

L U H – D – ☐ ☐ – ☐ ☐ – ☐ ☐ – ☐ ☐ – ☐

Code	kW	Volts	Phase	Element Part No.	Motor Part No.	Fan Part No.
02-81	2.67	208	1	118-303160-001 (2)	193-302912-001	112-302997-001
02-21	2.67	208/240	1	118-303160-002 (2)	193-302912-001	112-302997-001
02-71	2.67	277	1	118-303160-003 (2)	193-302120-001	112-130367-001
04-81	4	208	1	118-303160-001 (3)	193-302912-001	112-302997-001
04-83	4	208	3	118-303160-001 (3)	193-302912-001	112-302997-001
04-21	3/4	208/240	1	118-303160-002 (3)	193-302912-001	112-302997-001
04-23	3/4	208/240	3	118-303160-002 (3)	193-302912-001	112-302997-001
04-71	4	277	1	118-303160-003 (3)	193-302120-001	112-130367-001
04-43	4	480	3	118-303160-004 (3)	193-302912-003	112-302997-001
05-81	5	208	1	118-303160-005 (3)	193-302912-001	112-302997-001
05-83	5	208	3	118-303160-005 (3)	193-302912-001	112-302997-001
05-21	3.75/5	208/240	1	118-303160-006 (3)	193-302912-001	112-302997-001
05-23	3.75/5	208/240	3	118-303160-006 (3)	193-302912-001	112-302997-001
05-71	5	277	1	118-303160-007 (3)	193-302120-001	112-130367-001
05-43	5	480	3	118-303160-008 (3)	193-302912-003	112-302997-001
07-81	7.5	208	1	118-303170-005 (3)	193-302912-004	112-130367-007
07-83	7.5	208	3	118-303170-005 (3)	193-302912-004	112-130367-007
07-21	5.6/7.5	208/240	1	118-303170-001 (3)	193-302912-004	112-130367-007
07-23	5.6/7.5	208/240	3	118-303170-001 (3)	193-302912-004	112-130367-007
07-71	7.5	277	1	118-303170-006 (3)	193-302120-004	112-130367-007
07-43	7.5	480	3	118-303170-004 (3)	193-302912-005	112-130367-007
10-81	10	208	1	118-303169-001 (3)	193-302912-004	112-130367-002
10-83	10	208	3	118-303169-001 (3)	193-302912-004	112-130367-002
10-21	7.5/10	208/240	1	118-303169-002 (3)	193-302912-004	112-130367-002
10-23	7.5/10	208/240	3	118-303169-002 (3)	193-302912-004	112-130367-002
10-43	10	480	3	118-303169-003 (3)	193-302912-005	112-130367-002
12-83	12.5	208	3	118-303169-004 (3)	193-302912-004	112-130367-002
12-23	9.4/12.5	208/240	3	118-303169-005 (3)	193-302912-004	112-130367-002
12-43	12.5	480	3	118-303169-006 (3)	193-302912-005	112-130367-002
15-83	15	208	3	118-303169-007 (3)	193-302912-004	112-130367-002
15-23	11.2/15	208/240	3	118-303169-008 (3)	193-302912-004	112-130367-002
15-43	15	480	3	118-303169-009 (3)	193-302912-005	112-130367-002
20-23	15/20	208/240	3	118-130419-010 (3)	193-302120-005	112-130367-003
20-43	20	480	3	118-130419-011 (3)	193-302120-005	112-130367-003
25-43	25	480	3	118-130419-012 (3)	193-302120-005	112-130367-003
30-83	30	208	3	118-130384-013 (6)	193-302120-005	112-130367-004
30-23	22.5/30	208/240	3	118-130384-014 (6)	193-302120-005	112-130367-004
30-43	30	480	3	118-130384-015 (6)	193-302120-005	112-130367-004
35-23	26.2/35	208/240	3	118-130384-021 (6)	193-302120-005	112-130367-004
35-43	35	480	3	118-130384-016 (6)	193-302120-005	112-130367-004
40-23	30/40	208/240	3	118-130384-022 (6)	193-302120-005	112-130367-004
40-43	40	480	3	118-130384-017 (6)	193-302120-005	112-130367-004
45-43	45	480	3	118-130384-018 (6)	193-302120-005	112-130367-004

	Part Number			
Description	**2-5kW**	**7.5-15kW**	**20-25kW**	**30-45kW**
Louver	182-130329-001 (4)	182-130329-002 (5)	182-130329-003 (6)	182-130329-003 (6)
Louver spring	276-130368-001 (4)	276-130368-001 (5)	276-130368-001 (6)	276-130368-001 (6)
Cut-Out	300-049200-001	300-049200-001	300-049200-001	300-049200-001
Case Front	043-130336-014	043-130335-011	043-130334-008	043-130334-008
Case Back	043-130379-028	043-130379-031	043-130379-033	043-130379-033
Case Wrapper W/O Fuse Door	043-130314-005	043-130315-004	043-130316-004	043-130317-004
Case Wrapper With Fuse Door				043-130317-005

Power Fuses (Used when heater exceeds 48 Amps)

Code	Description	Part No.
45-53	Fuse Block 600V	129-025643-001 (2)
"30-83, 30-23, 35-23, 40-23"	Fuse Block 250V	129-048473-001
"30-83, 35-23, 40-23"	Fuse 60 Amp	128-026510-007 (6)
30-23	Fuse 50 Amp	128-026510-006 (6)
45-43	Fuse 35 Amp	128-026510-001 (6)

For Contactor Rating, refer to Specification Table shown on Page 1.

Code	Description	Heater Line Volts	Part No.	Wiring Figure
00-40	Thermostat DP	All	300-049197-004	
30-00	Contactor (24 V) 30A	All	072-303180-001	A, J, S
	Contactor (24 V) 50A	All	072-303180-002	
	Transformer	All	315-304252-002	
30-40	Contactor (24 V) 30A	All	072-303180-001	A, J
	Contactor (24 V) 50A	All	072-303180-002	
	Transformer	All	315-304252-002	
	Thermostat SP	All	300-049197-003	
30-41	Contactor (24V) 30A	All	072-303180-001	B, K
	Contactor (24V) 50A	All	072-303180-002	
	Transformer	All	315-304252-002	
	Thermostat SP	All	300-049197-003	
	Fan Switch 3PDT	All	292-057673-001	
30-42	Contactor (24V) 30A	All	072-303180-001	B, K
	Contactor(24V) 50A	All	072-303180-002	
	Transformer	All	315-304252-002	
	Remote Fan Switch 3PDT	All	292-057673-001	
30-43	Contactor (24V) 30A	All	072-303180-001	C, L, T
	Contactor (24V) 50A	All	072-303180-002	
	Transformer	All	315-304252-002	
	Fan Relay	2.6-5kW	072-303180-011	
	Fan Relay	7.5-45kW	072-303180-001	
	Remote Fan Switch 3PDT	All	292-057673-001	
30-44	Contactor (24V) 30A	All	072-303180-001	B, K
	Contactor (24V) 50A	All	072-303180-002	
	Transformer	All	315-304252-002	
	Remote Fan Switch 3PDT	All	292-057673-001	
	Thermostat SP	All	300-049197-003	
30-45	Contactor (24V) 30A	All	072-303180-001	C, L
	Contactor (24V) 50A	All	072-303180-002	
	Transformer	All	315-304252-002	
	Remote Fan Switch 3PDT	All	292-057673-001	
	Fan Relay	2.6-5kW	072-303180-011	
	Fan Relay	7.5-45kW	072-303180-001	
	Thermostat SP	All	300-049197-003	
31-00	Contactor (24V) 30A	All	072-303180-001	D, M, U
	Contactor (24V) 50A	All	072-303180-002	
31-40	Contactor (24V) 30A	All	072-303180-001	D, M
	Contactor (24V) 50A	All	072-303180-002	
	Thermostat SP	All	300-049197-003	
31-41	Contactor (24V) 30A	All	072-303180-001	E, N
	Contactor (24V) 50A	All	072-303180-002	
	Thermostat SP	All	300-049197-003	
	Fan Switch 3PDT	All	292-057673-001	
31-42	Contactor (24V) 30A	All	072-303180-001	E, N, V
	Contactor (24V) 50A	All	072-303180-002	
	Remote Fan Switch 3PDT	All	292-057673-001	
31-43	Contactor (24V) 30A	All	072-303180-001	F, O, R
	Contactor (24V) 50A	All	072-303180-002	
	Fan Relay	2.6-5kW	072-303180-011	
	Fan Relay	7.5-45kW	072-303180-001	
	Remote Fan Switch 3PDT	All	292-057673-001	
31-44	Contactor (24V) 30A	All	072-303180-001	E, N
	Contactor (24V) 50A	All	072-303180-002	
	Remote Fan Switch 3PDT	All	292-057673-001	
	Thermostat SP	All	300-049197-003	
31-45	Contactor (24V) 30A	All	072-303180-001	F, O
	Contactor (24V) 50A	All	072-303180-002	
	Fan Relay	All	072-303180-001	
	Fan Relay	7.5-45kW	072-303180-011	
	Remote Fan Switch 3PDT	All	292-057673-001	
	Thermostat SP	All	300-049197-003	
32-00	Contactor (120) 30A	All	072-303180-007	A, J, S
	Contactor (120) 50A	All	072-303180-008	
	Transformer	All	315-304252-001	
32-40	Contactor (120) 30A	All	072-303180-007	A, J
	Contactor (120) 50A	All	072-303180-008	
	Transformer	All	315-304252-001	
	Thermostat SP	All	300-049197-003	
32-41	Contactor (120) 30A	All	072-303180-007	B, K
	Contactor (120) 50A	All	072-303180-008	
	Transformer	All	315-304252-001	
	Thermostat SP	All	300-049197-003	
	Fan Switch 3PDT	All	292-057673-001	
32-42	Contactor (120) 30A	All	072-303180-007	B, K
	Contactor (120) 50A	All	072-303180-008	
	Transformer	All	315-304252-001	
	Remote Fan Switch 3PDT	All	292-057673-001	
32-43	Contactor (120) 30A	All	072-303180-007	C, L, T
	Contactor (120) 50A	All	072-303180-008	
	Transformer	All	315-304252-001	
	Fan Relay	2.6-5kW	072-303180-011	
	Fan Relay	7.5-45kW	072-303180-001	
	Remote Fan Switch 3PDT	All	292-057673-001	
32-44	Contactor (120) 30A	All	072-303180-007	B, K
	Contactor (120) 50A	All	072-303180-008	
	Transformer	All	315-304252-001	
	Remote Fan Switch	All	292-057673-001	
	Thermostat SP	All	300-049197-003	

Code	Description	Heater Line Volts	Part No.	Wiring Figure
32-45	Contactor (120) 30A	All	072-303180-007	C, L
	Contactor (120) 50A	All	072-303180-008	
	Transformer	All	315-304252-001	
	Fan Relay	2.6-5kW	072-303180-011	
	Fan Relay	7.5-45kW	072-303180-007	
	Remote Fan Switch 3PDT	All	292-057673-001	
	Thermostat SP	All	300-049197-003	
33-00	Contactor (120) 30A	All	072-303180-007	D, M, U
	Contactor (120) 50A	All	072-303180-008	
33-40	Contactor (120) 30A	All	072-303180-007	D, M
	Contactor (120) 50A	All	072-303180-008	
	Thermostat SP	All	300-049197-003	
33-41	Contactor (120) 30A	All	072-303180-007	E, N
	Contactor (120) 50A	All	072-303180-008	
	Fan Switch 3PDT	All	292-057673-001	
	Thermostat SP	All	300-049197-003	
33-42	Contactor (120) 30A	All	072-303180-007	E, N, V
	Contactor (120) 50A	All	072-303180-007	
	Remote Fan Switch 3PDT	All	292-057673-001	
33-43	Contactor (120) 30A	All	072-303180-007	F, O, R
	Contactor (120) 50A	All	072-303180-008	
	Fan Relay	2.6-5kW	072-303180-011	
	Fan Relay (120V)	7.5-45kW	072-303180-007	
	Remote Fan Switch 3PDT	All	292-057673-001	
33-44	Contactor (120) 30A	All	072-303180-007	E, N
	Contactor (120) 50A	All	072-303180-007	
	Remote Fan Switch 3PDT	All	292-057673-001	
	Thermostat SP	All	300-049197-003	
33-45	Contactor (120) 30A	All	072-303180-007	F, O
	Contactor (120) 50A	All	072-303180-008	
	Fan Relay	2.6-5kW	072-303180-011	
	Fan Relay	7.5-45kW	072-303180-007	
	Remote Fan Switch 3PDT	All	292-057673-001	
	Thermostat SP	All	300-049197-003	
34-00	Contactor (208/240) 30A	208/240	072-303180-013	G, P
	Contactor (208/240) 50A	208/240	072-303180-014	
34-40	Contactor (208/240) 30A	208/240	072-303180-013	G, P
	Contactor (208/240) 50A	208/240	072-303180-014	
	Thermostat SP	208/240	300-049197-003	
34-41	Contactor (208/240) 30A	208/240	072-303180-013	H, Q
	Contactor (208/240) 50A	208/240	072-303180-014	
	Fan Switch 3PDT	208/240	292-057673-001	
	Thermostat SP	208/240	300-049197-003	
34-42	Contactor (208/240) 30A	208/240	072-303180-013	H, Q
	Contactor (208/240) 50A	208/240	072-303180-014	
	Remote Fan Switch 3PDT	208/240	292-057673-001	
34-43	Contactor (208/240) 30A	208/240	072-303180-013	I, R, V
	Contactor (208/240) 50A	208/240	072-303180-014	
	Fan Relay	208/240	072-303180-013	
	Remote Fan Switch 3PDT	208/240	292-057673-001	
34-44	Contactor (208/240) 30A	208/240	072-303180-013	H, Q
	Contactor (208/240) 50A	208/240	072-303180-014	
	Remote Fan Switch 3PDT	208/240	292-057673-001	
	Thermostat SP	208/240	300-049197-003	
34-45	Contactor (208/240) 30A	208/240	072-303180-013	I, R, V
	Contactor (208/240) 50A	208/240	072-303180-014	
	Fan Relay	208/240	072-303180-013	
	Remote Fan Switch 3PDT	208/240	292-057673-001	
	Thermostat SP	208/240	300-049197-003	
35-00	Contactor (277) 30A	277	072-303180-019	G
	Contactor (277) 50A	277	072-303180-020	
35-40	Contactor (277) 30A	277	072-303180-019	G
	Contactor (277) 50A	277	072-303180-020	
	Thermostat SP	277	300-049197-003	
35-41	Contactor (277) 30A	277	072-303180-019	H
	Contactor (277) 50A	277	072-303180-020	
	Fan Switch 3PDT	277	292-057673-001	
	Thermostat SP	277	300-049197-003	
35-42	Contactor (277) 30A	277	072-303180-019	H
	Contactor (277) 50A	277	072-303180-020	
	Remote Fan Switch 3PDT	277	292-057673-001	
35-43	Contactor (277) 30A	277	072-303180-019	I
	Contactor (277) 50A	277	072-303180-020	
	Fan Relay	277	072-303180-019	
	Remote Fan Switch 3PDT	277	292-057673-001	
35-44	Contactor (277) 30A	277	072-303180-019	H
	Contactor (277) 50A	277	072-303180-020	
	Remote Fan Switch 3PDT	277	292-057673-001	
	Thermostat SP	277	300-049197-003	
35-45	Contactor (277) 30A	277	072-303180-019	I
	Contactor (277) 50A	277	072-303180-020	
	Fan Relay	277	072-303180-019	
	Remote Fan Switch 3PDT	277	292-057673-001	
	Thermostat SP	277	300-049197-003	

Note: Number in parentheses () in the Part Number Column indicates the quantity of that part required.

Code	Disconnect Rating	Disconnect Part No.
1	40A	292-303472-001
2	80A	292-303472-002
3	100A	292-303472-003

Miscellaneous Parts	
Thermostat Knob	169-049278-001
Mod. Decal Card	170-303678-001

Instruction Sheets	
1. Internal Thermostat	PF-448
2. Internal/External Summer Fan Switch	PF-480
3. Internal/External Summer Fan Switch with Relay	PF-481
4. Disconnect Switch	PF-482

WIRING DIAGRAMS

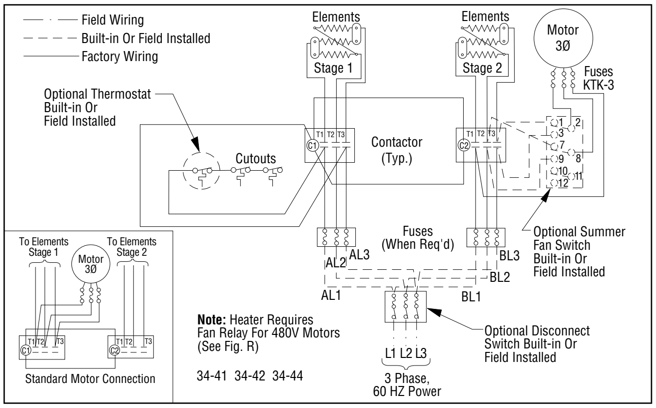


Figure Q

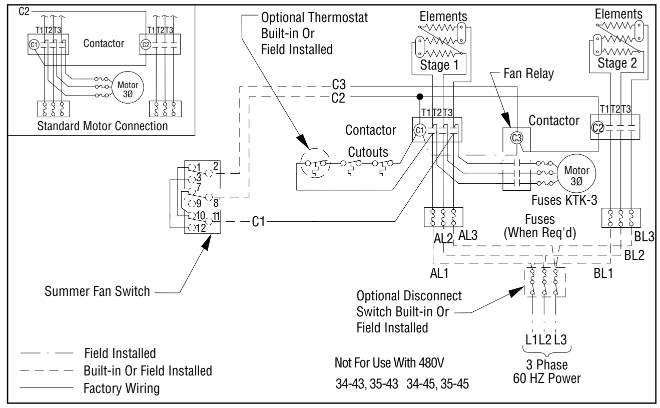
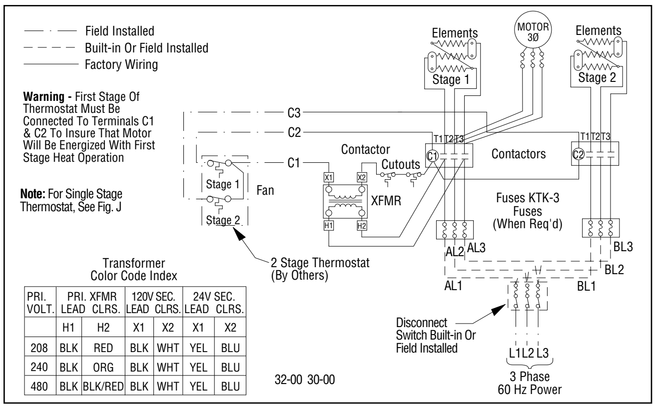
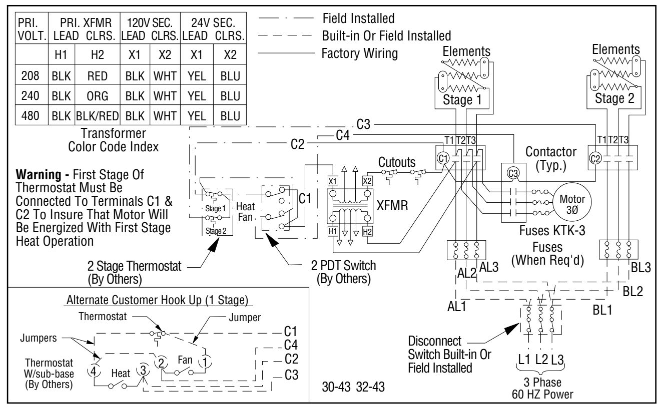


Figure R



PRI. VOLT.	PRI. XFMR LEAD CLRS.		120V SEC. LEAD CLRS.		24V SEC. LEAD CLRS.	
	H1	H2	X1	X2	X1	X2
208	BLK	RED	BLK	WHT	YEL	BLU
240	BLK	ORG	BLK	WHT	YEL	BLU
480	BLK	BLK/RED	BLK	WHT	YEL	BLU

Figure S



PRI. VOLT.	PRI. XFMR LEAD CLRS.		120V SEC. LEAD CLRS.		24V SEC. LEAD CLRS.	
	H1	H2	X1	X2	X1	X2
208	BLK	RED	BLK	WHT	YEL	BLU
240	BLK	ORG	BLK	WHT	YEL	BLU
480	BLK	BLK/RED	BLK	WHT	YEL	BLU

Figure T

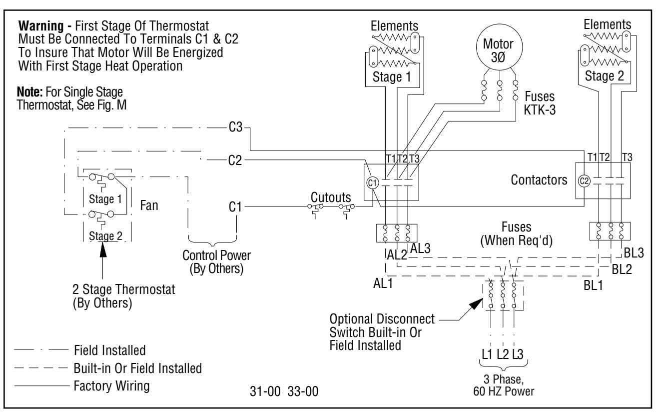


Figure U

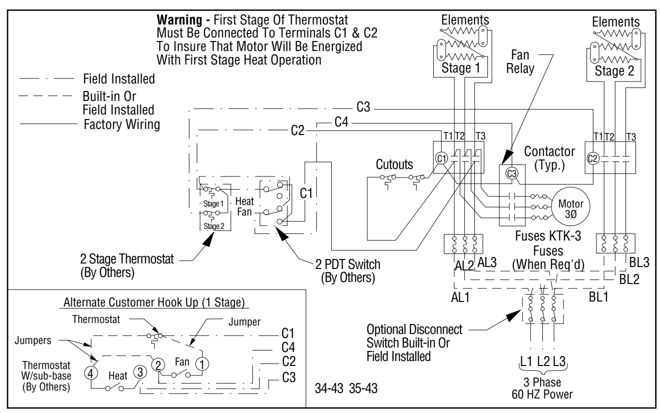


Figure V

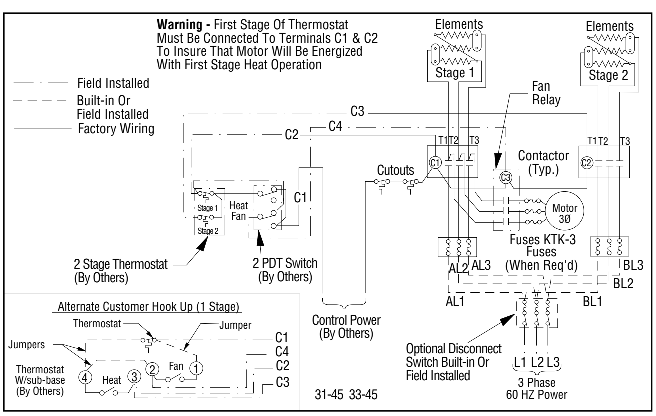
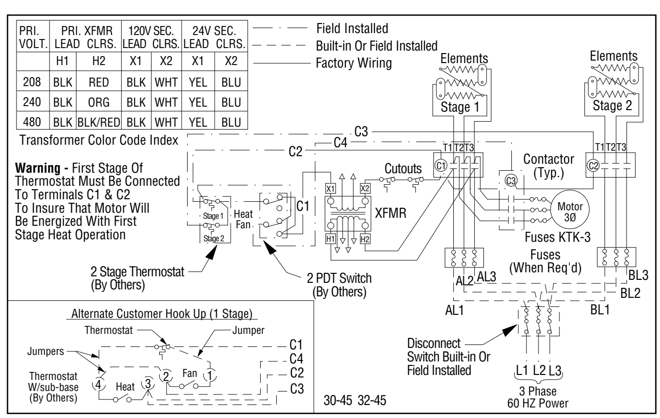


Figure W



PRI. VOLT.	PRI. XFMR LEAD CLRS.		120V SEC. LEAD CLRS.		24V SEC. LEAD CLRS.	
	H1	H2	X1	X2	X1	X2
208	BLK	RED	BLK	WHT	YEL	BLU
240	BLK	ORG	BLK	WHT	YEL	BLU
480	BLK	BLK/RED	BLK	WHT	YEL	BLU

Figure X

Limited Warranty:
Please refer to the Chromalox limited warranty applicable to this product at
http://www.chromalox.com/customer-service/policies/termsofsale.aspx.

Chromalox®
PRECISION HEAT AND CONTROL

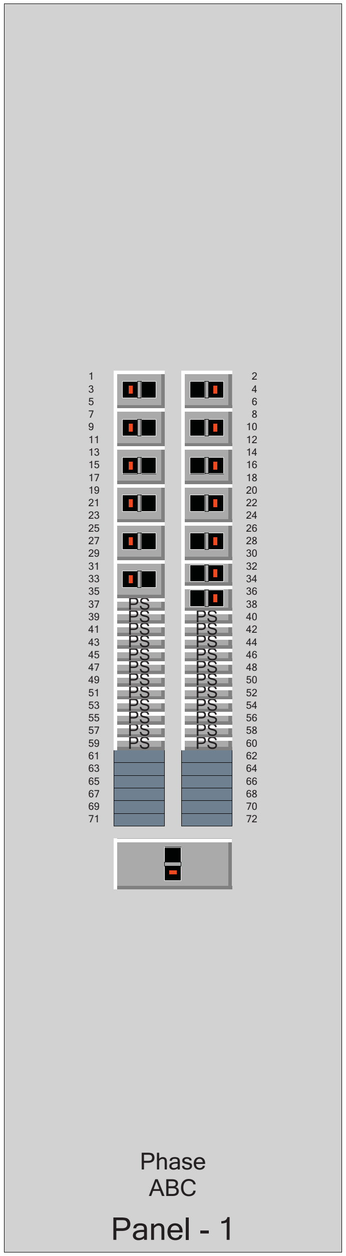
2150 N. RULON WHITE BLVD., OGDEN, UT 84404
Phone: 1-800-368-2493 www.chromalox.com

Chapter 28 ELECTRICAL PANELS

MANUFACTURER/DISTRIBUTOR:

CDE
298, Rue De Martigny Ouest
Saint-Jérôme (Québec)
J7Y 4C9
Phone.: (450) 438-1263
Fax: (450) 438-3728
Courriel : cde@cde.qc.ca

Shop Drawings
Contractor Approval
Approved by: S.B.S., G. F.
Date: Apr 28, 2015
SIFEC NORTH INC



Panel - 1

- Feeder 100A / 3P QOB_VH PH ABC
- Feeder 80A / 3P QOB_VH PH ABC
- Feeder 80A / 3P QOB_VH PH ABC
- Feeder 60A / 3P QOB_VH PH ABC
- Feeder 15A / 3P QOB_VH PH ABC
- Feeder 15A / 3P QOB_VH PH ABC
- Feeder 15A / 3P QOB_VH PH ABC
- Feeder 15A / 3P QOB_VH PH ABC
- Feeder 15A / 3P QOB_VH PH ABC
- Feeder 15A / 3P QOB_VH PH ABC
- Feeder 30A / 2P QOB_VH PH AB
- Feeder 15A / 3P QOB_VH PH ABC
- Prepared Space 15A / 1P PH A
- Feeder 30A / 2P QOB_VH PH CA
- Prepared Space 15A / 1P PH B
- Prepared Space 15A / 1P PH B
- Prepared Space 15A / 1P PH C
- Prepared Space 15A / 1P PH C
- Prepared Space 15A / 1P PH A
- Prepared Space 15A / 1P PH A
- Prepared Space 15A / 1P PH B
- Prepared Space 15A / 1P PH B
- Prepared Space 15A / 1P PH C
- Prepared Space 15A / 1P PH C
- Prepared Space 15A / 1P PH A
- Prepared Space 15A / 1P PH A
- Prepared Space 15A / 1P PH B
- Prepared Space 15A / 1P PH B
- Prepared Space 15A / 1P PH C
- Prepared Space 15A / 1P PH C
- Prepared Space 15A / 1P PH A
- Prepared Space 15A / 1P PH A
- Prepared Space 15A / 1P PH B
- Prepared Space 15A / 1P PH B
- Prepared Space 15A / 1P PH C
- Prepared Space 15A / 1P PH C
- Main 250A LA

Properties

Property	Value
Panel Type	NQ Standard
System	208Y/120-VAC 3-Phase, 4-W
Panel Number	1
H x W x D	74 x 20 x 6.5
Enclosure Type	Type 3R/4/4X/5/12 Stainles
Max # of Circuits	72
Trim Front	Not Required
Interior amps	400
Feed	ThroughTheBottom

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SIFEC NORTH INC

Properties

Panelboard
Description: Panelboard
Section Count: 1
Default Height: 48
Default Base Height: 1
Default Header Height: 0
Lineup Depth: 6.5

Panel - 1
Panel Type: NQ Standard
System: 208Y/120-VAC 3-Phase, 4-Wire 60 Hz
Panel Number: 1
H x W x D: 74 x 20 x 6.5
Enclosure Type: Type 3R/4/4X/5/12 StainlessStl
Max # of Circuits: 72
Trim Front: Not Required
Interior amps: 400
Feed: ThroughTheBottom

Feeder 100A / 3P QOB_VH PH ABC
Device Application: Feeder
Device Associated to: Main One
Phase Connection: ABC
Trip Ampacity: 100A
Breaker Type: Thermal-Mag / Basic Electronic
Breaker Frame Identification: QOB-VH
Device Load Connection Type: Al Mech Lug, Al / Cu Cable
Device Rating: 80% Rated
Wire Range Per Lug: #4 - 2/0 AWG
Quantity of Poles: 3
Neutral: Yes
Height: 2.25"

Feeder 80A / 3P QOB_VH PH ABC
Device Application: Feeder
Device Associated to: Main One
Phase Connection: ABC
Trip Ampacity: 80A
Breaker Type: Thermal-Mag / Basic Electronic
Breaker Frame Identification: QOB-VH
Device Load Connection Type: Al Mech Lug, Al / Cu Cable
Device Rating: 80% Rated
Wire Range Per Lug: #4 - 2/0 AWG
Quantity of Poles: 3
Neutral: Yes
Height: 2.25"

Feeder 80A / 3P QOB_VH PH ABC
Device Application: Feeder
Device Associated to: Main One
Phase Connection: ABC
Trip Ampacity: 80A
Breaker Type: Thermal-Mag / Basic Electronic
Breaker Frame Identification: QOB-VH
Device Load Connection Type: Al Mech Lug, Al / Cu Cable
Device Rating: 80% Rated
Wire Range Per Lug: #4 - 2/0 AWG
Quantity of Poles: 3
Neutral: Yes
Height: 2.25"

Feeder 60A / 3P QOB_VH PH ABC
Device Application: Feeder
Device Associated to: Main One
Phase Connection: ABC
Trip Ampacity: 60A
Breaker Type: Thermal-Mag / Basic Electronic
Breaker Frame Identification: QOB-VH
Device Load Connection Type: Al Mech Lug, Al / Cu Cable
Device Rating: 80% Rated
Wire Range Per Lug: #8 - #2 AWG
Quantity of Poles: 3
Neutral: Yes
Height: 2.25"

Feeder 15A / 3P QOB_VH PH ABC
Device Application: Feeder
Device Associated to: Main One
Phase Connection: ABC
Trip Ampacity: 15A
Breaker Type: Thermal-Mag / Basic Electronic
Breaker Frame Identification: QOB-VH
Device Load Connection Type: Al Mech Lug, Al / Cu Cable
Device Rating: 80% Rated
Wire Range Per Lug: #4 - 300 kcmil
Quantity of Poles: 3
Neutral: Yes
Height: 2.25"

Shop Drawings
Contractor Approval
Approved by: S.B.S., G. F.
Date: Apr 28, 2015
SIFEC NORTH INC

Properties

Height: 2.25"

<u>Feeder 15A / 3P QOB_VH PH ABC</u>
Device Application: Feeder
Device Associated to: Main One
Phase Connection: ABC
Trip Ampacity: 15A
Breaker Type: Thermal-Mag / Basic Electronic
Breaker Frame Identification: QOB-VH
Device Load Connection Type: Al Mech Lug, Al / Cu Cable
Device Rating: 80% Rated
Wire Range Per Lug: #4 - 300 kcmil
Quantity of Poles: 3
Neutral: Yes
Height: 2.25"

<u>Feeder 15A / 3P QOB_VH PH ABC</u>
Device Application: Feeder
Device Associated to: Main One
Phase Connection: ABC
Trip Ampacity: 15A
Breaker Type: Thermal-Mag / Basic Electronic
Breaker Frame Identification: QOB-VH
Device Load Connection Type: Al Mech Lug, Al / Cu Cable
Device Rating: 80% Rated
Wire Range Per Lug: #4 - 300 kcmil
Quantity of Poles: 3
Neutral: Yes
Height: 2.25"

<u>Feeder 15A / 3P QOB_VH PH ABC</u>
Device Application: Feeder
Device Associated to: Main One
Phase Connection: ABC
Trip Ampacity: 15A
Breaker Type: Thermal-Mag / Basic Electronic
Breaker Frame Identification: QOB-VH
Device Load Connection Type: Al Mech Lug, Al / Cu Cable
Device Rating: 80% Rated
Wire Range Per Lug: #4 - 300 kcmil
Quantity of Poles: 3
Neutral: Yes
Height: 2.25"

<u>Feeder 15A / 3P QOB_VH PH ABC</u>
Device Application: Feeder
Device Associated to: Main One
Phase Connection: ABC
Trip Ampacity: 15A
Breaker Type: Thermal-Mag / Basic Electronic
Breaker Frame Identification: QOB-VH
Device Load Connection Type: Al Mech Lug, Al / Cu Cable
Device Rating: 80% Rated
Wire Range Per Lug: #4 - 300 kcmil
Quantity of Poles: 3
Neutral: Yes
Height: 2.25"

<u>Feeder 15A / 3P QOB_VH PH ABC</u>
Device Application: Feeder
Device Associated to: Main One
Phase Connection: ABC
Trip Ampacity: 15A
Breaker Type: Thermal-Mag / Basic Electronic
Breaker Frame Identification: QOB-VH
Device Load Connection Type: Al Mech Lug, Al / Cu Cable
Device Rating: 80% Rated
Wire Range Per Lug: #4 - 300 kcmil
Quantity of Poles: 3
Neutral: Yes
Height: 2.25"

<u>Feeder 30A / 2P QOB_VH PH AB</u>
Device Application: Feeder
Device Associated to: Main One
Phase Connection: AB
Trip Ampacity: 30A
Breaker Type: Thermal-Mag / Basic Electronic
Breaker Frame Identification: QOB-VH
Device Load Connection Type: Al Mech Lug, Al / Cu Cable
Device Rating: 80% Rated
Wire Range Per Lug: #14 - #8 AWG
Quantity of Poles: 2
Neutral: Yes
Height: 1.5"

<u>Feeder 15A / 3P QOB_VH PH ABC</u>
Device Application: Feeder

Properties

Device Application: Feeder
Device Associated to: Main One
Phase Connection: ABC
Trip Ampacity: 15A
Breaker Type: Thermal-Mag / Basic Electronic
Breaker Frame Identification: QOB-VH
Device Load Connection Type: Al Mech Lug, Al / Cu Cable
Device Rating: 80% Rated
Wire Range Per Lug: #4 - 300 kcmil
Quantity of Poles: 3
Neutral: Yes
Height: 2.25"

Prepared Space 15A / 1P PH A
Device Application: Feeder
Device Associated to: Main One
Phase Connection: A
Trip Ampacity: 15A
Breaker Type: Thermal-Mag / Basic Electronic
Breaker Frame Identification: QOB-VH
Device Load Connection Type: Al Mech Lug, Al / Cu Cable
Prepared Space: Yes
Device Rating: 80% Rated
Wire Range Per Lug: #14 - #8 AWG
Quantity of Poles: 1
Neutral: Yes
Height: 0.75"

Feeder 30A / 2P QOB VH PH CA
Device Application: Feeder
Device Associated to: Main One
Phase Connection: CA
Trip Ampacity: 30A
Breaker Type: Thermal-Mag / Basic Electronic
Breaker Frame Identification: QOB-VH
Device Load Connection Type: Al Mech Lug, Al / Cu Cable
Device Rating: 80% Rated
Wire Range Per Lug: #14 - #8 AWG
Quantity of Poles: 2
Neutral: Yes
Height: 1.5"

Prepared Space 15A / 1P PH B
Device Application: Feeder
Device Associated to: Main One
Phase Connection: B
Trip Ampacity: 15A
Breaker Type: Thermal-Mag / Basic Electronic
Breaker Frame Identification: QOB-VH
Device Load Connection Type: Al Mech Lug, Al / Cu Cable
Prepared Space: Yes
Device Rating: 80% Rated
Wire Range Per Lug: #14 - #8 AWG
Quantity of Poles: 1
Neutral: Yes
Height: 0.75"

Prepared Space 15A / 1P PH B
Device Application: Feeder
Device Associated to: Main One
Phase Connection: B
Trip Ampacity: 15A
Breaker Type: Thermal-Mag / Basic Electronic
Breaker Frame Identification: QOB-VH
Device Load Connection Type: Al Mech Lug, Al / Cu Cable
Prepared Space: Yes
Device Rating: 80% Rated
Wire Range Per Lug: #14 - #8 AWG
Quantity of Poles: 1
Neutral: Yes
Height: 0.75"

Prepared Space 15A / 1P PH C
Device Application: Feeder
Device Associated to: Main One
Phase Connection: C
Trip Ampacity: 15A
Breaker Type: Thermal-Mag / Basic Electronic
Breaker Frame Identification: QOB-VH
Device Load Connection Type: Al Mech Lug, Al / Cu Cable
Prepared Space: Yes
Device Rating: 80% Rated
Wire Range Per Lug: #14 - #8 AWG
Quantity of Poles: 1
Neutral: Yes
Height: 0.75"

Prepared Space 15A / 1P PH C

Shop Drawings
Contractor Approval
Approved by: S.B.S., G. F.
Date: Apr 28, 2015
SIFEC NORTH INC

Properties

Prepared Space 15A / 1P PH C
Device Application: Feeder
Device Associated to: Main One
Phase Connection: C
Trip Ampacity: 15A
Breaker Type: Thermal-Mag / Basic Electronic
Breaker Frame Identification: QOB-VH
Device Load Connection Type: Al Mech Lug, Al / Cu Cable
Prepared Space: Yes
Device Rating: 80% Rated
Wire Range Per Lug: #14 - #8 AWG
Quantity of Poles: 1
Neutral: Yes
Height: 0.75"

Prepared Space 15A / 1P PH A
Device Application: Feeder
Device Associated to: Main One
Phase Connection: A
Trip Ampacity: 15A
Breaker Type: Thermal-Mag / Basic Electronic
Breaker Frame Identification: QOB-VH
Device Load Connection Type: Al Mech Lug, Al / Cu Cable
Prepared Space: Yes
Device Rating: 80% Rated
Wire Range Per Lug: #14 - #8 AWG
Quantity of Poles: 1
Neutral: Yes
Height: 0.75"

Prepared Space 15A / 1P PH A
Device Application: Feeder
Device Associated to: Main One
Phase Connection: A
Trip Ampacity: 15A
Breaker Type: Thermal-Mag / Basic Electronic
Breaker Frame Identification: QOB-VH
Device Load Connection Type: Al Mech Lug, Al / Cu Cable
Prepared Space: Yes
Device Rating: 80% Rated
Wire Range Per Lug: #14 - #8 AWG
Quantity of Poles: 1
Neutral: Yes
Height: 0.75"

Prepared Space 15A / 1P PH B
Device Application: Feeder
Device Associated to: Main One
Phase Connection: B
Trip Ampacity: 15A
Breaker Type: Thermal-Mag / Basic Electronic
Breaker Frame Identification: QOB-VH
Device Load Connection Type: Al Mech Lug, Al / Cu Cable
Prepared Space: Yes
Device Rating: 80% Rated
Wire Range Per Lug: #14 - #8 AWG
Quantity of Poles: 1
Neutral: Yes
Height: 0.75"

Prepared Space 15A / 1P PH B
Device Application: Feeder
Device Associated to: Main One
Phase Connection: B
Trip Ampacity: 15A
Breaker Type: Thermal-Mag / Basic Electronic
Breaker Frame Identification: QOB-VH
Device Load Connection Type: Al Mech Lug, Al / Cu Cable
Prepared Space: Yes
Device Rating: 80% Rated
Wire Range Per Lug: #14 - #8 AWG
Quantity of Poles: 1
Neutral: Yes
Height: 0.75"

Prepared Space 15A / 1P PH C
Device Application: Feeder
Device Associated to: Main One
Phase Connection: C
Trip Ampacity: 15A
Breaker Type: Thermal-Mag / Basic Electronic
Breaker Frame Identification: QOB-VH
Device Load Connection Type: Al Mech Lug, Al / Cu Cable
Prepared Space: Yes
Device Rating: 80% Rated
Wire Range Per Lug: #14 - #8 AWG
Quantity of Poles: 1
Neutral: Yes

Properties

Neutral: Yes
Height: 0.75"

Prepared Space 15A / 1P PH C
Device Application: Feeder
Device Associated to: Main One
Phase Connection: C
Trip Ampacity: 15A
Breaker Type: Thermal-Mag / Basic Electronic
Breaker Frame Identification: QOB-VH
Device Load Connection Type: Al Mech Lug, Al / Cu Cable
Prepared Space: Yes
Device Rating: 80% Rated
Wire Range Per Lug: #14 - #8 AWG
Quantity of Poles: 1
Neutral: Yes
Height: 0.75"

Prepared Space 15A / 1P PH A
Device Application: Feeder
Device Associated to: Main One
Phase Connection: A
Trip Ampacity: 15A
Breaker Type: Thermal-Mag / Basic Electronic
Breaker Frame Identification: QOB-VH
Device Load Connection Type: Al Mech Lug, Al / Cu Cable
Prepared Space: Yes
Device Rating: 80% Rated
Wire Range Per Lug: #14 - #8 AWG
Quantity of Poles: 1
Neutral: Yes
Height: 0.75"

Prepared Space 15A / 1P PH A
Device Application: Feeder
Device Associated to: Main One
Phase Connection: A
Trip Ampacity: 15A
Breaker Type: Thermal-Mag / Basic Electronic
Breaker Frame Identification: QOB-VH
Device Load Connection Type: Al Mech Lug, Al / Cu Cable
Prepared Space: Yes
Device Rating: 80% Rated
Wire Range Per Lug: #14 - #8 AWG

Quantity of Poles: 1
Neutral: Yes
Height: 0.75"

Prepared Space 15A / 1P PH B
Device Application: Feeder
Device Associated to: Main One
Phase Connection: B
Trip Ampacity: 15A
Breaker Type: Thermal-Mag / Basic Electronic
Breaker Frame Identification: QOB-VH
Device Load Connection Type: Al Mech Lug, Al / Cu Cable
Prepared Space: Yes
Device Rating: 80% Rated
Wire Range Per Lug: #14 - #8 AWG
Quantity of Poles: 1
Neutral: Yes
Height: 0.75"

Prepared Space 15A / 1P PH B
Device Application: Feeder
Device Associated to: Main One
Phase Connection: B
Trip Ampacity: 15A
Breaker Type: Thermal-Mag / Basic Electronic
Breaker Frame Identification: QOB-VH
Device Load Connection Type: Al Mech Lug, Al / Cu Cable
Prepared Space: Yes
Device Rating: 80% Rated
Wire Range Per Lug: #14 - #8 AWG
Quantity of Poles: 1
Neutral: Yes
Height: 0.75"

Prepared Space 15A / 1P PH C
Device Application: Feeder
Device Associated to: Main One
Phase Connection: C
Trip Ampacity: 15A
Breaker Type: Thermal-Mag / Basic Electronic
Breaker Frame Identification: QOB-VH
Device Load Connection Type: Al Mech Lug, Al / Cu Cable
Prepared Space: Yes
Device Rating: 80% Rated

Shop Drawings
Contractor Approval
Approved by: S.B.S., G. F.
Date: Apr 28, 2015
SIFEC NORTH INC

Properties

Device Rating: 80% Rated
Wire Range Per Lug: #14 - #8 AWG
Quantity of Poles: 1
Neutral: Yes
Height: 0.75"

Prepared Space 15A / 1P PH C
Device Application: Feeder
Device Associated to: Main One
Phase Connection: C
Trip Ampacity: 15A
Breaker Type: Thermal-Mag / Basic Electronic
Breaker Frame Identification: QOB-VH
Device Load Connection Type: Al Mech Lug, Al / Cu Cable
Prepared Space: Yes
Device Rating: 80% Rated
Wire Range Per Lug: #14 - #8 AWG
Quantity of Poles: 1
Neutral: Yes
Height: 0.75"

Prepared Space 15A / 1P PH A
Device Application: Feeder
Device Associated to: Main One
Phase Connection: A
Trip Ampacity: 15A
Breaker Type: Thermal-Mag / Basic Electronic
Breaker Frame Identification: QOB-VH
Device Load Connection Type: Al Mech Lug, Al / Cu Cable
Prepared Space: Yes
Device Rating: 80% Rated
Wire Range Per Lug: #14 - #8 AWG
Quantity of Poles: 1
Neutral: Yes
Height: 0.75"

Prepared Space 15A / 1P PH A
Device Application: Feeder
Device Associated to: Main One
Phase Connection: A
Trip Ampacity: 15A
Breaker Type: Thermal-Mag / Basic Electronic
Breaker Frame Identification: QOB-VH
Device Load Connection Type: Al Mech Lug, Al / Cu Cable

Prepared Space: Yes
Device Rating: 80% Rated
Wire Range Per Lug: #14 - #8 AWG
Quantity of Poles: 1
Neutral: Yes
Height: 0.75"

Prepared Space 15A / 1P PH B
Device Application: Feeder
Device Associated to: Main One
Phase Connection: B
Trip Ampacity: 15A
Breaker Type: Thermal-Mag / Basic Electronic
Breaker Frame Identification: QOB-VH
Device Load Connection Type: Al Mech Lug, Al / Cu Cable
Prepared Space: Yes
Device Rating: 80% Rated
Wire Range Per Lug: #14 - #8 AWG
Quantity of Poles: 1
Neutral: Yes
Height: 0.75"

Prepared Space 15A / 1P PH B
Device Application: Feeder
Device Associated to: Main One
Phase Connection: B
Trip Ampacity: 15A
Breaker Type: Thermal-Mag / Basic Electronic
Breaker Frame Identification: QOB-VH
Device Load Connection Type: Al Mech Lug, Al / Cu Cable
Prepared Space: Yes
Device Rating: 80% Rated
Wire Range Per Lug: #14 - #8 AWG
Quantity of Poles: 1
Neutral: Yes
Height: 0.75"

Prepared Space 15A / 1P PH C
Device Application: Feeder
Device Associated to: Main One
Phase Connection: C
Trip Ampacity: 15A
Breaker Type: Thermal-Mag / Basic Electronic
Breaker Frame Identification: QOB-VH

Properties

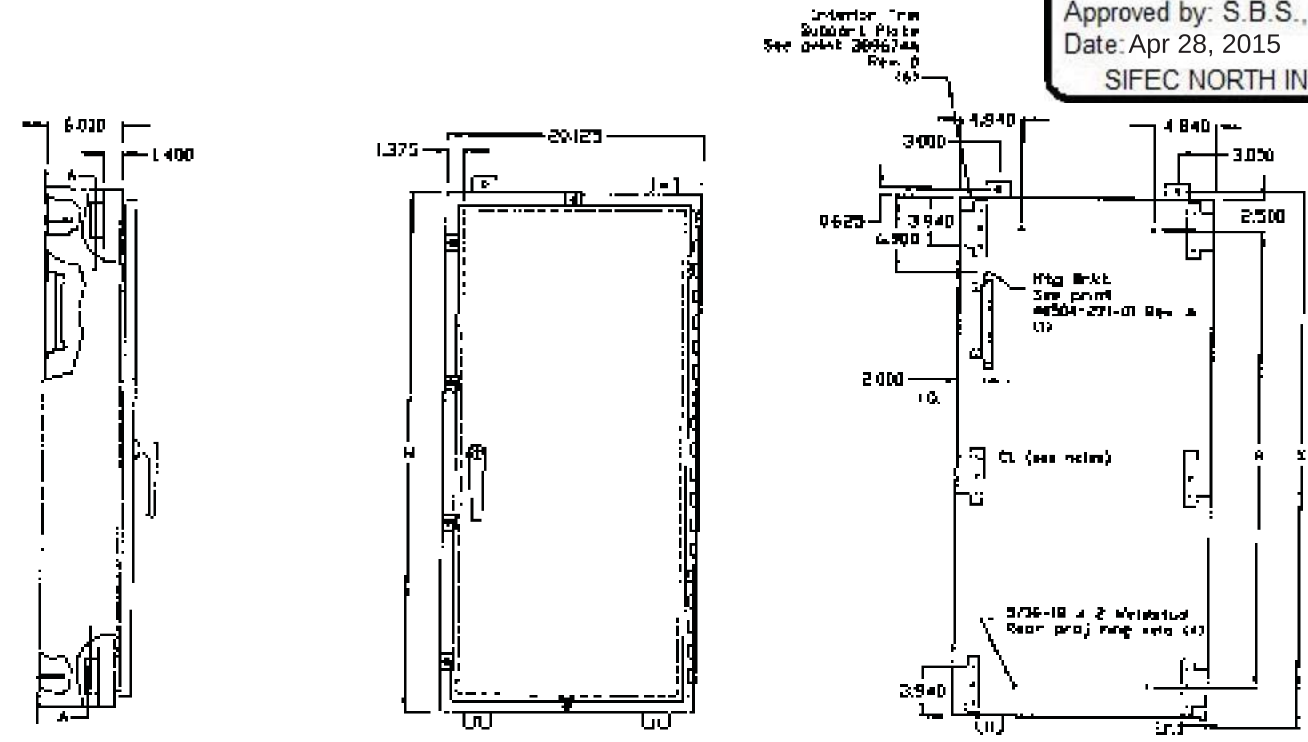
Shop Drawings
Contractor Approval
Approved by: S.B.S., G. F.
Date: Apr 28, 2015
SIFEC NORTH INC

Breaker Frame Identification: QOB-VH
Device Load Connection Type: Al Mech Lug, Al / Cu Cable
Prepared Space: Yes
Device Rating: 80% Rated
Wire Range Per Lug: #14 - #8 AWG
Quantity of Poles: 1
Neutral: Yes
Height: 0.75"

Prepared Space 15A / 1P PH C
Device Application: Feeder
Device Associated to: Main One
Phase Connection: C
Trip Ampacity: 15A
Breaker Type: Thermal-Mag / Basic Electronic
Breaker Frame Identification: QOB-VH
Device Load Connection Type: Al Mech Lug, Al / Cu Cable
Prepared Space: Yes
Device Rating: 80% Rated
Wire Range Per Lug: #14 - #8 AWG
Quantity of Poles: 1
Neutral: Yes
Height: 0.75"

Main 250A LA PH ABC
Device Application: Main One
Device Associated to: Incoming 1
Phase Connection: ABC
Trip Ampacity: 250A
Breaker Type: Thermal-Mag / Basic Electronic
Breaker Frame Identification: LA
Incoming Lug Type: Al Mechanical Lug Al/Cu Cable
Device Rating: 80% Rated
Wire Range Per Lug: #1 - 600,(2)#1 - 250 kcml
Quantity of Poles: 3
Neutral: Yes
Height: 4"

Shop Drawings
Contractor Approval
Approved by: S.B.S., G. F.
Date: Apr 28, 2015
SIFEC NORTH INC



Typ Side View

Typ Front View

Section A–A

* 14ga 304 SS #3 polish
* Chrome 1 pt. Key L Handle
* Nema 4 clamp assemblies

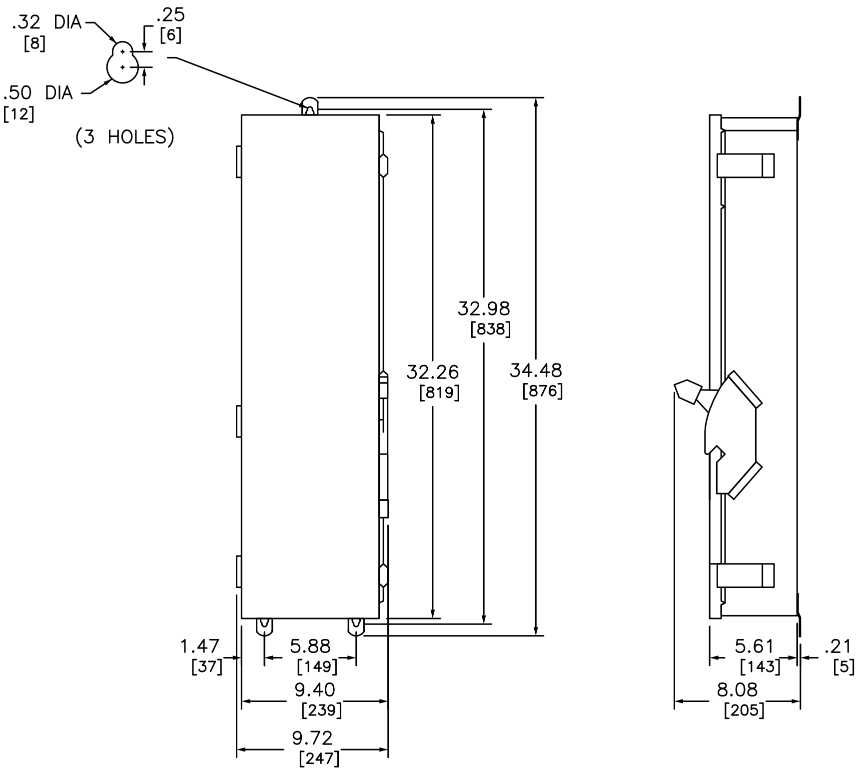
Note: For "X" Dim, add 1.25 to box height.
Note: Center interior trim support plate only applies to 41" boxes & up.

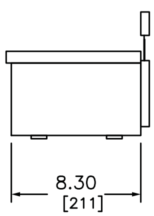
ENCLOSURE CATALOG NUMBER	HEIGHT		A	
	IN	mm	IN	mm
MH20WPSSUL	20.0	508.0	15.0	381.0
MH23WPSSUL	23.0	584.2	18.0	457.2
MH26WPSSUL	26.0	660.4	21.0	533.4
MH29WPSSUL	29.0	736.6	24.0	609.6
MH32WPSSUL	32.0	812.8	27.0	685.8
MH35WPSSUL	35.0	889.0	30.0	762.0
MH38WPSSUL	38.0	965.2	33.0	838.2
MH41WPSSUL	41.0	1041.4	36.0	914.4
MH44WPSSUL	44.0	1117.6	39.0	990.6
MH47WPSSUL	47.0	1193.8	42.0	1066.8
MH50WPSSUL	50.0	1270.0	45.0	1143.0

ENCLOSURE CATALOG NUMBER	HEIGHT		A	
	IN	mm	IN	mm
MH53WPSSUL	53.0	1346.2	48.0	1219.2
MH56WPSSUL	56.0	1422.4	51.0	1295.4
MH59WPSSUL	59.0	1498.6	54.0	1371.6
MH62WPSSUL	62.0	1574.8	57.0	1447.8
MH65WPSSUL	65.0	1651.0	60.0	1524.0
MH68WPSSUL	68.0	1727.2	63.0	1600.2
MH71WPSSUL	71.0	1803.4	66.0	1676.4
MH74WPSSUL	74.0	1879.6	69.0	1752.6
MH77WPSSUL	77.0	1955.8	72.0	1828.8
MH80WPSSUL	80.0	2032.0	75.0	1905.0
MH86WPSSUL	86.0	2184.4	81.0	2057.4

REV. DATE DESCRIPTION
TITLE :
CUSTOMER :
DATE : DRN BY : APPRVD BY
PRINT #
P.O. #
TOLERANCE :
DIE #
SCALE : NONE
SHT. OF

Main Breaker Enclosure

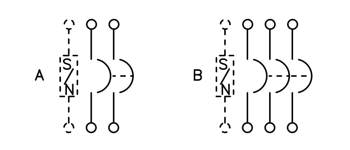




J250AWK
NEMA/EEMAC TYPE 12/3R

J250DS
NEMA/EEMAC TYPE 3,3R,4,4X,5 OR 12

WIRING DIAGRAM



CIRCUIT BREAKER TERMINAL LUG DATA

CIRCUIT BREAKER CATALOG NO. PREFIX	AMPERE RATING	CONDUCTORS PER PHASE	WIRE SIZE (AWG/KCMIL)		TYPE
			MAX	MIN	
HD, HG HJ, HL	15–150	1	#3/0	#14	AL/CU
JD, JG JJ, JL	150–250	1	#4/0	#1/0	AL/CU

FIELD INSTALLABLE SOLID NEUTRAL ASSEMBLIES AND GROUND KIT

CATALOG NUMBER	MAXIMUM AMPERE RATING	NUMBER OF TERMINALS	CONDUCTORS PER TERMINAL	WIRE SIZE (AWG/KCMIL)		TYPE
				MAX	MIN	
SN100FA	100A	2	1	#1/0	#14	AL
				#1/0	#12	AL
SN400LA	250A	2	1 OR 2	#600 #250	#1 #1	AL OR CU AL OR CU
		2	1	#300	#4	AL OR CU
PK0GTJ250	250A	2	1	#300	#6	AL OR CU

DUAL DIMENSIONS: INCHES
MILLIMETERS

FIELD INSTALLABLE CIRCUIT BREAKER DATA

CIRCUIT BREAKER CATALOG NO PREFIX	WIRING DIA	AMPERE RATING	UL LISTED INTERRUPTING RATING RMS SYMMETRICAL AMPERES								FEDERAL SPECS W–C–375B/ GEN
			AC VOLTAGE					DC VOLTAGE			
			240	480Y/277	480	600Y/347	600	125	250	500	
HD	A,B	15–150	25K	18K	18K	14K	14K	20K	20K	–	
JD	A,B	150–250	25K	18K	18K	14K	14K	20K	20K	–	
HG	A,B	15–150	65K	35K	35K	18K	18K	20K	20K	–	
JG	A,B	150–250	65K	35K	35K	18K	18K	20K	20K	–	
HJ	A,B	15–150	100K	65K	65K	25K	25K	20K	20K	–	
JJ	A,B	150–250	100K	65K	65K	25K	25K	20K	20K	–	
HL	A,B	15–150	125K	65K	65K	25K	25K	20K	20K	–	
JL	A,B	150–250	125K	65K	65K	25K	25K	20K	20K	–	

NOTES:
FINISH – NEMA/EEMAC TYPE 12/3R, GRAY BAKED ENAMEL ELECTRODEPOSITED OVER CLEANED PHOSPHATIZED STEEL. NEMA/EEMAC TYPE 3,3R,4,4X,5 OR 12 – TYPE 304 STAINLESS STEEL.
UL LISTED – FILE E-136861 CSA CERTIFIED – FILE #LL89067.
CE MARKED
SUITABLE FOR USE AS SERVICE EQUIPMENT WHEN NEUTRAL ASSEMBLY IS INSTALLED.
NEUTRAL – INSULATED GROUNDABLE.

CIRCUIT BREAKER ENCLOSURES
15–250 AMPERE
ENCLOSURE – NEMA/EEMAC TYPE 12/3R INDUSTRIAL
NEMA/EEMAC TYPE 3,3R,4,4X,5 OR 12 STAINLESS STEEL

SQUARE D
Schneider Electric

DWG# NO. 3363

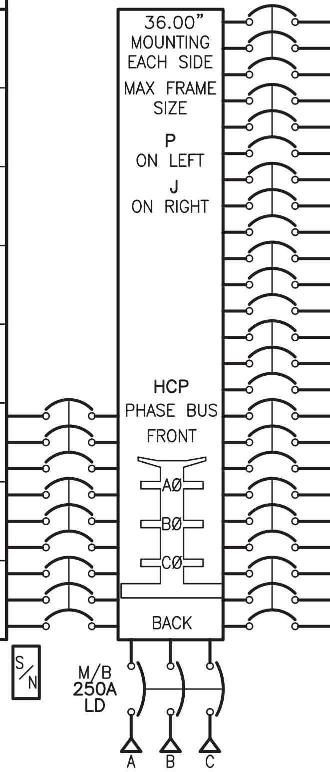
JULY 2008

Shop Drawings
Contractor Approval
Approved by: S.B.S., G. F.
Date: Mar 03, 2015
SIFEC NORTH INC

REV	DESCRIPTION	BY	DATE	–	––––	––	––/––/––
–	––––	––	––/––/––	–	––––	––	––/––/––

Panel P-1

CKT NO	ACCESSORIES	TYPE	RATING AMP/P	PHASE BUS CONN
	4.50" BLANK			
	4.50" BLANK			
	4.50" BLANK			
	4.50" BLANK			
	4.50" BLANK			
1		FA	60/3	ABC
3		FA	80/3	ABC
5		FA	80/3	ABC



PHASE BUS CONN	RATING AMP/P	TYPE	ACCESSORIES	CKT NO
ABC	/3	DP7		2
ABC	100 /3	FA		4
ABC	/3	DP6		6
ABC	/3	DP5		8
ABC	/3	DP4		10
ABC	/3	DP3		12
ABC	/3	DP2		14
ABC	/3	DP1		16

PHYSICAL DATA

ENCLOSURE Type 3R/4/4X/5/12 StainlessStl
FRONT CAT#: Trim w/Box
BOX CAT#: HCW4286WPSSUL
DIMENSIONS:
86''H x 42''W x 12.95''D
WIRE BENDING SPACE:
TOP – 11.66
BOTTOM – 16.18
RIGHT SIDE – 8.77
LEFT SIDE – 8.66
BUSSING: Copper
Tin Plated
OPTIONAL FEATURES:
SHIP COMPLETELY ASSEMBLED
ALUMINUM SOLID NEUTRAL
ALUMINUM GROUND BAR

ELECTRICAL DATA

SYSTEM: 208Y/120V 3Ph 4W 60Hz
System Ampacity: 400A
22kA SYMS. SCCR
MAIN: MAIN BREAKER LD 400AS/250AT
ACC: STD LI
Bottom FEED
25kA AIR
INCOMING CONDUCTORS(S) PER NEC:
(2) 2/0 – 500 kcmil
BRANCH MOUNTING TYPE: PLUG–ON
–––––––––––BRANCH SUMMATION–––––––––––

1 – 60A/3P FA	2 – 80A/3P FA
6 – 15A/1P–PS QO–VH DP7	1 – 100A/3P FA
6 – 15A/1P–PS QO–VH DP6	1 – 30A/2P QO–VH DP5
4 – 15A/1P–PS QO–VH DP5	1 – 15A/3P QO–VH DP4
1 – 30A/2P QO–VH DP4	1 – 15A/1P–PS QO–VH DP4
2 – 15A/3P QO–VH DP3	2 – 15A/3P QO–VH DP2
2 – 15A/3P QO–VH DP1	

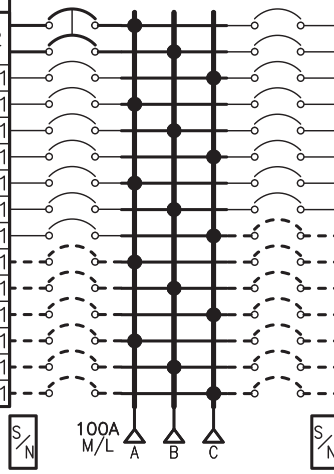
Shop Drawings
Contractor Approval
Approved by: S.B.S., G. F.
Date: Mar 03, 2015
SIFEC NORTH INC

JOB NAME:	SPE–PANGNIRTUNG	EQUIPMENT DESIGNATION:	a
JOB LOCATION:	MIRABEL QC	EQUIPMENT TYPE:	I–Line (Circuit Breaker Type) PANEL 1 OF 1
DRAWN BY:	(Q2C)	DRAWING TYPE:	ONE LINE DIAGRAM
ENGR:		SQUARE D by Schneider Electric	
DATE:	February 25 2015		290/665
DRAWING STATUS:	QUOTE	DWG# 035962847–01	PG 1 OF 1 REV –

REV	DESCRIPTION	BY	DATE	-	----	--	--/--/--
-	----	--	--/--/--	-	----	--	--/--/--

Panel P-2

CKT NO	ACCESSORIES	TYPE	RATING AMP/P
1		QOB-VH	30/2
3			
5		QOB-VH	15/1
7		QOB-VH	15/1
9		QOB-VH	15/1
11		QOB-VH	15/1
13		QOB-VH	15/1
15		QOB-VH	15/1
17		QOB-VH	15/1
19	PREPARED SPACE	QOB-VH	15/1
21	PREPARED SPACE	QOB-VH	15/1
23	PREPARED SPACE	QOB-VH	15/1
25	PREPARED SPACE	QOB-VH	15/1
27	PREPARED SPACE	QOB-VH	15/1
29	PREPARED SPACE	QOB-VH	15/1



RATING AMP/P	TYPE	ACCESSORIES	CKT NO
25/1	QOB-VH		2
20/1	QOB-VH		4
15/1	QOB-VH		6
15/1	QOB-VH		8
15/1	QOB-VH		10
15/1	QOB-VH		12
15/1	QOB-VH		14
15/1	QOB-VH		16
15/1	QOB-VH	PREPARED SPACE	18
15/1	QOB-VH	PREPARED SPACE	20
15/1	QOB-VH	PREPARED SPACE	22
15/1	QOB-VH	PREPARED SPACE	24
15/1	QOB-VH	PREPARED SPACE	26
15/1	QOB-VH	PREPARED SPACE	28
15/1	QOB-VH	PREPARED SPACE	30

PHYSICAL DATA

ENCLOSURE Type 3R/4/4X/5/12 StainlessStl
FRONT CAT#: Trim w/Box
BOX CAT#: MH32WPSSULNF
DIMENSIONS:
32"H x 20"W x 6.5"D
WIRE BENDING SPACE:
TOP - 3.25
BOTTOM - 9.6
SIDE - 6.13
BUSSING: Copper
Silver/Tin Plated
OPTIONAL FEATURES:
ALUMINUM SOLID NEUTRAL
ALUMINUM GROUND BAR

ELECTRICAL DATA

SYSTEM: 208Y/120V 3Ph 4W 60Hz
System Ampacity: 100A
22kA SYMS. SCCR
MAIN: MAIN LUGS : 100A
Bottom FEED
INCOMING CONDUCTORS(S) PER NEC:
#6 - 2/0 AWG
BRANCH MOUNTING TYPE: BOLT-ON
------------BRANCH SUMMATION------------
1 - 30A/2P QOB-VH
13 - 15A/1P-PS QOB-VH
1 - 20A/1P QOB-VH
13 - 15A/1P QOB-VH
1 - 25A/1P QOB-VH

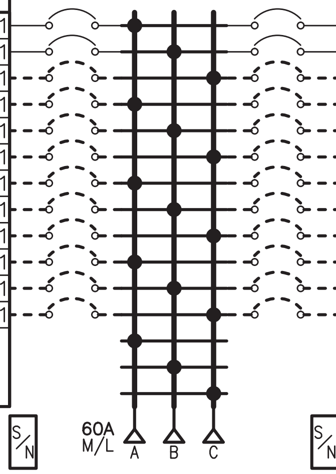
Shop Drawings
Contractor Approval
Approved by: S.B.S., G. F.
Date: Mar 03, 2015
SIFEC NORTH INC

JOB NAME:	SPE-PANGNIRTUNG	EQUIPMENT DESIGNATION:	P-2
JOB LOCATION:	MIRABEL QC	EQUIPMENT TYPE:	NQ (Circuit Breaker Type) PANEL 1 OF 1
DRAWN BY:	(Q2C)	DRAWING TYPE:	ONE LINE DIAGRAM
ENGR:			SQUARE D by Schneider Electric
DATE:	February 25 2015		291/665
DRAWING STATUS:	QUOTE	DWG# 035962847-01	PG 1 OF 1 REV -

REV	DESCRIPTION	BY	DATE	–	----	--	--/--/--
–	----	--	--/--/--	–	----	--	--/--/--

Panel PA-1

CKT NO	ACCESSORIES	TYPE	RATING AMP/P
1		QOB–VH	15/1
3		QOB–VH	15/1
5	PREPARED SPACE	QOB–VH	15/1
7	PREPARED SPACE	QOB–VH	15/1
9	PREPARED SPACE	QOB–VH	15/1
11	PREPARED SPACE	QOB–VH	15/1
13	PREPARED SPACE	QOB–VH	15/1
15	PREPARED SPACE	QOB–VH	15/1
17	PREPARED SPACE	QOB–VH	15/1
19	PREPARED SPACE	QOB–VH	15/1
21	PREPARED SPACE	QOB–VH	15/1
23	PREPARED SPACE	QOB–VH	15/1
25			
27			
29	BLANK		



RATING AMP/P	TYPE	ACCESSORIES	CKT NO
15/1	QOB–VH		2
15/1	QOB–VH		4
15/1	QOB–VH	PREPARED SPACE	6
15/1	QOB–VH	PREPARED SPACE	8
15/1	QOB–VH	PREPARED SPACE	10
15/1	QOB–VH	PREPARED SPACE	12
15/1	QOB–VH	PREPARED SPACE	14
15/1	QOB–VH	PREPARED SPACE	16
15/1	QOB–VH	PREPARED SPACE	18
15/1	QOB–VH	PREPARED SPACE	20
15/1	QOB–VH	PREPARED SPACE	22
15/1	QOB–VH	PREPARED SPACE	24
			26
			28
		BLANK	30

PHYSICAL DATA

ENCLOSURE Type 3R/4/4X/5/12 StainlessStl
FRONT CAT#: Trim w/Box
BOX CAT#: MH32WPSSULNF
DIMENSIONS:
32"H x 20"W x 6.5"D
WIRE BENDING SPACE:
TOP – 3.25
BOTTOM – 9.6
SIDE – 6.13
BUSSING: Copper
Silver/Tin Plated
OPTIONAL FEATURES:
SHIP COMPLETELY ASSEMBLED
ALUMINUM SOLID NEUTRAL
ALUMINUM GROUND BAR

ELECTRICAL DATA

SYSTEM: 208Y/120V 3Ph 4W 60Hz
System Ampacity: 60A
22kA SYMS. SCCR
MAIN: MAIN LUGS : 60A
Bottom FEED
INCOMING CONDUCTORS(S) PER NEC:
#6 – 2/0 AWG
BRANCH MOUNTING TYPE: BOLT–ON
------------BRANCH SUMMATION------------
4 – 15A/1P QOB–VH 20 – 15A/1P–PS QOB–VH

Shop Drawings
Contractor Approval
Approved by: S.B.S., G. F.
Date: Mar 03, 2015
SIFEC NORTH INC

JOB NAME:	SPE–PANGNIRTUNG	EQUIPMENT DESIGNATION:	PA–1
JOB LOCATION:	MIRABEL QC	EQUIPMENT TYPE:	NQ (Circuit Breaker Type) PANEL 1 OF 1
DRAWN BY:	(Q2C)	DRAWING TYPE:	ONE LINE DIAGRAM
ENGR:		SQUARE D by Schneider Electric	
DATE:	February 25 2015		292/665
DRAWING STATUS:	QUOTE	DWG# 035962847–01	PG 1 OF 1 REV –

MH Weatherproof Enclosure

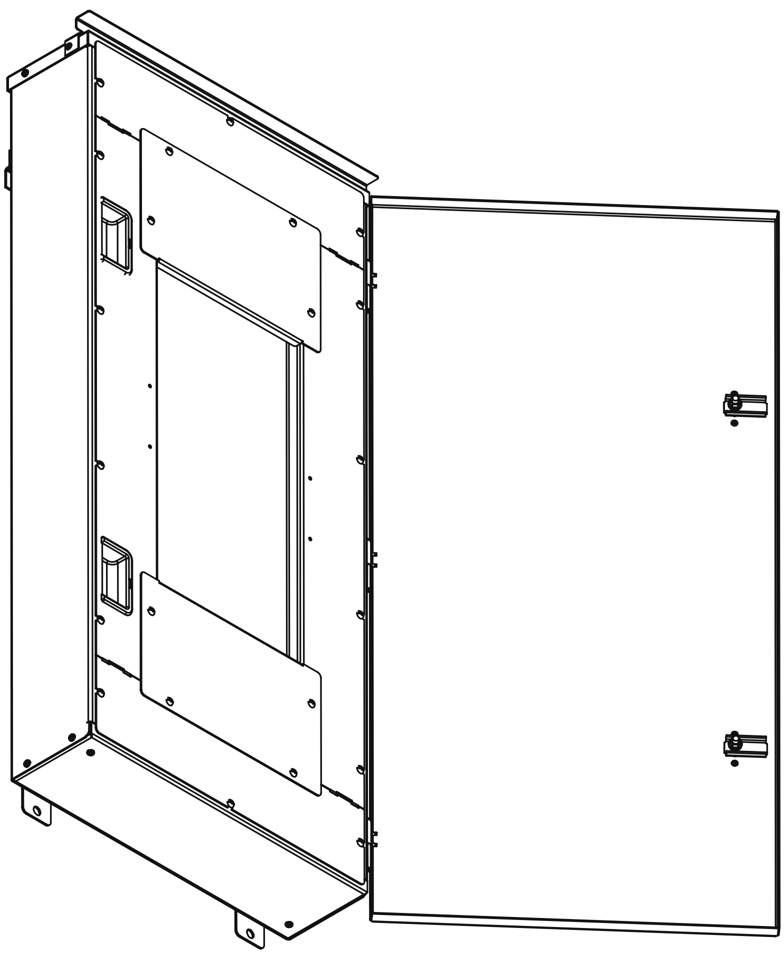
Gabinete MH a prueba de intemperie

Coffret MH étanche

Instruction Bulletin
Boletín de instrucciones
Directives d'utilisation

80043-771-01

Retain for Future Use. /
Conservar para uso futuro. /
À conserver pour usage ultérieur.



SQUARE D

by Schneider Electric

80043-771-01
03/2009
Peru, IN, USA

Instruction Bulletin

Replaces 80043-455-04 10/2007

MH Weatherproof Enclosure

Installation with an NQ or NF Panelboard
Class 1640 and 1670

Retain for future use.

Introduction

This bulletin contains instructions for installing a Square D® brand MH weatherproof enclosure with a Square D brand NQ or NF panelboard manufactured by Schneider Electric.

Safety Precautions

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- Apply appropriate personal protective equipment (PPE) and follow safe electrical work practices. See NFPA 70E.
- This equipment must only be installed and serviced by qualified electrical personnel.
- Turn off all power supplying this equipment before working on or inside equipment.
- Always use a properly rated voltage sensing device to confirm power is off.
- Replace all devices, doors, and covers before turning on power to this equipment.

Failure to follow these instructions will result in death or serious injury.

Tools Needed

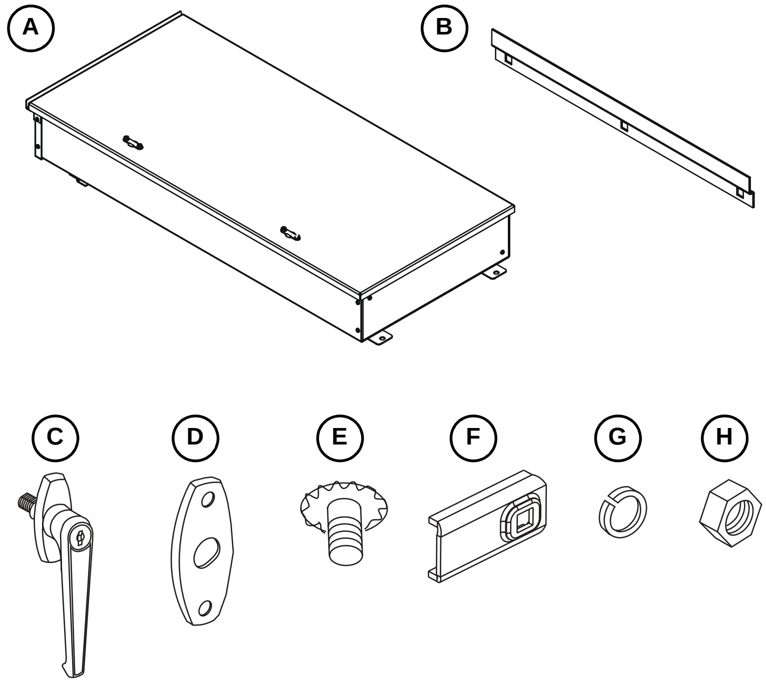
- #2 Square-head Robertson screwdriver
- Torque wrench with Flat-head driver
- Torque wrench with 5/8-in. hex socket driver

ENGLISH

Kit Contents

MH26WP–MH86WP
(see table below for item quantities)

A. Weatherproof enclosure
B. Wall bracket
C. Locking handle
D. Locking handle gasket
E. 8-32 x 5/16-in. SEMS machine screws
F. Latch plate
G. 3/8-in. Lock washer
H. 3/8-16 Hex nut



NOTE: Contents not shown to scale.

Cat #	MH26WP	MH32WP	MH38WP	MH44WP	MH50WP	MH56WP	MH62WP	MH68WP	MH74WP	MH80WP	MH86WP
Item	**Qty**	**Qty**	**Qty**	**Qty**	**Qty**	**Qty**	**Qty**	**Qty**	**Qty**	**Qty**	**Qty**
A	1	1	1	1	1	1	1	1	1	1	1
B	1	1	1	1	1	1	1	1	1	1	1
C	1	1	2	2	2	2	1	1	1	1	1
D	1	1	2	2	2	2	1	1	1	1	1
E	2	2	4	4	4	4	2	2	2	2	2
F	1	1	2	2	2	2	1	1	1	1	1
G	1	1	2	2	2	2	1	1	1	1	1
H	1	1	2	2	2	2	1	1	1	1	1

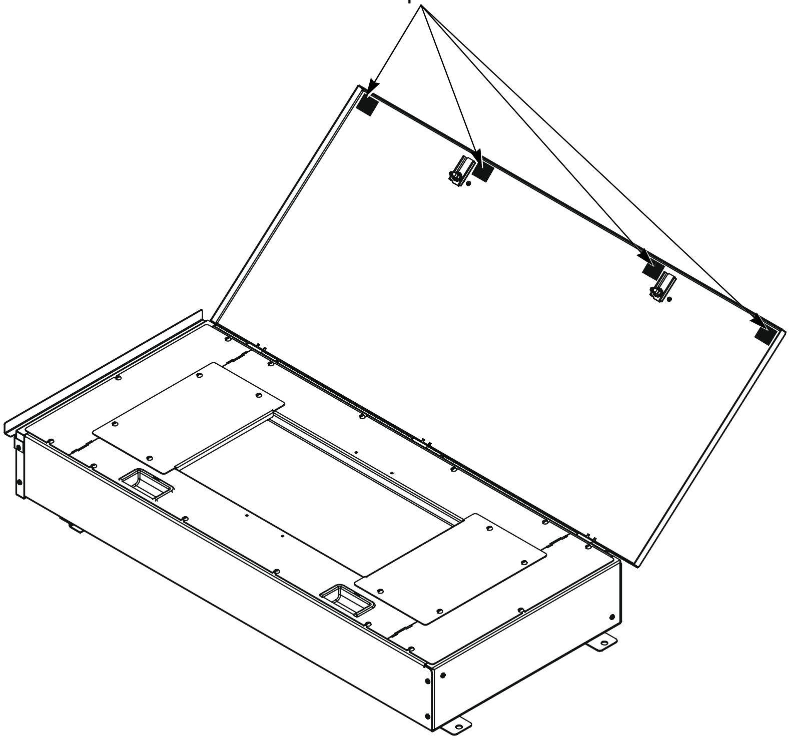
ENGLISH

Installing the MH Weatherproof Enclosure

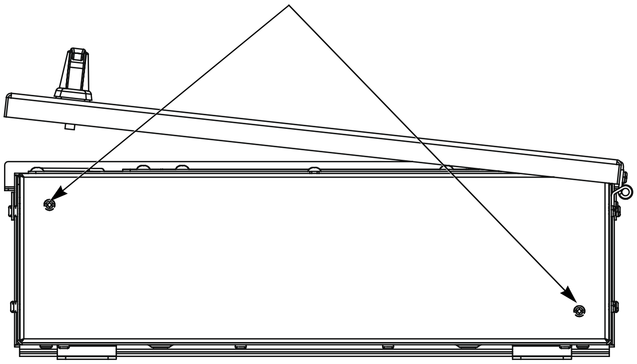
Turn off all power supplying this equipment before working inside the panelboard; follow all lockout/tagout procedures.

1 **For MH26WP–MH56WP enclosures only:**

MH26WP–MH56WP enclosures are shipped with the door fastened shut with clips. Remove and discard the clips and clip mounting screws.



2 Plastic spacers are applied to the inside of the door near the gasket. Remove and discard the spacers.



Bottom Endwall of MH Weatherproof Enclosure

3 Configure the enclosure for the desired application:

- NEMA Type 3R
- NEMA Type 5 / Type 12

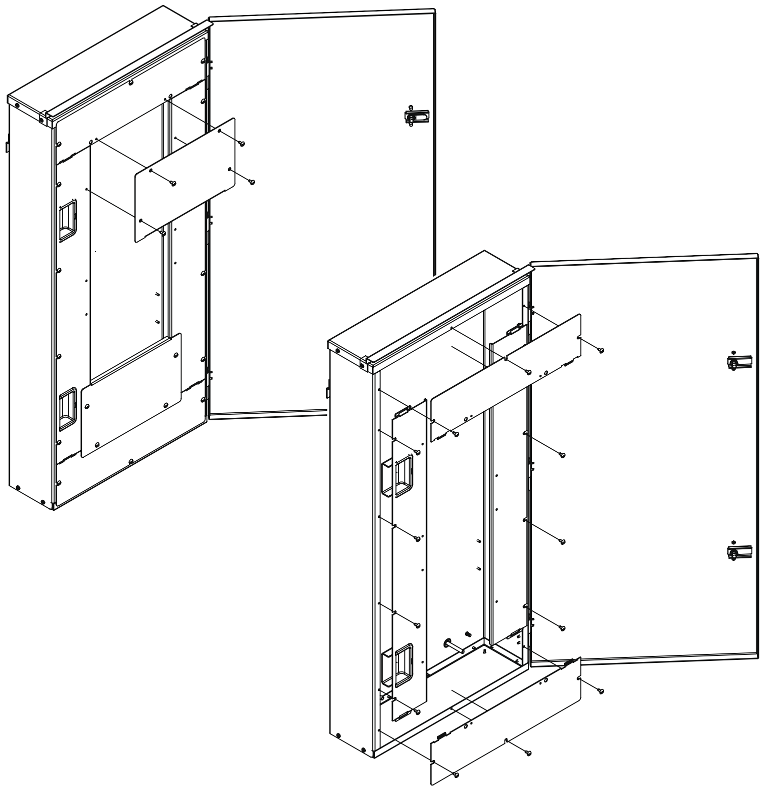
NOTE: The enclosure is shipped ready for NEMA Type 5 / Type 12 applications. For NEMA Type 3R applications, remove the two 10-32 x 7/16-in. self-tapping screws from the bottom endwall of the enclosure.

The enclosure can be reverted to NEMA Type 5 / Type 12 by reinserting the two 10-32 x 7/16-in. self-tapping screws into the holes in the bottom endwall of the enclosure.

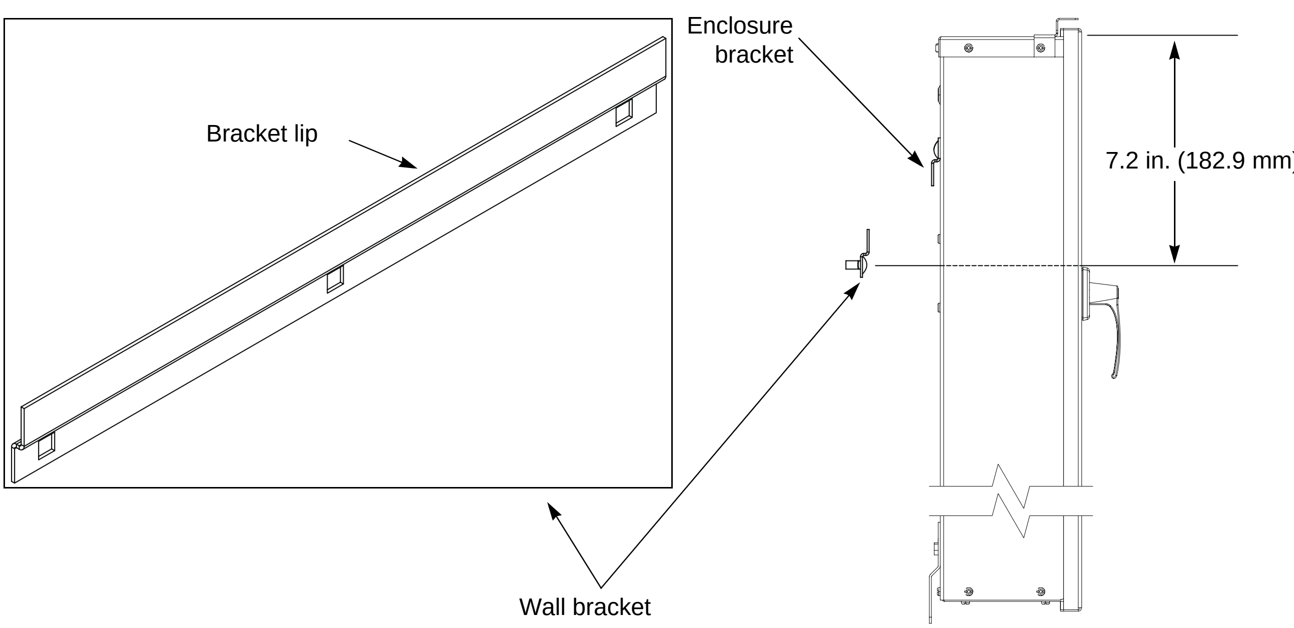
ENGLISH

4 **NOTE:** The weatherproof enclosure is shipped from the factory with the trim assembly installed.

Before mounting the enclosure, remove the trim assembly. Remove the top and bottom trim, then the side trim. Retain the trim assembly and all screws for use in step 12.

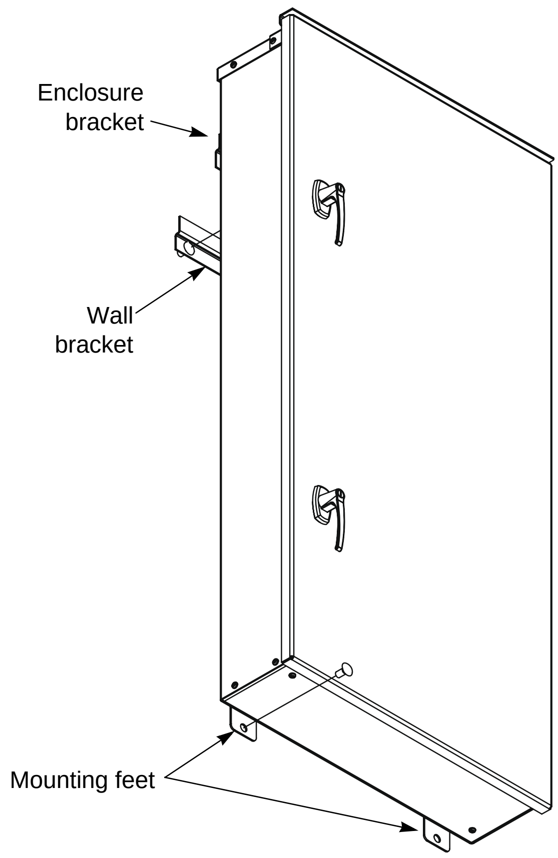


5 Locate the wall bracket packed inside the MH weatherproof enclosure. Position the wall bracket horizontally on the mounting surface in the desired installation location with the bracket lip oriented towards the top of the enclosure, and bolt onto the mounting surface (mounting fasteners not included).



Profile View of Mounting Brackets and Enclosure

ENGLISH



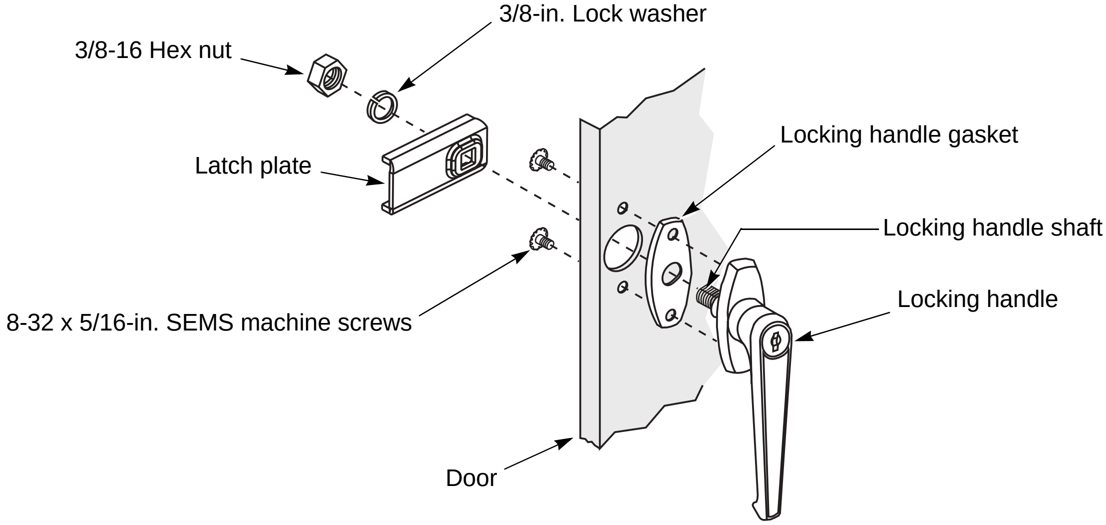
6 Pivot the mounting feet at the bottom of the weatherproof enclosure down to the mounting position at a 90° angle to the bottom of the enclosure.

Position the enclosure bracket on the wall bracket. Fasten the mounting feet to the mounting surface (mounting fasteners not included).

7 Install the panelboard interior using the instructions provided with the panelboard.

ENGLISH

8 Place the handle gasket onto the handle shaft. From the exterior side of the door, place the handle shaft through the large hole in the door, aligning the gasket and the handle with the small mounting holes in the door.



9 Insert two 8-32 x 5/16-in. SEMS machine screws through the holes in the door and the gasket, and into the handle. Tighten each screw to 24–35 lb-in (2.7–4.0 N•m).

10 Place the latch plate onto the handle shaft and press firmly in place over the shoulder of the shaft. Install the 3/8-in. lock washer and hex nut onto the handle shaft. Position the handle vertically as shown. Tighten each hex nut to 50–70 lb-in (5.6–7.9 N•m).

11 **For MH38WP–MH56WP enclosures only:**

Repeat steps 8 through 10 to attach the second door handle.

ENGLISH

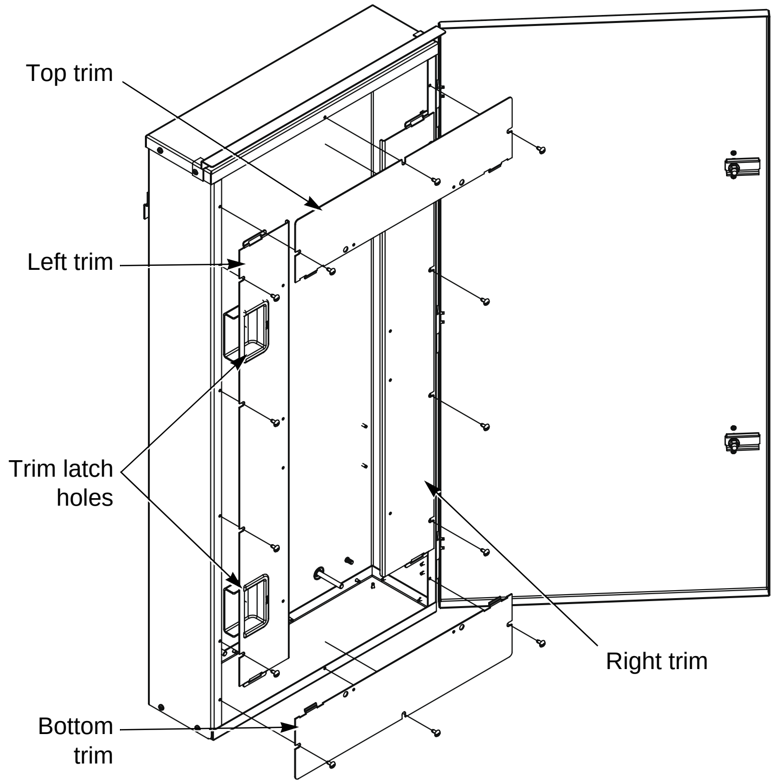
12 **NOTE:** Do not install the trim assembly until:

- Branch circuit breakers are installed
- Branch wiring is complete
- Interior deadfront assembly has been replaced

Using the trim assembly and the 10-32 screws retained from step 4, reattach the side trim to the weatherproof enclosure. Ensure the left trim latch holes align with the door handle latches.

Insert the tabs in the top and bottom trim into the slots in the side trims and pivot the trim into place.

Attach the top and bottom trim to the weatherproof enclosure using the 10-32 screws retained from step 4.

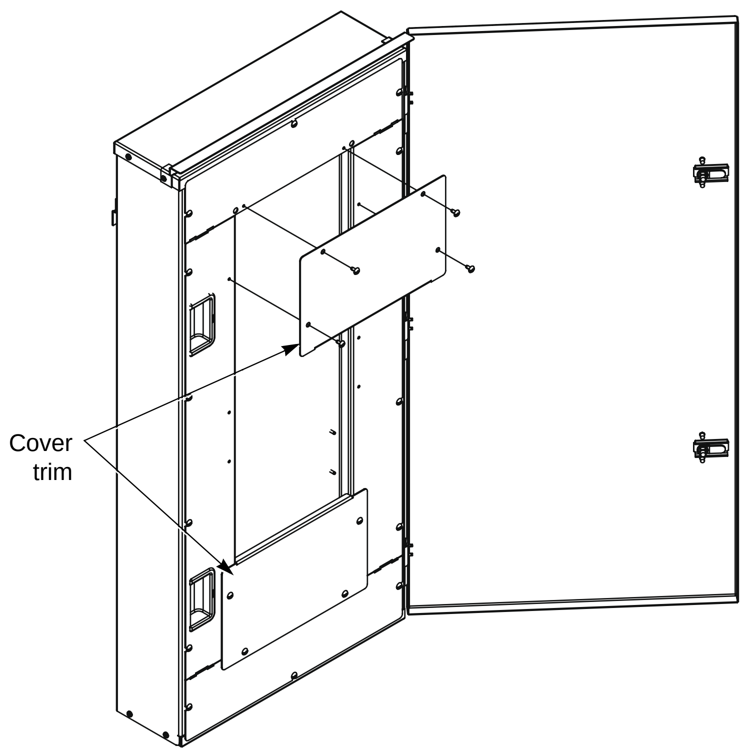


13 **If the panelboard is rated 400–600 A, and the weatherproof enclosure is 44 in. (1118 mm) or taller:**

Attach the cover trim with the 10-32 screws retained from step 4.

If the panelboard is not rated 400–600 A:

The cover trim is not required. Discard the cover trim.



ENGLISH

14 For NEMA Type 3R MH weatherproof enclosures:

Attach raintight conduit hubs that comply with the requirements in UL® Standard 514 for outlet boxes and fittings.

For NEMA Type 5 / Type 12 MH weatherproof enclosures:

Attach the following Square D conduit hubs:

Conduit Size		Catalog Number		Torque	
in.	mm	Zinc Plated	Chrome Plated	lb-ft	N•m
0.50	13	H050	H050CP	66	90
0.75	19	H075	H075CP		
1.00	25	H0100	H0100CP	83	113
1.25	32	H0125	H0125CP		
1.50	38	H0150	H0150CP		
2.00	51	H0200	H0200CP	133	180
2.50	64	H0250	H0250CP		
3.00	76	H0300	H0300CP		
3.50	89	H0350	H0350CP		
4.00	102	H0400	H0400CP		

Schneider Electric USA
252 North Tippecanoe
Peru, IN 46970 USA
1-888-SquareD (1-888-778-2733)
www.us.SquareD.com

Electrical equipment should be installed, operated, serviced, and maintained only by qualified personnel. No responsibility is assumed by Schneider Electric for any consequences arising out of the use of this material.

Product data sheet
Characteristics

JJL36250
3P, 600V, 250A MCCB

Main Breaker (250A)

Main

AC Magnetic Trip Setting	1250A - 2500A Adjustable Trip
Ampere Rating	250A
Approvals	UL Listed - CSA Certified - IEC Rated
Catalog Reference Number	0611CT0401
Circuit Breaker Type	Standard
Depth	5.00 Inches
For Use With	Industrial Enclosures and Switchboards
Frame Type	J-Frame
General Application	Provides overload and short circuit protection
HACR Rated	Yes
Height	7.52 Inches
Marketing Trade Name	Powerpact
Mounting Type	Unit Mount
Number of Poles	3-Pole
Short Circuit Current Rating	100kA@240VAC - 65kA@480VAC - 25kA@600VAC
Terminal Type	Line: Lug - Load: Lug
Type	JJ
Voltage Rating	600VAC/250VDC
Weight	5 Pounds
Width	4.12 Inches
Wire Size	#3/0-350 AWG/kcmil(Al/Cu)

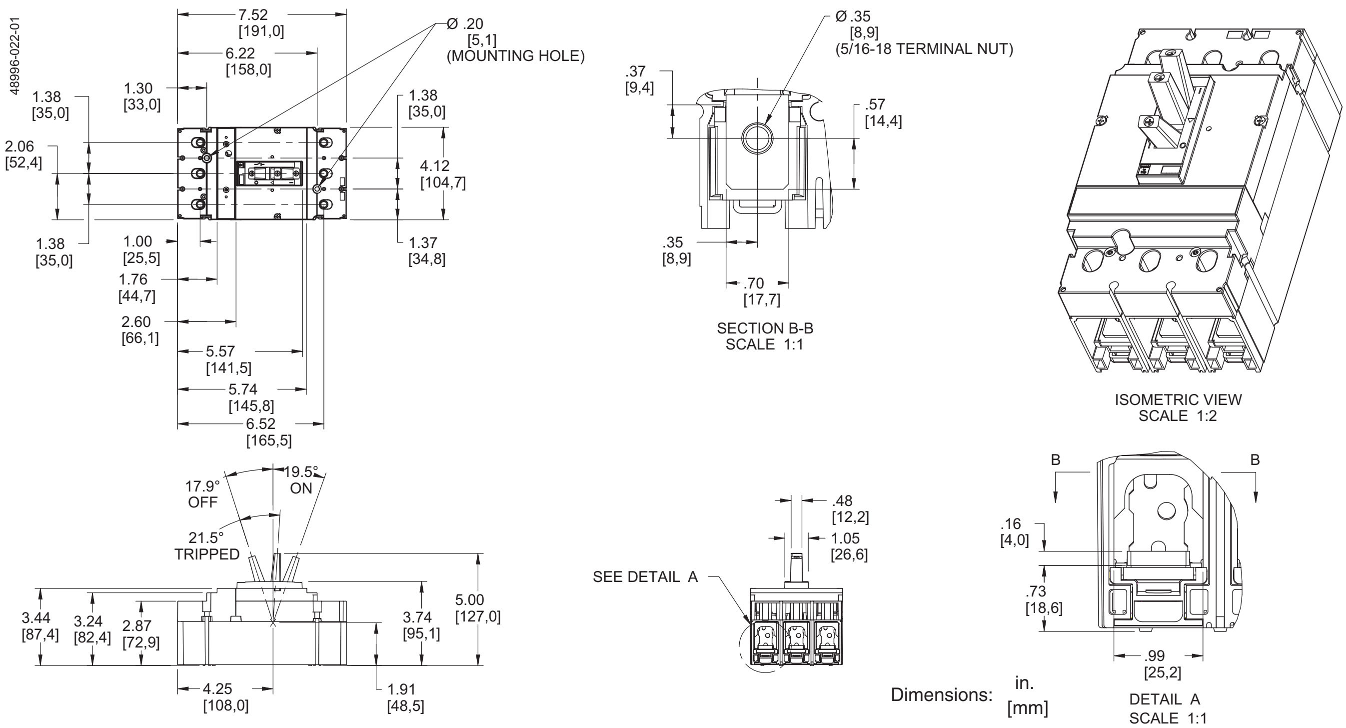
Shop Drawings
Contractor Approval
Approved by: S.B.S., G. F.
Date: Mar 03, 2015
SIFEC NORTH INC

303/665

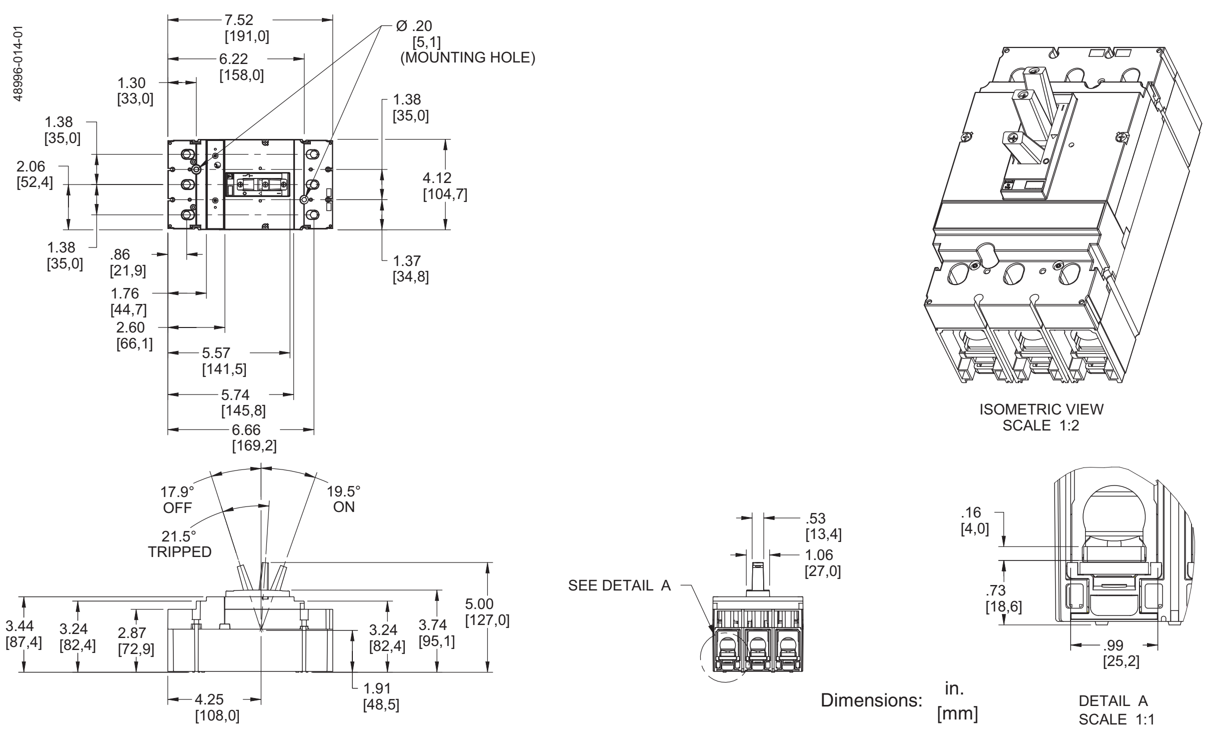
Main Breaker (250A)

J-frame Dimensional Drawings*

150–250 A Bus Bar J-frame 3-Pole



150–250 A Lug-Lug J-frame 3-Pole

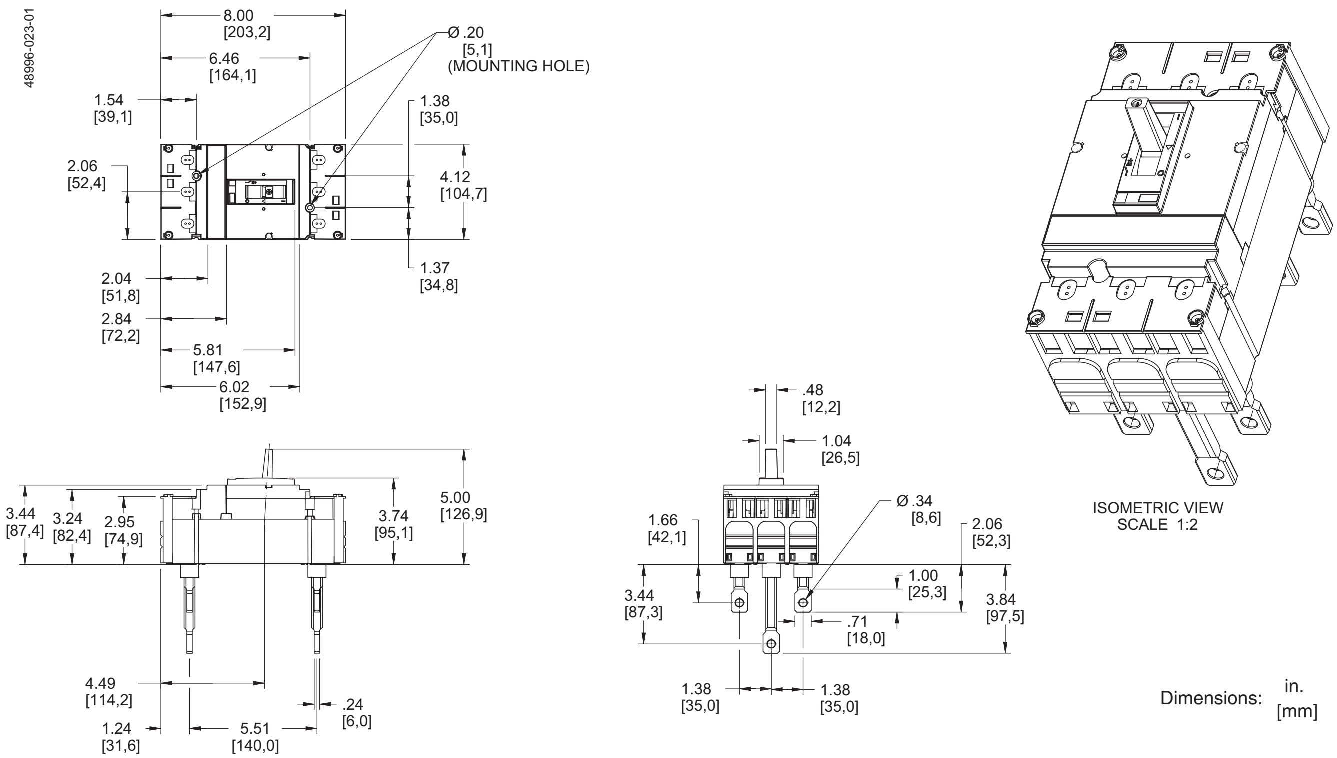


* 2-dimensional (2D) drawings & 3-dimensional (3D) models are available online in multiple file form

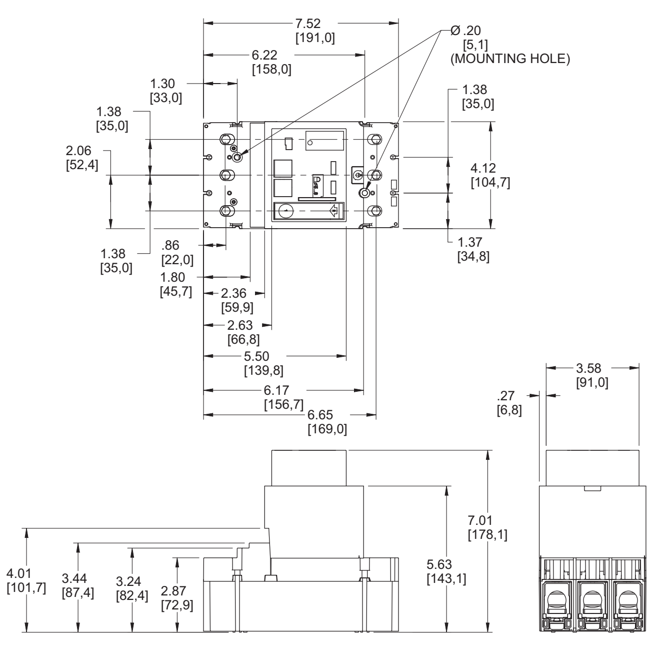
Shop Drawings
Contractor Approval
Approved by: S.B.S., G. F.
Date: Ma[illegible]2015
SIFEC NORTH INC

SQUARE D

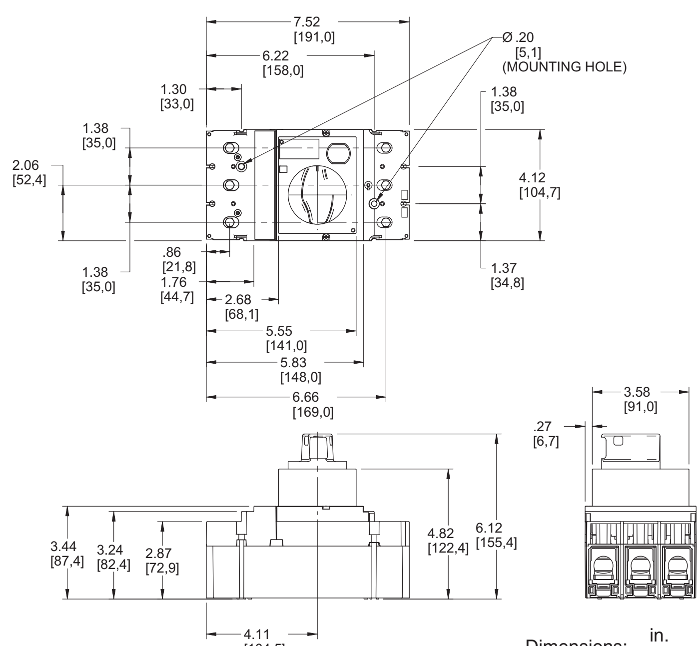
150–250 A Rear Connected J-frame 3-Pole



J-frame Motor Operator Detail



J-frame Rotary Handle Detail



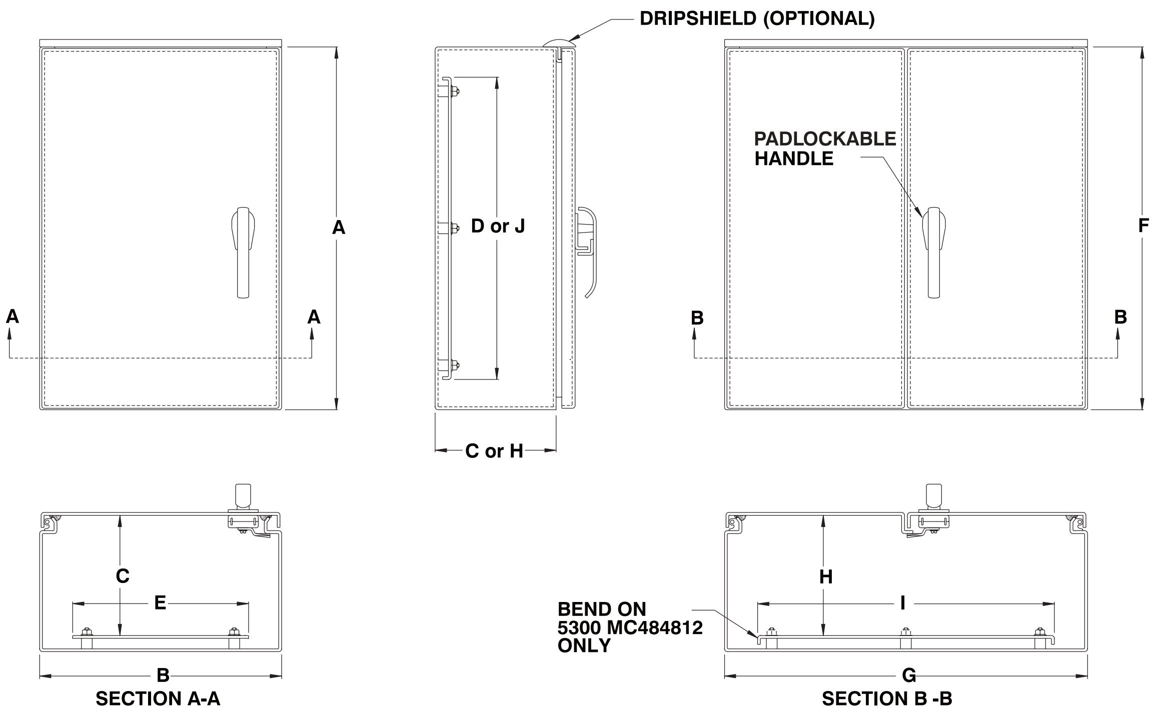
Dimensions: in. [mm]

Weatherproof metering cabinet

The 5300 MC weatherproof metering cabinets are specially designed for outdoor installation of metering transformers to protect against rain, sleet and snow. The 5300 MC are made from quality 14 GA steel, with corner seems tack welded. The opening has a curled lip around all sides to prevent dripping water from entering the enclosure when the door is open, it also increases rigidity. A high quality robotically poured-in-place seamless gasket ensures a complete and durable weathertight seal. The captive pins of the concealed hinges can be pulled to remove the door. The doors are closed with a 3 point padlockable handle.
Internal mounting holes are provided. Each enclosure comes complete with a 14 GA inner panel which mounts on M8 welded studs. Enclosures wider than 30" inclusively have double doors while smaller enclosures have single doors. Enclosures and panels are finished with heat fused powder paint, electrostatically applied on a pretreated base. Box is ANSI/ASA 61 gray, panel is white (other colors available).

CSA Certified / UL Listed
NEMA/EEMAC 3 / IP64

Refer to p.727 to validate choice of substrate for the application



CATALOG NUMBER	DIMENSIONS A	B	C	D	E	SHIP WGHT LBS.
5300 MC202010	20	20	10	18	18	40
5300 MC271310	27	13	10	25	11	45
5300 MC302010	30	20	10	28	18	50

CATALOG NUMBER	DIMENSIONS F	G	H	J	I	SHIP WGHT LBS.
5300 MC303010	30	30	10	28	28	76
5300 MC363612	36	36	12	34	34	133
5300 MC484812	48	48	12	46	46	205

Shown with optional 880 ESDS external drip shield, see p.474.

Data subject to change without notice.

METERING CABINET

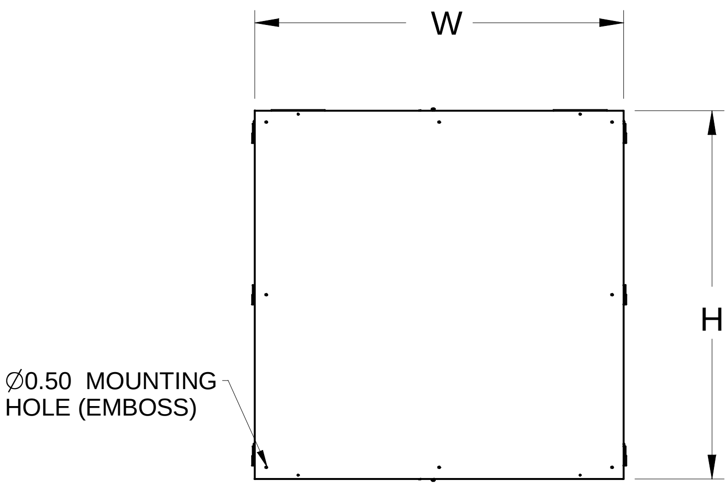
BUL10296
REV. A

ASSEMBLY INSTRUCTIONS FOR METERING CABINETS (CMC)

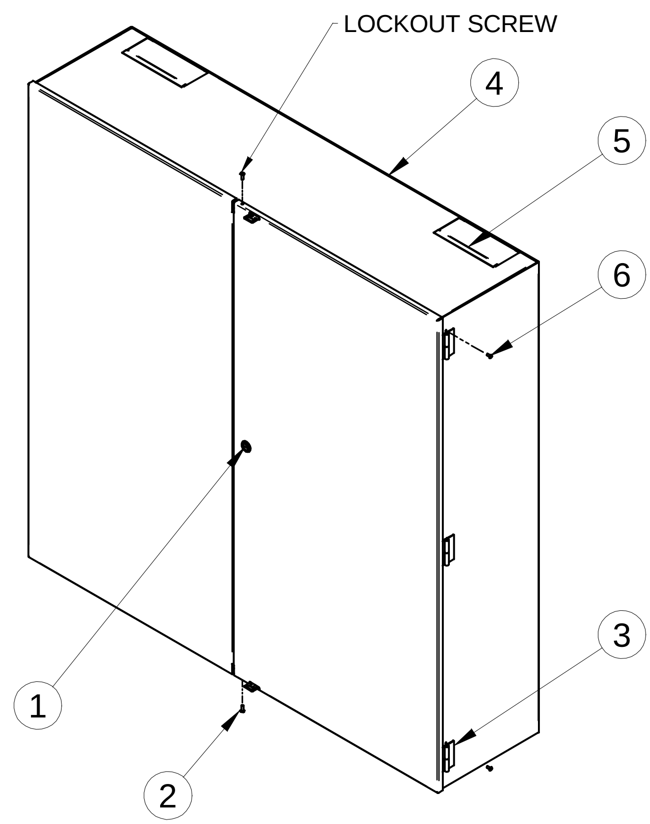
ITEM #	DESCRIPTION
1	SLOTTED 1/4 TURN FASTENER -BLK
2	SCREW - 10-32 X 1/2 PAN PH ZP - THREAD ROLLING
3	SLIP HINGE
4	METERING CABINET
5	COVER PLATE
6	SCREW 8 X 3/8 PAN PH

INSTRUCTIONS :

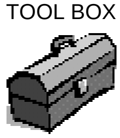
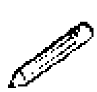
A) LOCATE METERING CABINET IN DESIRED LOCATION.
B) HOLD CABINET IN LOCATION AND SECURE USING SUPPLIED FASTENERS.
C) INSTALL TRANSFORMER OR METERING EQUIPMENT ONLY.
D) ENSURE THAT LOCKOUT SCREWS ARE INSTALLED WHILE IN USE (ONLY ON DOUBLE DOOR VERSIONS).
E) OMIT ITEMS 1,2, & 6 WITH SINGLE DOOR VERSIONS.
F) SLIP HINGES ARE REPLACED WITH HEAVY-BUTT HINGE ON SINGLE DOOR VERSIONS.



REAR VIEW



PART NUMBER	H	W	# OF MTG. SCREWS
CMC202010	20.00	20.00	4
CMC271310	27.00	13.00	4
CMC302010	30.00	20.00	4
CMC303010	30.00	30.00	4
CMC363612	36.00	36.00	4
PART SHOWN - CMC484812	48.00	48.00	8

TOOL BOX	Pencil	Philips Head Screw Driver
		

HAMMOND MANUFACTURING™
ENCLOSURES

307/665

SFC Series

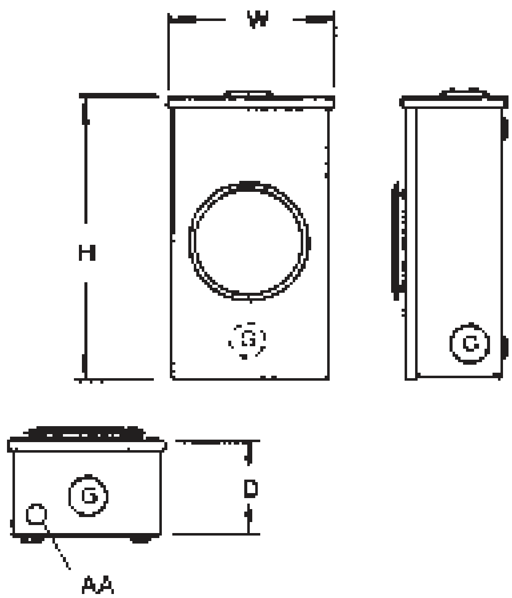
100 AMP - 7 JAW
Polyphase 3 PH - 4 Wire Meter Sockets

CATALOGUE #	DESCRIPTION	ENCLOSURE SIZE H X W X D	WEIGHT
SFC700PW	7 Jaw overhead c/w hub closure plate	15$^{3}/_{8}$" x 8$^{5}/_{8}$" x 5"	12 lbs.
SFC703PW	as above, c/w insulated neutral	15$^{3}/_{8}$" x 8$^{5}/_{8}$" x 5"	12 lbs.
SFC800PW	8 Jaw - overhead	15$^{3}/_{8}$" x 8$^{5}/_{8}$" x 5"	12 lbs.
SFC700RW	7 Jaw combination overhead/underground	15$^{3}/_{8}$" x 8$^{5}/_{8}$" x 5"	12 lbs.

- 100 Amp, 600 VOLT
- CSA enclosure 3
- CSA approved for copper or aluminum
- Conductor range #6 - 1/0 AWG CU/AL

- Order "SXC" hubs separately
*- Insulated neutral can be field added **"INK 100"***

KNOCKOUT CODE	CONDUIT SIZE
AA	$^{1}/_{2}$"
G	1$^{1}/_{4}$", 1$^{1}/_{2}$", 2", 2$^{1}/_{2}$"



Chapter 29 SUBMERSIBLE PUMP STARTER

MANUFACTURER/DISTRIBUTOR:

CDE
298, Rue De Martigny Ouest
Saint-Jérôme (Québec)
J7Y 4C9
Phone.: (450) 438-1263
Fax: (450) 438-3728
Courriel : cde@cde.qc.ca

29.1 PUMP STARTER SQUARE D 8539 SEW15V80CFF4P91P92T

002-00	2	8539SEW15V80CFF4P91P92T

Class 8539 Thermal Mag CB Combination Starter

Class 8539 Thermal Mag CB Combination Starter
8539SEW15V80CFF4P91P92T
NEMA Size 3
Thermal Mag circuit breaker combination
starter
Non-reversing 3 phase
3 pole device
Selected for 30 HP @ 230V 3Ph
Type 4/4X Glass Polyester Enclosure
Melting alloy overload
Starter will require 3 thermal units
Standard with NC overload contact
Specified for 230V 3Ph power system
Fused control transformer selected
with 120V 60Hz coil
T - Standard capacity
240 Volt primary
120 Volt secondary
Fusing
F4 - 2 primary control fuses
F - 1 secondary control fuse
Auxiliary contacts -
None
Control units supplied
Legends are supplied in French.
C - HAND-OFF-AUTO selector switch
Pilot lights supplied
P91 - Power OFF red pilot light (LED)
P92 - Power ON green pilot light (LED)
Revision - 3/10/2015 - (150217P4/150217P4)
3/19/2015 2:51:03 PM

Estimated Ship Days (ARO): 12 Working Days

Harmony™ 9001K/SK/KX 30 mm push buttons
9001SK

Shop Drawings
Contractor Approval
Approved by: S.B.S., G. F.
Date: Apr 28, 2015
SIFEC NORTH INC

Environmental specifications

Conforming to standards	CE Marked RoHS		EN/IEC 60947-1, EN/IEC 60947-5-1, EN/IEC 60947-5-4, JIS C 4520 and 852, UL 508, CSA C22-2 n° 14, CE marked, RoHS compliant
Product certifications	UL File E78403 CCN NKCR; CSA File LR25490 Class 3211-03		UL File E78403, CCN NKCR and CSA File LR25490, Class 3211-03
Protective treatment standard version			"TC"
Ambient air temperature around the device	Storage	°F (°C)	-40 to +158 (-40 to +70)
	Operation	°F (°C)	-13 to +158 (-25 to +70)
Vibration resistance	Conforming to IEC 60068-2-6		Frequency: 2 to 500 Hz: 7gn Ford Standard EA-1
Shock resistance	Conforming to IEC 60068-2-27		Half sine wave: 50 gn
Electric shock protection	Conforming to IEC 61140		Class II
Degree of protection	Conforming to EN/IEC 60529		IP 66
	Conforming to NEMA		Types 1, 2, 3, 3R, 4, 12 and 13
Mechanical life (in millions of operating cycles)	Push buttons, spring return		5
	Illuminated push buttons		5
	Selector switches and key switches		0.5
Mounting position			All positions

Electrical characteristics of contact blocks

Rated operational characteristics	∿ AC-15		3 A, 240 V			
	⎓ DC-13		0.55 A, 125 V			
Rated insulation voltage	Conforming to EN/IEC 60947-1	V	Ui = 250 degree of pollution 3 (except pilot lights with incandescent bulb: degree of pollution 2)			
Rated impulse withstand voltage	Conforming to EN/IEC 60947-1	kV	Uimp = 2.5			
Contact material	Normal environment and usage		Silver alloy			
Contact operation	"N/C" ou "N/O"		Slow break			
Positive operation	Conforming to EN/IEC 60947-5-1	N	N/C contact(s) with positive opening operation			
Short-circuit protection	Conforming to EN/IEC 60947-5-1	A	Cartridge fuse mounted upstream: 10			
Cabling capacity (9001KA contact blocks and 9001KM light modules)	Conforming to EN/IEC 60947-1	 mm^2 mm^2	Screw clamp terminals (cross headedslotted screw) Mini: 1 x 0.22 Maxi: 2 x 1.5 Recommended tightening torque: 0.8 N.m (10 in-lbs)			
Thermal current	Ith	A	10			
Maximum operation current	a.c. supply: utilization category AC-15 NEMA A600		Contact making capacity			
		V A VA	120 60 7200	240 30 7200	480 15 7200	600 12 7200
			Breaking capacity			
		V A VA	120 6 720	240 3 720	480 1.5 720	600 1.2 720
	d.c.supply: utilization category DC-13 NEMA Q600		Contact making capacity and breaking capacity			
		V A	125 0.55	250 0.27	600 0.1	

Product range: page 36 References: page 41 Dimensions: page 60 Mounting: page 61

Shop Drawings
Contractor Approval
Approved by: S.B.S., G. F.
Date: Apr 28, 2015
SIFEC NORTH INC

9001SK Operator Materials:

Push Button and Push-to-test Pilot Light
(9001SKR and 9001SKT)

Base – Thermoplastic Polyester
Stem – Acetal (non-illuminated push button)
Thermoplastic Polyester (illuminated push button and push-to-test pilot light)
Seal – Nitrile
Gasket – Nitrile
Spring – 302 Stainless Steel
Spring Support – CRS
Lock Ring – Nylon
Trim Washer – Polypropylene
Locking Thrust Washer – Thermoplastic Polyester
Ring Nut – Thermoplastic Polyester
Color Insert – Polyethylene (non-illuminated push button)
Color Cap – Polycarbonate (illuminated push button and push-to-test pilot light)
Mushroom Button – Acetal (non-illuminated push button)
Polycarbonate (illuminated push button)
Liner – Polypropylene (non-illuminated push button)

Selector Switch (9001SKS)

Base – Thermoplastic Polyester
Seal – Nitrile
Gasket – Nitrile
Seal Keeper – 302 Stainless Steel
Spring – 302 Stainless Steel
Cam Follower – Delrin 100
Bearing Washer – Polyester Film
Cam Carrier – Trogamid
Cam Profile – Delrin 100
Liner – Polypropylene (non-illuminated only)
Knob – Polycarbonate
Trim Washer – Polypropylene
Locking Thrust Washer – Thermoplastic Polyester
Spring Support – CRS

Pilot Light (9001SKP)

Gasket – Nitrile
Base – Thermoplastic Polyester
Trim Washer – Polypropylene
Locking Thrust Washer – Thermoplastic Polyester
Ring Nut – Thermoplastic Polyester
Color Cap – Polycarbonate

Contact Block And Light Module Materials:

Contact Block (9001KA)

Housing – Amorphous Nylon
Contact Slider – Phenolic, Nylon or Acetal
Terminal – Steel
Saddle Clamp – Steel
Spring – Stainless Steel
Contacts – Silver and Copper
Blade – Beryllium Copper
Mounting Screw – Steel
Label – Paper

Light Module (9001KM)

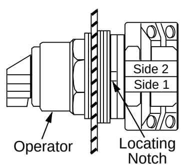
Housing – Thermoplastic Polyester
Socket – Steel
Terminal – Steel with Tin Plate
Saddle Clamp – Steel
Translating Pin – Polycarbonate
Transformer – Thermoplastic Polyester, Steel, Copper, Polyvinyl Chloride, Polytetrafluorethylene, Acetate, Paper
Lamp Spring – Tin Plated Music Wire

Harmony™ 9001K/SK/KX 30 mm push buttons
9001SK – Selector switches

Note: When ordering, add prefix "9001" to the reference.

3-Position Selector Switches

Contact Block Required — **1 — Contact Closed** **0 — Contact Open**



Top View

Contact Block Position	Quantity and Type	Mount on Side	Center ↖ ↑ ↗	Center ↖ ↑ ↗	Center ↖ ↑ ↗	Center ↖ ↑ ↗	Center ↖ ↑ ↗	Center ↖ ↑ ↗	Center ↖ ↑ ↗	Center ↖ ↑ ↗	Center ↖ ↑ ↗
	KA1 or KA3	KA1 or KA3 #2	1 0 0	1 0 0	0 0 1	1 0 0	1 0 0	1 0 0	1 0 0	0 1 0	1 1 0
	KA2	KA2 #2	0 1 1	0 0 1	0 1 0	0 1 0	0 0 1	0 1 1	0 1 1	1 0 0	0 0 1
	KA1 or KA3	KA1 or KA3 #1	0 0 1	1 0 0	0 0 1	1 0 0	0 1 0	0 0 1	1 0 1	0 0 1	0 1 1
	KA2	KA2 #1	1 1 0	0 0 1	0 1 0	0 1 0	0 0 1	1 0 0	0 1 0	0 1 0	1 0 0
Cam (see page 47)			**B**	**C**	**D**	**E**	**F**	**G**	**J**	**L**	**M**

Non-Illuminated Operators

	B	C	D	E	F	G	J	L	M
Manual Return, Operator Only (without contact blocks) *(1)*									
Without Knob	**SKS42**	**SKS43**	**SKS44**	**SKS45**	**SKS46**	**SKS47**	**SKS49**	**SKS401**	**SKS402**
With Knob (select style and color from table below)	**SKS42♦**	**SKS43♦**	**SKS44♦**	**SKS45♦**	**SKS46♦**	**SKS47♦**	**SKS49♦**	**SKS401♦**	**SKS402♦**
Operator with Contact Blocks and Standard black knob *(4)*									
With 1 KA1 on Side #2 (H13)	SKS42BH13	SKS43BH13	SKS44BH13	SKS45BH13	SKS46BH13	SKS47BH13	SKS49BH13	SKS401BH13	SKS402BH13
With 1 KA1 on Side #1 (H1)	SKS42BH1	SKS43BH1	SKS44BH1	SKS45BH1	SKS46BH1	SKS47BH1	SKS49BH1	SKS401BH1	SKS402BH1
With 1 KA1 on Side #1 and 1 KA1 on side #2 (H2)	SKS42BH2	SKS43BH2	SKS44BH2	SKS45BH2	SSKS46BH2	SKS47BH2	SKS49BH2	SKS401BH2	SKS402BH2
Spring Return from Left to Center, Operator Only (without contact blocks) *(1)*									
Without Knob	**SKS62**	**SKS63**	**SKS64**	**SKS65**	**SKS66**	**SKS67**	**SKS69**	**SKS601**	**SKS602**
With Knob (select style and color from table below)	**SKS62♦**	**SKS63♦**	**SKS64♦**	**SKS65♦**	**SKS66♦**	**SKS67♦**	**SKS69♦**	**SKS601♦**	**SKS602♦**
Spring Return from Right to Center, Operator Only (without contact blocks) *(1)*									
Without Knob	**SKS72**	**SKS73**	**SKS74**	**SKS75**	**SKS76**	**SKS77**	**SKS79**	**SKS701**	**SKS702**
With Knob (select style and color from table below)	**SKS72♦**	**SKS73♦**	**SKS74♦**	**SKS75♦**	**SKS76♦**	**SKS77♦**	**SKS79♦**	**SKS701♦**	**SKS702♦**
Spring Return from Both Sides to Center, Operator Only (without contact blocks) *(1)*									
Without Knob	**SKS52**	**SKS53**	**SKS54**	**SKS55**	**SKS56**	**SKS57**	**SKS59**	**SKS501**	**SKS502**
With Knob (select style and color from table below)	**SKS52♦**	**SKS53♦**	**SKS54♦**	**SKS55♦**	**SKS56♦**	**SKS57♦**	**SKS59♦**	**SKS501♦**	**SKS502♦**

Illuminated Operators

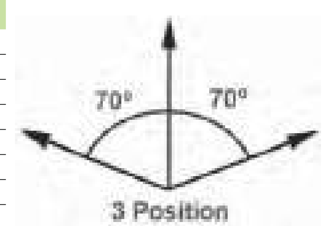
	B	C	D	E	F	G	J	L	M
Manual Return, Operator Only (without contact blocks) *(1)*									
Without Knob, 110-120V 50-60 Hz Transformer	**SK42J1**	**SK43J1**	**SK44J1**	**SK45J1**	**SK46J1**	**SK47J1**	**SK49J1**	**SK401J1**	**SK402J1**
With Standard Red Knob, 110-120V 50-60 Hz Transformer	**SK42J1R**	**SK43J1R**	**SK44J1R**	**SK45J1R**	**SK46J1R**	**SK47J1R**	**SK49J1R**	**SK401J1R**	**SK402J1R**
With Other Color Knob and other voltage Light Module *(2) (3)*	**SK42J■♦**	**SK43J■♦**	**SK44J■♦**	**SK45J■♦**	**SK46J■♦**	**SK47J■♦**	**SK49J■♦**	**SK401J■♦**	**SK402J■♦**
Spring Return from Left to Center, Operator Only (without contact blocks) *(1)*									
Without Knob, 110-120V 50-60 Hz Transformer	**SK62J1**	**SK63J1**	**SK64J1**	**SK65J1**	**SK66J1**	**SK67J1**	**SK69J1**	**SK601J1**	**SK602J1**
With Standard Red Knob, 110-120V 50-60 Hz Transformer	**SK62J1R**	**SK63J1R**	**SK64J1R**	**SK65J1R**	**SK66J1R**	**SK67J1R**	**SK69J1R**	**SK601J1R**	**SK602J1R**
With Other Color Knob and other voltage Light Module *(2) (3)*	**SK62J■♦**	**SK63J■♦**	**SK64J■♦**	**SK65J■♦**	**SK66J■♦**	**SK67J■♦**	**SK69J■♦**	**SK601J■♦**	**SK602J■♦**
Spring Return from Right to Center, Operator Only (without contact blocks) *(1)*									
Without Knob, 110-120V 50-60 Hz Transformer	**SK72J1**	**SK73J1**	**SK74J1**	**SK75J1**	**SK76J1**	**SK77J1**	**SK79J1**	**SK701J1**	**SK702J1**
With Standard Red Knob, 110-120V 50-60 Hz Transformer	**SK72J1R**	**SK73J1R**	**SK74J1R**	**SK75J1R**	**SK76J1R**	**SK77J1R**	**SK79J1R**	**SK701J1R**	**SK702J1R**
With Other Color Knob and other voltage Light Module *(2) (3)*	**SK72J■♦**	**SK73J■♦**	**SK74J■♦**	**SK75J■♦**	**SK76J■♦**	**SK77J■♦**	**SK79J■♦**	**SK701J■♦**	**SK702J■♦**
Spring Return from Both Sides to Center, Operator Only (without contact blocks) *(1)*									
Without Knob, 110-120V 50-60 Hz Transformer	**SK52J1**	**SK53J1**	**SK54J1**	**SK55J1**	**SK56J1**	**SK57J1**	**SK59J1**	**SK501J1**	**SK502J1**
With Standard Red Knob, 110-120V 50-60 Hz Transformer	**SK52J1R**	**SK53J1R**	**SK54J1R**	**SK55J1R**	**SK56J1R**	**SK57J1R**	**SK59J1R**	**SK501J1R**	**SK502J1R**
With Other Color Knob and other voltage Light Module *(2) (3)*	**SK52J■♦**	**SK53J■♦**	**SK54J■♦**	**SK55J■♦**	**SK56J■♦**	**SK57J■♦**	**SK59J■♦**	**SK501J■♦**	**SK502J■♦**

▲ *These operators can be ordered complete with contact blocks. Add the "H code" from page 51 as needed for your application.*
■ *Replace ■ with the voltage assembly code as chosen from the tables on page 54. Example: K25J■ with 208Vac = K25J3.*
♦ *Replace ♦ with the color code as chosen from the color code table below. For LED, knob color must match LED.*
★ *For other color knobs replace the B with knob color code from table below.*

Selector Switch Assembly Code and Knob Cat. No.

Color	Standard Knob ♦ Knob Code	Reference	Gloved Hand Knob ♦ Knob Code	Reference
Black	B	**B11**	FB	**B25**
Red	R	**R8**	FR	**R24**
Green	G	**G8**	FG	**G24**
Yellow	Y	**Y8**	FY	**Y24**
Blue	L	**L8**	FL	**L24**
White	W	**W8**	FW	**W24**
Amber	A	**A8**	FA	**A24**
Clear	C	**C8**	FC	**C24**

To select and order Contact Blocks, Light Modules, Knobs, and Accessories, see pages 50 to 59.



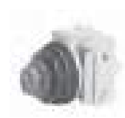
Product range: page 36
Specifications: page 38
Dimensions: page 60
Mounting: page 61

Harmony™ 9001K/SK/KX 30 mm push buttons
9001SK – Pilot lights

Shop Drawings
Contractor Approval
Approved by: S.B.S., G. F.
Date: Apr 28, 2015
SIFEC NORTH INC

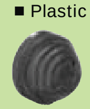
Note: When ordering, add prefix "9001" to the reference.

Pilot Lights—UL Types 4, 4X, 13/NEMA 4, 4X, 13
For use in hazardous locations, see page 53. Legend plate not included.

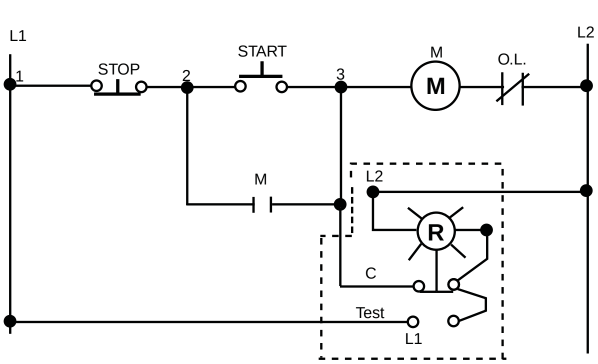
Description		Voltage	Style	With Red Fresnel Color Cap	With Green Fresnel Color Cap	With Other Color Cap *(2)*	Without Color Cap
 *9001SKP1*	Standard Pilot Light (Fresnel color cap shown)	110–120 V, 50–60 Hz	Transformer	SKP1R31	SKP1G31	SKP1■	SKP1
		220–240 V, 50–60 Hz	Transformer	SKP7R31	SKP7G31	SKP7■	SKP7
		24–28 Vac/Vdc	Full Voltage	SKP35R31	SKP35G31	SKP35■	SKP35
		For other voltages *(1)*	Transformer, Flashing or LED *(3)*	SKP▲R31	SKP▲G31	SKP▲■	SKP▲
			Full Voltage, Neon or Resistor *(4)*	SKP▲R31	SKP▲G31	SKP▲■	SKP▲
 *9001SKT1*	Push-To-Test Pilot Light (Fresnel color cap shown)	110–120 V, 50–60 Hz	Transformer	SKT1R31	SKT1G31	SKT1■	SKT1
		220–240 V, 50–60 Hz	Transformer	SKT7R31	SKT7G31	SKT7■	SKT7
		24–28 Vac/Vdc	Full Voltage	SKT35R31	SKT35G31	SKT35■	SKT35
		For other voltages *(1)*	92%	SKT▲R31	SKT▲G31	SKT▲■	SKT▲
			Full Voltage, Neon or Resistor *(4)*	SKT▲R31	SKT▲G31	SKT▲■	SKT▲
 *9001SKTR38*	Remote Test Pilot Light (Fresnel color cap shown)	120 Vac Only	Resistor	SKTR38R31	SKTR38G31	SKTR38■	SKTR38
		24–28 Vac Only	Full Voltage	SKTR35R31	SKTR35G31	SKTR35■	SKTR35
		For other voltages *(1)*	Full Voltage or Resistor *(5)*	SKTR▲R31	SKTR▲G31	SKTR▲■	SKTR▲

(1) Replace ▲ with the voltage assembly code as chosen from the tables on page 54.
Example: SKT▲R31 with 208 Vac red LED voltage = SKT37LRR31.
(2) Replace ■ with the color code as chosen from the color code table below.
Example: SKP1■ with a blue fresnel cap = SKP1L31.
(3) The cap must be the same color as the LED light module chosen, e.g., for a green LED, use a green color cap.
(4) On neon light modules, use clear color caps only.
(5) Use only full voltage or resistor voltage assembly codes on remote test pilot lights. Do not choose LED, neon or transformer codes. For AC use only.

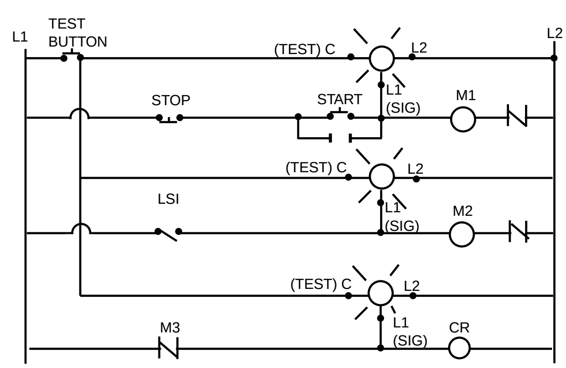
Color Caps

Color	■ Plastic Fresnel	■ Plastic Domed
		
Amber	A31	A9
Blue	L31	L9
Clear	C31	C9
Green	G31	G9
Red	R31	R9
White	W31	W9
Yellow	Y31	Y9

Typical Wiring Diagrams



Push-to-test Pilot Light



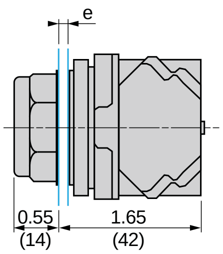
Remote Test Pilot Light

To select and order Contact Blocks, Light Modules, Knobs, and Accessories, see pages 50 to 59.

Harmony™ 9001K/SK/KX 30 mm push buttons
9001SK

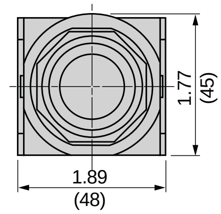
Dimensions

Push buttons

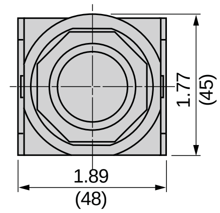


e: panel thickness 1 to 6 mm

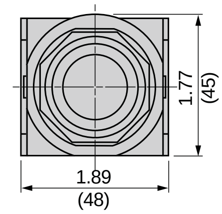
Full guard
9001SKR1●●●



No guard
9001SKR3●●●

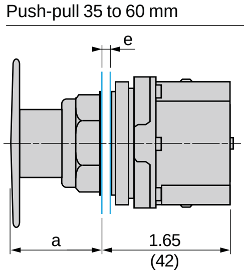


No guard with extended guard
9001SKR2●●●



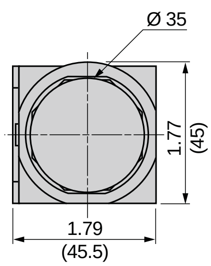
Mushroom head push buttons

Spring return 35, 57 and 60 mm	a = 28 mm
Push-pull 35 to 60 mm	a = 32 mm

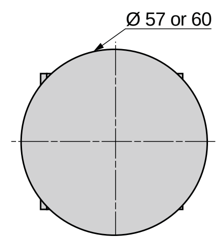


e: panel thickness 1 to 6 mm

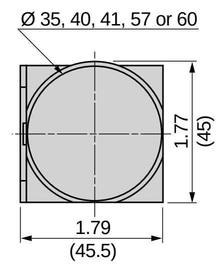
Spring return 35 mm:
9001SKR24●H13,
9001SKR4RH6,
9001SKR9R20H6

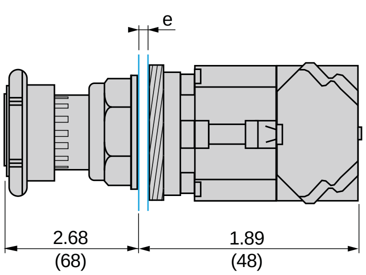


Spring return 57 mm:
9001SKR25●H13,
9001SKR5RH6



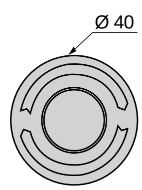
Push-pull 35 mm:
9001SKR9R20H6
Push-pull 41 mm:
9001SKR9●H13,
9001SKR9RH6
9001SKR8●H25
Push-pull 57 mm:
9001SKR9R21H6



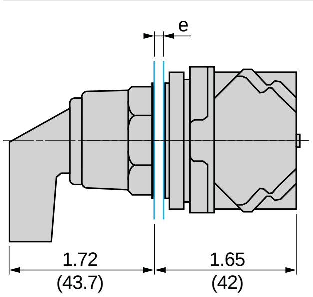


e: panel thickness 1 to 6 mm

Turn-to-release 9001SKR16H13, 9001SKR16H2 and 9001SKR16

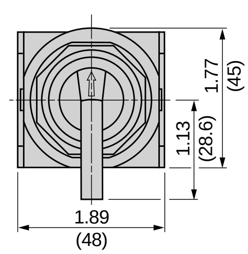


Selector switches



e: panel thickness 1 to 6 mm

Gloved handle 9001SKS●●FBH●●

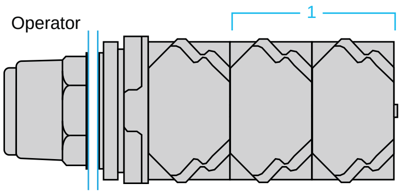


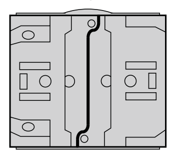
Dual Dimensions: in (mm)

Harmony™ 9001K/SK/KX 30 mm push buttons
9001SK

Mounting

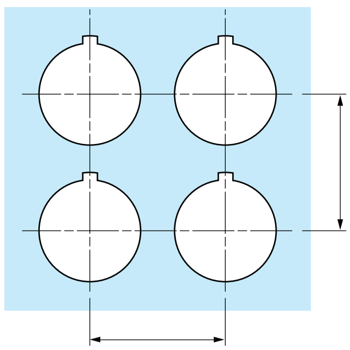
Contact block mounting position





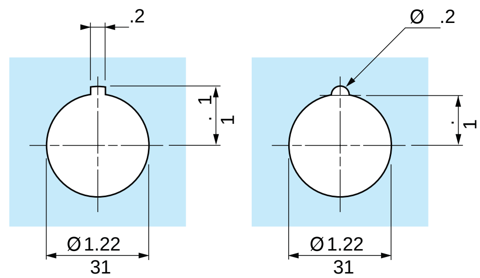
1 It is possible to mount up to 3 levels of contacts blocks (maximum of 6 contacts blocks) on 9001SK references. For Maximum Contact Block usage, see Page 50.

Panel cut-out



Individual cut-outs detail

2 alternatives



Preferred Cut-Out

Alternate Cut-Out

Use Greenlee Tool #60242 for punching hole and notch.

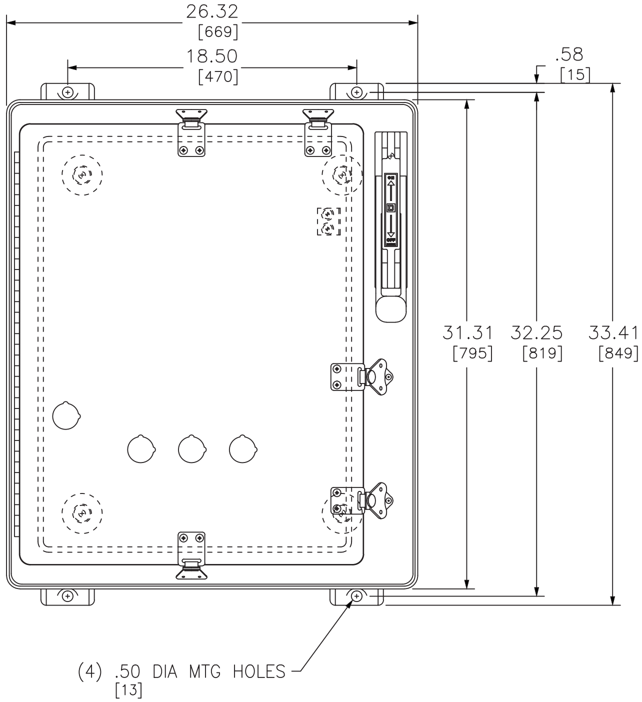
Type of 9001K unit	Legend plate	a: in (mm)	b: in (mm)
All units except 57 mm mushroom head push buttons	9001KN2●●	2.25 (57.2)	1.75 (44.5)
	9001KN3●●	2.25 (57.2)	2.00 (50.8)
57 mm mushroom head push buttons	9001KN2●●	2.25 (57.2)	2.25 (57.2)
	9001KN3●●	2.25 (57.2)	2.25 (57.2)

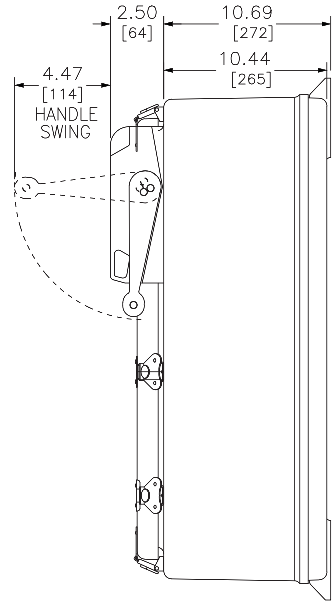
Dual Dimensions: in (mm)

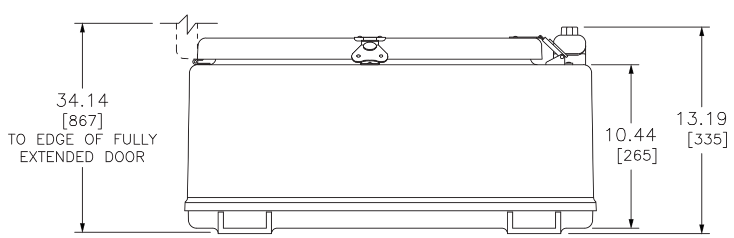
REV	DESCRIPTION	BY	DATE	-	----	--	--/--/--	-	----	--	--/--/--
-	----	--	--/--/--	-	----	--	--/--/--	-	----	--	--/--/--

CLASS 8538/8539 COMBINATION STARTERS
NEMA TYPE 4X CORROSION RESISTANT ENCLOSURE

Shop Drawings
Contractor Approval
Approved by: S.B.S., G. F.
Date: Apr 28, 2015
SIFEC NORTH INC







DUAL DIMENSIONS: INCHES
MILLIMETERS

NEMA SIZE	CLASS	TYPE	HUB * SIZE	HUB * QUANTITY
3	8538 & 8539	SEW	.75	1
			2.50	2
4	8539	SFW	.75	1
			2.50	2

PROJ NO: 030-62105
REF NO: 030-62105D

NOTE: THE DIMENSIONS INCLUDE SPACE FOR A CONTROL TRANSFORMER (FORM F4T).
* ENCLOSURES ARE NOT PREDRILLED FOR HUBS. HUBS ARE SUPPLIED WITH EACH NEMA 4X COMBINATION STARTER BUT NOT INSTALLED.

JOB NAME:	SPE-PANG DEMARREURS	EQUIPMENT DESIGNATION:	
JOB LOCATION:	MIRABEL QC	EQUIPMENT TYPE:	
DRAWN BY:	(Q2C)	DRAWING TYPE:	
ENGR:		SQUARE D by Schneider Electric	
DATE:	April 27 2015		
DRAWING STATUS:	QUOTE	DWG# F36265394-01	PG 1 OF 1 REV –

Class 8536 — **Type S C G - 3 V02** — **Form S**

General Classification

8502	Contactor Page 16-13
8536	Starter Page 16-17
8538	Combination Starter with Disconnect Switch Page 16-30
8539	Combination Starter with Circuit Breaker Page 16-34
8702	Reversing Contactor Page 16-43
8736	Reversing Starter Page 16-45
8738	Reversing Combination Starter with Disconnect Switch Page 16-50
8739	Reversing Combination Starter with Circuit Breaker Page 16-52
8810	Two Speed Starter Page 16-58 ▲
8903	Type S Lighting Contactors Page 16-65 ▲
8940	Pumping Plant Panel Page 16-81 ▲
8941	Duplex Controller Page 16-85 ▲

Design

Type S NEMA Contactors and Starters

NEMA Size		8903 (only)	
A	Size 00		
B	Size 0	M	30 Amperes
C	Size 1	P	60 Amperes
D	Size 2	Q	100 Amperes
E	Size 3	V	200 Amperes
F	Size 4	X	300 Amperes
G	Size 5	Y	400 Amperes
H	Size 6	Z	600 Amperes
J	Size 7	J	800 Amperes

Enclosure

A	NEMA 12 Industrial Use
F	NEMA 1 Flush Mounting General Purpose
G	NEMA 1 General Purpose Surface Mounting
H	NEMA 3R Rainproof
O	Open Style Device (no enclosure)
R	NEMA 7 & 9 Hazardous Environments, Spin Top
T	NEMA 7 & 9 Hazardous Environments, Bolted
W	NEMA 4 Watertight, 4X Corrosion Resistant

Numerals

Used to designate specific, physical arrangements, such as number of poles, fuse clip size, etc.; but the numbering varies with Class of equipment. Consult Digest listings for specific device numbers.

Voltage Code

AC operated devices without control transformer

Code	Voltage/Frequency
V01	24/60
V02	120/60 or 110/50
V06	480/60 or 440/50
V07	600/60 or 550/50
V08	208/60

V81 - 480V Primary, 120V Secondary for units using a fused transformer control circuit Form (F4T).

This is only a partial listing consult Digest pages 16-13 and 16-110 for more information.

Common Forms (factory modifications) Page 16-109

A	"Start-Stop" pushbuttons in the enclosure cover
B■	Bimetallic overload relays
C	"Hand-Off-Auto" selector switch in the enclosure cover
F4T	Fused transformer control circuit (primary fuses only)
FF4T	Fused transformer control circuit (primary & secondary fuses)
H	Solid state overload relay
P1	Red ON pilot light in the enclosure cover
P2	Green OFF pilot light in cover
S	Separate control circuit
X01	One "normally closed" auxiliary contact N.C.
X10	One "normally open" auxiliary contact N.O.

Consult Digest pages 16-109 to 16-113 for additional form letters, When more than one form is applied to a single device, arrange Forms in alphabetical order.

▲ Combination two speed starters will replace the "S" with a "C", "U" or "D". Pumping plant panels have Various leading characters. Not all use Type S contactors. Duplex controllers use "N", "C", "U", and "D".

■ May also designate Motor Logic Plus overload relay

Table 16.35: How to Order

To Order Specify:	Catalog Number			
	Class	Type	Voltage Code	Form(s)
• Class Number • Type Number • Voltage Code • Form(s) see pages 16-109–16-113	8539	SCG44	V06	AH20P1X11

Note: Description: NEMA Size 1, (10 Hp) Mag-Gard Combo Starter in a NEMA Type 1 enclosure with a 480V coil, start/stop pushbutton (A), class 20 SSOLR (H20), red pilot light (P1), 1 N.O. and 1 N.C. auxiliary contact (X11)

IMPORTANT - This information is intended for general interpretation of catalog numbers. Do not use to create catalog numbers for this product line.

Note: The terms Type and Form do not appear in the catalog number.

Devices are wired from factory according to customer preference as follows:

- Common control
- Separate control (Form S)
- Control power transformer (CPT)

Combination Starters

Class 8538/8539, 8738/8739

CONTENTS

SQUARE D
GROUPE SCHNEIDER

312/665

General Information

Class 8538 and 8539 Type S combination starters combine the requirements of motor overload and short circuit protection into one package. These starters are manufactured in accordance with NEMA standards and are UL Listed (although some FORM numbers may not be listed – contact your local Square D representative for information). Class 8538 and 8539 combination starters are designed to operate at 600 Vac maximum, 50 to 60 Hz – and are supplied with melting alloy overload relays as standard.

Type 2 Coordination

Square D is one of the leaders in North America and Europe in providing starters that are verified by UL to comply with IEC 947-4-1 and Type 2 coordination. This means that the components of a motor branch circuit protective device (fuses and circuit breaker), contactor, and overload relay will be suitable for further use following a short circuit fault (even though contact welding is recognized but can be easily broken) allowing for replacement of components druing normal scheduled maintenance.

Square D starters and specified fuses have been tested by UL and CSA (at 100,000 Amps fault current) for operation at 600 volts AC. Class 8538 Type S Combination Starters, NEMA size 0 through 5, with fusible disconnect switches have tested to Type 2 performance criteria.

Class 8538 Disconnect Switch Type

Class 8538 combination starters can be supplied with either a fusible or non-fusible disconnect switch. Class 8538 combination starters are available in NEMA Sizes 0-6.

The fusible disconnect switch type combination starter design utilizes a flange operated visible blade switch. Interchangeable fuse clips, straight through wiring, space for a fused control transformer with additional capacity, and provisions for adding a disconnect switch electrical interlock are key features of the combination starters.

The fusible disconnect switch type can be supplied with Class R fuse clips increasing the short-circuit rating to 100,000A.

Size 0-2 non-fusible combination starters can be converted to a fusible type. See Catalog 999CT9701 for fuse block kits and fuse clips.

Class 8539 MAG-GARD® Motor Circuit Protector or Thermal Magnetic Circuit Breaker

Class 8539 combination starters can be supplied with either a MAG-GARD® motor circuit protector (MCP) or a thermal magnetic circuit breaker. Class 8539 combination starters are available in NEMA Sizes 0-7.

The circuit breakers in Class 8539 combination starters can be supplied with a factory installed auxiliary switch for remote indication of an open and/or tripped or closed breaker. For one auxiliary switch, specify **Form Y74**. For two auxiliary switches, specify **Form Y75**. The switches are supplied with normally open and normally closed circuits with a common connection. Contacts must be used on the same polarity and are rated 15 Amps at 240 Volts AC.

An alarm switch can be factory supplied only, specify **Form Y742.** The alarm switch only operates when the breaker is tripped. It is used to actuate bell alarms and warning lights. The alarm switch consists of a normally open single pole single throw switch. The contacts are rated 4 Amps at 240 Volts AC.

Enclosures – Class 8538 and 8539 combination starters are available in the following enclosures:

NEMA Type 1 General Purpose
NEMA Type 4 & 4X Watertight and Dusttight Stainless Steel
NEMA Type 4X Watertight, Dusttight, and Corrosion Resistant Glass-Polyester
NEMA Type 7 & 9 Bolted and Spin-Top® for Hazardous Locations (Class 8539 only).
NEMA Type 12 Dusttight and Driptight for Industrial Use

The NEMA Type 4 & 4X stainless steel enclosure (Sizes 0 - 5) has a brushed finish. Sizes 6 & 7 are painted sheet steel enclosures and are rated NEMA Type 4 only. For an electropolished finish, specify **Form G16** and add 15% to the price of the standard device. Hubs are supplied as standard on NEMA Type 4 & 4X enclosures.

Hubs are supplied as standard on NEMA Type 4X enclosures.

NEMA Type 12 enclosures may be field modified for outdoor applications. Specify **Form G26** for NEMA Type 3R (no additional charge). See Catalog 9999CT9701 for additional information. Also, NEMA Type 12 devices are available UL Listed for use in Class II, Division 2, Group G and Class III, Divisions 1 and 2 locations. Request **Form G21** (no additional charge).

Oversized Enclosures – Class 8538 disconnect switch type and Class 8539 MAG-GARD® MCP (Sizes 0-2) are available in NEMA Type 1, 4 & 4X and 12 enclosures. The oversized enclosures provide additional panel space for customer installation of control transformers, fuse blocks, terminal blocks, relays, and other auxiliary equipment. These enclosures have three Class 9001 Type "K" holes as standard for installation of push buttons, pilot lights, and other cover mounted control units.

Coil Voltages – AC coils are available for application on 50-60 Hz. NEMA Sizes 00 - 5 are supplied with coils that are designed to operate satisfactorily on line voltages of 85% - 110% of rated voltage. NEMA Size 6 and 7 contactors are supplied with a DC coil operated by a solid state rectifier circuit that is powered by an AC source and is designed to operate satisfactorily on line voltages of 90-110% of rated voltage.

Please note that Voltage Codes have been added to the Type designations in order to improve customer service. It is necessary to include the Voltage Code when ordering combination starters. Also, 120 Volt polyphase combination starters will be wired for separate control.

Auxiliary Contacts – Additional auxiliary contacts may be added to Type S starters. Refer to Page 14 for maximum number of auxiliary units and Form designations for factory installed auxiliary contacts. See Catalog 9999CT9701 for auxiliary contact kits for field installation.

Type S Accessories – Additional accessories such as fuse blocks, fuse clip kits, disconnect switch and circuit breaker interlocks, and cover mounted control stations are available for field modifications, see Catalog 9999CT9701. For factory modifications (Forms), see Pages 30-34.

3-POLE POLYPHASE – 600 VOLTS AC MAXIMUM – 50-60 HZ

Devices require 3 thermal units (sizes 0-6). See Catalog 9065CT9701 for selection information.

Full Voltage Type, Non-Reversing, with Melting Alloy Overload Relays

Ratings						NEMA Type 1 General Purpose	NEMA Type 4 & 4X Watertight and Dusttight Enclosure Stainless Steel (304) (Sizes 0-5)‡	NEMA Type 4X Watertight Dusttight and Corrosion Resistant Polyester Enclosure	NEMA Types 7 & 9★ For Hazardous Locations Class I, Groups C & D Class II, Groups E, F & G (Cast Aluminum)		NEMA Type 12/3R▲ Dusttight and Driptight Industrial Use Enclosure	
Motor Voltage (Starter Voltage)	Max. HP Poly-phase	Coil Voltage ∗	NEMA Size	Circuit Breaker Type	Circuit Breaker Ampere Rating	Type	Type	Type	SPIN TOP® Type	Bolted Type	With External Reset Type	Without External Reset Type
200 (208)	2	208-60	0	FAL●	15	SBG1V08	SBW1V08	SBW11V08	SBR1V08	SBT1V08	SBA11V08	SBA1V08
	3				20	SBG3V08	SBW3V08	SBW13V08	SBR3V08	SBT3V08	SBA13V08	SBA3V08
	5		1	FAL●	35	SCG5V08	SCW5V08	SCW15V08	SCR5V08	SCT5V08	SCA15V08	SCA5V08
	7 1/2				50	SCG2V08	SCW2V08	SCW12V08	SCR2V08	SCT2V08	SCA12V08	SCA2V08
	10		2	FAL●	60	SDG1V08	SDW1V08	SDW11V08	SDR1V08	SDT1V08	SDA11V08	SDA1V08
	15		3	FAL	90	SEG3V08	SEW3V08	SEW13V08	SER3V08	SET3V08	SEA13V08	SEA3V08
	20			FAL	100	SEG1V08	SEW1V08	SEW11V08	SER1V08	SET1V08	SEA11V08	SEA1V08
	25			KAL	110	SEG5V08	SEW5V08	SEW15V08	SER5V08	SET5V08	SEA15V08	SEA5V08
	30		4	KAL	125	SFG3V08	SFW3V08	SFW13V08	SFR3V08	SFT3V08	SFA13V08	SFA3V08
	40				200	SFG4V08	SFW4V08	SFW14V08	SFR4V08	SFT4V08	SFA14V08	SFA4V08
	50		5	LAL	200	SGG6V08	SGW6V08	....	SGR6V08	SGT6V08	SGA16V08	SGA6V08
	60				250	SGG1V08	SGW1V08	....	SGR1V08	SGT1V08	SGA11V08	SGA1V08
	75				300	SGG4V08	SGW4V08	....	SGR4V08	SGT4V08	SGA14V08	SGA4V08
	100		6	MAL	450	SHG4V08	SHW4V08	....	....	....	SHA14V08	SHA4V08
	125				600	SHG3V08	SHW3V08	....	....	....	SHA13V08	SHA3V08
	150				600	SHG5V08	SHW5V08	....	....	....	SHA15V08	SHA5V08
230 (240)	2	240-60 220-50	0	FAL●	15	SBG1V03	SBW1V03	SBW11V03	SBR1V03	SBT1V03	SBA11V03	SBA1V03
	3				20	SBG3V03	SBW3V03	SBW13V03	SBR3V03	SBT3V03	SBA13V03	SBA3V03
	5		1	FAL●	30	SCG1V03	SCW1V03	SCW11V03	SCR1V03	SCT1V03	SCA11V03	SCA1V03
	7 1/2				45	SCG6V03	SCW6V03	SCW16V03	SCR6V03	SCT6V03	SCA16V03	SCA6V03
	10		2	FAL●	60	SDG1V03	SDW1V03	SDW11V03	SDR1V03	SDT1V03	SDA11V03	SDA1V03
	15				80	SDG7V03	SDW7V03	SDW17V03	SDR7V03	SDT7V03	SDA17V03	SDA7V03
	20		3	FAL	90	SEG3V03	SEW3V03	SEW13V03	SER3V03	SET3V03	SEA13V03	SEA3V03
	25			FAL	100	SEG1V03	SEW1V03	SEW11V03	SER1V03	SET1V03	SEA11V03	SEA1V03
	30			KAL	110	SEG5V03	SEW5V03	SEW15V03	SER5V03	SET5V03	SEA15V03	SEA5V03
	40		4	KAL	150	SFG1V03	SFW1V03	SFW11V03	SFR1V03	SFT1V03	SFA11V03	SFA1V03
	50				200	SFG4V03	SFW4V03	SFW14V03	SFR4V03	SFT4V03	SFA14V03	SFA4V03
	60		5	LAL	225	SGG3V03	SGW3V03	....	SGR3V03	SGT3V03	SGA13V03	SGA3V03
	75				250	SGG1V03	SGW1V03	....	SGR1V03	SGT1V03	SGA11V03	SGA1V03
	100				350	SGG2V03	SGW2V03	....	SGR2V03	SGT2V03	SGA12V03	SGA2V03
	125		6	MAL	450	SHG4V03	SHW4V03	....	....	....	SHA14V03	SHA4V03
	150				600	SHG3V03	SHW3V03	....	....	....	SHA13V03	SHA3V03
	200				800	SHG7V03	SHW7V03	....	....	....	SHA17V03	SHA7V03
	250		7	MAL	900	SJG2V03	SJW2V03	....	....	....	SJA12V03	....
	300				1000	SJG3V03	SJW3V03	....	....	....	SJA13V03	....

‡ NEMA Size 6 & 7 starters are NEMA Type 4 painted sheet steel enclosures.
★ NEMA Type 7 & 9 bolted are not UL Listed.
▲ NEMA Type 12 enclosures may be field modified for outdoor non-corrosive and non-service-entrance-rated applications; see Page 17 for more information.
∗ Coil voltage code must be specified to order this product. Refer to standard coil voltage codes listed in selection table above or additional standard voltage codes below.
● Rated 250 Volts Max.

NOTE: Some control transformers may require the use of oversized enclosures. Refer to control transformer selection table on Page 35.

Coil Voltage Codes

Voltage 60 Hz	Voltage 50 Hz	Code
24†▲	. . .	V01
120†	110	V02
208	. . .	V08
240	220	V03
480	440	V06
600	550	V07
Specify	Specify	V99

▲ 24V coils are not available on Sizes 4-7. On Sizes 00-3, where 24V coils are available, **Form S** (separate control) must be specified.
† These voltage codes must include **Form S** (supplied at No Charge). When specifying **Form S**, please supply motor voltage when ordering.

Dimensions . . . . Page 17
Factory Modifications (Forms). . . . . Page 30
Type S Accessories (Class 9999) . . . . Catalog 9999CT9701

3-POLE POLYPHASE – 600 VOLTS AC MAXIMUM – 50-60 HZ

Devices require 3 thermal units (sizes 00-6). See Catalog 9065CT9701 for selection information.

Line Voltage Type, Non-Reversing, with Melting Alloy Overload Relays

Ratings						NEMA Type 1 General Purpose Enclosure	NEMA Type 4 & 4X Watertight and Dusttight Enclosure Stainless Steel (304) (Sizes 0-5)‡	NEMA Type 4X Watertight Dusttight and Corrosion Resistant Polyester Enclosure	NEMA Types 7 & 9★ For Hazardous Locations Class I, Groups C & D Class II, Groups E, F & G (Cast Aluminum)		NEMA Type 12/3R▲ Dusttight and Driptight Industrial Use Enclosure	
Motor Voltage (Starter Voltage)	Max. HP Poly-phase	Coil Voltage ✱	NEMA Size	Circuit Breaker Type	Circuit Breaker Ampere Rating	Type	Type	Type	SPIN TOP® Type	Bolted Type	With External Reset Type	Without External Reset Type
460 (480)	5	480-60 440-50	0	FAL	15	SBG2V06	SBW2V06	SBW12V06	SBR2V06	SBT2V06	SBA12V06	SBA2V06
	7½		1	FAL	20	SCG3V06	SCW3V06	SCW13V06	SCR3V06	SCT3V06	SCA13V06	SCA3V06
	10				25	SCG7V06	SCW7V06	SCW17V06	SCR7V06	SCT7V06	SCA17V06	SCA7V06
	15		2	FAL	40	SDG3V06	SDW3V06	SDW13V06	SDR3V06	SDT3V06	SDA13V06	SDA3V06
	20				60	SDG4V06	SDW4V06	SDW14V06	SDR4V06	SDT4V06	SDA14V06	SDA4V06
	25				70	SDG5V06	SDW5V06	SDW15V06	SDR5V06	SDT5V06	SDA15V06	SDA5V06
	30		3	FAL	80	SEG6V06	SEW6V06	SEW16V06	SER6V06	SET6V06	SEA16V06	SEA6V06
	40				90	SEG3V06	SEW3V06	SEW13V06	SER3V06	SET3V06	SEA13V06	SEA3V06
	50				100	SEG1V06	SEW1V06	SEW11V06	SER1V06	SET1V06	SEA11V06	SEA1V06
	60		4	KAL	110	SFG5V06	SFW5V06	SFW15V06	SFR5V06	SFT5V06	SFA15V06	SFA5V06
	75				125	SFG3V06	SFW3V06	SFW13V06	SFR3V06	SFT3V06	SFA13V06	SFA3V06
	100				200	SFG4V06	SFW4V06	SFW14V06	SFR4V06	SFT4V06	SFA14V06	SFA4V06
	125		5	LAL	225	SGG3V06	SGW3V06	....	SGR3V06	SGT3V06	SGA13V06	SGA3V06
	150				250	SGG1V06	SGW1V06	....	SGR1V06	SGT1V06	SGA11V06	SGA1V06
	200				350	SGG2V06	SGW2V06	....	SGR2V06	SGT2V06	SGA12V06	SGA2V06
	250		6	MAL	450	SHG4V06	SHW4V06	....	....	....	SHA14V06	SHA4V06
	300				600	SHG3V06	SHW3V06	....	....	....	SHA13V06	SHA3V06
	350				600	SHG5V06	SHW5V06	....	....	....	SHA15V06	SHA5V06
	400				800	SHG7V06	SHW7V06	....	....	....	SHA17V06	SHA7V06
	500		7	MAL	900	SJG2V06	SJW2V06	....	....	....	SJA12V06	....
	600				1000	SJG3V06	SJW3V06	....	....	....	SJA13V06	....
575 (600)	5	600-60 550-50	0	FAL	15	SBG2V07	SBW2V07	SBW12V07	SBR2V07	SBT2V07	SBA12V07	SBA2V07
	7½		1	FAL	15	SCG8V07	SCW8V07	SCW18V07	SCR8V07	SCT8V07	SCA18V07	SCA8V07
	10				20	SCG3V07	SCW3V07	SCW13V07	SCR3V07	SCT3V07	SCA13V07	SCA3V07
	15		2	FAL	35	SDG8V07	SDW8V07	SDW18V07	SDR8V07	SDT8V07	SDA18V07	SDA8V07
	20				45	SDG9V07	SDW9V07	SDW19V07	SDR9V07	SDT9V07	SDA19V07	SDA9V07
	25				60	SDG4V07	SDW4V07	SDW14V07	SDR4V07	SDT4V07	SDA14V07	SDA4V07
	30		3	FAL	60	SEG4V07	SEW4V07	SEW14V07	SER4V07	SET4V07	SEA14V07	SEA4V07
	40				80	SEG6V07	SEW6V07	SEW16V07	SER6V07	SET6V07	SEA16V07	SEA6V07
	50				90	SEG3V07	SEW3V07	SEW13V07	SER3V07	SET3V07	SEA13V07	SEA3V07
	60		4	FAL	100	SFG6V07	SFW6V07	SFW16V07	SFR6V07	SFT6V07	SFA16V07	SFA6V07
	75			KAL	110	SFG5V07	SFW5V07	SFW15V07	SFR5V07	SFT5V07	SFA15V07	SFA5V07
	100			KAL	150	SFG1V07	SFW1V07	SFW11V07	SFR1V07	SFT1V07	SFA11V07	SFA1V07
	125		5	KAL	200	SGG7V07	SGW7V07	....	SGR7V07	SGT7V07	SGA17V07	SGA7V07
	150			LAL	200	SGG6V07	SGW6V07	....	SGR6V07	SGT6V07	SGA16V07	SGA6V07
	200			LAL	250	SGG1V07	SGW1V07	....	SGR1V07	SGT1V07	SGA11V07	SGA1V07
	250		6	MAL	350	SHG6V07	SHW6V07	....	....	....	SHA16V07	SHA6V07
	300				450	SHG4V07	SHW4V07	....	....	....	SHA14V07	SHA4V07
	350				500	SHG2V07	SHW2V07	....	....	....	SHA12V07	SHA2V07
	400				600	SHG3V07	SHW3V07	....	....	....	SHA13V07	SHA3V07
	500		7	MAL	800	SJG1V07	SJW1V07	....	....	....	SJA11V07	....
	600				900	SJG2V07	SJW2V07	....	....	....	SJA12V07	....

‡ NEMA Size 6 & 7 starters are NEMA Type 4 painted sheet steel enclosures.
★ NEMA Type 7 & 9 bolted are not UL Listed.
▲ NEMA Type 12 enclosures may be field modified for outdoor non-corrosive and non-service-entrance-rated applications; see Page 17 for more information.
✱ Coil voltage code must be specified to order this product. Refer to standard coil voltage codes listed in selection table above or additional standard voltage codes below.

NOTE: Some control transformers may require the use of oversized enclosures. Refer to control transformer selection table on Page 35.

Thermal Magnetic Circuit Breaker Type, SIngle Phase

Motor Voltage	Max. HP	Coil Voltage	NEMA Size	Circuit Breaker (Type)	Ampere Rating	NEMA Type 1 General Purpose Enclosure	NEMA Type 4 & 4X Watertight and Dusttight Enclosure Stainless Steel (304) (Sizes 0-5)‡	NEMA Type 4X Watertight, Dusttight and Corrosion Resistant Polyester Enclosure	NEMA Type 12/3R▲ Dusttight and Driptight Industrial Use Enclosure — With External Reset	NEMA Type 12/3R▲ — Without External Reset
						Type	Type	Type	Type	Type
120	1	120	0	FAL12030	30	SBG1S2V02	SBW1S2V02	SBW31S2V02	SBA21S2V02	SBA1S2V02
	2		1	FAL12050	50	SCG1S2V02	SCW1S2V02	SCW31S2V02	SCA21S2V02	SCA1S2V02
	3		2	FAL12070	70	SDG1S2V02	SDW1S2V02	SDW31S2V02	SDA21S2V02	SDA1S2V02
230	2	230	0	FAL22025	25	SBG1S2V03	SBW1S2V03	SBW31S2V03	SBA21S2V03	SBA1S2V03
	3		1	FAL22035	35	SCG1S2V03	SCW1S2V03	SCW31S2V03	SCA21S2V03	SCA1S2V03
	7½		2	FAL22080	80	SDG1S2V03	SDW1S2V03	SDW31S2V03	SDA21S2V03	SDA1S2V03

Full Voltage Contactors and Starters – NEMA Rated
Application Data for Selection

NEMA Size	Load Volts	Maximum HP Rating–Nonplugging and Nonjogging Duty: Single Phase	Maximum HP Rating–Nonplugging and Nonjogging Duty: Poly-Phase	Maximum HP Rating–Plugging and Jogging Duty †: Single Phase	Maximum HP Rating–Plugging and Jogging Duty †: Poly-Phase	Continuous Current Rating, Amperes–600 Volt Max.	Service—Limit Current Rating, Amperes ✱	Tungsten and Infrared Lamp Load, Amperes–250 Volts Max. ★	Resistance Heating Loads, KW – other than Infrared Lamp Loads ‡: Single Phase	Resistance Heating Loads, KW – other than Infrared Lamp Loads ‡: Poly-Phase	KVA Rating for Switching Transformer Primaries At 50 or 60 Cycles – Transformers Having Inrush Currents (Worst Case Peak) of Not More Than 20 Times Peak of Continuous Current Rating: Single Phase	KVA … Not More Than 20 Times …: Poly-Phase	KVA … Transformers Having Inrush Currents (Worst Case Peak) of Over 20 Through 40 Times Peak of Continuous Current Rating: Single Phase	KVA … Over 20 Through 40 Times …: Poly-Phase	3 PH Rating for Switching Capacitors ●: KVAR
00	115	1/2	...	...	...	9	11	5	...	...	...	...	...	...	...
	200	...	1 1/2	...	...	9	11	5	...	...	...	...	...	...	...
	230	1	1 1/2	...	...	9	11	5	...	...	...	...	...	...	...
	380	...	1 1/2	...	...	9	11	...	...	...	...	...	...	...	...
	460	...	2	...	...	9	11	...	...	...	...	...	...	...	...
	575	...	2	...	...	9	11	...	...	...	...	...	...	...	...
0	115	1	...	1/2	...	18	21	10	...	...	0.6	...	0.3	...	...
	200	...	3	...	1 1/2	18	21	10	...	...	...	1.8	...	0.9	...
	230	2	3	1	1 1/2	18	21	10	...	...	1.2	2.1	0.6	1.0	...
	380	...	5	...	1 1/2	18	21	...	...	...	...	...	...	...	...
	460	...	5	...	2	18	21	...	...	...	2.4	4.2	1.2	2.1	...
	575	...	5	...	2	18	21	...	...	...	3.0	5.2	1.5	2.6	...
1	115	2	...	1	...	27	32	15	3	5	1.2	...	0.6	...	...
	200	...	7 1/2	...	3	27	32	15	...	9.1	...	3.6	...	1.8	...
	230	3	7 1/2	2	3	27	32	15	6	10	2.4	4.3	1.2	2.1	...
	380	...	10	...	5	27	32	...	...	16.5	...	...	...	...	...
	460	...	10	...	5	27	32	...	12	20	4.9	8.5	2.5	4.3	...
	575	...	10	...	5	27	32	...	15	25	6.2	11.0	3.1	5.3	...
1P	115	3	...	1 1/2	...	36	42	24	...	...	...	...	...	...	...
	230	5	...	3	...	36	42	24	...	...	...	...	...	...	...
2	115	3	...	2	...	45	52	30	5	8.5	2.1	...	1.0	...	...
	200	...	10	...	7 1/2	45	52	30	...	15.4	...	6.3	...	3.1	...
	230	7 1/2	15	5	10	45	52	30	10	17	4.1	7.2	2.1	3.6	8
	380	...	25	...	15	45	52	...	...	28	...	...	...	...	...
	460	...	25	...	15	45	52	...	20	34	8.3	14	4.2	7.2	16
	575	...	25	...	15	45	52	...	25	43	10.0	18	5.2	8.9	20
3	115	...	...	...	...	90	104	60	10	17	4.1	...	2.0	...	...
	200	...	25	...	15	90	104	60	...	31	...	12	...	6.1	...
	230	...	30	...	20	90	104	60	20	34	8.1	14	4.1	7.0	27
	380	...	50	...	30	90	104	...	...	56	...	...	...	...	...
	460	...	50	...	30	90	104	...	40	68	16	28	8.1	14	53
	575	...	50	...	30	90	104	...	50	86	20	35	10	18	67
4	200	...	40	...	25	135	156	120	...	45	...	20	...	10	...
	230	...	50	...	30	135	156	120	30	52	14	23	6.8	12	40
	380	...	75	...	50	135	156	...	...	86.7	...	...	...	...	...
	460	...	100	...	60	135	156	...	60	105	27	47	14	23	80
	575	...	100	...	60	135	156	...	75	130	34	59	17	29	100
5	200	...	75	...	60	270	311	240	...	91	...	41	...	20	...
	230	...	100	...	75	270	311	240	60	105	27	47	14	24	80
	380	...	150	...	125	270	311	...	...	173	...	...	...	...	...
	460	...	200	...	150	270	311	...	120	210	54	94	27	47	160
	575	...	200	...	150	270	311	...	150	260	68	117	34	59	200
6▲	200	...	150	...	125	540	621	480	...	182	...	81	...	41	...
	230	...	200	...	150	540	621	480	120	210	54	94	27	47	160
	380	...	300	...	250	540	621	...	...	342	...	...	...	...	...
	460	...	400	...	300	540	621	...	240	415	108	188	54	94	320
	575	...	400	...	300	540	621	...	300	515	135	234	68	117	400
7▲	230	...	300	...	...	810	932	...	180	315	...	...	...	...	240
	460	...	600	...	...	810	932	...	360	625	...	...	...	...	480
	575	...	600	...	...	810	932	...	450	775	...	...	...	...	600

Tables and footnotes are taken from NEMA Standards.

† Ratings shown are for applications requiring repeated interruptions of stalled motor current or repeated closing of high transient currents encountered in rapid motor reversal, involving more than five openings or closings per minute and more than ten in a ten-minute period, such as plug-stop, plug-reverse or jogging duty. Ratings apply to single speed and multi-speed controllers.

✱ Per NEMA Standards ICS 2-1993 clause 4, the service-limit current represents the maximum rms current, in Amperes, which the controller may be expected to carry for protracted periods in normal service. At service-limit current ratings, temperature rises may exceed those obtained by testing the controller at its continuous current rating. The ultimate trip current of over-current (overload) relays or other motor protective devices shall not exceed the service-limit current ratings of the controller.

★ FLUORESCENT LAMP LOADS – 300 VOLTS AND LESS – The characteristics of fluorescent lamps are such that it is not necessary to derate Class 8502 contactors below their normal continuous current rating. Class 8903 contactors may also be used with fluorescent lamp loads. For controlling tungsten and infrared lamp loads, and resistance heating loads, Class 8903 ac lighting contactors are recommended. These contactors are specifically designed for such loads and are applied at their full rating as listed in the Class 8903 Section.

‡ Ratings apply to contactors which are employed to switch the load at the utilization voltage of the heat producing element with a duty which requires continuous operation of not more than five openings per minute. Class 8903 Types L and S lighting contactors are rated for resistance heating loads.

● When discharged, a capacitor has essentially zero impedance. For repetitive switching by a contactor, sufficient impedance should be connected in series to limit inrush current to not more than 6 times the contactor rated continuous current. In many installations, the impedance of connecting conductors may be sufficient for this purpose. When switching to connect additional banks, the banks already on the line may be charged and can supply additional available short-circuit current which should be considered when selecting the impedance to limit the current.
The ratings for capacitor switching above assume the following maximum available fault currents:
NEMA Size 2-3: 5,000 A RMS Sym.
NEMA Size 4-5: 10,000 A RMS Sym.
NEMA Size 6: 18,000 A RMS Sym.
NEMA Size 7: 30,000 A RMS Sym.
If available fault current is greater than these values, connect sufficient impedance in series as noted in the previous paragraph.

▲ For NEMA Size 6 and 7, the operation rate is as follows: Continuous operation rate is 3 operations per minute maximum; Jogging or Plugging Duty operation rate is 15 operations per minute for a maximum of three minutes.

The motor ratings in the above table are NEMA standard ratings and apply only when the code letter of the motor is the same as or occurs earlier in the alphabet than is shown in the table below.
Motors having code letters occurring later in the alphabet may require a larger controller. Consult local Square D field office.

Motor HP Rating	Maximum Allowable Motor Code Letter
1 1/2-2	L
3-5	K
7 1/2 and above	H

Power Contact Ratings: All contactors and starters are rated in accordance with NEMA standards. The ratings shown in the selection tables are for normal service. For complete data on power contact ratings, refer to Page 12.

Short Circuit Protection: According to the National Electrical Code branch circuit overcurrent protection must be provided for each contactor or starter. For starters refer to instructions furnished with the thermal unit selection table. For contactors (Class 8502 or 8702) provide branch circuit overcurrent protection in accordance with the National Electrical Code, except do not exceed the maximum protective device ratings in table below.

NEMA Size	Maximum Voltage	Class K5, RK5 or RK1 Fuse (Ampere)	Class J or T Fuse (Ampere)	Inverse-Time Circuit Breaker (Ampere)
00	600	10	15	15
	250	12	15	15
0	600	20	30	20
	250	25	30	35
1	600	30	60	40
	250	40	60	60
2	600	60	100	80
	250	60	100	90
3	600	100	200	125
	250	125	200	150
4	600	200	400	225
5	600	400	600	400
6	600	600	1200∗	800
7	600	600	1600∗	1200

∗ Class L Fuse only

Capacitor Switching: The kilovar ratings of enclosed, three phase contactors used as switches for capacitor loads, when only one load appears on the secondary of a distribution system are shown in the table on Page 12.

Coil Burden▲

NEMA Size	No. of Poles	Inrush VA		Sealed VA		Sealed Watts	
		50 Hz	60 Hz	50 Hz	60 Hz	50 Hz	60 Hz
00	2-3	....	165	....	33	....	6
0 & 1	1-5	232	245	26	27	7.7	7.8
2	2 & 3	296	311	36	37	12	14
	4 & 5	429	438	37	38	12	14
3	2-3	676	700	47	46	15	14
	4-5	1260	1185	89	85	23.4	22
4	2-5						
5	2-3	2970	2970	250	212	42	39
6‡	2-3	1495	1780	56	48	27	32
7‡	2-3	....	1960	....	59	....	36

▲ Mean values.
‡ Size 6 and 7 have a DC coil. The values shown are for the AC input to the DC power supply that provides power to the coil.
Ambient temperature (operating temperature): 0˚C - 40˚C (32˚F - 104˚F)

Maintenance of Equipment: Class 9998 Repair Parts Kits are available for all Class 8502 contactors and Class 8536 starters. Service bulletins with a complete list of replaceable parts are supplied with all enclosed devices. Separate bulletins can be ordered and are listed along with the appropriate contact parts kit.

Device NEMA Type	Type	Series	No. of Poles	Instruction Bulletin	Service Bulletin	Replacement Contacts Class 9998 Type
00	SA	A	2-3		362AS	SL2
		B	2-3	30072-013-08	556AS	SJ1
0	SB	A&B	1-3 4 5	30072-013-09	277AS 277AS & 250AS 277AS & 250AS	SL2 SL12 (1)SL12 & (1)SL22 or (1)SL2 & (2)SL22
1	SC	A&B	1-3 4 5	30072-013-10	278AS 278AS & 250AS 278AS & 250AS	SL3 SL13 (1)SL13 & (1)SL22 or (1)SL3 & (2)SL22
1P	SC	A	2	30072-013-10	278AS	SL3
2	SD	A	2-3 4 5	30072-013-11	279AS 279AS & 293AS 279AS & 293AS	SL4 SL14 (1)SL14 & (1)SL24 or (1)SL4 & (2)SL24
3	SE	A	2 3 4 5	30072-013-01 30072-013-01 30072-013-03 30072-013-03	305AS 305AS 326AS 326AS	SL6 SL7 (2)SL6 (1)SL6 & (1)SL7
4	SF	A	2 3 4 5	30072-013-02 30072-013-02 30072-013-03 30072-013-03	306AS 306AS 326AS 326AS	SL8 SL9 (2)SL8 (1)SL8 & (1)SL9
5	SG	A	2 3	30072-013-18 30072-013-18	328AS 328AS	SL10 SL11
6	SH	A	2 3		342AS 342AS	SL25 SL26
		B	2 3	30072-013-12 30072-013-12	370AS 370AS	SL25 SL26
7	SJ	A	2 3	30072-013-13 30072-013-13	397AS 397AS	SL30 SL31

Terminals

NEMA Size	Type	Power Terminals Type of Lug	Power Terminals Wire Sizes∗ Min.-Max.	Control Terminals Type of Lug	Control Terminals Wire Sizes∗ Min.-Max.
00, 0 & 1	SA, SB & SC	Pressure Wire	#14-#8	Pressure Wire	#16-#12
2	SD	Box Lug	#14-#4	Pressure Wire	#16-#12
3	SE	Box Lug	#14-1/0	Pressure Wire	#16-#12
4	SF	Box Lug	#8-250 kcmil	Pressure Wire	#16-#12
5	SG	Box Lug	#4-500 kcmil	Pressure Wire	#16-#12
6	SH	Parallel Groove	One or two 250-500 kcmil per phase	Pressure Wire	#16-#12
7	SJ	Parallel Groove	One to four 250-500 kcmil per phase	Pressure Wire	#16-#12

∗ Solid or stranded copper wire. One wire per connector.
Coil temperature: Not more than 85˚C rise in 40˚C ambient (125˚C max.).

Full Voltage Contactors & Starters – NEMA Rated
Application Data

Auxiliary Units

Auxiliary contacts, power poles, and timer attachments can be added by the factory or in the field on all Type S starters and contactors. The table below shows the maximum number of auxiliary units **(in addition to the holding circuit contact)** that can be added to a given size starter or contactor. In addition, it is possible to add a second internal contact on NEMA Size 0, 1, and 2 contactors and starters.

NEMA Size	Type	No. of Poles of Basic Contactor	Maximum Number of External Auxiliary Units (In addition to holding circuit contact)
00	SA	2-3	4 single circuit auxiliary contacts (N.O. or N.C.) if second internal auxiliary contact is not used.
0, 1 and 2	SB SC SD	1, 2 or 3	4 single circuit auxiliary contacts (N.O. or N.C.)
			3 single circuit auxiliary contacts (N.O. or N.C.) plus 1 attached timer (ON or OFF delay).
			2 single circuit auxiliary contacts (N.O. or N.C.) plus 1 power pole adder (1 or 2 poles, N.O. or N.C.).
			1 attached timer (ON or OFF delay) plus 1 power pole adder (1 or 2 poles, N.O. or N.C.) plus 1 auxiliary contact.
		4 or 5	2 single circuit auxiliary contacts (N.O. or N.C.) 1 timer attachment plus 1 auxiliary contact.
3, 4 & 5	SE SF SG	2–5 (Size 3 & 4)	4 single circuit auxiliary contacts (N.O. or N.C.)
			2 single circuit (Sizes 3 & 4) or 3 single circuit (Size 5) auxiliary contacts plus 1 attached timer (ON or OFF delay).
		2-3 (Size 5)	2 single circuit auxiliary contacts (N.O. or N.C.) plus 1 NEMA Size 0-1 or Size 2 power pole adder (1 or 2 poles, N.O. or N.C.)
6 and 7	SH SJ	2-3	4 single circuit auxiliary contacts (N.O. or N.C.)
			3 single circuit auxiliary contacts (N.O. or N.C.) plus 1 attached timer (ON or OFF delay).
			2 single circuit auxiliary contacts (N.O. or N.C.) plus 1 NEMA Size 0-1 or Size 2 power pole adder (1 or 2 poles, N.O. or N.C.)

Factory Installed Auxiliary Contacts

The table below lists the Form designations for factory installed electrical contacts. See Factory Modifications (Forms) section for pricing.

See Class 9999 for field modification kits.

Form Number
Of Additional Auxiliary Contacts

When ordering factory installed auxiliary contacts, the Form designations listed should be used.

Number of N.O. Contacts	Number of N.C. Contacts	Form Number
0 0 0 0	1 2 3 4	X01 X02 X03 X04
1 1 1 1	0 1 2 3	X10 X11 X12 X13
2 2 2	0 1 2	X20 X21 X22
3 3 4	0 1 0	X30 X31 X40

Control Circuit Transformers

Class 9070 Type T control transformers are normally used when it is necessary to provide a lower voltage to the control circuit. This transformer with fused protection may be ordered from the factory by specifying Form F4T. The addition of a transformer often requires the use of a larger enclosure (refer to dimensions on Page 17–19). The table below shows the transformer selection for given sized starters and contactors with or without auxiliary units.

NEMA Size	Type	No. of Poles	Auxiliary Units	Transformer Class 9070 Type
0 & 1	SB SC	1-3	With max. of 2 auxiliary contacts	T50
			With timer and maximum of 1 auxiliary contact	
			With 3 or 4 auxiliary contacts With timer and 2 or 3 auxiliary contacts	T100
0 & 1	SB SC	4 & 5	With or without auxiliary contacts or timer	T100
0 & 1 Mechanically Interlocked Devices	SB SC	1-5	With or without attachments	T100
2	SD	2-5	With or without attachments	T100
3	SE	2-3	With or without attachments	T150
3	SE	4 & 5	With or without attachments	T300
4	SF	2-5	With or without attachments	T300
5	SG	2-3	Any	T500
6, 7	SH, SJ	2-3	Any	‡

‡ A Class 9070 transformer is an integral part of the Size 6 and Size 7 control circuit providing 120 volt control circuit voltage as standard.

Power Poles

Single or double circuit power pole adders may be factory or field installed on 2 and 3 pole Type S contactors and starters. The table below lists the Form designation for factory installed power pole adders. Only one power pole adder may be installed per contactor. See Factory Modifications (Forms) section for pricing.

See Class 9999 for field modification kits.

Type	NEMA Size	Class 9999 Type	Form Designation
1 N.O.	0, 1 2	SB6 SB11	Y428 Y436
1 N.C.	0, 1 2	SB7 SB12	Y429 Y437
1 N.O., 1 N.C.	0, 1 2	SB8 SB13	Y435 Y440
2 N.O.	0, 1 2	SB9 SB14	Y430 Y438
2 N.C.	0, 1 2	SB10 SB15	Y434 Y439

File E78360
CCN NITW2

Transformers

File E61239
CCN XPTQ

File LR37055
Class 5411 06

NEMA Size 6 Starter
8536 SH

NEMA Size 7 Starter
8536 SJ

NEMA Size 6 Type SH and NEMA Size 7 Type SJ contactors and starters have a DC coil operated by a solid state rectifier circuit mounted on the device and powered from an ac source. The NEMA Sizes 6 and 7 are equipped as standard with a fused control circuit transformer (Form F4T) rated 240/480-120 volts 60 Hz, 220/440-110 volts 50 Hz. The purpose of this transformer is to provide an isolated 120 volts 60 Hz, 110 volts 50 Hz, supply for the control circuit. NEMA Sizes 6 and 7 may be ordered for other system voltages by specifying the voltage and frequency desired.

Operation Rates – Continuous operation rate: 3 operations/minute maximum. Jogging or Plugging Duty: 15 operations/minute - 3 minutes maximum.

Field conversion for other system voltages is accomplished by one of the following methods, NOT BY THE USUAL PRACTICE OF CHANGING THE COIL:

1. If the factory wiring is indicated as being for 480 volts 60 Hertz, 440 volts 50 Hertz, conversion to 240 volts 60 Hertz, 220 volts 50 Hertz, can be accomplished by reconnecting the control transformer as illustrated on instruction sheet supplied with the controller. This is the same method that would be used on Class 9070 control circuit transformers.

   Conversion to any other voltage requires replacement of the control transformer. For other system voltages: i.e. 208, 277, 380, 600 volts, a new transformer with single voltage primary must be selected from table at right. Control transformer connections are illustrated on the instruction sheet supplied with the controller.

2. If the factory wiring is indicated as being for any voltage other than 480 volts 60 Hertz, 440 volts 50 Hertz, conversion to any other voltage requires replacement of the control transformer. Refer to table at right.
3. In Square D combination starters, the standard transformer supplied may be used to power a maximum of five Class 9001 Type K illuminated operators powered with transformer type light modules. When extra capacity to power control relays or other inductive loads is required, a second transformer must be added. Extra capacity can be purchased as Form F4T with additions in 100 VA increments.
4. Standard controllers are wired for common control and are not convertible for operation of the control circuit from a separate source of supply voltage. Controllers designated Form S have special wiring designed for separate control. They are furnished with an isolating transformer, usually having a 120 volt primary and 120 volt secondary, that must not be bypassed. Form S controllers are not convertible for operation on common control.

The tables below give the replacement transformers for Type S NEMA Sizes 6 and 7 contactors and starters. To change voltages on these devices, coils are not changed, instead transformers with the desired voltage are changed.

Replacement Control Transformers (150VA) For Type S Size 6

Voltage		Class 9070 Type
60 Hertz	50 Hertz	
240/480-120	220/440-110	31104-512-50
208-120	. . . .	31104-512-52
277-120	. . . .	31104-512-53
. . . .	380-110	31104-512-54
600-120	550-110	31104-512-51
120-120	110-110	31104-512-55
240-120	220-110	31104-512-56

Replacement Control Transformers (200VA) For Type S Size 7

Voltage		Class 9070 Type
60 Hertz	50 Hertz	
240/480-120	220/440-110	31123-501-50
208-120	. . . .	31123-501-52
277-120	. . . .	31123-501-53
. . . .	380-110	31123-501-54
600-120	550-110	31123-501-51
120-120	110-110	31123-501-55
240-120	220-110	31123-501-56

Auxiliary Contacts: A N.O. holding circuit contact and a N.C. auxiliary contact are provided as standard. The holding circuit contact may or may not be required for either 3-wire or 2-wire control. NEMA Sizes 6 and 7 have an additional N.C. auxiliary contact which is wired in the coil control circuit. **DO NOT USE THIS N.C. CONTACT FOR ANY OTHER PURPOSE.**

Class 8539 – UL Listed Short Circuit Ratings

MAG-GARD® Motor Circuit Protector Type			
NEMA Size	Voltage	Enclosure	Available Amperes RMS Symmetrical
0 & 1, 2 Size 3 Type SE✱41 & SE✱51 Only (GJL)	0-480	Standard† and Oversize	100,000
0 & 1 (FAL)	0-480	Standard† and Oversize	22,000
0 & 1 (FAL)	481-600	Standard† and Oversize	10,000
0 & 1, 2 Size 3 Type SE✱41 & SE✱51 Only (GJL)	481-600	Standard† and Oversize	10,000
0-2 with Current Limiting Module	600	Oversize	100,000
0-3 with Current Limiting Module	600	Standard†	100,000
0-3	600	NEMA 7 & 9	5,000•
2	600	Oversize	22,000
2-6	600	Standard†	22,000
4 & 5	600	NEMA 7 & 9	10,000
7	0-480	Standard†	30,000
7	481-600	Standard†	22,000

† Standard enclosure includes non-oversize NEMA Types 1, 4 & 4X Stainless, and 12.
● Consult factory for higher withstand ratings.

Table 1: MAG-GARD Trip Range

Suffix No.		Suffix No.	Range Amps	Suffix No.	Range Amps	Suffix No.	Range Amps
M01	9-33	11M	8-28	25M	625-1250	33M	1500-3000
M02	21-77	12M	18-70	26M	750-1500	35M	1750-3500
M03	45-165	13M	50-180	29M	875-1750	36M	2000-4000
M04	90-330	15M	100-350	30M	1000-2000	40M	2500-5000
M05	150-550	16M	150-580	31M	1125-2250	42M	3000-6000
M06	225-825	18M	300-1100	32M	1250-2500	44M	3500-7000

The MAG-GARD adjustable trip range is determined by the suffix of the circuit breaker catalog number. Table 1 indicates the trip range which corresponds to a given suffix number. The MAG-GARD Motor Circuit Protector should be adjusted to a level just above Locked-Rotor Current of the motor. This setting will provide optimum overcurrent protection for the motor. For more information on MAG-GARD instantaneous trip circuit breakers, refer to the MAG-GARD circuit breaker section of this Catalog.

Class 8539 – UL Listed Short Circuit Ratings

Thermal Magnetic Circuit Breaker Type			
NEMA Size	Voltage	Enclosure	Available Amperes RMS Symmetrical
0-3	600	Standard†	5,000
4 & 5	600	Standard†	10,000
6	600	Standard†	18,000
7	0-480	Standard†	30,000
7	481-600	Standard†	22,000

† Standard enclosure includes non-oversize NEMA Types 1, 4 & 4X Stainless, and 12.

Class 8538 – UL Listed Short Circuit Ratings

NEMA Size	NEMA Fuse Class	Enclosure	Available Amperes RMS Symmetrical
0-3	Class H or K	Standard†	5,000
0-3	Class R	Standard†	100,000
0-2	Class H or K	Oversize	5,000
0-2	Class R	Standard	100,000
4-5	Class H or K	Standard†	10,000
4-5	Class R	Standard†	100,000
6	Class H or K	Standard†	18,000
6	Class R	Standard†	100,000

† Standard enclosure includes non-oversize NEMA Types 1, 4 & 4X Stainless, and 12.

Table 2: Motor Code Letter Table

Horsepower	Motor Code Letters
½ or less	A-L
¾ — 1½	A-K
2 — 3	A-J
5 — 25	A-H
30 — 125	A-G
150 or more	A-F

The combination starter selection tables on Pages 7 —9 are suitable for motors with Locked-Rotor Current letters per NEC Table 430-7(b) as listed in Table 2. For other motors a special thermal magnetic circuit breaker with adjustable magnetic trip settings for the specific motor is required. When ordering for these special applications, specify the motor horsepower, voltage, frequency, full load current and code letter (or locked rotor current) to assure proper protection.

Terminals

NEMA Size	Type	Line Terminals on Disconnect			Power Terminals On Magnetic Starter			Control Terminals On Magnetic Starter		
		Type of Lug	Wire Size Min.-Max. Switch	Wire Size Min.-Max. Circuit Breaker	Type of Lug	Wire Size Min.-Max.	Wires Per Terminal	Type of Lug	Wire Size Min.-Max.	Wires Per Terminal
0 & 1	SB & SC	Box Lug	#14-1/0 Cu/Al	#14-#4 Cu▼ #12-#4 Al or #14-#1/0 Cu #12-#1/0 Al #14-#1 Cu/#8-#1/0 Al (GJL Breaker)	Pressure Wire	#14-#8 Cu	1 or 2	Pressure Wire	#16-#12 Cu	2
2	SD	Box Lug	#14-1/0 Cu/Al	#14-#1/0 Cu or #12-#1/0 Al #14-#1 Cu/#8-#1/0 Al (GJL Breaker)	Box Lug	#14-#4 Cu	1	Pressure Wire	#16-#12 Cu	2
3	SE	Box Lug	#14-1/0 Cu/Al	#14-#2 Cu #10-#2 Al (FA Breaker) #4-300 MCM Cu/Al (KA Brkr) #14-#1 Cu/#8-#1/0 Al (GJL Breaker)	Box Lug	#14-#0 Cu	1	Pressure Wire	#16-#12 Cu	2
4	SF	Box Lug	#6-300 MCM Cu/Al	#14-#1/0 Cu #12-#1/0 Al (FA Breaker) #4-300 MCM Cu/Al (KA Brkr)	Box Lug	#8-250 MCM Cu	1	Pressure Wire	#16-#12 Cu	2
5	SG	Box Lug	One #4-500 MCM Cu	#4-300 MCM Cu/AL (KA Breaker) (1)#1-600 MCM or (2)#1-250 MCM Cu/Al (LA Brkr)	Box Lug	#4-500 MCM Cu	1	Pressure Wire	#16-#12 Cu	2
6	SH	Box Lug	. . . .	(1)#1-600 MCM or (2)#1-250 MCM Cu/Al (LA Breaker) (3)#3/0-500 MCM Cu/Al (MA Brkr)	Parallel Groove	250-500 MCM Cu●	1 or 2	Pressure Wire	#16-#12 Cu▲	2
7	SJ	Box Lug	. . . .	(3)#3/0-500 MCM Cu/Al	Parallel Groove	250-500 MCM Cu	1-4	Pressure Wire	#16-#12 Cu	2

● Order Class 9999 Type SAL-16 parts kit to convert power terminals to accept sizes 1/0-300 MCM wire.
▲ Terminal block range limited to #16-#14.
▼ Use on FAL circuit breakers rated 25 Amps or less.

NEMA Type 1 Enclosure – Figure 1

NEMA Size	Class	Type	Dimensions in Inches∗																Top & Bottom		Sides	Wt. (Lbs.)
			A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	W	X	Y	
0-1	8538 & 8539	SBG SCG	9½	22½	8¹¹⁄₃₂	6⅜	20½	14²¹⁄₃₂	1¹³⁄₁₆	1¹¹⁄₁₆	3	2⁵⁄₁₆	1¹⁄₁₆	3¼	2³⁄₁₆	1¼	⅞	. . .	½-¾	½-¾	½	38
2	8538 & 8539	SDG	10½	26	9¹⁹⁄₃₂	7⅜	24	16²⁹⁄₃₂	2⅛	2	4	2⁵⁄₁₆	1¹⁄₁₆	3¼	2³⁄₁₆	1¼	⅞	. . .	1-1¼	½-¾	½	54

∗ Above dimensions include space for control circuit transformers.

NEMA Type 1 Enclosure – Figure 2

NEMA Size	Class	Type	Dimensions in Inches∗																Top & Bottom		Sides	Wt. (Lbs.)
			A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	W	X	Y	
3■	8538 & 8539	SEG	15¼	42	10¹⁹⁄₃₂	9¼	3	22²³⁄₃₂	41	½	. . .	2⁵³⁄₆₄	3¹⁷⁄₃₂	5	2¹¹⁄₁₆	5⅜	1⁹⁄₃₂	²⁹⁄₃₂	1-1¼ 2-2½	½-¾	½	102
4	8538	SFG	16	52½	10¹⁷⁄₃₂	10	3	23²¹⁄₃₂	51½	½	. . .	2⁵³⁄₆₄	3¹⁷⁄₃₂	5	2¹¹⁄₁₆	5⅜	1⁹⁄₃₂	²⁹⁄₃₂	2½	½-¾	½	163
	8539	SFG	16	52½	10¹⁷⁄₃₂	10	3	23²¹⁄₃₂	51½	½	. . .	2⁵³⁄₆₄	3¹⁷⁄₃₂	5	2¹¹⁄₁₆	5⅜	1⁹⁄₃₂	²⁹⁄₃₂	2½	½-¾	½	163
5	8538	SGG	20	78	15½	12	4	29¹³⁄₃₂	77	½	. . .	3³³⁄₆₄	4³⁹⁄₆₄	9¼	3³⁄₁₆	. . .	. . .	. . .	½-¾†	3	. . .	450
	8539	SGG	20	66	13²³⁄₃₂	12	4	29¹³⁄₃₂	65	½	. . .	3³³⁄₆₄	4³⁹⁄₆₄	5	3³⁄₁₆	. . .	. . .	. . .	½-¾†	3	. . .	420
6▲	8538 & 8539	SHG	36	90	21¹⁄₃₂	. . .	. . .	41⅜	. . .	. . .	. . .	. . .	. . .	5	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .

† Left side only
▲ Size 6 enclosures are floor mounting.
∗ Above dimensions include space for control circuit transformers.
■ Class 8538 Size 3 devices with 200 Amp fuse clips use dimensions for Class 8538 Size 4.

NEMA Type 12 Enclosure – Figure 3

NEMA Size	Class	Type	Dimensions in Inches∗										Wt. (Lbs.)
			A	B	C	D	E	F	G	H	I	J	
0-1	8538 & 8539	SBA SCA	9½	8¹¹⁄₃₂	24	3¼	2½	4½	23½	¹⁹⁄₃₂	4⁷⁄₁₆	14⁵⁄₁₆	40
2	8538 & 8539	SDA	10½	9¹⁹⁄₃₂	27¾	3¼	2½	5½	27	⅜	4⅛	16⁹⁄₁₆	55
3■	8538 & 8539	SEA	15¼	10¹⁹⁄₃₂	42	5	3	9¼	41	½	5¹⁄₁₆	22⁵⁄₁₆	111
4	8538	SFA	16	10¹⁷⁄₃₂	52½	5	3	10	51½	½	4³⁄₁₆	22³¹⁄₃₂	170
	8539	SFA	16	10¹⁷⁄₃₂	52½	5	3	10	51½	½	5³⁄₁₆	22³¹⁄₃₂	170
5	8538	SGA	20	13²³⁄₃₂	78	9¼	4	12	77	½	7²⁵⁄₃₂	29¹³⁄₃₂	. . .
	8539	SGA	20	13²³⁄₃₂	66	5	4	12	65	½	7²⁵⁄₃₂	27¹³⁄₃₂	440
6▲	8538 & 8539	SHA	36	17	90	5	. . .	. . .	. . .	. . .	. . .	47⅜	. . .

▲ Size 6 enclosures are floor mounting.
∗ Above dimensions include space for control circuit transformers.
■ Class 8538 Size 3 devices with 200 Amp fuse clips use dimensions for Class 8538 Size 4.

NOTE: Illustrations may not represent the actual enclosure, they are intended for dimensional information only.

NEMA Type 12 Enclosures Modified for Outdoor Applications (not to be used in salt air or corrosive environments)

Field Modifications for NEMA Type 3 dusttight, raintight and sleet resistant outdoor applications are as follows: Watertight conduit hubs or equivalent provision for watertight connection at the conduit entrance shall be used.

Field Modifications for NEMA Type 3R rainproof and sleet resistant outdoor applications are as follows:

1. Watertight conduit hubs or equivalent provision for watertight connection at the conduit entrance, when the conduit enters at a level higher than the lowest live part, shall be used.
2. Drain holes of 1/8 inch diameter shall be added to the bottom of the enclosure.

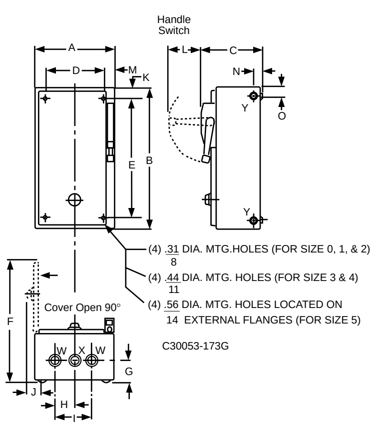


Figure 1
NEMA Type 1 Enclosure

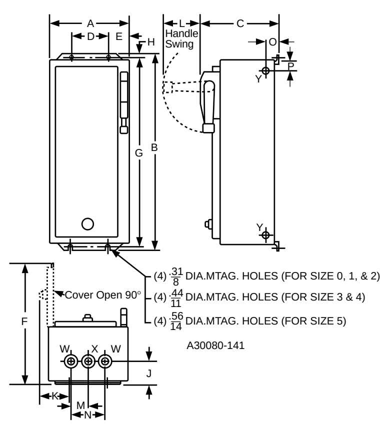


Figure 2
NEMA Type 1 Enclosure

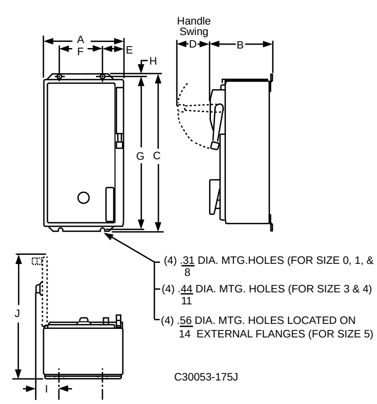


Figure 3
NEMA Type 12 Enclosure

Combination Starters — NEMA Rated
Approximate Dimensions, Shipping Weights

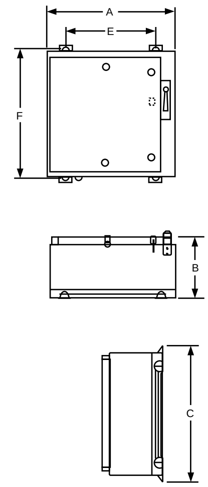


Figure 1
NEMA 4X
Polyester Enclosure

NEMA Type 4X Polyester Enclosure

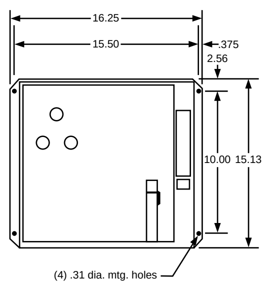
NEMA Size	Class	Dimensions (in inches)∗ – see Figure 1					
		Type	A	B	C	E	F
0, 1	8538	SBW SCW SDW	13.72	11.4	26.94	6.25	25.75
0, 1, & 2	8539						
0, 1, & 2	8738 8739	SBW SCW SDW	25.25	11.4	27.00	17.88	25.75
3 - 4	8538, 8738 8539, 8739	SEW SFW●	26.31	11.4	33.50	18.50	32.25

∗ Dimensions also for **Form F4T** (standard control transformer) and **Form F4T10** (50 VA additional capacity). Other control transformers may require the use of oversized enclosures. Refer to the control transformer selection table on Page 35.
● 8539 Size 4 only.

Information on Hubs

Hubs are supplied with each NEMA Type 4X combination starter as shown in the table below. Note that hubs are only installed in stainless steel enclosures; they are not installed in polyester enclosures.

NEMA Size	Quantity	Hub Size
0 & 1	1 2	0.75" 1.00"
2	1 2	0.75" 1.50"
3 & 4	1 2	0.75" 2.50"



NEMA Type 4 & 4X Stainless Enclosures – Figure 4

NEMA Size	Class	Type	Dimensions in Inches∗												Bottom	Top & Bot.	Wt. (Lbs.)
			A	B	C	D	E	F	G	H	I	J	K	L	W	X	
0-1	8538 & 8539	SBW SCW	9½	8 11/32	24 1/16	3¼	2½	4½	23½	19/32	3 1/32	1 5/16	2 5/16	14 9/32	¾ Hub	1 Hub	40
2	8538 & 8539	SDW	10½	9 19/32	27¾	3¼	2½	5½	27	19/32	3	2	2⅝	16 17/32	¾ Hub	1½ Hub	55
3●	8538 & 8539	SEW	15¼	10 19/32	42	5	3 3/16	10¼	40½	19/32	3	2 9/16	3 3/16	22 3/16	¾ Hub	2½ Hub	111
4	8538	SFW	16	10 17/32	52½	5	3 9/16	11	51	19/32	3	2 9/16	3 3/16	22 15/32	¾ Hub	2½ Hub	158
	8539	SFW	16	10 17/32	52½	3¼	2½	11	51	19/32	3	2 9/16	3 3/16	22 15/32	¾ Hub	2½ Hub	120
5	8538	SGW	20	13 23/32	78	9¼	4	12	77	9/16	4½	3	3½	29 13/32	¾ Hub	3½ Hub	. . .
	8539	SGW	20	13 23/32	66	5	4	12	65	9/16	4½	3	3½	29 13/32	¾ Hub	3½ Hub	440
6▲	8538 & 8539	SHW	36	17	90	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	47⅞	. . .	. . .	. . .

∗ Dimensions also for **Form F4T** (standard control transformer), **Form F4T11** (100 VA extra capacity) and **Form F4T12** (200 VA extra capacity).
▲ Size 6 enclosures are floor mounting.
● Class 8538 Size 3 devices with 200 Amp fuse clips use dimensions for Class 8538 Size 4.

NEMA Type 1, 4, 4X Stainless, 12 Oversize Enclosure — Figure 3

NEMA Size	NEMA Type Encl.	Dimensions in Inches					
		Wide A	High B	Deep C	Handle L	Mounting D	E
0-2	1	15	28¾	9 19/32	3¼	11⅝	26¼
	4	15	30 1/32	9 19/32	3¼	10	29¾
	12	15	31	10 31/32	3¼	9	30¼

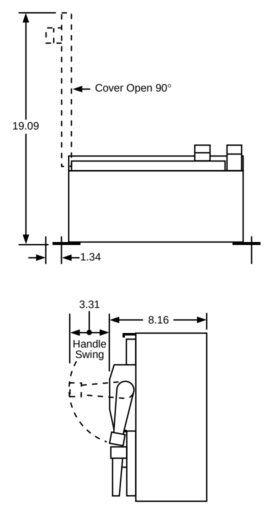


Figure 2
Class 8538 — Horizontal Type
NEMA Type 12

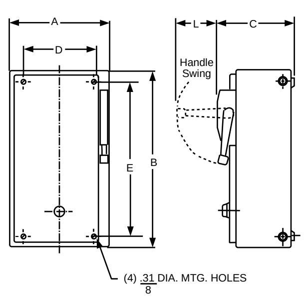


Figure 3
Class 8538 and 8539
In Oversize Enclosures —
NEMA Type 1, 4 & 4X
Stainless, 12

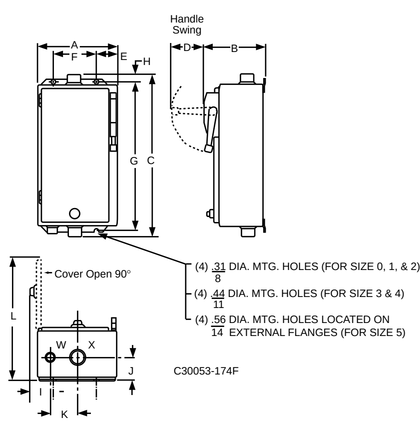


Figure 4
Class 8538 and 8539
Stainless Steel Enclosure
NEMA Type 4 & 4X

Class 8539 – NEMA Type 7 & 9 Bolted Enclosure – Figure 1★

NEMA Size	Type	Dimensions In Inches										Wt. (Lbs.)
		A	B	C	D	E	F	G	H, J	K, L, M, N	P	Z	
0-2	SBT SCT SDT	14¼	27⅝	9½	12¼	19¼	9⅝	11	2⅜	3⅛	1½	1½	115
3-4	SET SFT	18⅛	31⅝	10	16¼	19¼	9⅝	12⅝	2⅜	3¾	2½	2½	180
5	SGT	24½	45⅝	13¾	22½	27½	13¾	15⅜	3 7/16	4	4	4	500

★ NOTE – Bolted enclosure comes equipped with 3 closing plates in the door.

Class 8539 – NEMA Type 7 & 9 SPIN TOP® Enclosure – Figure 2

NEMA Size	Type	E	F	G	H	J	K	L	M	N	P	Q	R	S	T	Wt. (Lbs.)
		Dimensions in Inches														
0-1	SBR SCR	10⅝	26	15¼	8	4¾	5⅜	1½	1 1/16	7½	11	7 5/16	2 1/16	–	–	70
2	SDR	13⅞	30½	19¼	8	4¾	5¼	1½	1 1/16	7	18	9⅜	2¾	–	–	115
3-4	SER SFR	13⅜	39½	20¼	8	4¾	7½	2½	–	10½	23	8⅝	3	–	–	140
5	SGR	19	53½	27¾	–	–	11¼	4	⅛	16	20⅝	11⅜	4 5/16	12	6½	290

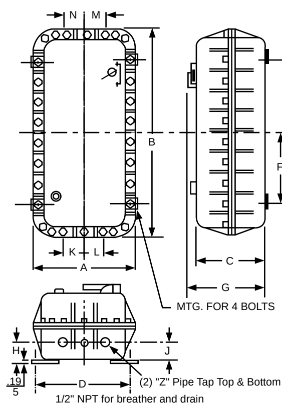


Figure 3: Class 8539
NEMA Type 7 and 9 Bolted Enclosure

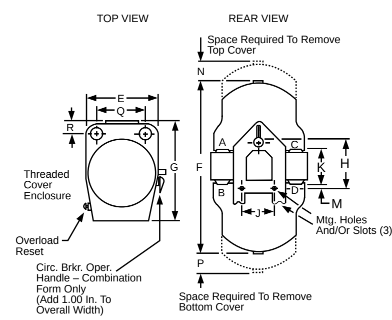


Figure 4: Class 8539
NEMA Type 7 and 9 SPIN TOP® Enclosure

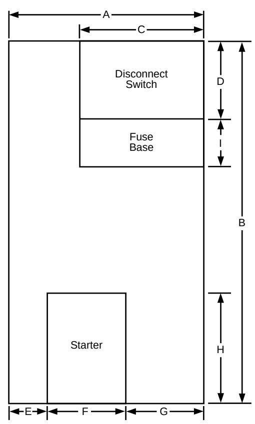
Combination Starters — NEMA Rated
Panel Layout Drawings – Class 8538, 8539

Standard NEMA Type 1, 4 & 4X Stainless, 12

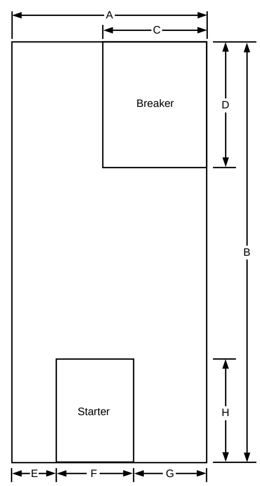
The following table is provided to identify open panel space on standard NEMA Type 1, 4 & 4X stainless steel and 12 combination starters. Space and mounting holes are provided in all combination starters (except NEMA Type 7 & 9 SPIN TOP®) for the field addition of a control transformer – see Page 35 for control transformer selection.

Class	NEMA Size	Dimensions in Inches								
		A	B	C	D	E	F	G	H	I
8538	0, 1	6.9	18.5	6.9	6.5	0	3.5	3.4	6.9	4.0
8539				6.5	7.9					—
8538	2	7.9	22.0	7.5	7.0	3.1	4.8	0	7.7	6.0
8539				6.5	8.4					—
8538	3	12.0	29.5	9.0	7.7	0	5.6	6.4	12.9	5.3
8539				FAL: 6.5 KAL: 6.8	FAL: 8.5 KAL: 10.5					—
8538	4	13.0	39.0	11.0	11.5	0	7.0	6.0	13.0	9.0
8539				6.8	12.5					—
8538	5∗	17.3	59.0	13.5	25.0	0	10.8	6.5	20.5	—
8539				KAL: 6.8 LAL: 9.0	KAL: 23.0 LAL: 24.5					—
8538	6	32.0	82.0	32.0	40.0	0	13.0	19.0	35.0	—
8539				LAL: 9.0 MAL: 12.5	LAL: 25.5 MAL: 40.5					—

∗ Size 5 combination starter does not contain a full size panel. No usable panel space is available.



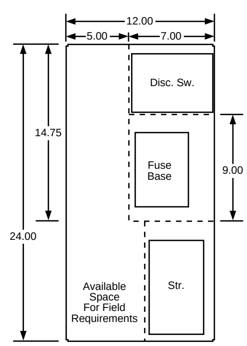
Class 8538



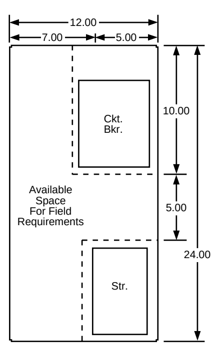
Class 8539

Oversize Enclosures, NEMA Type 1, 4 & 4X Stainless, 12

Combination starters in oversized enclosures provide additional panel space for field addition of control relays, timing relays, terminal blocks or other auxiliary equipment. Disconnect type devices offer over 130 square inches of available panel space. Circuit breaker type devices offer over 180 square inches of available panel space.



Class 8538



Class 8539

General – Class 8738 and 8739 Type S reversing combination starters combine the requirements of motor overload and short circuit protection into one convenient package. Type S reversing combination starters are manufactured in accordance with NEMA standards, are UL Listed, and CSA certified.● Class 8738 and 8739 reversing combination starters are designed to operate at 600 Volts AC, 50-60 Hz. Type S reversing combination starters are supplied with melting alloy overload relays as standard.

Enclosures – Class 8738 and 8739 reversing combination starters are available in the following enclosures:

- NEMA Type 1 General Purpose
- NEMA Type 4X Watertight, Dusttight, and Corrosion Resistant Glass-Polyester
- NEMA Type 7 & 9 Bolted and Spin-Top® for Hazardous Locations (Class 8739 only)
- NEMA Type 4 & 4X Watertight and Dusttight
- NEMA Type 12 Dusttight and Driptight for Industrial Use

The NEMA Type 4 & 4X stainless steel enclosure (Sizes 0 - 5) has a brushed finish. Size 6 & 7 are sheet steel enclosures and are rated NEMA Type 4 only. For an electropolished finish, specify **Form G16** and add 15% to the price of the standard device. Hubs are supplied as standard on NEMA Type 4 & 4X enclosures.

The NEMA Type 4X glass-polyester enclosed devices are UL Listed. Hubs are supplied as standard on NEMA Type 4X enclosures.

NEMA Type 12 enclosures may be field modified for outdoor applications with **Form G26**. Contact your local Square D Field Sales Office for additional information.

Also, NEMA Type 12 devices are available UL Listed for use in Class II, Division 2, Group G and Class III, Divisions 1 and 2 locations. Request **Form G21**, no additional charge.

Coil Voltages – AC coils are available for application on 50/60 Hz. NEMA Sizes 00 - 5 are supplied with coils that are designed to operate satisfactorily on line voltages of 85%-110% of rated voltage. NEMA Size 6 and 7 contactors are supplied with a DC coil operated by a solid state rectifier circuit that is powered by an AC source.

Please note that Voltage Codes have been added to the Type designations in order to improve customer service. It is necessary to include the Voltage Code when ordering combination starters. Also, 120 Volt Polyphase combination starters will be wired for **separate control.**

Auxiliary Contacts – Additional auxiliary contacts may be added to Type S starters. See Page 14 for maximum number of auxiliary units and Form designations for factory installed auxiliary contacts. See Catalog 9999CT9701 for auxiliary contact kits for field installation.

Type S Accessories – Additional accessories such as fuse blocks, fuse clip kits, disconnect switch and circuit breaker interlocks, and cover mounted control stations are available for field modifications. For factory modifications (Forms), see Pages 30-34. For field modification kits, see Catalog 9999CT9701.

3-Pole Polyphase - 600 Volts AC Maximum - 50-60 Hz

Thermal Units - Devices require 3 thermal units, see Catalog 9065CT9701 for selection information.

Class 8738 Full Voltage Type, Reversing With Melting Alloy Overload Relays

Ratings					NEMA Type 1 General Purpose Enclosure	NEMA Type 4 & 4X Watertight and Dusttight Enclosure Stainless Steel (304)	NEMA Type 4X★ Watertight, Dusttight and Corrosion Resistant Polyester Enclosure	NEMA Type 12 Dusttight and Driptight Industrial Use Enclosure	
Motor Voltage (Starter Voltage)	Max. HP Polyphase	Coil Voltage✱	NEMA Size	Fuse Clip Size Amps				With External Reset	Without External Reset
					Type	Type	Type	Type	Type
200 (208)	3	208-60	0	30	SBG12V08	SBW12V08	SBW22V08	SBA22V08	SBA12V08
	5		1	30	SCG12V08	SCW12V08	SCW22V08	SCA22V08	SCA12V08
	7½			60	SCG13V08	SCW13V08	SCW23V08	SCA23V08	SCA13V08
	10		2	60	SDG12V08	SDW12V08	SDW22V08	SDA22V08	SDA12V08
	20		3	100	SEG15V08	SEW15V08	....	SEA25V08	SEA15V08
	40		4	200	SFG15V08	SFW15V08	....	SFA25V08	SFA15V08
	75		5	400	SGG15V08	SGW15V08	....	SGA25V08	SGA15V08
230 (240)	3	240-60 220-50	0	30	SBG12V03	SBW12V03	SBW22V03	SBA22V03	SBA12V03
	5		1	30	SCG12V03	SCW12V03	SCW22V03	SCA22V03	SCA12V03
	7½			60	SCG13V03	SCW13V03	SCW23V03	SCA23V03	SCA13V03
	15		2	60	SDG12V03	SDW12V03	SDW22V03	SDA22V03	SDA12V03
	25		3	100	SEG15V03	SEW15V03	....	SEA25V03	SEA15V03
	50		4	200	SFG15V03	SFW15V03	....	SFA25V03	SFA15V03
	100		5	400	SGG15V03	SGW15V03	....	SGA25V03	SGA15V03
460 (480)	5	480-60 440-50	0	30	SBG13V06	SBW13V06	SBW23V06	SBA23V06	SBA13V06
	10		1	30	SCG14V06	SCW14V06	SCW24V06	SCA24V06	SCA14V06
	15		2	30	SDG16V06	SDW16V06	SDW26V06	SDA26V06	SDA16V06
	25			60	SDG14V06	SDW14V06	SDW24V06	SDA24V06	SDA14V06
	50		3	100	SEG13V06	SEW13V06	....	**SEA23V06**	SEA13V06
	100		4	200	SFG13V06	SFW13V06	....	SFA23V06	SFA13V06
	200		5	400	SGG13V06	SGW13V06	....	**SGA23V06**	SGA13V06
575 (600)	5	600-60 550-50	0	30	SBG13V07	SBW13V07	SBW23V07	SBA23V07	SBA13V07
	10		1	30	SCG14V07	SCW14V07	SCW24V07	SCA24V07	SCA14V07
	15		2	30	SDG16V07	SDW16V07	SDW26V07	SDA26V07	SDA16V07
	25			60	SDG14V07	SDW14V07	SDW24V07	SDA24V07	SDA14V07
	50		3	100	SEG13V07	SEW13V07	....	SEA23V07	SEA13V07
	100		4	200	SFG13V07	SFW13V07	....	SFA23V07	SFA13V07
	200		5	400	SGG13V07	SGW13V07	....	SGA23V07	SGA13V07

● Most Square D combination starters are pending CSA approval. Please have your Square D representative contact the factory.
✱ Coil voltage code must be specified to order this product. Refer to standard coil voltage codes listed in selection table above or additional standard voltage codes below and insert as shown in the How To Order block.
★ NEMA Type 4x polyester devices are not UL Listed.

Coil Voltage Codes

Voltage		Code
60 Hz	50 Hz	
24†▲	. . .	V01
120†	110	V02
208	. . .	V08
240	220	V03
480	440	V06
600	550	V07
Specify	Specify	V99

▲ 24V coils are not available on Sizes 4-7. On Sizes 00-3, where 24V coils are available, **Form S** (separate control) must be specified.
† These voltage codes must include **Form S** (supplied at No Charge).

Standard unit

File E152395
CCN NKJH, NKJH7

File LR584
Class 3211 04

Explosion proof unit

File E10214
CCN NOTH

Note that not all units are or explosion proof. Consult factory.

Reversing Combination Starters – NEMA Rated
Non-Fusible and Fusible Disconnect Switch Type – Class 8738

3-Pole Polyphase – 600 Volts AC Maximum – 50-60 Hz

Devices require 3 thermal units. See Catalog 9065CT9701 for selection information.

Non-Fusible Disconnect Switch Type – Full-Voltage Type Reversing with Melting Alloy Overload Relays

Ratings					NEMA Type 1 General Purpose Enclosure	NEMA Type 4 & 4X Watertight and Dusttight Enclosure Stainless Steel (304)	NEMA Type 4X Watertight, Dusttight and Corrosion Resistant Polyester Enclosure	NEMA Type 12/3R▲ Dusttight and Driptight Industrial Use Enclosure	
Motor Voltage (Starter Voltage)	Max. HP Poly-Phase	Coil Voltage ✱	NEMA Size	Fuse Clip Size Amps	Type	Type	Type	With External Reset Type	Without External Reset Type
200 (208)	3	208-60	0	None	SBG11V08	SBW11V08	SBW21V08	SBA21V08	SBA11V08
	7½		1	None	SCG11V08	SCW11V08	SCW21V08	SCA21V08	SCA11V08
	10		2	None	SDG11V08	SDW11V08	SDW21V08	SDA21V08	SDA11V08
	25		3	None	SEG11V08	SEW11V08	....	SEA21V08	SEA11V08
	40		4	None	SFG11V08	SFW11V08	....	SFA21V08	SFA11V08
	75		5	None	SGG11V08	SGW11V08	....	SGA21V08	SGA11V08
230 (240)	3	240-60 220-50	0	None	SBG11V03	SBW11V03	SBW21V03	SBA21V03	SBA11V03
	7½		1	None	SCG11V03	SCW11V03	SCW21V03	SCA21V03	SCA11V03
	15		2	None	SDG11V03	SDW11V03	SDW21V03	SDA21V03	SDA11V03
	30		3	None	SEG11V03	SEW11V03	....	SEA21V03	SEA11V03
	50		4	None	SFG11V03	SFW11V03	....	SFA21V03	SFA11V03
	100		5	None	SGG11V03	SGW11V03	....	SGA21V03	SGA11V03
460 (480)	5	480-60 440-50	0	None	SBG11V06	SBW11V06	SBW21V06	SBA21V06	SBA11V06
	10		1	None	SCG11V06	SCW11V06	SCW21V06	SCA21V06	SCA11V06
	25		2	None	SDG11V06	SDW11V06	SDW21V06	SDA21V06	SDA11V06
	50		3	None	SEG11V06	SEW11V06	....	SEA21V06	SEA11V06
	100		4	None	SFG11V06	SFW11V06	....	SFA21V06	SFA11V06
	200		5	None	SGG11V06	SGW11V06	....	SGA21V06	SGA11V06
575 (600)	5	600-60 550-50	0	None	SBG11V07	SBW11V07	SBW21V07	SBA21V07	SBA11V07
	10		1	None	SCG11V07	SCW11V07	SCW21V07	SCA21V07	SCA11V07
	25		2	None	SDG11V07	SDW11V07	SDW21V07	SDA21V07	SDA11V07
	50		3	None	SEG11V07	SEW11V07	....	SEA21V07	SEA11V07
	100		4	None	SFG11V07	SFW11V07	....	SFA21V07	SFA11V07
	200		5	None	SGG11V07	SGW11V07	....	SGA21V07	SGA11V07

▲ NEMA Type 12 enclosures may be field modified for outdoor non-corrosive and non-service-entrance-rated applications; see Page 17 for more information.
✱ Coil voltage code must be specified to order this product. Refer to standard coil voltage codes listed in selection table above or additional standard voltage codes shown on Page 31.

Fusible Disconnect Switch Type With Class R Fuse Clips — 100,000 AIC Rating★

Ratings					NEMA Type 1 General Purpose Enclosure	NEMA Type 4 & 4X Watertight and Dusttight Enclosure Stainless Steel (304)	NEMA Type 4X Watertight, Dusttight and Corrosion Resistant Polyester Enclosure	NEMA Type 12/3R▲ Dusttight and Driptight Industrial Use Enclosure	
Motor Voltage (Starter Voltage)	Max. HP Poly-Phase	Coil Voltage ✱	NEMA Size	Fuse Clip Size Amps	Type	Type	Type	With External Reset Type	Without External Reset Type
200 (208)	3	208-60	0	30	SBG32V08	SBW32V08	SBW42V08	SBA42V08	SBA32V08
	5		1	30	SCG32V08	SCW32V08	SCW42V08	SCA42V08	SCA32V08
	7½			60	SCG33V08	SCW33V08	SCW43V08	SCA43V08	SCA33V08
	10		2	60	SDG32V08	SDW32V08	SDW42V08	SDA42V08	SDA32V08
	20		3	100	SEG35V08	SEW35V08	....	SEA45V08	SEA35V08
	40		4	200	SFG35V08	SFW35V08	....	SFA45V08	SFA35V08
	75		5	400	SGG35V08	SGW35V08	....	SGA45V08	SGA35V08
230 (240)	3	240-60 220-50	0	30	SBG32V03	SBW32V03	SBW42V03	SBA42V03	SBA32V03
	5		1	30	SCG32V03	SCW32V03	SCW42V03	SCA42V03	SCA32V03
	7½			60	SCG33V03	SCW33V03	SCW43V03	SCA43V03	SCA33V03
	15		2	60	SDG32V03	SDW32V03	SDW42V03	SDA42V03	SDA32V03
	25		3	100	SEG35V03	SEW35V03	....	SEA45V03	SEA35V03
	50		4	200	SFG35V03	SFW35V03	....	SFA45V03	SFA35V03
	100		5	400	SGG35V03	SGW35V03	....	SGA45V03	SGA35V03
460 (480)	5	480-60 440-50	0	30	SBG33V06	SBW33V06	SBW43V06	SBA43V06	SBA33V06
	10		1	30	SCG34V06	SCW34V06	SCW44V06	SCA44V06	SCA34V06
	15		2	30	SDG36V06	SDW36V06	SDW46V06	SDA46V06	SDA36V06
	25			60	SDG34V06	SDW34V06	SDW44V06	SDA44V06	SDA34V06
	50		3	100	SEG33V06	SEW33V06	....	SEA43V06	SEA33V06
	100		4	200	SFG33V06	SFW33V06	....	SFA43V06	SFA33V06
	200		5	400	SGG33V06	SGW33V06	....	SGA43V06	SGA33V06
575 (600)	5	600-60 550-50	0	30	SBG33V07	SBW33V07	SBW43V07	SBA43V07	SBA33V07
	10		1	30	SCG34V07	SCW34V07	SCW44V07	SCA44V07	SCA34V07
	15		2	30	SDG36V07	SDW36V07	SDW46V07	SDA46V07	SDA36V07
	25			60	SDG34V07	SDW34V07	SDW44V07	SDA44V07	SDA34V07
	50		3	100	SEG33V07	SEW33V07	....	SEA43V07	SEA33V07
	100		4	200	SFG33V07	SFW33V07	....	SFA43V07	SFA33V07
	200		5	400	SGG33V07	SGW33V07	....	SGA43V07	SGA33V07

★ For Class J fuse clips, use **Form Y91** (no additional charge).
▲ NEMA Type 12 enclosures may be field modified for outdoor non-corrosive and non-service-entrance-rated applications; see Page 17 for more information.
✱ Coil voltage code must be specified to order this product. Refer to standard coil voltage codes listed in selection table above or additional standard voltage codes shown on Page 31.

3-Pole Polyphase – 600 Volts AC Maximum – 50-60 Hz

Devices require 3 thermal units. See Catalog 9065CT9701 for selection information.

Full-Voltage Type, Reversing with Melting Alloy Overload Relays

Ratings					NEMA Type 1 General Purpose Enclosure	NEMA Type 4 & 4X Watertight and Dusttight Enclosure Stainless Steel (304) (Sizes 0-5)‡	NEMA Type 4X Watertight Dusttight and Corrosion Resistant Polyester Enclosure	NEMA Type 7 & 9★ For Hazardous Locations Class I, Groups C & D Class II, Groups E, F & G		NEMA Type 12/3R▲ Dusttight and Driptight Industrial Use Enclosure	
Motor Voltage (Starter Voltage)	HP Range Poly-phase	Coil Voltage ✱	NEMA Size	Circuit Breaker (See Page 1-48 for Breaker Adjustment Range)	Type	Type	Type	SPIN TOP® Type	Bolted Type	With External Reset Type	Without External Reset Type
200 (208)	¼-⅓	208-60	0	GJL36003-M01	SBG41V08	SBW41V08	SBW51V08	SBR41V08	SBT41V08	SBA51V08	SBA41V08
	½-1			GJL36007-M02	SBG42V08	SBW42V08	SBW52V08	SBR42V08	SBT42V08	SBA52V08	SBA42V08
	1½-3			GJL36015-M03	SBG43V08	SBW43V08	SBW53V08	SBR43V08	SBT43V08	SBA53V08	SBA43V08
	¼-⅓		1	GJL36003-M01	SCG41V08	SCW41V08	SCW51V08	SCR41V08	SCT41V08	SCA51V08	SCA41V08
	½-1			GJL36007-M02	SCG42V08	SCW42V08	SCW52V08	SCR42V08	SCT42V08	SCA52V08	SCA42V08
	1½-3			GJL36015-M03	SCG43V08	SCW43V08	SCW53V08	SCR43V08	SCT43V08	SCA53V08	SCA43V08
	5			GJL36030-M04	SCG44V08	SCW44V08	SCW54V08	SCR44V08	SCT44V08	SCA54V08	SCA44V08
	7½			GJL36050-M05	SCG45V08	SCW45V08	SCW55V08	SCR45V08	SCT45V08	SCA55V08	SCA45V08
	1½-3		2	GJL36015-M03	SDG41V08	SDW41V08	SDW51V08	SDR41V08	SDT41V08	SDA51V08	SDA41V08
	5			GJL36030-M04	SDG42V08	SDW42V08	SDW52V08	SDR42V08	SDT42V08	SDA52V08	SDA42V08
	7½-10			GJL36050-M05	SDG43V08	SDW43V08	SDW53V08	SDR43V08	SDT43V08	SDA53V08	SDA43V08
	15-25		3	FAL36100-18M	SEG42V08	SEW42V08	SEW52V08	....	SET42V08	SEA52V08	SEA42V08
	30		4	KAL36250-25M	SFG42V08	SFW42V08	SFW52V08	....	SFT42V08	SFA52V08	SFA42V08
	40			KAL36250-26M	SFG43V08	SFW43V08	SFW53V08		SFT43V08	SFA53V08	SFA43V08
	50		5	KAL36250-30M	SGG42V08	SGW42V08	....	....	....	SGA52V08	SGA42V08
	60			LAL36400-32M	SGG44V08	SGW44V08	....	....	....	SGA54V08	SGA44V08
	75			LAL36400-33M	SGG45V08	SGW45V08	....	....	....	SGA55V08	SGA45V08
	100		6	LAL36400-36M	SHG43V08	SHW43V08	....	....	....	SHA53V08	SHA43V08
	125			MAL36600-40M	SHG44V08	SHW44V08	....	....	....	SHA54V08	SHA44V08
	150			MAL36600-42M	SHG45V08	SHW45V08	....	....	....	SHA55V08	SHA45V08
230 (240)	¼-⅓	240-60 220-50	0	GJL36003-M01	SBG41V03	SBW41V03	SBW51V03	SBR41V03	SBT41V03	SBA51V03	SBA41V03
	½-1			GJL36007-M02	SBG42V03	SBW42V03	SBW52V03	SBR42V03	SBT42V03	SBA52V03	SBA42V03
	1½-3			GJL36015-M03	SBG43V03	SBW43V03	SBW53V03	SBR43V03	SBT43V03	SBA53V03	SBA43V03
	¼-⅓		1	GJL36003-M01	SCG41V03	SCW41V03	SCW51V03	SCR41V03	SCT41V03	SCA51V03	SCA41V03
	½-1			GJL36007-M02	SCG42V03	SCW42V03	SCW52V03	SCR42V03	SCT42V03	SCA52V03	SCA42V03
	1½-3			GJL36015-M03	SCG43V03	SCW43V03	SCW53V03	SCR43V03	SCT43V03	SCA53V03	SCA43V03
	5-7½			GJL36030-M04	SCG44V03	SCW44V03	SCW54V03	SCR44V03	SCT44V03	SCA54V03	SCA44V03
	1½-3		2	GJL36015-M03	SDG41V03	SDW41V03	SDW51V03	SDR41V03	SDT41V03	SDA51V03	SDA41V03
	5-7½			GJL36030-M04	SDG42V03	SDW42V03	SDW52V03	SDR42V03	SDT42V03	SDA52V03	SDA42V03
	10			GJL36050-M05	SDG43V03	SDW43V03	SDW53V03	SDR43V03	SDT43V03	SDA53V03	SDA43V03
	15			FAL36100-18M	SDG44V03	SDW44V03	SDW54V03	SDR44V03	SDT44V03	SDA54V03	SDA44V03
	15-30		3	FAL36100-18M	SEG42V03	SEW42V03	SEW52V03	....	SET42V03	SEA52V03	SEA42V03
	40		4	KAL36250-26M	SFG43V03	SFW43V03	SFW53V03	....	SFT43V03	SFA53V03	SFA43V03
	50			KAL36250-29M	SFG44V03	SFW44V03	SFW54V03	....	SFT44V03	SFA54V03	SFA44V03
	60		5	KAL36250-31M	SGG43V03	SGW43V03	....	....	...	SGA53V03	SGA43V03
	75			LAL36400-32M	SGG44V03	SGW44V03	....	....	....	SGA54V03	SGA44V03
	100			LAL36400-35M	SGG46V03	SGW46V03	....	....	....	SGA56V03	SGA46V03
	125-150		6	MAL36600-40M	SHG44V03	SHW44V03	....	....	....	SHA54V03	SHA44V03
	200			MAL36600-44M	SHG46V03	SHW46V03	....	....	....	SHA56V03	SHA46V03

‡ NEMA Size 6 starters are NEMA Type 4 painted sheet steel enclosures.
★ **NEMA Type 7 & 9 Bolted are not UL Listed.**
▲ NEMA Type 12 enclosures may be field modified for outdoor non-corrosive and non-service-entrance-rated applications; see Page 17 for more information.
✱ Coil voltage code must be specified to order this product. Refer to standard coil voltage codes listed in selection table above or additional standard voltage codes below.
Form **Y534** may be used to substitute an FAL circuit breaker for a GJL circuit breaker (no additional charge).

Coil Voltage Codes

Voltage		Code
60 Hz	50 Hz	
24†▲	. . .	V01
120†	110	V02
208	. . .	V08
240	220	V03
480	440	V06
600	550	V07
Specify	Specify	V99

▲ 24V coils are not available on Sizes 4-7. On Sizes 00-3, where 24V coils are available, **Form S** (separate control) must be specified.
† These voltage codes must include **Form S** (supplied at No Charge).

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Factory Modifications (Forms). . . . . Page 30
Type S Accessories (Class 9999) . . . . .Catalog 9999CT9701

Reversing Combination Starters – NEMA Rated
MAG-GARD® Circuit Breaker – Class 8739

3-Pole Polyphase – 600 Volts AC Maximum – 50-60 Hz

Devices require 3 thermal units. See Catalog 9065CT9701 for selection information.

Full-Voltage Type, Reversing with Melting Alloy Overload Relays

Ratings					NEMA Type 1 General Purpose Enclosure	NEMA Type 4 & 4X Watertight and Dusttight Enclosure Stainless Steel (304) (Sizes 0-5)‡	NEMA Type 4X Watertight Dusttight and Corrosion Resistant Polyester Enclosure	NEMA Type 7 & 9★ For Hazardous Locations Class I, Groups C & D Class II, Groups E, F & G		NEMA Type 12/3R▲ Dusttight and Driptight Industrial Use Enclosure	
Motor Voltage (Starter Voltage)	HP Range Poly-phase	Coil Voltage ✱	NEMA Size	Circuit Breaker (See Page 1-48 for Breaker Adjustment Range)	Type	Type	Type	SPIN TOP® Type	Bolted Type	With External Reset Type	Without External Reset Type
460 (480)	¼-1	480-60 440-50	0	GJL36003-M01	SBG41V06	SBW41V06	SBW51V06	SBR41V06	SBT41V06	SBA51V06	SBA41V06
	1½-3			GJL36007-M02	SBG42V06	SBW42V06	SBW52V06	SBR42V06	SBT42V06	SBA52V06	SBA42V06
	5			GJL36015-M03	SBG43V06	SBW43V06	SBW53V06	SBR43V06	SBT43V06	SBA53V06	SBA43V06
	¼-1		1	GJL36003-M01	SCG41V06	SCW41V06	SCW51V06	SCR41V06	SCT41V06	SCA51V06	SCA41V06
	1½-3			GJL36007-M02	SCG42V06	SCW42V06	SCW52V06	SCR42V06	SCT42V06	SCA52V06	SCA42V06
	5-7½			GJL36015-M03	SCG43V06	SCW43V06	SCW53V06	SCR43V06	SCT43V06	SCA53V06	SCA43V06
	10			GJL36030-M04	SCG44V06	SCW44V06	SCW54V06	SCR44V06	SCT44V06	SCA54V06	SCA44V06
	5-7½		2	GJL36015-M03	SDG41V06	SDW41V06	SDW51V06	SDR41V06	SDT41V06	SDA51V06	SDA41V06
	10-15			GJL36030-M04	SDG42V06	SDW42V06	SDW52V06	SDR42V06	SDT42V06	SDA52V06	SDA42V06
	20-25			GJL36050-M05	SDG43V06	SDW43V06	SDW53V06	SDR43V06	SDT43V06	SDA53V06	SDA43V06
	20-25		3	GJL36050-M05	SEG41V06	SEW41V06	SEW51V06	....	SET41V06	SEA51V06	SEA41V06
	30-50			FAL36100-18M	SEG42V06	SEW42V06	SEW52V06		SET42V06	SEA52V06	SEA42V06
	60-75		4	KAL36250-25M	SFG42V06	SFW42V06	SFW52V06	....	SFT42V06	SFA52V06	SFA42V06
	100			KAL36250-29M	SFG44V06	SFW44V06	SFW54V06	....	SFT44V06	SFA54V06	SFA44V06
	125		5	KAL36250-31M	SGG43V06	SGW43V06	....	....	....	SGA53V06	SGA43V06
	150			LAL36400-32M	SGG44V06	SGW44V06	....	....	....	SGA54V06	SGA44V06
	200			LAL36400-35M	SGG46V06	SGW46V06	....	....	....	SGA56V06	SGA46V06
	250		6	LAL36400-36M	SHG43V06	SHW43V06	....	....	....	SHA53V06	SHA43V06
	300			MAL36600-40M	SHG44V06	SHW44V06	....	....	....	SHA54V06	SHA44V06
	350			MAL36600-42M	SHG45V06	SHW45V06	....	....	....	SHA55V06	SHA45V06
	400			MAL36600-44M	SHG46V06	SHW46V06	....	....	....	SHA56V06	SHA46V06
575 (600)	¼-1	600-60 550-50	0	GJL36003-M01	SBG41V07	SBW41V07	SBW51V07	SBR41V07	SBT41V07	SBA51V07	SBA41V07
	1½-3			GJL36007-M02	SBG42V07	SBW42V07	SBW52V07	SBR42V07	SBT42V07	SBA52V07	SBA42V07
	5			GJL36015-M03	SBG43V07	SBW43V07	SBW53V07	SBR43V07	SBT43V07	SBA53V07	SBA43V07
	¼-1		1	GJL36003-M01	SCG41V07	SCW41V07	SCW51V07	SCR41V07	SCT41V07	SCA51V07	SCA41V07
	1½-3			GJL36007-M02	SCG42V07	SCW42V07	SCW52V07	SCR42V07	SCT42V07	SCA52V07	SCA42V07
	5-10			GJL36015-M03	SCG43V07	SCW43V07	SCW53V07	SCR43V07	SCT43V07	SCA53V07	SCA43V07
	5-10		2	GJL36015-M03	SDG41V07	SDW41V07	SDW51V07	SDR41V07	SDT41V07	SDA51V07	SDA41V07
	15-20			GJL36030-M04	SDG42V07	SDW42V07	SDW52V07	SDR42V07	SDT42V07	SDA52V07	SDA42V07
	25			GJL36050-M05	SDG43V07	SDW43V07	SDW53V07	SDR43V07	SDT43V07	SDA53V07	SDA43V07
	25-30		3	GJL36050-M05	SEG41V07	SEW41V07	SEW51V07	....	SET41V07	SEA51V07	SEA41V07
	40-50			FAL36100-18M	SEG42V07	SEW42V07	SEW52V07	....	SET42V07	SEA52V07	SEA42V07
	60-100		4	KAL36250-25M	SFG42V07	SFW42V07	SFW52V07	....	SFT42V07	SFA52V07	SFA42V07
	125		5	KAL36250-29M	SGG41V07	SGW41V07	....	....	....	SGA51V07	SGA41V07
	150			KAL36250-30M	SGG42V07	SGW42V07	....	....	....	SGA52V07	SGA42V07
	200			LAL36400-32M	SGG44V07	SGW44V07	....	....	....	SGA54V07	SGA44V07
	250		6	LAL36400-35M	SHG42V07	SHW42V07	....	....	....	SHA52V07	SHA42V07
	300			LAL36400-36M	SHG43V07	SHW43V07	....	....	....	SHA53V07	SHA43V07
	350-400			MAL36600-40M	SHG44V07	SHW44V07	....	....	....	SHA54V07	SHA44V07

‡ NEMA Size 6 starters are NEMA Type 4 painted sheet steel enclosures.
★ **NEMA Type 7 & 9 Bolted are not UL Listed.**
▲ NEMA Type 12 enclosures may be field modified for outdoor non-corrosive and non-service-entrance-rated applications; see Page 17 for more information.
✱ Coil voltage code must be specified to order this product. Refer to standard coil voltage codes listed in selection table above or additional standard voltage codes below.
Form **Y534** may be used to substitute an FAL circuit breaker for a GJL circuit breaker (no additional charge).

Coil Voltage Codes

Voltage		Code
60 Hz	50 Hz	
24†▲	. . .	V01
120†	110	V02
208	. . .	V08
240	220	V03
480	440	V06
600	550	V07
Specify	Specify	V99

▲ 24V coils are not available on Sizes 4-7. On Sizes 00-3, where 24V coils are available, **Form S** (separate control) must be specified.
† These voltage codes must include **Form S** (supplied at No Charge).

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Factory Modifications (Forms). . . . . Page 30
Type S Accessories (Class 9999) . . . . Catalog 9999CT9701

3-Pole Polyphase – 600 Volts AC Maximum – 50-60 Hz

Devices require 3 thermal units. See Catalog 9065CT9701 for selection information.

Full-Voltage Type, Reversing with Melting Alloy Overload Relays

Ratings: Motor Voltage (Starter Voltage)	Ratings: Max. HP Poly-phase	Ratings: Coil Voltage ✱	Ratings: NEMA Size	Ratings: Circuit Breaker Type	Ratings: Circuit Breaker Ampere Rating	NEMA Type 1 General Purpose Enclosure: Type	NEMA Type 4 & 4X Watertight and Dusttight Enclosure Stainless Steel (304) (Sizes 0-5)‡: Type	NEMA Type 4X Watertight Dusttight and Corrosion Resistant Polyester Enclosure: Type	NEMA Type 7 & 9★ For Hazardous Locations Class I, Groups C & D Class II, Groups E, F & G: SPIN TOP® Type	NEMA Type 7 & 9★: Bolted Type	NEMA Type 12/3R▲ Dusttight and Driptight Industrial Use Enclosure: With External Reset Type	NEMA Type 12/3R▲: Without External Reset Type
200 (208)	2	208-60	0	FAL♦	15	SBG1V08	SBW1V08	SBW11V08	SBR1V08	SBT1V08	SBA11V08	SBA1V08
	3				20	SBG3V08	SBW3V08	SBW13V08	SBR3V08	SBT3V08	SBA13V08	SBA3V08
	5		1	FAL♦	35	SCG5V08	SCW5V08	SCW15V08	SCR5V08	SCT5V08	SCA15V08	SCA5V08
	7½				50	SCG2V08	SCW2V08	SCW12V08	SCR2V08	SCT2V08	SCA12V08	SCA2V08
	10		2	FAL♦	60	SDG1V08	SDW1V08	SDW11V08	SDR1V08	SDT1V08	SDA11V08	SDA1V08
	15		3	FAL	90	SEG3V08	SEW3V08	SEW13V08	....	SET3V08	SEA13V08	SEA3V08
	20			FAL	100	SEG1V08	SEW1V08	SEW11V08	....	SET1V08	SEA12V08	SEA1V08
	25			KAL	110	SEG5V08	SEW5V08	SEW15V08	....	SET5V08	SEA15V08	SEA5V08
	30		4	KAL	125	SFG3V08	SFW3V08	SFW13V08	....	SFT3V08	SFA13V08	SFA3V08
	40				200	SFG4V08	SFW4V08	SFW14V08	....	SFT4V08	SFA14V08	SFA4V08
	50		5	LAL	200	SGG6V08	SGW6V08	....	....	....	SGA16V08	SGA6V08
	60				250	SGG1V08	SGW1V08	....	....	....	SGA11V08	SGA1V08
	75				300	SGG4V08	SGW4V08	....	....	....	SGA14V08	SGA4V08
	100		6	MAL	450	SHG4V08	SHW4V08	....	....	....	SHA14V08	SHA4V08
	125				600	SHG3V08	SHW3V08	....	....	....	SHA13V08	SHA3V08
	150				600	SHG5V08	SHW5V08	....	....	....	SHA15V08	SHA5V08
230 (240)	2	240-60 220-50	0	FAL♦	15	SBG1V03	SBW1V03	SBW11V03	SBR1V03	SBT1V03	SBA11V03	SBA1V03
	3				20	SBG3V03	SBW3V03	SBW13V03	SBR3V03	SBT3V03	SBA13V03	SBA3V03
	5		1	FAL♦	30	SCG1V03	SCW1V03	SCW11V03	SCR1V03	SCT1V03	SCA11V03	SCA1V03
	7½				45	SCG6V03	SCW6V03	SCW16V03	SCR6V03	SCT6V03	SCA16V03	SCA6V03
	10		2	FAL♦	60	SDG1V03	SDW1V03	SDW11V03	SDR1V03	SDT1V03	SDA11V03	SDA1V03
	15				80	SDG7V03	SDW7V03	SDW17V03	SDR7V03	SDT7V03	SDA17V03	SDA7V03
	20		3	FAL	90	SEG3V03	SEW3V03	SEW13V03	....	SET3V03	SEA13V03	SEA3V03
	25			FAL	100	SEG1V03	SEW1V03	SEW11V03	....	SET1V03	SEA11V03	SEA1V03
	30			KAL	110	SEG5V03	SEW5V03	SEW15V03	....	SET5V03	SEA15V03	SEA5V03
	40		4	KAL	150	SFG1V03	SFW1V03	SFW11V03	....	SFT1V03	SFA11V03	SFA1V03
	50				200	SFG4V03	SFW4V03	SFW14V03	....	SFT4V03	SFA14V03	SFA4V03
	60		5	LAL	225	SGG3V03	SGW3V03	....	....	....	SGA13V03	SGA3V03
	75			LAL	250	SGG1V03	SGW1V03	....	....	....	SGA11V03	SGA1V03
	100			LAL	350	SGG2V03	SGW2V03	....	....	....	SGA12V03	SGA2V03
	125		6	MAL	450	SHG4V03	SHW4V03	....	....	....	SHA14V03	SHA4V03
	150				600	SHG3V03	SHW3V03	....	....	....	SHA13V03	SHA3V03
	200				800	SHG7V03	SHW7V03	....	....	....	SHA17V03	SHA7V03

‡ NEMA Size 6 starters are NEMA Type 4 painted sheet steel enclosures.
★ **NEMA Type 7 & 9 Bolted are not UL Listed.**
▲ NEMA Type 12 enclosures may be field modified for outdoor non-corrosive and non-service-entrance-rated applications; see Page 17 for more information.
✱ Coil voltage code must be specified to order this product. Refer to standard coil voltage codes listed in selection table above or additional standard voltage codes shown below.
♦ Rated 250 volts max.

Coil Voltage Codes

Voltage: 60 Hz	Voltage: 50 Hz	Code
24†▲	. . .	V01
120†	110	V02
208	. . .	V08
240	220	V03
480	440	V06
600	550	V07
Specify	Specify	V99

▲ 24V coils are not available on Sizes 4-7. On Sizes 00-3, where 24V coils are available, **Form S** (separate control) must be specified.
† These voltage codes must include **Form S** (supplied at No Charge).

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Type S Accessories (Class 9999) . . . . Catalog 9999CT9701

Reversing Combination Starters – NEMA Rated
Thermal Magnetic Circuit Breaker – Class 8739

3-Pole Polyphase – 600 Volts AC Maximum – 50-60 Hz

Devices require 3 thermal units. See Catalog 9065CT9701 for selection information.

Full-Voltage Type, Reversing with Melting Alloy Overload Relays

Ratings						NEMA Type 1 General Purpose Enclosure	NEMA Type 4 & 4X Watertight and Dusttight Enclosure Stainless Steel (304) (Sizes 0 - 5)‡	NEMA Type 4X Watertight Dusttight and Corrosion Resistant Polyester Enclosure	NEMA Type 7 & 9★ For Hazardous Locations Class I, Groups C & D Class II, Groups E, F & G		NEMA Type 12/3R▲ Dusttight and Driptight Industrial Use Enclosure	
Motor Voltage (Starter Voltage)	Max. HP Poly-phase	Coil Voltage ✱	NEMA Size	Circuit Breaker Type	Circuit Breaker Ampere Rating	Type	Type	Type	SPIN TOP® Type	Bolted Type	With External Reset Type	Without External Reset Type
460 (480)	5	480-60 440-50	0	FAL	15	SBG2V06	SBW2V06	SBW12V06	SBR2V06	SBT2V06	SBA12V06	SBA2V06
	7½		1	FAL	20	SCG3V06	SCW3V06	SCW13V06	SCR3V06	SCT3V06	SCA13V06	SCA3V06
	10				25	SCG7V06	SCW7V06	SCW17V06	SCR7V06	SCT7V06	SCA17V06	SCA7V06
	15		2	FAL	40	SDG3V06	SDW3V06	SDW13V06	SDR3V06	SDT3V06	SDA13V06	SDA3V06
	20				60	SDG4V06	SDW4V06	SDW14V06	SDR4V06	SDT4V06	SDA14V06	SDA4V06
	25				70	SDG5V06	SDW5V06	SDW15V06	SDR5V06	SDT5V06	SDA15V06	SDA5V06
	30		3	FAL	80	SEG6V06	SEW6V06	SEW16V06	....	SET6V06	SEA16V06	SEA6V06
	40				90	SEG3V06	SEW3V06	SEW13V06	....	SET3V06	SEA13V06	SEA3V06
	50				100	SEG1V06	SEW1V06	SEW11V06	....	SET1V06	SEA11V06	SEA1V06
	60		4	KAL	110	SFG5V06	SFW5V06	SFW15V06	....	SFT5V06	SFA15V06	SFA5V06
	75				125	SFG3V06	SFW3V06	SFW13V06	....	SFT3V06	SFA13V06	SFA3V06
	100				200	SFG4V06	SFW4V06	SFW14V06	....	SFT4V06	SFA14V06	SFA4V06
	125		5	LAL	225	SGG3V06	SGW3V06	....	....	....	SGA13V06	SGA3V06
	150				250	SGG1V06	SGW1V06	....	....	....	SGA11V06	SGA1V06
	200				350	SGG2V06	SGW2V06	....	....	....	SGA12V06	SGA2V06
	250		6	MAL	450	SHG4V06	SHW4V06	....	....	....	SHA14V06	SHA4V06
	300				600	SHG3V06	SHW3V06	....	....	....	SHA13V06	SHA3V06
	350				600	SHG5V06	SHW5V06	....	....	....	SHA15V06	SHA5V06
	400				800	SHG7V06	SHW7V06	....	....	....	SHA17V06	SHA7V06
575 (600)	5	600–60 550–50	0	FAL	15	SBG2V07	SBW2V07	SBW12V07	SBR2V07	SBT2V07	SBA12V07	SBA2V07
	7½		1	FAL	15	SCG8V07	SCW8V07	SCW18V07	SCR8V07	SCT8V07	SCA18V07	SCA8V07
	10				20	SCG3V07	SCW3V07	SCW13V07	SCR3V07	SCT3V07	SCA13V07	SCA3V07
	15		2	FAL	35	SDG8V07	SDW8V07	SDW18V07	SDR8V07	SDT8V07	SDA18V07	SDA8V07
	20				45	SDG9V07	SDW9V07	SDW19V07	SDR9V07	SDT9V07	SDA19V07	SDA9V07
	25				60	SDG4V07	SDW4V07	SDW14V07	SDR4V07	SDT4V07	SDA14V07	SDA4V07
	30		3	FAL	60	SEG4V07	SEW4V07	SEW14V07	....	SET4V07	SEA14V07	SEA4V07
	40				80	SEG6V07	SEW6V07	SEW16V07	....	SET6V07	SEA16V07	SEA6V07
	50				90	SEG3V07	SEW3V07	SEW13V07	....	SET3V07	SEA13V07	SEA3V07
	60		4	FAL	100	SFG6V07	SFW6V07	SFW16V07	....	SFT6V07	SFA16V07	SFA6V07
	75			KAL	110	SFG5V07	SFW5V07	SFW15V07	....	SFT5V07	SFA15V07	SFA5V07
	100			KAL	150	SFG1V07	SFW1V07	SFW11V07	....	SFT1V07	SFA11V07	SFA1V07
	125		5	KAL	200	SGG7V07	SGW7V07	....	....	....	SGA17V07	SGA7V07
	150			LAL	200	SGG6V07	SGW6V07	....	....	....	SGA16V07	SGA6V07
	200			LAL	250	SGG1V07	SGW1V07	....	....	....	SGA11V07	SGA1V07
	250		6	MAL	350	SHG6V07	SHW6V07	....	....	....	SHA16V07	SHA6V07
	300				400	SHG4V07	SHW4V07	....	....	....	SHA14V07	SHA4V07
	350				500	SHG2V07	SHW2V07	....	....	....	SHA12V07	SHA2V07
	400				600	SHG3V07	SHW3V07	....	....	....	SHA13V07	SHA3V07

‡ NEMA Size 6 starters are NEMA Type 4 painted sheet steel enclosures.
★ **NEMA Type 7 & 9 Bolted are not UL Listed.**
▲ NEMA Type 12 enclosures may be field modified for outdoor non-corrosive and non-service-entrance-rated applications; see Page 17 for more information.
✱ Coil voltage code must be specified to order this product. Refer to standard coil voltage codes listed in selection table above or additional standard voltage codes shown below.

Coil Voltage Codes

Voltage 60 Hz	Voltage 50 Hz	Code
24†▲	. . .	V01
120†	110	V02
208	. . .	V08
240	220	V03
480	440	V06
600	550	V07
Specify	Specify	V99

▲ 24V coils are not available on Sizes 4-7. On Sizes 00-3, where 24V coils are available, **Form S** (separate control) must be specified.
† These voltage codes must include **Form S** (supplied at No Charge).

Control Circuit Transformers

Space and drilling are provided in all combination starters, in NEMA Types 1, 4 & 4X stainless and 12 enclosures, for the field addition (or factory installation) of a Class 9070 transformer. For standard control transformer selection in reversing combination starters, see table below. For primary fusing of the control circuit, use of the Class 9999 Type SF4 fuse holder kit is suggested. This kit can be either panel mounted or side mounted on the Type S starter.

Transformer Selection

NEMA Size	Starter Type	Standard Capacity (Form F4T)	50 VA Additional Capacity (Form F4T10)	100 VA Additional Capacity (Form F4T11)	200 VA Additional Capacity (Form F4T12)
		Class 9070 Type	Class 9070 Type	Class 9070 Type	Class 9070 Type
0-2	SB-SD	T100	T300	T300	T300
3	SE	T150	T300	T300	T500
4	SF	T300	T500	T500	T500
5	SG	T300	T500	T500	T500
6	SH	E03S2 is standard	E03S2 and T50	E03S2 and T100	E03S2 and T200

Class 8738 Application Data

NEMA Size	Fuse Clip Type	Enclosure	Amps Interrupting Capability Rating (AIC)
0-3	Standard	Standard*	5,000
0-3	Class R	Standard*	100,000
4-5	Standard	Standard*	10,000
4-5	Class R	Standard*	100,000

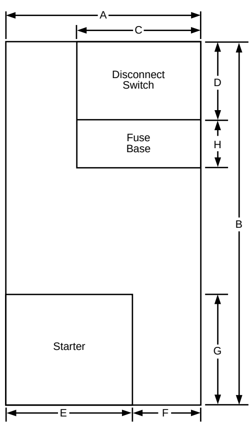
* Standard enclosure includes: NEMA Types 1, 4 & 4X stainless, and 12/3R.

Class 8739 Application Data

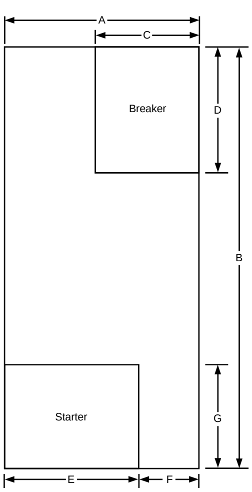
NEMA Size	Voltage	Enclosure	Amps Interrupting Capability Rating (AIC)
MAG–GARD® Motor Circuit Protector Type			
0 & 1, 2 (GJL)	0 – 480	Standard*	100,000
0 & 1 (FAL)	0 – 480	Standard*	22,000
0, 1, 2, & 3 (GJL)	481 – 600	Standard*	10,000
0 & 1	481 – 600	Standard*	10,000
2 – 6	600	Standard*	22,000
Thermal Magnetic Circuit Breaker Type			
0-3	600	Standard*	5,000
4 & 5	600	Standard*	10,000
6	600	Standard*	18,000

* Standard enclosure includes: NEMA Types 1, 4 & 4X stainless, and 12.

Panel Layout



Class 8738



Class 8739

Panel Layout Drawings
NEMA Type 1, 4 & 4X Stainless 6, 12

Class	NEMA Size	Dimensions in Inches A	B	C	D	E	F	G	H
8738	0, 1	10¾	19	6.9	6½	7¼	3½	9	4
8739				6½	7.9				–
8738	2	12	24	7½	7.0	7¾	4¼	9 11/32	6
8739				7	8.8				–
8738	3	15½	32½	9	7.7	15½	0	14	5 5/16
8739				8¼	8½				–
8738	4	18	39	11½	20½	18	0	17	–
8739		15½	32½	9¼	10½	15	0	15	
8738	5*	27	59	26	25.0	21	6	21	–
8739		27	58	KAL: 6.8 LAL: 9	KAL: 23 LAL: 24½	21	6	21	–
8739	6	32	82	LAL: 9 MAL: 12½	LAL: 26 MAL: 27½	22½	9½	36	–

* Size 5 combination starter does not contain a full size panel. No usable panel space is available.

Reversing Combination Starters – NEMA Rated
Class 8738, 8739 – Approximate Dimensions

NEMA Type 1 Enclosure (Size 0 - 2)

NEMA Size	Class	Type	Dimensions (in inches)∗ – see Figure 1																Top & Bottom		Sides	Wt. (Lbs.)
			A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	W	X	Y	
0-1	8738 & 8739	SBG SCG	13¾	23	8 11/32	10⅝	21	18 29/32	1⅞	1⅞	3¾	2 5/16	1 1/16	3¼	2 3/16	1¼	⅞	. . .	½-¾-1	½-¾-1	½	49
2	8738 & 8739	SDG	15	28¾	9 19/32	11⅝	26¼	21 15/32	2 3/16	2	4	2 9/16	1¼	3¼	2 3/16	1¼	29/32	. . .	1-1¼	1-1¼	½	80

NEMA Type 1 Enclosure (Size 3 - 6)

NEMA Size	Class	Type	Dimensions (in inches)∗ – see Figure 2																Top & Bottom		Sides	Wt. (Lbs.)
			A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	W	X	Y	
3	8738 & 8739	SEG	18½	44	10 19/32	12½	3	25 31/32	43½	¼	. . .	2 13/16	3½	5	2 11/16	5⅜	1 7/32	29/32	1-1¼ 2-2¼	½-¾	½	245
4	8738	SFG	21	51½	10 17/32	15	3	30 23/32	51	¼	. . .	2 13/16	3½	5	2 11/16	5⅜	1 7/32	29/32	2½	½-¾	½	. . .
	8739	SFG	18½	44	10 19/32	12½	3	25 31/32	43½	¼	. . .	2 13/16	3½	5	2 11/16	5⅜	1 7/32	29/32	1-1¼ 2-2¼	½-¾	½	. . .
5	8738	SGG	30	77	15½	22	4	39 13/32	76	½	. . .	3½	6 9/32	9¼	3 3/16	. . .	. . .	. . .	½-¾†	3	. . .	. . .
	8739	SGG	30	65	13 23/32	22	4	39 13/32	64	½	. . .	3½	6 9/32	5	3 3/16	. . .	. . .	. . .	½-¾†	3	. . .	. . .
6	8738 & 8739	SHG	36	90	17 1/32	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .

NEMA Type 12 Enclosure

NEMA Size	Class	Type	Dimensions (in inches)∗ – see Figure 3										Wt. (Lbs.)
			A	B	C	D	E	F	G	H	I	J	
0-1	8738 & 8739	SBA SCA	13¾	10 3/32	24¾	3¼	2½	8¾	24	⅜	3¾	20 5/16	52
2	8738 & 8739	SDA	15	10 31/32	31	3¼	3	9	30¼	⅜	3¾	23 7/16	95
3	8738 & 8739	SEA	18½	10 19/32	45	5	3	12½	44	½	3¾	25 19/32	255
4	8738	SFA	21	10 19/32	52½	5	3	15	51½	½	3¾	30 11/32	. . .
	8739	SFA	18½	10 19/32	45	3¼	3	12½	44	½	3¾	25 19/32	. . .
5	8738	SGA	30	15½	78	9¼	4	22	77	½	7½	39 13/32	. . .
	8739	SGA	30	15½	66	. . .	4	22	65	½	7½	37⅞	. . .
6▲	8739	SHA	36	17 1/32	90	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .

▲ Size 6 enclosures are floor mounting.

NEMA Type 4X Polyester Enclosure♦

NEMA Size	Class	Dimensions (in inches)∗ – see Figure 4					
		Type	A	B	C	E	F
0-2	8738 & 8739	SBW SCW SDW	25.25	11.4	27.00	17.88	25.75
3-4	8739	SEW SFW	26.31	11.4	33.50	18.50	32.25

♦ See Page 12-69 for important information on hubs for NEMA Type 4X enclosures.
∗ The dimensions shown in all tables above are also for **Form F4T** (standard control transformer), **Form F4T11** (100 VA extra-capacity), and **Form F4T12** (200 VA extra-capacity).

NOTE: Illustrations may not represent the actual enclosure; they are intended for dimensional information only.

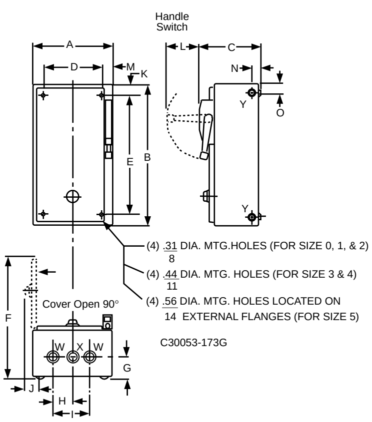


Figure 1:
NEMA Type 1 Enclosure (Sizes 0 - 2)

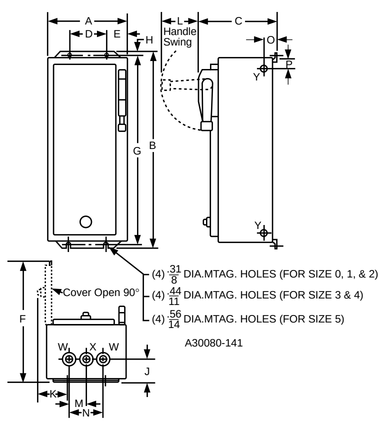


Figure 2:
NEMA Type 1 Enclosure (Sizes 3 - 6)

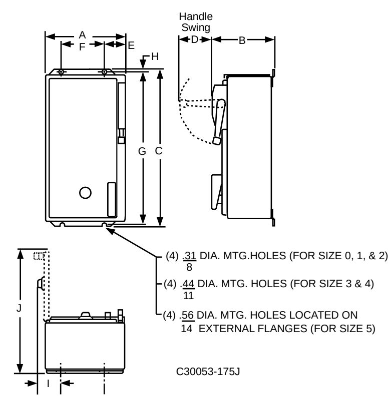


Figure 3:
NEMA Type 12 Enclosure

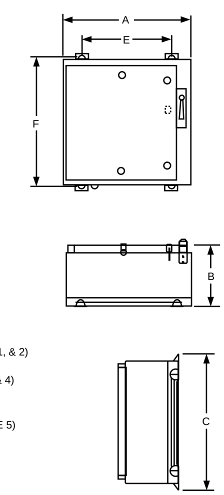


Figure 4:
NEMA Type 4X Polyester Enclosure

NEMA Type 4 & 4X Stainless Enclosure

NEMA Size	Class	Type	Dimensions (in inches)∗ – see Figure 1												Bottom	Top & Bot.	Wt. (Lbs.)
			A	B	C	D	E	F	G	H	I	J	K	L	W	X	
0-1	8738 & 8739	SBW SCW	13¾	8¹¹⁄₃₂	25³⁄₁₆	3¼	2½	8¾	24	¹⁹⁄₃₂	3	1⅝	2⁵⁄₁₆	18¹⁷⁄₃₂	¾ Hub	1 Hub	52
2	8738 & 8739	SDW	15	9¹⁹⁄₃₂	30¹⁄₃₂	3¼	2½	10	29¾	⅝	3	2	2⅝	21¹⁄₃₂	¾ Hub	1½ Hub	95
3	8738 & 8739	SEW	18½	10⁹⁄₁₆	45³⁄₁₆	5	3	12½	44	¹⁹⁄₃₂	3½	2⅝	3³⁄₁₆	25½	¾ Hub	2½ Hub	255
4	8738	SFW	21	10¹⁷⁄₃₂	52¹¹⁄₁₆	5	3	15	51½	¹⁹⁄₃₂	3½	2⅝	3³⁄₁₆	30¼	¾ Hub	2½ Hub	. . .
	8739	SFW	18½	10⁹⁄₁₆	45³⁄₁₆	5	3	12½	44	¹⁹⁄₃₂	3½	2⅝	3³⁄₁₆	25½	¾ Hub	2½ Hub	. . .
5	8738	SGW	30	15½	78³⁄₃₂	9¼	4	22	77	⁹⁄₁₆	6³⁄₃₂	3	3½	39¹³⁄₃₂	¾ Hub	3½ Hub	. . .
	8739	SGW	30	13⁵⁷⁄₆₄	66³⁄₃₂	5	4	22	65	⁹⁄₁₆	6³⁄₃₂	3	3½	37⅞	¾ Hub	3½ Hub	. . .
6	8739	SHW	36	17¹⁄₃₂	98	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .

∗ Above dimensions also for **Form F4T** (standard control transformer), **Form F4T11** (100 VA extra capacity) and **Form F4T12** (200 VA extra capacity).

Class 8739 – NEMA Type 7 & 9 Bolted Enclosure∗

NEMA Size	Type	Dimensions (in inches) – see Figure 2										Wt. (Lbs.)
		G	H	J	K	L	N	P	Q, R	S, T, U, V	Z	
0-1	SBT SCT	14¼	27⅝	9½	12¼	19¼	9⅝	11	2⅜	3⅛	1½	115
2	SDT	18⅛	31⅝	10	16¼	19¼	9⅝	12⅝	2⅜	3¾	2½	180
3-4	SET SFT	24½	45⅝	13¾	22½	27½	13¾	15⅜	3⁷⁄₁₆	4	4	500

∗ Note: Enclosure has 3 door mounted Closing Plates.

Class 8739 - NEMA Type 7 & 9 SPIN TOP® Enclosure

NEMA Size	Type	Dimensions (in inches) – see Figure 3												Wt. (Lbs.)
		E	F	G	H	J	K	L	M	N	P	Q	R	
0-1	SBR, SCR	13⅞	45¼	19¼	8	4¾	5¼	1½	1¹⁄₁₆	7	18	9⅜	2¾	120
2	SDR	13⅜	52½	20¼	8	4¾	7½	2½	-	7¾	23	8⅝	3	130

Information on Hubs

Hubs are supplied with each NEMA Type 4X combination starter as shown in the table below. Note that hubs are only installed in stainless steel enclosures; they are not installed in polyester enclosures.

NEMA Size	Quantity	Hub Size
0 & 1	1 2	0.75" 1.00"
2	1 2	0.75" 1.50"
3 & 4	1 2	0.75" 2.50"

NOTE: Illustrations may not represent the actual enclosure; they are intended for dimensional information only.

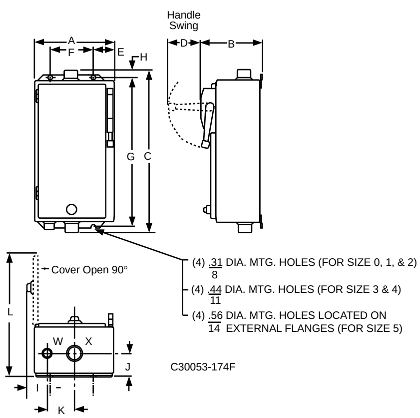


Figure 1:
NEMA Type 4 & 4X Stainless Enclosure

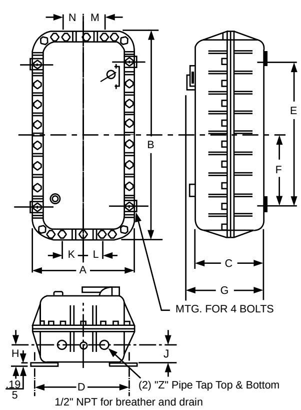


Figure 2:
NEMA Type 7 & 9 Bolted Enclosure

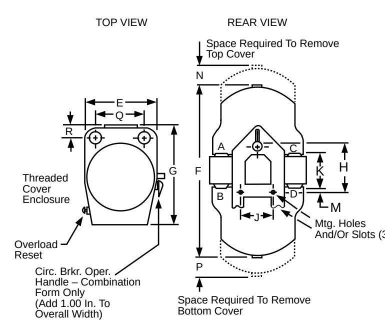


Figure 3:
NEMA Type 7 & 9 SPIN TOP® Enclosure

Factory Modifications (Forms)
For Full Voltage Contactors and Starters

Factory installed modifications are available for the classes of control equipment listed in the respective tables. Prices shown are **additions** to standard equipment prices and are **not** to be used as separate selling prices. Kits are also available for many field modifications and normal parts replacement on most control items. Refer to Classes 9998 and 9999 for complete listings.

Standard equipment dimensions and enclosure construction may not apply when certain special features are added. Such cases should be referred to the factory with complete description when accurate dimensions are required. **Note:** If UL label is required, consult local Square D Field Sales Office. Some forms **are not** UL Listed.

Full Voltage Starters

	Factory Modifications	Enclosure Type	Form Letters
PILOT DEVICES IN COVER Full Voltage Non-Reversing Controllers Only Classes 8538 8539	**Push Buttons ★**		
	“Start-Stop”	1 3R, 4, 4X, 12 7 & 9	A A A
	“Start-Stop” (maintained contact)❻	1, 3R, 4, 4X■, 12	A16
	“Start-Stop” push button and “Hand-Off-Auto” selector switch	1, 3R, 4, 4X■, 12	AC
	“On-Off”	1 3R, 4, 4X■, 12	A3 A3
	Single Oiltight Pushbutton (specify marking)	1, 3R, 4, 4X■, 12	A11
	Selector Switches		
	“Hand-Off-Auto”	1 3R, 4, 4X, 12 7 & 9	C C C
	“On-Off”	1 3R, 4, 4X■, 12 7 & 9	C6 C6 C6
	Key Operated Selector Switch (specify marking and Key withdrawal position/code)	1, 3R, 4, 12	C33
	NON-STANDARD markings for Pilot Devices	1, 3R, 4, 12	G12▼
	Addition of padlock attachment to Class 9001 operators	1, 3R, 4, 12	G122
	Pilot Lights (specify color/type) ▲		
	Without Operating Interlock: Per light Per light Push-to-test (each)	 1, 3R, 4, 4X, 12 7 & 9♦ 1, 3R, 4, 4X■, 12	 P▲ P▲ P▲
	With Operating Interlock: Add price of each interlock per light	1, 3R, 4, 4X■, 12	X✱
PILOT DEVICES IN COVER Full Voltage Reversing and Multi-Speed Controllers Only Classes 8738 8739	**Push Buttons ★**		
	“Forward-Reverse-Stop”	1, 4, 4X■, 12	A1
	“High-Low-Stop”	1, 4, 12	A2
	“Fast-Off-Slow”	1, 4, 12	A9
	“High-Low” push button and “Hand-Off-Auto” selector	1, 4, 12	A10C
	Single Oiltight Pushbutton (specify marking)	1, 4, 4X■, 12	A11
	Selector Switches		
	“Hand-Off-Auto”	1, 4, 4X■, 12 7 & 9	C C
	“On-Off”	1, 4, 4X■ 7 & 9	C6 C6
	“High-Off-Low”	1, 4, 12	C7
	“Forward-Off-Reverse”	1, 4, 4X■, 7, 9, 12	C14
	“High-Low” and “Hand-Off-Auto”	1, 4, 12	CC17
	“Slow-Fast”	1, 4, 4X■, 12	C19
	“Forward-Reverse”	1, 4, 4X■, 12	C20
	“High-Low-Off-Auto”	1, 4, 12	C25
	NON-STANDARD markings for Pilot Devices	Any	G12▼
	Pilot Lights (specify color/type)▲ One Pilot Light: one light with two electrical interlocks. Two Pilot Lights: each light is wired in parallel, no interlocks used		
	Without Operating Interlock: Per light Per light Push-to-test (each)	 1, 4, 4X■, 12 7 & 9♦ 1, 4, 4X■, 12	 P▲ P▲ P▲
	With Operating Interlock: Add price of each interlock per light	1, 4, 4X■, 12	X✱

★ All push buttons are momentary contact unless specified otherwise.
■ This adder, used with a NEMA Type 4X enclosure, applies to Classes 8538, 8539, 8738, 8739.
▲ Indicate pilot light color as Form P1 (red) or Form P2 (green), etc. as shown in the table below. Unless otherwise requested, standard practice is to wire red pilot light to indicate device is energized. No additional auxiliary contact is required. Also, standard practice is to wire green pilot light to indicate device is de-energized. An additional normally-closed auxiliary contact is required. A wiring diagram must be supplied for other pilot light colors and/or arrangements.
♦ Pilot lights available at 120 to 600 volt only.
▼ Specify marking and/or Class 9001 Type KN or Type SKN legend plate required.
† Specify appropriate Class 9001 Type K or SK operator required.
✱ To determine the maximum number of auxiliary contacts which can be added to each Type S device and for the appropriate “X Form”, refer to the tables in the Class 8736 section on Page 12-81 (for reversing or two-speed devices).

Standard Pilot Light Form	Push -to-Test Pilot Light Form	LED Pilot Light	Color
P1	P21	P51	Red
P2	P22	P52	Green
P3	P23	—	Amber
P4	P24	—	Clear
—	P25	P55	Yellow

Full Voltage Controllers Only

Classes 8538, 8539, 8738 and 8739

Factory Modifications		Enclosure Type	Form Letters
CONTROL CIRCUIT FULL VOLTAGE AND MULTI-SPEED CON-TROLLERS ONLY CLASSES 8538 8539 8738 8739	Separate Control Circuit — (specify voltage and frequency)	Any	S★
	Fused Control Circuit (without control transformer)		
	One fuse	1, 3R, 4, 4X, 12	F
	Two fuses	1, 3R, 4, 4X, 7, 9, 12	F4
	Control Circuit Transformers■		
	Standard capacity (50 or 60 Hz)		
	NOTE: All orders requesting Form FT will be supplied as Form F4T.		
	FUSES: Primary / Secondary		
	2 / 0	1, 4, 4X, 12	F4T□
	2 / 0	7 & 9	F4T□
	1 / 1‡	1, 4, 4X, 12	FF1T
	2 / 1	1, 4, 4X, 12	FF4T
	2 / 1	7 & 9	FF4T
	1 / 2‡	1, 4, 4X, 12	F1F10T
	2 / 2	1, 4, 4X, 12	F4F10T
	Additional Capacity (50 or 60 Hz)		
	Two fuses in primary		
	100 VA additional capacity	1, 4, 4X, 12	F4T11◑
	100 VA additional capacity	7 & 9	F4T11◑
	200 VA additional capacity	1, 4, 4X, 12	F4T12◑
	Two fuses in primary and one fuse in secondary		
	100 VA additional capacity	1, 4, 4X, 12	FF4T11
	100 VA additional capacity	7 & 9	FF4T11
	200 VA additional capacity	1, 4, 4X, 12	FF4T12
	300 VA additional capacity	1, 4, 4X, 12	FF4T13
	400 VA additional capacity	1, 4, 4X, 12	FF4T14
	500 VA additional capacity	1, 4, 4X, 12	FF4T15
	Substitute non-standard single primary, and/or single secondary voltage rating on control transformer■	Any	T1▼
	Substitute dual-voltage magnet coil.	Any	Y5†

★ All combination style devices such as 8538, 8539, 8738, 8739, that use Form S should also use Form Y74 (auxiliary contact installed on disconnect switch) per NEC Article 430-74.
■ Table at right.
▲ **Single** primary voltage must be specified.
▼ Must be used with another form of F4T. (Ex. Standard capacity transformer required, 208-24V. Order as Form F4TT1, 208-24V.)
† Not available on Size 2 or Size 3 devices with 4 or 5 poles.
∗ Not available on this Size. Select appropriate transformer with secondary fuse protection.
□ Not available with 24V secondary on Size 3. Select appropriate transformer with secondary fuse protection. See Table at right for 24V secondary restrictions.
◑ Not available with 24V secondary. Select appropriate transformer with secondary fuse protection. See Table at right for 24V secondary restrictions.
‡ Single phase with one leg grounded or grounded B phase applications ONLY.

■Selection of Control Circuit Transformers

The standard primary/secondary voltages for control circuit transformers are indicated in the following table.

AC-OPERATED DEVICES With Control Transformers

Voltage 60Hz (Primary–Secondary)	Code
120–12▲	V88
120–24▲	V89
208–120	V84
240–24▲	V82
240–120	V80
277–120	V85
480–24▲	V83
480–120	V81
480–240	V87
600–120	V86
Specify	V99

▲ 12V coils are not available on Sizes 3-7. 24V coils are not available on Sizes 4-7.

To order, select the desired device with the appropriate transformer form designation. Then convert the previously selected voltage code (V_ _) to reflect the desired primary/secondary voltage for the transformer. The secondary voltage should equal the previously selected coil voltage of the device.

Example:

You have previously selected a Class 8536SDG1V02S. V02S means that you need a coil voltage of 120-60/110-50 wired for separate control. You would like to add form FF4T with the transformer voltages being 48 volt primary, 120 volt secondary with Solid State Overload Relay Protection Class 20 Trip Class (H20).

The new and complete class, type, voltage code and form number will be:

Class	Type	Voltage Code	Form∗
8536	SDG1	V81	FF4TH20

∗ Form numbers should always be shown in alphabetical order.

Marine Control

Class	Factory Modification	Enclosure Type	Form
8538 8539 8738 8739	Modification of standard device for use as marine control per UL508	12/3R 4/4X (S.S. only)	M10
	Modification of standard device for use as marine control like Form 10 standards in addition to IEEE45.	12/3R 4/4X (S.S. only)	M11

Factory Modifications (Forms)
For Full Voltage Contactors and Starters

Full Voltage Controllers Only

CLASSES 8538, 8539, 8738 and 8739			
Factory Modifications		**Enclosure Type**	**Form Letters**
OVERLOAD RELAYS	**Non-Compensated Bimetallic Overload Relays**		
	Single Phase:		
	Types SB–SD (Sizes 0–2)②	Any	B1
	Polyphase:		
	Two Element — For 2 Phase Only		
	Types SB–SD (Sizes 0–2)	Any	B1
	Three Element		
	Types SB–SD (Sizes 0–2)	Any	B2
	Types SE–SF (Sizes 3–4)	Any	B5
	Type SG (Size 5)	Any	B2Y500
	Type SH (Size 6)	Any	B2
	Ambient Compensated Bimetallic Overload Relays		
	Three Element		
	Types SB–SD (Sizes 0–2)	1, 4, 7, 9, 12	2B
	Types SE–SF (Sizes 3 & 4)	Any	Y59
	Type SG (Size 5)	Any	BY500
	Type SH (Size 6)	Any	B
	Overload Relays – General		
	Substitute Class 9065 SSRO100 For Standard Overload Protection	Any	B11
	Omit overload protection from combination starters. (Classes 8538, 8539, 8738, 8739 only) Do not use with MAG–GARD® Circuit Breakers. Deduct per starter.	Any	Y76
	Modify Size 3 Type SE starters with melting alloy overload relays to accept Type FB quick trip or SB slow trip thermal units and Size 4 Type SF starters to accept Type FB quick trip thermal units. (Rejects Type CC standard trip thermal units.)	Any	Y81
	Substitute 9999 SO4 isolated alarm contact (N.O.) on melting alloy overload relay	Any	Y342
	Substitute 9999 SO5 isolated alarm contact (N.C.) on melting alloy overload relay	Any	Y344

① Size 7 uses a solid state overload relay as standard. See Class 8536 for complete details.
② Single phase bimetallic overload relays for Type S Sizes 0–2 require **two** (2) thermal units per starter.
③ For Classes 8736, 8738 and 8739, Type SG, consult Local Square D Field Office.

Solid State Overload Relay Factory Modifications (Forms)

The solid state overload relay is available on NEMA Size 00-7.
For Class 8536, 8538, 8539, 8736, 8738, 8739 and 8810 devices.

Form Description

Type S Starter with Motor Logic
Solid State Overload Relay
1 - Motor Logic, Base Unit, Trip Class 10
2 - Motor Logic, Base Unit, Trip Class 20
3 - Motor Logic, Feature Base Unit
0 - No additional modifications
1 - N.O. Aux. Contact (Field Convertible to N.C.)
Special Overload/Contactor Size Combinations (Base Unit & Feature Base Units):
(Must Be Specified On Size 00 Starter Orders)
Blank -Overload Matched to Starter Size (i.e. Size 1 contactor & 9-27A overload)
0 - A 6 – 18A overload on a starter size as indicated by the Starter Catalog Number
1 - A 9 – 27A overload on a starter size as indicated by the Starter Catalog Number
2 - A 15 – 45A overload on a starter size as indicated by the Starter Catalog Number
3 - A 30 – 90A overload on a starter size as indicated by the Starter Catalog Number
4 - A 45 – 135A overload on a starter size as indicated by the Starter Catalog Number
8 - A 1.5 – 4.5A overload on a starter size as indicated by the Starter Catalog Number (only offered on Feature Base Units)
9 - A 3 – 9A overload on a starter size as indicated by the Starter Catalog Number

SPECIAL NOTE FOR Class 8810 devices:
You MUST SPECIFY TWO SEPARATE FORM NUMBERS TO GET MOTOR LOGIC OVERLOADS ON TWO SPEED STARTERS. The first form number is for the low speed winding and the second is for the high speed winding.
EXAMPLE: Open Style, Size 4 Two Speed Starter with Motor Logic Overloads Required.
Single Winding, 460V, Constant Horsepower
High Speed FLA = 96A
Low Speed FLA = 27A (use Size 2 Overload)
Catalog Number to Order: 8810 SF01V02 form S H20 H202
Where: Form H20 is a Size 4 Contactor with a 45-135A Motor Logic Overload for the High Speed and form H202 is a 15-45A Motor Logic Overload on the low speed contactor.

Classes 8538, 8539, 8738 and 8739

Factory Modifications		Form
Motor Logic Solid State Overload	Base Unit, Trip Class 10	H10
	Base Unit, Trip Class 20	H20
	Feature Base Unit	H30
Motor Logic Solid State Overload with Auxiliary Contact	Base Unit, Trip Class 10	H11
	Base Unit, Trip Class 20	H21
	Feature Base Unit	H31

Special Starter Combinations with Motor Logic™ Overload Relay Protection

NEMA Contactor Size	Solid State Overload Relay Size							NEMA Contactor Size	Solid State Overload Relay Size						
	00B	00C	0	1	2	3	4		00B	00C	0	1	2	3	4
00	▲	Std.						2	▲	▲	▲	▲	Std.		
0	▲	▲	Std.					3	n/a	n/a	n/a	n/a	n/a	Std.	
1	▲	▲	▲	Std.				4	n/a	n/a	n/a	n/a	n/a	▲	Std.

▲ Possible factory starter combinations available.

Full Voltage Controllers Only

CLASSES 8538, 8539, 8738, 8739 and 8810			
Factory Modifications		**Enclosure Type**	**Form Letters**
POWER POLES	Addition of one NEMA Size 1, 30 Amp single pole N.O. unit	Any	Y428
	Addition of one NEMA Size 1, 30 Amp single pole N.C. unit	Any	Y429
	Addition of one NEMA Size 1, 30 Amp double pole N.O./N.O. unit	Any	Y430
	Addition of one NEMA Size 1, 30 Amp double pole N.C./N.C. unit	Any	Y434
	Addition of one NEMA Size 1, 30 Amp double pole N.O./N.C. unit	Any	Y435
	Addition of one NEMA Size 2 single pole N.O. unit	Any	Y436
	Addition of one NEMA Size 2 single pole N.C. unit	Any	Y437
	Addition of one NEMA Size 2 double pole N.O./N.O. unit	Any	Y438
	Addition of one NEMA Size 2 double pole N.C./N.C. unit	Any	Y439
	Addition of one NEMA Size 2 double pole N.O./N.C. unit	Any	Y440
MISCELLANEOUS	Coil transient suppressor (120 Volt only). Per Coil	Any	Y145
	Addition of terminal blocks (specify wired or unwired).		
	Wired, per terminal. Each	1, 4, 12	G50★
	Unwired, per terminal. Each	1, 4, 12	G50★

★ Addition of terminal block type 9080 CA or 9080 GR6 only. Number of circuits is same as ending of form number. (Ex.: G507 is 7 wire terminal block.)
■ When adding a power pole to a Size 2 device, it is necessary to also specify **Form Y118.**

MAG-GARD®

Circuit Breaker	Factory Modifications	Enclosure Type	Form Letters
8539 8739	Substitute FAL for GJL circuit breaker. (Note that the GJL breaker must be used with the SSOLR.)	1 4, 4X 12	Y534

Full Voltage and Reduced Voltage Controllers★

CLASSES 8538, 8539, 8738 and 8739			
Factory Modifications		Enclosure Type	Form Letters
Auxiliary Relays	Control relay (1 thru 4 poles) — specify pole arrangement, voltage and type required♦	1, 12 4, 4X✱, 9	R17‡ R17‡
	Pneumatic Timing Relay – specify Class 9050 Type A or B, "On" or "Off" delay and wiring instructions.		
	0.2 Sec. to 1.0 Min.	1, 12 4, 4X✱, 7, 9	K K
	1.0 Min. to 3.0 Min.	1, 12 4, 4X✱, 7, 9	K16 K16
	Solid State Timing Relay (specify timing range) and timer (120V control req'd.)	1, 4, 4X, 7, 9, 12	K1
	Pneumatic Timing Attachment — 0.2 sec. to 1.0 min.		
	Addition of Class 9999 Type SK3 (off delay) attachment	1, 4, 4X✱, 12	K36
	Addition of Class 9999 Type SK4 (on delay) attachment.	1, 4, 4X✱, 12	K35
	Motor driven timing relay♦▼	1, 4, 12	K5
	Phase Failure and Reverse Phase Relay▼	1, 4, 12	Y444
	Undervoltage Relay▼	1, 4, 12	Y447
	Overvoltage Relay▼	1, 4, 12	Y448
	Under and Overvoltage Relay▼▲	1, 4, 12	Y449
Meters And Metering■	Ammeter in cover (includes current transformer if req'd.)	1, 12	G91
	Ammeter and switch with two current transformers	1, 12	G92
	Ammeter and switch with three current transformers	1, 12	G93
	Voltmeter mounted	1, 12	G94
	Voltmeter and switch mounted	1, 12	G95
	Elapsed time meter	1, 12	G97
	Operation counter	1, 12	G99
	Wattmeter	1, 12	G911
	Varmeter	1, 12	G913
	Power factor meter	1, 12	G914
Auxiliary Contacts	Additional starter (contactor) auxiliary contacts (Specify number of additional normally open or closed contacts required per contactor.) Each	Any	X†
	Auxiliary contacts installed on disconnect switch or circuit breaker operating mechanism.		
	SPDT	1, 4, 4X, 12	Y74
	DPDT	1, 4, 4X, 12	Y75
	(Note: Above contacts do not switch with automatic tripping of circuit breaker. If such operation is required, consult your local Square D field office.)		
Enclosures	Space heater with N.C. auxiliary contact	1, 4, 4X, 12	G51
	Function identification plate, with marking as specified.	Any	G11
	Convenience receptacle (2-wire) mounted in side of enclosure	1, 12	Y31
	Drain and breather installed	7 & 9	Y41
	Cover gaskets added to NEMA Type 1 enclosures:		
	For Classes 8538 and 8539	1	Y47
	For Classes 8738 and 8739	1	Y47
	For other full voltage controllers	1	Y47
	For reduced voltage controllers	1	Y47

♦ If controller has a control transformer, price that transformer with additional capacity for the relay provided.
✱ This adder, used with a NEMA Type 4X enclosure, applies only to Classes 8538, 8539, 8738, 8739 and 8810 non-reversing.
▼ Specify control and line voltage.
■ Motor HP and voltage required when placing order. Meters will be panel mounted in NEMA Type 12 enclosures.
† To determine the maximum number of auxiliary contacts which can be added to each Type S device and for the appropriate "X Form", refer to the tables in the Class 8536 section on Page 12-29 (for non-reversing single-speed devices) or the Class 8736 section on Page 12-81 (for reversing or two-speed devices). For Class 8600 Reduced Voltage controllers, consult local Square D Field Office.
‡ Addition of control relay one (1) thru eight (8) poles. Number of poles is same as ending of form number. (Ex: R174 = 4 pole relay).
★ NEMA Type 7 & 9 enclosures not available with Class 8600 devices.
▲ For single phase applications only.

Selection of Control Circuit Transformers

The standard primary/secondary voltages for control circuit transformers are indicated in the following table.

Voltage 60 Hz (Primary–Secondary)	Code
120-12	V88
120-24	V89
208-120	V84
240-24	V82
240-120	V80
277-120	V85
480-24	V83
480-120	V81
480-240	V87
600-120	V86
Specify	V99

To order, select the desired device with the appropriate transformer form designation. Then convert the previously selected voltage code (V__) to reflect the desired primary/secondary voltage for the transformer. The secondary voltage should equal the previously selected coil voltage of the device. (24Vac coils for NEMA Sizes 4-7 are not available).

Example:

You have previously selected a Class 8606SDG1V02S. V02S means that you need a coil voltage of 120-60/110-50 wired for separate control. You would like to add **Form FF4T** with the transformer voltages being 480 volt primary, 120 volt secondary.

The new and complete class, type, voltage code and form number will be:

Class	Type	Voltage Code	Form∗
8606	SDG1	V81	FF4T

∗ Form numbers should always be shown in alphabetical order.

An electrical interlock may also be factory installed in either a disconnect switch or circuit breaker combination starter. Specify **Form Y74** for single pole, or **Form Y75** for two pole interlocks. For pricing see factory modifications (FORMs).

INTERLOCKS AND CONTROL TRANSFORMERS

A one or two pole electrical interlock can be added to the disconnect switch or circuit breaker. Thus if a separate control circuit is used, the magnetic starter can be de-energized when the disconnect is switched to the OFF position. See Table 1 for proper interlock selection. For electrical ratings of disconnect and circuit breaker interlocks, see Table 2 below.

Table 1: Disconnect Switch and Breaker Interlocks

Class	Type	Class 9999 SPDT Type	Class 9999 DPDT Type
8538	SB‡, SC‡, SD‡ (Series B)	R6	R7
8538 & 8738	SD (Series C)	R43	R44
	SB, SC (Series C)	R45	R46
	SE, SF (Series A)	R8	R9
	SE (Series B & C)	R41	R42
	SF (Series B & C)	R39	R40
	SG	R35	R36
8539, 8739	SB, SC, SD, SE, SF, SG▲	R26	R27
8538	SBA, SCA, SBG, SCG (Series D)	TC11	TC21
8538	SBAS8, SCAS8, SBGS8, SCGS8 (Series D)	TC10	TC20
8738	SBAS8, SCAS8, SBGS8, SCGS8 (Series E)	TC10	TC20
8738	SBA, SCA, SBG, SCG (Series E)	TC11	TC21
8538	SDA, SDA‡, SDG, SDG‡ (Series D)	TC10	TC20
8738	SDA, SDG (Series E)	TC10	TC20
8538, 8738	SEA, SEG (Series D)	TC10	TC20

▲ No interlocks available for the GJL circuit breaker.
‡ Class 8538 type numbers ending in suffix "S8".

Table 2: Disconnect Switch and Breaker Interlock Electrical Ratings

Class 9999 Type R6, 8, 26, 35, 39, 41, 43, 45, TC10, & TC11				Class 9999 Type R7, 9, 27, 36, 40, 42, 44, 46 & TC 20, 21					
AC – 50 or 60 Hz				AC – 50 or 60 Hz					
Volts	Maximum Current Make Amps	Maximum Current Break Amps	Continuous Carrying Current Amps	Volts	Maximum Current Make Amps	Make VA	Break Amps	Break VA	Continuous Carrying Current Amps
120	40	15	15	120	30	3450	3	345	10
240	20	10	15	240	15	3450	1.5	345	10
480	10	8	15	480	7.5	3450	.75	345	10
600	8	6	15	600	6	3450	.6	345	10

Table 3: Control Transformer Selection (8538 and 8539 only)

NEMA Size	Starter Type	Standard Capacity (Form F4T) Class 9070 Type	50 VA Additional Capacity (Form F4T10) Class 9070 Type	100 VA Additional Capacity (Form F4T11) Class 9070 Type	200 VA Additional Capacity (Form F4T12) Class 9070 Type
0 & 1	SB & SC	T50	T100	T150	T300♦
2	SD	T100	T150	T300●	T300●
3	SE	T150	T150	T300	T500
4	SF	T300	T300	T500	T500
5	SG	T50 and 8501XO20	T100 and 8501XO20	T150 and 8501XO20	T300 and 8501XO20
6	SH	EO3S2 is standard	EO3S2 and T50	EO3S2 and T100	EO3S2 and T200
7	SJ	EO19S2 is standard	EO19S2 and T50	EO19S2 and T100	EO3S2 and T200

♦ Requires oversized enclosure. (Size 2 reversing enclosure.)
● Available in standard enclosure with MAG-GARD® circuit breaker and non-fusible disconnect switch. Requires oversized enclosure with thermal-magnetic circuit breakers and fusible disconnect switches. (Size 2 reversing enclosure.)

Transformer

File E61239
CCN XPTQ
Above 250 VA also XPTQ7

File LR37055
Class 5411 06

Internal Auxiliary Switch – Circuit breakers can be supplied with a factory installed auxiliary switch for remote indication of an open and/or tripped or a closed breaker. One (specify **Form Y741**) or two (specify **Form Y751**) auxiliary switches can be supplied. The switches are supplied with normally open and normally closed circuits with a common connection. Contacts must be used on the same polarity and are rated 15 Amps at 240 volts AC. The auxiliary switches are located internally and are furnished with 19-20 inch long leads.

Alarm Switch – The alarm switch only operates when the breaker is tripped. It is used to actuate bell alarms and warning lights. The alarm switch is factory installed only (specify **Form Y742**) and consists of a single pole single throw switch which is normally open except when the breaker is tripped. The contacts are rated 4 Amps at 240 volts AC. This switch is located in the breaker and is supplied with 19-20 inch long leads.

Transformer Selection – Space and drilling are provided in all disconnect switch and circuit breaker combination starters in NEMA Type 1, 4 & 4X stainless and polyester, 12 and 7 & 9 bolted enclosures for the field addition (or factory installation) of a Class 9070 control circuit transformer and Class 9999 Type SFR4 fuse holder. This kit can be either panel mounted or side mounted on the Type S starter. For standard control transformer selection in combination starters, see Table 3. Consult field office for transformer additions to NEMA Type 7 & 9 SPIN-TOP® enclosures.

Fuse Block Mounting Brackets – The standard capacity transformer, Class 9070 Type T50, for the Size 0 and 1 starters mounts to the right of the magnetic starter.

Standards – Most combination starters and forms are UL Listed in file E152395, Category NKJH. Many combination starters have or are pending CSA Approval for File CR 584.

Square D Company
Highway 64 East
Knightdale, NC 27545 USA
(919) 266-3671

Shop Drawings
Contractor Approval
Approved by: S.B.S., G. F.
Date: Apr 28, 2015
SIFEC NORTH INC

Disjoncteur PowerPact

Disjoncteur MCP
Tripolaire polyphasé– 600 volts CA maximum – 50 ou 60 Hertz

8539 SCG

Unités thermiques – Les prix indiqués n'incluent pas les unités thermiques. Les démarreurs combinés exigent 3 unités thermiques (calibres 00 à 6). Les unités de déclenchement thermiques standard sont **$ -** chacune. Voir les tableaux de sélection aux pages 1-117 - 1-138.

Type pleine tension, non inverseur avec relais de surcharge thermiques

Valeurs nominales				NEMA 1 Coffret d'usage général		NEMA 4 et 4X Coffret étanche à l'eau, antipoussière acier inoxydable (304) (calibres 0 à 5)		NEMA 4X Coffret en polyester étanche à l'eau, antipoussière et résistant à la corrosion		NEMA 12/3R Coffret à l'épreuve des poussières et des égouttures pour usage industriel		
Tension moteur (tension démar-reur)	H.P. max. (poly-phasé)	Calibre NEMA	Disjoncteur (voir la gamme de réglage du disjoncteur à la page 1-39)	Type	Prix	Type	Prix	Type	Prix	Avec réarmement externe Type	Sans réarmement externe Type	Prix
200 (208)	¼-3	0	HLL36030M71	SBG43*		SBW43*		SBW53*		SBA53*	SBA43*	
	¼-5 7½	1	HLL36030M71 HLL36050M72	SCG44* SCG45*		SCW44* SCW45*		SCW54* SCW55*		SCA54* SCA55*	SCA44* SCA45*	
	1½-5 7½-10	2	HLL36030M71 HLL36050M72	SDG42* SDG43*		SDW42* SDW43*		SDW52* SDW53*		SDA52* SDA53*	SDA42* SDA43*	
	15-25	3	HLL36100M73	SEG42*		SEW42*		SEW52*		SEA52*	SEA42*	
	30-40	4	JLL36250M75	SFG44*		SFW44*		SFW54*		SFA54*	SFA44*	
	50-60 75	5	JLL36250M75 DJL36400M36	SGG44* SGG45*		SGW44* SGW45*		....		SGA54* SGA55*	SGA44* SGA45*	
	100 125-150	6	DJL36400M36 DJL36600M42	SHG43* SHG45*		SHW43* SHW45*		....		SHA53* SHA55*	SHA43* SHA45*	
230 (240)	¼-3	0	HLL36030M71	SBG43*		SBW43*		SBW53*		SBA53*	SBA43*	
	¼-7½	1	HLL36030M71	SCG44*		SCW44*		SCW54*		SCA54*	SCA44*	
	1½-7½ 10 15	2	HLL36030M71 HLL36050M72 HLL36100M73	SDG42* SDG43* SDG44*		SDW42* SDW43* SDW44*		SDW52* SDW53* SDW54*		SDA52* SDA53* SDA54*	SDA42* SDA43* SDA44*	
	15-30	3	HLL36100M73	SEG42*		SEW42*		SEW52*		SEA52*	SEA42*	
	40-50	4	JLL36250M75	SFG44*		SFW44*		SFW54*		SFA54*	SFA44*	
	60 75-100	5	JLL36250M75 DJL36400M36	SGG44* SGG45*		SGW44* SGW45*		....		SGA54* SGA55*	SGA44* SGA45*	
	125-150 200	6	DJL36600M42 PLL34080M68	SHG45* SHG46*		SHW45* SHW46*		....		SHA55* SHA56*	SHA45* SHA46*	
	250-300	7	PLL34100M69	SJG43*		SJW43*		....		SJA53*	....	

Les démarreurs NEMA de calibres 6 et 7 comportent des coffrets en acier peints NEMA de Type 4.

* Le code de tension de la bobine doit être spécifié pour commander ce produit. Voir les codes de tension de bobine standard du tableau ci-dessus ou les codes supplémentaires ci-dessous et insérer comme indiqué dans la case «Pour commander».

Codes de tension de la bobine

Tension		Code	Supplément de prix
60 Hz	50 Hz		
24†▲	. . .	V01	S.F.
120†	110	V02	S.F.
208	. . .	V08	S.F.
240	220	V03	S.F.
480	440	V06	S.F.
600	550	V07	S.F.
Spécifier	Spécifier	V77	✓

† Ces codes de tension doivent comprendre la **Forme S** (aucun supplément).
▲ Les bobines de 24 V ne sont pas livrables avec les calibres 4 à 7. Pour les calibres 00 à 3, si des bobines de 24 V sont disponibles, on doit préciser la **Forme S** (commande séparée).

Modifications en usine (formes) . . . . . . Pages 1-112 — 1-116
Données d'utilisation . . . . Pages 1-34, 1-39
Dimensions . . . . Pages 1-41 — 1-42
Pièces de rechange (Classe 9998) . . . Pages 1-100 — 1-103
Accessoires du type S (Classe 9999) . . Pages 1-104 — 1-111

Pour commander

Préciser :	Exemple :			
● Numéro de classe ● Numéro de type ● Code de tension de la bobine ● Forme(s)	Classe	Type	Code de tension de la bobine	Forme(s
	8539	SBG41	V06	AP1X1

Démarreurs combinés – homologués NEMA

Shop Drawings
Contractor Approval
Approved by: S.B.S., G. F.
Date: Apr 28, 2015
SIFEC NORTH INC

Dimensions approximatives, poids d'expédition

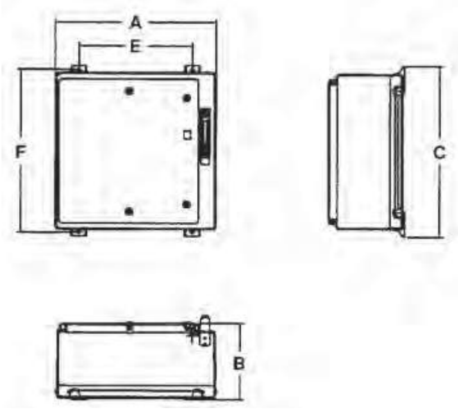


Figure 1
NEMA 4X
Coffret en polyester

Coffret en polyester NEMA Type 4X – Figure 1

Calibre NEMA	Classe	Dimensions en pouces✱					
		Type	A	B	C	E	F
0-1	8538 8539	SBW SCW	13.72	10.5	24.38	6.25	25.75
2	8738 8739	SDW	24.78	12	27.06	17.78	25.75
3-4	8738 8739	SEW SFW●	25.81	12	33.50	18.50	32.25

✱ Les dimensions conviennent aussi à la **Forme F4T** (transformateur de commande standard), à la **Forme F4T11** (capacité supérieure 100 VA) et **Forme F4T12** (capacité supérieure 200 VA).
● 8539 calibre 4 seulement.

Les manchons sont fournis avec chaque démarreur combiné NEMA Type 4X en coffret en polyester comme suit : (non installés)

Calibre NEMA	Quantité	Diam. du manchon
0 et 1	1 2	¾" 1"
2	1 2	¾" 1½"
3 et 4	1 2	¾" 2½"

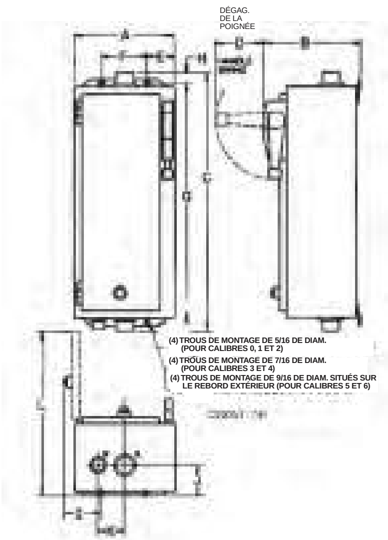


Figure 2
Coffret en acier inoxydable
NEMA Types 4 et 4X

Coffrets en acier inoxydable NEMA Types 4 et 4X – Figure 2

Calibre NEMA	Classe	Type	Dimensions en pouces✱												Fond	Dessus et fond	Poids (lb)
			A	B	C	D	E	F	G	H	I	J	K	L	W	X	
0-1	8538 et 8539	SBW SCW	9½	8¹¹⁄₃₂	24¹⁄₁₆	3¼	2½	4½	23½	¹⁹⁄₃₂	3¹⁄₃₂	1⁵⁄₁₆	2⁵⁄₁₆	14⁹⁄₃₂	¾ manchon	1 manchon	40
2	8538 et 8539	SDW	10½	9¹⁹⁄₃₂	27¾	3¼	2½	5½	27	¹⁹⁄₃₂	3	2	2⅝	16¹⁷⁄₃₂	¾ manchon	1½ manchon	55
3■	8538 et 8539	SEW	15¼	10¹⁹⁄₃₂	42	5	3³⁄₁₆	10¼	40½	¹⁹⁄₃₂	3	2⁹⁄₁₆	3³⁄₁₆	22³⁄₁₆	¾ manchon	2½ manchon	111
4	8538	SFW	16	10¹⁷⁄₃₂	52½	5	3⁹⁄₁₆	11	51	¹⁹⁄₃₂	3	2⁹⁄₁₆	3³⁄₁₆	22¹³⁄₃₂	¾ manchon	2½ manchon	158
	8539	SFW	16	10¹⁷⁄₃₂	52½	3¼	2½	11	51	¹⁹⁄₃₂	3	2⁹⁄₁₆	3³⁄₁₆	22¹⁵⁄₃₂	¾ manchon	2½ manchon	120
5	8538	SGW	20	13²³⁄₃₂	78	9¼	4	12	77	⁹⁄₁₆	4½	3	3½	29¹⁵⁄₃₂	¾ manchon	3½ manchon	. . .
	8539	SGW	20	13²³⁄₃₂	66	5	4	12	65	⁹⁄₁₆	4½	3	3½	29¹³⁄₃₂	¾ manchon	3½ manchon	440
6▲	8538 et 8539	SHW	36	17	90	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	47⅞	. . .	. . .	. . .

✱ Les dimensions conviennent aussi à la **Forme F4T** (transformateur de commande standard), à la **Forme F4T11** (capacité supérieure 100 VA) et **Forme F4T12** (capacité supérieure 200 VA).
▲ Les coffrets de calibre 6 sont montés sur le plancher.
■ Les dispositifs de classe 8538 calibre 3, avec pinces à fusibles de 200 A ont les dimensions du modèle de classe 8538 calibre 4.

Pour convertir : po en mm, multiplier par 25.4
lb en kg, multiplier par 0.454

Démarreurs combinés – homologués NEMA

Données d'utilisation

Classe 8538 Type à sectionneur

Classe 8539 Type à protecteur de circuits de moteur PowerPact®

Généralités – Les démarreurs combinés du type S des classes 8538 et 8539 allient les protections de surcharge et de court-circuit des moteurs en un seul module pratique. Les démarreurs combinés de type S sont fabriqués conformément aux normes NEMA, sont homologués UL et CSA. Les démarreurs combinés des classes 8538 et 8539 sont conçus pour un fonctionnement à 600 volts CA maximum, 50 ou 60 Hertz. Les démarreurs combinés du type S sont normalement offerts avec des relais de surcharge à éléments en alliage fusible.

Coordination de type 2

Schneider Electric est un leader en Amérique du Nord et en Europe pour la fourniture de démarreurs dont la conformité avec la norme 947-4-1 de la série et la coordination de Type 2 sont vérifiés par les UL et la CSA. Ainsi, les composants du circuit d'artère de moteur, le dispositif de protection contre les courts-circuits (fusibles ou disjoncteurs), le contacteur et le relais de surcharge pourront être utilisés suite à une défaillance par court-circuit.

Les démarreurs et les fusibles Schneider Electric ont été testés par les UL et la CSA (à un courant de fuite de 100 000 A) sous 600 volts CA. Les démarreurs combinés de Classe 8538, Type S de type sectionneur à fusible (NEMA calibre 0 à 5), ont subi des essais de performance de Type 2 avec les vérificateurs indépendants UL et CSA.

Type à sectionneur Classe 8538

Les démarreurs combinés de la classe 8538 sont offerts avec un sectionneur à fusibles ou non. Les démarreurs combinés de la classe 8538 sont disponibles dans les calibres NEMA 0 à 6.

Le démarreur combiné du type sectionneur à fusible utilise un interrupteur à lames visibles commandé par levier. Des pinces à fusibles interchangeables, un câblage direct, de l'espace pour un transformateur de commande à fusibles, avec capacité supplémentaire et des provisions pour l'ajout d'un interverrouillage électrique du sectionneur, sont les caractéristiques maîtresses des démarreurs combinés.

Le sectionneur à fusibles est offert avec des pinces à fusibles. **Classe J** en modèle standard, ce qui porte le courant de court-circuit nominal à **100,000** A.

Les combinés non fusibles de calibres 0 à 2 peuvent être transformés en types à fusibles. Ensembles de blocs à fusibles et de pinces à fusibles de Classe 9999 à la page 1/111.

Type à protecteur de circuit de moteur PowerPact® Classe 8539

Les démarreurs combinés de la classe 8539 peuvent être offerts avec un protecteur de circuit de moteur PowerPact®. Les démarreurs combinés de la classe 8539 sont disponibles dans les calibres NEMA 0 à 7.

Les disjoncteurs dans les démarreurs combinés de la classe 8539 peuvent être fournis avec un interrupteur auxiliaire installé en usine pour la télé indication de l'état ouvert et/ou déclenché ou fermé du disjoncteur. Pour un interrupteur auxiliaire, spécifiez la **forme Y74**. Pour deux, spécifiez le **forme Y75**. Les interrupteurs sont offerts avec des circuits normalement ouverts et normalement fermés avec connexion commune. Les contacts doivent être utilisés sur la même polarité et ont une valeur nominale de 15 ampères à 240 volts CA.

Un interrupteur d'alarme peut être ajouté à l'usine seulement; spécifiez la **forme Y742**. L'interrupteur d'alarme ne fonctionne que lorsque le disjoncteur est déclenché. Il est utilisé pour commander des alarmes sonores ou lumineuses. L'interrupteur d'alarme consiste en un interrupteur unipolaire normalement ouvert. Les contacts ont une valeur nominale de 4 ampères à 240 volts CA.

Coffrets – Les démarreurs combinés des classes 8538 et 8539 sont offerts dans les coffrets suivants :

NEMA, type 1 Usage général
NEMA, types 4 et 4X Étanche à l'eau et antipoussière en acier inoxydable
NEMA, type 4X Verre-polyester résistant à la corrosion, étanche à l'eau et antipoussière
NEMA, type 12 À l'épreuve des poussières et des égouttures pour usage industriel

Le coffret en acier inoxydable NEMA, types 4 et 4X (calibres 0 à 5) a un fini brossé. Les calibres 5, 6 et 7 sont des coffrets en tôle d'acier homologués NEMA 4 seulement.

Des bagues d'entrée sont normalement fournies sur les coffrets NEMA type 4 et 4X.

Les coffrets NEMA de Type 12 peuvent être modifiés sur place pour les applications extérieures. Préciser la **Forme G26** pour les coffrets NEMA Type 3R (sans supplément). Renseignements supplémentaires sur la Classe 9991 à la page 1/92. De plus, les dispositifs NEMA Type 12 sont disponibles avec homologation UL pour utilisation dans les emplacements de Classe II, Division 2, Groupe G et de Classe III, Divisions 1 et 2. Demander la **Forme G21** (sans supplément).

Tensions de la bobine – Les bobines CA fonctionnent à 50 ou 60 Hertz. Les calibres NEMA 00 à 5 sont fournis avec des bobines conçues pour bien fonctionner avec des tensions de ligne variant de 85 à 110 % de la tension nominale. Les calibres NEMA 6 et 7 sont munis d'une bobine CC fonctionnant à partir d'un circuit électronique redresseur alimenté à partir d'une source CA et est conçu pour fonctionner de façon satisfaisante à des tensions de 90 à 110 % de la tension nominale.

Veuillez prendre note que des codes de tension ont été ajoutés à la désignation afin de mieux vous servir. Il est cependant nécessaire d'inscrire le code de tension pour commander. De plus, les démarreurs combinés polyphasés à 120 volts sont câblés pour une source de commande distincte.

Contacts auxiliaires – Des contacts auxiliaires supplémentaires peuvent être ajoutés aux démarreurs du type S. Voir la section 8536 pour le nombre maximum de contacts auxiliaires et les désignations des formes de contacts auxiliaires installés à l'usine. Voir à la page 106, la classe 9999 pour les kits de contacts auxiliaires montables sur place.

Accessoires du type S – Des accessoires supplémentaires tels que blocs de fusibles, trousses de pinces à fusibles, sectionneurs et interverrouillages de disjoncteurs sont offerts pour être montés sur place, voir la page 1-111. Pour les modifications en usine (formes), voir les pages 1-112 à 1-116. Pour les trousses de modification sur place, voir la classe 9999 aux pages 1-104 à 1-111.

Chapter 30 LIGHTING

MANUFACTURER/DISTRIBUTOR:

CDE
298, Rue De Martigny Ouest
Saint-Jérôme (Québec)
J7Y 4C9
Phone.: (450) 438-1263
Fax: (450) 438-3728
Courriel : cde@cde.qc.ca

30.1 **TYPE A LITHONIA VAP 12000LM PCL MD MVOLT GZ10 35K 80CRI CMB**

30.2 **TYPE B - Lithonia TWS LED 1 50K 120 PE**

30.3 **TYPE C - Lithonia TWP LED 20C 700 50K T3M 120 PE DDBXD**

30.4 **EXIT SIGN - AIMLITE CARPW0636 U M-2SM4LJ WHT/ATD**

LITHONIA LIGHTING®

Catalog Number	
Notes	
Type	

FEATURES & SPECIFICATIONS

INTENDED USE — Ideal for use in applications where smart, energy-efficient fixtures are desired. Typical applications include parking garages, canopies, transportation, schools, hospitals, cold storage and exterior retail environments where moisture or dust is a concern. Polycarbonate enclosure protects fixture while remaining easy to service and clean.

CONSTRUCTION — UV-stabilized, injection-molded, impact-resistant, frosted polycarbonate housing with continuous pouredin-place, closed-cell gasket. 20-gauge steel channel and channel cover. Aluminum sheet metal board plate for thermal conduction and support. Captive, tamper-resistant, polycarbonate latches standard (8 Torx T-20 tamper-resistant screws included). Stainless steel latches also available. Fixture design allows for approximately 4% up-light.

OPTICS — UV-stabilized, injection-molded, impact-resistant, clear transparent and frosted, polycarbonate lens with aesthetic rib detail (.080" thick). Miro 5 aluminum reflector used to achieve wide distribution.

ELECTRICAL — Utilizes high-output LEDs integrated on a two-layer circuit board, ensuring cool-running operation. Electronic LED driver rated for 44 input watts and is standard 0-10V dimming. Integral 6kV/3kA surge protection, tested in accordance to IEEE/ANSI standards. L85 at 60,000 hours.

INSTALLATION — Stainless steel surface spring-mounting brackets standard (2 included) allows for ceiling or suspended mount. A variety of stainless steel mounting options also available: J-box mounting and mounting brackets for suspension with aircraft cable (cable not included). Optional stainless steel V-hooks available for chain hanging (chain not included). Surface conduit entry on each end and on top. For horizontal and vertical mounting on a wall, application must be under a covered ceiling and QMB option recommended. 1/2" - 3/4" KO. When wall mounted the product will be rated for damp location only.

LISTINGS — CSA Certified to UL and C-UL standards. For use in ambient temperatures ranging from -20°F (-29°C) to 104°F(40°C). VAP LED is wet location listed for covered ceiling applications. IP65 and IP66 rated. When wall mounted the product will be rated for damp location only. DesignLights Consortium® (DLC) qualified product. Not all versions of this product may be DLC qualified. Please check the DLC Qualified Products List at www.designlights.org to confirm which versions are qualified.

WARRANTY — 5-year limited warranty. Complete warranty terms located at www.acuitybrands.com/CustomerResources/Terms_and_conditions.aspx

For installed Rough Service Product(s), Acuity warrants that, for the lifetime of the product(s), the polycarbonate lens and/or polycarbonate housing will withstand breakage resulting from occasional physical abuse and rough handling (the "Rough Service Warranty"), notwithstanding the vandalism exclusion set forth at www.acuitybrands.com/CustomerResources/Terms_and_conditions.aspx

Note: Actual performance may differ as a result of end-user environment and application.

All values are design or typical values, measured under laboratory conditions at 25 °C.

Specifications subject to change without notice.

Shop Drawings
Contractor Approval
Approved by: S.B.S., G. F.
Date: May 06, 2015
SIFEC NORTH INC

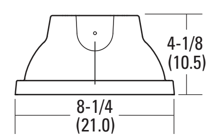
Rough Service Fixture

VAP LED

CEILING/
SUSPEND MOUNT

Specifications

Length: 54-3/4 (139.1)
Width: 8-1/4 (21.0)
Depth: 4-1/8 (10.5)
Weight: 13.5 lbs. (5.9 kg)



All dimensions are shown in inches (centimeters) unless otherwise noted.

ORDERING INFORMATION Lead times will vary depending on options selected. Consult with your sales representative.

Example: VAP 4000LM FST MD MVOLT GZ10 40K 80CRI

Series	Nominal lumens	Diffuser	Distribution	Voltage	Driver	Color temperature	CRI
VAP	4000LM 4,000 lumens 6000LM 6,000 lumens 12000LM 12,000 lumens[1]	FST Frosted polycarbonate lens PCL Clear polycarbonate lens	MD Medium WD Wide	MVOLT MVOLT 120 120V 277 277V 347 347V[2] 480 480V[2]	GZ10 0 - 10V dimming	30K 3000K 35K 3500K 40K 4000K 50K 5000K	80CRI 80 CRI 90CRI 90 CRI

Options[3]

SF	Single fuse[4]	STSL	Stainless steel tamper resistant latches	MSI10XAWL10M DSCXAWL	Xpoint wireless integral motion sensor, On/Off operation for motion sensing, override Off due to daylight[4]
BSL722	Bodine® emergency LED battery pack for 0°C and up[4,5]	QMB	Quick-mount ceiling bracket	MSI10NWL	Low mount 360 integral motion sensor, wet location, On/Off operation[4]
BSL722C	Bodine® emergency LED battery pack for -20°C and up[4,5]	CMB	Chain-mount suspension bracket	MSI102L3VWL	Low mount 360 integral motion sensor, wet location, High/Low operation (bi-level)[4]
WLF	Wet location fitting (two outboard, top)[6]	JSB	Junction box snap-bracket	MSI10NWL DSCNWL	Low mount 360 integral motion sensor, wet location, On/Off operation for motion sensing, override Off due to daylight[4]
WLFIN	Wet location fitting (two inboard, top)[6]	LSC	Lens safety clip	XAD	XPoint™ wireless controller ,0-10V dimming[9]
WLFEND	Wet location fitting (one end)[6]	DL	Damp location[8]		
WLFEND2	Wet location fitting (both ends)[6,7]	L/SP	Less surge protection device		
CS89	6' white cord, 16/3, no plug, wet location				
CS88	6' Brad Harrison 16/3 cord and straight blade plug set[4]				
CS88L12	12' Brad Harrison 16/3 cord and straight blade plug set[4]				

Accessories: *Order as separate catalog number. (Ships separately)*

VAPSMB	Surface spring-mount bracket	RK1 T20BIT	Hex base driver bit, Torx T20. Tamper resistant screws with center reject pin
VAPQMB	Quick-mount ceiling bracket	RK1 T20DRV	Torx T20 screwdriver for use with tamper resistant screws with center reject pin
VAPCMB	Chain-mount bracket		
VAPJSB	Junction box snap bracket		
HC36	Wire hook and 36" chain set[10,11]		

Notes

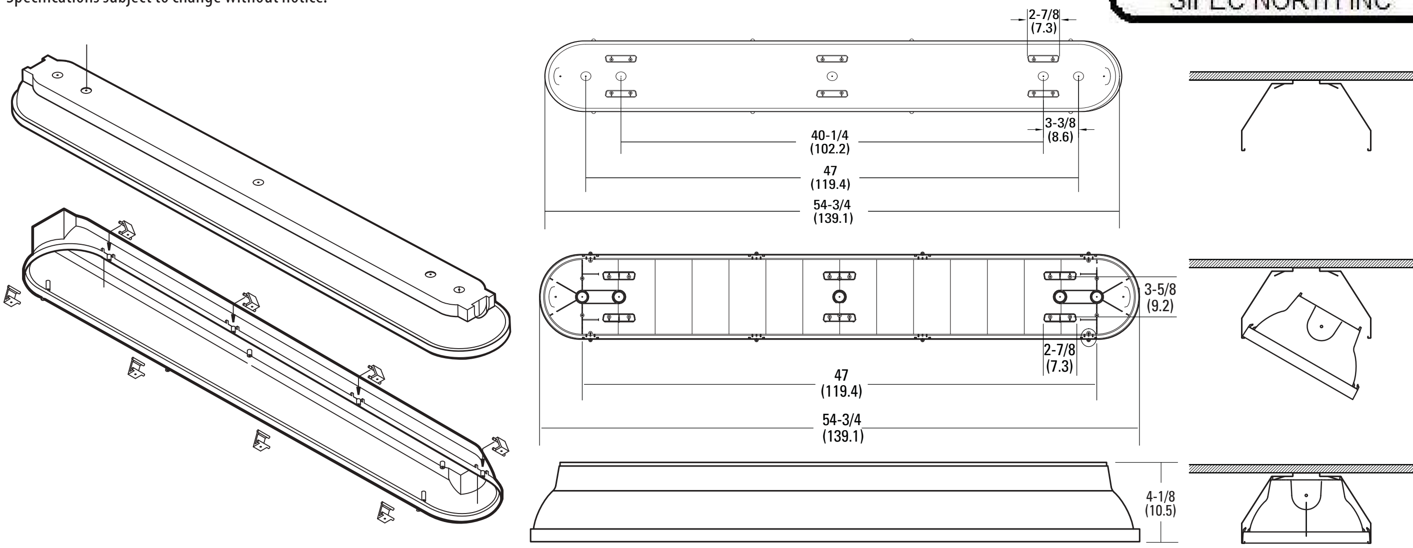
1 Not available with BSL722 or BSL722C options.
2 347V and 480V utilize a step-down transformer. Available 60HZ only.
3 For additional options, consult factory.
4 Must specify voltage.
5 Not available with 12000LM lumen package. Maximum ambient temperature 30 C.
6 5/8" long NPT threaded hub.
7 Not available with cord, sensor, or photocell options.
8 Required when using battery packs or cord sets that are not rated for wet locations.
9 Not available with BSL722 and BSL722C option.
10 Requires CMB (chain mount bracket) option.
11 For stainless steel, specify STS (example: HC36 STS).

Shop Drawings
Contractor Approval
Approved by: S.B.S., G. F.
Date: May 06, 2015
SIFEC NORTH INC

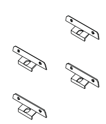
DIMENSIONS

All dimensions are shown in inches (centimeters) unless otherwise noted.

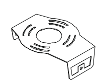
Specifications subject to change without notice.



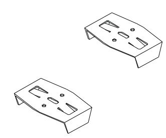
MOUNTING ACCESSORIES



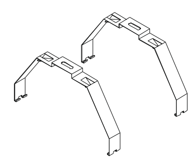
CMB - Ceiling Mounting Brackets



JSB - Junction Box Mounting Bracket



QMB - Quick-Mount Mounting Brackets



SMB - Surface Mounting Brackets (ship with fixture as standard)

ARCHWAY™ PASSAGE™ LED Specification Matrix								
Nominal lumens	Initial delivered lumens @ 80CRI with clear polycarbonate lens			Initial delivered lumens @80CRI with frosted polycarbonate lens			Wattage @120V	Comparable source
	3500K	4000K	5000K	3500K	4000K	5000K		
4000LM	5,200	5,208	5,672	4,420	4,428	4,822	44	2-lamp 32W T8, 1-lamp 54W T5HO, 70W HID
6000LM	6,630	6,643	7,234	5,637	5,648	6,150	64	3-lamp 32W T8, 2-lamp 54W T5HO, 100W HID
12000LM	11,034	11,056	12,040	9,380	9,400	10,236	109	4-lamp 32W T8, 2-lamp 54W T5HO, 150W HID

Operating hours	0	10,000	20,000	25,000	35,000	50,000	60,000	75,000	100,000
Lumen Maintenance Factor	1	.95	.92	.91	.89	.86	.84	.81	.77

LITHONIA LIGHTING®
An Acuity Brands Company

INDUSTRIAL: One Lithonia Way, Conyers, GA 30012 Phone: 800-315-4963 Fax: 770-981-8191 www.lithonia.com

SBOR - WET LOCATION Motion Sensor (see www.sensorswitch.com for additional informat

Shop Drawings
Contractor Approval
Approved by: S.B.S., G. F.
Date: May 06, 2015
SIFEC NORTH INC

- 360° coverage
- On/Off dim
- Photocell optional
- IP66 rated
- Photocell and 0-10VDC dimming options.

Fixture sensor nomenclature	SBOR sensor nomenclature
For shortest lead times use one of the following SBOR confi gurations	
MSI10NWL	SBOR 10 OEX EB3 WH
MSI102L3VWL	SBOR 10 OEX D EB3 WH 3V
MSI10NWL DSCNWL	SBOR 10 OEX P EB3 WH

MOTION SENSOR

ORDERING INFORMATION Lead times will vary depending on options selected. Consult with your sales representative.

Example: MSI6NWL

Series	Lens option	Dimming	Minimum dim level	Environmental factors
MSI Passive infrared occupancy sensor	6 High mount, 360° 10 Low mount, 360°	N On\off 2LXX Bi level range[1] CXX Continous dim range[1] XA Xpoint wireless signal to external system	0V Off 1V 1VDC 2V 2VDC 3V 3VDC 4V 4VDC 5V 5VDC	WL Wet location

PHOTOCELL

ORDERING INFORMATION Lead times will vary depending on options selected. Consult with your sales representative.

Example: DSCNWL

Series	Dimming	Environmental factors
DSC Passive infrared occupancy sensor with photocell	N On\off 2LXX Bi level range[1] CXX Continous dim range[1] XA Xpoint wireless signal to external system	WL Wet location

Notes

1 XX denotes dimming range.(Ex. 3V, 4V, etc.)

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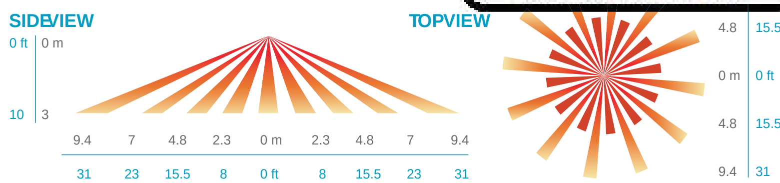
INDUSTRIAL: One Lithonia Way, Conyers, GA 30012 Phone: 800-315-4963 Fax: 770-981-8191 www.lithonia.com

COVERAGE PATTERNS

Shop Drawings
Contractor Approval
Approved by: S.B.S., G. F.
Date: May 06, 2015
SIFEC NORTH INC

PARKING GARAGE / LOW MOUNT APPLICATIONS

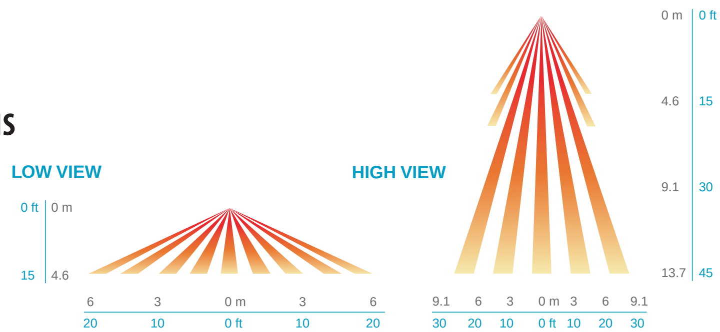
In general, the SBOR 10 is recommended for 8-15 ft (2.44-4.57 m) mounting and provides a coverage area radius for walking motion of greater than 2x the mounting height. The SBOR 10 ODP is ideal for parking garage and low pole mount applications. When mounted 10 ft high, for example, on a luminaire in a parking garage, the sensor's coverage for walking motion extends out 30 ft in a 360º pattern. This closely matches the lighting distribution of a typical parking garage luminaire. When mounted to a light pole, for example, in a parking lot or along a path, the sensor provides 270º of coverage (90º is blocked by the pole). Note, walking askew to sensor typically results in earlier detection than walking directly at sensor.



Coverage Pattern of Low Mount Lens Option (SBOR 10)

SITE & AREA LIGHTING / HIGH MOUNT APPLICATIONS

The SBOR 6 is intended for higher pole mount applications, between 15-30 ft (4.57-9.14 m), and provides a coverage area radius for walking motion of 15-20 ft (4.57-6.10 m). When mounted to a pole the sensor provides 270º of coverage (90º is blocked by the pole).



Coverage Pattern of High Mount Lens Option (SBOR 6)

LITHONIA LIGHTING®
An Acuity Brands Company

INDUSTRIAL: One Lithonia Way, Conyers, GA 30012 Phone: 800-315-4963 Fax: 770-981-8191 www.lithonia.com

Type B Lights - Lithonia TWS LED 1 50K 120 PE

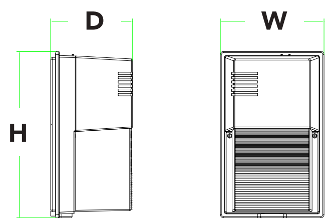
TWS LED
LED Wall Luminaire

Catalog Number	
Notes	
Type	

Hit the Tab key or mouse over the page to see all interactive elements.

Specifications

Width:	6-3/4" *(17.2 cm)*
Height:	10-7/8" *(27.7 cm)*
Depth:	5-5/16" *(13.5 cm)*
Weight:	3.19 lbs *(1.45 kg)*



Introduction

The popular TWS luminaire is now available with long-lasting, energy-efficient LED technology. Featuring a classic dayform, the TWS LED offers a traditional appearance and is powered by advanced LEDs.

The TWS LED luminaire is powerful yet energy efficient, capable of replacing up to a 70W HPS wall pack while saving up to 78% in energy costs. With long-life LEDs, the TWS LED eliminates frequent lamp and ballast replacements associated with traditional technologies.

Ordering Information

EXAMPLE: TWS LED 1 50K 120 PE

TWS LED					
Series	**Performance Package**	**Color Temperature**	**Voltage**	**Control Options**	**Finish**
TWS LED	1 1017 lumens	50K 5000K [1]	120 120V [2]	PE Photoelectric cell, button type	(blank) Dark bronze

Accessories

Ordered and shipped separately.

TWSWG	Wire Guard

NOTES
1 Corrected color temperature (CCT) shown is nominal per ANSI C78, 377-2008.
2. 120V driver operates on 120V.

FEATURES & SPECIFICATIONS

INTENDED USE
The TWS LED combines traditional wall pack design with high-output LEDs to provide an energy-efficient, low maintenance LED wall pack suitable for replacing up to 70W HPS fixtures. The traditional shape helps maintain building aesthetics when replacing only a portion of your building's wall packs. TWS LED is for outdoor applications such as personnel doors, loading areas, driveways and parking areas.

CONSTRUCTION
Back plate is die-cast aluminum. Front cover is impact-resistant polycarbonate which is fully gasketed. All electronics are protected in the upper housing. Housing is sealed against moisture and environmental contaminants.

FINISH
UV stabilized polycarbonate front cover has dark bronze color which provides superior resistance to corrosion and weathering and that can withstand extreme climate changes without cracking or peeling.

OPTICS
Protective polycarbonate lens covers the LEDs. Prismatic front cover and precision-molded reflector for superior uniformity and fixture spacing. Light engine is available in 5000K (69 min. CRI).

ELECTRICAL
Light engine consists of two high-powered, long-life, high-efficacy LEDs mounted on an internal aluminum heat sink to maximize heat dissipation and promote long life (L95/100,000 hours at 40°C). Driver and integral photocell operate at 120V and are fully enclosed in the upper housing. There are no user serviceable parts.

INSTALLATION
Back housing easily mounts to any recessed junction box. With all electronics in upper housing the open lower section makes wiring easy. Mount on any vertical surface. Not recommended in applications where a sprayed stream of water can come in direct contact with polycarbonate lens.

LISTINGS
UL Certified to US and Canadian safety standards for wet-location mounting higher than 4 feet off the ground.

Rated for -40°C to 40°C ambient temperature.

WARRANTY
Five-year limited warranty. Full warranty terms located at www.acuitybrands.com/CustomerResources/Terms_and_conditions.aspx.

Note: Specifications are subject to change without notice. Actual performance may differ as a result of end-user environment and application

SHOP DRAWING
Reviewed by: Samuel Charbonneau
Date: 17 juin 2016
Reviewed [X]
Reviewed as noted [ ]
Resubmit [ ]
Out for approval
SIFEC NORTH INC.

LITHONIA LIGHTING
One Lithonia Way • Conyers, Georgia 30012 • Phone: 800.279.8041 • Fax: 770.918.1209 • www.lithonia.com

Performance Data

Lumen Output

Lumen values are from photometric tests performed in accordance with IESNA LM-79-08. Data is considered to be representative of the configurations shown, within the tolerances allowed by Lighting Facts. Actual performance may differ as a result of end-user environment and application.

Performance Package	Drive Current (mA)	CCT	System Watts	50K (5000K, 67 CRI)				
				Lumens	B	U	G	LPW
1	900	5000K	19W	1,017	1	3	1	54

Lumen Ambient Temperature (LAT) Multipliers

Use these factors to determine relative lumen output for average ambient temperatures from 0-40°C (32-104°F).

Ambient		Lumen Multiplier
0°C	32°F	1.03
10°C	50°F	1.02
20°C	68°F	1.01
25°C	**77°F**	**1.00**
30°C	86°F	0.99
40°C	104°F	0.98

Projected LED Lumen Maintenance

Data references the extrapolated performance projections in a **40°C ambient**, based on 10,000 hours of LED testing (tested per IESNA LM-80-08 and projected per IESNA TM-21-11).

To calculate LLF, use the lumen maintenance factor that corresponds to the desired number of operating hours below. For other lumen maintenance values, contact factory.

Operating Hours	0	25,000	50,000	55,000	100,000
Lumen Maintenance Factor	1.0	0.98	0.97	0.97	0.95

Electrical Load

LED Package	Drive Current (mA)	System Watts	Current (A)			
			120	208	240	277
1	1000	19W	0.20	0.12	0.10	0.09

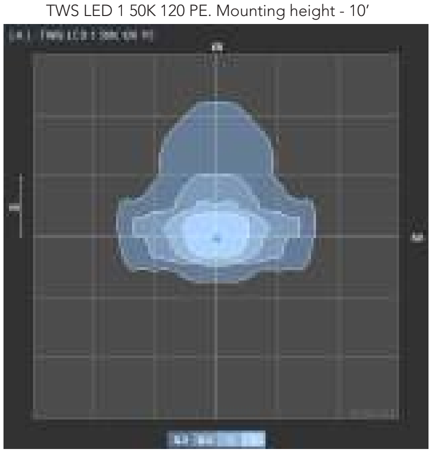
Photometric Diagrams

To see complete photometric reports or download .ies files for this product, visit the Lithonia Lighting TWS LED homepage. Tested in accordance with IESNA LM-79 and LM-80 standards

LEGEND

- 0.2 fc
- 0.5 fc
- 1.0 fc
- 2.0 fc

TWS LED 1 50K 120 PE. Mounting height - 10'



Test No. LTL22672S tested in accordance with IESNA LM-79-08.

Lighting Facts Labels

Type C Lights Lithonia TWP LED 20C 700 50K T3M 120 PE DDXB

TWP LED

LED Wall Luminaire

Catalog Number	
Notes	
Type	

SHOP DRAWING
Reviewed by: Samuel Charbonneau
Date: 17 juin 2016
Reviewed [X]
Reviewed as noted [ ]
Resubmit [ ]
Out for approval
SIFEC NORTH INC.

Hit the Tab key or mouse over the page to see all interactive elements.

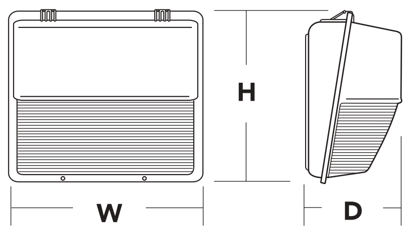
Introduction

The popular TWP luminaire is now available with LED technology. Cast in a traditional dayform, the TWP LED offers a classic appearance and is powered by advanced LEDs. A one-piece polycarbonate cover delivers enhanced durability and is vandal resistant, making the TWP LED ideal for lower mounting heights or high-traffic areas.

The new TWP LED luminaire is powerful yet energy efficient, capable of replacing up to a 250W metal halide luminaire while saving up to 77% in energy costs. Offering an expected service life of more than 20 years, the TWP LED eliminates frequent lamp and ballast replacements associated with traditional technologies.

Specifications

Width:	16-1/8" *(41.0 cm)*
Height:	15-1/2" *(39.4 cm)*
Depth:	7-3/4" *(19.7 cm)*
Weight:	15 lbs *(6.8kg)*



Ordering Information

EXAMPLE: TWP LED 30C 700 50K T3M MVOLT DDBXD

TWP LED						
Series	**Performance Package**	**Distribution**	**Voltage**	**Control Options**	**Other Options**	**Finish** *(required)*
TWP LED	**LEDs** 10C 10 LEDs (one engine) 20C 20 LEDs (two engines) 30C 30 LEDs (one engine) **Drive current** 700 700 mA **Color temperature** 40K 4000 K 50K 5000 K	T3M Type III Medium	MVOLT [1] 120 [1] 208 [1] 240 [1] 277 [1] 347 [2] 480 [2]	**Shipped installed** PE Photoelectric cell, button type [3]	**Shipped installed** SF Single fuse (120, 277, 347V) [4] DF Double fuse (208, 240, 480V) [4] TP Tamper proof screws NOM NOM Certified SPD Separate surge protection [5] **Shipped separately** WG Wire guard [6]	DDBXD Dark bronze DBLXD Black DWHXD White DDBTXD Textured dark bronze DBLBXD Textured black DWHGXD Textured white

Stock configurations are offered for shorter lead times:

Standard Part Number	Stock Part Number
TWP LED 10C 700 40K T3M MVOLT DDBXD	**TWP LED 10C 40K**
TWP LED 20C 700 40K T3M MVOLT DDBXD	**TWP LED 20C 40K**
TWP LED 30C 700 40K T3M MVOLT DDBXD	**TWP LED 30C 40K**
TWP LED 10C 700 50K T3M MVOLT DDBXD	**TWP LED 10C 50K**
TWP LED 20C 700 50K T3M MVOLT DDBXD	**TWP LED 20C 50K**
TWP LED 30C 700 50K T3M MVOLT DDBXD	**TWP LED 30C 50K**

Accessories

Ordered and shipped separately.

TWPWG U	Wire guard accessory [7]

NOTES

1. MVOLT driver operates on any line voltage from 120-277V (50/60 Hz). Specify 120, 208, 240 or 277 options only when ordering with fusing (SF, DF options) or photocontrol (PE).
2. Not available with 10C option.
3. Must specify voltage; not available with MVOLT or 480 voltage options.
4. Single fuse (SF) requires 120, 277 or 347 voltage option. Double fuse (DF) requires 208, 240 or 480 voltage option.
5. See the electrical section on page 2 for more details.
6. Also available as a separate accessory; see Accessories information at left.
7. Requires field modification (only when ordered as a separate accessory).

Performance Data

Lumen Output

Lumen values are from photometric tests performed in accordance with IESNA LM-79-08. Data is considered to be representative of the configurations shown, within the tolerances allowed by Lighting Facts. Contact factory for performance data on any configurations not shown here.

LEDs	Drive Current (mA)	Performance Package	System Watts	Dist. Type	40K (4000 K, 70 CRI)					50K (5000 K, 70 CRI)				
					Lumens	B	U	G	LPW	Lumens	B	U	G	LPW
10C (10 LEDs)	700	10C 700 --K	26W	T3M	2,183	0	3	2	83	2197	0	3	2	84
20C (20 LEDs)	700	20C 700 --K	45W	T3M	4,207	0	3	3	93	4233	0	3	3	94
30C (30 LEDs)	700	30C 700 --K	67W	T3M	5,176	0	3	3	77	5208	0	3	3	77

Lumen Ambient Temperature (LAT) Multipliers

Use these factors to determine relative lumen output for average ambient temperatures from 0-40°C (32-104°F).

Ambient		Lumen Multiplier
0°C	32°F	1.02
10°C	50°F	1.01
20°C	68°F	1.00
25°C	**77°F**	**1.00**
30°C	86°F	1.00
40°C	104°F	0.98

Projected LED Lumen Maintenance

Data references the extrapolated performance projections for the **TWP LED 30C 700** platform in a **25°C ambient**, based on 10,000 hours of LED testing (tested per IESNA LM-80-08 and projected per IESNA TM-21-11).

To calculate LLF, use the lumen maintenance factor that corresponds to the desired number of operating hours below. For other lumen maintenance values, contact factory.

Operating Hours	0	25,000	50,000	100,000
Lumen Maintenance Factor	1.0	0.99	0.99	0.98

Electrical Load

LEDs	Drive Current (mA)	System Watts	Current (A)					
			120V	208V	240V	277V	347V	480V
10C	700	26 W	0.24	0.14	0.12	0.10	-	-
20C	700	45 W	0.42	0.24	0.21	0.18	0.14	0.10
30C	700	67 W	0.62	0.36	0.31	0.27	0.21	0.16

FEATURES & SPECIFICATIONS

INTENDED USE
The energy savings, long life and easy-to-install design of the TWP LED make it the smart choice for building-mounted doorway and pathway illumination for nearly any facility.

CONSTRUCTION
Die-cast aluminum rear housing has an impact-resistant, UV-stabilized polycarbonate front housing and refractor that is fully gasketed. Modular design allows for ease of maintenance. The LED driver is mounted to the front casting to thermally isolate it from the light engine for low operating temperature and long life. Housing is completely sealed against moisture and environmental contaminants.

FINISH
Exterior parts are protected by a zinc-infused Super Durable TGIC thermoset powder coat finish that provides superior resistance to corrosion and weathering. A tightly controlled multi-stage process ensures a minimum 3 mils thickness for a finish that can withstand extreme climate changes without cracking or peeling. Available in textured and non-textured finishes.

OPTICS
Protective polycarbonate lens covers the light engine's precision-molded proprietary acrylic lenses. Light engines are available in 4000K and 5000K configurations.

ELECTRICAL
Light engine(s) consist of 10 or 30 high-efficacy LEDs mounted to a metal-core circuit board and integral aluminum heat sink to maximize heat dissipation and promote long life (L94/100,000 hrs at 25°C). The electronic driver has a power factor of >90%, THD <20%, and a minimum 2.5 KV surge rating. When ordering the SPD option, a separate surge protection device is installed within the luminaire which meets a minimum Category C low operation (per ANSI/IEEE C62.41.2).

INSTALLATION
Top 3/4" threaded wiring access. Back access through removable 3/4" knockout. Feed-thru wiring can be achieved by using a condulet tee. Mount on any flat, vertical surface.

LISTINGS
UL listed for wet locations. Rated for -40°C minimum ambient. DesignLights Consortium® (DLC) qualified product. Not all versions of this product may be DLC qualified. Please check the DLC Qualified Products List at www.designlights.org to confirm which versions are qualified.

WARRANTY
Five year limited warranty. Full warranty terms located at www.acuitybrands.com/CustomerResources/Terms_and_conditions.aspx.

Note: Actual performance may differ as a result of end-user environment and application. All values are design or typical values, measured under laboratory conditions at 25 °C. Specifications subject to change without notice.

CARPW

Project: | Contractor:

Shop Drawings
Contractor Approval
Approved by: S.B.S., G. F.
Date: May 06, 2015
SIFEC NORTH INC

COMBO ALUMINUM

NBC2010 Compliant
LED 120/347VAC Input

Approvals:
CSA Certified to C22.2 #141 and C860

Energy Verified
Énergie Vérifiée

DESCRIPTION

The CARPW series of commercial combination extruded signs and battery units features a fully modern appearance. The extruded aluminum design provides for a rigid, durable and lightweight sign. Two PAR18 small style, front mounted heads are standard, PAR36 large style or MR16 type are optional. Available with either 6VDC or 12VDC.

CIRCUITRY

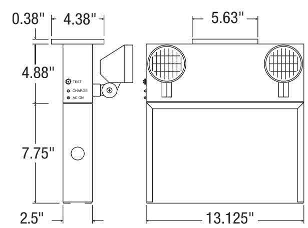
- LED ultra bright light source
- 120/347VAC Input, field selectable
- 1.9 Watt power consumption for LED exit portion of combination sign
- LED Emergency DC wattages as follows:
  6VDC = 0.9W **12VDC** = 0.9W
- Wattage capacities from 36 to 72 watts
- 30 minutes emergency power duration standard
- Momentary push button test switch
- Pilot LEDs for AC ON and CHARGE
- Fully automatic, constant voltage current limited charger
- Solid state design and construction with brownout and short circuit protection
- Temperature compensated
- Maintenance free, sealed lead acid battery

Comes standard with three pictogram legends for direction selection.

MECHANICAL

- Extruded aluminum construction
- Slide in/out captive faceplate(s) and backplate for rapid and simplified installation
- Universal spider knockout pattern stamped into backplate for junction box mounting
- Universal models include ceiling or end mount, field installable canopy kit c/w spider plate
- Multiple conduit entry knockouts
- White powder coat finish standard, other finishes and colors optional
- Front head mounted is standard, side mount is optional

DIMENSIONS



New model does not offer "Universal Faces" anymore

ORDERING GUIDE

M — /

Series	Nbr of faces	Mounting	Head/Lamp		Color	Options†
CARPW0636 **CARPW0650** **CARPW1236** **CARPW1250** **CARPW1272** (See model ratings table below)	**1** - Single face **2** - Double face	**M** - Universal	**0** - No heads **1SM** - One PAR18 **2SM** - Two PAR18 **1LG** - One PAR36 **2LG** - Two PAR36	**1MD** - One MR16 **2MD** - Two MR16 **1MB** - One MR16 **2MB** - Two MR16 (See lamp list below)	**WHT** - White (standard) **BLK** - Black **GRY** - Grey **CUS** - Custom color (specify)	**VDR, WRG*, LXG, SPW, BKO, BNO, ATD, LPD, BTD, TDL**** **0** - No indicators (double face only) ↓ ↑ ↗ ↘ ↙ ↖ **D U UR DR DL UL** **Note:** Indicators option available for single & double option only.

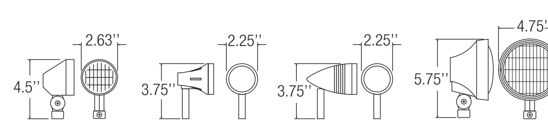
† For detailed options descriptions, please consult the options page. * Specify mounting. ** Specify AC voltage.

LAMP SELECTION

	6 Volts	12 Volts
PAR18 - Small head		
LED	3LJ, 4LJ	3LJ, 4LJ
Quartz halogen	08Q, 10Q, 12Q	08Q, 10Q, 12Q
Tungsten	09T	09T, 12T, 18T
MR16 - Small head c/w MR16 Lamp		
LED	4LR	4LR, 6LA, 7LA
Quartz halogen	08Q, 10Q, 12Q	08Q, 10Q, 12Q, 20Q
PAR36 - Large head		
Quartz halogen	08Q, 10Q, 12Q, 20Q	08Q, 10Q, 12Q, 20Q, 35Q
Tungsten	09T, 18T, 25T	09T, 18T, 25T
Quartz sealed beam	08SBQ, 10SBQ, 12SBQ, 20SBQ	08SBQ, 12SBQ, 20SBQ, 35SBQ, 55SBQ
Tungsten sealed beam	09SBT, 18SBT	N/A

MODEL RATINGS

		Wattage capacities			
Model	Voltage	30 min.	60 min.	90 min.	120 min.
CARPW0636	6V	36	18	12	9
CARPW0650	6V	50	25	16	12
CARPW1236	12V	36	18	12	9
CARPW1250	12V	50	25	16	12
CARPW1272	12V	72	36	24	18



Type SM - PAR18 Thermoplastic 18W max. | **Type MD - MR16** Die cast 35W max. | **Type MB - MR16** Die cast 35W max. | **Type LG - PAR36** Thermoplastic 18W max.

Les produits d'éclairage AimLite Lighting Products
514-227-1288 • 1-866-348-2374 514-227-1285 • www.aimlite.com

Chapter 31 FIRE ALARM

MANUFACTURER/DISTRIBUTOR:

CDE
298, Rue De Martigny Ouest
Saint-Jérôme (Québec)
J7Y 4C9
Phone.: (450) 438-1263
Fax: (450) 438-3728
Courriel : cde@cde.qc.ca

31.1 **CHUBB EDWARDS 283B-PL**

31.2 **CHUBB EDWARDS 284B-PL**

Edwards Signaling

Rate-of-rise/Fixed Temperature Heat Detectors

280B-PL Series

Overview

280B-PL Series heat detectors offer fixed temperature or combination rate-of-rise and fixed temperature detection.

RATE-OF-RISE: A temperature increase at the sensor of 15°F (9°C) or more per minute activates the rate-of-rise feature. This closes the contacts in the sensor to transmit the alarm condition to the fire alarm control panel. When the rate-of-rise element alone has been activated, the sensor is self-restoring.

FIXED TEMPERATURE: If the temperature of the center disk rises to the sensor's rated temperature, the fixed temperature element activates. This closes contacts in the sensor and transmits an alarm condition to the fire alarm control panel. The fixed temperature element is non-restorable and, when activated, the detector must be replaced. The need for replacement is indicated when the center disk has fallen free from the detector .

Standard Features

- UL listed for 50 ft. (15.2m) spacing
- Single pole — normally open contact
- Low profile with mounting plate
- Pure white finish
- Mounting flexibility with screw terminals
- Easy twist-on installation
- On-site testing of rate-of-rise feature
- Positive operating indication — for fixed temperature element

Application

Heat detectors are most suitable for environments where rapid fire development can be expected. When selecting the location on the ceiling for the heat sensor, do not locate it in direct path of hot or cold air flow. Refer to the detector specifications for the recommended maximum spacing. Earlier detector response may be obtained by reducing the spacing between detectors.

Installation

Edwards 280B series heat sensors come standard with a white plastic reversible mounting plate. The plate is designed for surface or flush mounting and installs directly to a standard North American 3½ or 4 inch octagon box. Once the mounting plate is fixed, a simple twist will lock the sensor in place. It can be removed using a screwdriver to release the tamper-resistant locking finger. This helps prevent unauthorized removal.

EDWARDS
United Technologies

Contact us...

Phone: 1-800-336-4206
Web: www.edwardssignaling.com

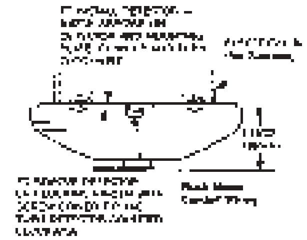
Edwards Signaling is
an **EDWARDS** brand.

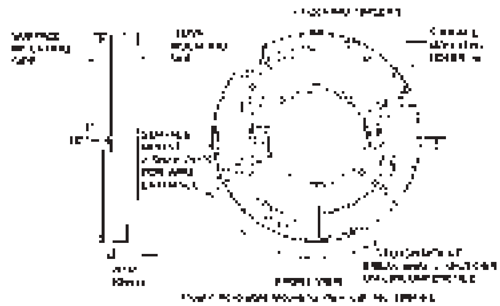
3 Farm Glen Boulevard
Farmington, CT 06032

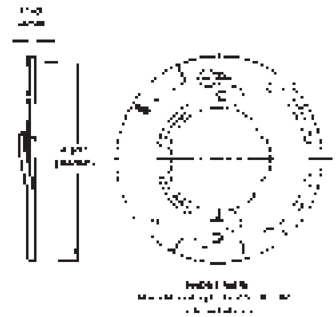
In Canada, contact Chubb Edwards...
Email: inquiries@chubbedwards.com
Web: www.chubbedwards.com

Mounting

The plastic mounting plate is molded to accommodate exposed wiring.







Specifications

Catalog Number	281B-PL	282B-PL	283B-PL	284B-PL
UL Temperature Rating	135°F (57°C)	194°F (90°C)	135°F (57°C)	194°F (90°C)
UL Max Ambient Temp. at Ceiling	100°F (38°C)	150°F (66°C)	100°F (38°C)	150°F (66°C)
Detector Type	Fixed Temperature and Rate-of-Rise Rate-of-rise: 15° F (9° C), self restoring		Fixed Temperature Only	
UL Recommended Coverage*	2,500 ft.^{2} (232 m^2)			
UL Recommended Spacing	50 ft. (15.2 m)			
FM Recommended Spacing	30 ft. (9.14 m)			
UL Maximum Distance from Wall	25 ft. (7.6m) from any wall or projection extending down from the ceiling more than 12 inches (305 mm)			
Contacts – Rating	Single Pole Normally Open 3.0 amps at 6 to 125 Vac; 1.0 amp at 6 to 24 Vdc; 0.3 amps at 125 Vdc; 0.1 amps at 250 Vdc			
Operating Environment	Indoor – Dry			
Agency Listings	UL, FM, CSFM			

* Maximum detector coverage has been determined by UL to provide detection time equal to sprinkler devices spaced at 10 ft (3.05m) intervals on a smooth ceiling 15 feet 9 inches (4.8m) high. Higher ceilings may adversely affect detection time. Earlier detection may be obtained by reducing the spacing between sensors. (See NFPA 72, Chapter 5)

WARNING – Use For Property Protection Only: Heat sensors do not protect life against fire and smoke. In most fires, hazardous levels of smoke, heat and toxic gases can build up before a heat detector would initiate an alarm. Independent studies indicate that heat detectors should only be used when property protection alone is involved. In cases where life safety is a factor, the use of smoke detectors is recommended.

Under no circumstances should heat detectors be relied upon as the sole measure to ensure fire safety. However, if they are spaced in accordance with the directions in the Specifications table, these sensors can contribute, within an overall fire safety program, to reducing the risk of avoidable property losses.

Ordering Information

Cat. No.	Description	Ship Wt. lb (kg)
281B-PL	Heat Detector, 135°F (57°C), Rate-of-Rise and Fixed Temperature	1.0 (0.5)
282B-PL	Heat Detector, 194°F (90°C), Rate-of-Rise and Fixed Temperature	
283B-PL	Heat Detector, 135°F (57°C), Fixed Temperature	
284B-PL	Heat Detector, 194°F (90°C), Fixed Temperature	

Detector Accessories	
280A-PL	Plastic Mounting Plate – White, Reversible (included)

Chapter 32 THERMOSTAT

MANUFACTURER/DISTRIBUTOR:

S.C.I. Montréal Inc.
3311, boul. Industriel
Laval Qc H7L 4S3
T : 450-668-8866
T : 514-990-8866
1-800-667-8866
info@scimtl.ca

32.1 **HONEYWELL T775M2048 TEMPERATURE CONTROLER**

32.2 **HONEYWELL T631A1162 THERMOSTAT RED SQUARE**

32.3 **HONEYWELL T87K1015 THERMOSTAT ROUND**

Honeywell

T775A/B/M Series 2000 Electronic Stand-Alone Controllers

INSTALLATION INSTRUCTIONS

PRODUCT DESCRIPTION

The T775 electronic stand-alone controllers are the next generation of commercial and agricultural controls capable of remote sensing of temperature and providing switched and/or proportional outputs to various types of loads.

Five models have analog (modulating) outputs for actuator and motor control, and NEMA-4 weatherproof enclosures are available for wet environments.

IMPORTANT

Each T775A/B/M controller is an operating control, not a limit or safety control. If used in applications requiring safety or limit controls, a separate safety or limit control device is required.

Table 1. T775A/B/M Controller Configurations.

Controller Model[a]	Description	Replaces	SPDT Relay Outputs	Analog (Mod) Outputs[b]	Floating Outputs[c]	Sensor Inputs	Nbr of Sensors Included	Enclosure
T775A2009	Standard	T775A1001	1	None	None	1	1	NEMA 1
T775B2016	Standard	N/A	2	None	1	2	1	NEMA 4X
T775B2024	Standard	T775C1009 T775D1008	4	None	2	2	1	NEMA 4X
T775B2032	Standard	T775A1019 T775B1000	2	None	1	2	1	NEMA 1
T775B2040	Standard	T775A1027 T775A1035 T775B1018 T775B1026 T775B1042	4	None	2	2	1	NEMA 1
T775M2006	Modulating	N/A	None	2	N/A	2	1	NEMA 1
T775M2014	Modulating	T775G1005 T775G1013 T775G1021 T775G1039	4	2	N/A	2[d]	1	NEMA 4X
T775M2022	Modulating	N/A	2	2	N/A	2[d]	1	NEMA 4X
T775M2030	Modulating	T775E1114 T775F1022 T775F1055 T775F1089	4	2	N/A	2[d]	1	NEMA 1
T775M2048	Modulating	T775E1015 T775E1023 T775E1056 T775E1064 T775E1098	2	2	N/A	2[d]	1	NEMA 1

[a] All models include a digital input for use with the disable or setback option.
[b] The modulating (analog) outputs are 4-20 mA, 0-10 Vdc, 2-10 Vdc, or Series 90 selectable.
[c] Each floating output eliminates two SPDT relays.
[d] These models can support a high/low modulating limit at Sensor B for temperature control at Sensor A.

358/665
62-0254-13

Temperature Sensors[a]

The controller accepts 1,097 Ohms PTC at 77°F (25°C):
- 50021579-001 – Standard sensor (included with all models except NEMA 4X models)
- T775-SENS-STRAP– Strap on sensor with wiring box
- T775-SENS-WR – Water resistant with 5 foot leads (included with NEMA 4X models)
- T775-SENS-WT – Watertight with 6 foot lead
- T775-SENS-OAT – Outdoor air temperature sensor
- C7031B2005 – 6 inch duct mount with wiring box
- C7031D2003 – 5 inch immersion sensor with wiring box (use immersion well; P/N 50001774-001)
- C7031J2009 – 12 foot duct averaging sensor with wiring box
- C7046D1008 – 8 inch duct probe with mounting flange
- C7100D1001 – 12 inch fast response, duct averaging sensor with flange
- C7130B1009 – Room mount sensor

[a] See form 62-0265 - *Temperature Sensors for the T775 Series 2000 Stand-alone Controller*

Accessories

- 107324A – Bulb Holder, duct insertion
- 107408 – Heat Conductive Compound, 4 ounce
- 50001774-001 – Immersion Well, stainless steel 304, 1/2 in. threading.

Product Changes

Below are the changes to T775A/B/M models starting with Series 3 (March 2009). Series 3 can be identified by the sideways 3 after the part number on the device label.

1. Modulating high and low limit now both function in either the heat or the cool mode.
2. MIN ON added.
3. SYNC added.
4. Differential and throttling range increased to 300°F.
5. Setpoint and Enable options added to the DI options.
6. HIDE option added to MOD1 and MOD2 (to hide them on the home screen).

Controller Dimensions

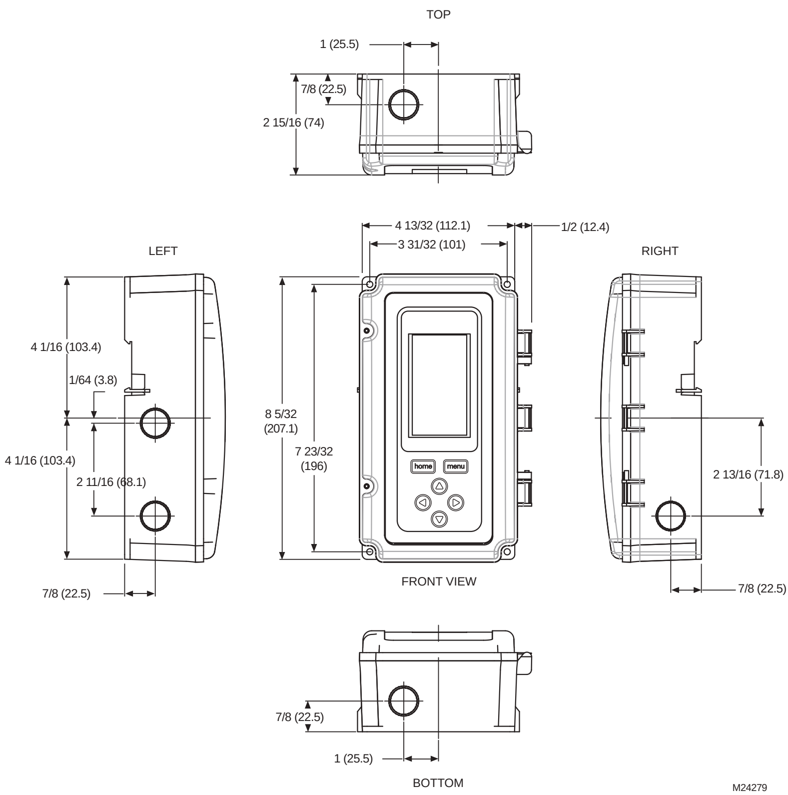


Fig. 1. T775A/B/M Dimensions in inches (mm).

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BEFORE INSTALLATION

Review the “SPECIFICATIONS” on page 35 before installing the controller.

When Installing This Product

1. Read these instructions carefully. Failure to follow them could damage the product or cause a hazardous condition.
2. Check ratings given in instructions and on the product to ensure the product is suitable for your application.
3. Installer must be a trained, experienced service technician.
4. After installation is complete, check out product operation as provided in these instructions.

INSTALLATION AND SETUP

The following installation procedures are typically performed in the order listed:

1. Mounting — See “MOUNTING” below.
2. Wiring — See “WIRING” on this page.
3. Checkout — See page 11.
4. Programming — See page 14.
5. Scheduling (optional) — See page 30.

Additional topics are:
- Temperature sensor calibration begins on page 11.
- Interface overview begins on page 12.
- Setup (for advanced options) begins on page 17.
- Summary menu begins on page 34.
- Troubleshooting begins on page 34.

MOUNTING

This section describes the mounting procedures for the controller and temperature sensor(s).

Controller Mounting

IMPORTANT

Avoid mounting in areas where acid fumes or other deteriorating vapors can attack the metal parts of the controller circuit board, or in areas where escaping gas or other explosive vapors are present.

IMPORTANT

The controller must be mounted in a position that allows clearance for wiring, servicing, and removal.

Use a screwdriver to pry out only the knockouts that you will use.

If mounting on DIN rail, be sure to remove the knockouts before mounting. See “Controller Wiring” on page 5 and Fig. 7 on page 6 for recommended knockout usage and locations. If you do not use an opened knockout be sure to cover it.

Mount the controller on any convenient interior location using the four mounting holes provided on the back of the enclosure using #6 or #8 screws (screws are not provided and must be obtained separately). Use controller dimensions in Fig. 1 on page 2 as a guide.

The controller may be mounted in any orientation. However, mounting in the orientation shown in Fig. 1 on page 2 permits proper viewing of the LCD display and use of the keypad.

NEMA 4 Enclosure Mounting

For models with NEMA 4 enclosures, ensure that waterproof wire/conduit fittings are used at the knockouts for all wiring attachments. Refer to Fig. 7 on page 6 for knockout locations.

IMPORTANT

For NEMA 4 enclosures, be sure to cover and seal all unused open knockouts.

Temperature Sensor(s) Mounting and Location

Temperature sensors may be located up to 1,000 feet (304 m) from the T775A/B/M controller. Refer to Table 3 on page 11 for calibration guidelines.

The sensors may be mounted on a wall or panel for sensing space temperature, strapped to a pipe or inserted in an immersion well (see Fig. 2) for hot or cold water sensing, or taped to a standard cap or bulb holder for duct air sensing. To prevent moisture or condensation entering the sensor through the lead wire holes, mount the sensor with the lead wires exiting the bottom of the sensor.

NOTES:
1. The included sensor is not designed for very wet applications. For immersion applications, an immersion well is used.
2. Heat conductive compound must be used in immersion wells.
3. Refer to the list of temperature sensors on page 2 for this type of installation

.

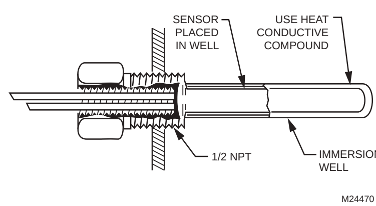

Fig. 2. Sensor Inserted in Immersion Well.

NOTE: Multiple sensors may be parallel-series wired to sense average temperatures in large spaces. Refer to Fig. 3 on page 4.

WIRING

All wiring must comply with applicable electrical codes and ordinances, or as specified on installation wiring diagrams. Controller wiring is terminated to the screw terminal blocks located inside the device.

The remainder of this section describes the temperature sensor wiring and the T775A/B/M controller wiring.

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Wiring Connections Access

To access the wiring connections, remove the two screws on the left side of the enclosure and gently swing open the top. Be careful to not stress the ribbon cables that connect the keypad and LCD display to the controller circuit board.

Temperature Sensor Wiring

⚠ CAUTION

Electrical Shock Hazard.
Can short equipment circuitry.
Make sure that metal tube of sensor does not short against T terminals in wall-mounted case.

IMPORTANT

Poor wiring practices can cause erratic readings from the sensor. Avoid the following to ensure proper operation:

- *Do not route the temperature sensor wiring with building power wiring.*
- *Do not locate the temperature sensor wiring next to control contactors.*
- *Do not locate the temperature sensor wiring near electrical motors.*
- *Do not locate the temperature sensor wiring near welding equipment.*
- *Make sure good mechanical connections are made to both the sensor and the controller.*
- *Do not mount the sensor with the lead wire end pointing up in an area where condensation can occur.*

If any of the above conditions cannot be avoided, use shielded cable.

NOTE: Each T775 controller must be wired to its own sensor(s). However, a benefit of the T775 controller's accuracy is that there is no more than a 2° F (-7° C) differential between any two T775 controllers.

Multiple Parallel Sensors

Multiple sensors can be parallel-series wired to sense average temperatures in large spaces. To maintain control accuracy, the number of sensors to be parallel-series wired must be of the n^2 power (for example, 4, 9, 16, etc.). Refer to Fig. 3

.

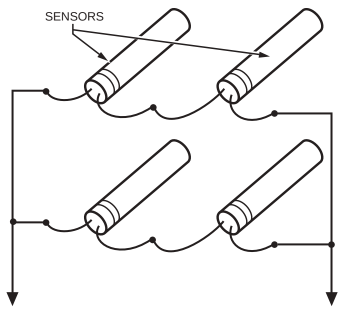

Fig. 3. Parallel-Series Wiring of Sensors.

Temperature Sensor Wire Type and Size

Temperature sensors use standard AWG 18/2 unshielded wire. For cable runs greater than 25 feet or where electrical interference may be a problem, shielded cable is recommended (See Fig. 4).

Refer to "Temperature Sensor Calibration" on page 11 for wire size selection where cable runs are longer than 25 feet.

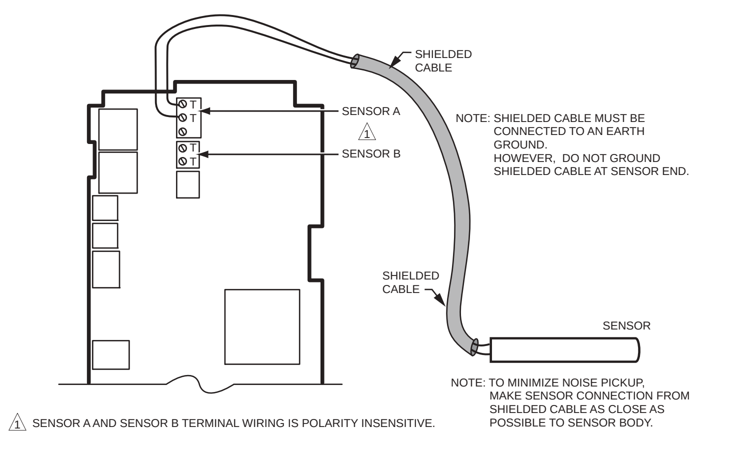

Fig. 4. Sensor Wiring — Showing Shielded Cable Connection to Sensor A.

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Controller Wiring

WARNING
Electrical Shock Hazard.
Can cause severe injury, death or property damage.
Disconnect power supply before beginning wiring, or making wiring connections, to prevent electrical shock or equipment damage.

CAUTION
Do not use 24 Vac power to power any external loads if 120 Vac or 240 Vac is used to power the T775A/B/M controller.

CAUTION
A separate earth ground is required.
Equipment damage can result if the earth ground is not connected. See Fig. 5 and Table 2 on page 6.

CAUTION
Equipment Damage Hazard.
Electrostatic discharge can short equipment circuitry.
Ensure that you are properly grounded before handling the unit

.

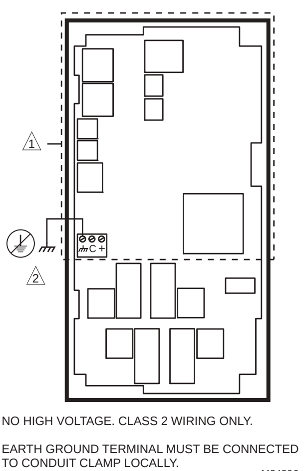

Fig. 5. Earth Ground.

IMPORTANT
Poor wiring practices can cause erratic readings from the sensor. To ensure proper operation, ensure that good mechanical connections are made to both the sensor and the controller.

IMPORTANT
When wiring the input power, only one source of power can be applied to the T775A/B/M controller (24 Vac or 120 Vac or 240 Vac).

See Fig. 7 on page 6 for locating the appropriate power input, remote sensors input, low voltage, contact closure, and load output terminals.

Access to the terminals can be gained through standard conduit knockouts (A through E in Fig. 7 on page 6) located around the perimeter of the enclosure:
- Knockouts A and B should be used only for sensor and low-voltage wiring.
- Knockouts C, D, and E can be used to gain access to the load relay output terminals and 120/240 Vac power wiring.

Controller Wiring Method

Wire the sensors and outputs, then wire the power connection.

Each terminal can accommodate the following gauges of wire:
- Single wire – from 14 AWG to 22 AWG solid or stranded
- Multiple wires – up to two 22 AWG stranded

For 24, 120, or 240 Vac power connections:
- Single wire – from 14 to 18 AWG solid or stranded

Prepare wiring for the terminal blocks, as follows:
1. Strip 1/2 in. (13 mm) insulation from the conductor.
2. Cut a single wire to 3/16 in. (5 mm). Insert the wire in the required terminal location and tighten the screw.
3. If two or more wires are being inserted into one terminal location, twist the wires together a minimum of three turns before inserting them to ensure proper electrical contact.
4. Cut the twisted end of the wires to 3/16 in. (5 mm) before inserting them into the terminal and tightening the screw.
5. Pull on each wire in all terminals to check for good mechanical connection

.

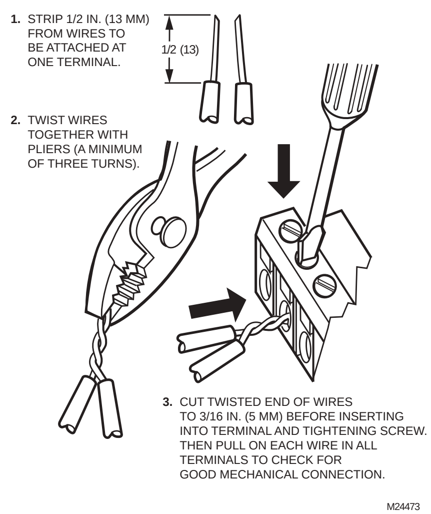

Fig. 6. Attaching Two or More Wires at Terminal Blocks.

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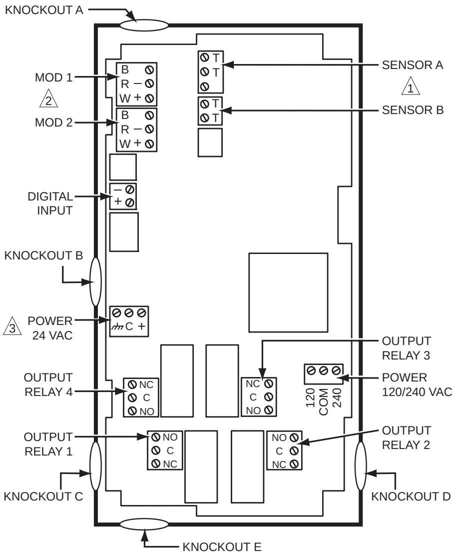
Controller Wiring Details

The wiring connection terminals are shown in Fig. 7 and are described in Table 2.

See Fig. 8 – 22 beginning on page 6 for typical T775A/B/M wiring applications.



1 SENSORS A AND B USE THE TWO TT CONNECTIONS AND ARE POLARITY INSENSITIVE.

2 FOR MOD 1 AND MOD 2 CURRENT (mA) OR VOLTAGE (VDC) OUTPUT, USE SIGNAL (+) & COMMON (-).
FOR MOD 1 AND MOD 2 SERIES 90 OUTPUT, USE W, R, & B.

3 A SEPARATE EARTH GROUND IS REQUIRED FOR ANY POWER SOURCE (24, 120, OR 240 VAC).

M24474

Fig. 7. T775A/B/M Terminal and Feature Locations.

NOTE: Refer to Table 1 on page 1 for the specific configuration of sensors and outputs supported by the model you are installing.

NOTE: For NEMA 4 enclosures, use waterproof fittings for wiring/conduit connections at knockouts.

Table 2. Description of Wiring Terminal Connections.

Connection	Terminal Label	Description
	Sensors	
Sensor A	T T	Temperature Sensor; polarity insensitive
Sensor B		
	Outputs	
Relay 1 Relay 2 Relay 3 Relay 4	NO COM NC	120-240 Vac Relay Output
Mod 1	+ - (Vdc or mA)	Modulating Output
Mod 2	W R B (Series 90)[a]	

Table 2. Description of Wiring Terminal Connections. (Continued)

Connection	Terminal Label	Description
	Input	
DI	+ -	Digital Input (dry contact)
	24 Vac Power	
24V +	+	24 Vac Hot
Common	C	24 Vac Common
Ground	⏚	Earth Ground[b]
	120 or 240 Vac Power	
120 Vac	120	120 Vac Power
Common	COM	Common
240 Vac	240	240 Vac Power

[a] For Series 90 connections, you must insert a 340 Ohm resistor across terminals R and W. Refer to Fig. 19 on page 9. The resistor is included with the controller.

[b] A separate earth ground is required for all installations regardless of the power source (24, 120, or 240 Vac). Refer to Fig. 5 on page 5.

WIRING APPLICATIONS (EXAMPLES)

Fig. 8 – 22 illustrate typical controller wiring for various applications.

NOTE: The electronic Series 90 output provided with modulating T775 models can not drive electro-mechanical slidewire devices like older Series 3 modulating meters (prior to Series 6), V9055s, and S984s.

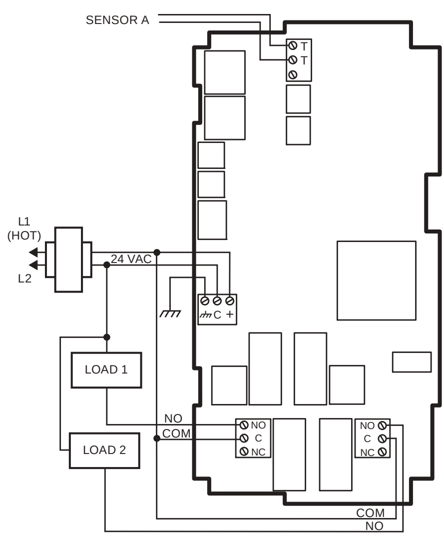


Fig. 8. Wiring for Two-Stage Control – 24 Vac Input and 24 Vac Load.

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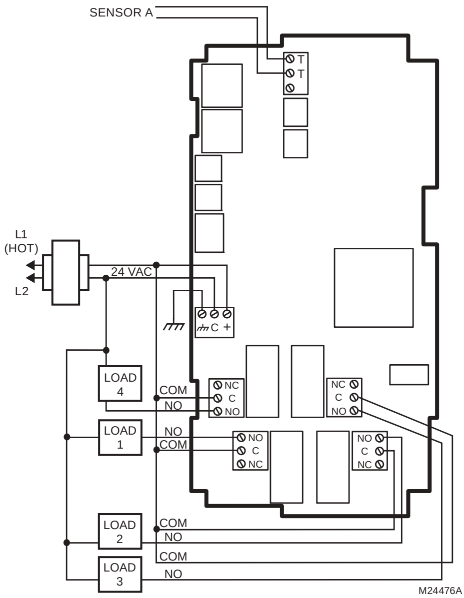

Fig. 9. Wiring for Four-Stage Control – 24 Vac Input and 24 Vac Load.

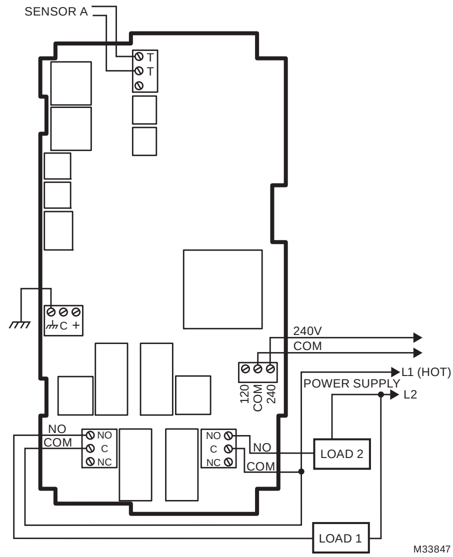

Fig. 11. Wiring for Two-Stage Control with 240 Vac.

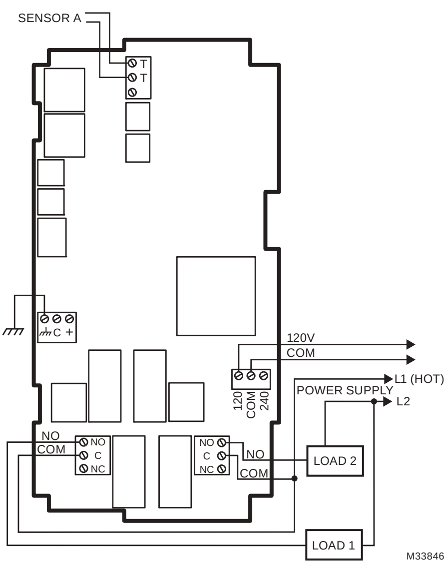

Fig. 10. Wiring for Two-Stage Control with 120 Vac (120 Vac Input and 120 Vac Load Shown).

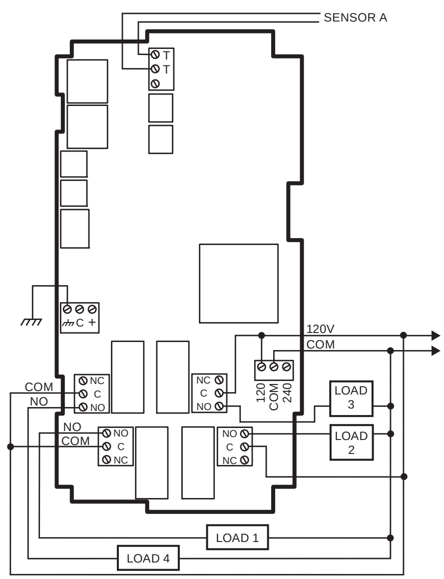

Fig. 12. Wiring for Four-Stage Control with 120 Vac (120 Vac Input and 120 Vac Load Shown).

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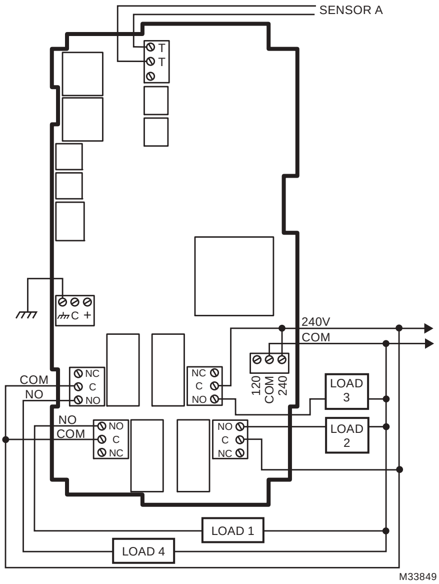
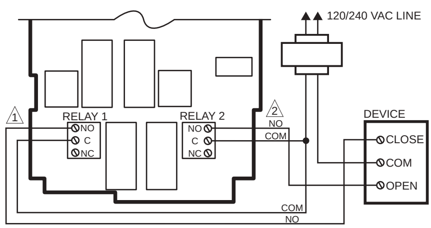


Fig. 13. Wiring for Four-Stage Control with 240 Vac.



1 CLOSE RELAY TO DRIVE DEVICE CLOSED. RELAY 1 SHOWN. (RELAYS 1 AND 3 ARE USED FOR CLOSE).

2 CLOSE RELAY TO DRIVE DEVICE OPEN. RELAY 2 SHOWN. (RELAYS 2 AND 4 ARE USED FOR OPEN).

THE RELAYS MUST BE WIRED IN PAIRS WITH RELAYS 1 AND 2 BEING THE FIRST PAIR, AND RELAYS 3 AND 4 BEING THE SECOND PAIR.

M31361

Fig. 14. Wiring for Floating Output (Relay 1 and Relay 2 Pair Shown)

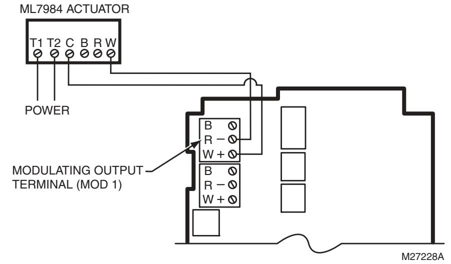


Fig. 15. Wiring for ML7984 Valve Actuator (Using 4 to 20 mA Signal)

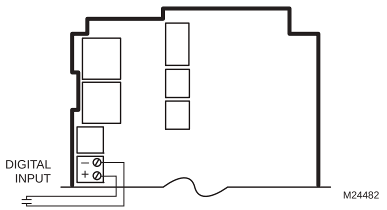
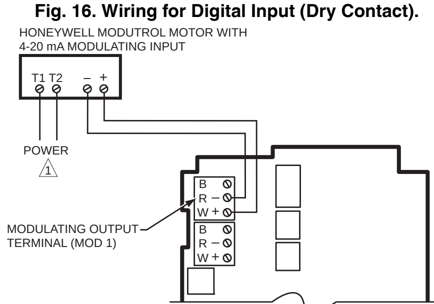


Fig. 16. Wiring for Digital Input (Dry Contact).



1 USE SEPARATE TRANSFORMER FOR T775R WHEN USING 24 VAC.

M24481A

Fig. 17. Wiring for Mod Motor or Direct Coupled Actuator with 4 to 20 mA Control Input

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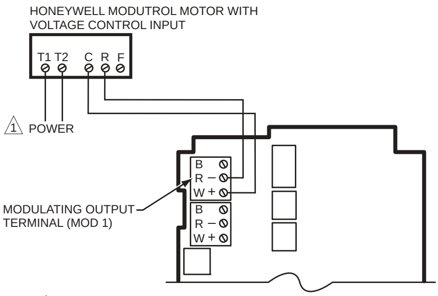
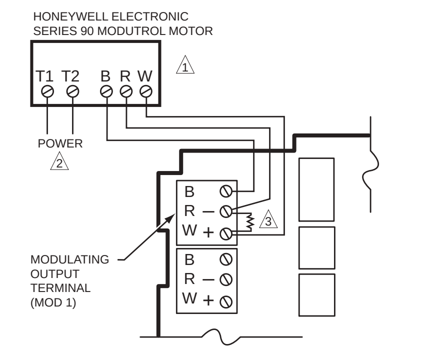


1 USE SEPARATE TRANSFORMER FOR T775R WHEN USING 24 VAC.

M24483A

Fig. 18. Wiring for Mod Motor or Direct Coupled Actuator with 0 to 10 Vdc Control Input



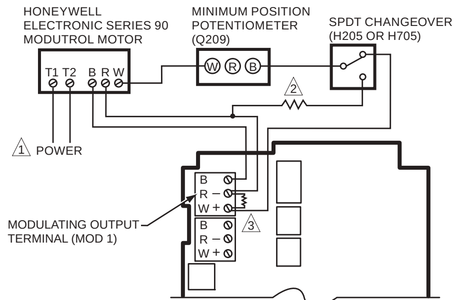
1 TO VERIFY OUTPUT, TEST OPEN CIRCUIT VOLTAGE BETWEEN THE MOD 1 TERMINALS W AND R.
- MINIMUM (DRIVE CLOSED) SIGNAL LESS THAN 0.17 VDC
- MAXIMUM (DRIVE OPEN) SIGNAL IS GREATER THAN 1.7 VDC

2 USE SEPARATE TRANSFORMER FOR T775R WHEN USING 24 VAC.

3 INSERT 340 OHM RESISTOR (INCLUDED) ACROSS TERMINALS R AND W.

M24484A

Fig. 19. Wiring for Series 90 Modutrol Motor Control



1 USE SEPARATE TRANSFORMER FOR T775R WHEN USING 24 VAC.

2 A 250 OHM RESISTOR PROVIDES 40% AUTHORITY WHEN USING A 150 OHM MINIMUM POSITION POTENTIOMETER.

3 INSERT 340 OHM RESISTOR (INCLUDED) ACROSS TERMINALS R AND W.

M24485A

Fig. 20. Wiring for Changeover Relay and Minimum Position Potentiometer Used with Series 90 Modutrol Motors.

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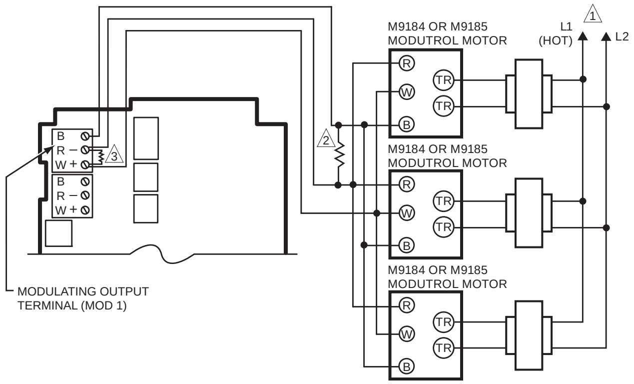
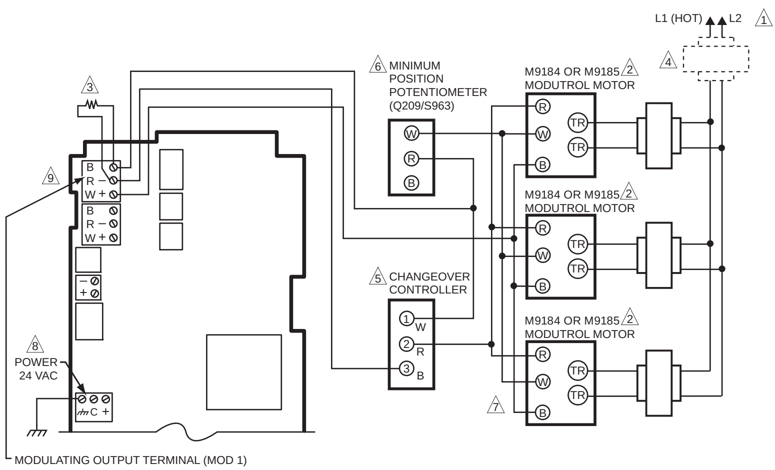


1. POWER SUPPLY. PROVIDE DISCONNECT MEANS AND OVERLOAD PROTECTION AS REQUIRED.
2. USE A 1300 OHM RESISTOR FOR TWO MOTORS, 910 OHM RESISTOR FOR THREE MOTORS. THE 407EAU RESISTOR KIT, WHICH IS SHIPPED WITH THE M9184 AND M9185 MOTORS, INCLUDES BOTH RESISTORS.
3. INSERT 340 OHM RESISTOR (INCLUDED) ACROSS TERMINALS R AND W.

M24486

Fig. 21. Wiring for Three Series 90 Modutrol Motors

.



1. POWER SUPPLY. PROVIDE DISCONNECT MEANS AND OVERLOAD PROTECTION AS REQUIRED.
2. UP TO SIX SIMILAR MOTORS CAN BE CONNECTED IN UNISON.
3. USE RESISTOR BETWEEN R AND B ON THE MOD 1 TERMINAL: 1300 OHMS FOR TWO MOTORS; 910 OHMS FOR THREE MOTORS (4074EAU KIT).
4. IF COMMON TRANSFORMER IS USED, ALL MOTORS MUST BE IN PHASE. CONNECT THE SAME TRANSFORMER LEAD TO T1 ON EACH MOTOR, CONNECT THE OTHER TRANSFORMER LEAD TO T2 ON EACH MOTOR.
5. USE TEMPERATURE CONTROLLER SUCH AS H205 OR H705, OR T675A FOR CHANGEOVER CONTROL.
6. AUTHORITY OF MINIMUM POSITION POTENTIOMETER, IF USED, INCREASES WITH THE NUMBER OF MOTORS IN PARALLEL. WITH ONE MOTOR, 50% STROKE; WITH TWO MOTORS, 100% STROKE; WITH THREE MOTORS, 100% STROKE WITH 1/3 OF FULL POTENTIOMETER ROTATION.
7. REVERSING THE B AND W TERMINALS ON ONE OR MORE MOTORS WILL NOT AFFECT CONTROL PERFORMANCE ON THE OTHER MOTORS. THE SYSTEM CAN BE CONFIGURED TO HAVE SOME MOTORS BE REVERSE ACTING AND OTHER MOTORS BE DIRECT ACTING.
8. USE SEPARATE TRANSFORMER FOR T775 WHEN POWERING FROM 24 VAC.
9. THE SYSTEM IS SHOWN CONNECTED FOR COOLING. FOR HEATING, REVERSE THE W AND B LEADS OF THE MODULATING OUTPUT ON THE T775 CONTROLLER.

M24487

Fig. 22. Wiring for Unison Control of M9184 or M9185 Modutrol IV Motor Using One Minimum Position Potentiometer for All Motors.

CHECKOUT

Inspect all wiring connections at the controller terminals, and verify compliance with the installation wiring diagrams.

⚠ WARNING

Electrical Shock Hazard.
Can cause severe injury, death or property damage.
Disconnect power supply before beginning wiring or making wiring connections, to prevent electrical shock or equipment damage.

If any wiring changes are required, *first* be sure to remove power from the controller *before* starting work. Pay particular attention to verifying the power connection (24, 120, or 240 Vac).

After the controller is installed and wired, apply power.

Power Loss

The date and time settings are retained for 24 hours after a power outage. After a power loss of more than 24 hours, the date and time settings may need to be reentered. All other settings are stored permanently.

Temperature Sensor Calibration

As wire length increases, resistance increases and thus the temperature reading increases. If necessary, calibrate the sensor input by reducing the value by the amount shown in the Table 3. For example, a wire run with 18 gauge wire of 1,000 feet, requires a calibration offset of -6.0° F (-21° C).

IMPORTANT

If the calibration value in the table exceeds the controller's calibration limits of +/-10° F (+/-6° C), you must use a heavier gauge wire.

For example, with a wire run of 1,000 feet you must use 20 AWG wire or heavier in order to calibrate for wire loss within the limits of the controller.

See "2.2.2.2. CALIBRATE (the sensor)" on page 18 for the instructions to enter the calibration value.

Table 3. Temperature Sensor Calibration for Resistance Loss Due to Wire Length.

AWG Rating	mΩ/ft	Temperature Offset in °F (Foot)[a]		
		200 ft	500 ft	1,000 ft
14	2.5	0.46	1.14	2.28
16	4.0	0.72	1.82	3.64
18	6.4	1.16	2.90	5.82
20	10.2	1.86	4.64	9.28
22	16.1	2.92	7.32	14.64
AWG Rating	mΩ/m	Temperature Offset in °C (Meter)[a]		
		100 m	200 m	300 m
14	8.3	0.44	0.86	1.30
16	13.2	0.68	1.38	2.06
18	21.0	1.10	2.18	3.28
20	33.5	1.74	3.48	5.22
22	52.8	2.74	5.48	8.22

[a] This is the distance from the controller to the sensor (already accounts for round trip distance).

Fig. 23 shows how sensor resistance varies with temperature for a sensor having a positive temperature coefficient (PTC) of 2.1 Ohms per degree F (3.85 Ohms per degree C)

.

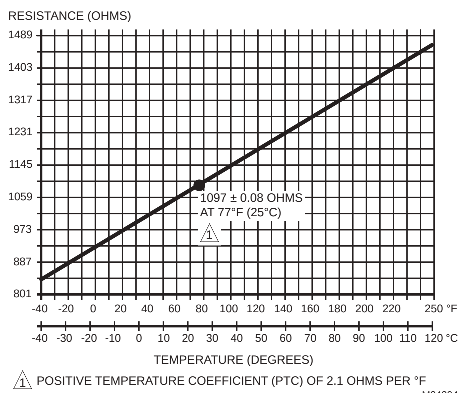


Fig. 23. Sensor Resistance vs. Temperature.

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INTERFACE OVERVIEW

The T775A/B/M controllers use an LCD panel and 6-button keypad to provide status information and permit user input of the programming, setup, and scheduling parameters.

The following figure describes the display areas of the LCD and the keypad

.

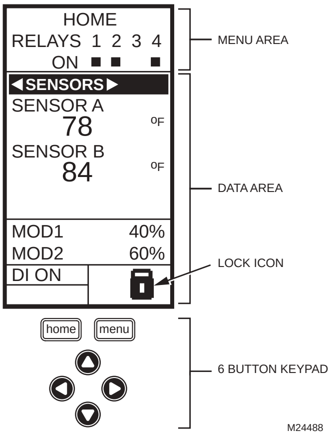

Fig. 24. LCD Display - Home Screen And Keypad.

Menu Area – On the home screen, the LCD displays the configured relays and whether they are active. In Program, Setup or Schedule mode, the LCD displays the current menu selection and its order within the menu hierarchy.

Data Area – On the home screen, the LCD displays the sensors and outputs status. In Setup or Program mode, the LCD displays menu choices, parameter selections, and data values.

Lock Icon – The icon indicates the **MENU** button is locked and prevents access to the Setup and Program menus.

NOTE: Pressing and holding the HOME and MENU buttons simultaneously for five seconds locks/unlocks the MENU button.

6-Button Keypad – The keypad is used to access the menus and enter values (See "Using the LCD Panel Interface").

Using the LCD Panel Interface

The 6-button keypad is used to move through the menus and enter or change parameter values.

Home Button

Pressing the **HOME** button at any time exits the current Programming or Setup display screen and returns to the home screen as shown in Fig. 24 and Fig. 25.

Menu Button

- Pressing the **MENU** button always displays the Program menu. If you are in Setup mode, you exit setup and return to the Program menu.
- **Pressing and holding the MENU button for five seconds leaves the current screen and displays the Setup menu.**

Left and Right Arrow Buttons (◀ and ▶)

Use these buttons to move backward (◀) and forward (▶) through the Program and Setup menus.

Up and Down Arrow Buttons (▲ and ▼)

Use these buttons to move your selection up and down through a menu or list.

- When the desired item is highlighted, you press the ▶ arrow button to display that item's content.
- When a value is displayed (e.g. 70° F), the up and down arrows increase and decrease the value.

NOTE: Once you select an item from a list or enter a value, pressing the ◀ or ▶ or HOME button accepts your selection or value and stores it in the controller's memory.

Home Screen

In the normal run state, the LCD home screen displays the current sensed temperatures, the modulating outputs status, the active status of the output relays, and error and status codes.

Active relays are indicated by the small black square (■) just below the relay number. Fig. 25 shows the home screen with relays 1, 2, and 4 energized.

Pressing the ◀ and ▶ buttons from the home screen cycles through each modulating output that is paired with the sensor it controls and the active output relays

.

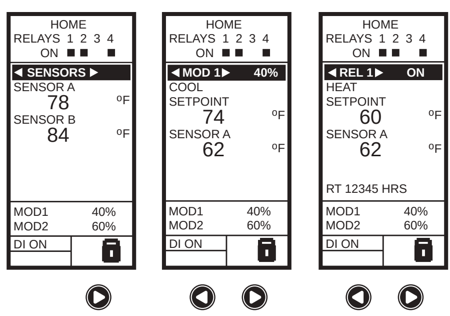

Fig. 25. LCD Display - Home Screen Displaying Sensors, Active Relays, and Mod Outputs.

NOTE: The modulating output home screen and the relay home screen do not dynamically update the active relay status, sensor values, and modulating output percentages. The information is a snapshot taken when you press the ◀ or ▶ button to display the screen.

IMPORTANT

After four minutes of inactivity (no buttons pressed), the LCD display reverts to the home screen display.

Accessing the Menus

Menus are used for programming, scheduling, viewing the summary settings, and setup of advanced options.

Programming, Scheduling, and Summary Menus

To access these menus from the home screen, press the **MENU** button (See Fig. 26)

.

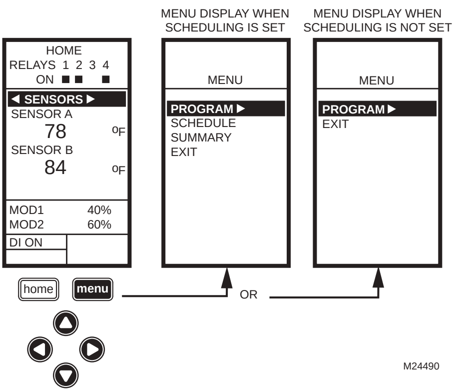

Fig. 26. Menus.

Depending on whether scheduling is enabled or not, the LCD displays one of two menus as shown in Fig. 26. Scheduling is enabled from the Setup menu's Output settings (See "2.3.3.1. USE SCHED" on page 25).

Setup Menu

To access the Setup menu, press and hold the **MENU** button for five seconds (Refer to Fig. 27).

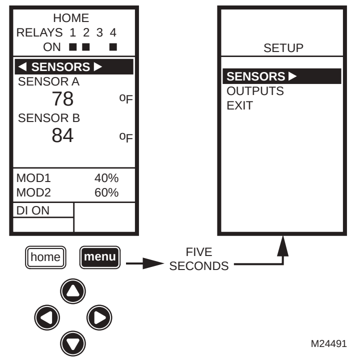

Fig. 27. Setup Menu.

Using the Menus

When you are working with the menus, use the:

- **Left arrow button (◀) to scroll backward through the menus •Right arrow button** (▶) to select the highlighted menu item and display its content
- **Up and Down arrow buttons** (▲ and ▼) to scroll up and down through a list of items or to increase or decrease the value of a displayed parameter

NOTE: If you press the HOME button or there is no keypad activity for four minutes, you exit Program mode and return to the home screen.

If you press the MENU button, you exit and return to the menu.

1. PROGRAMMING

The controller must be programmed before being placed into service.

IMPORTANT

During programming, the controller is live at all times. For example, the contacts may open and close when adjusting the setpoint.

The Programming process uses a hierarchical menu structure that is easy to use. You press the ◀ and ▶ arrow buttons to move forward and backward through the menus.

NOTES:

1. The controller interface is intuitive. You may find that you do not need the following procedure instructions to program the controller. You may want to use this procedure simply as a reference to locate the particular option or parameter of interest.
2. The menus can display only those relays that are defined in Setup (See “2.3.2. NBR OF RELAYS” on page 24). For example, if you configure only two relays, then only two relays display on the appropriate menus.
3. If you press the **HOME** button or there is no keypad activity for four minutes, you exit Program mode and return to the home screen.
4. If you press the **MENU** button, you exit Program mode and return to the menu.

Setpoint and Differential

The following describes the relationship between setpoint and differential for heating and cooling. These settings are programmed for each output relay.

Heating Mode Setpoint and Differential

In heating mode, the differential is below the setpoint. The relay de-energizes when the temperature rises to the setpoint. As the temperature drops to the setpoint minus the differential, the relay energizes.

Cooling Mode Setpoint and Differential

In cooling mode, the differential is above the setpoint. The relay de-energizes when the temperature falls to the setpoint. As the temperature rises to the setpoint plus the differential, the relay energizes.

Setpoint High Limit

You can set a single irreversible setpoint high limit maximum value, which is applied to all outputs.

Adjust the setpoint (at any output) to the desired maximum setpoint. Then, simultaneously press the **home,** ◀ , and ▶ buttons and continue to press all three buttons for five seconds to set the setpoint high limit maximum to this value.

NOTE: You must press all three buttons at exactly the same time for this action to occur.

IMPORTANT

1. *This action sets the maximum setpoint value of* ***all*** *outputs to the setpoint high limit maximum.*
2. *Setting the high limit setpoint maximum is* ***irreversible****. If you perform the action inadvertently gently and this setpoint adversely affects the control of your system, you must replace the controller.*

Programming the T775A/B/M Controller

To program the controller, perform the following procedures in the order listed:

1. Enter Program mode — see “1.1. Entering Program Mode”
2. Program the Outputs — see “1.2. Program Menu for Outputs”

When programming is complete, you may continue with “3. SCHEDULING” on page 30 or, for advanced options, continue with “2. SETUP (ADVANCED OPTIONS)” on page 17.

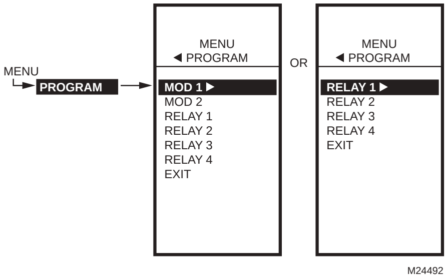

Fig. 28. Program Menu.

1.1. Entering Program Mode

Press the **MENU** button, then select PROGRAM and press the ▶ button to view the Program menu.

Fig. 28 shows the Program menus for controllers with and without Modulating Outputs.

NOTE: Modulating outputs are not available on the T775A and T775B controller models.

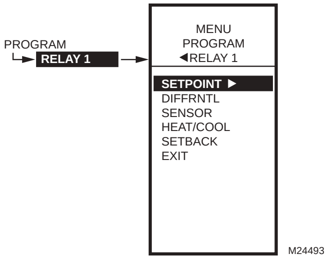

Fig. 29. Program Menu Outputs.

1.2. Program Menu for Outputs

Press the **MENU** button, select PROGRAM, then select RELAY 1 (or MOD 1) to view the parameters. Fig. 29 shows RELAY 1.

NOTE: For MOD 1 and 2, THROT RNG replaces DIFFRNTL.

NOTE: The Setback parameter displays only if scheduling is enabled (See Fig. 57 on page 24) or the DI Option is set to Setback. (See Fig. 60 on page 26).

Continue with “1.2.1. SETPOINT”.

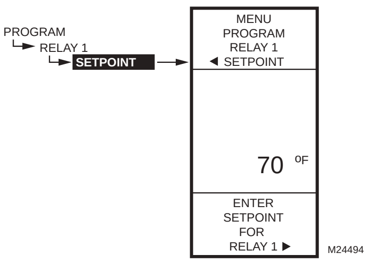

Fig. 30. Program - Setpoint.

1.2.1. SETPOINT

1. From the menu, use the ▲ and ▼ buttons to highlight SETPOINT.
2. Press the ▶ button to display the setpoint value.
3. Use the ▲ and ▼ buttons to increase/decrease the desired setpoint temperature.
   Default: 70° F (21° C)
   Range: -40° to 248° F (-40° to 120° C)
4. Press the ▶ button to accept the setpoint temperature and display the next option.

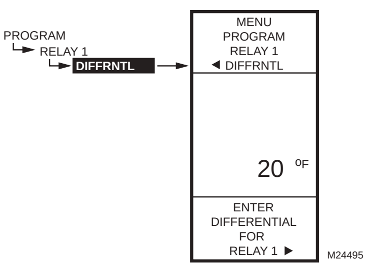

Fig. 31. Program - Differential or Throttling Range.

1.2.2. DIFFERENTIAL or THROTTLING RANGE

Differential is used for Relay outputs and Throttling Range is used for Modulating outputs.

1. From the menu, use the ▲ and ▼ buttons to highlight THROT RNG or DIFFERNTL.
2. Press the ▶ button to display the throttling range value.
3. Use the ▲ and ▼ buttons to increase/decrease the desired value.
   Default: 20° F (-7° C)
   Range: 1° to 300° F (1° to 149° C).
4. Press the ▶ button to accept the value and display the next option.

In heating mode, the Differential is below the setpoint. The relay de-energizes when the temperature rises to the setpoint. As the temperature drops to the setpoint minus the Differential, the relay energizes.

In cooling mode, the Differential is above the setpoint. The relay de-energizes when the temperature falls to the setpoint. As the temperature rises to the setpoint plus the Differential, the relay energizes.

The Throttling Range brackets the setpoint setting, e.g., if the setpoint is 72°F (22° C) and the throttling range is 10° F (-12° C), then the effective throttling temperature range is 67° to 77° F (19° to 25° C). This applies to both modulating outputs and floating outputs.

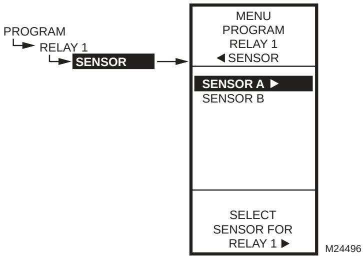

Fig. 32. Program - Sensor.

1.2.3. SENSOR

1. From the menu, use the ▲ and ▼ buttons to highlight SENSOR.
2. Press the ▶ button to display the sensor selections.
3. Use the ▲ and ▼ buttons to select Sensor A or B.
4. Press the ▶ button to accept the highlighted sensor and display the next option.

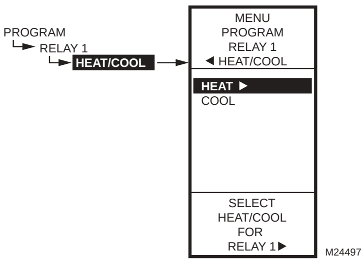

Fig. 33. Program - Heat/Cool.

1.2.4. HEAT/COOL

1. From the menu, use the ▲ and ▼ buttons to highlight HEAT/COOL.
   Default: HEAT
2. Press the ▶ button to display the heat and cool selections.
3. Use the ▲ and ▼ buttons to select Heat or Cool.
4. Press the ▶ button to accept the highlighted selection and display the next option.

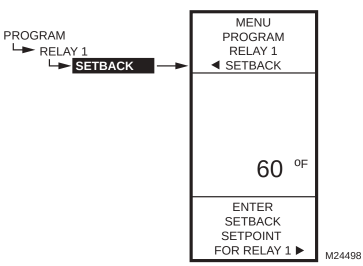

Fig. 34. Program - Setback.

1.2.5. SETBACK

The Setback temperature option displays if scheduling is enabled (See Fig. 57 on page 24) or the DI Option is set to Setback. (See Fig. 60 on page 26).

This is the desired setpoint temperature that you want to use during setback mode for this output. For example, if your setpoint is 70° F (21° C) and you want the temperature to drop 10° F during setback mode, enter 60° F (16° C) as the setpoint for this output.

1. From the menu, use the ▲ and ▼ buttons to highlight SETBACK.
2. Use the ▲ and ▼ buttons to increase/decrease the desired setpoint temperature.
   Default: 60° F (16° C)
   Range: -40° to 248° F (-40° to 120° C)
3. Press the ▶ button to accept the value and display the menu.

1.2.6. Program Next Output (Mod or Relay)

For the next output (Mod or Relay), select the desired output from the Program menu (Refer to Fig. 28 on page 14).

Go to “1.2.1. SETPOINT” on page 15 to program the next output.

When you finish programming the outputs, continue with “1.2.7. Exiting Program Mode” on page 17.

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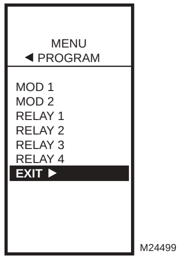

Fig. 35. Program - Exit.

1.2.7. Exiting Program Mode

Press the **HOME** button to leave programming mode and return to the home screen.

This completes the programming procedure.

2.SETUP (ADVANCED OPTIONS)

Setup provides the ability to change the factory default settings for the temperature sensors and outputs, to enable/disable reset control, and to enable/disable scheduling.

NOTE: The controller interface is intuitive. You may find that you do not need the following setup instructions for the sensors and outputs. You may want to use this procedure simply as a reference to locate the particular option or parameter of interest.

NOTES:
1. If you press the **HOME** button or there is no keypad activity for four minutes, you exit Setup mode and return to the home screen.
2. If you press the **MENU** button, you exit Setup mode and return to the menu.

Setup Procedure

The Setup process uses a hierarchical menu structure that is easy to use. You press the ◀ and ▶ arrow buttons to move forward and backward through the menus.

NOTE: The menus can display only those relays that are defined in Setup (see “2.3.2. NBR OF RELAYS” on page 24). For example, if you configure only two relays, then only two relays display on the appropriate menus.

Once in Setup mode, you use the —

- **Left arrow button (◀)** to scroll backward through the Setup menus
- **Right arrow button** (▶) to select the highlighted menu item and display its content
- **Up and Down arrow buttons** (▲ and ▼) to scroll up and down through a list of items or to increase or decrease the value of a displayed setup parameter

To change the controller’s sensors and output setup parameters, perform the following procedures in the order listed:

1. Enter Setup mode — see “2.1. Entering Setup Mode”
2. Setup Sensors — see “2.2. Setting up the Sensors”
3. Setup Outputs — see “2.3. Setting up the Outputs” on page 21
4. Exit Setup Mode — see “2.4. EXIT Setup Mode” on page 30

2.1. Entering Setup Mode

To enter Setup mode, press and hold the **MENU** button for five seconds to display the Setup menu. Refer to Fig. 27 on page 13.

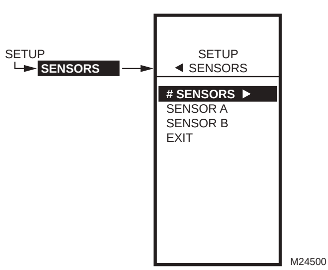

Fig. 36. Setup - Sensors Menu.

2.2. Setting up the Sensors

1. From the Setup menu, use the ▲ and ▼ buttons to highlight SENSORS.
2. Press the ▶ button to display the Sensors menu.

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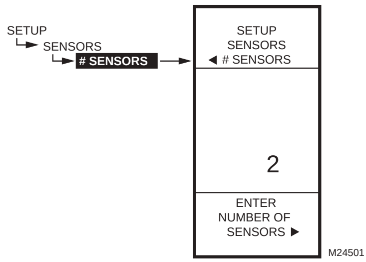

Fig. 37. Setup - Sensors - Number of Sensors.

2.2.1. Number of SENSORS

The value entered here determines the number of sensors displayed on the home screen.

1. From the Sensors menu, highlight # SENSORS then press the ▶ button to display the number of sensors.
2. Use the ▲ and ▼ buttons to enter the number of sensors (1 or 2).
   Default: 2
3. Press the ▶ button to accept the value and display the SENSOR A selection.

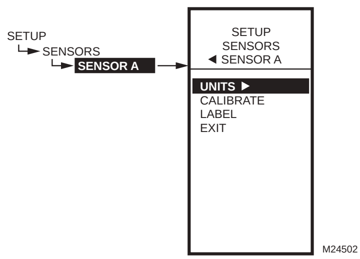

Fig. 38. Setup - Sensors - Sensor A Menu.

2.2.2. SENSOR A

1. From the Sensors menu, highlight SENSOR A.
2. Press the ▶ button to display the Sensor A selections.

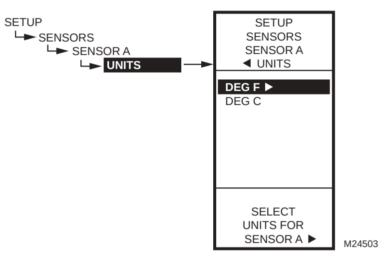

Fig. 39. Setup - Sensors - Sensor A - Units.

2.2.2.1. UNITS (° F or ° C)

IMPORTANT

This is a global change and affects the unit values for all temperature parameters on all displays.

The UNITS screen displays only for Sensor A.

1. From the Sensor A selections, use the ▲ and ▼ buttons to highlight UNITS.
2. Press the ▶ button to display the temperature units.
3. Use the ▲ and ▼ buttons to highlight F or C.
   Default: F (Fahrenheit)
4. Press the ▶ button to accept the units and return to the Sensor A selections.

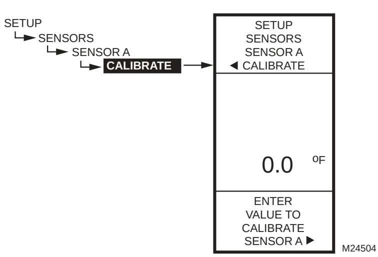

Fig. 40. Setup - Sensors - Sensor A - Calibrate.

2.2.2.2. CALIBRATE (the sensor)

Ensure that the wire size calibration value is within the limits. See “Temperature Sensor Calibration” on page 11.

1. From the Sensor A selections, use the ▲ and ▼ buttons to highlight CALIBRATE.
2. Press the ▶ button to display the calibration degree value.
3. Use the ▲ and ▼ buttons to increase/decrease the desired calibration degrees.
   Default: 0.0
   Range: +/-10° F (+/-6° C)
4. Press the ▶ button to accept the value and return to the Sensor A selections.

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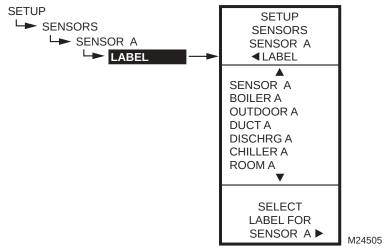

Fig. 41. Setup - Sensors - Sensor A - Label.

2.2.2.3. LABEL (the sensor input)

For a sensor already labeled, the display positions to and highlights that label.

1. From the Sensor A selections, use the ▲ and ▼ buttons to highlight LABEL.
2. Press the ▶ button to display the label list.
3. Use the ▲ and ▼ buttons to scroll through list and highlight the desired label.
   You may need to scroll up or down to view all possible labels.
4. Use the ▶ button to accept the highlighted label and exit the list.

NOTE: The label names in list order are: Sensor, Boiler, Outdoor, Duct, Dischrg, Chiller, Room, Supply, Return, and Animals.

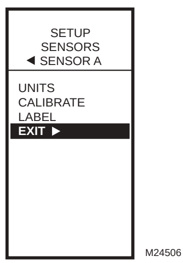

Fig. 42. Setup - Sensors - Sensor A - Exit.

2.2.2.4. Exit Sensor A Setup

Press the ◀ button to exit Sensor A selections and return to the Sensors menu.
or
Use the ▲ and ▼ buttons to highlight EXIT and press the ▶ button.

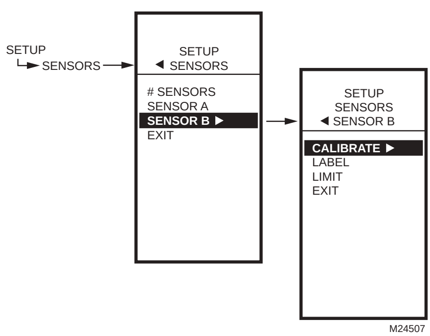

Fig. 43. Setup - Sensors - Sensor B Menu.

2.2.3. SENSOR B

For the T775M2030 and T775M2048 models only, which have a High/Low modulating temperature limit, the LIMIT item displays on the Sensor B menu.

1. From the Sensors menu, use the ▼ button to highlight SENSOR B.
2. Press the ▶ button to display the Sensor B menu.

2.2.3.1. CALIBRATE

Setting the calibration value is accomplished the same way as the Sensor A. See “2.2.2.2. CALIBRATE (the sensor)” on page 18.

2.2.3.2. LABEL

Setting the label is accomplished the same way as the Sensor A. See “2.2.2.3. LABEL (the sensor input)” on page 19.

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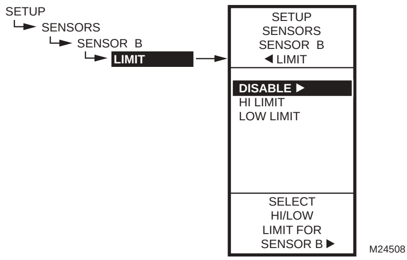

Fig. 44. Setup - Sensors - Sensor B - Limit.

2.2.4. LIMIT (Sensor B only)

For the T775M2030 and T775M2048 models only, the LIMIT item displays on the Sensor B menu.

NOTE: The LIMIT option acts *only* on Modulating Output 1.

1. From the Sensors menu, use the ▼ button to highlight SENSOR B.
2. Press the ▶ button to display the Sensor B menu.
3. Use the ▲ and ▼ buttons to select the LIMIT item.
4. Use the ▶ button to display the Limit selections.
5. Use the ▲ and ▼ buttons to select the desired limit, (Disable, Hi Limit, or Low Limit).
   Default: Disable
6. Press the ▶ button to accept the value and return to the Sensor B menu.

When you select Hi Limit or Low Limit, the Sensor B menu changes and adds the Hi/Low Limit and Throttling Range items.

If you are setting a Hi or Low Limit, continue with “2.2.4.1. HI LIMIT or LOW LIMIT (Sensor B only)”.

If you selected Disable for the Limit value, continue with “2.3. Setting up the Outputs” on page 21.

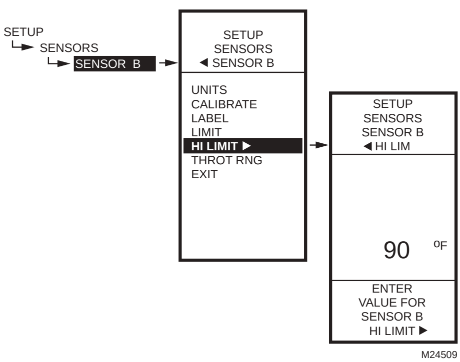

Fig. 45. Setup - Sensors - Sensor B - Hi/Low Limit (showing Hi Limit).

2.2.4.1. HI LIMIT or LOW LIMIT (Sensor B only)

Fig. 45 shows the High Limit, but the process is the same for setting the Low Limit.

Sensor B can be assigned a high/low limit, so that as you are controlling temperature at Sensor A, the control adjusts its modulating output to prevent exceeding the user-entered limit for Sensor B.

1. From the Sensor B menu, use the ▼ button to highlight HI LIMIT or LOW LIMIT.
2. Press the ▶ button display the LIMIT value.
3. Use the ▲ and ▼ buttons to increase/decrease the desired Limit value.
4. Press the ▶ button to accept the value and return to the Limit menu.

The high and low limit action will work in either the heat or the cool mode as follows:
- When the low limit is used in the heat mode, the MOD1 output *increases* to prevent reaching the low limit at sensor B.
- When the high limit is used in the heat mode, the MOD1 output *decreases* to prevent reaching the hi limit at sensor B.
- When the low limit is used in the cool mode, the MOD1 output *decreases* to prevent reaching the low limit at sensor B.
- When the high limit is used in the cool mode, the MOD1 output *increases* to prevent reaching hi limit at sensor B.

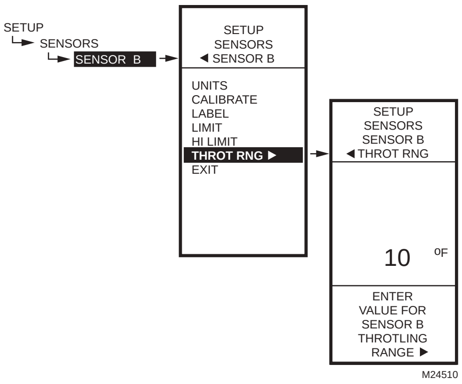

Fig. 46. Setup - Sensors - Sensor B - Throttling Range.

2.2.4.2. THROTTLING RANGE (Sensor B only)

The throttling range for the modulating high or low limit positions the setpoint at the end of the throttling range. For example, with a high limit at Sensor B of 200°F and a throttling range of 10°F, the modulating output controlling Sensor A begins to throttle back at 190°F (88°C), and fully closes at 200°F (93°C). Conversely, the throttling range for the low limit begins above the setpoint in the same manner.

1. From the Limit menu, use the ▼ button to highlight THROT RNG.
2. Use the ▲ and ▼ buttons to increase/decrease the desired value for the Throttling Range.
   Default = 0
3. Press the ▶ button to accept the value and return to the Limit menu.
4. Press the ◀ button to exit the Limit menu.
5. Press the ◀ button to exit the Sensors menu and return to the Setup menu.

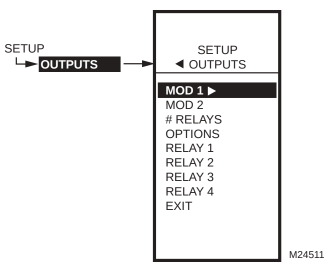

Fig. 47. Setup - Outputs Menu.

2.3. Setting up the Outputs

1. From the Setup menu, use the ▲ and ▼ buttons to highlight OUTPUTS.
2. Press the ▶ button to display the Outputs menu.

NOTE: The menus (e.g. the Outputs menu shown here) can display only those relays that are defined in Setup (see "2.3.2. NBR OF RELAYS" on page 24). For example, if you configure only two relays, then only two relays display on the appropriate menus.

The following procedures set up each modulating output and relay output.

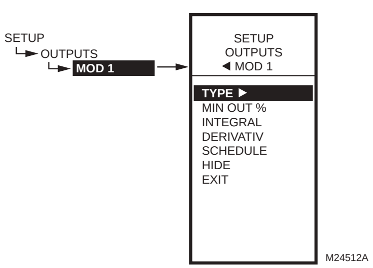

Fig. 48. Setup - Outputs - Modulating Output Menu.

2.3.1. Setting up the Modulating Outputs

1. From the Output menu, use the ▲ and ▼ buttons to highlight the desired modulating output (MOD 1 or MOD 2).
2. Press the ▶ button to display the selected MOD menu.

NOTE: Modulating outputs are not available on the T775A and T775B controller models. If you are setting up one of these controllers, skip to "2.3.2. NBR OF RELAYS" on page 24.

Use the remaining procedures, beginning with "2.3.1.1. TYPE (of output signal)" on page 22, to set up each modulating output. If you have two modulating outputs, repeat these procedures for each modulating output.

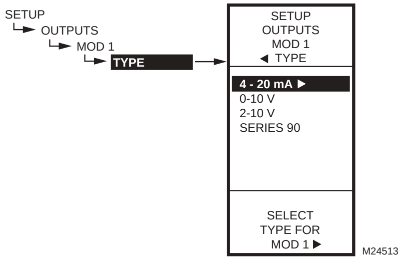

Fig. 49. Setup - Outputs - Mod Out - Type.

2.3.1.1. TYPE (of output signal)

1. From the Mod menu, use the ▲ and ▼ buttons to highlight TYPE.
2. Press the ▶ button to display the Type selections.
3. Use the ▲ and ▼ buttons to highlight the desired output type.
   Default: 4-20 mA
4. Press the ▶ button to accept the selected type and return to the Mod menu.

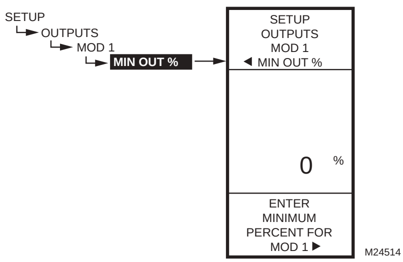

Fig. 50. Setup - Outputs - Mod Out - Minimum Output Percentage.

2.3.1.2. MIN OUT %

The minimum output % prevents the output from dropping below the value entered. This value can be useful to maintain minimum damper position.

Using the time clock or digital input to disable the output forces the output to 0%.

1. From the Mod menu, use the ▲ and ▼ buttons to highlight MIN OUT %.
2. Press the ▶ button to display the Min Out %.
3. Use the ▲ and ▼ buttons to increase/decrease the desired value from 0% to 100% in 1% increments.
   Default: 0%
   Range: 0 to 100%
4. Press the ▶ button to accept the percentage and return to the Mod menu.

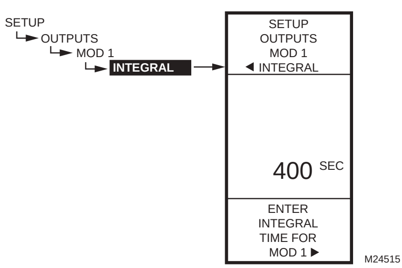

Fig. 51. Setup - Outputs - Mod Out - Integral.

2.3.1.3. INTEGRAL

1. From the Mod menu, use the ▲ and ▼ buttons to highlight INTEGRAL.
2. Press the ▶ button to display the Integral seconds.
3. Use the ▲ and ▼ buttons to increase/decrease the value from 0 to 3,600 in 10 second increments.
   Default: 400 seconds
   Range: 0 to 3,600 seconds
4. Press the ▶ button to accept the seconds and return to the Mod menu.

NOTES:

1. The Integral time is factory set for 400 seconds. This is a good middle range and should satisfy many applications. The integral time can be increased for applications where sensed response is slow, and can be decreased for applications where sensed response is fast (e.g. discharge air control).

2. As a starting point, an optimal integral time for discharge air typically ranges from 12 to 200 seconds. An optimal integral time for room control typically ranges from 60 to 2,500 seconds. The purpose of integral action is to reduce or eliminate the offset from setpoint during steady state control that is often seen in proportional only control.

3. Keep in mind that control is most sensitive to throttling range. Adjust the throttling range first before any adjustment to integral time. Adjust throttling range to be as wide as possible to start since this will provide the most stable control. Remember that the integral will eliminate the steady state error so you do not need to have a small throttling range to have accurate control. (Integral action allows for controlling to a setpoint even with a wide throttling range).

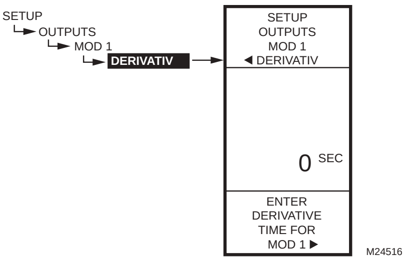

Fig. 52. Setup - Outputs - Mod Out - Derivative.

2.3.1.4. DERIVATIVE

The Derivative default value is factory set to zero (no derivative control). It is strongly recommended that the derivative remain at zero (0) unless you have a very good reason to adjust it. Derivative control is not needed in the vast majority of HVAC applications.

1. From the Mod menu, use the ▲ and ▼ buttons to highlight DERIVATIV.
2. Press the ▶ button to display the Derivative seconds.
3. Use the ▲ and ▼ buttons to increase/decrease the value.
   Default: 0 (zero)
   Range: 0 to 3,600 seconds
4. Press the ▶ button to accept the seconds and return to the Mod menu.

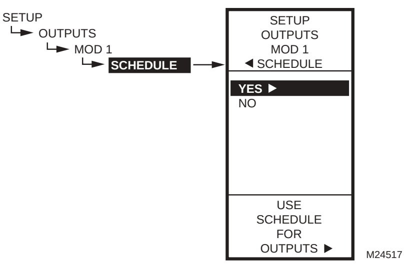

Fig. 53. Setup - Outputs - Mod Out - Schedule.

2.3.1.5. SCHEDULE

The Schedule option displays only if the USE SCHED parameter is set to Yes (See “2.3.3.1. USE SCHED” on page 25).

1. From the Mod menu, use the ▲ and ▼ buttons to highlight SCHEDULE.
2. Use the ▲ and ▼ buttons to highlight YES or NO.
   Default: YES
3. Press the ▶ button to accept the selection and return to the Mod menu.

Each output can be set up to follow or ignore the built in scheduler. To disable the scheduler for all outputs, see “2.3.3.1. USE SCHED” on page 25.

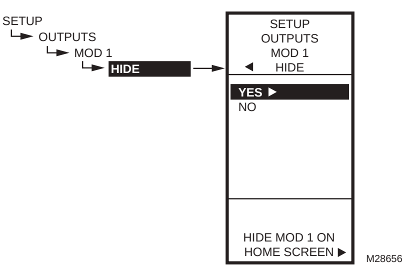

Fig. 54. Setup - Outputs - Mod 1/2 - Hide.

2.3.1.6. HIDE

The Hide option is used to prevent the MOD 1 and MOD 2 outputs from displaying on the Home screen.

1. From the Mod menu, use the ▲ and ▼ buttons to highlight HIDE.
2. Use the ▲ and ▼ buttons to highlight YES or NO.
   Default: YES
3. Press the ▶ button to accept the selection and return to the Mod menu.

NOTE: The MOD1 and MOD2 outputs are still active even when hidden from the Home screen.

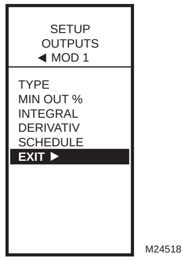

Fig. 55. Setup - Outputs - Mod Out - Exit.

2.3.1.7. EXIT

Press the ◀ button (or highlight EXIT and press the ▶ button) to exit the Mod menu and return to the Outputs menu.

If you have a second modulating output to configure, go to “2.3.1. Setting up the Modulating Outputs” on page 21.

If you are finished setting up the modulating outputs, continue with “2.3.2. NBR OF RELAYS”.

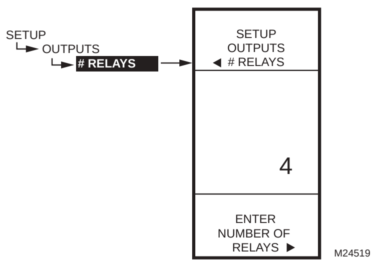

Fig. 56. Setup - Outputs - Number of Relays.

2.3.2. NBR OF RELAYS

1. From the Outputs menu, use the ▲ and ▼ buttons to highlight # RELAYS.
2. Press the ▶ button to display the number of relays.
3. Use the ▲ and ▼ buttons to display the number from 1 to 4 depending on the model. (See notes below.)
4. Press the ▶ button to accept the value and display the Outputs menu.

NOTES:
1. The T775A/B/M models have the following outputs available:
   T775A2019 1 relay output
   T775B2016 up to 2 relay outputs
   T775B2024 up to 4 relay outputs
   T775B2032 up to 2 relay outputs
   T775B2040 up to 4 relay outputs
   T775M2006 no relay outputs
   T775M2014 up to 4 relay outputs
2. The number of relay outputs entered here determines how many relays display on the home screen.

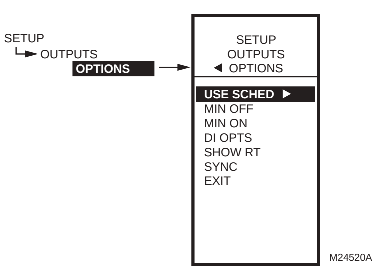

Fig. 57. Setup - Outputs - Options Menu.

2.3.3. OPTIONS

1. From the Outputs menu, use the ▲ and ▼ buttons to highlight OPTIONS.
2. Press the ▶ button to display the Options menu.

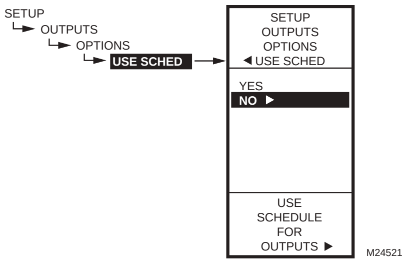

Fig. 58. Setup - Outputs - Options - Schedule.

2.3.3.1. USE SCHED

1. Press the ▶ button to display the schedule selections.
2. Use the ▲ and ▼ buttons to highlight YES or NO.
   Default: NO
3. Press the ▶ button to accept the value and display the MIN OFF option.

Selecting NO disables scheduling for **all** outputs.

Selecting YES enables scheduling for **all** outputs. When YES is selected, all individual outputs default to follow the schedule. However, each individual output can be removed from scheduling as desired.

With Scheduling enabled, when you return to Program mode, the new option for Scheduling displays. You can press the home key and then the menu key to view the Schedule options in the menu.

See “2.3.1.5. SCHEDULE” on page 23.

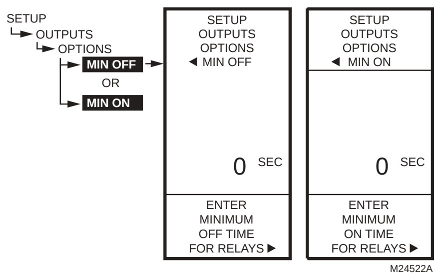

Fig. 59. Setup - Outputs - Options - Min Off/On Time.

2.3.3.2. MIN OFF or MIN ON

This is the minimum number of seconds of “off time” or “on time” for **all** relays.

1. Press the ▶ button to display the Min Off/On value.
2. Use the ▲ and ▼ buttons to increase/decrease the desired number of seconds from 0 to 990 seconds in 10 second increments.
   Default: 0 (zero)
   Range: 0 to 990 seconds
3. Press the ▶ button to accept the seconds and display the DI OPTIONS.

NOTES:
1. The minimum OFF or ON time applies to **all** relay outputs.
2. When minimum OFF or ON time is active, relays waiting to be energized display a flashing square underneath the relay number on the home screen.
3. If the minimum OFF time is not equal to zero (0), the minimum OFF time activates at power-up. To manually override, press the ◀ button at any time.

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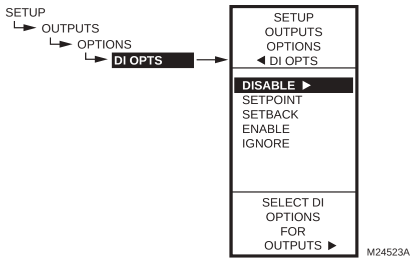

Fig. 60. Setup - Outputs - Options - DI Options.

2.3.3.3. DI OPTIONS (digital input options)

The DI Option you select applies to **all** outputs. This option overrides any Setpoint/Setback values entered in the Schedule.

1. Press the ▶ button to display the DI Option selections.
2. Use the ▲ and ▼ buttons to highlight DISABLE, SETBACK, or IGNORE.
   Default: DISABLE
3. Press the ▶ button to accept the value and display the SHOW RT option.

When the digital input (DI) closes, all outputs follow the DI option value (Disable, Setback, or Ignore):

- **DISABLE** disables the outputs; relays return to de-energized state and Mod outputs return to 0% output.
- **SETPOINT** forces the control to the setpoint temperature.
- **SETBACK** enables a setback temperature value to be programmed for each output and forces the control to the setback temperature.
  — To program the Setback temperature, see Fig. 34 on page 16.
- **ENABLE** energizes all relays and MOD outputs to 100%. Use this option carefully.
- **IGNORE** causes the digital input to have no effect on the Relay or Mod outputs.

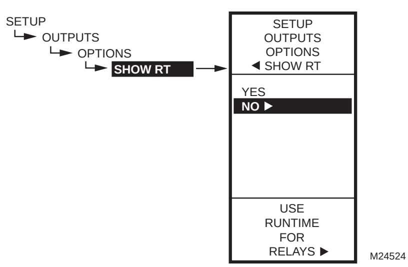

Fig. 61. Setup - Outputs - Options - Show Runtime.

2.3.3.4. SHOW RT (show run time hours)

1. Press the ▶ button to display the Show RT values.
2. Use the ▲ and ▼ buttons to select YES or NO.
   Default: YES
3. Press the ▶ button to accept the value and return to the Options menu.

Selecting YES shows the RT (run time) hours for **each** relay on the home screen displays.

NOTE: Run times can be reset to zero for each individual relay. You must do this for each relay that you want to reset to zero. See "2.3.4.3. RESET RT (run time hours)" on page 29.

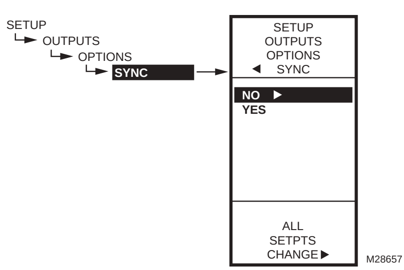

Fig. 62. Setup - Outputs - Options - Sync.

2.3.3.5. SYNC (synchronize setpoint changes)

1. Press the ▶ button to display the Sync values.
2. Use the ▲ and ▼ buttons to select YES or NO.
   Default: NO
3. Press the ▶ button to accept the value and return to the Options menu.

Depending on the model, selecting YES causes all setpoints for all relays and MODs to sync to any change to:

- Relay 1 for models without MOD outputs
- MOD1 for models with MOD outputs

For example, assume the MOD1 setpoint is 110°F, MOD2 is 115°F, and Relay 1 is 120°F. With SYNC=YES, when the MOD1 setpoint is adjusted to 112°F (increase 2°F), then MOD2 and all other relay setpoints increase by 2°F. Thus the MOD2 setpoint is now 117°F and the relay 1 setpoint is 122°F.

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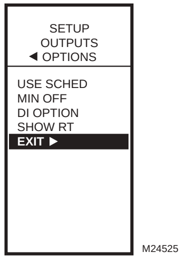

Fig. 63. Setup - Outputs - Options - Exit.

2.3.3.6. Exit Options Setup

Press the ◀ button (or highlight EXIT and press the ▶ button) to exit and return to the Outputs menu.

Continue with “2.3.4. Setting up the Relays”

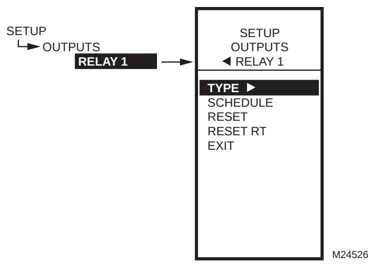

Fig. 64. Setup - Outputs - Relay Menu.

2.3.4. Setting up the Relays

1. From the Outputs menu, use the ▲ and ▼ buttons to highlight the desired relay (1-4 depending on model).
2. Press the ▶ button to display the selected relay menu.

The TYPE selection shown in Fig. 64 displays only for Relay 1 and Relay 3.

Continue with the remainder of section 3.4 to setup the relay outputs.

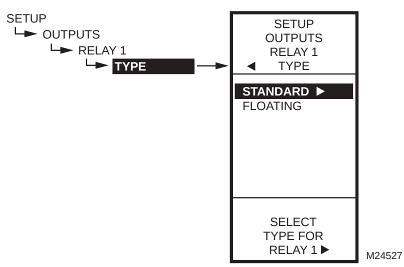

Fig. 65. Setup - Outputs - Relay - Type.

2.3.4.1. TYPE (standard or floating)

The Floating option is only available on the T775B2016, T775B2024, T775B2032, and T775B2040 models.

For these models, this selection displays only for Relay 1 and/or Relay 3.

1. Press the ▶ button to display the Type values.
2. Use the ▲ and ▼ buttons to select STANDARD OR FLOATING.
   Default: STANDARD (not floating)
3. Press the ▶ button to accept the value and return to the Relay menu.

If you select FLOATING, the relays are paired (1-2 or 3-4) and are setup together. Continue with “2.3.4.1.1. Floating Relay Menu”.

If you select STANDARD, go to “2.3.4.2. SCHEDULE” on page 29.

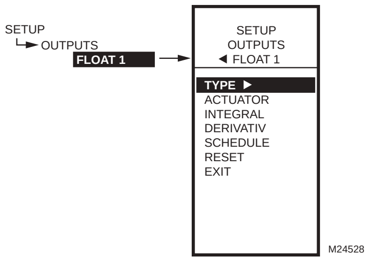

Fig. 66. Setup - Outputs - Floating Relay - Menu.

2.3.4.1.1. Floating Relay Menu

The Floating option is only available on the T775B2016, T775B2024, T775B2032, and T775B2040 models.

When Relay 1 or Relay 3 is setup as floating, relays are paired and the Float 1 or Float 2 menu displays with the selections shown in Fig. 66.

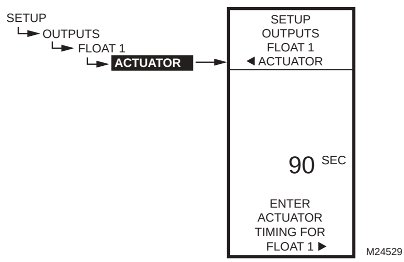

Fig. 67. Setup - Outputs - Floating Relay - Actuator.

2.3.4.1.1.1. ACTUATOR (floating relay only)

The Actuator option displays only on the T775B2016, T775B2024, T775B2032, and T775B2040 models when the Type option = Floating.

1. From the menu, use the ▲ and ▼ buttons to highlight ACTUATOR.
2. Press the ▶ button to display the actuator value.
3. Use the ▲ and ▼ buttons to increase/decrease the desired number of seconds.
   Default: 90 seconds
   Range: 0 to 3,600 seconds)
4. Press the ▶ button to accept the value and display the INTEGRAL option.

The actuator run time is defined as the time needed to move the actuator from the fully closed to fully open position and visa versa.

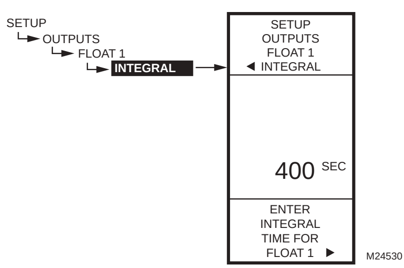

Fig. 68. Setup - Outputs - Floating Relay - Integral.

2.3.4.1.1.2. INTEGRAL (modulating/floating relay only)

The Actuator option displays only on the T775B2016, T775B2024, T775B2032, and T775B2040 models when the Type option = Floating.

1. From the menu, use the ▲ and ▼ buttons to highlight INTEGRAL.
2. Press the ▶ button to display the actuator value.
3. Use the ▲ and ▼ buttons to increase/decrease the desired number of seconds.
   Default: 400 seconds
   Range: 0 to 3,600 seconds)
4. Press the ▶ button to accept the value and display the DERIVATIV option.

See Integral NOTES on page 22 for additional information about setting the Integral time.

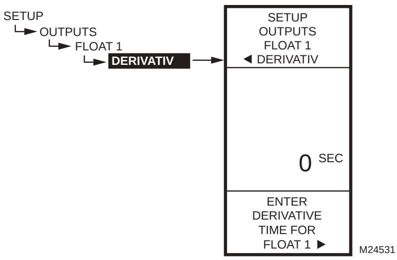

Fig. 69. Setup - Outputs - Floating Relay - Derivative.

2.3.4.1.1.3. DERIVATIVE (modulating/floating relay only)

The Derivative option displays only on the T775B2016, T775B2024, T775B2032, and T775B2040 models when the Type option = Floating.

1. From the menu, use the ▲ and ▼ buttons to highlight DERIVATIV.
2. Press the ▶ button to display the actuator value.
3. Use the ▲ and ▼ buttons to increase/decrease the desired number of seconds.
   Default: 0 seconds
   Range: 0 to 3,600 seconds)
4. Press the ▶ button to accept the value and display the SCHEDULE option.

Continue with “2.3.4.2. SCHEDULE” for the remaining relay selections.

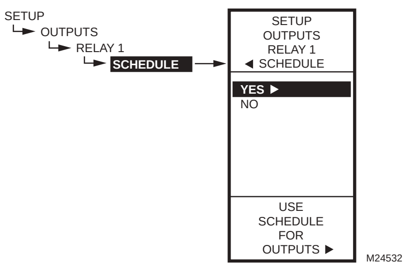

Fig. 70. Setup - Outputs - Relay - Schedule.

2.3.4.2. SCHEDULE

This selection displays only if “Use Sched = YES” is selected during the Output Options setup (see “2.3.3.1. USE SCHED” on page 25). When selected, individual outputs default to follow the schedule.

1. Press the ▶ button to display the Schedule values.
2. Use the ▲ and ▼ buttons to select YES or NO.
   Default: YES
3. Press the ▶ button to accept the value and return to the Relay menu.

An individual output can be selected to be controlled or not controlled by the schedule.

If NO is selected, the Setback selection does not appear in the Program menu for this output.

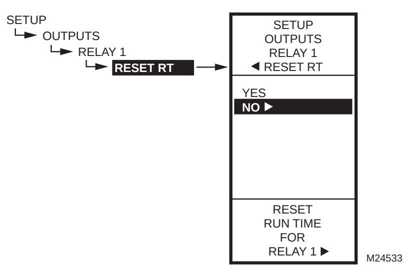

Fig. 71. Setup - Outputs - Relay - Reset Runtime.

2.3.4.3. RESET RT (run time hours)

This selection displays only if “Show RT = YES” is selected during Output Options setup (see “2.3.3.4. SHOW RT (show run time hours)” on page 26).

1. From the Relay menu, press the ▶ button to display the Reset RT values.
2. Use the ▲ and ▼ buttons to select YES or NO.
   Default: NO
3. Press the ▶ button to accept the value and return to the Relay menu.

Selecting YES immediately resets the output run time hours to zero for this output. When you subsequently return to this screen, the RESET RT defaults to NO.

NOTE: Run times can be reset to zero for each individual relay. You must do this for each relay that you want to reset to zero.

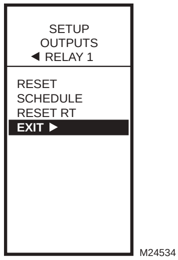

Fig. 72. Setup - Outputs - Relay - Exit.

2.4. EXIT Setup Mode

Press the ◀ button to exit the selected relay set up and return to the Outputs menu.

To setup the next relay output go to “2.3.4. Setting up the Relays” on page 27.

If you are finished setting up the relay outputs, press the **HOME** button to exit Setup mode and return to the home screen display.

This completes the Setup procedure.

3. SCHEDULING

Scheduling provides the ability to set daily temperature settings for up to two events per day. Typically, these are the daytime (setpoint) and the nighttime (setback) settings.

IMPORTANT

*To enable Scheduling, you must first enter Setup mode (press and hold the **MENU** button for 5 seconds), select OUTPUTS, select OPTIONS, select USE SCHED, and then select YES. (See “2.3.3.1. USE SCHED” on page 25).*

IMPORTANT

*To properly account for Daylight Saving time, be sure to set the Date **before** setting the Time. See “3.2.2. SET DATE” on page 31.*

NOTE: Each output is independently configurable to follow the schedule or not. For modulating outputs, See “2.3.1.5. SCHEDULE” on page 23. For relay outputs, see “2.3.4.2. SCHEDULE” on page 29.

NOTE: The controller interface is intuitive. You may find that you do not need the following scheduling instructions. You may want to use this procedure simply as a reference to locate the particular option or parameter of interest.

NOTES:

1. If you press the **HOME** button or there is no keypad activity for four minutes, you exit Scheduling mode and return to the home screen.
2. If you press the **MENU** button, you exit Scheduling mode and return to the menu.

To create or change a schedule, you use the —

- **Left arrow button** (◀) to scroll backward through the Schedule menus
- **Right arrow button** (▶) to select the highlighted menu item and display its content
- **Up and Down arrow buttons** (▲ and ▼) to scroll up and down through a list of items or to increase or decrease the value of a displayed schedule parameter

Creating a Schedule

To create a schedule, perform the following in the order listed:

1. Enable Scheduling in Setup mode - See *“2.3.3.1. USE SCHED” on page 25*
2. Enter Schedule mode — See “3.1. Entering Schedule Mode”
3. Set the Schedule Options — See “3.2. OPTIONS”
4. Set Individual Schedules — begin with “3.3. Setting Individual Schedules” on page 32
5. Exit Schedule Mode — See “3.4. Exiting Scheduling Mode” on page 33

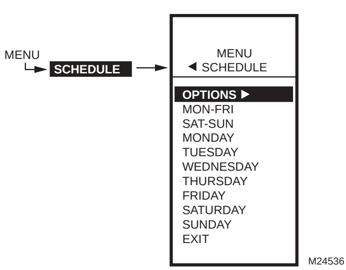

Fig. 73. Schedule - Menu.

3.1. Entering Schedule Mode

Press the **MENU** button, then select SCHEDULE and press the ▶ button to view the Schedule menu.

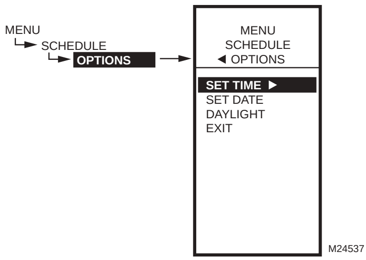

Fig. 74. Schedule - Options Menu.

3.2. OPTIONS

1. From the Schedule menu, use the ▲ and ▼ buttons to highlight OPTIONS.
2. Press the ▶ button to display the Options menu.

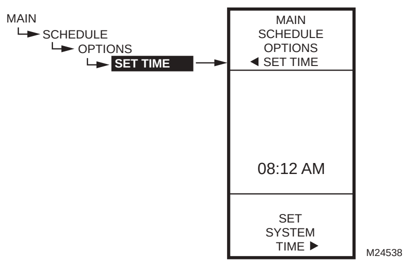

Fig. 75. Schedule - Options - System Time.

3.2.1. SET TIME

Setting the system time is required to enable the controller to follow daylight saving time.

IMPORTANT

*Set the Date **before** setting the Time. See "3.2.2. SET DATE".*

1. From the Options menu, use the ▲ and ▼ buttons to highlight SET TIME.
2. Press the ▶ button to display the current system time setting.
3. Use the ▶ button to cycle between the hour, minute, and AM/PM values.
4. Use the ▲ and ▼ buttons to increase/decrease the desired value for the hour, minute, and AM/PM.
5. Press the ◀ button to accept the Time and return to the Options menu.

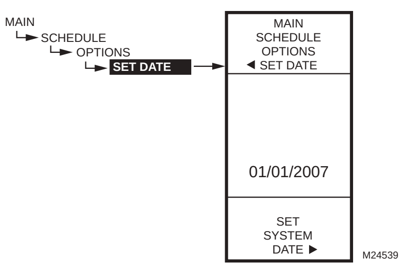

Fig. 76. Schedule - Options - System Date.

3.2.2. SET DATE

Setting the system date is required to enable the controller to follow daylight saving time.

IMPORTANT

*To properly account for Daylight Saving time, be sure to set the Date **before** setting the Time.*

1. From the Options menu, use the ▲ and ▼ buttons to highlight SET DATE.
2. Press the ▶ button to display the current system date setting.
3. Use the ▶ button to cycle between the month, day, and year values.
4. Use the ▲ and ▼ buttons to increase/decrease the desired value for the month, day, and year.
5. Press the ◀ button to accept the Date and return to the Options menu.

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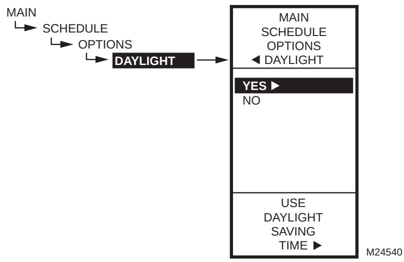

Fig. 77. Schedule - Options - Daylight Saving Time.

3.2.3. DAYLIGHT (daylight saving time)

1. From the Options menu, use the ▲ and ▼ buttons to highlight DAYLIGHT.
2. Press the ▶ button to display the current system setting for daylight saving time.
3. Use the ▲ and ▼ buttons to select YES or NO.
   Default: YES
4. Press the ▶ button to accept the value and return to the Options menu.
5. From the Options menu, use the Use the ▲ and ▼ buttons to highlight EXIT.
6. Press the ▶ button to return to the Schedule menu.

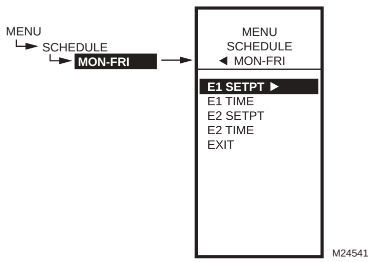

Fig. 78. Schedule Event Menu (Showing MON-FRI).

3.3. Setting Individual Schedules

As shown in the Schedule menu (Fig. 73 on page 30), schedules can be set for the following time periods:
- Monday through Friday
- Saturday and Sunday
- Individual days of the week

1. From the Schedule menu, use the ▲ and ▼ buttons to highlight the desired time period.
2. Press the ▶ button to display the Schedule menu for the selected time period.

For each selected time period, the schedule event (E1 and E2) parameters are exactly the same as shown in Fig. 78.

SCHEDULING EXAMPLE
Setting the schedule is independent of the temperature settings for the relay outputs. The following illustrates a weekly schedule for daytime (setpoint) and night time (setback) use and shows the factory default settings:

Table 4. Mon-Fri Schedule Defaults

DAY	EVENT	SETPT ACTION	TIME
Mon-Fri	Event 1 (E1)	Setpoint	6:00 AM [a]
Mon-Fri	Event 2 (E2)	Setback	6:00 PM [b]
Sat-Sun	Not used; remains in Setback from Mon-Fri E2 settings		

[a] Setpoint time span is 6:00 AM until 5:59 PM because setback starts at 6:00 PM.
[b] Setback time span is 6:00PM until 5:59 AM because setpoint starts at 6:00 AM.

To set a schedule, continue with “3.3.1. E1 SETPT (setpoint for event 1)”.

The following figures show the MON-FRI menu, but the menu selections are the same for any time period.

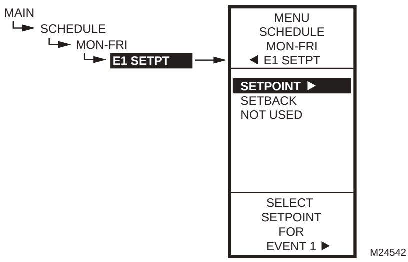

Fig. 79. Schedule - Event 1 Setpoint.

3.3.1. E1 SETPT (setpoint for event 1)

1. From the selected time period menu, use the ▲ and ▼ buttons to highlight E1 SETPT.
2. Press the ▶ button to display the setpoint options.
3. Use the ▲ and ▼ buttons to highlight the desired option.
4. Press the ▶ button to accept the value and return to the selected time period menu.

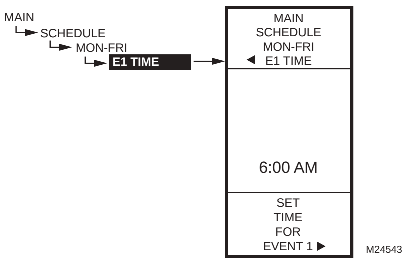

Fig. 80. Schedule - Event 1 Time.

3.3.2. E1 TIME (time for event 1)

1. From the selected time period menu, use the ▲ and ▼ buttons to highlight E1 TIME.
2. Press the ▶ button to display the current time setting for event 1.
3. Use the ▶ button to cycle between the hour, minute, and AM/PM values.
4. Use the ▲ and ▼ buttons to increase/decrease the desired value for the hour, minute, and AM/PM.
5. Press the ◀ button to accept the time and return to the selected time period menu.

3.3.3. E2 SETPOINT (setpoint for event 2)

Creating the setpoint for event 2 is accomplished the same way as the first event. See“3.3.1. E1 SETPT (setpoint for event 1)” on page 33.

3.3.4. E2 TIME (time for event 2)

Creating the time for event 2 is accomplished the same way as the first event. See “3.3.2. E1 TIME (time for event 1)” above.

3.3.5. EXIT (exit from selected time period settings)

After entering the time for event 2, use the ◀ button to exit the schedule time period and return to the Schedule menu (Fig. 73 on page 30) to select a different time period.

When you finish scheduling the time periods, continue with “3.4. Exiting Scheduling Mode”.

3.4. Exiting Scheduling Mode

Press the **HOME** button to exit the Schedule menu and return to the home screen display.

This completes the Scheduling procedure.

SUMMARY MENU

The Summary menu provides the ability to view the schedule (E1 and E2 times) for each relay for each day of the week.

NOTE: Scheduling must be enabled for the Summary menu to display. Enabling the schedule is determined in the Setup process for the Output Options (see “2.3.3.1. USE SCHED” on page 25).

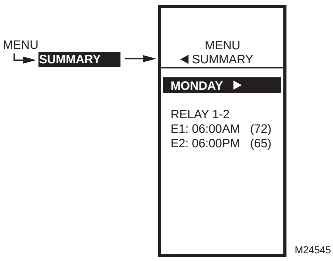

Fig. 81. Summary Example - Monday Settings.

For each relay, the Summary display indicates the time and temperature (in parenthesis) for each of the two scheduled events E1 and E2.

1. Press the **MENU** button to view the menu.
2. Use the ▲ and ▼ buttons to highlight SUMMARY.
3. Press the ▶ button to display the Summary settings.
4. Use the ▶ button to scroll forward through each day of the week (Monday, Tuesday, Wednesday, Thursday, Friday, Saturday, and Sunday).
5. While viewing a specific day, use the ▲ and ▼ buttons to cycle through the individual relay schedules for that day.

When finished, press the home key to return to the home display screen.

TROUBLESHOOTING

Power Loss

The date and time settings are retained for 24 hours after a power outage. After a power loss of more than 24 hours, the date and time settings may need to be reentered. All other settings are stored permanently.

Errors and Diagnostics

The controller provides an error message and diagnostic status as described below.

Error Message

There is a two-character error code that displays in response to controller software problems:

EE

EEPROM Failure — The values read back from the EEPROM are not the same as written into the EEPROM. This error cannot be field repaired. Replace the device.

Diagnostic Messages

There are two diagnostic messages that can display in response to sensor problems. The diagnostic codes that can flash on the display are:

– –

Sensor Open or Shorted — Two dashes display when a sensor (typically temperature) is open or shorted. An open circuit is considered anything greater than 1570 ohms (greater than 300F), shorted anything less than 770 ohms (less than -73F). Whichever stages are operating with this sensor cease to control (meaning relays go to OFF and proportional outputs go to zero percent).

This message can also mean that the sensor is programmed, but not physically connected.

-60° or **270**° **F** (-51° or 132° C) Blinking

Temperature Out of Range — The temperature display blinks when the sensed temperature range is outside of the display range, below -60° F (-51° C) or above 270° F (132° C). The displayed value remains at that displayed limit and control continues. Controller continues to function unless an open or shorted state is detected.

Blinking relay status

Relay Minimum Off Time is Active — On the home screen, each relay’s indicator (■) blinks while the relay’s minimum off time is active.

391/665

SPECIFICATIONS

Power: 24, 120, or 240 Vac; 50/60 Hz;
A separate earth ground is required for any power source.

Power Consumption:
- 8 VA maximum at 60 Hz
- 10 VA maximum at 50 Hz

Operating & Storage Temperature Ambient Rating:
- -40° to 125° F (-40° to 52° C) @ 50 Hz
- -40° to 140° F (-40° to 60° C) @ 60 Hz

Relative Humidity: 5% to 95% non-condensing

Relay Contact Output Ratings (N.O. and N.C.):
- 1/2 hp; 9.8 AFL, 58.8 ALR @ 120 Vac
- 1/2 hp; 4.9 AFL, 29.4 ALR @ 240 Vac
- 125 VA pilot duty @ 120/240 Vac
- 10A @ 24 Vac (resistive)

Modulating Outputs:
- 0-10 Vdc; drive a minimum of 2,000 Ohms
- 2-10 Vdc; drive a minimum of 2,000 Ohms
- 4-20 mA; drive a maximum of 600 Ohms
- Electronic Series 90
- Floating

DOC

Emissions Compliance

EN 55022: 2006
CISPR 22: 2006
VCCI V-3/2006.04
ICES-003, Issue 4: 2004
FCC PART 15 SUBPART B Class B Limit

Immunity Compliance

EN 61000-6-1: 2001 covering
  EN 61000-4-2: 1995 + A1: 1998 + A2: 2001
  EN 61000-4-3: 2002
  EN 61000-4-4: 2004
  EN 61000-4-5: 1995 + A1: 2001
  EN 61000-4-6: 1996 + A1: 2001
  EN 61000-4-8: 1993 + A1: 2001
  EN 61000-4-11 2nd Ed.: 2004

Safety Compliance

UL 60730-1 for US and Canada

FCC Compliance Statement:

This equipment has been tested and found to comply with limits for a Class B digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference in residential installations. This equipment generates, uses, and can radiate radio frequency energy, and if not installed and used in accordance with the instructions, may cause harmful interference to radio communications.

However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause interference to radio or television equipment reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:
— Reorient or relocate the receiving antenna
— Move the equipment away from the receiver
— Plug the equipment into an outlet on a circuit different from that to which the receiver is connected
— Consult the dealer or an experienced radio/television technician for additional suggestions

You are cautioned that any change or modifications to the equipment not expressly approve by the party responsible for compliance could void Your authority to operate such equipment.

This device complies with Part 15 of the FCC Rules. Operation is subjected to the following two conditions 1) this device may not cause harmful interference and 2) this device must accept any interference received, including interference that may cause undesired operation.

Automation and Control Solutions

Honeywell International Inc.

1985 Douglas Drive North

Golden Valley, MN 55422

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62-0254—13   M.S. Rev. 10-12
Printed in United States

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Honeywell

FARM-O-STAT AIRSWITCH CONTROLLERS

T631 CONTROLLERS PROVIDE LINE VOLTAGE CONTROL OF HEATING, COOLING, AND VENTILATION SYSTEMS IN FARM BUILDINGS OR STORAGE AREAS.

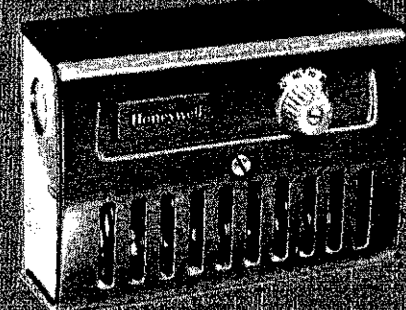
☐ Typical applications include barns, brooder houses, poultry houses, hog houses, pump houses, milk houses, and crop storage houses.

☐ Slots in front and bottom of case provide maximum air circulation over the coiled sensing element.

☐ Rugged steel case treated to resist corrosion.

☐ Dependable switching provided by spdt snap switch(es) permanently sealed against contamination.

☐ Temperature setting knob and scale on front of controller.



T631A-C

G.P.
Rev. 7-83•

Form Number 60-2214—6

SPECIFICATIONS

TRADELINE MODELS

TRADELINE models are selected and packaged to provide ease of stocking, ease of handling, and maximum replacement value. TRADELINE model specifications are the same as those of standard models except as noted below.

TRADELINE MODEL AVAILABLE: T631C Airswitch Controller, with switch rated for 1 hp [0.7 kW].
TEMPERATURE SCALE RANGE: Minus 30 F to plus 100 F [minus 34 C to plus 38 C].
DIFFERENTIAL: 5 F [2.8 C].
ADDITIONAL FEATURES: TRADELINE pack with cross reference label and special instruction sheet.

STANDARD MODELS

MODELS (also refer to Table 1):
- T631A Farm-O-Stat Controller—for control of barn ventilation, red finish, spdt switching.
- T631B Farm-O-Stat Controller—for control of barn ventilation, red finish, two spdt switches.
- T631C Airswitch Controller—for temperature or ventilation control, gray finish, spdt switching.
- For weatherproof Farm-O-Stat Controller in NEMA 4X enclosure, use T631F,G. See specification sheet, form 60-2509.

SENSING ELEMENT: Coiled copper tube.
MAXIMUM AMBIENT TEMPERATURES (tabulated by scale range):

TEMPERATURE SCALE RANGE	MAX. AMBIENT F	MAX. AMBIENT C
20 C to 60 C	150	66
35 F to 100 F	120	49
70 F to 140 F	150	66
0 F to 70 F	125	52
20 F to 90 F	125	52
-10 F to 60 F	125	52
-10 C to 30 C	125	52
-10 F to 100 F	125	52
-30 F to 100 F	125	52
70 F to 160 F	175	79
0 C to 40 C	120	49

MOUNTING MEANS: Screws through holes in back of case.
ADJUSTMENT: Knob on front of case.
UNDERWRITERS LABORATORIES INC. LISTED: File No. E4436, Vol. 1, dated 2-27-55; Guide No. XAPX.
CANADIAN STANDARDS ASSOCIATION COMPONENT LISTED: File No. LR1620, Guide No. 400-E-O.
REPLACEMENT PART:
103774 Spdt Switch.

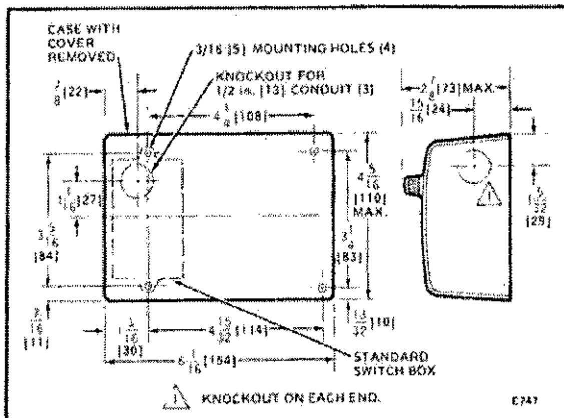


FIG. 1—T631 INSTALLATION DIMENSIONS, IN in. [mm SHOWN IN BRACKETS].

(continued on page 3)

ORDERING INFORMATION

WHEN PURCHASING REPLACEMENT AND MODERNIZATION PRODUCTS FROM YOUR TRADELINE WHOLESALER OR YOUR DISTRIBUTOR, REFER TO THE TRADELINE CATALOG OR PRICE SHEETS FOR COMPLETE ORDERING NUMBER, OR SPECIFY—

1. **Order number (specify T631C with ground screw, if desired).**
2. **Scale range.**
3. **Differential (including interstage differential for T631B).**
4. **One hp [0.7 kW] switch(es) if desired.**
5. **Accessory, if desired.**

IF YOU HAVE ADDITIONAL QUESTIONS, NEED FURTHER INFORMATION, OR WOULD LIKE TO COMMENT ON OUR PRODUCTS OR SERVICES, PLEASE WRITE OR PHONE:

1. **YOUR LOCAL HONEYWELL RESIDENTIAL SALES OFFICE (CHECK WHITE PAGES OF YOUR PHONE DIRECTORY).**
2. HOME AND BUILDING CONTROL CUSTOMER RELATIONS
HONEYWELL, INC., 1885 DOUGLAS DRIVE NORTH
MINNEAPOLIS, MINNESOTA 55422-4386

(IN CANADA--HONEYWELL LIMITED/HONEYWELL LIMITEE, 35 DYNAMIC DRIVE, SCARBOROUGH, ONTARIO M1V 4Z9) INTERNATIONAL SALES AND SERVICE OFFICES IN ALL PRINCIPAL CITIES OF THE WORLD.

TABLE 1—MODEL NUMBERS

MODEL NUMBER	TEMPERATURE RANGE		DIFFERENTIAL SWITCH		ADDITIONAL FEATURES
	F	C	F	C	
T631A	35 to 100	2 to 38	2	1.1	—
	70 to 140	21 to 60	2	1.1	—
	0 to 70	-18 to 21	3	1.7	—
	-10 to 100	-23 to 38	3	1.7	—
	0 to 40	32 to 104	1.1	2	—
	70 to 140	21 to 60	8	4.4	—
	70 to 160	21 to 71	3	1.7	—
	35 to 100	2 to 38	3-1/2	1.9	with 1 hp [0.7 kW] rated switch
T631B	35 to 100	2 to 38	2	1.1	3-1/2 F [1.9 C] between switches
	35 to 100	2 to 38	2	1.1	9 F [5 C] between switches
	35 to 100	2 to 38	2	1.1	adjustable interstage differential[a]
	35 to 100	2 to 38	3-1/2	1.9	adjustable interstage differential[a]; with 1 hp [0.7 kW] rated switches
T631C	-10 to 60	-23 to 16	3	1.7	with 1 hp [0.7 kW] rated switch
	20 to 90	-7 to 32	3	1.7	with 1 hp [0.7 kW] rated switch
	70 to 140	21 to 60	2	1.1	—
	14 to 86	-10 to 30	3	1.7	—
	68 to 140	20 to 60	3	1.1	—
	35 to 100	2 to 38	2	1.1	—
	14 to 86	-10 to 30	3	1.7	with ground screw

[a]Interstage differential is adjustable from 0 F to 7 F [0 C to 4 C]. At 0 differential, both switches make at set point. With differential set above 0, speed change switch closes after fan switch, on temperature rise.

ELECTRICAL RATINGS (Amperes):

T631A,B

VOLTAGE (Vac)	24[a]	120	240	WITH 1 hp SWITCH 120	WITH 1 hp SWITCH 240
Full Load	2.0	7.4	3.7	16.0	8.0
Locked Rotor	—	44.4	22.2	96.0	48.0

[a]24 Vac rating for T631B.

T631C

					WITH 1 hp SWITCH			
					R-B		R-W	
VOLTAGE (Vac)	24	120	240	277	120	240	120	240
Full Load	2.0	7.4	3.7	3.0	8	5.1	16	8
Locked Rotor	—	44.4	22.2	18.0	48	30.6	80	40
Resistive Load	—	10.0	5.0	—	—	—	—	—

INSTALLATION

WHEN INSTALLING THIS PRODUCT...

1. Read these instructions carefully. Failure to follow them could damage the product or cause a hazardous condition.
2. Check the ratings given in the instructions and on the product to make sure the product is suitable for your application.
3. Installer must be a trained, experienced service technician.
4. After installation is complete, check out product operation as provided in these instructions.

CAUTION

Disconnect power supply before beginning installation to prevent electrical shock and equipment damage.

LOCATION

Locate the T631 controller about 5 ft [1.5 m] above the floor in an area with good air circulation and average temperature. The controller mounts on any flat surface or on switch box with screws through back of case. Do not locate T631 on an outside wall, or where the controller will be affected by drafts or radiant heat from the sun.

MOUNTING ON FLAT SURFACE OR SWITCH BOX

1. Remove cover by unscrewing single screw in cover.
2. Remove appropriate knockout for wiring.
3. Attach controller to mounting surface or switch box.

NOTE: A wooden panel should be placed between the controller and the mounting surface if the surface is brick, metal, or concrete.

4. Run wires through the knockout and into the controller case.

WIRING

Disconnect power supply before making wiring connections to avoid possible electrical shock or equipment damage. All wiring must agree with local codes and ordinances.

Refer to the wiring diagrams (Figs. 2-8) and to installation information furnished with the system equipment when wiring the T631.

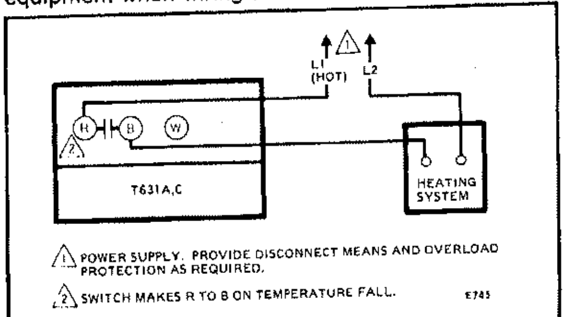


FIG. 2—T631A OR C HOOKUP FOR CONTROL OF HEATING SYSTEM.

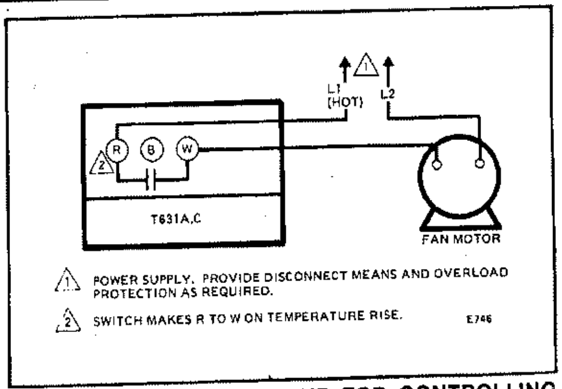


FIG. 3—T631A OR C HOOKUP FOR CONTROLLING FAN.

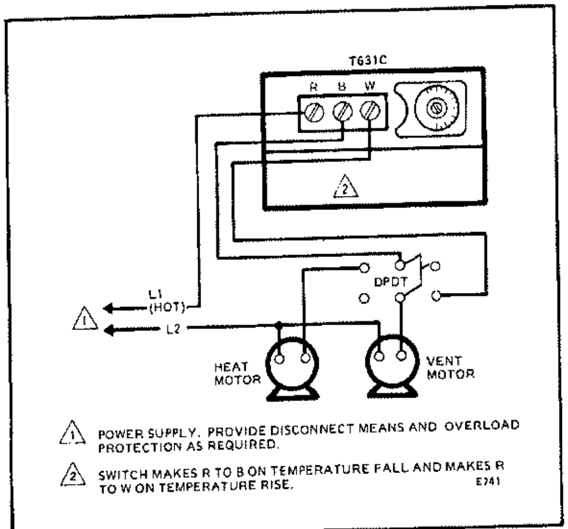


FIG. 4—T631C CONTROLLING HEATING AND VENTILATION.

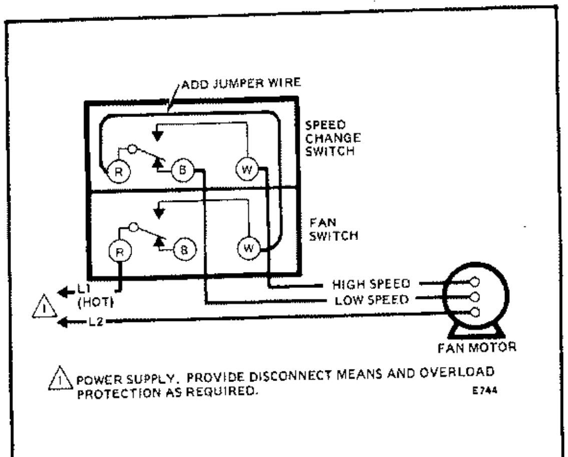


FIG. 5—TYPICAL HOOKUP OF T631B FOR CONTROLLING A 2-SPEED FAN.

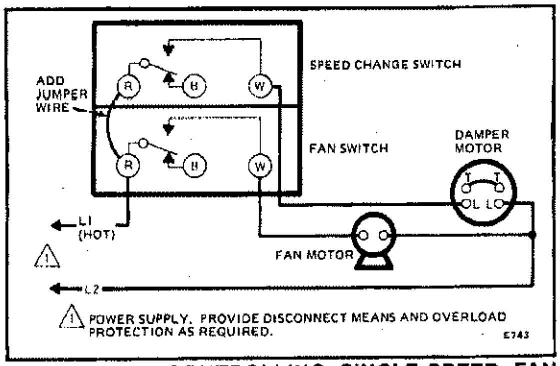


FIG. 6—T631B CONTROLLING SINGLE-SPEED FAN AND DAMPER MOTOR.

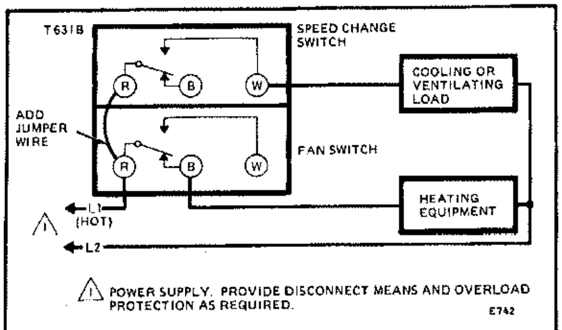


FIG. 7—TYPICAL T631B CONNECTIONS FOR HEATING AND COOLING (or ventilating) CONTROL.

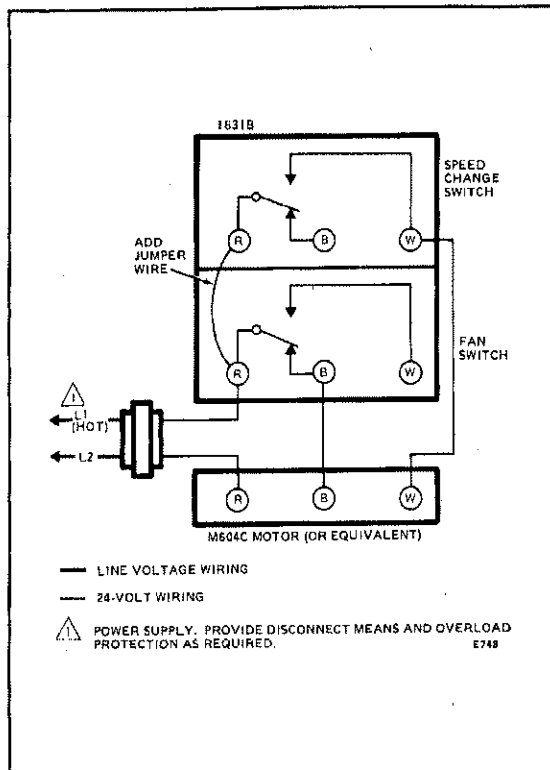


FIG. 8—TYPICAL T631B CONNECTIONS FOR FLOATING CONTROL OF DAMPER MOTOR.

CHECKOUT

1. Turn on the power.
2. Turn the temperature adjusting knob and scale across the indicator and back again. See Fig. 9. The controlled equipment should switch on and off.

When wired for heating (R to B), turning the dial counterclockwise to a higher setting simulates a space temperature drop and the heating equipment should come on. When the controller is wired for a cooling or ventilating application (R to W), turning the dial clockwise to a lower setting simulates a rise in temperature and the cooling or ventilating equipment should come on.

3. If the controlled equipment does not start and stop as indicated in step 2, disconnect the power supply and check the wiring and terminal connections.
4. If the controlled equipment operates opposite to the sequence desired, shut off the power and check for reversed leads on the switch.

IMPORTANT

If the T631 is mounted in an area where it is subjected to dust or other substances, clean periodically. Wipe the temperature sensing coil to maintain maximum air contact if the surrounding air contains oil or other adhesive substances.

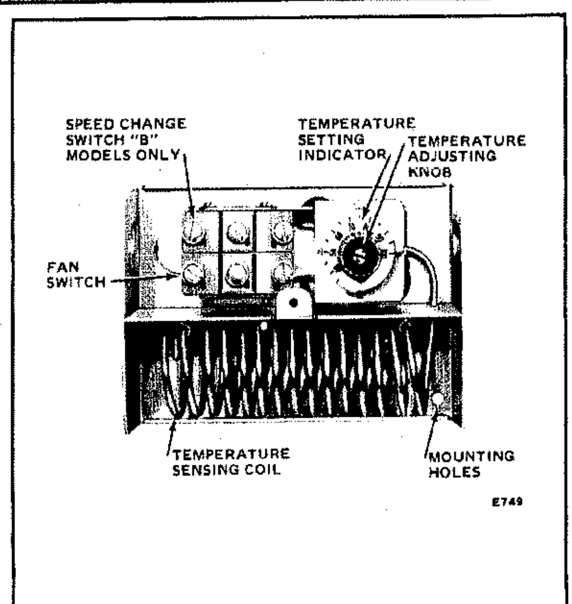


FIG. 9—T631B WITH COVER REMOVED. T631A AND C HAVE 3 WIRING TERMINALS ONLY.

If questions arise regarding this product, contact your distributor or local Honeywell representative.

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The Round®

Mercury-Free Thermostat

Honeywell

The world's most popular thermostat has taken a turn for the future — with mercury-free models. Built on the proven performance and reliability of Honeywell tradition, The Round® Mercury-Free Thermostat features a precision electronic switch that completely eliminates the need for mercury. The display features an enlarged scale that makes it easier than ever to set the temperature exactly where you want it. And since The Round offers precise temperature accuracy, you'll know that what you set is what you'll get. From its classic design to its ease of use, The Round Mercury-Free Thermostat is a true source of comfort.

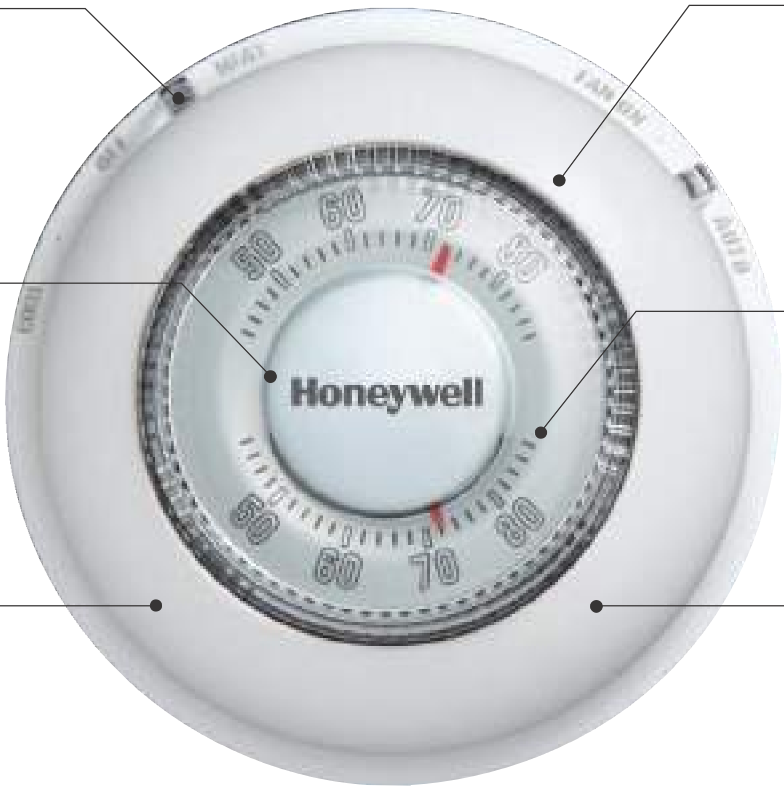
The Round® Mercury-Free Thermostat

IMPROVED DESIGN MAKES IT BETTER THAN EVER.

Electronic Switch —
Replaces mercury for environmentally friendly performance.

Proven Performance —
Accuracy and reliability has made Honeywell the number one thermostat choice of homeowners.

Classic Design —
The Round is the world's most popular thermostat.



Easy-To-See™ Model —
The Easy-to-See model has an enlarged scale and raised designations that make seeing and setting the temperature easier than ever.

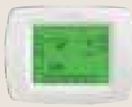
Precision Accuracy —
Reliable temperature control eliminates temperature swings.

5-Year Warranty

Part Numbers – U.S.	Part Numbers – Canada	Stages	Display Size
T87K1007	T87K1015	Heat Only	Standard
T87N1000	T87N1018	1 Heat/1 Cool	Standard
T87N1026		1 Heat/1 Cool	Large – Easy-to-see

Upgrade Options

Ask your heating and cooling professional about:



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5-YEAR WARRANTY

50-9421
May 2006

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T87 Range Stops

INSTALLATION INSTRUCTIONS

APPLICATION

Use the 50010944-001 range stops with the T87K, N thermostats to limit the minimum and maximum temperature settings.

The 50010944-001 contains two range stop scales and two #2-28 x 3/8 phillips pan head screws.

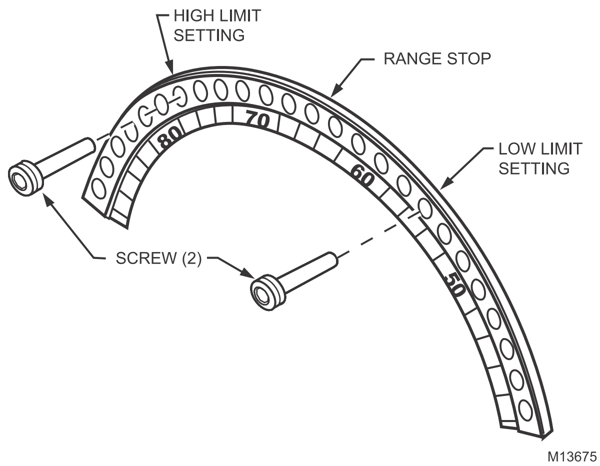

Fig. 1. Range stop and screws (Fahrenheit range).

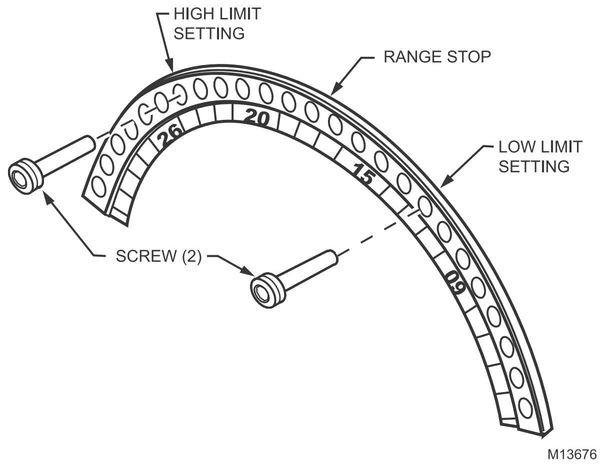

Fig. 2. Range stop and screws (Celsius range).

INSTALLATION

1. Set the thermostat to a temperature setting in the middle of the upper and lower range desired.
2. Remove the thermostat from its base (if already attached).
3. On the back of the thermostat, align the range stop with the holes on the back of the thermostat. See Fig. 3.

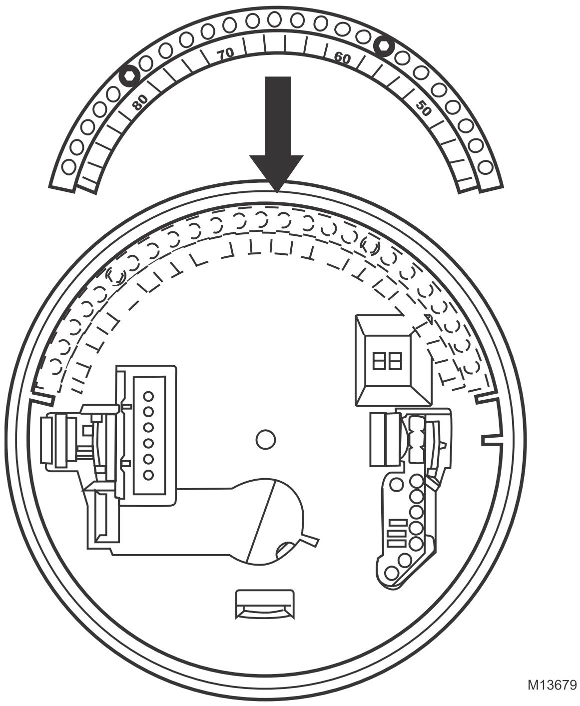

Fig. 3. Aligning range stop with thermostat.

4. Using the temperature markings on the range stop, insert supplied screws into the minimum and/or maximum range stop holes and tighten. Refer to Tables 1 and 2 for range stop temperatures. See Figs. 4 and 5.
5. Mount the thermostat onto its base and set desired temperature. See Fig. 5.

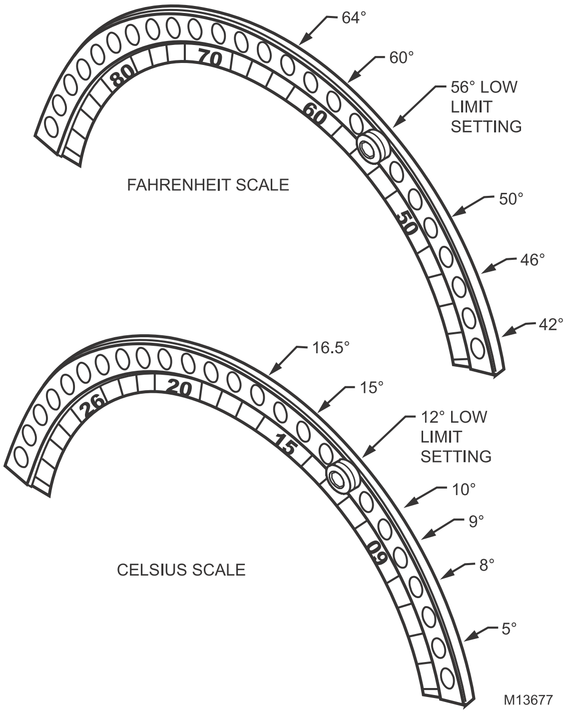

Fig. 4. Low range stop settings.

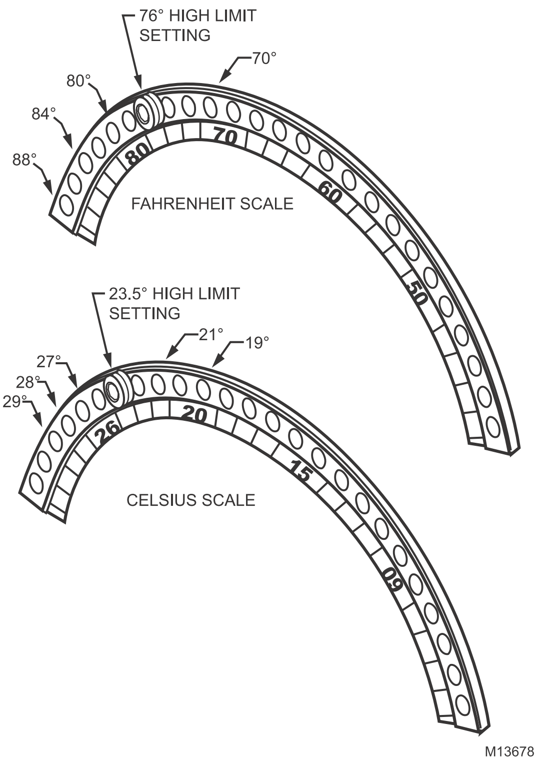

Fig. 5. High range stop settings.

Table 1. Low Limit Range Stop

°F	°C
42	4
44	5
46	6.5
48	8
50	9
52	10
54	11
56	12
58	13
60	14.5
62	15.5
64	16.5
66	17.5
68	19
70	20
72	21
74	22.5
76	23.5
78	24.5
80	26

Table 2. High Limit Range Stop

°F	°C
88	31
86	29.5
84	28
82	27.5
80	26
78	25
76	24
74	22.5
72	21.5
70	20
68	19
66	18
64	17
62	16
60	14.5

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Chapter 33 HEAT TRACE

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33.1 **HEAT TRACE CONTROLLER - Urecon UTC-2030-11**

33.2 **HEAT TRACE CABLE - Urecon Thermocable C13-240-COJ**

33.3 **TEMPERATURE SENSOR #1 - Urecon URTD-15-G**

33.4 **TEMPERATURE SENSOR #2 - Urecon URTD-15-R**

33.5 **TEMPERATURE SENSOR #3 - Urecon URTD-30-G**

33.6 **POWER FEEDER KIT - Urecon PFK-4**

URECON PRE-INSULATED PIPE

Heat trace control

Submittal Data #151 E

Electronic Thermostat
Model No. UTC-2030 program code #
and
Model No. UTC-2230 program code #
(with circuit breaker)

This state-of-the-art electronic thermostat is designed to control one or more heating cables operating between 120 and 240 Vac having a total current draw that does not exceed 30A. It can be fitted with up to three temperature sensors as required by the application. Because separate temperature sensors are used, they may be installed on the pipe during the initial installation phase while the controller itself may be installed at a later date.

Features include:

- Universal power supply allowing operation at 120 to 240 Vac without wiring modifications (no neutral required).
- 2-pole, 30A, 240 Vac circuit breaker that allows operation from 120 to 240 Vac provides a local means of disconnect (on model 2230 only).
- Internal ground fault detection circuitry eliminating the need for an external ground fault device. “Alarm only” or “alarm and trip” is activated when ground fault condition is present.
- Three temperature sensor inputs: TS1 for pipe temperature control, TS2 (when enabled) for pipe temperature control at second location on the piping system and TS3 (when enabled) to serve as a high temperature limit for plastic piping protection. An alarm is activated when an enabled “open” or “shorted” sensor is detected.
- Low temperature alarm on both controlling sensors TS1 and TS2. Alarm level is factory set at dedicated level for each sensor. Feature is enabled at customer request.
- On-off control with a 1^0C *(1.8^0F)* temperature dead band for accurate control of piping systems. This close tolerance control can save thousands of kilowatt hours of power consumption and is ideal to control electric tracing systems in locations where power is costly.
- Override input (factory programmable): timed between 1-48 hours or non-timed. This feature forces the output “on” or “off” to suit the application.
- Auto-cycle function (when enabled) momentarily turns heating cable “on” at 24 hour interval to monitor ground fault condition of the load.
- One three-color LED indicator lamp mounted on the door of the controller operates as follows:
-
    - ❖ Green: When illuminated, the power supply to the controller is “on” and the pipe temperature at the sensor is above the set point. When extinguished, the power supply is “off”.
    - ❖ Amber: When illuminated, the temperature controller is calling for heat.
    - ❖ Red: When illuminated, this indicates that one of the alarms has been triggered. Controller is not calling for heat.
    - ❖ Amber and Red (alternating): This indicates that one of the alarms has been triggered. Controller is calling for heat.
- Non-volatile memory retains all programmed parameters in the event of a power outage.

Sensor type:
This temperature controller can be factory programmed to operate with one of two different types of temperature sensor. By default the controller is programmed for 100 ohms Platinum RTD sensor(s). It can also be programmed for 2252 ohms thermistor(s) on special req... digits of the controller’s catalog nu... programming code. Control progr... to 49 are for use with RTDs and... 99 are for thermistors. Ensure tha...

Shop Drawings
Contractor Approval
Approved by: S.B.S., G. F.
Date: Mar 05, 2015 40-063
SIFEC NORTH INC

of temperature sensor is used with the controller. Program codes are listed in tables 5 and 6.

URTD Temperature sensor:
100 ohms RTD temperature sensor for use with the UTC line of electronic thermostats. Available with 6 m *(20 ft),* 15 m *(50 ft)* or 30 m *(100 ft)* of grey or red PVC extension lead wire for ease of identification.

UTC-2030 specifications:

Alarm output:
1A max, 240 Vac max., 50/60 Hz, SPDT (form C) relay output configured for “fail safe” operation.

Approvals:
CSA “C” – “US” for ordinary locations.

Enclosure:
Nema 4, grey painted steel with ¼ turn latch.

Indicator light:
Nema 4 multi-function three color LED.

Input voltage range:
120-240 Vac, 50/60 Hz.

Monitoring and alarming:
The electronics monitor low temperature, ground fault current, open / shorted temperature sensor(s) and high cable temperature.

Operating ambient:
-40 to +40^{0}C (-40 to + 104^{0}F).

Power output:
2-pole relay output rated 30A - 240 Vac.

Terminal blocks:

Power terminals for #22 to #8 AWG		Spring loaded signal terminals for #28 to #12 AWG	
Power in	L1, N or L2	Sensors: TS1	#1 – 2 – 3 - 4
Heater out	H1, N or H2	TS2	#5 – 6 – 7 - 8
		TS3	#12 – 13 – 14 – 15
		Alarm relay	#9 – 10 – 11
		Alarm reset	#16 – 17
		Override input	#18 - 19

Factory programmable:
Note: You can use the default settings of the following features by selecting the appropriate program code.

Auto cycle:
When the temperature controller is energized, and then at 24 hours intervals, the controller performs an auto-cycle test by turning on the load to measure the ground fault leakage current. If the measured ground fault current is above the set level, the ground fault current alarm is activated. Can be disabled at the factory upon special request Ground fault detection

Factory adjustable to trip and alarm or alarm only. Setting @ 30 or 100 ma.

Remote override:
The user may force the unit on/off via a remote dry contact. Factory adjustable to operate in timed (1 – 48 hours) or continuous mode.

Temperature control: Three 3-wire 100 Ω @ 0^{0}C Platinum RTD.(alpha = 0,00385 Ω/Ω/^{0}C0, lead compensated to 20 Ω per lead.
or
three 2-wire 2 252 Ω @ 25 ^{0}C NTC Thermistor.

Dead band:
1 to 5 ^{0}C *(1.8 to 9 ^{0}F).*

Control temperature set point range:
-5 to 75 ^{0}C *(23 to 167 ^{0}F).*

Low temperature alarm:
Feature can be enabled to provide low temperature alarm on TS1 and TS2.

Low temperature set point range:
-10 to 75 ^{0}C *(14 to 167 ^{0}F).*

High cable temperature:
The third temperature sensor (referred to as TS3) is used as a high cable temperature limit for plastic piping system protection. When TS3 is enabled the high limit feature will override demand for heat and shut off the load when a high cable temperature condition is reached.

High temperature set point range:
25 to + 100 ^{0}C *(77 to +212 ^{0}F).*

UTC-2230 specifications:
Same as the UTC-2030 except for the following:
Circuit breaker: 2-pole, 30 A, 240 Vac, pre-wired to the temperature control board.

Terminal blocks:
Incoming power lugs at the circuit breaker for #14 to #4 AWG.

Enclosure:
Nema 4, grey painted steel with clips.

CANADA

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URECON
PRE-INSULATED PIPE

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INSTALLATION INSTRUCTION #44E

ELECTRONIC THERMOSTAT

Model No. UTC-2030-(program code #) and Model No. UTC-2230-(program code #) (with 2-pole circuit breaker) and Contactor version

These electronic thermostats are designed to control one or more heating cables having a total current draw that does not exceed 30 A for the relay version and up to 60 A for the contactor version. They can be fitted with up to three temperature sensors as required by the application. Because separate temperature sensors are used, they may be installed on the pipe during the initial installation phase while the controller itself may only be installed at a later date.

Features include:

- Universal power supply allowing operation at 120 to 240 Vac without wiring modifications.
- Internal ground fault detection circuitry eliminating the need for an external ground fault device. Alarm only or alarm and trip is activated when ground fault condition is present.
- Three temperature sensor inputs: TS1 for pipe temperature control, TS2 (when enabled) for pipe temperature control at another location on the piping system and TS3 (when enabled) to serve as a high temperature limit for plastic piping protection. An alarm is activated when an enabled “open” or “shorted” sensor is detected.
- Low temperature alarm on both controlling sensors TS1 and TS2. Alarm level is factory set at a dedicated level for each sensor.
- On-off control with a 1°C *(1.8 °F)* temperature differential for accurate control of piping systems. This close tolerance control can save thousands of kilowatt-hours of power consumption and is ideal to control electric tracing systems in locations where power is costly.
- Override input (factory programmable): timed between 1-48 hours or non-timed.
- Auto-cycle function (when enabled) momentarily turns on heating cable at 24 hours interval to monitor ground fault condition of the load.
- One three-color LED indicator lamp mounted on the door of the controller operates as follows:
  - ✤ Green: When illuminated, the power supply to the controller is ‘on’ and the pipe temperature at the sensor is above the setpoint. When extinguished, the power supply is ‘off’.
  - ✤ Amber: When illuminated, the temperature controller is calling for heat.
  - ✤ Red: When illuminated, this indicates that one of the alarms has been triggered. Controller is not calling for heat.
  - ✤ Amber and Red (alternating): This indicates that one of the alarms has been triggered. Controller is calling for heat.
- Non-volatile memory retains all programmed parameters in the event of a power outage.

Conducted and radiated emissions FCC/DOC statement of compliance

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

This Class B digital apparatus complies with Canadian ICES-003.

Installation:

- Be sure that the personnel involved in the installation and servicing is qualified and familiar with electrical equipment, their ratings and applicable codes.
- The wide ambient operating temperature range of the temperature controller allows installation in any convenient location. Considerations should include exposure to weather elements and accessibility for maintenance and testing.
- Mounting hole positions are shown on the drawings in annexes A, B and C.
- Backplate should be removed from the enclosure before any holes are drilled or cut to prevent damage due to flying debris.
- Conduit/cable entries should be made on the bottom of the enclosure to reduce the possibility of water entry. Avoid having holes drilled on the sides adjacent to the electronic components.
- The user may choose to drill 3 mm *(1/8 in)* drain holes on the bottom of the enclosure on both the left and right sides (note that drilling holes in the enclosure compromises the Nema 4 rating).
- Use connector bushings suitable for the enclosure type and install such that the completed installation remains waterproof.

Wiring:

- Always verify wiring connections before applying power to the controller. To avoid injury or equipment damage, do not install or remove wiring while controller is powered.
- To minimize chances of loose connections, lever-operated spring-loaded terminals are used for signal wiring.
- Use shielded, twisted, three-conductor wire for the extension of the RTD leads.
- Use shielded, twisted, two-conductor wire for the extension of the thermistor leads.
- Shields on the temperature sensor wiring should be grounded only at the controller end using the appropriate terminals provided (# 4, 8 and 15).

  Note: Some sensor constructions may have continuity between the drain wire and the metal housing at the tip; in this case, the drain wire should not be connected to ground. Drain wire continuity should be verified with a digital multi-meter.
- To minimize the risk of damages to the controller due to a cable fault, the integrity of the heating cable should be verified by:
  - ✤ Performing a high voltage insulation test.
  - ✤ Measuring the load resistance with an ohmmeter.
  - ✤ In both cases, the results should be recorded for future reference.

Sensor type:

This temperature controller can be factory programmed to operate with one of two different types of temperature sensor. By default, the controller is programmed for 100 ohms @ 0 °C *(32 °F)* Platinum RTD sensor(s). It can also be programmed for 2 252 ohms @ 25 °C *(77 °F)* thermistor(s) on special request. The last two digits of the controller's catalog number indicate the programming code. Control program codes from 01 to 49 are for use with RTDs and codes from 51 to 99 are for thermistors. Ensure that the proper type of temperature sensor is used with the controller. Program codes are listed in annex E and is identified by a label on the electronics.

Sensor location:

- Install the temperature sensor(s) with aluminum foil tape to enhance heat transfer.
- The controlling sensor is to be taped directly to the pipe wall, 180° away from the heating cable.
- The controlling sensor(s) TS1 and TS2 (when feature enabled) should be located at the expected coldest point(s) of the piping system.
- If controlling a pipe entering a heated building, the sensor(s) must be located at least 3 m *(10 ft)* away from the outside wall to avoid inaccurate temperature sensing.
- The high cable temperature sensor (TS3) is to be taped to an active heating zone of the heating cable (not to the cold lead), within the heat trace channel.

Note: The accurate identification and positioning of the sensor(s) are essential for an efficient and safe operation of the system.

Troubleshooting :

Temperature sensor failure :

This alarm will indicate that one of the sensors is not operating properly. The temperature sensor may fail due to an "open" or "shorted" condition. Ensure that you are using the correct type of sensor i.e. : 3-wire RTD or 2-wire thermistor (refer to program code table in annex E), and that it is wired correctly.

Probable causes of alarm :

- Incorrect or damaged field wiring, “open” leads or excess resistance due to broken or damaged wires or loose connections.
- Damaged or inoperative temperature sensor.
- Wrong type of sensor used.

When using RTDs :

- Ensure that the RTD is a 3-wire 100 ohms @ 0 °C *(32 °F)* Platinum type.
- Disconnect the RTD wiring from the input terminals.
- Measure the resistance between the source (white) and sense (black) leads at the controller. It should not exceed 40 ohms. Excessive lead resistance will cause a sensor failure alarm and must be corrected. Look for loose terminals, excessive lead length or insufficient wire gauge and correct as necessary.
- Measure the resistance between the source (white) or sense (black) lead and the common (red) lead of the RTD at the controller. It should be between 84 and 178 ohms depending on the probe temperature and lead resistance. Refer to the resistance table in annex F.
- Verify that the RTD is wired correctly. Refer to the wiring diagram in annex D.
- Ensure that the RTD extension wire (when used) is grounded at one end only, normally at the controller terminal.

When using thermistors :

- Ensure that the thermistor is a 2-wire 2 252 ohms @ 25 °C *(77 °F)* NTC thermistor.
- Disconnect the thermistor wiring from the input terminals.
- Measure the resistance between both leads of the thermistor at the controller. It should be between 75,593 and 152 ohms depending on the probe temperature and lead resistance. Refer to the resistance table in annex F.
- Verify that the thermistor is wired correctly. Refer to the wiring diagram in annex D.
- Ensure that the thermistor extension wire (when used) is grounded at one end only, normally at the controller terminal.

Low temperature alarm (when enabled) :

This alarm will appear when the temperature at the sensor decreases below the low temperature setpoint.

Probable causes of alarm :

- Alarm setpoint too close to maintain temperature setpoint.
- Flow of cold liquid.
- Empty pipe venting out in the atmosphere.
- Damaged or missing thermal insulation.
- Heating cable not sized properly for the application.
- Damaged heating cable.
- Recent power outage allowing pipe to cool under setpoint.

Seemingly incorrect temperature :

Disconnect the temperature sensor from the input terminals at the controller.

When using RTDs :

- To evaluate the temperature at an RTD, measure the resistance from source or sense lead wire to the common lead wire and substract the resistance measured between source and sense lead wires. The resulting value can be cross-referenced to the table in annex F.

When using thermistors :

- To evaluate the temperature at a thermistor, measure the resistance between both leads. The resulting value can be cross-referenced to the table in annex F.

In both cases, you can usually determine if the temperature obtained from the list is representative of the conditions on the pipe. If you have more than one sensor installed, you can compare the readings. Note that when comparing values of a sensor on the pipe with a sensor on the heating cable, you should ensure that the heating cable has been de-energized for a substantial period of time to allow for both sensors to be in similar temperature environments.

GFI alarm :

This alarm is caused by a ground fault leakage current in excess of the setting.

Probable causes of alarm :

- Alarm level set too close to normal leakage current.
- Damaged cable insulation or moisture presence.
- Poor cable splice or termination.
- Moisture in enclosure that provides a conductive ground path sufficient to trigger the alarm.

UTC-2030 SPECIFICATIONS:

Alarm output : 1 A max, 240 Vac max., 50/60 Hz, SPDT (form C) relay output configured for "fail-safe" operation.

Approvals : CSA "C" - "US" for ordinary locations.

Enclosure: Nema 4, gray painted steel with ¼ turn latch.

Indicator light: Nema 4 multi-function three color LED.

Input voltage range : 120-240 Vac, 50/60 Hz.

Monitoring and alarming : The electronics monitor low temperature, ground fault current and open / shorted temperature sensor(s).

Operating ambient temp.: -40 to +40 °C *(-40 to +104 °F).*

Power output : 2-pole relay output rated 30 A - 240 Vac.

Terminal blocks:

Power terminals for #22 to #8 AWG

Power in: L1, N or L2.
Heater out: H1, N or H2

Signal terminals for #28 to #12 AWG

Sensors:	TS1:	#1-2-3-4.
	TS2:	#5-6-7-8.
	TS3:	#12-13-14-15.
	Alarm relay:	#9-10-11.
	Alarm reset:	#16-17.
	Override input:	#18-19.

Valid temperature range: -40 to +100 °C *(-40 to +212 °F).*

FACTORY PROGRAMMABLE:

Auto-cycle : When the temperature controller is energized, and then at 24 hours intervals, the controller performs an auto-cycle test by turning on the load to measure the ground fault leakage current. If the measured ground fault current is above the set level, the ground fault current alarm is activated.

Ground fault detection : Factory adjustable to trip or alarm only. Setting @ 30 or 100 ma.

Remote override : The user may force the unit on/off via a remote dry contact. Factory adjustable to operate in timed (1-48 hours) or non-timed mode.

Temperature control : three 3-wire 100 Ω @ 0 °C *(32 °F)* Platinum RTD (alpha=0,00385 Ω/Ω/°C), lead compensated to 20 Ω per lead.
or
three 2-wire 2 252 Ω @ 25 °C *(77 °F)* NTC Thermistor.

Deadband : 1 to 5 °C *(1.8 to 9 °F)* see ANNEX E.

Control temperature setpoint range: -5 to 75 °C *(23 to 167 °F)* see ANNEX E.

Low temperature alarm : Feature can be enabled to provide low temperature alarm on TS1 and TS2.

Low temperature setpoint range: -10 to 75 °C *(14 to 167 °F)* see ANNEX E.

High cable temperature: The third temperature sensor (referred to as TS3) is used as a high cable temperature limit for plastic piping system protection. When TS3 is enabled, the high limit feature will override demand for heat and shut off the load when a high cable temperature condition is reached.

High temperature set point range: 25 to 100 °C *(77 to 212 °F)* see ANNEX E.

UTC-2230 SPECIFICATIONS :

Same specifications as the UTC-2030, with the addition of :

Circuit breaker : 2-pole, 30 A, 240 Vac, pre-wired to the temperature control board.

Terminal blocks: Incoming power lugs at the circuit breaker for: #14 to #4 AWG

CONTACTOR VERSION SPECIFICATIONS :

Same specifications as the UTC-2030, except for the following :

Sequence of number is : UTC-VPAA-xx

'V' in the catalog number denotes the operating voltage, i.e. : 2 for 208, 4 for 480 or 6 for 600 .

'P' in the catalog number denotes the number of poles on the circuit breaker, i.e. : 2 or 3.

'AA' in the catalog number denotes the amperage of the circuit breaker,
i.e. : 15, 20, 25, 30, 35, 40, 45, 50 or 60.

'xx' in the catalog number denotes the control program code (see annex E).

Input voltage : 208, 480 or 600 Vac, 50/60 Hz, 3-phase / 4-wire.

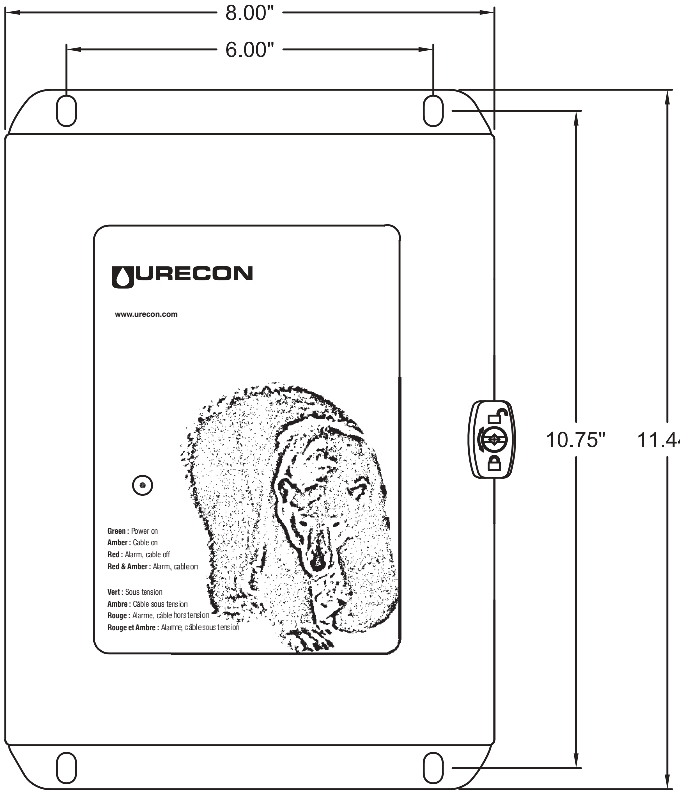
Power output : 3-pole contactor output rated 60 A - 600 V ac.

Terminal blocks:

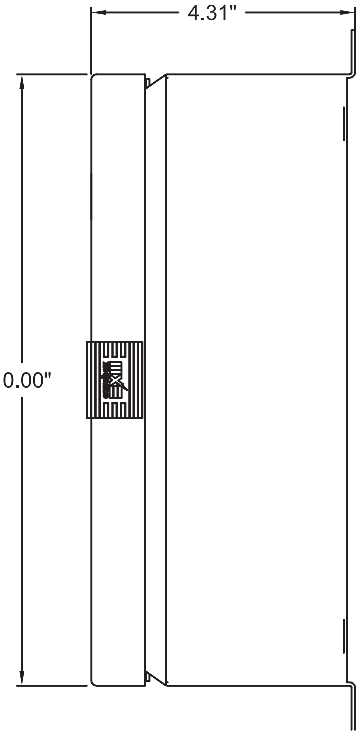
Power in terminals;	L1, L2 and L3:	#14 to # 4 AWG
Heater terminals;	H1, H2 and H3:	#14 to # 3 AWG
Neutral terminals:		#14 to # 6 AWG

ANNEXE / ANNEX **A**

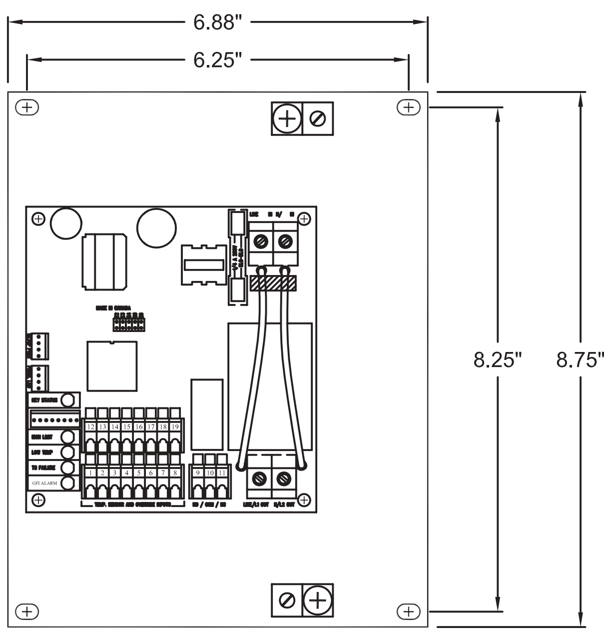
UTC-2030
Thermostat électronique / Electronic thermostat



ÉLÉVATION / FRONT VIEW



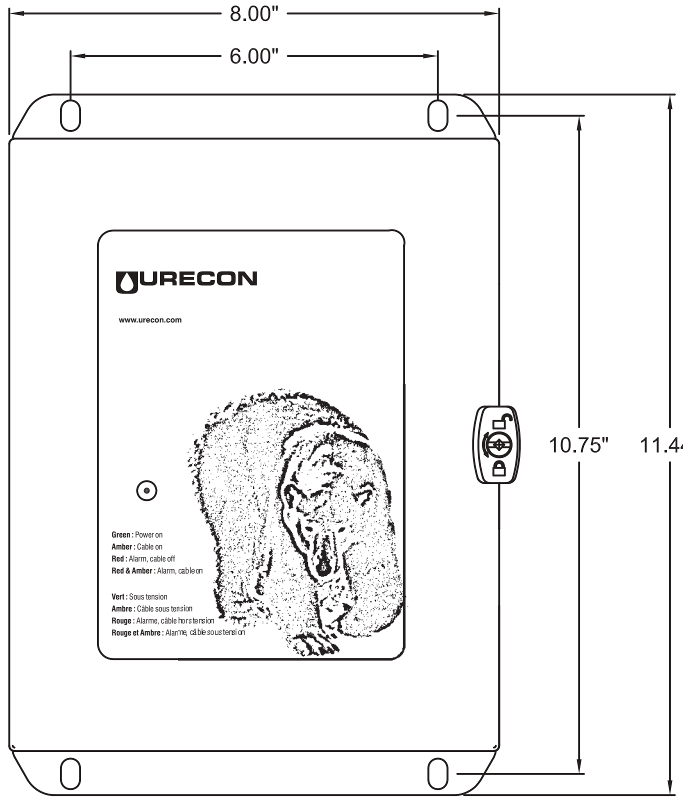
PROFIL / LEFT SIDE VIEW



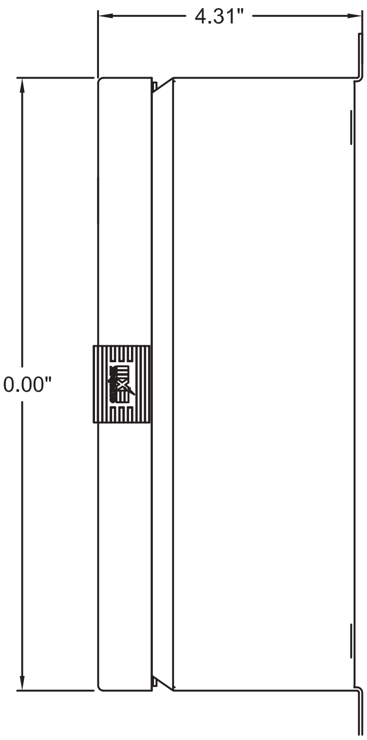
PLAQUE DE FOND / BACKPLATE

ANNEXE / ANNEX B

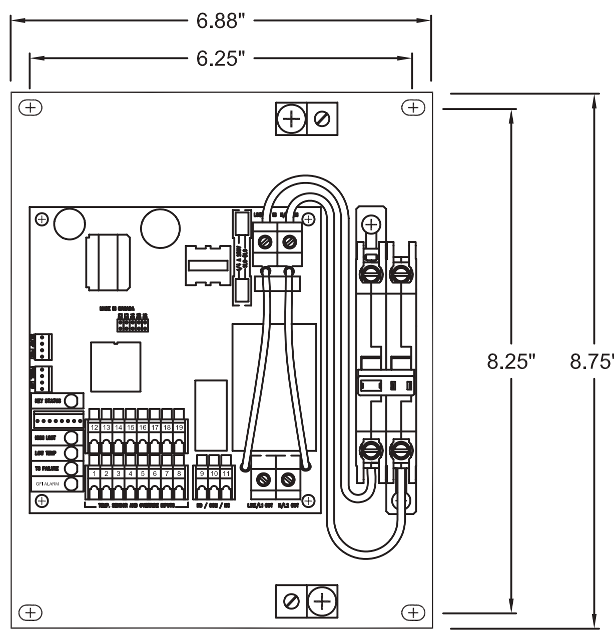
UTC-2230
Thermostat électronique / Electronic thermostat



ÉLÉVATION / FRONT VIEW



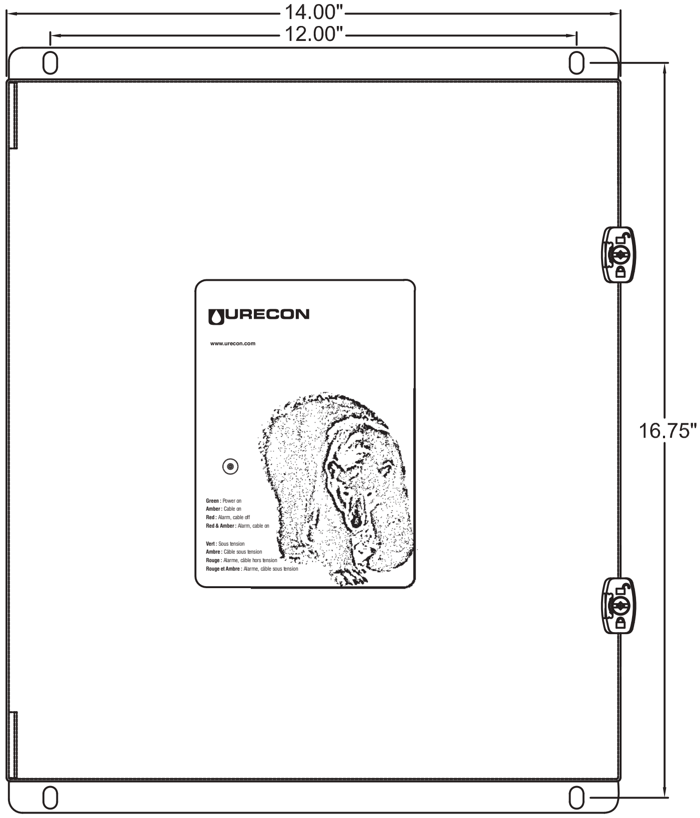
PROFIL / LEFT SIDE VIEW



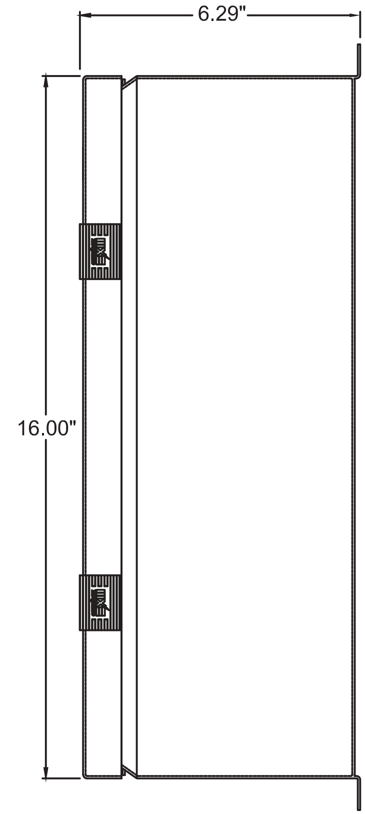
PLAQUE DE FOND / BACKPLATE

ANNEXE / ANNEX **C**

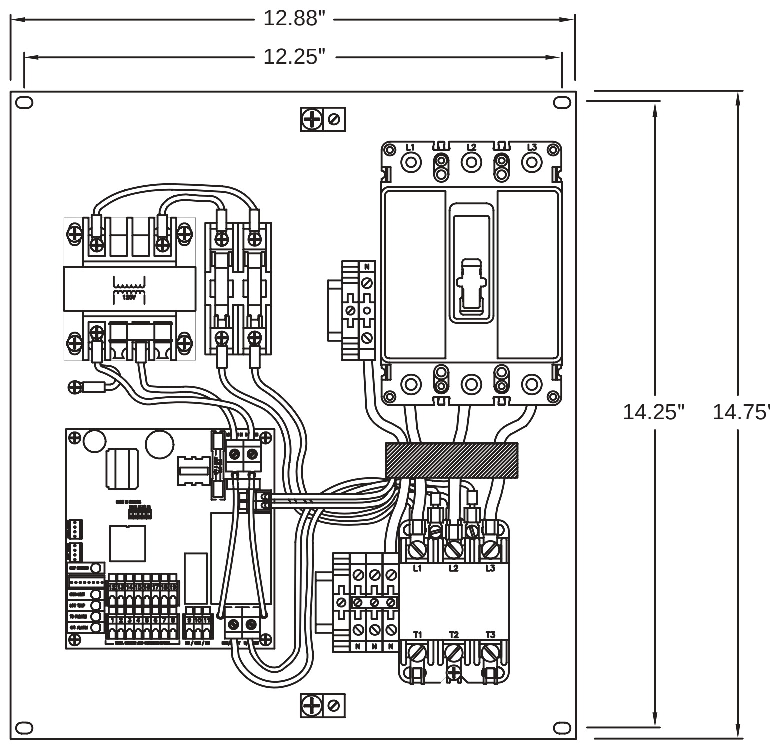
Thermostat électronique à contacteur / Contactor version electronic thermostat



ÉLÉVATION / FRONT VIEW

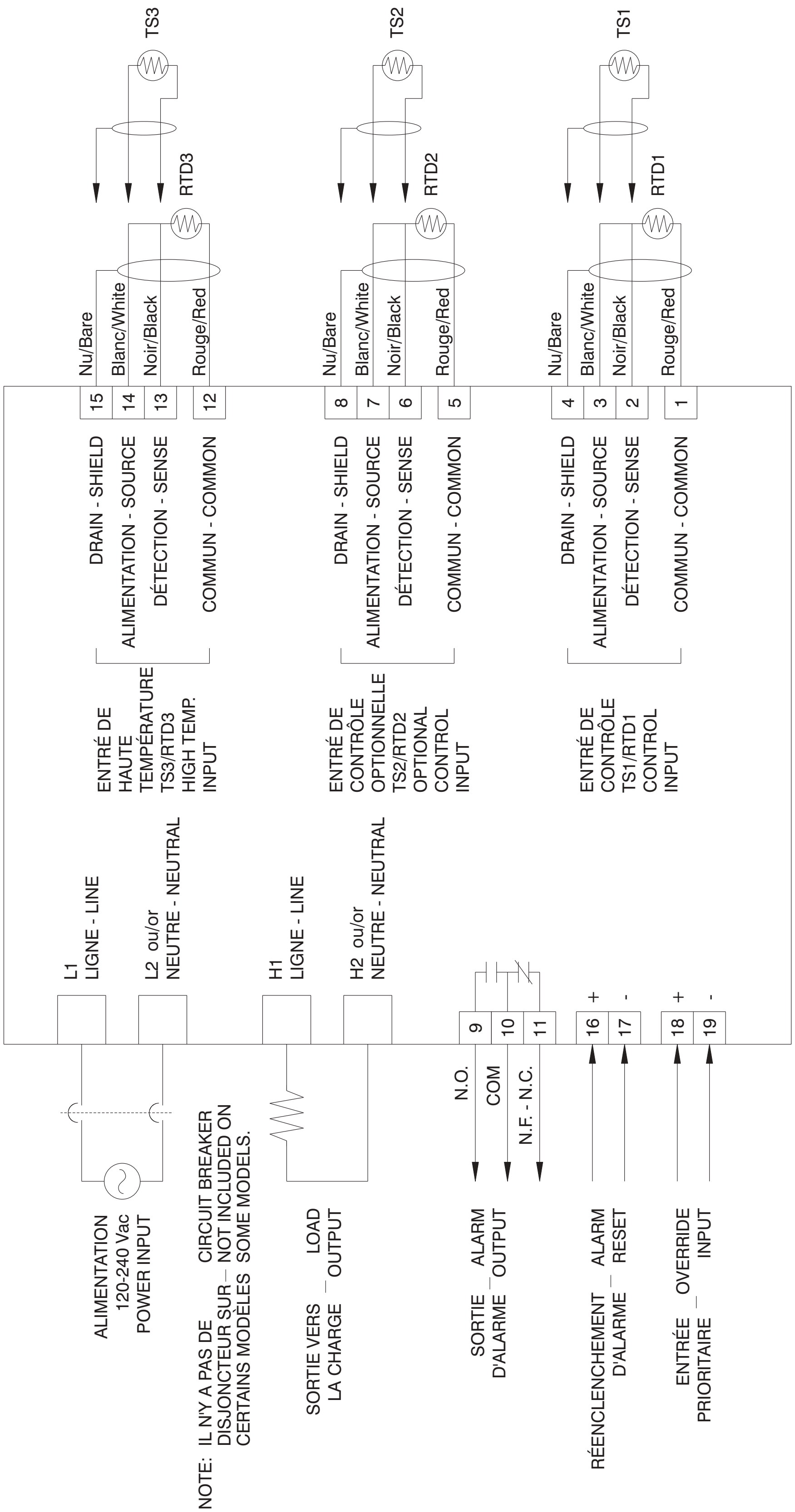


PROFIL / LEFT SIDE VIEW



PLAQUE DE FOND / BACKPLATE

Schéma de câblage / Wiring Diagram



UTC-2030-xx, UTC-2230-xx, UTC-VPAA-xx

xx doit être remplacé par le code de programmation approprié

xx is to be replaced by the appropriate program code number

	code de programmation pour RTD RTD program code	Capteur de contrôle TS1 (alarme en indice) Température Controlling sensor TS1 (alarm in subscript)	Capteur de contrôle TS2 (alarme en indice) Température Controlling sensor TS2 (alarm in subscript)	Capteur de haute température TS3 Température High temperature sensor TS3	code de programmation pour thermistance Thermistor program code	
POUR TUYAU DE PLASTIQUE FOR PLASTIC PIPE	01	3 °C (37.4 °F)	–	65 °C (149 °F)	51	POUR TUYAU DE PLASTIQUE FOR PLASTIC PIPE
	02	3_{1} °C ($37.4_{33.8}$ °F)	–	65 °C (149 °F)	52	
	03	5 °C (41 °F)	–	65 °C (149 °F)	53	
	04	5_{3} °C ($41_{37.4}$ °F)	–	65 °C (149 °F)	54	
	05	10 °C (50 °F)	–	65 °C (149 °F)	55	
	06	10_{5} °C (50_{41} °F)	–	65 °C (149 °F)	56	
	07	15 °C (59 °F)	–	65 °C (149 °F)	57	
	08	15_{10} °C (59_{50} °F)	–	65 °C (149 °F)	58	
	11	3 °C (37.4 °F)	3 °C (37.4 °F)	65 °C (149 °F)	61	
	12	3_{1} °C ($37.4_{33.8}$ °F)	3_{1} °C ($37.4_{33.8}$ °F)	65 °C (149 °F)	62	
	13	5 °C (41 °F)	5 °C (41 °F)	65 °C (149 °F)	63	
	14	5_{3} °C ($41_{37.4}$ °F)	5_{3} °C ($41_{37.4}$ °F)	65 °C (149 °F)	64	
	15	10 °C (50 °F)	10 °C (50 °F)	65 °C (149 °F)	65	
	16	10_{5} °C (50_{41} °F)	10_{5} °C (50_{41} °F)	65 °C (149 °F)	66	
	17	15 °C (59 °F)	15 °C (59 °F)	65 °C (149 °F)	67	
	18	15_{10} °C (59_{50} °F)	15_{10} °C (59_{50} °F)	65 °C (149 °F)	68	
POUR TUYAU DE MÉTAL FOR METAL PIPE	21	3 °C (37.4 °F)	–	–	71	POUR TUYAU DE MÉTAL FOR METAL PIPE
	22	3_{1} °C ($37.4_{33.8}$ °F)	–	–	72	
	23	5 °C (41 °F)	–	–	73	
	24	5_{3} °C ($41_{37.4}$ °F)	–	–	74	
	25	10 °C (50 °F)	–	–	75	
	26	10_{5} °C (50_{41} °F)	–	–	76	
	27	15 °C (59 °F)	–	–	77	
	28	15_{10} °C (59_{50} °F)	–	–	78	
	31	3 °C (37.4 °F)	3 °C (37.4 °F)	–	81	
	32	3_{1} °C ($37.4_{33.8}$ °F)	3_{1} °C ($37.4_{33.8}$ °F)	–	82	
	33	5 °C (41 °F)	5 °C (41 °F)	–	83	
	34	5_{3} °C ($41_{37.4}$ °F)	5_{3} °C ($41_{37.4}$ °F)	–	84	
	35	10 °C (50 °F)	10 °C (50 °F)	–	85	
	36	10_{5} °C (50_{41} °F)	10_{5} °C (50_{41} °F)	–	86	
	37	15 °C (59 °F)	15 °C (59 °F)	–	87	
	38	15_{10} °C (59_{50} °F)	15_{10} °C (59_{50} °F)	–	88	

Capteurs de température utilisés avec les thermostats électroniques de la série UTC.

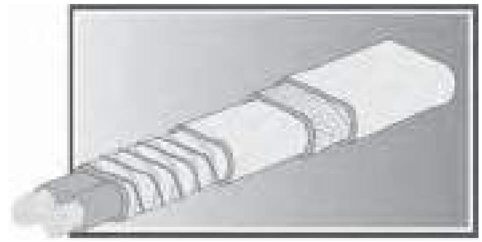
Temperature sensors used with the UTC line of electronic thermostats.

Thermistance / Thermistor (Modèle précedent / Previous model) **de / of 2 252 ohms @ 25 °C *(77 °F)***	
Température Temperature	**Résistance Resistance**
-40 °C *(-40 °F)*	75 593 Ω
-35 °C *(-31 °F)*	54 542 Ω
-30 °C *(-22 °F)*	39 789 Ω
-25 °C *(-13 °F)*	29 331 Ω
-20 °C *(-4 °F)*	21 839 Ω
-15 °C *(5 °F)*	16 416 Ω
-10 °C *(14 °F)*	12 453 Ω
-5 °C *(23 °F)*	9 529,2 Ω
0 °C *(32 °F)*	7 353,0 Ω
5 °C *(41 °F)*	5 719,1 Ω
10 °C *(50 °F)*	4 482,3 Ω
15 °C *(59 °F)*	3 538,8 Ω
20 °C *(68 °F)*	2 813,6 Ω
25 °C *(77 °F)*	2 252,0 Ω
30 °C *(86 °F)*	1 814,2 Ω
35 °C *(95 °F)*	1 470,6 Ω
40 °C *(104 °F)*	1 192,2 Ω
45 °C *(113 °F)*	983,4 Ω
50 °C *(122 °F)*	810,9 Ω
55 °C *(131 °F)*	672,2 Ω
60 °C *(140 °F)*	560,1 Ω
65 °C *(149 °F)*	468,9 Ω
70 °C *(158 °F)*	394,5 Ω
75 °C *(167 °F)*	333,3 Ω
80 °C *(176 °F)*	282,9 Ω
85 °C *(185 °F)*	241,1 Ω
90 °C *(194 °F)*	206,3 Ω
95 °C *(203 °F)*	177,2 Ω
100 °C *(212 °F)*	152,8 Ω

RTD de Platine / Platinum RTD (Modèle courant / Current model) **de / of 100 ohms @ 0 °C *(32 °F)***	
Température Temperature	**Résistance Resistance**
-40 °C *(-40 °F)*	84,27 Ω
-35 °C *(-31 °F)*	86,25 Ω
-30 °C *(-22 °F)*	88,22 Ω
-25 °C *(-13 °F)*	90,19 Ω
-20 °C *(-4 °F)*	92,16 Ω
-15 °C *(5 °F)*	94,12 Ω
-10 °C *(14 °F)*	96,09 Ω
-5 °C *(23 °F)*	98,04 Ω
0 °C *(32 °F)*	100,00 Ω
5 °C *(41 °F)*	101,95 Ω
10 °C *(50 °F)*	103,90 Ω
15 °C *(59 °F)*	105,85 Ω
20 °C *(68 °F)*	107,79 Ω
25 °C *(77 °F)*	109,73 Ω
30 °C *(86 °F)*	111,67 Ω
35 °C *(95 °F)*	113,61 Ω
40 °C *(104 °F)*	115,54 Ω
45 °C *(113 °F)*	117,47 Ω
50 °C *(122 °F)*	119,40 Ω
55 °C *(131 °F)*	121,32 Ω
60 °C *(140 °F)*	123,24 Ω
65 °C *(149 °F)*	125,16 Ω
70 °C *(158 °F)*	127,07 Ω
75 °C *(167 °F)*	128,98 Ω
80 °C *(176 °F)*	130,89 Ω
85 °C *(185 °F)*	132,80 Ω
90 °C *(194 °F)*	134,70 Ω
95 °C *(203 °F)*	136,60 Ω
100 °C *(212 °F)*	138,50 Ω

URECON
PRE-INSULATED PIPE

Heat trace controllers (HTC1,2), cables (HT1,2) and accessories



Submittal Data #147 E
Thermocable

Short Form Specifications
The electric heat tracing shall be constant watt parallel resistance THERMOCABLE® , supplied by Urecon.

Product Description
Urecon THERMOCABLE® is specifically designed for freeze protection of Urecon UIP® pre-insulated pipe. The THERMOCABLE® is a parallel resistance type heating strip which uses a thermally stable nichrome heating wire. The cable is has a series of heating zones which produce constant, predictable wattage per meter *(per ft)* output. Some of THERMOCABLE® features are:

- Smooth Teflon® overjacket permits easy conduit pulling
- Metallic ground braiding
- Can be cut to length in the field
- Moisture resistant
- Since Constant Watt cable does not have inrush current as with Self Limiting cables, smaller circuit breakers, wiring and fewer feed points are required resulting in reduced installation cost of the system.
- Cables are color coded for easy field identification. Helps eliminate the mistake of pulling in the wrong cable on projects where several cable types are being installed
- Over 20 years proven experience with millions of meters installed across North America
- All cable is CSA certified for wet locations

THERMOCABLE® can be used on any type of pipe, either metal or plastic. THERMOCABLE® is also available in several different watt densities and voltages as indicated on the Table 1.0.

Table 1.0 – THERMOCABLE® offered by Urecon

Part Number	Color	Watts		Volts	AWG	Maximum Circuit Length	
		per meter	*per foot*			meters	*feet*
C7-120-COJ	Blue	7	*2*	120	12	140	*450*
C8-120-COJ	Red	8	*2.4*	120	16	80	*275*
C13-120-COJ	Yellow	13	*4*	120	12	125	*400*
C10-240-COJ	Green	10	*3*	240	12	245	*800*
C13-240-COJ	Red	13	*4*	240	12	245	*800*
C20-240-COJ	Orange	20	*6*	240	12	200	*650*
C26-240-COJ	White	26	*8*	240	12	175	*570*
C13-575-COJ	Clear	13	*4*	575	12	425	*1400*
C20-575-COJ	Red	20	*6*	575	12	365	*1200*

Shop Drawings
Contractor Approval
Approved by: S.B.S., G. F.
Date: Mar 03, 2015
SIFEC NORTH INC

Accessories

Urecon also provides electrical accessories for the THERMOCABLE® (power feed kit, splice kit, ect.) A complete listing of the electrical accessories can be found on table 1.1.

Table 1.1 – Accessories for THERMOCABLE®

A1333-12-COJ	Power and end termination kit for #12 AWG bus cable
A1333-12-COJ	Power and end termination kit for #16 AWG bus cable
E1336-COJ	Three pack end termination kits for #12 and #16 AWG bus cable
S1334-12-COJ	Splice Kit for #12 AWG bus cables
S1334-16-COJ	Splice Kit for #16 AWG bus cables
PFK 1	6m *(20ft)* power feed kit; contains all necessary material to connect two #12 AWG bus wire THERMOCABLE® on pre-insulated pipe to a Urecon Controller
PFK 4	3m *(10ft)* power feed kit; contains all necessary material to connect a 120 volts THERMOCABLE® on pre-insulated pipe to a Urecon Controller

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URECON
PRE-INSULATED PIPE

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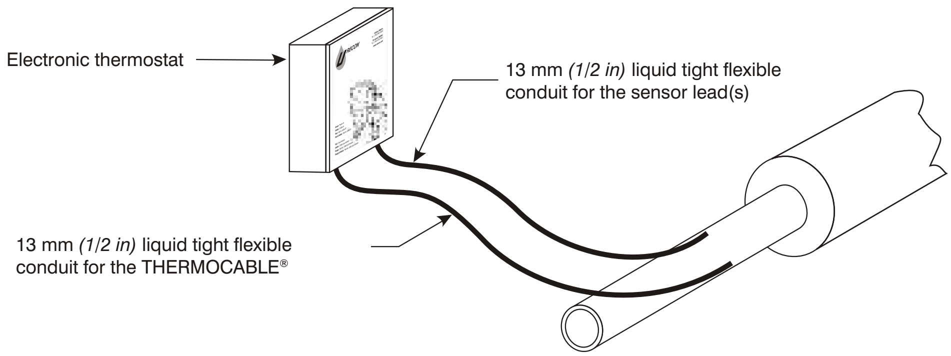
Rockledge, Florida Tel.: (321) 638-2364

INSTALLATION INSTRUCTION # 4E

PFK-4 (Power feed kit)

One PFK-4 power feed kit contains all the necessary electrical components to connect a THERMOCABLE® to an electronic thermostat of the UTC series. The thermostat may be located up to 3m *(10 ft)* away from the pipe.



Each kit contains:

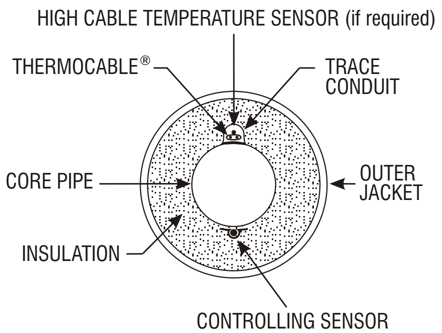
ITEM	QUANTITY	DESCRIPTION
		Components for the installation and connection of the heating cable.
1	3 m *(10 ft)*	13 mm *(½ in)* liquid tight flexible conduit.
2	1	Connector to join the 13 mm *(½ in)* liquid tight flexible conduit to the thermostat.
3	1	13 mm *(½ in)* sealing ring.
4	1	19 mm *(¾ in)* wide x 1 m *(39 in)* long roll of Teflon® tape, to insulate the nichrome resistance heating wire when skinning back heating cable to expose bus wires.
5a	1	Blue insulated butt splice connector # 2RB14X, to splice the C8-120-COJ THERMOCABLE® grounding braid to the # 14 AWG ground wire.
6a	1	# 14 AWG, RW-90 stranded ground wire, green in color.
5b	1	Yellow insulated butt splice connector # 2RC10X, to splice the #12 AWG bus wire THERMOCABLE® grounding braid to the # 12 AWG ground wire.
6b	1	# 12 AWG, RW-90 stranded ground wire, green in color.
7	1	End bushing for liquid tight flexible conduit.
8	1	HSC8-4,adhesive lined heat shrink end cap to terminate remote end of THERMOCABLE®.
9	1	19 mm *(¾ in)* diameter X 150 mm *(6 in)* long heat shrink tube, to shrink over the grounding braid at the end cap.

Components for the installation of the sensor(s).

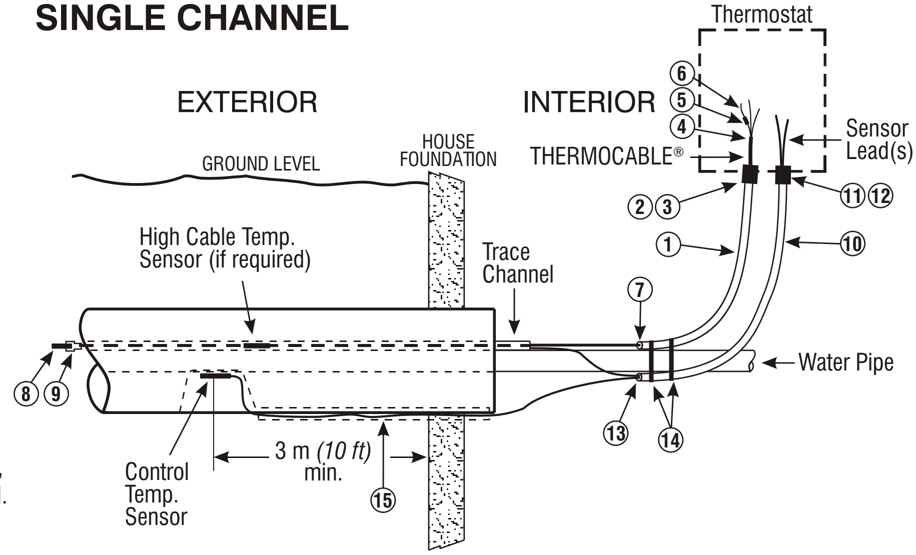
10	3 m *(10 ft)*	13 mm *(½ in)* liquid tight flexible conduit.
11	1	Connector to join the 13 mm *(½ in)* liquid tight flexible conduit to the thermostat.
12	1	13 mm *(½ in)* sealing ring.
13	1	End bushing for liquid tight flexible conduit.
		Miscellaneous components.
14	2	Stainless steel collars, to attach both conduits to the pipe.
15	1	50 mm *(2 in)* wide x 15 m *(50 ft)* long butyl mastic lined polymer tape to cover exposed sensor wire and insulation cutaway for sensor.
16	1	50 mm *(2 in)* wide X 1m *(39 in)* long roll of aluminum tape, to tape sensor(s) and heating cable into place.
17	1	Installation instruction # 1E, THERMOCABLE®.

NOTE: Item numbers are keyed to those on the diagrams.

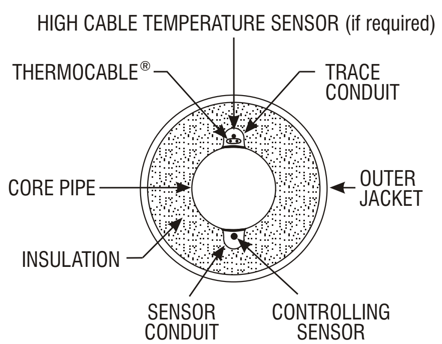
SINGLE CHANNEL



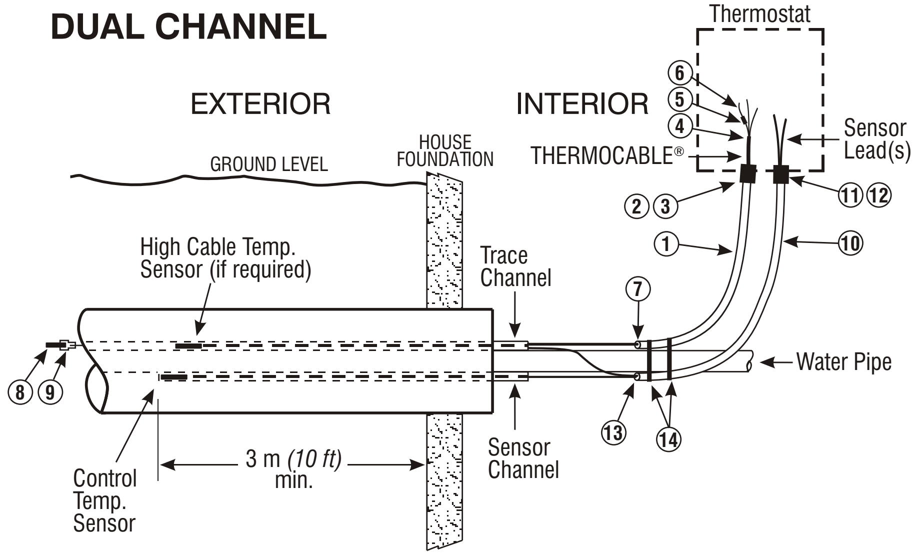
IMPORTANT
TAPE THE CONTROLLING SENSOR DIRECTLY TO THE PIPE, 180° FROM THE HEATING CABLE, UNDER THE INSULATION.



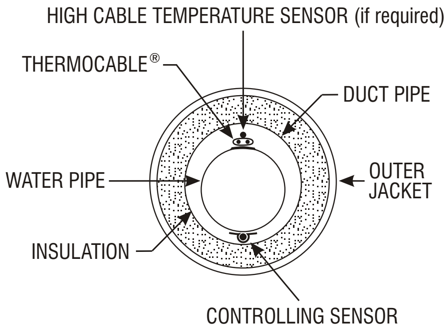
DUAL CHANNEL



IMPORTANT
ENSURE THAT THE CONTROLLING SENSOR IS AT LEAST 3 m *(10 ft)* IN THE SENSOR CHANNEL.

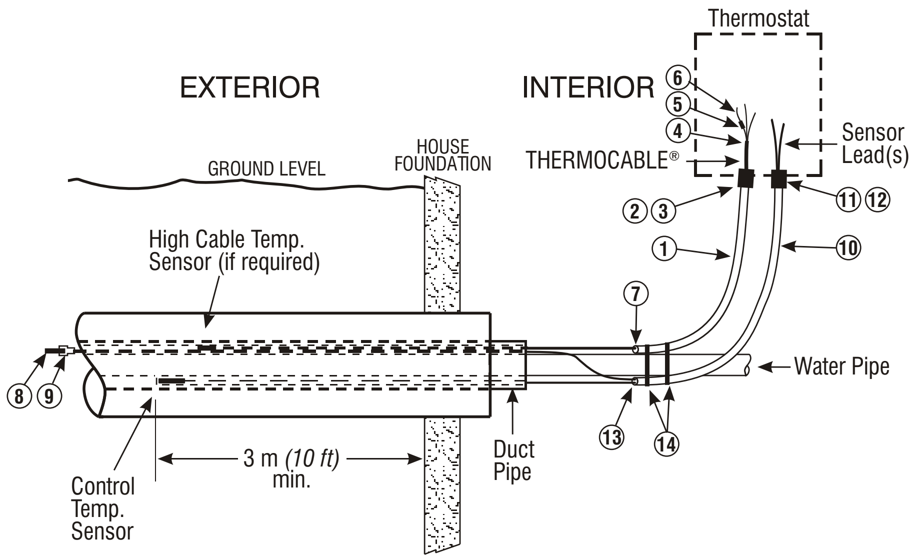


DUCT SYSTEM



IMPORTANT

TAPE THE CONTROLLING SENSOR DIRECTLY TO THE PIPE, 180° FROM THE HEATING CABLE.



Assembly instruction:

1) Normally the power feed kit is attached to the pipe at the point of entry in the building, where the pipe is exposed. The other end is fastened to the thermostat with the connectors provided in the kit.
2) Install the thermostat in the appropriate position close to the service pipe (within 3 m *(10 ft)* maximum).
3) Mount the conduit connector bodies (ensuring that the gasket is on the exterior side) to the bottom of the thermostat enclosure.
4) Cut each liquid tight flexible conduits to the appropriate length and fit in the connector body at the thermostat. Tighten the connector.
5) Screw the end bushings on the liquid tight flexible conduits.
6) Attach the two flexible conduits to the pipe and secure with the pipe collars, tighten with a screwdriver.
7) Terminate the THERMOCABLE® following the detailed instructions for the power end termination shown in the THERMOCABLE® installation recommendation # 1E, using the butt splice connector, ground wire and Teflon® tape. The strain relief connector shown is not required nor supplied in this kit.
8) Pull gently the THERMOCABLE® through one of the flexible conduit. Connect the heater and ground wire to the appropriate terminals in the thermostat in accordance with the installation instruction supplied.

Sensor installation:

9) When more than one temperature sensor is used, they have to be identified according to their use i.e. : controlling sensor or high cable temperature sensor (on plastic pipe) in order to connect them to the proper terminals. As a general rule, when multiple sensors are required, they can be supplied with two different color lead wires. Pull the sensor(s) through the available conduit, be sure that the sensors are properly identified. Connect the sensor leads to the proper terminals in the thermostat.

IMPORTANT

PLACE THE HIGH CABLE TEMPERATURE SENSOR IN CONTACT WITH AN ACTIVE ZONE OF THE HEATING CABLE.

There are three basic installation methods;

- Pre-insulated pipe supplied with only one channel; meant to insert the heating cable (and the high cable temperature sensor when a plastic pipe).
- Pre-insulated pipe supplied with two channels; one for the heating cable and the second one to insert the controlling sensor.
- Pre-insulated duct; in this case, the carrier pipe is fitted with a heating cable and temperature sensor(s) before it is inserted in the duct.

Pre-insulated pipe supplied with only one channel

10a) Install the sensor(s) in their proper location with aluminum tape, the high cable temperature sensor is to be taped to an active zone of the THERMOCABLE® (not the cold lead) within the trace channel. The controlling sensor is to be taped directly to the pipe 180° away from the heating cable. This is done by cutting away a 50 mm *(2 in)* x 250 mm *(10 in)* portion of insulation to expose the pipe. The sensor is then routed on the exterior of the insulation from the controller to the cutaway section and taped. The insulation is installed back over the sensor and then sealed by wrapping the butyl mastic tape around the cutaway ensuring that there is a minimum overlap of 25 mm *(1 in)*. The sensor lead wire should also be covered with a layer of tape from the sensing point to the inside of the building.

Pre-insulated pipe supplied with two channels

10b) The high cable temperature sensor is to be taped to an active zone of the THERMOCABLE® (not the cold lead) within the trace channel. The controlling sensor is fished in at least 3 m *(10 ft)* in the second channel provided.

Pre-insulated duct

10c) The high cable temperature sensor is to be taped to an active zone of the THERMOCABLE® (not the cold lead) and the controlling sensor is to be taped directly to the pipe 180° away from the heating cable before the assembly is inserted into the duct system.

Because this system is controlling a pipe which enters a heated building, the sensors must be located at least 3m *(10 ft)* away from the outside wall to avoid inaccurate temperature sensing. **The accurate identification and positioning of the sensors is absolutely essential to the efficient and safe operation of the system.**

11) Before installing the insulation on the pipe joints, test the heat tracing circuit to ensure that the thermostat and THERMOCABLE® are operating as specified and record those values for future reference.

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Chapter 34 ALARM UNIT

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ProTalk®
Plus

Installation & Operation Manual

December 2013
Rev. 2.03

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TABLE OF CONTENTS

LIST OF TABLES AND ILLUSTRATIONS

1. INTRODUCTION

This manual is for use with both Version 1 and Version 2 of the ProTalk Plus.

Additional features available on the version 2 model are:
USB serial port – replaces the RS232 port
Event Logging including a high stability real time clock
Field reprogrammable firmware upgrades

Basic Operation

The ProTalk Plus model B1290 is a device used to monitor alarms at an unattended site. If an alarm occurs, such as building intrusion, power failure, high or low temperature or equipment failure, the B1290 automatically dials out on the telephone line. When the telephone is answered, the B1290 announces, in a clear voice, the name of the site and the alarm condition that has occurred. If there is no answer, the B1290 will continue to dial through a list of telephone numbers until it reaches someone and is able to report its alarm.

This manual describes the basic operation of the ProTalk Plus model B1290, and its most common applications. The B1290 can, however, be programmed to perform many more functions at the discretion of the user. It can announce alarms over radio, telephone, a public address system or any combination thereof. It can also be programmed to send coded tones along with the voice messages to activate such devices as radio pagers, relays or annunciator panels. It can be used as a master station to concentrate alarms from a number of remote sites. It can be commanded to perform remote control functions by receiving codes from a tone telephone. Expanders can be added to increase the capacity of the unit from the basic 8 alarm inputs and 4 relay outputs up to 64 alarm inputs and 32 relay outputs.

The B1290 can be completely customized for your application as all of the operating parameters are programmable by the user, including the voice messages. The B1290 can be programmed using a standard tone telephone. Stored voices in the B1290 prompt you step-by-step when you are entering new voice messages or codes, and speak back all the values that you have saved.

Using the PC software, it is also possible to program the B1290 from a computer. All of the information in the B1290 can be read, written and stored. This manual concentrates on handset programming; refer to the Help files in the PC programming application when using it to configure the B1290.

If event logging is used with the Version 2 model, the log reports can be read from the B1290 and saved to file.

The programming sections of this manual describe how the B1290 is configured with a phone set. Instructions for programming with the software application are found in the Help section of the program.

2. HOW TO USE THIS MANUAL

This manual is organized in such a way that, if you want the B1290 to function with its default settings as a simple telephone dialer, you only need to read the first two chapters of the manual covering the physical installation, basic programming and operation. If you wish to change some of the default settings or have the B1290 perform more advanced functions, continue on to the next chapter where the Program Codes are described in detail. Several step-by-step examples of programming the B1290 into different configurations are provided. The final chapter describes some of the problems most commonly experienced when the B1290 is first installed, and gives advice on troubleshooting.

3. GETTING STARTED

Description

The B1290 is housed in a metal case with plug-in terminal blocks and jacks for field wiring. Table 1 and Figure 1 show the connection points to the B1290. Figure 3 shows how wiring connections are made to the unit.

Table 1 ProTalk Wiring Connections

RADIO

1	Radio TX
2	Radio RX
3	PTT Output
4	COS Input
5	Ground
6	ACK Input
7	Ground
8	+11.5 to +28 power (Version 1) +10 to +30V power (Version 2)

RELAYS

1	Relay 1 NC
2	Relay 1 Common
3	Relay 1 NO
4	Relay 2 NC
5	Relay 2 Common
6	Relay 2 NO
7	Relay 3 NC
8	Relay 3 Common
9	Relay 3 NO
10	Relay 4 NC
11	Relay 4 Common
12	Relay 4 NO

ALARMS

1	Alarm 1 Input
2	Alarm 2 Input
3	Alarm 3 Input
4	Alarm 4 Input
5	Alarm 5 Input
6	Alarm 6 Input
7	Alarm 7 Input
8	Alarm 8 Input
9	Ground
10	Ground

POWER

2.1mm power, centre ground

PHONE

RJ11 Line 1

PGM

RJ11 Line 1

EXP

2.1 mm mono, centre data

SERIAL – RS232 (Ver.1)

2	RXD
3	TXD
4	DTR
5	GND
6	DSR

SERIAL – USB (Ver.2)

1	VBus
2	D1
3	D+
4	GND

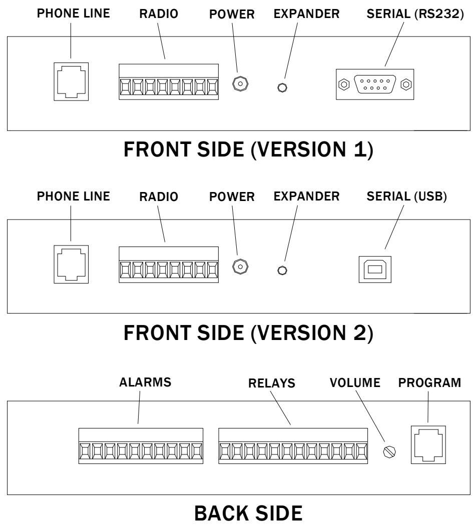

Figure 1 Connector Locations

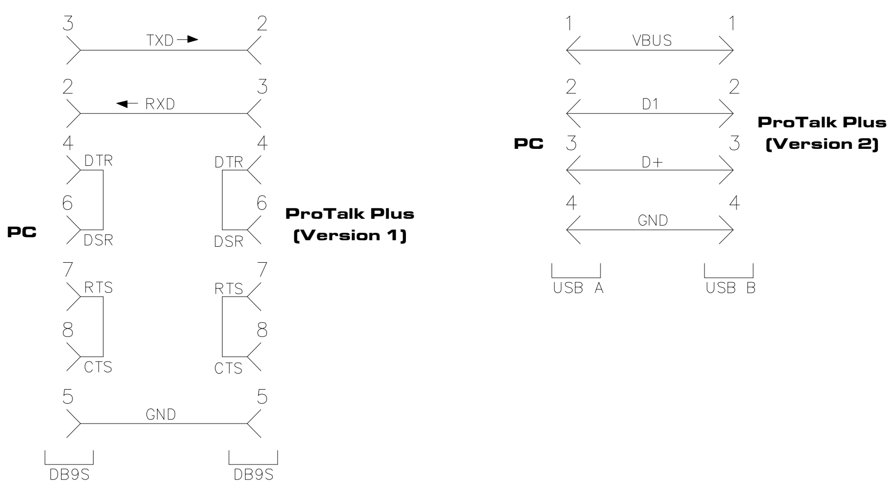

Figure 2 Programming Cable Wiring

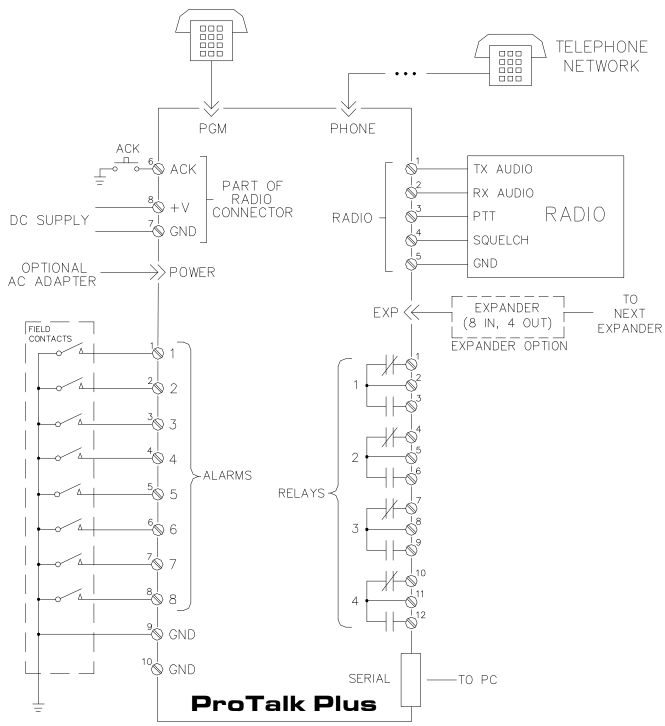

Figure 3 ProTalk Plus Wiring Diagram

Power Requirements

The B1290 will operate from a supply of +11.5 VDC to +28 VDC (Version 1) *or* +10 VDC to +30VDC (Version 2). The typical current requirement is 100 mA plus 10 mA per relay. Each expander uses an additional 60 mA plus 10 mA per active relay.

Connect power only to one of the two available inputs: the DC inputs on the Radio terminal block or the plug used with an AC adapter. The power supply used should be a safety approved Class 2 power supply source, current limited using a 2A in line slow blow fuse.

Installation

The B1290 should be installed in a clean, dry place suitable for electronic equipment. The unit will operate from -40°C to +60°C.

Caution: Power and the telephone line should not be connected until the rest of the installation is complete.

Use a flat blade screwdriver to make connections to the screw terminals on the sides of the enclosure.

Alarms

In its default condition, the B1290 looks for a normally open (NO) contact which closes to ground to indicate an alarm. The B1290 may also be programmed to accept inputs normally closed (NC) to ground which open on an alarm condition. To change this parameter, refer to the alarm format in I/O Configuration - Program Code 5. Ensure that all unused alarm points are either disabled or connected to ground when using NC contacts. Refer to Figure 4 for details on how to connect an alarm signal line.

All of the alarm inputs are optically isolated and are operated from the B1290's internal 12 volt supply.

Connect the alarm inputs to the positions labeled 1 through 8 on the ALARM terminal block.

Caution: DO NOT connect a voltage source to the alarm inputs.

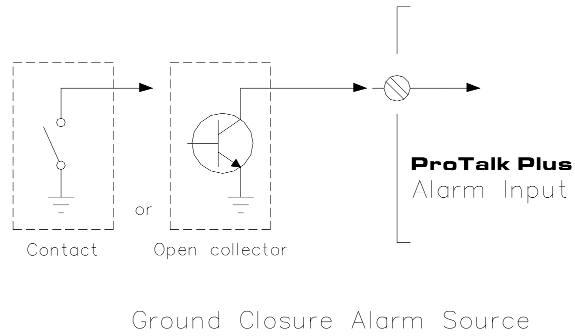

Figure 4 Alarm Input Connection

Relays

Four form C relay outputs are available, rated for 1.0 A at 30 VDC, or 0.3 A at 120 VAC. Connect external devices to the contacts on the RELAY connector. When connecting to larger loads, connect an interposing relay between the B1290 and the load.

Radio

If the alarms are to be announced over a radio, connect TX to the transmit audio of the radio, and RX to the receive audio. *RX should always be connected to squelched audio.* Independent transmit level adjustments are available for voice, DTMF and tone signals. Adjust the levels of the transmit audio signals using the programming phone or the software setup. For the receive level adjustment, set the programmed level to match the level of the incoming signal: for a -10 dBm received signal from the radio the programmed value would be -10 dBm. The range of adjustment for both receive and transmit signals is -20 dBm to 0 dBm.

The PTT output provides a ground closure through an open collector to signal the radio to transmit. Connect this point to the radio's push-to-talk circuit. The maximum rating is 150 mA, 25V.

The COS input is used to indicate to the B1290 whether the radio channel is busy. Connect this point to the output of the radio's carrier-operated switch or relay (COS or COR). In its default condition, the B1290 looks for a high signal to indicate the channel is clear and a low signal when the channel is busy. The B1290 may also be programmed to recognize the reverse polarity. To change this parameter, refer to the squelch polarity in System Settings - Program Code 6. This input is internally pulled up to work with open collector radio outputs. In its default program condition, the input is pulled high when clear and driven low when busy.

Local Acknowledge

This input is used to acknowledge an alarm locally at the B1290 without having to call in over the radio or telephone. Connect the ACK input to a normally open contact which will be grounded to acknowledge the alarm.

Telephone

The telephone line is connected to the RJ11 jack labeled PHONE on the side of the B1290. The line should be using the inner (red/green) pair. Audio levels to the telephone line are fixed internally in conformance with FCC regulations.

The telephone should always be the last item connected.

Caution: DO NOT plug the telephone line into the PGM jack, as damage could result to the B1290.

Expanders

Expanders are used to increase alarm and relay capacity of the B1290. They come in their own metal cases with all connectors clearly labeled. Expanders must be located in close proximity to the master B1290 unit for them to communicate properly. The new B1290 Version 2, when paired with the B1292 expander, can yield a maximum distance of 100ft. All other combinations of past units (B1290 Version 1 and/or B1290E) are limited to a 14ft maximum distance. Shielded cables are provided to connect between the units and are cut to accommodate the maximum allowable distance of previous versions. Custom cables lengths are required for any other distances. Substituting cables is not recommended.

The alarm and relay connections on the expander are the same for the B1290 connections. Use the shielded cable provided to connect between the EXP connector on the B1290 and EXP on the expander. On subsequent expanders, use the cable supplied with the expander to connect between EXP on one expanders and EXP on the next.

Next set the rotary switch on the expander to configure its ID number. *(refer to the B1292 manual for more information)*

If the expander address is changed, the unit must have power removed and then reapplied in order for the master to recognize its new address. All the expander's programmed parameters, including the voice messages, are stored in the main ProTalk Plus and are downloaded on power-up.

The expander database will be automatically transferred from the ProTalk Plus if an expander address is changed or an expander is replaced.

The expander requires its own +12/+24 VDC and GND connections. Be sure that all units, master and expander(s), are always powered up and down together. Do not connect or disconnect expander cables when the system is powered up.

The PWR LED lights when the power is on. The expander also has an RX LED which lights when it is being polled by the master B1290, and a TX LED which indicates when it is responding.

Power-up Sequence

Once the installation is complete, DC power can be connected to the B1290. On start-up, the B1290 will go through a self-test sequence; ending with the firmware version being spoken over the speaker and the RUN LED staying on solid.

The telephone line may then be plugged in as the last connection. *Ensure that the telephone is connected into the PHONE port on the B1290.*

Start-up Programming – Version 1 Only*

**for Version 2 information, see tutorials on the programming disc included with this unit or visit our website at www.barnett-engg.com/support.*

Introduction

Now you are ready to begin programming. When the B1290 is initially powered up, it will prompt you to input three parameters which must be entered before it can operate — the voice messages, a list of telephone numbers and the Acknowledge Code. Once these values have been entered, with its default settings, the unit will function as a telephone dialer when an alarm is present. If you require the B1290 to perform more advanced functions, continue on to the chapter where the Program Codes are explained in detail.

Before you start programming, there are a few points with which you must be familiar. First, although it is possible to program the B1290 remotely by calling it up over the telephone line, it is assumed that when you initially install the unit you will be using a local programming phone. The B1290 must be programmed with a phone which sends DTMF tones (Touch Tone); it will not recognize the signals from a phone which sends dial pulses.

The B1290 is designed to be user friendly. When you listen in the earpiece of the programming phone, you will hear spoken messages. These are called voice "prompts", and they tell you what information the B1290 is expecting you to enter. Whenever you program a new value, the B1290 will immediately speak that parameter back to you, so you will know right away whether the code was entered correctly. You can change a parameter as many times as you like before going on to the next one. If you make a mistake, such as entering a value outside the range for that parameter, the B1290 will immediately let you know by announcing *Error.* And if you get confused, just hang up the phone and start again. The B1290 will start again at the beginning when you pick up the handset.

The other feature you need to know is how to enter data. If you were entering information from a keyboard or other terminal, you would use the "Enter" key or a "Carriage Return". A telephone does not have this key, so we substitute the code [*][*] for "Enter". The two "stars" (asterisks) must be entered one after the other, with no more than one second between the beginning of the first digit and the beginning of the second. This is a much longer time than most people think, and there is no need to rush when entering the code. If you enter the digits too fast, the telephone will only recognize one [*]. You may get an *Error* message if this happens or else the B1290 will ignore the entry and wait for another ******. The ****** code is used throughout the programming sequence to enter information or proceed to the next step. With practice you will soon determine the correct speed.

Where the # digit is used in a DTMF code or a telephone number it must be entered as two # digits. For example, the DTMF code #2# would be entered as ##2##.

The B1290 will not work correctly until all three of the required parameters have been entered, so if you hang up in the middle of this procedure, the B1290 will take you back to the beginning of the sequence the next time you come off hook.

Throughout the programming sequence, the unit will speak stored parameters using a prompt, followed by the word "is", then the stored data. For example, to tell you the Acknowledge Code is set to 1234, the B1290 says *Acknowledge Code is 1234*. Input from the telephone's keypad is expected following this message. Whenever voice messages are required, the unit will beep twice, prompting the user to speak into the telephone handset.

Site ID and Voice Alarm Messages

Plug any standard tone telephone into the jack labeled "PGM".

Lift the handset to your ear. You will hear the B1290 speak the words *Program voice; site is* followed by silence since there is no voice message programmed.

B1290: "Program Voice"

B1290: "Site is…"

The B1290 is prompting you to enter the name of the site. The name you program will be announced at the start of every message along with the list of alarms. To record the voice message, enter the record code (2).

YOU: 2**

After you hit the second star, the B1290 will prompt you with a beep-beep tone.

B1290: "beep-beep"

As soon as you hear the tone, you can begin to record your message. The VOICE LED on the front panel will light while the B1290 is recording. Speak the name of the site, e.g. Ajax Compressor Station. The B1290 detects when you stop speaking and automatically plays back the message. The VOICE LED will light while it is playing back. *Do not hit any keys when you are finished recording your message; pauses between words may cause the recording to terminate.*

YOU: "Ajax Compressor Station"

B1290: "Site is Ajax Compressor Station"

Did the message played back sound acceptable? If you think it could be improved, enter the record code (2) followed by ** again and repeat the message as many times as you like. Once you are satisfied with the way the message sounds, hit the enter code (**).

YOU: ** *Next*

The B1290 will prompt you for the next entry.

B1290: "Alarm One is... "

Repeat the above steps to record the alarm message, e.g. power failure.

YOU: 2**

B1290: "beep-beep"

YOU: "Power Failure"

B1290: "Alarm One is Power Failure."

Repeat the above steps until you are satisfied with the way the message sounds.

YOU: ** *Next*

B1290: "Alarm Two is... "

Enter the voice message associated with the second alarm point, e.g. intrusion alarm.

YOU: 2 * *

B1290: "beep-beep"

YOU: "Intrusion Alarm"

B1290: "Alarm Two is Intrusion Alarm"

YOU: * * *Next*

B1290: "Alarm Three is... "

Repeat the above steps until all the alarm points have been programmed. When you have entered all the voices, enter Quit (# * *) at the announcement of the next empty alarm. If you use all eight alarms, the B1290 will automatically advance after you enter the last voice message. The next step in the startup process is to program the telephone numbers.

YOU: # * * *Quit*

Telephone Numbers

B1290: "Program Directory"

B1290: "Directory A, Line One, is Radio Alert Voice" (*default*)

The B1290 has just spoken the actions that will occur from the commands on the first line in Directory A. The default radio announcement will now be replaced with a phone call-out command. Enter 2 to indicate you want to program the line with new commands.

YOU: 2 * * *Change line*

B1290: "beep"

Details on how directory commands are entered are shown in Program Code 2 Directories. The startup process described here provides only the basic auto-dialer configuration.

Enter the phone number using the pushbuttons on your telephone. The entry shown below will result in the B1290 dialing the selected number and then speaking the alarm messages. The # 0 at the beginning is the DIAL command, followed by a # 8 command for VOICE.

YOU: # 0 4 0 3 2 5 5 9 5 4 4 # 8 * *

B1290: "Directory A, Line One is DIAL 4032559544 VOICE."

If there is an error in the entry, hit the program code 2 followed by * * and try again. If the sequence is played back correctly, hit the enter code.

YOU: * * *Next*

B1290: "Directory A, Line Two is empty"

The B1290 is prompting you for the second directory line. The commands entered for line 2 are what will occur if there is no acknowledgement after the first line commands are completed during operation.

YOU: 2 * * *Change line*

B1290: "beep"

YOU: # 0 4 0 3 2 5 5 2 3 4 3 # 8 * *

B1290: "Directory A, Line Two is DIAL 4032552343 VOICE."

YOU: * * *Next*

B1290: "Directory A, Line Three is empty."

The B1290 is prompting you for a third telephone number to dial if it cannot get an acknowledgement from the first two. Continue entering telephone numbers up to a maximum of twenty. If you are not using twenty numbers, enter the Quit code (#) at the prompt. If you hit the Enter code (* *) for an empty telephone number, the B1290 assumes that you have no more telephone numbers to enter and will jump to the next function.

YOU: [*][*] *Next*

or

YOU: [#][*][*] *Quit*

Acknowledge Code

B1290: "Program Acknowledge Code."

B1290: "Acknowledge Code is 1234."

The B1290 is prompting you to enter an acknowledge code. This is the code you send to the B1290 when it calls you to announce an alarm, to acknowledge that you have received the message, otherwise the unit will keep on dialing. 1234 is the default code. You may use this code or enter a different one from 1 to 8 digits in length. It should be something easy to remember.

YOU: [2][4][6][8][*][*]

B1290: "Acknowledge Code is 2468."

YOU: [*][*] *Next*

B1290: "Enter Program Code"

The B1290 is prompting you to enter a Program Code if you need to program more advanced functions into the unit. If you require them, proceed to the chapter where Program Codes are explained in detail. Otherwise, hang up the programming phone.

At this point the B1290 will function as an alarm reporting unit over the telephone, dialing through the numbers you have programmed into Directory A until it is answered, then announcing the voice messages you have recorded to report an alarm.

These parameters will be stored indefinitely and you will not be prompted to enter them again.

The next time you lift the programming phone off hook, the B1290 will announce its status and prompt you to *Enter Control Code*. DO NOT enter any codes from the telephone. WAIT five seconds; the B1290 will time out and automatically enter the programming mode. When you hear the prompt *Program Access; Enter Program Code,* you may begin programming.

Do not remove power from the B1290 while you are programming. Always put the telephone handset back on-hook before removing power.

4. FRONT PANEL

The front panel of the B1290 is shown in Figure 5. The description of the front panel indicators will assist you in verifying the correct operation of the unit.

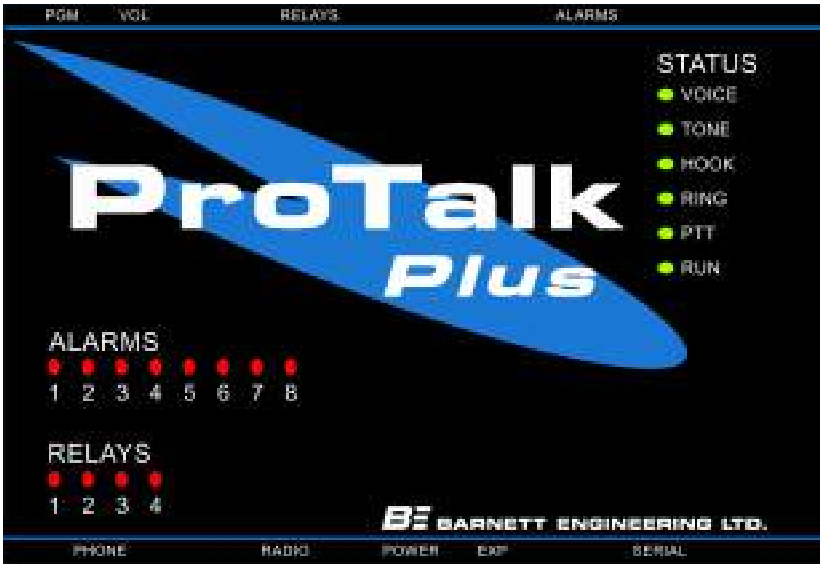

Figure 5 ProTalk Plus Front Panel

Alarm LEDs

The Alarm LEDs light when the associated alarm input is in the alarm state. Unacknowledged alarms will be flashing and any that have been acknowledged will be on solid.

Relay LEDs

The Relay LEDs light whenever the associated relay is on.

Voice

The Voice LED is on whenever the B1290 is recording or playing user messages. It flashes when vocabulary messages are being played or when there is an error in the user voices.

Tone

The Tone LED is on for the duration of a transmitted DTMF digit or other generated tone. It will also be on when call progress tones are detected on the phone line. It will flash once for each received or transmitted DTMF digit.

Hook

The Hook LED comes on whenever the B1290 goes off hook, to dial or answer the telephone. It will flash if a phone port error is detected (no dial tone or other expected call progress signal). The hook LED will also flash during pulse dialing.

Run

Version 1: The Run LED will be on steady when the B1290 is operating correctly; it will flash if an error condition is present.

Version 2: The Run LED will flash when the B1290 is operating correctly.

Ring

When ringing is detected on the telephone line, the Ring LED illuminates. Since answering the telephone is a low priority task to the B1290, it may ignore the ringing if it is processing other tasks (e.g. speaking on the radio).

PTT

The PTT LED will light when the B1290 generates a push-to-talk signal to the radio.

5. OPERATION

This chapter gives a detailed description of exactly how the B1290 will operate after the start-up programming has been completed. Parameters which may be altered are pointed out, with reference to the appropriate Program Code section.

Alarm Sequence

When the B1290 receives an alarm on one of its inputs, it goes off hook and listens for dial tone. If dial tone is not present, the B1290 will hang up and try again. After three unsuccessful attempts to detect dial tone, the B1290 will conclude there is a problem with the line and stop dialing. When this occurs the unit will report *Telephone Access Error* over the radio, set the error relay and flash the RUN and HOOK LEDs.

If dial tone is detected, the B1290 dials the first telephone number stored in Directory A using tone dialing. When the telephone line is answered, the B1290 will announce its Site ID, the list of any alarms present, and prompt the user to *Enter Acknowledge Code.* It will repeat this message a minimum of three times, pausing five seconds after each announcement to wait for an acknowledgment. When the Acknowledge Code is detected, the B1290 will announce *Alarms Acknowledged* and then prompt “Enter Control Code”.

If the line is busy, if there is no answer, or if the B1290 does not receive the Acknowledge Code after announcing the alarm, it will hang up the telephone line, then go off hook again and dial the next number in the directory. If the B1290 dials all the way through the directory without being acknowledged, it will wait two minutes (Interval Timer A), then start dialing again from the top of the directory. After three tries (Times A) at two minute intervals, the B1290 will retry the list every ten minutes (Interval Timer B) thereafter, not stopping until it is acknowledged.

All of the timers and intervals mentioned above are adjustable. In addition, the B1290 may be programmed to announce the alarm a number of times over radio, or a public address system, as well as dialing on the telephone.

Acknowledging an Alarm

When the B1290 calls you on the telephone, it may take up to five seconds before it starts speaking. After it announces the alarms, it prompts you to *Enter Acknowledge Code.* You have five seconds to begin entering the digits.

If the B1290 has been programmed to operate its relays (Program Code 3, DTMF Codes), you may send a relay code over the telephone before acknowledging the alarms. The B1290 will actuate the relay, speak the associated voice message, and then prompt you again to *Enter Acknowledge Code.*

After the B1290 has detected the Acknowledge Code, it will speak the phrase *Alarms Acknowledged* and return to the “Enter Control Code” prompt. If no activity occurs for 5 seconds it will hang up.

Appending the # digit at the end of the Acknowledge code allows you to acknowledge the alarm for sixty minutes only. After one hour, the B1290 will check the alarm inputs again, and if the same alarm is still present, it will begin the reporting cycle just as if it was a new alarm.

Any series of digits entered immediately after the acknowledge code will be echoed back to the user. This feature is sometimes used in systems applications.

To acknowledge the B1290 locally, activate the local acknowledge switch connected to the unit (see the section on “Installation - Local Acknowledge”). The alarms may be acknowledged at any time. The *Alarms Acknowledged* announcement will occur whenever the B1290 is available to speak.

Telephoning the B1290

When you call the B1290 on the telephone, it will answer after four rings (Rings before Answer) and announce its site ID, any alarms which are present, and the status of any relays which have been assigned codes. After this announcement, the B1290 will prompt you to *Enter Control Code.* The B1290 then waits ten seconds for you to enter a code. This could be a code to operate one of the relays, an Acknowledge Code, an Interrogate Code, or an Access Code which would allow you to go into the programming mode. If an Access Code (password) has not been programmed, the B1290 will automatically go into the programming mode after five seconds, prompting you to *Enter Program Code.* You may then program the B1290 from your telephone, the same as you would from a local programming phone.

The B1290 will hang up whenever it has waited for more than ten seconds without receiving a DTMF code.

Changing Telephone Directories

Telephone directories can be changed remotely without entering the programming mode. The directory can be changed by entering the Directory Control Code over the telephone system, local programming telephone, or two-way radio.

Refer to the Directory section, Program Code 2, for a description of the directory format and its uses.

This example uses the local programming phone to change the telephone format from DIRECTORY A to DIRECTORY B and then to DIRECTORY C. A typical installation may use a programming telephone mounted permanently at the site to make this procedure as simple as possible.

B1290:	"Enter Control Code"
YOU:	0 0 0
B1290:	"Telephone Format is Directory B"
YOU:	0 0 0
B1290:	"Telephone Format is Directory C"

It is also common to enter this code using a DTMF keypad over the radio system when the operators at the site change shift.

The B1290 will not allow an empty directory to be selected.

Error Messages

The B1290 will speak error messages when it is called on the phone line, interrogated over the radio port or when the local program phone is used.

Hardware Error

The B1290 speaks *Alert - Site Error* when either the user voices or the vocabulary memory space is corrupt.

Database Error

The B1290 speaks *Alert - Program Error* when either the configuration database is corrupt.

Phone Error

The B1290 speaks *Alert - Telephone Access Error* when there has been a call progress error, such as no dial tone, during a phone call.

Expander Error

The B1290 speaks *Alert - Expander Error* when a communication error is experienced with an expander.

6. PROGRAM SUMMARY

The codes used in the main programming menu are given as a summary below.

1 * *	Voices (page 16)
2 * *	Directories (page 17)
3 * *	DTMF Codes (page 20)
4 * *	Timer Configuration (page 21)
5 * *	I/O Configuration (page 22)
6 * *	System Settings (page 25)
7 * *	Expanders (page 26)
8 * *	Reset Database (page 27)
9 * *	Audio Levels (page 27)

7. PROGRAM CODES

How to Enter the Programming Mode

To begin programming, you must hear the prompt *Enter Program Code* from the B1290. One way to get to this prompt was discussed in the chapter on **Getting Started**. After you have entered the initial voice messages, telephone numbers and an Acknowledge Code, the B1290 will prompt you to begin programming. A local programming phone may be used at any time to alter parameters. It is also possible to program the B1290 remotely by calling into it over the telephone line.

If you call a B1290 over the phone once it has been programmed, it will answer after four rings (default) and announce its site ID, any alarms present, the status of the relays (if they have been programmed) and any error status messages. Then it will prompt you to *Enter Control Code.* If the unit has been programmed to operate with a password, you must enter the Access Code at this time. The B1290 will reply with *Program Access* and prompt you to *Enter Program Code*. If an Access Code has not been programmed, the B1290 will time out after five seconds and automatically enter the programming mode. You will hear the prompt *Program Access; Enter Program Code*.

When you connect a local programming phone, the B1290 goes through a similar sequence. It will announce its site ID, any alarms present, the status of any programmed relays and any error status messages. Then it will prompt you to *Enter Control Code*. It is not necessary to know the Access Code to program from the local phone. Wait five seconds, and the B1290 will automatically prompt you with *Program Access; Enter Program Code.*

IMPORTANT: Remember that all programming codes must be followed by the “**” code to enter them.

The following chapter, **Programming Reference**, divides the programming parameters into functional blocks. Refer to that chapter to determine the parameter changes required for a specific function.

Appendix C is a **Programming Tree** for the B1290. It gives an overview of the parameters which may be programmed and how they are organized. The Program Codes are explained in detail in the next section.

1** Voices

When you enter Program Code 1, you will hear the following prompt:

B1290: "Enter Voice Code"

YOU:	1**	*Record Site ID and alarm messages*
	2**	*Record relay messages*
	3**	*Erase all messages*
	**	*Exit to Enter Program Code prompt*

Record Site ID and Alarm Messages

Record the voice messages associated with the unit (site ID) and each individual alarm point. These are the messages which will be announced over the radio or telephone whenever the alarm is present.

B1290: "Site is Ajax Compressor Station"

YOU:	2**	*Record*
	#**	*Quit*
	**	*Enter/Next*

Default: empty

If the message is OK, continue by hitting Enter. If you would like to record a new message, enter 2** to record. As soon as you hit the second asterisk of the Enter code, the B1290 will beep, prompting you to record a voice message. When you stop speaking, the B1290 will detect your silence and immediately play back the message that you recorded. Pauses between words may cause the recording to terminate. Do NOT enter ** during the recording as the tones will disrupt normal callout operation. Repeat as many times as you need until the voice message sounds acceptable. Then hit Enter ** to proceed, or #** to return to the Enter Voice Code prompt.

Entering Next advances to the alarm message section and the first alarm message will be spoken

B1290: "Alarm One is …"

YOU: 2 * * *Record*

* * *Quit*

* * *Enter/Next*

If you enter messages for all eight alarms, the B1290 will automatically exit to the Enter Voice Code prompt.

Default: empty

Record Relay Messages

Record the voice messages associated with each relay. Note that the messages will only be announced if the relays have been programmed to operate from a string (see Program Code 3, Relay On/Off Codes). When a relay is operated, the B1290 will speak the voice message followed by the word “On” or “Off” to verify that the action was taken.

In some applications, it is not necessary to have voice confirmation when a relay is operated. To disable this feature, refer to Program Code 6 - Relay Voices.

The B1290 will always announce the condition of the relays when it is called up or interrogated for status.

B1290: "Relay One is ... "

YOU: 2 * * *Record*

YOU: # * * *Quit*

* * *Enter/Next*

Default: empty

Erase All Messages

B1290: "Enter Voice Empty Code"

YOU: # 3 1 * * *Erase (exit with any other entry)*

B1290: "Voice is Empty"

YOU: * * *Enter/Next*

2 * * Directories

There are four directories in the B1290. To allow different alarms to perform different actions when they are active, each alarm can be selected to use any one of the directories. Each directory defines a unique sequence of actions. There is also a Directory Control Code that modifies the directory selection that the alarms are programmed for. When this code is used there are restrictions placed on how the alarms are assigned to directories. There are three possible ways that the directories can be used.

1. If there is No Directory Control Code:

Alarms can be assigned to any of the four directories and will always use the one that has been assigned.

2. If there is a Directory Control Code (method 1):

Alarms can only be assigned to Directory A. When the Directory Control Code is received, the directory usage is modified such that the alarms now use the next directory with commands in it. If Directory B has commands, then it will be used. When the Directory Control Code is received again, directory usage advances to the next directory with commands in it.

If all four directories have commands in them, then the Directory Control Code will simply advance to the next directory each time it is received. If the current setting is Directory D when the code is received, then it will return to Directory A.

If the next directory is unused, it will be skipped.

3. If there is a Directory Control Code (method 2):

If the alarms are assigned only to Directory A and Directory C, when the Directory Control Code is received, all of the alarms that are assigned to Directory A will switch to use Directory B and all of the Alarms assigned to Directory C will switch to use Directory D. When the Directory Control Code is received again, directories A and C will become the active directories.

Alarms cannot be assigned to Directory B or Directory D when this mode of operation is selected.

The directory structure is made up of a list of lines with each line containing a sequence of instructions. The B1290 performs the actions defined in each line then waits for a response. If the expected response is not received, the actions in the next line are carried out

Commands are placed into the directory line-by- line with a series of digits representing the required actions.

Commands that can be used in the directory and the digits used to select them are:

#0	Dial + digits
#1	Radio
#2	Wait + 1-3 digits (seconds)
#3	Alert
#4	Two Tone Paging + (4 or 5 digits) + *+ (4 or 5 digits) (frequencies in .1 Hz. ie: 12345 would be 1234.5 Hz)
#5	Five Tone Paging + 5 digits (5 digit cap code) *or* Five Tone Paging + 1digit + * + 5 digits (preamble+ cap code)
#6	Single tone + (4 or 5 digits), frequency in .1 Hz. ie: 12345 would be 1234.5 Hz
#7	DTMF + 1-16 digits
#8	Voice
#9	Answer

When Program Code 2 is selected, the B1290 responds with the prompt:

B1290: "Enter Directory"

YOU:	1**	*Directory A*
	2**	*Directory B*
	3**	*Directory C*
	4**	*Directory D*
	0**	*Help (speaks a summary of commands)*
	#**	*Quit*

If one of the directories is selected, a typical response would be:

B1290: "Directory A, Line One is DIAL 4032559544 WAIT 3 SEC VOICE"

This is the command sequence in the first line of the directory and would result in the B1290 dialing the number 2559544, waiting for 3 seconds and then speaking the voice messages. At this time the following options are available:

2**	*Change this line*
3**	*Delete this line*
4**	*Insert a new line before the current line*
#**	*Quit*
**	*Next*

Change This Line

To change the line, a complete sequence of commands and values must be entered. For example, if the setting was to be changed so that the wait time was 5 seconds instead of 3, the entry would be:

YOU: [2][*][*] *Change this line*

B1290: "beep"

YOU: [#][0] [4][0][3][2][5][5][9][5][4][4] [#][2][5] [#][8] [*][*]

B1290: "Directory A, Line One is DIAL 4032559544 WAIT 5 SEC VOICE"

This is the same command as [DIAL]4032559544 [WAIT]5 [VOICE] for this line in the PC programming software.

For an invalid entry, the B1290 will speak the word "Error" at the end.

Delete This Line

Deleting a line will automatically alter the line numbers of any subsequent commands. If there are no lines in use following the deletion, the B1290 will simply read empty. If there are commands in the lines following deletion, the numerical value of the subsequent lines will shift up in sequence: commands from line 3 will move to line 2 (line deleted), commands from line 4 will move to line 3,…

YOU: [3][*][*] *Delete this line*

B1290: "empty" *If the next line in the directory is empty*

or

B1290: "Directory A, Line One is DIAL 4032559544 DTMF 1234 VOICE" *Contents of the next line*

You can either accept this entry or edit the line.

Insert A New Line

Inserting a line will automatically alter the line numbers of any subsequent commands. If there are previously programmed commands in the subsequent lines to the line inserted, the numerical value of the lines will shift down in sequence: commands from line 2 (line inserted) will move to line 3, commands from line 3 will move to line 4,…

YOU: [4][*][*] *Insert a new line*

B1290: "beep"

YOU: [#][0] [4][0][3][2][5][5][9][5][4][4] [#][8] [*][*] *(new entry)*

B1290: "Directory A, Line One is DIAL 4032559544 VOICE"

Next

The Next option allows you to advance to the next line in the directory

YOU: [*][*] *Next*

Quit

The Quit option returns the B1290 to the Enter Directory Code prompt.

YOU: [#][*][*] *Quit*

Limits: Each phone number may contain up to 39 digits.

Default: Directory A has the single command to turn on the radio and speak the voice messages; the other three directories are empty.

If a pause is required when dialing, use the Wait command to insert a delay interval followed by a DTMF command with more digits. This feature is most often used when communicating with devices which require special signaling, such as paging terminals. The #, or pound digit, has no special meaning and is dialed as a pound.

When calling a paging terminal or someone who cannot acknowledge the call from their phone, it may be useful to wait before starting the next telephone call. This allows the called party to get to a phone and call the B1290 to acknowledge it before it calls out again. To do this, put a Wait command with the required delay on the next directory line and then a Dial command on the following line.

To send a group call with 2 Tone Paging, set tone A equal to tone B.

Do not use the Answer command immediately following a Dial command in the directories when Call Progress is enabled. This is the equivalent of two Answer commands and may result in unreliable operation.

3** DTMF Codes

The B1290 is capable of decoding, storing, and transmitting all DTMF codes, including codes received from a 4x4 keypad. Enter #** to clear a DTMF Code.

B1290: "Enter DTMF Code"

YOU:	1**	*Acknowledge Code*
	2**	*Access Code*
	3**	*Relay On/Off Codes*
	4**	*Alarm On/Off Codes*
	5**	*Remote Alarm Input Codes*
	6**	*Interrogate Code*
	7**	*Directory Control Code*
	**	*Exit to Enter Program Code prompt*

Acknowledge Code

The Acknowledge Code is sent by the called party to indicate that the alarm message has been received. This stops the calling sequence of the B1290.

B1290: "Acknowledge Code is ... "

YOU: X** *(x = 1 to 8 DTMF digits)*

Default: 1234

Access Code

The Access Code is used as a password to prevent unauthorized callers from altering the programming of the B1290. If an Access Code has been programmed, it must be entered before a telephone caller will receive the *Enter Program Code* prompt. The Access Code is not required for local programming.

B1290: "Access Code is ... "

YOU: X** *(x = 1 to 8 DTMF digits, # = clear)*

Default: empty

Relay On/Off Input Codes

The relay codes allow users to perform remote control functions at the unattended site. Callers can operate relays on the B1290 by sending DTMF codes from their telephone or radio keypads. Each relay has one code to turn it on and a separate code to turn it off. When a relay is operated, the B1290 speaks a voice message associated with that relay followed by the word “On” or “Off” (see Program Code 1 - Record Relay Voices).

B1290: "Relay One On Code is ... "

"Off Code is ... "

YOU: X * * *(x = 1 to 8 DTMF digits, # = clear)*

Default: empty

Alarm On/Off Output Codes

These codes are used to control DTMF-operated devices at the receiving end when an alarm is reported. A typical example would be sending a message to a pager with a digital display. The DTMF On string is sent during the alarm announcement, preceding the voice announcement for that alarm. The DTMF Off string is sent only over the radio port when the alarm returns to normal, and is not accompanied by a voice message. This feature might be used to turn the lamps of an annunciator panel on or off depending on the condition of the alarm. In simple system applications, the alarm On/Off codes of one B1290 might be programmed to be the same as the relay On/Off codes or remote alarm input codes of another B1290.

B1290: "Alarm One On code is ... "

"Off code is ... "

YOU: X * * *(x = 1 to 8 DTMF digits, # = clear)*

Default: empty

Remote Alarm Input Codes

If a remote alarm input code has been programmed, when it is received by the B1290 it will be interpreted exactly the same as an alarm on that input. The most common application is to obtain an alarm report from a remote site via radio. The Alarm LED will show the status for remote alarms.
Do not connect an alarm signal line to an input that has been programmed with a remote alarm input code.

B1290: "Alarm One Remote Alarm Code is ... "

YOU: X * * *(x = 1 to 8 DTMF digits, # = clear)*

Default: empty

Interrogate Code

The Interrogate Code is used to find the current status of the B1290. When it receives the code, the unit reports its site ID, any alarms which are present, the status of any relays which have been programmed to operate and any error status messages. Only the voice messages are repeated; no signaling is sent. As the B1290 always announces its status when it is telephoned, this code is used primarily for querying over radio.

B1290: "Interrogate Code is ... "

YOU: X * * *(x = 1 to 8 DTMF digits, # = clear)*

Default: 5678

Directory Control Code

The Directory Control Code is used to call up the B1290 and change the way that the alarms are using the directories. When it receives the code, the directory usage is modified. If the Directory Control Code is used there are restrictions on what directories are available - refer to Program Code 2 Directories for details.

B1290: "Directory Control Code is ... "

YOU: X * * *(x = 1 to 8 DTMF digits, # = clear)*

Default: 000

4 * * Timer Configuration

When you enter Program Code 4, the B1290 will automatically cycle through the following parameters. After the last one, “Times A”, it will go back to the *Enter Program Code* prompt.

Rings Before Answering

When the B1290 is dialed, this parameter sets the number of times it will let the telephone ring before it answers.

B1290: "Answer rings is ... "

YOU: 0 * * *no answer*

X * * *number of rings (x = 1 to 8)*

* * *answer and automatically acknowledge after 8 rings*

Default: 4 (answer after 4 rings)

If the B1290 is on its own telephone line, it will normally be programmed to answer right away, after one or two rings. However, if the line is shared with other users, it should be programmed to answer after 6 to 8 rings, giving people lots of time to pick up the phone before the B1290 automatically answers.

The # is used when the called parties have dial pulse phones. They cannot acknowledge receipt of an alarm using a code. Instead the B1290 recognizes 8 rings on the telephone line as an Acknowledge Code. In the directory, a Wait command with the required delay, is placed on the line following the Dial command. This gives the called party

time to hang up the phone, call the B1290 back and let the phone ring 8 times to acknowledge receipt of the alarm (refer to Program Code 2 - Phone Directory).

Interval Timer A

If an alarm is not acknowledged after one pass through the directory, this timer determines how often the B1290 will repeat the reporting sequence.

B1290: "Timer A is 2 minutes"

YOU: X * * *minutes (x = 1 to 249)*

Default: 2 minutes

Interval Timer B

After the Timer A cycle has completed, this timer determines how often the B1290 goes through its alarm reporting sequence.

B1290: "Timer B is 10 minutes"

YOU: 0 * * *automatically acknowledge after Interval A*

X * * *minutes (x = 1 to 249)*

0 would be selected if the alarms were announced over a public address system, for example, where there is no way for the alarms to be acknowledged.

Default: 10 minutes

Cycles Through Timer A (Times A)

This number determines how many times the B1290 will cycle through its alarm reporting sequence at A intervals before switching to B intervals. With its default settings, the B1290 will try 3 times at 2 minute intervals, then switch to reporting at 10 minute intervals. The switch to the B interval is primarily to conserve air time on busy radio systems.

B1290: "Times A is …"

YOU: X * * *times (x = 0 to 8)*

Default: 3

5 * * I/O Configuration

After you enter Program Code 5, the B1290 prompt for the Configuration Code. If you wish to go back to the *Enter Program Code* prompt without going through all of the codes, enter * *.

B1290: "Enter Configuration Code"

YOU:	1 * *	*Alarm Input Setup*
	2 * *	*Using Directory*
	3 * *	*Relay Setup*
	* *	*Exit to Enter Program Code prompt*

Alarm Input Setup

Alarm Format

This parameter changes the format of the B1290 alarm inputs to match the output of your monitoring devices in the field. Normally open inputs indicate an alarm when the input is grounded, and when the ground signal is removed, the alarm is interpreted as having cleared. Normally closed inputs are grounded in their normal state, and open when an alarm occurs. Latched inputs recognize a pulse as an alarm. After the pulse has disappeared, the input is deemed to be in the alarm condition until it is acknowledged.
Note: A latched alarm should provide a short, predictable pulse to the input of the ProTalk Plus; otherwise, it may have to be acknowledged twice. If the alarm is acknowledged while the input is active, the alarm will not be cleared and new alarms will not activate that input.

B1290: "Alarm Format is …"

YOU:	0 * *	*Normally Open*
	1 * *	*Normally Closed*
	2 * *	*Normally Open, Latched*
	3 * *	*Normally Closed, Latched*
	* *	*Next*

Default: 0 (normally open)

Alarm Timer (Debounce) Timescale

The debounce timers on the alarm inputs can operate with a resolution of .1 seconds or .1 minutes. When the B1290 speaks ‘seconds’ for this value it is indicating that the timer is counting in .1 second steps and when it speaks ‘minutes’ it is counting in .1 minute steps.

B1290: "Alarm Timer is seconds"

YOU:	0 * *	*Seconds*
	1 * *	*Minutes*
	* *	*Next*

Default: 0 (seconds)

Alarm Delay (Debounce)

This parameter controls the amount of time an alarm must be present before it actually registers as an alarm. This feature is often used to eliminate fleeting alarms, where the device in the field does not present a clean closure to indicate an alarm, but a series of bounces on the contacts. Another example might be to overcome momentary power fluctuations which cause false alarms to be reported. The debounce on each alarm may be individually set.

B1290: "Alarm One Delay is _ _ point _ seconds"

YOU:	X * *	*(x = 0.1 to 19.9)*
	# * *	*Exit*
	* *	*Next*

The value must be entered in tenths of a second, from 1 to 3 digits. The last digit entered is interpreted as the least significant, i.e. tenths of a second.

Default: 0.5 seconds

Using Directory

B1290:	"Alarm One is Directory A"	
YOU:	0 * *	*Off*
	1 * *	*Directory A*
	2 * *	*Directory B*
	3 * *	*Directory C*
	4 * *	*Directory D*
	# * *	*Exit*
	* *	*Next*

Default: 1 (Directory A)
The selected directory will determine which sequences of actions are performed when this alarm is active. Each alarm can use any directory. If the Directory Control Code is used there are restrictions on what directories should be used - refer to Program Code 2 Directories for details.

Relay Setup

Relay Timer Timescale

The interval timers on the relay outputs can operate with a resolution of 1 second or 1 minute. When the B1290 speaks ‘seconds’ for this value it is indicating that the timer is counting in 1 second steps and when it speaks ‘minutes’ it is counting in 1 minute steps.

B1290:	"Relay Timer is seconds"	
YOU:	0 * *	*Seconds*
	1 * *	*Minutes*
	* *	*Next*

Default: 0 (seconds)

Relay On Time

The B1290 has four relays that are turned On with the relay On codes and turned Off with the relay Off codes. The relay timer may be used to turn On a relay for a specified duration and then turn it Off automatically. The timer controls the period of time the relay is On. The interval is programmable from 1 to 199 seconds or from 1 to 199 minutes depending on the setting of the relay timescale. The timers for each relay are programmed separately and operate independently.

Setting the time to zero will make the relay an On/Off type of relay. Setting the timer with the # digit makes the relay operate as a ‘special function’ output. This function is only available on the main ProTalk Plus unit and not on the expanders. The special functions are:

Relay 1	Unacknowledged Alarm Present
Relay 2	Any Alarm Present
Relay 3	Alarm Acknowledge Received - pulsed when the unit is acknowledged.
Relay 4	Error

B1290:	"Relay One On Timer is _ _ seconds"	
YOU:	0 * *	*Not timed, uses the Relay Off Code*
	X * *	*(x = 1 to 199)*

[#][*][*] *(Special function)*

Default: 0 (On until turned Off)

[6][*][*] System Settings

When you enter Program Code 6, the B1290 will automatically cycle through the following parameters as you hit Enter ([*][*]). When it has completed the whole list, it will return to the *Enter Program Code* prompt.

Dial Format

This parameter determines the method of dialing telephone. Tone format dials using DTMF tones (Touch-Tone). Pulse format dials using pulses as a rotary phone would. This parameter is only programmable in Version 1. The choice of format is only available in Version 1.

Version 1

B1290: "Dial Format is …"

YOU: [0][*][*] *Tone Dialing*

[1][*][*] *Pulse Dialing*

[#][*][*] *Exit*

[*][*] *Next*

Version 2

B1290: "Dial Format is 0"

Default: 0 (tone dialing)

Squelch Polarity

This setting changes the polarity of the signal used to indicate a busy radio channel.

B1290: "Squelch is …"

YOU: [0][*][*] *Busy when the input is low*

[1][*][*] *Busy when the input is high*

[#][*][*] *Exit*

[*][*] *Next*

Default: 0 (transmit on high)

Relay Voices

This setting enables or disables the B1290's spoken response to a relay operation. If the B1290 is used in a control situation where monitoring the relay operation is not required, the B1290 would be programmed with the relay voices muted. The B1290 relay voices should be enabled where verification of a relay operation is required.

B1290: "Relay Voice is ... "

YOU: [0][*][*] *Relay voices are not used*

[1][*][*] *Relay voices are used*

[#][*][*] *Exit*

[*][*] *Next*

Default: 1 (voices on)

Acknowledge Request

This setting enables or disables the B1290's voice prompt *Enter Acknowledge Code.* If the alarm announcement is over a public address system, for example, acknowledgment is not possible. The B1290 would be programmed for automatic acknowledge (see Interval Timer B, Program Code 4) and the request for an Acknowledge Code would be disabled.

The B1290 will continue transmitting its alarms until it receives some form of acknowledgment, automatic or otherwise, even if it does not request one.

B1290: "Acknowledge Voice is …"

YOU: [0][*][*] *Acknowledge request is not used*

[1][*][*] *Acknowledge request is used*

[#][*][*] *Exit*

[*][*] *Next*

Default: 1 (enabled)

Call Progress (Dial Tone Enable)

This setting enables or disables the feature where the B1290 monitors the audio activity on the phone line when it places a call. If enabled, Call Progress will cause the B1290 to look for dial tone before dialing, watch for a busy signal on the called line and then wait until the called party speaks before the alarm announcement begins. Without Call Progress enabled, the B1290 will perform the dial-out operation and speak regardless of the signals encountered on the phone line.
Do not use the Answer command immediately following a Dial command in the directories when Call Progress is enabled. This is the equivalent of two Answer commands and may result in unreliable operation.

B1290: "Dial Tone is …"

YOU: [0][*][*] *Call Progress is not used*

[1][*][*] *Call Progress is used*

[#][*][*] *Exit*

[*][*] *Next*

Default: 1 (enabled)

[7][*][*] Expanders

When Program Code 7 is entered, the B1290 gives you the following parameters.

Number of Expanders

Increase the capacity of a basic B1290 by adding up to 7 expanders, each with an additional 8 alarm inputs and 4 relay outputs.

B1290: "Expander Number is . . . "

YOU: [X][*][*] *Expanders (x = 0 to 7)*

[#][*][*] *Exit*

[*][*] *Next*

Default: 0

Site Voice Enable

This setting enables or disables the announcement of a site ID from the expander unit. If the expander is being used to increase the number of alarms to be reported from a single site, you probably don't need to announce the site ID again. However, the site ID might be useful to differentiate between alarms from different areas or pieces of equipment.

B1290: "Expander Site Voice is . . . "

YOU: [0][*][*] Site voice is not used

1 * * Site voice is used

* * Next

Default: 0 (expander site ID disabled)

To program the parameters within the expander, the PGM port on the B1290 is used. Programming is done exactly as though the main unit itself was being programmed, except that the expander number precedes the program code. Refer to Example 10 - Adding an Expander for a specific description of this procedure.

8 * * Reset Database

This code is used to reset all of the programmed parameters (excluding voices) to their default values.

B1290: "Enter Empty Code"

YOU: # 3 1 * * *Clear Database*

* * *Next*

Any other entry will leave the database unchanged.

9 * * Audio Levels

This code is used to adjust audio levels for specific signals. For receive levels the setting should correspond to the level of the signal that is coming from the attached equipment. Receive levels can be in the range between -20 dBm and 0 dBm. For transmit levels, the setting determines the amplitude of the signal that will be produced at the output of the B1290. Transmit levels can be set in the range between -20 dBm and 0 dBm. Only even numbers are valid. If an odd number is entered, it will be rounded down. The negative sign is automatically applied to any non-zero value.

The settings for the audio levels are presented in the following order for modification

B1290: "Radio Code One is . . . " (Radio Transmit Tone Level)

YOU: X X * * *Level setting (x = 20 to 0)*

* * *Exit*

* * *Next*

Default: 0

B1290: "Radio Code Two is . . . " (Radio Transmit DTMF Level)

YOU: X X * * *Level setting (x = 20 to 0)*

* * *Exit*

* * *Next*

Default: 0

B1290: "Radio Code Three is . . . " (Radio Transmit Voice Level)

YOU: X X * * *Level setting (x = 20 to 0)*

* * *Exit*

* * *Next*

Default: 0

B1290: "Radio Code Four is . . . " (Radio Receive Level)

YOU: X X * * *Level setting (x = 20 to 0)*

* * *Exit*

* * *Next*

Default: 0

B1290: "Telephone Code Five is . . . " (Telephone Receive Level)

YOU: [X][X][*][*] *Level setting (x = 20 to 0)*

[#][*][*] *Exit*

[*][*] *Next*

Default: 0

8. PROGRAMMING REFERENCE

The ProTalk Plus is capable of performing many functions other than those set by its default values. If you require these extended capabilities, they are accessed through the program codes. If the default operation of the unit as described in the **Getting Started** chapter of this manual is sufficient, then you may ignore this section.

This chapter organizes the programming parameters by their functions. See the chapter on **Program Codes** for more detail on the use and meaning of the referenced parameters.

1. Alarm Announcement

This section identifies all of the parameters that determine WHAT is sent when an alarm occurs. By programming these parameters, you may send voice, signaling, and paging tones.

Directory Used (Program Code 5.2)

Directories (Program Code 2)

Record Alarm Voices (Program Code 1.1)

Alarm On/Off Output Codes (Program Code 3.4)

Acknowledge Request (Program Code 6)

Speak Messages (Program Code 2)

2. Alarm Operation

This section identifies all of the parameters that determine WHEN an alarm will be announced. By programming these parameters, you control when an alarm is recognized and announced by the ProTalk Plus.

Alarm Format (Program Code 5.1)

Alarm Delay Timebase (Program Code 5.1)

Alarm Debounce (Program Code 5.1)

Interval Timer A (Program Code 4)

Interval Timer B (Program Code 4)

Cycles Through Timer A (Program Code 4)

3. Operation Codes

These parameters control how the unit operates. When one of these codes is received, the B1290 performs the required function.

Acknowledge Code (Program Code 3.1)

Access Code (Program Code 3.2)

Interrogate Code (Program Code 3.6)

Remote Alarm Input Code (Program Code 3.5)

Directory Control Code (Program Code 3.7)

Access Code (Program Code 3.2)

4. Relay Control

The parameters required to control a relay are listed here. You may use any number of relays, but the ON/OFF input codes, voice message and relay ON time must be programmed for each relay used. The relay voice code enables or disables the voice confirmation for all relays.

Relay ON/OFF Control Codes (Program Code 3.3)

Record Relay Voices (Program Code 1.2)

Relay Timer Timebase (Program Code 5.3)

Relay On Time (Program Code 5.3)

Relay Voice (Program Code 6)

Relay Special Functions (Program Code 5.3)

5. Telephone Specific Parameters

This section describes the parameters used when the unit is required to transmit alarms or signaling over the telephone system.

Using Directory (Program Code 5.2)

Directory Telephone Numbers (Program Code 2)

Rings Before Answering (Program Code 4)

Dial Format (Program Code 6)

6. Radio Specific Parameters

These parameters control the operation of the unit when it is connected to a two-way radio. Refer to the installation section in Getting Started for the required connections to the radio.

Directory Radio Command (Program Code 2)

Squelch Polarity (Program Code 6)

Radio Warmup (Program Code 2)

7. Expander Attachment

When an expander is added to the system, these parameters must be set. They configure the main B1290 unit to accept the expander. The parameters within the expander must also be programmed. Refer to the Advanced Programming Examples for an example of how this is done.

Number of Expanders (Program Code 7)

Site Voice Enable (Program Code 7)

8. Audio Levels

Audio Levels (Program Code 9)

9. PROGRAMMING EXAMPLES

Example 1: Reporting Alarms over Radio and Telephone

In this example, assume that your company has a mobile radio system which is monitored by field personnel. Radio operators have DTMF pads on their mics so they can acknowledge an alarm from the B1290. They would like to have the alarm reported over the radio system three times with a 2 minute interval between transmissions, then dialed out over the telephone if it is not acknowledged. If the alarm is not acknowledged, the B1290 should try again in ten minutes. After six tries at ten minute intervals, the B1290 should switch to trying once an hour. The COS on the radio used with the B1290 gives a high signal when the channel is busy.

B1290:	Enter Program Code
YOU:	2** _Directory Code_
B1290:	Enter Directory
YOU:	1** _Directory A_
B1290:	Directory A, Line One is...
YOU:	2** _Change_
B1290:	‘beep’
YOU:	#1 #8 ** _[RADIO] [VOICE]_
B1290:	Directory A, Line One is RADIO VOICE
YOU:	** _Next_
B1290:	Directory A, Line Two is...
YOU:	2** _Change_
B1290:	‘beep’
YOU:	#2120 ** _[WAIT]120 (seconds)_
B1290:	Directory A, Line Two is WAIT 120
YOU:	** _Next_
B1290:	Directory A, Line Three is...
YOU:	2** _Change_
B1290:	‘beep’
YOU:	#1 #8 ** _[RADIO] [VOICE]_
B1290:	Directory A, Line Three is RADIO VOICE
YOU:	** _Next_
B1290:	Directory A, Line Four is...
YOU:	2** _Change_
B1290:	‘beep’
YOU:	#2120 ** _[WAIT]120 (seconds)_
B1290:	Directory A, Line Four is WAIT 120
YOU:	** _Next_
B1290:	Directory A, Line Five is...
YOU:	2** _Change_
B1290:	‘beep’

YOU:	#1 #8 ** *[RADIO] [VOICE]*
B1290:	Directory A, Line Five is RADIO VOICE
YOU:	** *Next*
B1290:	Directory A, Line Six is...
YOU:	2** *Change*
B1290:	‘beep’
YOU:	#2120 ** *[WAIT]120 (seconds)*
B1290:	Directory A, Line Six is WAIT 120
YOU:	** *Next*
B1290:	Directory A, Line Seven is...
YOU:	2** *Change*
B1290:	‘beep’
YOU:	#0 4032559544 #8 ** *[DIAL]4032559544 [VOICE]*
B1290:	Directory A, Line Seven is DIAL 4032559544 VOICE
YOU:	** *Next*
B1290:	Directory A, Line Eight is...
YOU:	#** *Quit*
B1290:	Enter Directory
YOU:	#** *Quit*
B1290:	Enter Program Code
YOU:	4** *Configuration*
B1290:	Answer Rings is 4
YOU:	** *Next*
B1290:	Timer A is 2 minutes
YOU:	10** *Enter 10 minutes*
B1290:	Timer A is 10 minutes
YOU:	** *Next*
B1290:	Timer B is 10 minutes
YOU:	60** *Enter 60 minutes*
B1290:	Timer B is 60 minutes
YOU:	** *Next*
B1290:	Times A is 3
YOU:	6** *Enter 6 times*
B1290:	Times A is 6
YOU:	** *Next*
B1290:	Enter Program Code
YOU:	6** *Select System Settings*
B1290:	Dial Format is 0

YOU: * * *Next*

B1290: Squelch is 0

YOU: 1 * * *Enter busy when high*

B1290: Squelch is 1

YOU: * * *Next*

B1290: Relay Voice is On

At this point you are finished programming and may hang up the telephone. The directory is programmed with the voice message repeated three times on the radio and then once on the phone line. Another method of programming the radio announcement would be to have an alert tone followed by the message repeated twice. In this case the entry for each of the radio related commands would be:

B1290: Directory A, Line One is...

YOU: # 1 # 3 # 8 # 8 * * *[RADIO][ALERT] [VOICE][VOICE]*

B1290: Directory A, Line One is RADIO ALERT VOICE VOICE

Over the telephone, the message will be repeated only once.

If this programming is used, when the B1290 registers an alarm, the reporting cycle will be as follows:

Over radio: Alert tone
Ajax Compressor Station; Power Failure
Ajax Compressor Station; Power Failure
Enter Acknowledge Code
pause for 2 minutes

Alert tone
Ajax Compressor Station; Power Failure
Ajax Compressor Station; Power Failure
Enter Acknowledge Code
pause for 2 minutes

Alert tone
Ajax Compressor Station; Power Failure
Ajax Compressor Station; Power Failure
Enter Acknowledge Code
pause for 2 minutes

Over telephone: Dial 4032559544
Ajax Compressor Station; Power Failure
Enter Acknowledge Code
pause for 5 seconds -waiting for acknowledge code
Ajax Compressor Station; Power Failure
Enter Acknowledge Code
pause for 5 seconds -waiting for acknowledge code

This sequence repeats for 60 seconds.

If the Acknowledge Code is not received over the telephone, the B1290 will wait ten minutes and try the complete sequence again, starting with the radio cycle. If no Acknowledge Code is received after six tries at ten minute intervals, the B1290 will switch to reporting every hour until the alarm is acknowledged.

Example 2: Dialing from Two Different Telephone Directories

In this example, the B1290 is programmed to telephone whoever is on call if there is an alarm. The company has two groups of employees who take turns being on call. Instead of reprogramming the B1290 directory every week, two directories are programmed. When the Directory Control Code is received, the B1290 is directed to dial from the other directory. The directory may be switched with the Directory Control Code over the telephone, local programming phone, or two-way radio. There are specific rules governing how the alarms can be assigned to directories if the Directory Change Code is used. Refer to Program Code 2 Directories for more information concerning these rules. This example starts by setting the telephone numbers in the two directories.

B1290: Enter Program Code

YOU: [2][*][*] *Directory Code*

B1290: Enter Directory

YOU: [1][*][*] *Directory A*

B1290: Directory A, Line One is...

YOU: [2][*][*] *Change*

B1290: ‘beep’

YOU: [#][0] [4][0][3][2][5][5][9][5][4][4] [#][8] [*][*]
[DIAL]4032559544 [VOICE]

B1290: Directory A, Line One is DIAL 4032559544 VOICE

YOU: [*][*] *Next*

B1290: Directory A, Line Two is...

YOU: [2][*][*] *Change*

B1290: ‘beep’

YOU: [#][0] [4][0][3][2][5][5][9][5][9][8] [#][8] [*][*]
[DIAL]4032559598 [VOICE]

B1290: Directory A, Line Two is DIAL 4032559598 VOICE

YOU: [*][*] *Next*

B1290: Directory A, Line Three is...

YOU: [#][*][*] *Quit*

B1290: Enter Directory

YOU: [2][*][*] *Select Directory B*

B1290: Directory B, Line One is...

YOU: [2][*][*] *Change*

B1290: ‘beep’

YOU: [#][0] [4][0][3][7][6][6][4][4][2][2] [#][8] [*][*]
[DIAL]4032554437 [VOICE]

B1290: Directory B, Line One is DIAL 4032554437 VOICE

YOU: [*][*] *Next*

B1290: Directory B, Line Two is...

YOU: [2][*][*] *Change*

B1290: ‘beep’

YOU: [#][0] [4][0][3][2][5][5][9][5][4][5] [#][8] [*][*]
[DIAL]4032559545 [VOICE]

B1290: Directory B, Line Two is DIAL 4032559545 VOICE

YOU: [*][*] *Next*

B1290: Directory B, Line Three is...

YOU: [#][*][*] *Quit*

B1290: Enter Directory

YOU: [#][*][*] *Quit*

The telephone numbers have now been programmed. Now enter the Directory Control Code

B1290: Enter Program Code

YOU: [3][*][*] *DTMF Codes*

B1290: Enter DTMF Code

YOU: [7][*][*] *Directory Control Code*

B1290: Directory Control Code is...

YOU: [7][8][*][*] *Enter Control Code*

B1290: Directory Control Code is 78

YOU: [*][*] *Next*

B1290: Enter Program Code

Right now the B1290 is programmed with dialing commands in Directory A and Directory B. Any alarms that are to be switched between these two directories should be programmed to use Directory A or the control code will have no effect. Each alarm has its own setting for the directory it is using. Make sure that the alarms you want to have changed are set properly.

YOU: [5][*][*] *Select Configuration*

B1290: Enter Configuration Code

YOU: [2][*][*] *Select Using Directory*

B1290: Alarm One is Directory is...

YOU: [1][*][*] *Select Directory A*

B1290: Alarm One is Directory is A

YOU: [*][*] *Next*

Repeat this for all of the alarms

When you wish to dial from the B directory, call up the B1290 and follow these steps:

B1290: Enter Control Code

YOU: [7][8] *Directory Control Code*

B1290: Telephone Format is Directory B

And to change it back:

B1290: Enter Control Code

YOU: [7][8] *Directory Control Code*

B1290: Telephone Format is Directory A

Example 3: Different Alarms Dialing Different Telephone Numbers

A B1290 is used in an application where there are two different types of related alarms. Some are building alarms, such as intrusion alarms, building temperature, power failure, etc. Others are alarms relating to specific equipment failures, such as compressor failure, high tank level or sump overflow. It is desirable to have the maintenance personnel alerted if there is a building alarm, but if there is a problem with the equipment, it would be preferable to alert the operations technicians.

In this example, alarms 1 and 2 are connected to intrusion alarm and building high temperature respectively. These are building alarms, and are to dial the building maintenance people at 403-255-9544 and then 403-255-9598.

Compressor failure and high tank level are fed to alarms 3 and 4. Since these are equipment problems, operations technicians at 403-255-4437 and then 403-255-9545 are to be alerted. Follow the previous example to enter the telephone numbers in Directory A and Directory B then set the alarms to use these two directories.

B1290:	Enter Program Code
YOU:	5 * * *Select I/O Configuration*
B1290:	Enter Configuration Code
YOU:	2 * * *Select Using Directory*
B1290:	Alarm One is Directory...
YOU:	1 * * *Select Directory A*
B1290:	Alarm One is Directory A
YOU:	* * *Next*
B1290:	Alarm Two is Directory...
YOU:	1 * * *Select Directory A*
B1290:	Alarm Two is Directory A
YOU:	* * *Next*
B1290:	Alarm Three is Directory A
YOU:	2 * * *Select Directory B*
B1290:	Alarm Three is Directory B
B1290:	Alarm Four is Directory A
YOU:	2 * * *Select Directory B*
B1290:	Alarm Four is Directory B
YOU:	# * * *Quit*

The B1290 is now programmed to dial Directory A when alarms 1 or 2 occur, and Directory B when alarms 3 or 4 occur.

Example 4: Actuating Relays

In this example, when you receive the alarm "High Pressure" from the B1290, you would like to be able to operate a bypass valve for up to ten minutes. The valve can be controlled by one of the relays on the B1290 using Relay On and Relay Off codes.

B1290:	Enter Program Code
YOU:	1 * * *Select Voices*
B1290:	Enter Voice Code
YOU:	2 * * *Select Relay Voices*
B1290:	Relay One is...
YOU:	2 * * *Change*
B1290:	beep-beep
YOU:	*Bypass Valve*
B1290:	Relay One is Bypass Valve
YOU:	* * *Next*
B1290:	Relay Two is...
YOU:	# * * *Quit*

B1290: Enter Voice Code

YOU: #** *Quit*

B1290: Enter Program Code

YOU: 3** *Select DTMF Codes*

B1290: Enter DTMF Code

YOU: 3** *Select Relay On and Off Codes*

B1290: Relay One On Code is empty

YOU: 555* *(pause)* ** *Enter On code*

B1290: Relay One On Code is 555*

YOU: ** *Next*

B1290: Relay One Off Code is empty

YOU: 555# ** *Enter Off code*

B1290: Relay One Off code is 555#

YOU: ** *Next*

B1290: Relay Two On Code is empty

YOU: ** *Next*

B1290: Relay Two Off Code is empty

And so on until all of the Relay Codes are done...

B1290: Enter DTMF Code

YOU: ** *Next*

B1290: Enter Program Code

YOU: 5** *I/O Configuration*

B1290: Enter Configuration Code

YOU: 3** *Next*

B1290: Relay Timer is seconds

YOU: 1** *Select minutes for the timebase*

B1290: Relay Timer is minutes

YOU: ** *Next*

B1290: Relay One On Timer is 00 minutes

YOU: 10** *Select 10 minutes for the time*

B1290: Relay One On is 10 minutes

YOU: ** *Next*

B1290: Relay Two On timer is 00 minutes

At this time you are finished programming and can hang up the phone. When the B1290 calls you with an alarm, the sequence will be as follows:

B1290: Ajax Compressor Station; High Pressure.

Enter Acknowledge Code

YOU: 555* *Send the Relay On Code*

Ajax Compressor Station;

Bypass Valve On (and Alarm - Enter Acknowledge Code).

YOU: 1234 *Send the Acknowledge Code*

B1290: Ajax Compressor Station;

Alarms Acknowledged

Example 5: Operating a Radio Pager

In this example, when an alarm is received you want to contact the person on call, who is carrying a two-tone radio pager which operates on the company's private radio system. If the person does not call back to acknowledge the alarm, you want the B1290 to start dialing telephone numbers.

B1290: Enter Program Code

YOU: 2** *Directory Code*

B1290: Enter Directory

YOU: 1** *Directory A*

B1290: Directory A, Line One is...

YOU: 2** *Change*

B1290: 'beep'

YOU: #1 #4 08555*14334 #8 **
[RADIO][2TONE]855.5/1433.4 [VOICE]

B1290: Directory A, Line One is RADIO 2 TONE 855.5 Hz 1433.4 Hz VOICE

YOU: ** *Next*

B1290: Directory A, Line Two is...

YOU: 2** *Change*

B1290: 'beep'

YOU: #0 4032559544 #8 **

B1290: Directory A, Line Two is DIAL 4032559544 VOICE

YOU: ** *Next*

B1290: Directory A, Line Three...

You are finished programming and may hang up the phone.

Example 6: Dialing a Paging Terminal

In this example, rather than using a private radio system, the company's employees utilize a city-wide paging service. Normally when you dial the paging terminal, you are prompted to enter your own telephone number. Your number is then displayed on the digital read-out of the pager, so the paged party knows what number to call back. We are going to program the B1290 to call this paging terminal when it reports an alarm.

B1290: Enter Program Code

YOU: 2** *Directories*

B1290: Enter Directory

YOU: 1** *Directory A*

B1290: Directory A, Line One is...

YOU: 2** *Change*

B1290: 'beep'

YOU: # 0 4 0 3 2 5 5 9 5 4 4 # 2 4 # 7 7 3 4 * *
[DIAL]4032559544 [WAIT]4 [DTMF]734

B1290: Directory A Line One is DIAL 4032559544 WAIT 4 seconds DTMF 734

YOU: * * *Next*

You are finished programming and may hang up the phone.

When an alarm occurs, the B1290 will dial the number of the paging terminal, 255-9544; wait for the terminal to answer, wait 4 seconds while the terminal is prompting, then send the DTMF string 734 which represents the calling site. Any alarm will result in the paging message 734.

If you want to distinguish between one alarm and another, use the Alarm On Codes that can be assigned to each input.

B1290: Enter Program Code

YOU: 3 * * *DTMF Codes*

B1290: Enter DTMF Code

YOU: 4 * * *Select Alarm On/Off Codes*

B1290: Alarm One On Code is...

YOU: * 1 * *(pause)* * * *Code for alarm 1*

B1290: Alarm One On Code is ✱1✱

YOU: * * *Next*

B1290: Alarm One Off Code is...

YOU: * * *Next*

B1290: Alarm Two On Code is...

YOU: * 2 * *(pause)* * * *Code for alarm 2*

B1290: Alarm Two On Code is ✱2✱

YOU: * * *Next*

With this Alarm ON code programmed, the DTMF string *734* will be sent immediately preceding the alarm one message when alarm one is active. The message displayed on the pager will be: 734*1*

The string *2* will be sent with alarm two.

In this example, the same result could have been achieved by sending 734 as part of the alarm ON DTMF code. The 734 is included as part of the telephone number and is sent with every alarm. It appears much like a site identifier.

This example also assumes that the pager could be dialed directly. Sometimes a separate number for the pager must be dialed after the number for the paging terminal. In that case, you might need to insert another delay, and there might not be room to include the site identifier as part of the telephone number.

Another way the B1290 could be programmed to dial a paging terminal would be to make the alarm On DTMF code the same as the telephone number of the B1290. The telephone number would then be displayed on the pager, and the called party would receive the alarm message when he called the B1290 back. The B1290 would have to be programmed to wait some time for an acknowledgment before it continued dialing.

Example 7: Announcing Alarms over a Public Address System

In this example, the B1290 is used to announce alarms from an unattended location over a building's public address system. You want the alarms to be announced twice, repeated again one minute later then repeated for the last time one minute after this. To make the process stop after the third repetition, program Timer B to zero. A zero value in Timer B means that the alarm is automatically acknowledged after A Times.

Connect the radio port, TX Audio and PTT, from the B1290 to the PA inputs.

Starting with the timer setup:

B1290: Enter Program Code

YOU: [4][*][*]

B1290: Answer Rings is 4 (No effect on operation)

YOU: [*][*] *Next*

B1290: Timer A is 2 minutes

YOU: [1][*][*] *Change the timer to 1 minute*

B1290: Timer A is 1 minutes

YOU: [*][*] *Next*

B1290: Timer B is 10 minutes

YOU: [0][*][*] *Change the timer to zero*

B1290: Timer B is 0 minutes

YOU: [*][*] *Next*

B1290: Times A is 3

YOU: [2][*][*] *Change the times A to 2*

B1290: Times A is 2

YOU: [*][*] *Next*

The timers are now set, now put the commands into the directory.

B1290: Enter Program Code

YOU: [2][*][*] *Directory Code*

B1290: Enter Directory

YOU: [1][*][*] *Directory A*

B1290: Directory A, Line One is...

YOU: [2][*][*] *Change*

B1290: ‘beep’

YOU: [#][1] [#][3] [#][8] [#][8]

[RADIO][ALERT][VOICE][VOICE]

B1290: Directory A, Line One is RADIO ALERT VOICE VOICE

YOU: [*][*] *Next*

B1290: Directory A, Line Two is..

YOU: [#][*][*] *Quit*

B1290: Enter Directory

YOU: [#][*][*] *Quit*

Now remove the acknowledge request prompt.

B1290: Enter Program Code

YOU: [6][*][*]

B1290: Dial Format is Zero

YOU: [*][*] *Next*

B1290: Squelch is 0

YOU: [*][*] *Next*

B1290: Relay voice is On

YOU: [*][*] *Next*

B1290: Acknowledge Voice is On

YOU: [0][*][*]

B1290: Acknowledge Voice is Off

YOU: [*][*] *Next*

B1290: Dial Tone is on

At this point you are finished programming and may hang up.

YOU: [*][*] *Next*

Example 8: Activating an Annunciator Panel

In this system application, a B1290 is used to report alarms from a number of remote locations by turning the lamps of an annunciator panel on and off.

Figure 6 shows a system where two remote sites are transmitting DTMF codes to a central site. The Alarm On code associated with the remote alarms is the same as the Relay On code at the central site. Similarly, the Alarm Off codes at the remote locations are the same as the Relay Off codes at the central site.

When a remote alarm occurs, the DTMF code for that alarm is transmitted to the central site. On receiving this code, the central site activates the relay associated with that alarm. When the alarm clears, the Off code is transmitted from the remote, and the central site's associated relay is released.

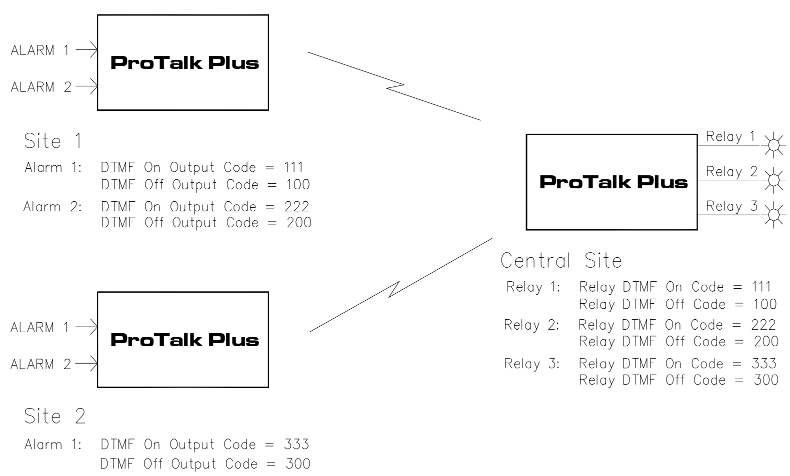

Figure 6 Activating an Annunciator Panel

Example 9: Concentrating Alarms from Remote Sites

In the following example, a number of remote sites report their alarms over radio to a B1290, which concentrates the alarms and reports them over the telephone.

Figure 7 is an example of two remote sites communicating with a central site to have their alarms announced over the telephone. At the remote sites, the B1290s are programmed to operate over radio. They are programmed with an alarm On output code and an Acknowledge Code. At the central site, the B1290 is programmed to accept remote alarm inputs on alarms 1, 2, and 3, and is connected to a telephone.

When one of the remote units is alarmed, it will send its alarm ON output code over the radio. This code will be interpreted as a remote alarm input code at the central unit. This will initiate the B1290 to send its alarm report over radio and telephone. As part of its alarm sequence over radio, the B1290 will send its alarm On output code. This code will be interpreted as an acknowledgment by the remote, and it will stop sending the alarm. The central unit will continue to report over radio and telephone until it is acknowledged.

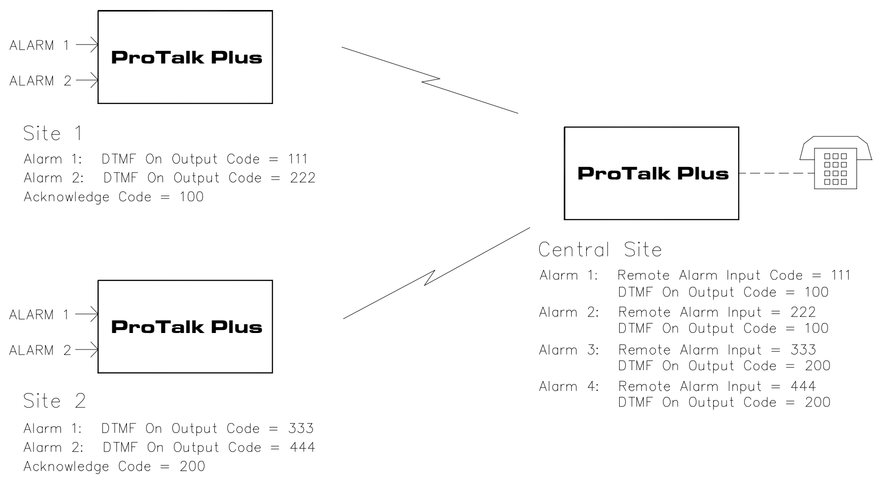

Figure 7 Concentrating Remote Alarms

Example 10: Adding an Expander (B1292)

In this example, you are adding an expander to a B1290 to increase the number of alarm inputs and relay outputs.

Install and program the main B1290 unit as per the instructions in this manual. Install the expander within 100' of the B1290. Complete the wiring to all the alarms and relays. Connect the cable supplied with the expander from the auxiliary connector on the B1290 to the EXP connector on the expander. Apply power to the installation

The expander is programmed from the B1290. Note that when the Program Code is entered, it is preceded by the number of the expander.

B1290: Enter Program Code

YOU: 7 * * *Expanders*

B1290: Expander Number is 0

YOU: 1 * * *Enter 1 for the number of expanders*

B1290: Expander Number is One

YOU: * * *Next*

B1290: Expander Site Voice is 0 (default is not to announce the expander ID)

YOU: * * *Next*

B1290: Enter Program Code

YOU: 1 1 * * *Expander 1, Voices*

B1290: Enter Voice Code

YOU: 1 * * *Record Alarm Voices*

B1290: Expander One Site is...

YOU: * * *Next (Site ID is disabled - don't need a voice message)*

B1290: Expander One, Alarm One is...

YOU: 2** *Change this voice*

B1290: beep-beep

YOU: *Intrusion*

B1290: Expander One, Alarm One is Intrusion

YOU: ** *Next*

B1290: Expander One Alarm Two is...

YOU: 2** *Change this voice*

B1290: beep-beep

YOU: *High Temperature*

B1290: Expander One, Alarm Two is High Temperature

YOU: ** *Next*

B1290: Expander One, Alarm Three is...

Continue programming in the normal fashion, remembering to enter the number of the expander before the Program Code. Only the voices MUST be programmed; the other parameters have their standard defaults. Not all parameters are accessible in the expander. The following is a list of those which may be programmed:

- Voices
- Relay On/Off codes
- Alarm On/Off codes
- Remote alarm input codes
- Alarm format
- Relay On time
- Alarm delay (debounce)
- Expander Site ID enable

If you try to change the parameters in other expanders, the B1290 will announce *Error.* To solve this problem, define all of the expanders in the system in the B1290 using program code 7 (number of expanders).

To change the Alarm On code for the first alarm on the second expander, you would program the following (the example assumes that the number of expanders has already been set to 2 as shown above):

B1290: Enter Program Code

YOU: 23** *Expander 2, DTMF Codes*

B1290: Enter DTMF Code

YOU: 4** *Alarm On/Off Output codes*

B1290: Expander Two Alarm One On Code is Empty

YOU: 9678** Enter code 9678

B1290: Expander Two Alarm One On Code is 9678

YOU: ** *Next*

etc.

10. TROUBLESHOOTING

Problem: I've hooked up the B1290 as per the installation instructions but nothing happens.

- Use a voltmeter to check that the power supply is properly connected. If an AC adapter is being used, it should have an output of at least 12 volts DC with a center-negative power connector. If the DC power source is connected to the RADIO terminal block, it should have the positive lead connected to terminal 8 and the negative lead to terminal 7.

- Do not attach power to both inputs at the same time.

Problem: The B1290 will not program from a local programming phone.

- If you do not hear the voice prompt to begin programming, check that the programming phone is plugged into the PGM jack and not the PHONE jack.

- If you hear the voice prompt to begin programming, but the B1290 does not register your entries, check that you are using a tone phone. Sometimes a pushbutton phone actually sends dial pulses rather than DTMF. You can tell the difference by listening in the earpiece; pulse dialing sounds like clicking, DTMF like tones.

- Check for the TONE LED on the front panel when a digit is being received. Some phones send short bursts of tone rather than continuous tone while the key is depressed. If the B1290 is not detecting DTMF, try another phone.

- Check the setting of the receive level for the phone port. Since it is not possible to do this using the programming phone, it will have to done with the programming software.

- Disconnect the RX input from the radio. Audio received from this input is summed with the audio from the programming phone. If noise is being received, it will affect the decoding of tones and the programming of the voices. The RX input should always be connected to squelched audio.

Problem: The B1290 does not dial out over the telephone line when an alarm occurs.

- Check that the phone line is plugged into the correct jack. The jack labeled PGM is for a local programming phone; the telephone line should be plugged into the PHONE jack.

- Check that the telephone is dialing from the correct directory (Program Code 2). The B1290 has four separate directories: A, B, C and D. Check that the telephone numbers are entered correctly in the selected directory, and that the directory is not empty.

- Check that an alarm is actually present, as indicated by the LEDs on the front panel. In its default condition, the B1290 expects to see a closure to ground at the alarm input. If your alarm inputs are normally closed contacts which open on an alarm condition, this parameter may be adjusted using Program Code 5. The debounce can also be set in this section. This parameter may be set to delay reporting an alarm until it has been present for a certain number of seconds, in which case it will not recognize a momentary closure.

- Check the program cable. The B1290 (Version 1) will remain in program mode if the DB9 cable is still connected to the unit. The alarm and RUN LEDs will flash when in this state.

Problem: The B1290 waits a long time before announcing the alarm over the radio.

- The B1290 will wait for one minute when the COS input is busy and then transmit anyway. This is done to ensure that an open squelch on the radio does not disable the reporting operation. Check the Squelch Polarity setting to make sure that it matches the operation of the radio's COS output. If the COS input to the B1290 is left open the Squelch Polarity should be set to 0 using Program Code 6.

- Check the alarm delay (debounce) parameter using Program Code 5. If a delay has been programmed, the B1290 will wait until the alarm has been present for that interval before reporting it.

- Check the directory programming to make sure that there is not an unwanted Wait command present.

Problem: The B1290 continues dialing even after the alarms have been acknowledged.

- The most common cause of this problem is fleeting alarms. They occur when the device reporting an alarm to the B1290 gives a series of pulses on the contacts instead of a clean closure. If the problem cannot be corrected in the field wiring, one option is to “debounce” the alarms using the B1290 alarm delay parameter using Program Code 5. When this value is set, contacts must be closed for a specific period of time before they are recognized as alarms.

- Check if any new alarms are announced when the B1290 continues to dial after it has been acknowledged. Sometimes alarms at a remote site are related, occurring in a chain reaction from a single cause. The B1290 will start dialing when it receives the first alarm, but if another alarm occurs in the meantime, it will keep dialing until all the alarms are acknowledged.

Problem: The B1290 won’t answer the phone.

- Check that the phone line is plugged into the PHONE jack and not the PGM jack.

- Check that the phone line is using the inner red/green pair, and not the outer black/yellow pair (normally reserved for line 2).

- Check that the B1290 is configured to answer the phone, using Program Code 4. If the number of rings before answering is set to 0, the B1290 will never answer the phone.

- Answering the telephone will not occur if the B1290 is engaged in any of these activities: speaking on the radio, in local programming mode and when it is using the phone line to call out. Counting of rings only begins once the unit is in its idle state.

- Check that the ringing voltage on the telephone line exceeds 40 VAC at 20 Hz. The RING LED located on the front panel will indicate if proper ringing voltage is being received.

- Check that the telephone line has a standard ringing cadence of two seconds on, four seconds off. If the ringing cadence is greatly different, it may not be detected.

Problem: The B1290 will not acknowledge.

- Check that you are sending the correct digits. The acknowledge code can be changed using Program Code 3.

- If the B1290 is not acknowledging over radio, it may be necessary to adjust the receive level setting for the radio port.

- If the B1290 is not acknowledging over the telephone line, it may be necessary to adjust the receive level setting for the phone port.

- Check that the TONE LED on the front panel of the B1290 lights when a DTMF digit is received.

Problem: The B1290 does not activate its relay when I send the DTMF On code.

- Check that you are sending the right digits. The relay On/Off codes can be changed by using Program Code 3.

- Check the relay On time using Program Code 5. If the setting is 0, the relay will stay On until it is commanded Off. For any other setting, the relay will only operate for the programmed number of seconds.

- If the relays do not operate from codes sent over the radio, it may be necessary to adjust the receive level setting for the radio port.

- If the relays do not operate from codes sent over the telephone, it may be necessary to adjust the receive level setting for the phone port.

- Check that the TONE LED on the front panel of the B1290 lights when a digit is received.

Problem: Our operators live in an area which has a dial pulse exchange. How can they acknowledge the B1290 when it calls?

- Even though the operators have rotary phones, they can still send tone codes if they have a DTMF pad, purchased separately, which sits by the phone.

- The B1290 may be programmed to automatically acknowledge after eight rings. Thus if the B1290 calls an operator with a dial pulse phone, the operator can hang up after he hears the message, call the B1290 right back, let the phone ring eight times, and the B1290 will recognize that as an acknowledgment. Set the number of rings before answering to # in the Configuration section (Program Code 4), and put a Wait command in the next directory line to allow time for them to call the B1290 back.

Problem: How can I prevent unauthorized personnel from calling up the B1290 and altering its programming?

- In its default condition, the B1290 does not require any type of password. If you wish to enter one, refer to the Access Code in the DTMF Codes section (Program Code 3). If an Access Code is programmed, anyone calling the B1290 will receive a report of its status, but it will prompt the caller to enter the Access Code before allowing them into the programming mode.

Problem: Can I use the * character as part of my DTMF strings? Won't this be confused with the "Enter" code?

- The # and * characters may be used as a part of any programmable DTMF string. The only time you must be careful is when entering an asterisk (*) as the last digit in a string. Be sure to wait more than one second after entering the last digit before hitting Enter (**); otherwise the last * will be interpreted as part of the Enter code.

Problem: The B1290 has lost its programming.

- As it runs, the B1290 is constantly performing internal self-checks, and on rare occasions it may find that a memory location has been corrupted. If that happens, the B1290 resets all programmed parameters (except the voice messages) to the default values. At the same time, it will announce *Program Code Error* over the radio. As the telephone directories have been lost, the B1290 cannot dial out to report the failure over the phone. The only way you will be able to tell that something has gone wrong is by phoning the B1290; it will announce a *Program Code Error* as soon as it answers the phone. In order to have some local indication that an error has occurred, hook a local speaker into the radio connections.

The most common causes of a memory loss are power spikes which enter the board through the power, ground, telephone line, or radio connections.

Problem: I tried to change the telephone numbers and now the B1290 will not dial out at all.

- Check the programming for Directory A to be sure that the correct command sequence is entered. If a Directory Control Code is being used, make sure that the B1290 has not been changed to a directory that disables the alarm reporting. This would be the case where a directory contains the single Wait command or possibly commands for only the radio port.

11. SPECIFICATIONS

Alarm Inputs	8, optically isolated, 2mA to operate, ground closure required.
Control Outputs	4 independent form C outputs controlled by programmable codes or used as special function outputs. Rated: 1 Amp at 30 Volts DC, 0.3A at 120V AC
Telephone Connection	RJ11; tone or pulse line.
Programming Connection	RJ11; accepts a standard telephone.
Receive Audio	-20 dBm to 0 dBm, 10 k ohm impedance; unbalanced, AC coupled.
Transmit Audio	-20 dBm to 0 dBm, 600 ohm impedance, unbalanced, AC coupled.
Channel Busy (COS)	Ground closure.
PTT	Open collector, 25 V max, 150 mA max.
Acknowledge Input	Ground closure.
Voice Quality	Digitized, toll quality, 32 kbps.
Power	Version 1: +11.5 VDC to +28 VDC, 100 mA standby current, 10 mA per active relay. Version 2: +10V DC to +30V DC, 50 mA standby current, 150 mA maximum current, 10mA per active relay
Environment	-40^{o}C to + 60^{o}C, 95% relative humidity, non-condensing.
Physical	6.5” x 8.5” x 2” Plug-in terminals

12. APPENDIX A – PROGRAMMABLE FEATURES

Alarm Messages	Unique Site ID plus individual messages for each input. Message length is variable
Alarm Polarity	Selects NO or NC input format
Alarm Latch	Latches fleeting alarm inputs
Alarm Debounce	Selects the delay time before a change of state on the input is valid. Range is 0.1 to 19.9 in either seconds or minutes
Alarm Directory	Selects one of four directories that contain command actions to be taken when the alarm is active.
Interval Timer	Two stage timer that uses 'A' interval 'A' times before switching to 'B' interval. Both 'A' and 'B' interval are adjustable up to 249 minutes.
Acknowledge Code	Stops the reporting sequence: 1 to 8 digits
Interrogate Code	Speaks alarms and relay state: 1 to 8 digits
Alarm On/Off Output Codes	Sent when an alarm becomes active (on) or when it returns to normal (off). Different codes for each alarm. 1 to 8 digits
Remote Alarm Input	Simulate an alarm condition when received. Different codes for each alarm. 1 to 8 digits
Directory Control Code	Changes the alarms to use different directories; also referred to as shift change. Two modes are available: one where all alarms are assigned to Directory A and can be controlled to alternately use the other three directories and another where Directory A alternates with Directory B and Directory C alternates with Directory D.
Directory Commands	Each directory can have up to 20 lines of command sequences. The commands are executed when an alarm using the directory is active. The commands are: ▸ Dial - phone the programmed number. ▸ Voice - Speak the alarm messages ▸ Radio - turn on the radio transmitter ▸ Wait - Insert a pause: 1 to 249 seconds. ▸ 2 Tone - send a two tone page ▸ 5 Tone - send a five tone page ▸ 1 Tone - send a single tone ▸ Alert - send a beeping tone ▸ DTMF - send a string of digits ▸ Answer - monitor the call progress signals and wait for the called party to speak before announcing the alarm message.
Access Code	Password for dial-up access to programming:1 to 8 digits
Acknowledge Request	The acknowledge request at the end of the alarm annunciation can be disabled for use with public address systems.
Number of Rings	Sets the number of rings before the B1290 will answer the line: 1 to 8 rings or never.
Squelch Polarity	Sets the radio busy monitor to either high or low when busy.
Relay Voices	Voice messages that are returned when a relay is operated.
Disable Relay Voices	Relay voices are not spoken.
Relay On/Off Codes	DTMF codes that turn the relay on and off. Independent for each relay: 1 to 8 digits
Relay Timer	Makes the relay a timed type where it will remain on for the specified time after the On code is received. Range is 1 to 199 in either seconds or minutes
Relay Special Function	These automatic functions can be assigned to the relays: ▸ Relay 1: New (unacked) alarm on ▸ Relay 2: Any alarm on ▸ Relay 3: Alarm acknowledged (timed) ▸ Relay 4: Error

Pulse Dial	Forces dialing to be pulse instead of tone.
Number of Expanders	Sets the number of connected expanders.
Disable Expander ID	Stops the site ID in the expander from being spoken.
Audio Levels	Sets the gain for audio signals in the B1290

13. APPENDIX B – OPTIONS

B1256	AC Adapter
B1292	Expander module. Adds 8 inputs and 4 relays. Maximum of 7 expanders
Option 004	External power pack with 120 VAC power supply, sealed battery and charger, 12 hour capacity in standby. Connection of the Option 004 power supply is shown in Figure 8.

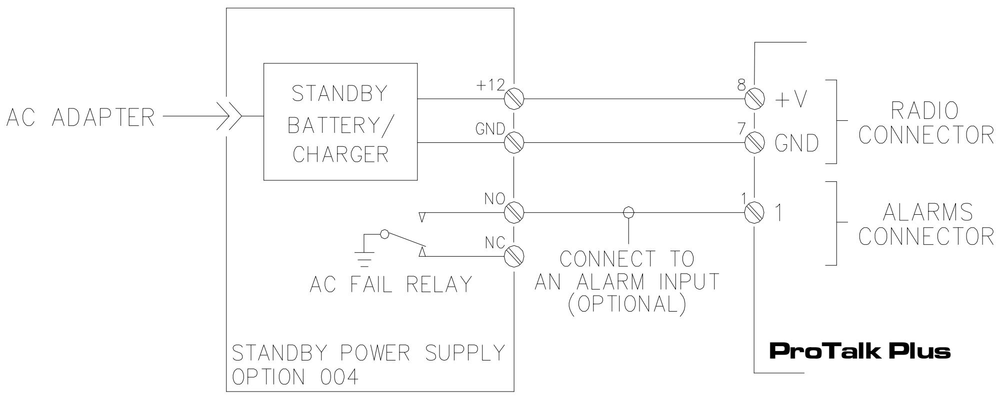

Figure 8 Option 004 Connections

14. APPENDIX C – PROGRAMMING TREE

The parameters used to program the ProTalk Plus are given as a summary below. Where X appears, user data is entered

- [1][*][*] Voices
  - [1][*][*] Site ID/Alarms
    - [2][*][*] Record
    - [*][*] Next
    - [#][*][*] Quit
  - [2][*][*] Relays
    - [2][*][*] Record
    - [*][*] Next
    - [#][*][*] Quit
  - [3][*][*] Erase
    - [#][3][1][*][*] Erase
- [2][*][*] Directory
  - [1][*][*] Dir A
    - [2][*][*] Change Line
      - [#][0][X] [DIAL]…
      - [#][1] [RADIO]
      - [#][2][X] [WAIT]...
      - [#][3] [ALERT]
      - [#][4][X] [2 TONE] ...
      - [#][5][X] [5 TONE] ...
      - [#][6][X] [1 TONE] ...
      - [#][7][X] [DTMF] ...
      - [#][8] [VOICE]
      - [#][9] [ANSWER]
    - [3][*][*] Erase Line
    - [4][*][*] Insert Line
    - [*][*] Next
    - [#][*][*] Quit
  - [2][*][*] Dir B - Same as Directory A
  - [3][*][*] Dir C - Same as Directory A
  - [4][*][*] Dir D - Same as Directory A
  - [0][*][*] Directory help
- [3][*][*] DTMF Codes
  - [1][*][*] Acknowledge
    - [X][*][*] Change
    - [#][*][*] Clear
    - [*][*] Next
  - [2][*][*] Access
    - [X][*][*] Change
    - [#][*][*] Clear
    - [*][*] Next
  - [3][*][*] Relay On/Off
    - [X][*][*] Change
    - [#][*][*] Clear
    - [*][*] Next
  - [4][*][*] Alarm On/Off
    - [X][*][*] Change

- # * * Clear
- * * Next

- 5 * * Remote Alarm
  - X * * Change
  - # * * Clear
  - * * Next
- 6 * * Interrogate
  - X * * Change
  - # * * Clear
  - * * Next
- 7 * * Directory Control
  - X * * Change
  - # * * Clear
  - * * Next

4 * * Configuration

- Rings Before Answer
  - X * * Change
  - # * * Auto Ack
  - * * Next
- Timer A
  - X * * Change
  - * * Next
- Timer B
  - X * * Change
  - * * Next
- Times A
  - X * * Change
  - * * Next

5 * * I/O Config.

- 1 * * Alarm Format
  - 0 * * NO
  - 1 * * NC
  - 2 * * NO latched
  - 3 * * NC latched
  - * * Next
- Alarm Timebase
  - 0 * * Seconds
  - 1 * * Minutes
  - * * Next
- Alarm Debounce
  - X * * Change
  - * * Next
- 2 * * Using Directory
  - 0 * * Disabled
  - 1 * * Dir A
  - 2 * * Dir B
  - 3 * * Dir C
  - 4 * * Dir D
  - * * Next

	[3][*][*] Relay Timebase	[0][*][*]	Seconds
		[1][*][*]	Minutes
		[*][*]	Next
	Relay Timer	[0][*][*]	Not timed
		[1][*][*]	Special
		[X][*][*]	Change
		[*][*]	Next
[6][*][*] System	Dial Format	[0][*][*]	Tone
		[1][*][*]	Pulse
		[*][*]	Next
	Squelch Polarity	[0][*][*]	Busy low
		[1][*][*]	Busy high
		[*][*]	Next
	Relay Voices	[0][*][*]	Off
		[1][*][*]	On
		[*][*]	Next
	Ack Request	[0][*][*]	Off
		[1][*][*]	On
		[*][*]	Next
	Dial Tone (Call Progress)	[0][*][*]	Off
		[1][*][*]	On
		[*][*]	Next
[7][*][*] Expanders	Number of Expanders	[X][*][*]	Change
		[*][*]	Next
	Site Voice Enable	[0][*][*]	Off
		[1][*][*]	On
		[*][*]	Next
[8][*][*] Reset Database		[#][3][1][*][*]	Reset
		[*][*]	Next
[9][*][*] Audio Levels	Radio TX Tone	[X][*][*]	Change
		[*][*]	Next
	Radio TX DTMF	[X][*][*]	Change
		[*][*]	Next
	Radio TX Voice	[X][*][*]	Change
		[*][*]	Next
	Radio RX	[X][*][*]	Change
		[*][*]	Next
	Phone RX	[X][*][*]	Change
		[*][*]	Next

15. APPENDIX D – MOUNTING

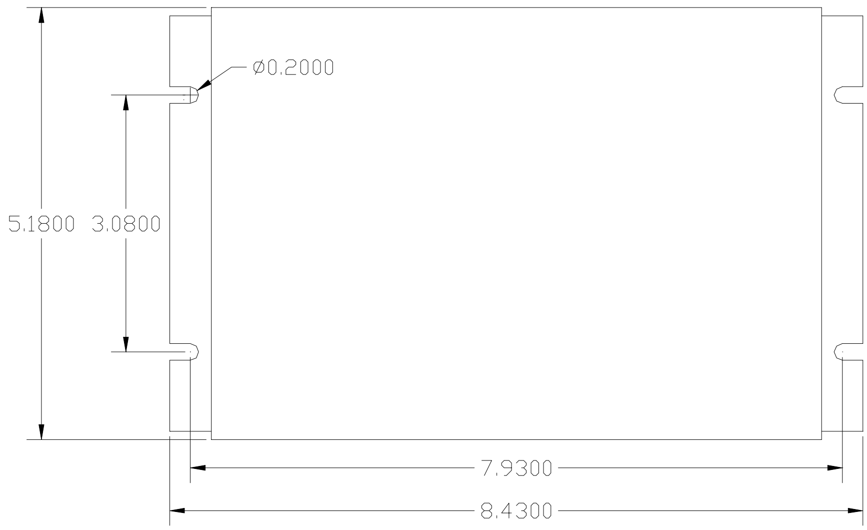

Figure 9 Mounting Detail

16. NOTICES

CSA Certification

The B1290 product has 60950-1 safety certification for Canada and USA.

Compliance

This Class A digital apparatus complies with Canadian ICES-003. This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:

(1) this device may not cause harmful interference and,

(2) this device must accept any interference received, including interference that may cause undesired operation.

Warning

This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions manual, may cause interference to radio communications.

Operation of this equipment in a residential is likely to cause interference. Should this occur, the user (at his own expense) will be required to apply whatever measures necessary to correct the interference.

17. WARRANTY STATEMENT

Barnett Engineering Ltd. warrants that all equipment supplied shall be free from defects in material or workmanship at the time of delivery. Such warranty shall extend from the time of delivery for a period of 2 years. Buyer must provide written notice to Barnett Engineering Ltd. within this prescribed warranty period of any defect. If the defect is not the result of improper usage, service, maintenance, or installation and equipment has not been otherwise damaged or modified after delivery, Barnett Engineering Ltd. shall either replace or repair the defective part or parts of equipment or replace the equipment or refund the purchase price at Barnett Engineering Ltd.'s option after return of such equipment by buyer to Barnett Engineering Ltd. Shipment to Barnett Engineering Ltd.'s facility shall be borne on account of buyer.

(1)Consequential Damages: Barnett Engineering Ltd. shall not be liable for any incidental or consequential damages incurred as a result of any defect in any equipment sold hereunder and Barnett Engineering Ltd.'s liability is specifically limited to its obligation described herein to repair or replace a defective part or parts covered by this warranty.

(2)Exclusive Warranty: The warranty set forth herein is the only warranty, oral or written, made by Barnett Engineering Ltd. and is in lieu of and replaces all other warranties, expressed or implied, including the warranty of merchantability and the warranty of fitness for particular purpose.

Chapter 35 CHLORINATION INJECTION SYSTEM

MANUFACTURER/DISTRIBUTOR:

Metcon Sales & Engineering
A/S Julia Alstanei
15 Connie Crescent, Unit 3
Concord, ON, L4K 1L3
Email: juliaa@metconeng.com
Tel: 905-738-2355 ext.302
Fax: 905-738-5520

35.1 **METCON DUPLEX PUMP PANEL SYSTEM**

35.2 **ARCH CHEMICALS CALCIUM HYPOCHLORITE FEEDING SYSTEM MC4-50**

35.3 **SEVERN TRENT SERVICES MICROCHEM2 ANALYZER CONTROLLER**

35.4 **NANODAC RECORDER**

35.5 **BADGER MAGNETIC FLOWMETER M-2000**

metcon
SALES & ENGINEERING LTD.

Job Name: Pangnirtung

Job Number: 15-2010782

Date: Mar 05, 2015

SHOP DRAWINGS

SHOP DRAWING

This review is solely for the verification of general design quality and does not alleviate the responsibility of the contractor for insuring that all specification, space and installation requirements are met.

Reviewed By: N.K.

Date: March 19, 2015

Reviewed pages 1 to 70

- Reviewed ☒
- Reviewed as noted ☐
- Resubmit ☐

CHIARELLI ENGINEERING LTD.

Shop Drawings Contractor Approval
Approved by: J.D., G.F.
Date Mar. 18, 2015
SIFEC NORTH INC

KUDLIK CONSTRUCTION LTD
P.O. BOX 727, 1519 FEDERAL ROAD
IQALUIT, NUNAVUT X0A 0H0
PHONE: (867) 979-1166
FAX: (867) 979-1169

DM March 18, 2015

Geon Tanadie, P.Eng
Sr. Project Manager

Phone 905 738 2355 x 230
E-mail:
jtanadie@metconeng.com

metcon
SALES & ENGINEERING LTD.

Table of contents:

Shop Drawings
Contractor Approval
Approved by: J.D., G. F.
Date:
SIFEC NORTH INC

2.6 Chlorination System

System Description
Two identical dual pump, redundant piping, Viton elastomers for components, control box for power and signal with 3-way selector switch for duty selection. Each system is pre-mounted, pre-piped, pre-wired and pressure tested on HDPE board, as supplied by Metcon Sales & Engineering Ltd.

Bill of Materials

4 PROMINENT Gala Pumps

(Tag #: CP1, CP2, CP3 & CP4)

- Model: Gala 1005NPB800UD11200
- Max Capacity: 1.1 gph (4.4 l/hr) = 26.4 gpd (105.6 l/d)
- Max. Back Pressure: 145 psi (10 bar)
- Max stroking rate: 180 SPM and 100% stroke length
- Liquid End: Auto-degassing liquid end
- Operational status displayed via three LED lights indicating normal, low flow warning or lack of chemical/operational error
- Direct calibration function and built-in warning indicator
- Feed rate display: LPH or US gal/hour
- Pump Control: Manual + External + Analog Ctrl.
- Relay Contact: 2 A @ 250 Vac
- Power requirements: 0.7 A 115 / 1 / 60
- Suc./disch. connectors: 1/2" x 3/8"
- Control cable (2m): 1001300

Material of Construction
Liquid end type – Acrylic
Suction/Discharge Connectors – PVC
Seals – Viton
Valve Balls - Ceramic
Diaphragm – PTFE

Pumps Panel Accessories:

4 PROMINENT Flow Monitors Type II

- Model: 1009338
- Type: New Style
- Material: PVDF
- Seals: Viton B

Shop Drawings
Contractor Approval
Approved by: J.D., G. F.
Date: Mar. 18, 2015
SIFEC NORTH INC

8 CHEMLINE Back Pressure / Pressure Relief Valves

- Model: SB12A005VU
- Material: PVC
- Seals: Viton
- Size: ½" (12 mm)
- Ends: Union

28 CHEMLINE Ball Valves

- Model: 21A005VS
- Material: PVC
- Seals: Viton
- Size: ½" (12 mm)
- Ends: Socket

4 CHEMLINE Pressure Gauge and Isolator

- Model: SGA005-002PG
- Material: PVC
- Seals: Teflon
- Size: ½" (12 mm) - ¼" (6 mm)
- Pressure Range: 0-200 psi
- Filled: Glycerin

4 BLACOH Pulsation Dampener

- Model: RC-10PVC-E50
- Capacity: 10 cu.in (0.16 L)
- Body Material: PVC
- Ends: ½" FNPT
- Max. Pressure: 150 psi

Shop Drawings
Contractor Approval
Approved by: J.D., G. F.
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SIFEC NORTH INC

4 PRIMARY FLUID Calibration Column

- Model: PV#2 – 500
- Capacity: 500 mL
- Body Material: Clear PVC
- Ends: Threaded

4 CHEMLINE Y Strainer

- Model: YSA005VS
- Size: ½” (12 mm)
- Material: PVC/Viton
- Screen Mesh: 24 (standard(

Note: Please advise if mesh 35 or 55 is required.

4 CHEMLINE Check Valves

- Model: BTA005VS
- Size: ½” x 3/8”
- Material: PP/Viton

2 PROMINENT Injection Valve

- Model: N/A (comes with pump)
- Size: ½” x 3/8”
- Material: PP/Viton

2 CHEMLINE Corp Stop, Chemlance Series (ship loose)

- Model: CL-005-VF
- Material: PVC
- Valve Material: Brasss
- Size: ½” (12 mm)
- Seals: Viton
- Ends: Threaded

2 Metcon Control Panel

- Model: 121006
- Size: 12”H x 10”W x 6”D
- Protection Rating: NEMA-4X
- Power Requirements: 3A @ 115 / 1 / 60
- Approvals: CSA
- Panel Components: As per drawing # 2

Shop Drawings
Contractor Approval
Approved by: J.D., G. F.
Date: Mar. 18, 2015
SIFEC NORTH INC

2.6.10.1 Magnetic Flow Meter

2 BADGER Magnetic Flow Meter

(Tag #: FM-1 & FM-2)

- Model: M2000 / 6"/ HR / GR / Intergral
- Element Size: 6" (150 mm)
- Flow Range: 30-11890 L/min (7.85-3141 gpm)
- Connections: 150# Flanged
- Amplifier: Mounted on meter
- Electrodes: Alloy-C
- Liner: Hard Rubber
- Body Material: Carbon Steel
- Power Requirements: 20 W @ 85….265 Vac
- Enclosure: NEMA-4X (IP66)
- Comes with: 316SS Grounding Rings

2.6.10.4 Hypochlorite Feeding System

2 ARCH CHEMICAL Calcium Hypo Feeding System

(Tag #: MC 4-50-#1 & MC 4-50-#2)

- Model: MC 4-50
- Dry Chemical Capacity: 62 lbs (28 kg)
- Nominal Operating Conc.: 1.7% AvCL
- Chlorine Delivery Rate: 1-50 lbs AvCI/Day @ 70°F
- Water Requirements: 1.0 gpm @ 50-150 psi
- Power Requirements: 15 A @ 120 Vac
- Comes with: 2 Pails (100 lbs) of Chlor Plus Dry Chlorinator Briquettes per Feeder

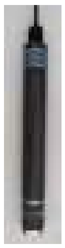
2.6.10.5 STS Chlorine Controller

2 STS Chlorine Controller, MicroChem2

- Model: T17M D 4 3 D 1 3 4 D E XX
- Input Channels: 3 (free chlorine, pH & temperature)
- Flow Cell: Panel Mount with pressure regulator
- Power Requirements: 120 Vac
- Installation: Wall Mounted
- Communication: RS-232
- Approval: CE / CSA

Shop Drawings
Contractor Approval
Approved by: J.D., G. F.
Date: Mar. 18, 2015
SIFEC NORTH INC

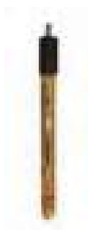
2.6.10.6 STS Chlorine Probe



2 STS Chlorine Controller, MicroChem2

- Model: 23184
- Measuring Range: 0-5 ppm
- Tolerable: 4 – 9.5 pH
- Comes with: 12 ft of cable

2.6.10.7 STS pH Probe



2 STS Chlorine Controller, MicroChem2

- Model: 01-4068
- Temperature Sensor: Built-In
- Probe Diameter: 12 mm (1/2 “)
- Comes with: 10 ft of cable

2.6.11 NANODAC Recorder / Controller

1 NANODAC Recorder / Controller

- Model: VH C P LRR XX TS SV XXXX ENG
- Power Requirements: 2 A @ 120 Vac
- Input Ports: 4
- Virtual Inputs 30
- Flash Memory: 50 Mb
- Communication Port: USB
- Communications: Modbus TCP/IP slave
- Screen: ¼ VGA color
- Keyboard with: 4 keys

Note: Images are for illustration purposes only and may not reflect the actual product described.

Shop Drawings
Contractor Approval
Approved by: J.D., G. F.
Date: Mar. 18, 2015
SIFEC NORTH INC

Job Name: Pangnirtung

Job Number: 15-S010792

Date: Sep 05, 2016

O & M Manuals - rev

Gen Tanasie, P. Eng
Sr. Project Manager

Phone: 905-738-2355 x 236
E-mail:

genovevt@metconeng.com

Table of contents:

Section 22 42 01 – Plumbing Specialties & Accessories

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- Communication: RS-232
- Approval: CE / CSA

2.6.10.6 STS Chlorine Probe

2 STS Chlorine Controller, MicroChem2

- Model: ~~23184~~ 23183
- Measuring Range: ~~0-5 ppm~~ 0-2ppm
- Tolerable: 4 – 9.5 pH
- Comes with: 12 ft of cable

2.6.10.7 STS pH Probe

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- Input Ports: 4
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- Flash Memory: 50 Mb
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- Communications: Modbus TCP/IP slave
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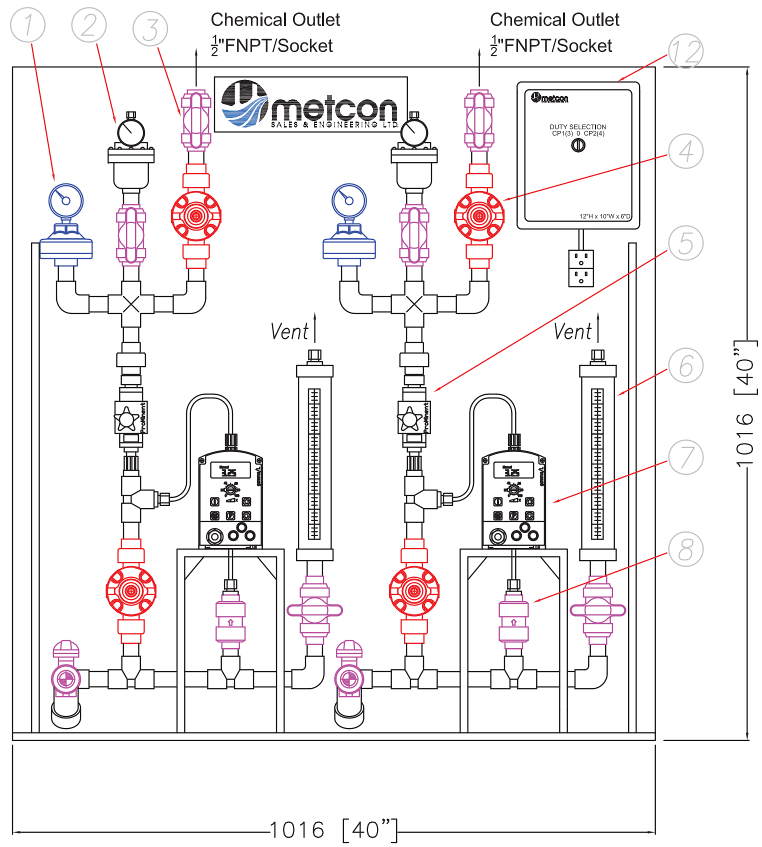
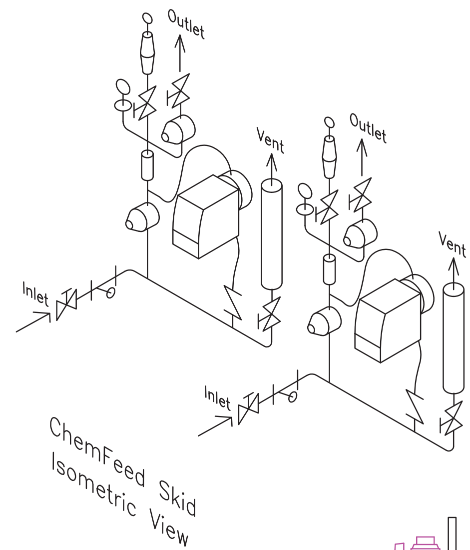
- Keyboard with: 4 keys

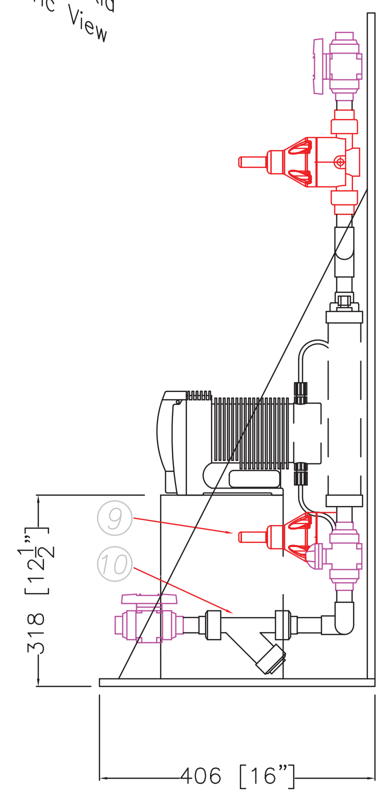
Note: Images are for illustration purposes only and may not reflect the actual product described.

NOTES:

1. Two identical dual pump syetems.
2. Control panel for power signals and automating switchover, if required.
3. Selector switch for selection of duty pump.







REVISIONS:

No	Date	By	Description
1.			
2.			

BILL OF MATERIALS

#	Part #	Make	Description	Pcs
1.	SGA005002PG	Chemline	Pressure Gauge	4
2.	RC-10PVC-E50	Blacoh	Pulsation Dampener	4
3.	21A005VS	Chemline	Ball Valve	28
4.	SB12A005VU	Chemline	Back Pressure Valve	4
5.	1009338	Prominent	Flow Monitor	4
6.	PV#2 - 500	Primary Fluid	Calibration Column	4
7.	Gala 1005NPB 900UD11300	Prominent	Chemical Feeding Pump	4
8.	BTA005VS	Chemline	Foot Valve	4
9.	SB12A005VU	Chemline	Pressure Relief Valve	4
10	YSA005VS	Chemline	Strainer	4
11	CL-005-VF	Chemline	Corp Stop (shipped loose)	2
12	121006	Metcon	Control Panel	2

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☒ FOR APPROVAL
☐ FOR CONSTRUCTION
☐ AS BUILT

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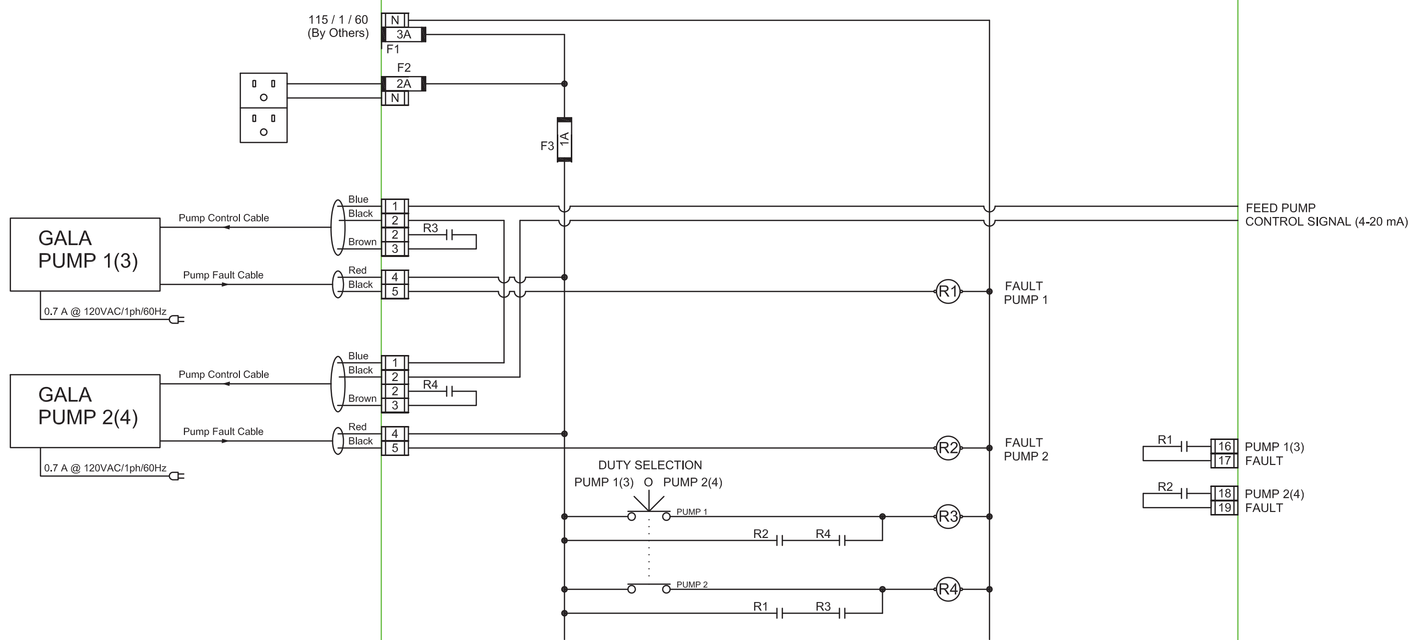
Dual Pump System

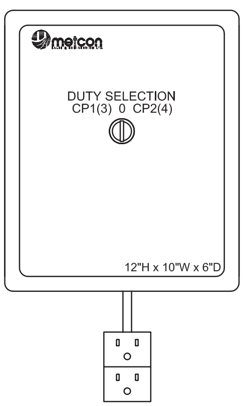
Layout & Dimensions

Date:	Mar 05, 2015
Job Number:	15-S010792
Job Name:	Pangnirtung
Dwg. #:	1
Approved by:	GM
Drawn by:	GT

Notes:
1. [●] Indicates supplied by others.
2. Unit: Inches (mm). Do not scale this drawing. All dimmensions, sizing, orientation of piping, wiring and equipment, are estimations and approximations and are not to be used in other related design.
3. The information contained on this drawing is of confidential nature and shall not be used or reproduced without written consent from Metcon Sales and Engineering Limited.

CHEMICAL PUMPS CONTRL PANEL





NOTES:

1. Two identical control panels, one for each chemical system
2. Selected duty pump will automatically start after selection from selector switch. Second pump will be the stand-by one.
3. If selected duty pump fails, the stand-by pump will automatically start. Please advise if this feature is not required.
4. If manual control is required, disconnect control cable from pump. On manual control, start/stop and speed adjustment from pump key pad.
5. Control panels will have CSA approval (general inspection).

REVISIONS:

No	Date	By	Description
1.			
2.			

BILL OF MATERIALS

#	Part #	Make	Description	Pcs
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				

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Control Panel

Wiring and Layout

Date:	Mar 05, 2015
Job Number:	15-S010792
Job Name:	Pangnirtung
Dwg. #:	2
Approved by:	GM
Drawn by:	GT

Notes:
1. [•] Indicates supplied by others.
2. Unit: Inches (mm). Do not scale this drawing. All dimmensions, sizing, orientation of piping, wiring and equipment, are estimations and approximations and are not to be used in other related design.
3. The information contained on this drawing is of confidential nature and shall not be used or reproduced without written consent from Metcon Sales and Engineering Limited.

3. Equipment O&M
3.1 - Metering Pump

Operating Instructions Manual

ProMinent® gamma/ L
Solenoid Metering Pump

GALA ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___
Please enter ident code of the device here

Please read the operating instructions through completely before commissioning this equipment! Do not discard!
Any part which has been subject to misuse is excluded from the warranty!

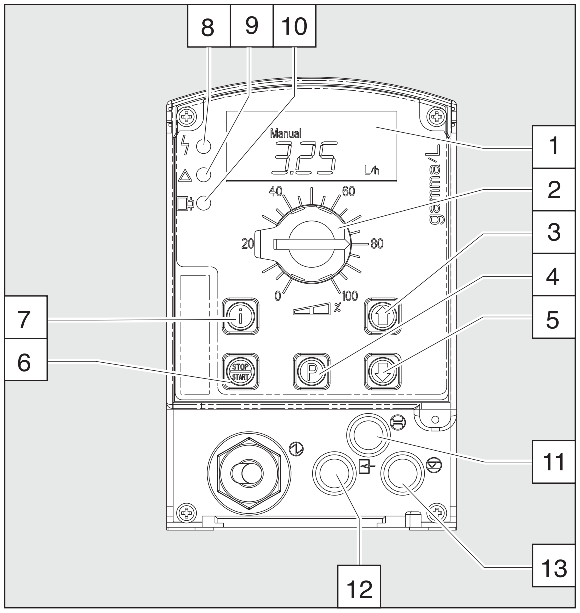
Printing:
Operating Instructions ProMinent® gamma/ L

Address:
ProMinent Dosiertechnik GmbH
Im Schuhmachergewann 5-11
69123 Heidelberg
Germany
info@prominent.com
www.prominent.com

Subject to technical alteration.

Please fold out this page!

Control elements: overview



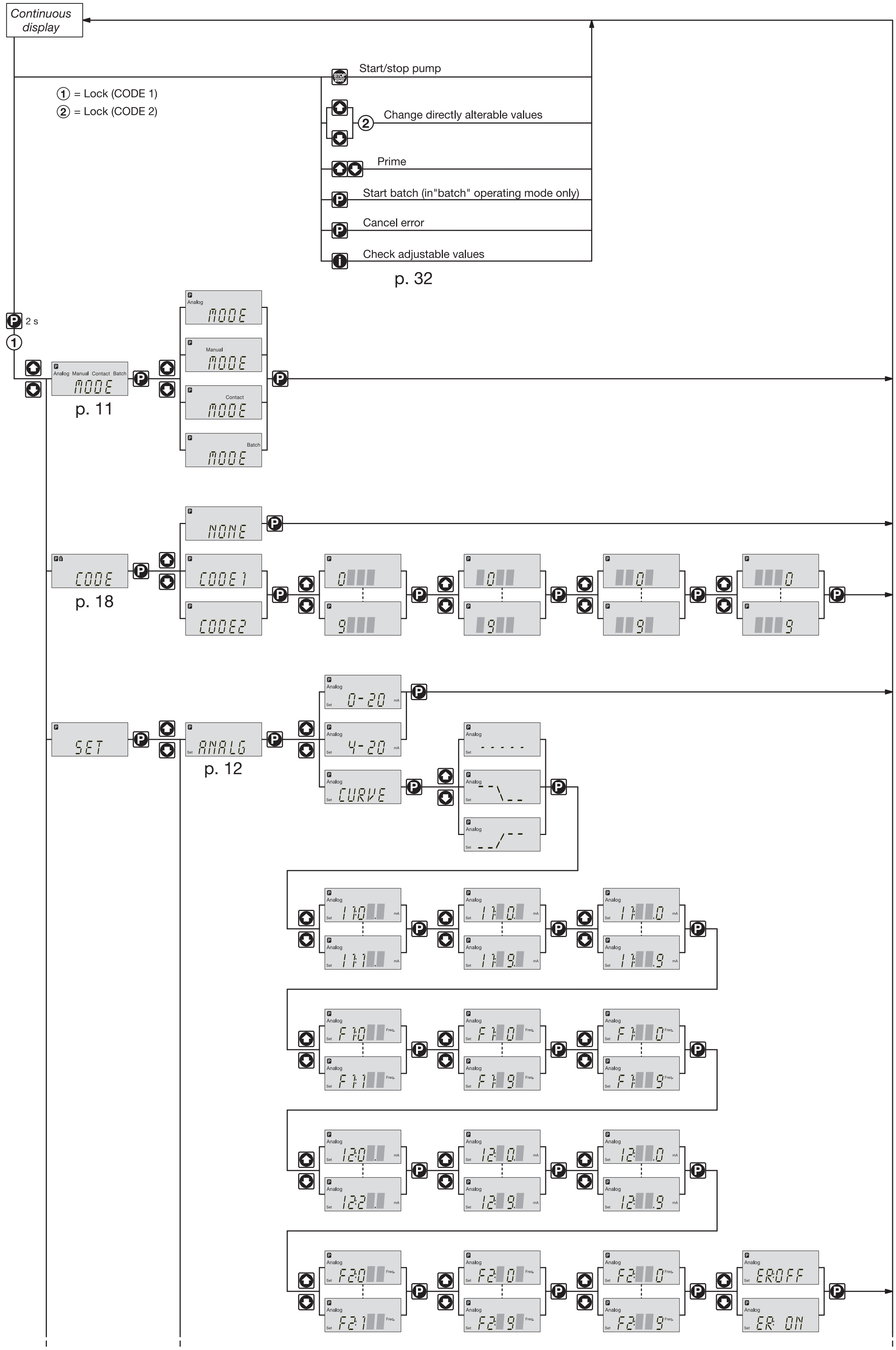
1 LCD display
2 Stroke length adjusting knob
3 UP key
4 P key
5 DOWN key
6 STOP/START key
7 i key
8 Fault indicator (red)
9 Warning indicator (yellow)
10 Operating indicator (green)

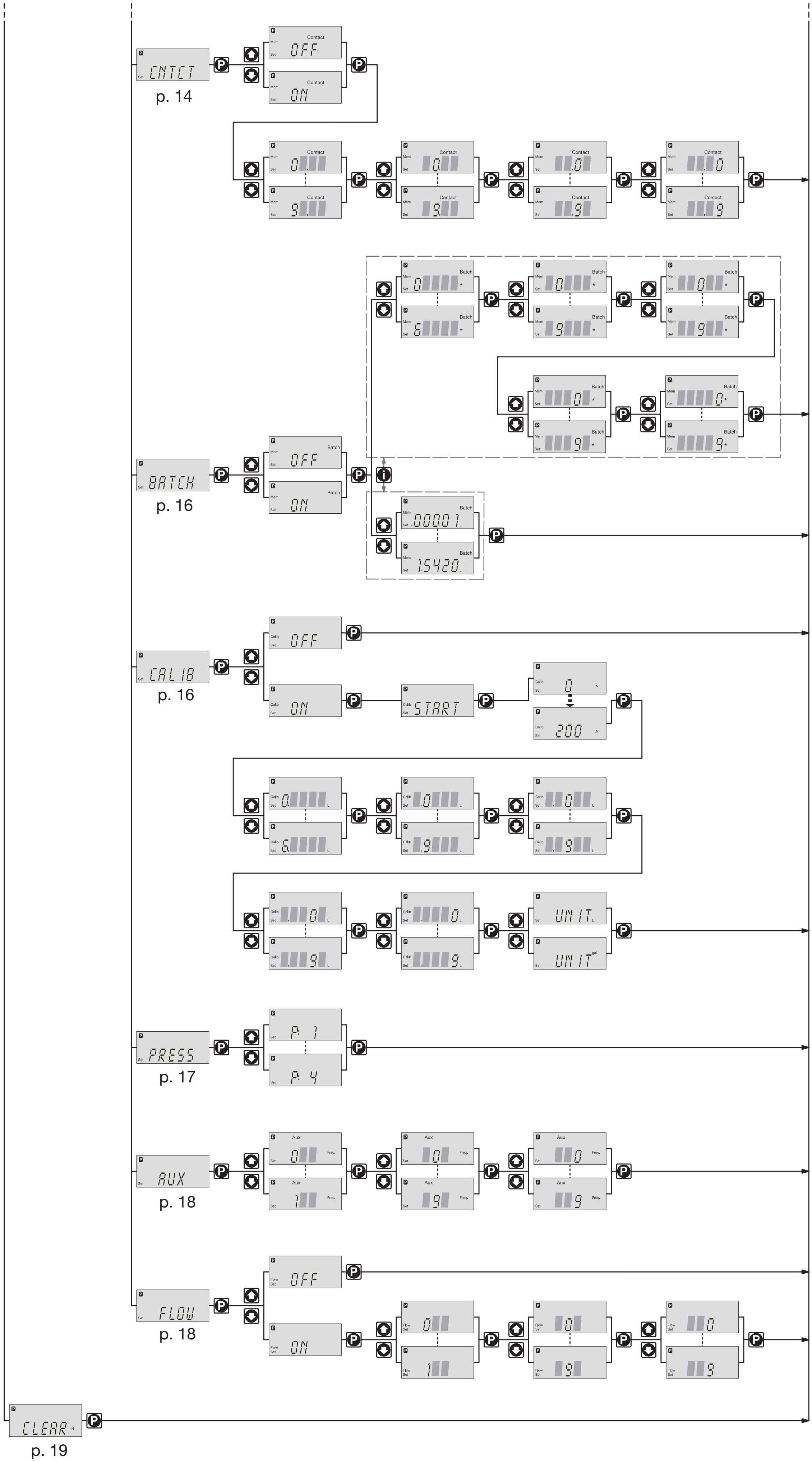
11 “Dosing monitor” terminal
12 “External control” terminal
13 “Float switch” terminal

Key functions

	In continuous display mode (operating)	**In settings mode (settings)**
STOP/START key		
Press briefly	Stop pump, start pump	Stop pump, start pump
P key		
Press briefly	Start batch (in “batch” operating mode only), Cancel error	Confirm entry- jump to next menu option or continuous display
Press for 2 s	Change to settings mode	---
Press for 3 s	---	Jump to continuous display
Press for 10 s	Display software version	---
Press for 15 s	Load factory settings (calibration)	---
Touche i		
Press x1	Toggle between continuous displays	Toggle between “change individual digits” and change a figure”
Press x2	---	For “change individual digits”: jumps to first digit
Arrow keys UP and DOWN		
Press x1 (until “Set” appears)	Change directly alterable values	Select other settings, change individual digit or figure
Press simultaneously	Prime	---

Operating-/Settings Diagram




CNTCT
p. 14
Contact
OFF
ON
BATCH
p. 16
Batch
CALIB
p. 16
Calib
START
200
UNIT
PRESS
p. 17
P. 1
P. 4
AUX
p. 18
Aux
FLOW
p. 18
Flow
CLEAR
p. 19

Continuous display

Continuous display	Operating mode "**Analog**" 0-20 mA	Operating mode "**Manual**"	Operating mode "**Contact**" with memory and tansfer factor 5	Operating mode "**Batch**" with memory and tansfer factor 5
Stroke rate	Stop Analog 180 Freq.	◘◘ Stop Manual 180 Freq.	◘◘ Stop Contact 180 Freq.	◘◘ Stop Batch 180 Freq.
Feed rate	Stop Analog 7.50 L/h	◘◘ Stop Manual 7.50 L/h		
Total stroke number	Stop Analog 356 N	Stop Manual 356 N	Stop Contact 356 N	Stop Batch 356 N
Total litres (feed quantity)	Stop Analog 12.368 L	Stop Manual 12.368 L	Stop Contact 12.368 L	Stop Batch 12.368 L
"External" display	Stop Analog EXT		Stop Mem Contact EXT	Stop Mem Batch EXT
Signal current	Stop Analog 20.0 mA			
Strokes remaining				◘◘ Stop Mem Batch 25 * N
Batch size/ Litres remaining				◘◘ Stop Mem Batch 0.00 10 * L
Factor			Stop Mem Contact 5.00 *	
Stroke length	Stop Analog 65 %	Stop Manual 65 %	Stop Contact 65 %	Stop Batch 65 %

◘◘ = UP and/or DOWN arrow keys, directly alterable values

"Mem" appears only when "memory" function activated

Table of Contents

Identcode

Please enter the identity code on the device label into the grey box below

GALA | **GALA Series gamma/ L, version a**

Type	Capacity bar	l/h	
1000	10	0.74	Solenoid Ø 70/M70
1601	16	1,1	
1602	16	2.1	
1005	10	4.4	
0708	7	7.1	
0413	4	12.3	
0220	2	19.0	
1605	16	4.1	Solenoid Ø 85/M85
1008	10	6.8	
0713	7	11.0	
0420	4	17.1	
0232	2	32.0	

Material version:

PPE	Polypropylene/EPDM
PPB	Polypropylene/FPM
NPE	Acrylic glass/EPDM
NPB	Acrylic glass/FPM
PVT	PVDF/PTFE
TTT	PTFE/PTFE
SST	Stainless steel 1.4571/PTFE

Liquid end version:

0	Non-bleed, no valve spring, for NP, TT and SS only
1	Non-bleed, with valve spring, for NP, TT and SS only
2	Bleed function, no valve spring for PP, NP, PV, not type 0232
3	Bleed function, no valve spring for PP, NP, PV, not type 0232
4	No-vent with valve springs for highly viscous media
9	Self bleed function, for PP, NP, not for type 1000 and 0232

Hydraulic connection:

0	Standard connector as indicated in technical data
5	12/6 hose connector, pressure side only
9	10/4 hose connector, pressure side only

Version:

0	With ProMinent® logo

Power supply:

U	100 - 230 V, ±10 %, 50/60 Hz
M	12...24 V DC (only M 70)
N	24 V DC (only M 85)
P	24 V AC

Cable and plug:

A	2 m Euro
B	2 m Swiss
C	2 m Australian
D	2 m USA
1	2 m open end

Relay:

0	No relay
1	Fault indicating relay, (N/C) changeover relay
3	Fault indicating relay, (N/O) changeover relay
4	As 1 + pacing relay, (1 input each)
5	As 3 + pacing relay, (1 input each)

Accessories:

0	No accessories
1	Foot and dosing valve,, 2 m PVC suction tube, 5 m PE discharge tubing, PP, PC, and NP only
2	As 0 + calibrating cylinder
3	As 1 + calibrating cylinder

Control variants:

0	Manual + external 1:1
1	Manual + external with pulse control
2	Manual + external 1:1 with analogue current
3	Manual + external with pulse control + analogue current
4	as 0 + timer
5	as 3 + timer
P	as 3 + Profibus®

Access code:

0	No access code
1	Access code

Dosing monitoring:

0	Pulse input
1	Input for continuous contact

Pause/level:

0	Pause N/C level N/C

FPM = Fluorkautschuk

GALA ___ _ _ _ _ _ _ _ _ _ _ _ _

General User Guidelines

Please read through the following user Guidelines. Familiarity with these points ensures optimum use of the operating instructions.

On the fold-out page after the title page you will find the overviews “control elements and key functions” and “operating/settings diagrams”.
You will find it useful to open out the “control elements and key functions” overview as you read this instruction manual.

Key points in the text are indicated as follows:

- Enumerated points

▶ Hints

Working Guidelines:

NOTE

Guidelines are intended to make your work easier.

Safety Guidelines:

WARNING

Describes a potentially dangerous situation.
Could result in loss of life or serious injury if preventative measures are not taken.

CAUTION

Describes a potentially dangerous situation.
Could result in lesser injuries or damage to property if preventative measures are not taken.

IMPORTANT

Describes a potentially threatening situation.
Could result in damage to property if preventative measures are not taken.

The name plate affixed to the title page is identical to that on the gamma/ L pump supplied. This facilitates matching the correct operating instructions manual to the correct pump.

Please quote the identity code and the serial number, which you will find on the name plate, in any subsequent correspondence or when ordering spare parts. This will ensure accurate identification of the pump type and material version.

1 About This Pump

The pumps in the ProMinent® gamma/ L pump series are microprocessor controlled solenoid dosing pumps with the following special features:

- The feed rate can be displayed in l/h and/or gal/h (calibrated), or in strokes/min.
- The stroke rate is continuously adjustable and is displayed in the LCD display.
- Stroke rate adjustment is digitally accurate and is displayed in the LCD display.
- The rated pressure of the gamma/ L can be adapted to individual systems.
- Two pumps can be controlled in different ways via the same standard signal.
- Large, illuminated LCD display

The hydraulic parts of the gamma/ L are identical to those of the Beta®.

2 Safety

Correct use

The gamma/ L must be used for liquids only!
The gamma/ L may be used only in compliance with the technical data and specifications given in the operating instructions!
It is forbidden to use the gamma/ L for any other purpose, or to modify it in any way!
The gamma/ L is not suitable for dosing gases or solids!
The gamma/ L must be used by trained and authorised personnel only!
You must take notice of the information in the operating instructions concerning the various stages in the lifecycle of the device.

Safety Guidelines

WARNING

- **As soon as the gamma/ L is connected to the electricity supply it may commence pumping!**
  Avoid leakage of hazardous chemicals in this case!
  If this should occur, then press the STOP/START key or disconnect the gamma/ L from the power supply immediately!
- **The gamma/ L cannot be switched to a current-free status! In the event of an electrical accident, disconnect cable from the mains power supply!**
- **Disconnect cable from the mains power supply before commencing work on the gamma/ L!**
- **Always depressurise liquid end before commencing work on the gamma/ L!**
- **Empty and rinse out the liquid end before commencing work on the gamma/ L after use with hazardous or unknown chemicals!**
- **Pumps for radioactive materials may not be returned to ProMinent after use!**

CAUTION

- **It is not permitted to assemble and install ProMinent® dosing pumps with non-original parts unless these have been checked and recommended by ProMinent. It can result in harm to persons and property for which no liability will be accepted!**
- **When dosing aggressive materials, check the resistance of the pump materials (see ProMinent® resistance list in the product catalogue!)**
- **If another liquid end size is installed the pump must be reprogrammed on factory premises!**
- **Observe applicable national directives during installation!**

Sound intensity level

The sound intensity level is < 70 dB (A) at maximum stroke, maximum stroke rate, maximum back pressure (water) in accordance with:
DIN EN 12639 (Metering Pump Noise Measurement)

3 Storage, Transport and Unpacking

Transport and store the gamma/ L in the original packaging!

Protect the packed gamma/ L from moisture and the effects of chemicals!
Environmental conditions for storage and transport:
Storage and transport temperature: -10 bis +50 °C
Humidity: < 92 % relative humidity

Check that the delivery is complete:

Delivery range

- Dosing pump with mains lead
- Operating instructions manual with EU conformity declaration
- Accessories if applicablesecteur

4 Device Overview and Control elements

When reading this section it is helpful to fold out the overview “Control elements and key functions”!

4.1 Device overview

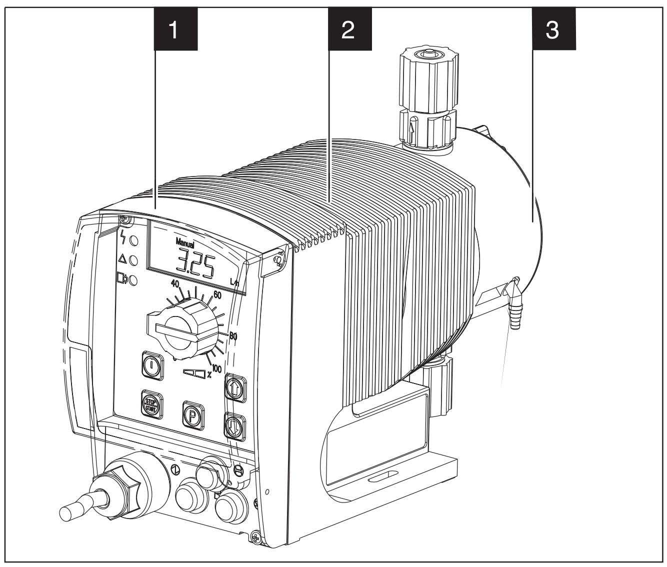


Fig. 01

1 Control unit
2 Power end
3 Liquid end

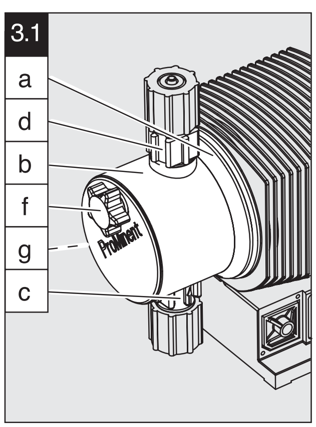


Fig. 02

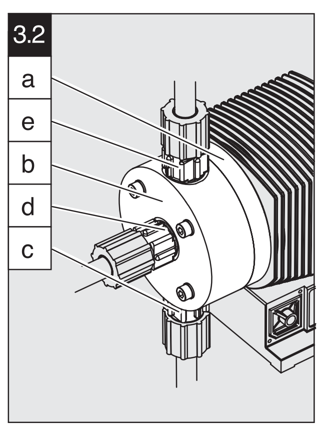


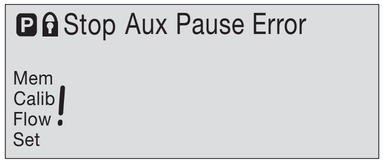
Fig. 03

a Backplate
b Liquid end
c Suction valve
d Discharge valve
e Bleed valve
f Coarse/fine bleed valve
g Bypass hose nozzle

4.2 Control elements

Please acquaint yourself with the gamma/ L control elements with the help of the “control elements and key functions” overview!

Indicators The LCD display supports the operation and setting of the gamma/ L with a range of indicators:



The indicators are interpreted as follows:

Symbol for P key:	The gamma/ L is in settings mode.
Close symbol:	In a continuous display: lock (if code has been set). In settings mode: indicates access to code menu.
Stop:	The gamma/ L has been stopped using the STOP/START key.
Aux:	The gamma/ L is pumping at the auxiliary frequency. In AUX menu: the gamma/ L is in the AUX menu.
Pause:	The gamma/ L has been stopped using the “pause” function (external).
Error:	A fault has occurred and the pump has been stopped.
Auto:	The gamma/ L is in “Auto” operating mode. Depending on the Identcode this means that the gamma/ L can be controlled using PROFIBUS® or the timer (as a comparison see the relevant supplementary instructions).
Mem:	An additional “memory” function has been set in the “contact” and “batch” operating modes. In CNTCT or BATCH menus (“mem” flashes): the memory function can be set
Calib:	The gamma/ L is in the CALIB menu. In a continuous display (“calib” flashes”): Deviation in stroke length of more than 10 degrees (e.g. a stroke length of 40 % when set at less than 30 % or greater than 50 %) from the value at the time of calibration.
Flow:	The gamma/ L is in the FLOW menu.
Set:	The gamma/ L is in the SET menu.
Command symbol:	The number of strokes reached is above the maximum value (99999) that can be shown in the LCD display

NOTE

The pump gamma/ L only displays the metering output in l or l/h or in gal or gal/h when calibrated.

5 Function Description

Function principle Dosing takes place as follows: the dosing diaphragm is forced into the liquid end; the pressure in the liquid end causes the suction valve to close and the chemical flows out of the liquid end through the discharge valve. The dosing diaphragm is then forced back out of the liquid end. The vacuum in the liquid end causes the discharge valve to close and fresh chemical flows into the suction valve in the liquid end. This concludes one operating cycle.

The dosing diaphragm is driven by an electronically controlled electrical solenoid.

Feed rate The feed rate is determined by the stroke length and the stroke rate.
The stroke length is set between 0 - 100 % using the stroke length adjusting knob.
Optimum dosing reproducibility is achieved by setting the stroke length to between 30 - 100 % (SEK type: 50 - 100 %)!
The stroke rate is set using the arrow keys (not in “analogue” operating mode) to between 0 - 180 strokes/min.

Self-bleed function Pumps with self-bleed function (= SEK types) can operate a prime action even when the discharge tubing is closed, discharging existing air through a bypass valve. These pumps can release gas even during operation, irrespective of the actual operating pressure.
An in-built pressure maintenance valve allows accurate dosing even in depressurised states.

Operating modes Operating modes are selected using the MODE menu (depending upon identity code, some operating modes may be absent).

“Analog” operating mode: (Identity code, control variant: analogue current)

The stroke rate is controlled via an analogue electrical signal via the “external control” terminal. Signal processing is pre-selected at the controller.

“Manual” operating mode: (Identity code, control variant: manual, standard function)

The stroke rate is controlled manually via the controller.

“Contact” operating mode:
(Identity code, control variant: external 1:1 / external with pulse control)

This operating mode offers the opportunity to make fine adjustments with small increase/ decrease factors. Dosing can be activated by a pulse via the “external control” terminal or by a semiconductor element. With the “pulse control” option it is possible to pre-set a feed quantity (batch) or number of strokes (factor 0.01 to 99.99) via the control unit.

“Batch” operating function:
(Identity code, control variant, external 1:1 / external with pulse control)

This operating mode offers the option of working with larger transfer factors (up to 65535). Metering can be triggered by pressing the P key or a pulse from the “external control” terminal via a contact or semiconductor element.
A batching quantity or number of strokes can be pre-selected via the control unit.

Operating mode “PROFIBUS®”: (Identcode, control variant: profibus®)

This operating mode offers the possibility to control the pump via PROFIBUS® (see “supplemental instructions for ProMinent gamma/ L and ProMinent Sigma versions with “PROFIBUS®”).

Functions The following functions can be selected using the SET menu:

“Calibrate” function:
The gamma/ L can be operated in all operating modes including in calibrating mode.
The corresponding continuous displays can show the actual feed quantity or the feed rate.
Calibration is maintained within the stroke frequency range 0 - 180 strokes/min.
Calibration is also maintained when a stroke frequency is altered up to ±10 %.

“Pressure level” function:
It is possible to set different pressure levels.

“Auxiliary frequency” function:
It is possible to set a stroke rate in the SET menu, which may be activated via the “external control” terminal. This auxiliary frequency overrides all other pre-set stroke rate frequencies.

“Flow” function:
Stops the gamma/ L when the flow is insufficient.
In the SET menu, the number of failed strokes is entered after which the pump will be turned off.

The following functions are available as standard:

“Float switch” function:
Information on the liquid level in the feed chemical container is transmitted to the gamma/ L. This option requires the installation of a 2-stage float switch. This is connected to the “float switch” terminal.

“Pause” function:
The gamma/ L can be stopped by remote control via the “external control” terminal.
The “pause” function operates only via the “external control” terminal.

The following functions are activated by keystrokes:

“Stop” function:
The gamma/ L can be stopped by pressing the STOP/START key without disconnecting from the mains power supply.

“Prime” function:
Priming (short term feed at maximum frequency) is activated by pressing both arrow keys at the same time (in “Stroke rate” permanent display).

Optional relay The gamma/ L has two connection options.de deux options :

“Fault indicating relay” option:
In the event of fault signals, warning signals or float switch activation signals, connects an electrical circuit to trigger alarm sirens etc. The relay is retrofitted via an aperture in the power end.

“Fault indicating and pacing relay” option:
Along with the fault indicating relay, the pacing relay produces a contact for every stroke.
The relay is retrofitted via an aperture in the power end.

Function and error indicators The operating and error status is shown via the three LEDs and the “error” indicator on the LCD (see also section 11):

LCD indicator If a fault occurs “error” will appear along with an additional fault warning.

LED indicator **Operating indicator (green)**
This indicator is lit as long as the gamma/ L is operating correctly.
It stops briefly with each stroke.

Warning indicator (yellow)
This warning light appears if the gamma/ L electronics detect a situation that could lead to a fault, e.g. “liquid levels low 1st stage”.

Warning indicator (red)
This warning light appears if a fault occurs, e.g. “liquid levels low 2nd stage”.

Hierarchy of operating modes, functions and fault statuses

The different operating modes, functions and fault statuses each have a differing effect on whether and how the gamma/ L functions. These effects are given below:

1. **Prime**
2. **Fault, stop, pause**
3. **Auxiliary frequency**
4. **Manual, analogue, contact, batch**

to:

1. “Prime” can take place in the permanent “Stoke rate” display in any pump mode (as long as it is operational).
2. “Fault”, “stop” and “pause” stop all system parts up to “prime”.
3. The stroke frequency of the “auxiliary frequency” always has precedence over the stroke frequency, which is set by an operating mode listed under 4.

6 Assembly and Installation

WARNING

- **Installation must be carried out by a trained engineer!**
- **Disconnect gamma/ L from mains power supply during installation!**
- **Risk of electric shock – This pump is supplied with a grounding conductor and grounding-type attachment plug. To reduce the risk of electric shock, be certain that it is connected only to a properly grounding-type receptacle.**
- **Observe applicable national directives when installing the dosing pumps!**
- **When connecting with parallel inductive power consumers a switch contact must be fitted, e.g. relay or contactor!**

IMPORTANT

The universal signal cable, the external/connecting cable and the liquid level monitoring cable should never be shortened to less than 1.20 m, otherwise the cable identification system will fail.

Connection to mains power supply

Connect the gamma/ L to the mains power supply using the mains lead

Parallel connection to inductive power consumers

If the gamma/ L is connected to the mains in parallel with inductive power consumers (e.g. solenoid valve, motor) they must be electrically isolated. This will avoid damage caused by induction and voltage surges when switching off.

▶ Fit individual contacts for the gamma/ L and supply power via auxiliary contactor or relay.

If this is not possible, then:

▶ Connect a varistor in parallel (order number 710912) or an RC circuit, 0.22 µF/220 Ω (order number 710802).

Power element (in base of pump)

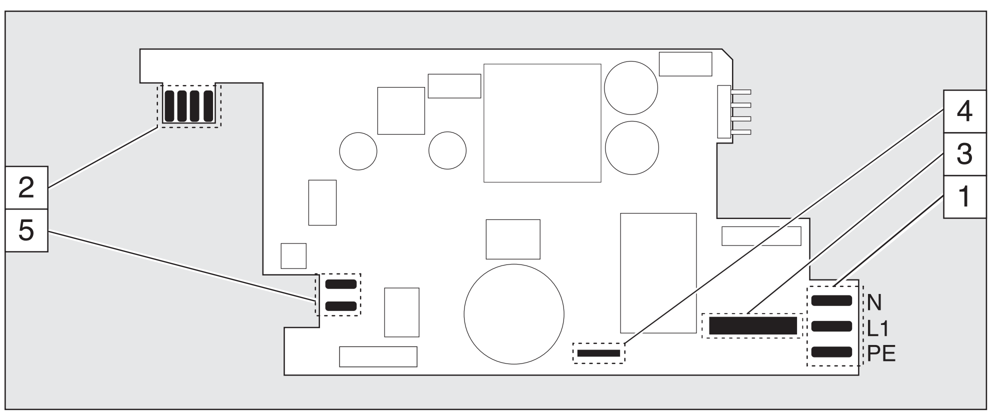


Fig. 04

1 Mains terminal
2 Relay circuit terminal
3 Fuse
4 Solenoid earth lead terminal
5 Solenoid terminal

"External control" terminal

The "external control" terminal is a five pin in-built terminal. It is compatible with the two and four core cables used previously.
The "auxiliary frequency" function is only available with a five core cable.

gamma/ L configuration

Electrical interface for “external contact” - “pause” - “auxiliary frequency”:

- tension contacts ouverts : env. 5 V
- Voltage when contacts open: approx. 5 V
- Input resistance: 10 kΩ
- Control: voltage free contact (load: 0.5 mA at 5 V),
  or: Semiconductor switch (residual voltage < 0.7 V)
- Maximum pulse frequency: 25 pulses/s
- Required pulse duration: ≥ 20 ms

Electrical interface for “external analogue”:

- Input load resistance: approx. 120 Ω
- Maximum current at input: 50 mA

gamma/ L configuration

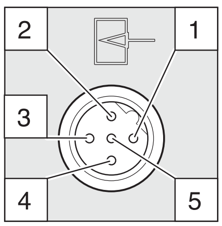


Fig. 05

Pin	Function	2 core cable	4 core cable	5 core cable
Pin 1	Pause	Jumped at pin 4	Brown	Brown
Pin 2	External contact	Brown	White	White
Pin 3	External analogue	–	Blue	Blue
Pin 4	Earth	White	Black	Black
Pin 5	Auxiliary frequency	–	–	Grey

Plug configuration

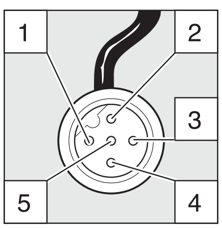


Fig. 06

“Pause” function

The gamma/ L is not operating when

- The cable is connected and pins 1 and 4 are free.

The gamma/ L is operating when

- The cable is connected and pins 1 and 4 are connected.
- There is no cable connected (pin 1 is free).

“Contact” and “Batch” operating modes

One or more discharge strokes are triggered when pin 2 and pin 4 are connected to one another for at least 20 ms.
Otherwise, pin 1 and pin 4 must be connected.

“Analogue” operating mode

The stroke frequency of the gamma/ L is controlled via an electrical signal. The electrical signal is applied between pins 3 and 4.
Otherwise, pin 1 and pin 4 must be connected.

“Auxiliary frequency” function

The gamma/ L runs at a pre-set stroke rate when pin 5 and pin 4 are connected to one another.
Otherwise, pin 1 and pin 4 must be connected.

The factory setting for this function is 180 strokes.

NOTE

For function and operating mode hierarchy, see section 5!

Connecting two gamma/ L pumps in series

Connect two gamma/ L pumps in series as follows if you wish to control both via **one** electrical signal in the “analog” operating mode (see section 7.4.2):

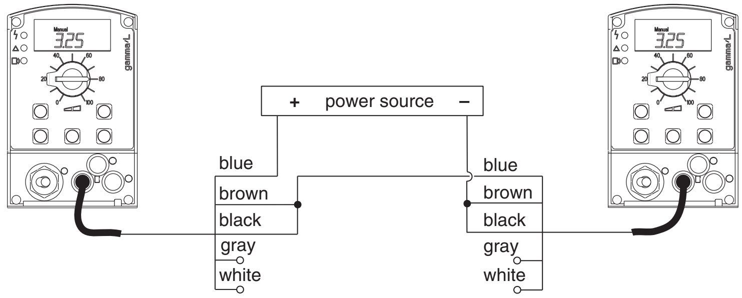


Fig. 07

“Float switch” terminal

Optional fitting of a 2-stage float switch with prior warning and limit switch capacity.

gamma/ L configuration

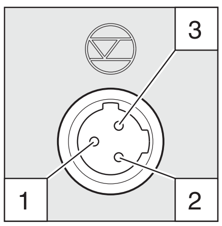


Fig. 08

Electrical interface:

- Voltage when contacts open: approx. +5 V
- Input resistance: 10 kΩ
- Controller: voltage free contact (load: 0.5 mA at + 5V),
  or: semiconductor switch (residual voltage < 0.7 V)

Plug configuration

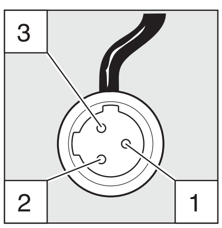


Fig. 09

Function		**3 core cable**
Pin 1	Earth	black
Pin 2	Minimum prior warning	blue
Pin 3	Minimum limit switch	brown

“Dosing monitor” terminal

Optional connection of dosing monitor.

gamma/ L configuration

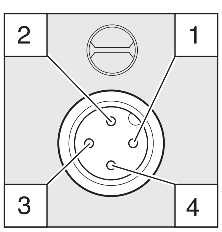


Fig. 10

Electrical interface:

- Voltage when contacts open: approx. +5 V
- Input resistance: 10 kΩ
- Controller: voltage free contact (load: 0.5 mA at +5 V)

Plug configuration

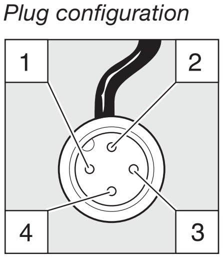


Fig. 11

Function		**4 core cable**
Pin 1	Power supply (5V)	brown
Pin 2	Encoding	white
Pin 3	Response	blue
Pin 4	Earth	black

Relay

"Fault indicating relay" output

A fault indicating relay may be ordered optionally. It is used as the signal output when a pump fault has been detected and to indicate the prior warning signal "liquid level low, stage 1" and the fault signal "liquid level low, stage 2".
Allocation of signal types to "N/O" and "N/C" relay states is selected on the basis of the identity code descriptors.
The relay can be retrofitted and is ready to operate after inserting the relay component (see section 6.2).

The gamma/ L is delivered ex works with default settings for a N/C relay. If an alternative switch function is required the gamma/ L can be reprogrammed at ProMinent.

Electrical interface

- Contact load: 250 V/2 A 50/60 Hz
- Operating life: > 200.000 switch cycles

"Fault indicating relay and pacing relay" output

A fault indicating relay and pacing relay output may be ordered optionally. The pacing relay output is electrically isolated via an optical coupler with a semiconductor switch. The second switch is a relay as for the "fault indicating relay" variant.
The fault indicating / pacing relay can be retrofitted (see section 6.2).

The gamma/ L is delivered ex works with default settings for a N/C fault indicating relay and a N/O pacing relay. If an alternative switch function is required the gamma/ L can be reprogrammed at ProMinent.

Electrical interface

For semiconductor switch

- Residual voltage: < 0,4 Volt at I_C = 1 mA
- Maximum voltage: < 100 mA
- Maximum current: 24 V/DC
- Pacing relay pulse duration: approx. 100 ms

For relay output

- Contact load: 24 V/100 mA 50/60 Hz
- Operating life: > 200.000 switch cycles

Relay cable contact configuration

"Fault indicating relay" option

VDE cable	CSA cable	Contact
white	white	NO (normally open)
green	red	NC (normally closed)
brown	black	C (common)

"Fault indicating relay and pacing relay" option

VDE cable	Contact	Relay
yellow	NO (normally open)	Fault indicating relay
green	C (common)	Fault indicating relay
white	NO (normally open)	Pacing relay
brown	C (common)	Pacing relay

6.1 Retrofitting relays

Delivery range:

1 relay circuit set with 2 screw fasteners
1 relay cable set with socket
1 seal

Press-out relay opening

WARNING

Disconnect gamma/ L from the mains power supply and rinse liquid end before commencing work (see section 12)!

IMPORTANT

When preparing the opening, ensure that the punch is not forced through the entire pump base!
Pump circuits may become damaged.

- Place the gamma/ L on a firm surface with the relay opening press-out section at the top (see fig. 12:a)
- Place a punch (dia. 8-15 mm) in the centre of the relay opening press-out section, and strike briefly and sharply with a hammer (approx. 250 g)
- If necessary clean up the edges of the opening
- Remove the pressed out section from the gamma/ L

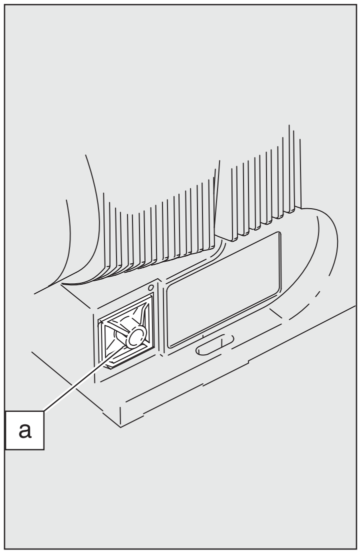


Fig. 12

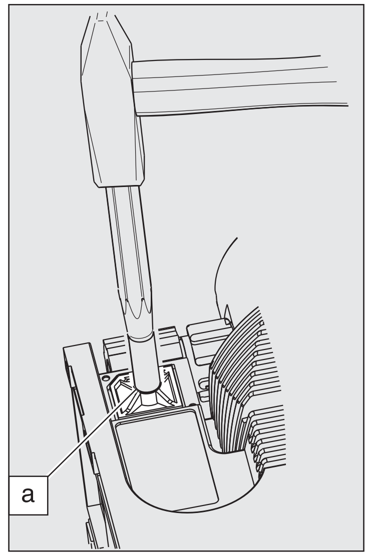


Fig. 13

Inserting the relay component

- Hold the relay component with your right hand gripping the left and right hand edges of the relay cover, and tilt the front end slightly to the left (see fig. 14)
- Push the relay component through the relay opening, holding the upper corner of the lower edge against the guide rail on the pump base, until the contact of the relay component has reached the controller contact. (See fig. 15: test: can you still move the end of the circuit back and forth?)
- Gently push the relay component right into the opening.
- Screw the relay cover firmly onto the housing using the screws provided.
- Insert the relay cable plug seal into the relay cover and screw on the plug (see fig. 16)

The gamma/ L is delivered ex works with default settings for a N/C fault indicating relay and a N/O pacing relay. If an alternative switch function is required the gamma/ L can be reprogrammed at ProMinent.

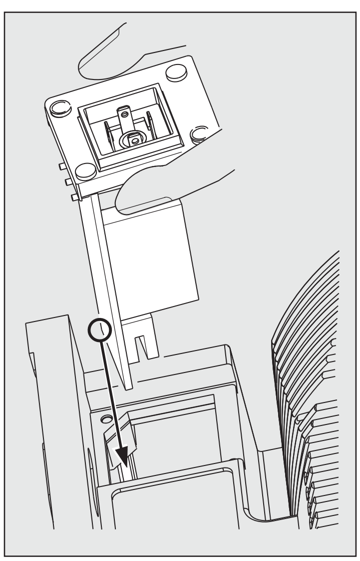


Fig. 14

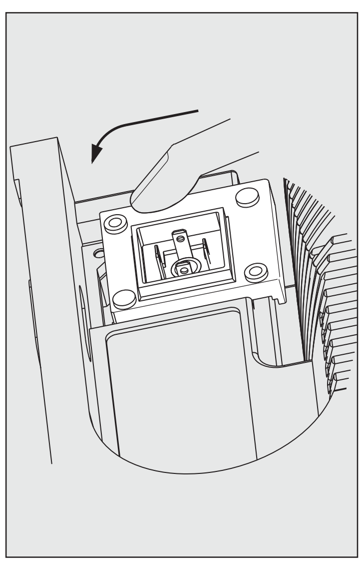


Fig. 15

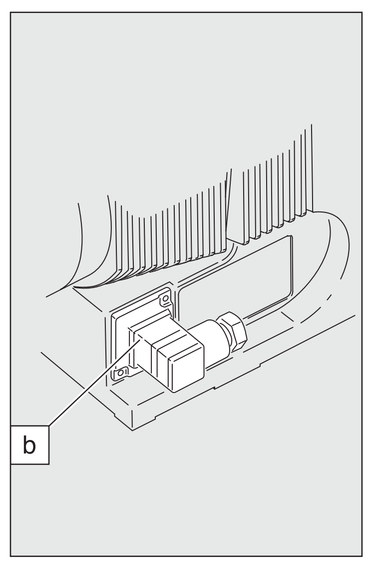


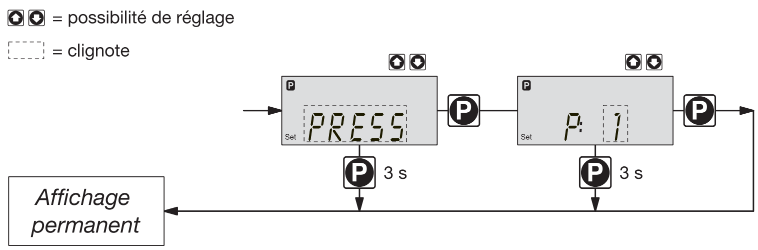
Fig. 16

7 Settings

NOTE

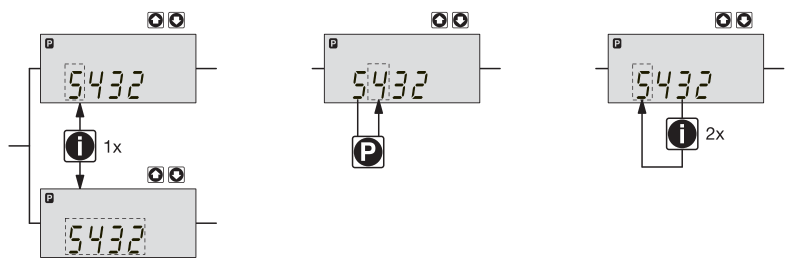
- **Open out the fold-out page following the title page fully! There you will find the overviews “control elements and key functions” and “operating/settings diagram”.**
- **If no keys are pressed within a period of 1 minute, the gamma/ L will return to a continuous display.**

Basic information for setting up the gamma/ L



Confirm entries Press the P key briefly;
you will automatically move to the next menu option or to a continuous display.

Exit menu option without confirming Press the P key for 3 s:
The entry is cancelled and you will return to a continuous display.



Incremental change Iof a value Press the i key 1x;
you can toggle between altering the digits of a value (“change individual digits” = standard) or incremental alteration of a value (“change a figure”).

Change adjustable values Press UP or DOWN arrow key;
The flashing digit or figure will start to increase or decrease incrementally.

Confirm adjustable values For “change individual digits”: confirm each digit using the P key. When the last digit has been confirmed you will automatically move to the next menu option or to a continuous display.

For “change a figure”; press the P key 1x; you will simultaneously move to the next menu option or to a continuous display.

Correct wrongly set digits Press the i key 2x;
you will go back to the first digit.

7.1 Check adjustable values

Before setting up the gamma/ L you can check the current settings of adjustable values.

Press the i key ("i" as in "info") when the gamma/ L is in continuous display mode
(There is no P key symbol in the LCD display):

Each time you press the i key you will see a different continuous display. The number of continuous displays depends upon the identcode, the selected operating mode and the connected accessories (see overview "continuous displays").

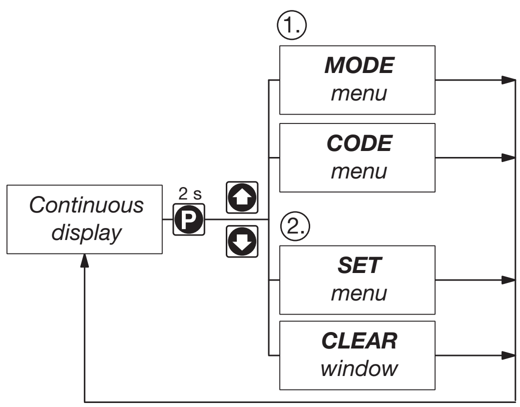
7.2 Change to settings mode

If you hold down the P key for 2 seconds in any continuous display, the gamma/ L will change to the settings mode.
If CODE 1 is set, the code must be entered after pressing the P key.

The following menu options appear first in the settings mode (see also overview "operating/ settings diagram"):

- MODE menu
- CODE menu (optional)
- SET menu
- CLEAR window

In order to adapt the gamma/ L to your process requirements you must:

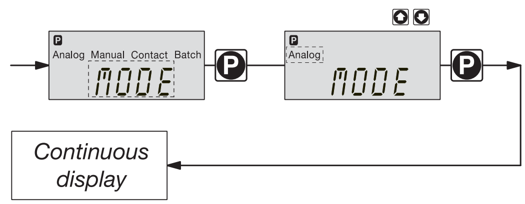


1. Select the operating mode in the MODE menu
2. Adjust settings to this operating mode in the SET menu

7.3 Select operating mode (MODE menu)

The following operating modes are selected via the MODE menu (depending upon identcode, some operating modes may be absent):

- Manual: for operation by hand
  (Identcode, control variant: manual, standard option)
- Analogue: for electronic control
  (Identcode, control variant: analogue current)
- Contact: for contact operation
  (Identcode, control variant: external 1:1 / external with pulse control)
- Batch: for batch operation
  (Identcode, control variant: external with pulse control)



7.4 Settings for operating mode (SET menu)

In the SET menu you can adjust various settings depending upon the selected operating mode.

The following programmable function settings menus appear in all operating modes:

- Calibrate (CALIB menu)
- Pressure levels (PRESS menu)
- Auxiliary frequency (AUX menu)
- Flow (FLOW menu, available only if flow monitor is connected)

See also section 7.5!

Further settings menus depend upon the selected operating mode.

7.4.1 Settings for “manual” operating mode

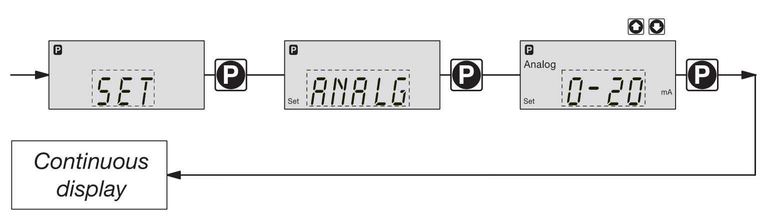
There are no other settings menus in the overall SET menu for the “manual” operating mode apart from those described in 7.5.

7.4.2 Settings for “analogue” operating mode (ANALG menu)

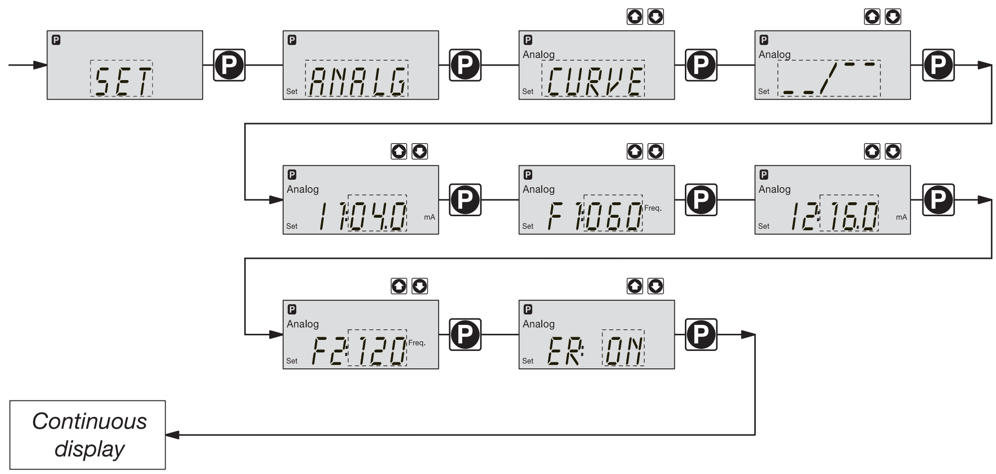
In addition to those settings menus described in 7.5, there is an additional ANALG menu in the overall SET menu for the “analogue” operating mode.

The stroke rate is controlled by an analogue electrical signal via the “external control” terminal.
You can select three signal-processing methods:

- 0 - 20 mA: at 0 mA the gamma/ L does not operate
  at 20 mA the gamma/ L operates at max. stroke rate
  Between these two extremes the stroke rate is proportional to the electrical signal.



- 4 - 20 mA: at 4 mA the gamma/ L does not operate
  at 20 mA the gamma/ L operates at max. stroke rate
  Between these two extremes the stroke rate is proportional to the electrical signal.
  For signals of below 3.8 mA a fault will be detected and the gamma/ L will stop (e.g. cable break).
- Curve: In the "curve" processing mode you can programme the gamma/ L ratios.
  There are 3 options available:
  - - - - - - = straight line
  - ¯¯_ _ = lower band
  - _ _/¯¯ = upper band



Straight line:

The following symbol appears in the LCD display: - - - - - .
You can enter any stroke frequency ratio for the gamma/ L in proportion to the electrical signal. You must enter two points P1 (I1, F1) and P2 (I2, F2). F1 is the stroke rate at which the pump should operate at current I1: the straight line and the ratio are fixed accordingly:

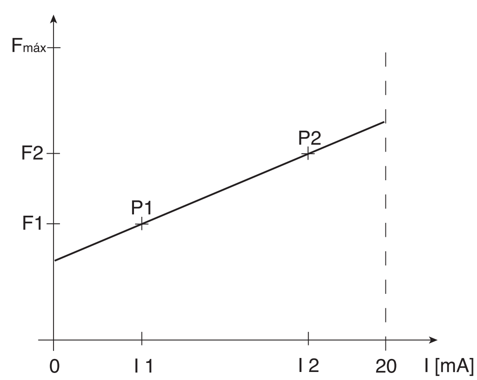


Fig. 17

NOTE

Draw a diagram like the one above - with values for (I1, F1) and (I2, F2) - in order to set the gamma/ L to your required stroke rate!

Lower/upper band:

This processing mode allows you to control a pump via an electrical signal as shown in the diagrams below.

You may also control two pumps for different feed chemicals from a single signal (e.g. one acid pump and one alkali pump from a pH sensor signal). The pumps must be connected electrically in series (see wiring plan in section 6.1).

Lower band

e.g. Alkali pump

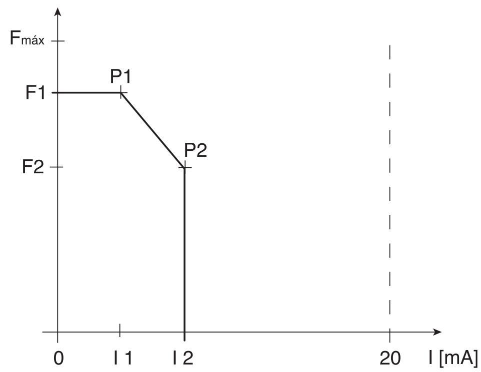


Fig. 18

Upper band

e.g. acid pump

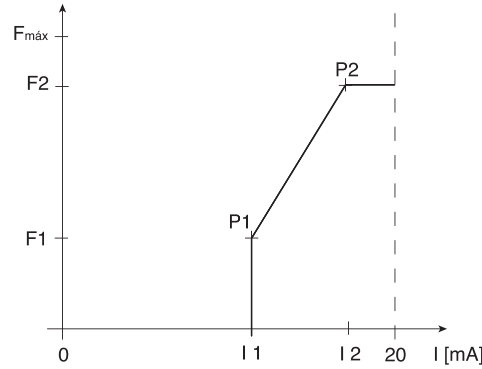


Fig. 19

Lower band:

The symbol ¯¯__ appears in the LCD display. The gamma/ L will operate below I1 at F1. Above I2, the gamma/ L ceases to operate. Between I1 and I2 the stroke rate is between F1 and F2, proportional to the signal current.

Upper band:

The signal __/¯¯ appears in the LCD display. The gamma/ L will cease to operate below I1. Above I2, the gamma/ L will operate at F2. Between I1 and I2 the stroke rate between is F1 and F2, proportional to the signal current.

The smallest processable difference between I1 and I2 is 4 mA.

Error processing In the “ER” (error) menu option you can activate an error processing function for the “curve” mode. An error message appears for signals below 3.8 mA and the gamma/ L stops.

7.4.3 Settings for “contact” operating mode (CONTCT menu)

In addition to those settings menus described in 7.5, there is an additional CONTCT in the overall SET menu for the “contact” operating mode.

The operating mode “contact” allows you to activate a single stroke or a series of strokes.
The strokes can be activated by a pulse or via the “external control” terminal. This operating mode is intended to transfer input pulses into a reduction (break) or small increase in strokes.

IMPORTANT

- **When switching to another operating mode the factor is reset to “1”.**
- **When switching from “Manual” to “Contact” operating mode, the gamma/ L maintains the stroke frequency.**
  The stroke frequency can also be adjusted in the “Contact” operating mode. It should normally be set at 180 strokes/min.

The following versions are available:

- Contact - identcode: external 1:1
- Contact - identcode: external with pulse control

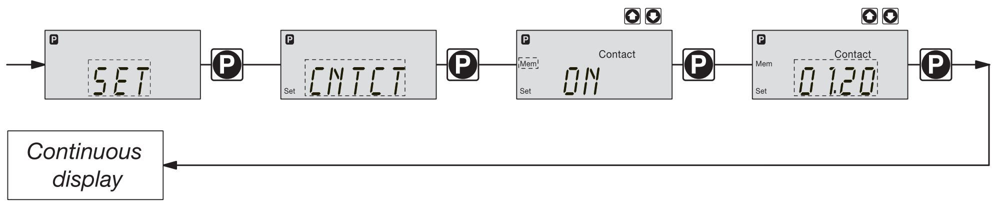
Contact – identcode: external 1:1

In the “contact - identcode: external 1:1” version the gamma/ L makes precisely 1 stroke per pulse (identcode: external 1:1).

No entry possible.

Contact – identcode: external with pulse control

In the “contact - identcode: external with external pulse control” you can enter the number of pulses after which a stroke should be carried out. “Contact - identcode: external with external pulse control” is intended for small dosing quantities.



The number of strokes per pulse depends upon the factor, which you can enter. This allows you to vary to a certain extent the input pulses by a factor of 1.01 to 99.99 and/or reduce by a factor of 0.01 to 0.99:
“Number of strokes activated = factor x number of input pulses”

Examples

	Factor	Pulse (sequential)	Stroke number (sequential)
Increase	1	1	1
	2	1	2
	25	1	25
	99.99	1	99.99
	1.50	1	1.5 (1 / 2)
	1.25	1	1.25 (1 / 1 / 1 / 2)
Reduction	1	1	1
	0.50	2	1
	0.10	10	1
	0.01	100	1
	0.25	4	1
	0.40	2.5 (3 / 2)	(1 / 1)
	0.75	1.33 (2 / 1 / 1)	(1 / 1 / 1)

Explanation of increase

At a factor of 1 — For every 1 pulse, 1 stroke is activated
At a factor of 2 — For every 1 pulse, 2 strokes are activated
At a factor of 25 — For every 1 pulse, 25 strokes are activated

Explanation of decrease

At a factor of 1 — After 1 pulse, 1 stroke is activated
At a factor of 0.5 — After 2 pulses, 1 stroke is activated
At a factor of 0.1 — After 10 pulses, 1 stroke is activated
At a factor of 0.75 — After 2 pulses, 1 stroke is activated, then after 1 pulse, 1 stroke is activated, then after 2 pulses, 1 stroke is activated etc.

NOTE

If a remainder occurs when the factor is processed, the gamma/ L counts up the remainder values. When the sum reaches or exceeds “1” the gamma/ L will activate a stroke. This ensures that the stroke number corresponds exactly to the factor throughout the dosing operation.

The number of input pulses which have not been processed are stored by the gamma/ L in the stroke memory. When the STOP/START key is pressed or the “pause” function is activated, the stroke memory is deleted (this can be avoided using the “memory” extension function, see below).

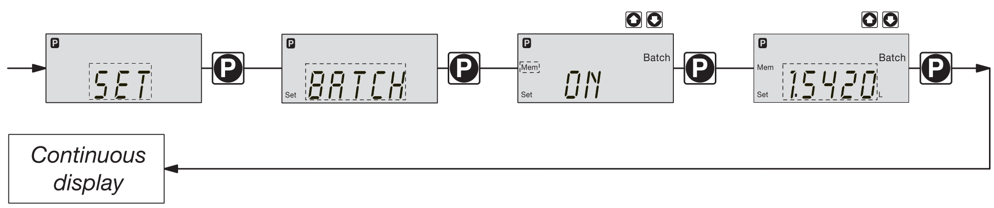
The “contact - identcode: external with pulse control” version allows optimum adaptation of the gamma/ L, in conjunction with e.g. water contact meters, to any process.

“Memory” extension function

The “memory” extension function can be optionally activated (“mem” appears in the LCD display). When “Memory“ is activated, the gamma/ L adds up the unused excess strokes, up to the stroke memory’s maximum capacity of 65535 strokes. If the maximum capacity is exceeded the pump will malfunction.

7.4.4 Settings for “batch” operating mode (BATCH menu)

In addition to those settings menus described in 7.5, there is an additional BATCH menu in the overall SET menu for the “batch” operating mode.



The “batch” operating mode is a variant of the “contact” operating mode (see 7.4.3).
You can pre-select a stroke number (no breaks, whole numbers only from 1 to 65535) as well as a feed quantity (batch). To switch between entries for “stroke number” and “feed quantity” press the i key 1x in the corresponding menu option (see also overview “operating/settings diagram”, fold-out page).
The “batch” operating mode is intended for large dosing quantities.

Metering is activated by pressing the P key or via a pulse from the "external control" terminal.

The number of input pulses which have not been processed are stored by the gamma/ L in the stroke memory. The stroke memory is limited to the batch size if “Memory“ is not activated (with “Memory“ this is 65535 strokes). You can clear it by changing to a different operating mode.

CAUTION

- **When switching from “Manual” to “Batch” operating mode, the gamma/ L maintains the stroke frequency.**
  The stroke frequency can also be adjusted in the “Batch” operating mode. It should normally be set at 180 strokes/min.

“Memory” extension function

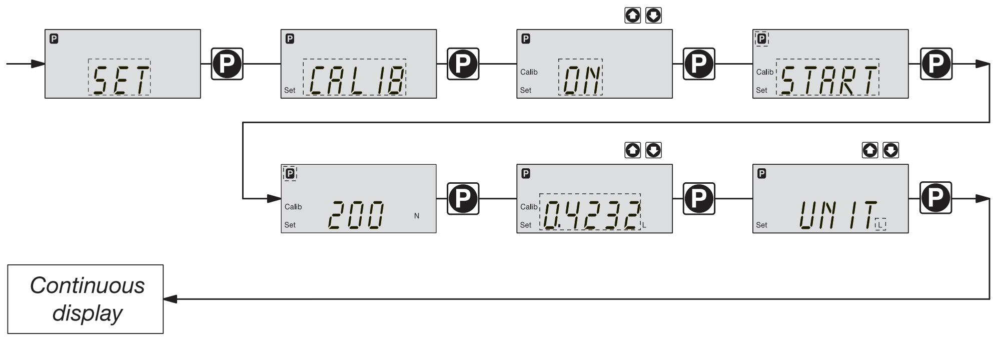
The “memory” extension function can be optionally activated (“mem” appears in the LCD display). When “Memory“ is activated, the gamma/ L adds up the unused excess strokes, up to the stroke memory’s maximum capacity of 65535 strokes. If the maximum capacity is exceeded the pump will malfunction.

7.5 Settings for programmable functions (SET menu)

The following programmable function settings menus appear in all operating modes:

- Calibrate (CALIB menu)
- Pressure levels (PRESS menu)
- Auxiliary frequency (AUX menu)
- Flow (FLOW menu, available only if flow monitor is connected)

7.5.1 Settings for “calibration” function (CALIB menu)



The gamma/ L can also run in calibration mode. The corresponding continuous displays show the current dosing quantities or the feed rate.

Calibration is maintained when a stroke rate is altered up to ±10 degrees (where the stroke length is set at 40 %, the range is 30-50 %). If the stroke rate is altered more than ±10 degrees the yellow warning light is lit, the continuous display flashes and the flashing message “calib” appears.

NOTE

- **Do not go below 30 % stroke length (SEK type: 50 %).**
  This will significantly affect accuracy of calibration.
- **Calibration becomes increasingly accurate the more strokes made by the gamma/ L during calibration (recommended: at least 200 strokes).**

WARNING

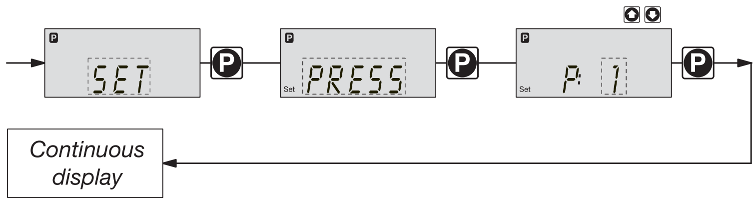
If using a hazardous feed chemical, the following setting instructions ensure adequate safety precautions have been taken!

Calibration

▶ Insert the suction tube into a measuring cylinder containing the feed chemical - the discharge tubing must also be correctly installed (operating pressure, …!)
▶ Suck up the feed chemical (press both arrow keys at the same time) when the suction tube is empty
▶ Note the liquid level in the measuring cylinder and the stroke length
▶ Select the CALIB menu and go to the first menu option using the P key
▶ Select “ON” using an arrow key and change to the next menu option using the P key
▶ To commence calibration, press the P key. The gamma/ L starts to pump and displays the number of strokes (“STOP” appears at regular intervals) (the gamma/ L works at the stroke frequency set under “MANUAL“).
▶ After a sufficient number of strokes, stop the gamma/ L with the P key
▶ Calculate the dosed quantity (difference between the original quantity and the quantity remaining)
▶ Enter this quantity in the next menu and then go to the next menu option using the P key
▶ Select the unit (“L” or “gal”) in the “UNIT” menu with an arrow key

The gamma/ L is calibrated.
The corresponding continuous displays show the calibrated values.
The total stroke number and total litres are set during calibration to “0”.
The gamma/ L is in the STOP state.

7.5.2 Settings for the “pressure levels” function (PRESS menu)



The programmable function “pressure levels” is used to reduce the rated pressure of the gamma/ L.

CAUTION
- **The rated pressure can be considerably exceeded at stroke lengths of below 100 %! The rated pressure relates to a stroke length of 100 %.**
- **If another liquid end size is installed the pump must be reprogrammed on factory premises!**
- **Select as large a rated pressure as required and as small as possible!**
  This will increase system safety (reduces the risk of the tubing bursting when blocked)!
  This also protects the diaphragm and saves electricity.

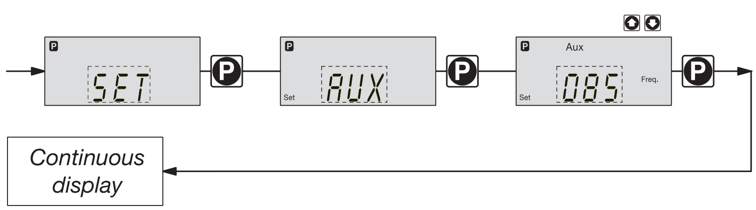
NOTE
If installing another liquid end size the pump must be reprogrammed on factory premises.

The following rated pressures can be selected for these liquid end sizes (rated pressure in bar):

Liquid end size	Pressure level 1	Pressure level 2	Pressure level 3	Pressure level 4
1601, 1602, 1605	4	7	10	16
1000, 1005, 1008	4	7	10	
0708, 0713	4	7		

No adjustments can be made for pump types 0413, 0420, 0220, 0232.

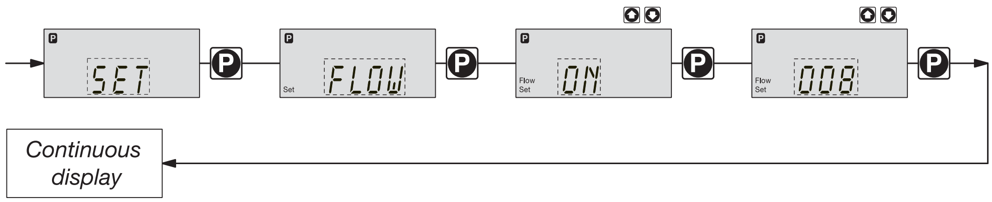
7.5.3 Settings for “auxiliary frequency” function (AUX menu)



The programmable function “auxiliary frequency” allows switching to a different stroke frequency, which can be set in the AUX menu. It can be activated via the “external control” terminal. When the auxiliary frequency is activated, “aux” appears in the LCD display.

This auxiliary frequency overrides the current stroke frequency set for the selected operating mode.

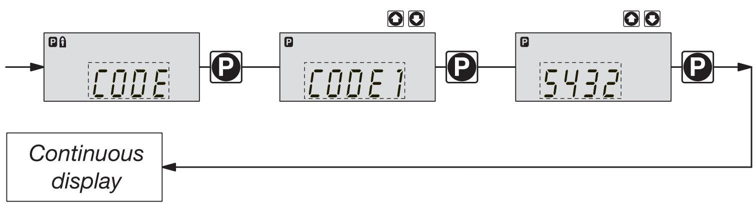
7.5.4 Settings for the “flow” function (FLOW menu)



The flow menu only appears when a dosing monitor is connected to the “dosing monitor” terminal. This dosing monitor registers each discharge stroke of the gamma/ L at the discharge connector and transmits it back to the gamma/ L. If this response transmission is serially omitted for a period set in the FLOW menu (due to failure or below-minimum dosing) the gamma/ L stops.

7.6 Setting code (CODE menu)

The code menu is used to select whether you want to prevent access to parts of the settings options.



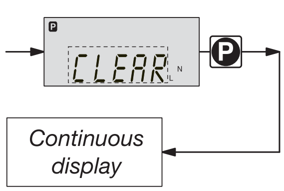
In the first menu option you can choose CODE 1 or CODE 2 (both use the same number).

- Select CODE 1 to prevent access to the settings mode (① in the overview “operating/ settings diagram”, fold-out page). In the next menu option, enter the number you wish to use as the code.
- Select CODE 2 to prevent access to the settings options for directly alterable values in the continuous displays (② in the overview “operating/settings diagram”, fold-out page). In the next menu option, enter the number you wish to use as the code.
- Select NONE to remove a pre-set security lock.

7.7 Cancel total stroke number or total litres (CLEAR window)

In the CLEAR window you can delete the stored total stroke number and simultaneously the total litres (= set to “0”). You may then press the P key briefly to exit this window.

The values displayed are counted incrementally from the point of commissioning the pump, or from the last delete action.



8 Operating

This section describes all operating options available to you when the gamma/ L is in continuous display mode (no P key symbol in the LCD display).

NOTE

- **Open out the fold-out page following the title page fully! There you will find the overviews “control elements and key functions” and “operating/settings diagram”.**
- **Look at the overview “continuous displays”. This page shows you which displays are available in which operating mode, and which values are directly alterable in the corresponding continuous displays.**

8.1 Manual operation

Set stroke length Stroke length is continually adjustable within a range of 0 - 100 %.
The recommended stroke length range, which will practically guarantee technical reproducibility, is 30 - 100 % (SEK type: 50 - 100 %).

The following operating options are available via the different keys
(see also figure on the next page):

Stop/Start gamma/ L To stop gamma/ L: press STOP/START key.
To start gamma/ L: press STOP/START key.

Start batch Press the P key briefly in “batch” operating mode.

Load factory settings Press the P key for 15 s only if you wish to load factory calibration settings!
Current settings will be deleted.

Change to settings mode When you press the P key for 2 s in any continuous display the gamma/ L will change to settings mode (see section 7).
If CODE 1 is set, the code must be entered after pressing the P key.

Check adjustable values Each time you press the i key you will see a different continuous display.
The number of continuous displays depends upon the identity code, the selected operating mode and the connected accessories.

Change directly alterable values To change a value (see below) directly in the corresponding continuous display, press one of the arrow keys until “set” appears in the LCD display. The delay has been programmed in to prevent inadvertent changing of values.
If CODE 2 has been set, this code must be entered after pressing the arrow key.

Directly alterable values are as follows:

Stroke rate In “manual”, “contact” and “batch” operating modes:
The stroke rate can be altered in the “stroke rate” display.

Feed rate In “manual” operating mode
The feed rate can be altered in the “feed rate” display.

Factor The factor is the number of strokes activated by an external pulse or a press of the P key (in “batch” mode only).

In “batch” operating mode:

You can alter the factor from the “remaining strokes” display.

The gamma/ L returns to the original continuous display a few seconds after the factor has been reset.

Batch size In “batch” operating mode:
The batch size can by changed from the “batch size/remaining litres” display.
The gamma/ L returns to the original continuous display a few seconds after the batch size has been reset.

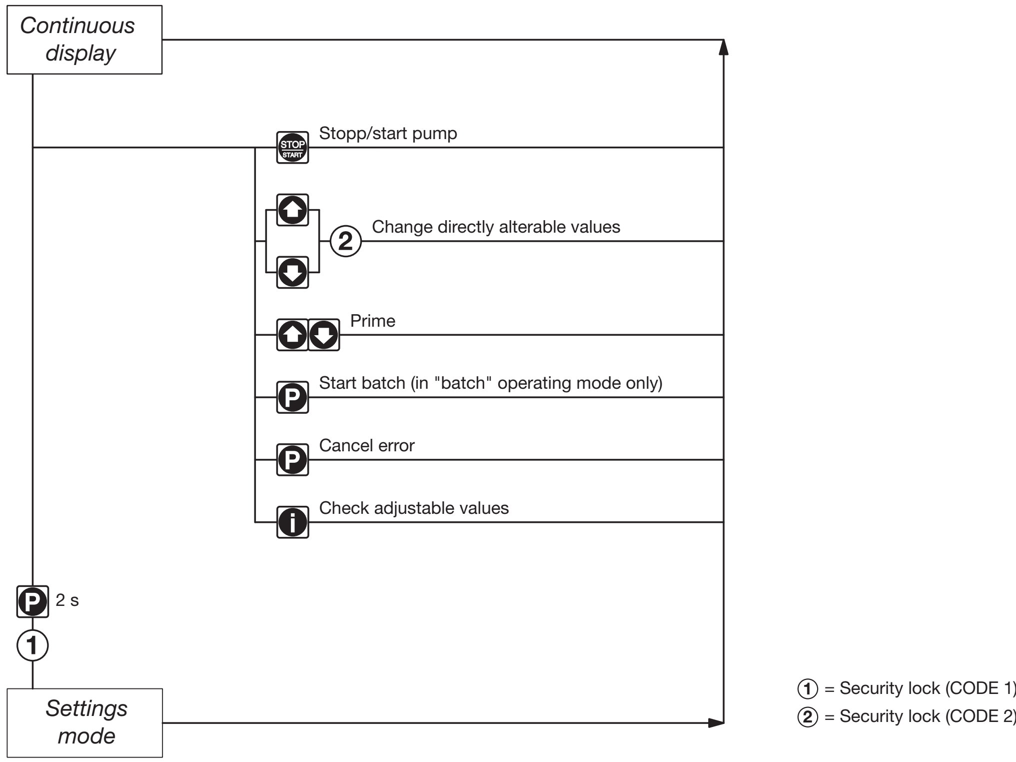
Priming The “priming” function is activated by pressing both arrow keys at the same time in “Stroke rate” permanent display.

Cancel error Error messages are cancelled by pressing the P key briefly.

Display programme versions Press on the P key for 10 seconds to display the programme versions.

Example: “V 1052“ + X 1010“.

Release the key on “LOAD 3“ immediately.



8.2 Remote control

It is possible to control the gamma/ L remotely via a signal cable or Profibus® (see section 6.1 and section 7, “Supplementary Instructions for ProMinent® gamma/ L and ProMinent® Sigma versions with Profibus®” and plant documentation).

9 Maintenance

Maintenance intervals

- Every quarter, when subject to normal usage (continuous operation - approx. 30 %)
- Shorter intervals when subject to heavier usage (e.g. continuous operation)

Maintenance actions

Standard liquid ends:

▶ Check the diaphragm for damage (see section 10)

▶ Check chemical seepage at vent hole

▶ Check that the discharge tubing is connected firmly to the liquid end

▶ Check that discharge and suction valves are firmly fixed

▶ Check that the liquid end is generally watertight (especially vent hole! See fig. 20)

▶ Check for correct feed: run the gamma/ L run for a short period (press both arrow keys together)

▶ Check electrical connections for wear

▶ Check that liquid end screws are fastened tightly (on coarse/fine bleeding versions, first remove knob and cover)

Screw fastening torque: 4,5 to 5 Nm

NOTE

- **For PP liquid end, check fastening torque every quarter!**

Additionally, for liquid ends with coarse/fine bleed function and SEK type:

- **Check that the bypass tubing is connected firmly to the liquid end**
- **Check that the bleed valve is firmly fixed in place**
- **Examine the discharge and bypass tubing for kinks**
- **Check that the coarse/fine bleed function is working correctly**

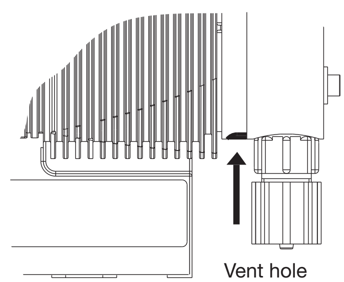


Fig. 20

10 Repairs

NOTE

Repair work may be carried out by authorised personnel only, or on factory premises:

- **Replacement of damaged mains cables**
- **Replacement of fuses and electronic controller.**

Only send the equipment for repair or maintenance in a cleaned condition and with the liquid end flushed. However, should any safety precautions be necessary even after careful draining and cleaning of the equipment, the required information must be listed in the Safety Declaration!

The Safety Declaration forms part of the inspection/repair contract.

Maintenance or repair work will only be carried out if a Safety Declaration - correctly and fully completed by an authorised and qualified member of the Operator’s staff - is available.

A copy of the form is included in the “General operating instructions ProMinent solenoid metering pumps” or can be downloaded at www.prominent.com.

WARNING

Pumps used for radioactive materials cannot be returned to ProMinent after use! They will not be accepted by ProMinent!

Repairs: These should only be carried out by qualified personnel (in accordance with Safety section):

- Cleaning the valve
- Changing the diaphragm

WARNING

- **Always take suitable precautions when using hazardous chemicals!**
- **Ensure equipment is de-pressurised**

NOTE

Take the explosion drawings annexed t the help.

Cleaning the discharge valve (PP, NP, PV) for types 1000, 1005, 1605, 1601, 1602

NOTE

- **Discharge and suction valves are different! Dismantle one after the other to avoid confusion.**
- **Only use new parts, which fit your valve (in shape and chemical resistance)!**
- **The pump must be reset after replacing a valve.**
- **Insert an Allen key or similar into the smaller hole of the pressure connector and push out the valve inserts.**

Cleaning the sucction valve (PP, NP, PV) for types 1000, 1005, 1605, 1601, 1602

Dismantling, cleaning and reassembly of the suction valve is practically the same as for a discharge valve.

Notice however that:

- both valve inserts are actually identical
- an additional spacer is found under the valve inserts
- in the liquid end a shaped seal is used instead of an O-ring
- the flow direction of the suction connection is reversed as for the pressure connector.

Cleaning the discharge valve (PP, NP, PV) for types 0708, 1008, 0220, 0420, 0413, 0713, 0232

NOTE

- **Discharge and suction valves are different! Dismantle one after the other to avoid confusion!**
- **Only use new parts, which fit your valve (in shape and chemical resistance)!**
- **The pump must be reset after replacing a valve.**
- **Insert an Allen key or similar into the smaller hole of the pressure connector and push out the valve inserts.**

Cleaning the suction valve (PP, NP, PV) for types 0708, 1008, 0220, 0420, 0413, 0713, 0232

Dismantling, cleaning and reassembly of the suction valve is practically the same as for a discharge valve.

Notice however that:

- an additional spacer is found under the valve inserts
- in the liquid end the O-ring is used, not the shaped seal
- the flow direction of the suction connection is reversed as for the pressure connector.

Change diaphragm

WARNING
- **Always take suitable precautions when using hazardous chemicals!**
- **Ensure that the equipment is de-pressurised!**

▶ Empty the liquid end (turn the unit upside down and let the feed chemical run out, rinse with a suitable material: rinse the liquid end thoroughly after use with hazardous materials!).

▶ When gamma/ L is running set the stroke length to 0 % (the drive axis is then set).

▶ Switch off the gamma/ L.

▶ Unscrew the hydraulic connectors from the discharge and suction side.

▶ For versions with coarse/fine bleed function: firstly pull out the coarse/fine bleed (knob), then lift off the cover from the liquid end using a screwdriver.

▶ Remove the screws (1).

For pump types 0220, 0232 and 0420 see the following page (4 holes on the diaphragm rim)!

Supply unit types, except 0220, 0232 and 0420

▶ Loosen the liquid end (2) and the top plate (4) from the pump housing (6) (loosen only!).
▶ Hold the housing (6) in one hand and with the other, clamp the diaphragm (3) between the liquid end (2) and the top plate (4); release the diaphragm (3) from the drive spindle with a light anticlockwise turn of the liquid end (2) and top plate (4).
▶ Unscrew the diaphragm (3) completely from the drive spindle.
▶ Remove the top plate (4) from the housing (6).
▶ Check the condition of the safety diaphragm (5) and replace if necessary.
▶ Push the safety diaphragm (5) only as far onto the drive axis until it lies flat on the pump housing (6) – no further!
▶ Screw the new diaphragm (3) carefully up to the stop on the drive axis – this must be exact to ensure correct metering!
▶ Screw the diaphragm (3) tight once more.
▶ Position the top plate (4) on the pump housing (6).

IMPORTANT
- **The leakage hole must point downwards when the pump is fully assembled (see fig. 20).**
- **Position the top plate (4) correctly on the pump housing (6). Do not distort the top plate on the pump housing, otherwise the safety diaphragm (5) will not fit.**

▶ Lay the diaphragm (3) into the top plate (4).
▶ Hold the top plate (4) and screw the diaphragm (3) in a clockwise direction until it is firmly in position (you will feel the resistance of the return spring).

IMPORTANT
- **Do not overtighten the diaphragm (3) (particularly on type 1601).**
- **The top plate (4) must remain in position to prevent the safety diaphragm (5) from distorting.**

▶ Place the liquid end (2) with the screws (1) on the diaphragm (3) and the top plate (4) (the priming connector must point downwards once the pump is fully assembled).
▶ Screw on screws (1) lightly and tighten (starting torque, see below).
▶ For versions with coarse/fine bleed function, ensure that the liquid end cover engages in the liquid end, then push the coarse/fine bleed vent (knob) into the liquid end.

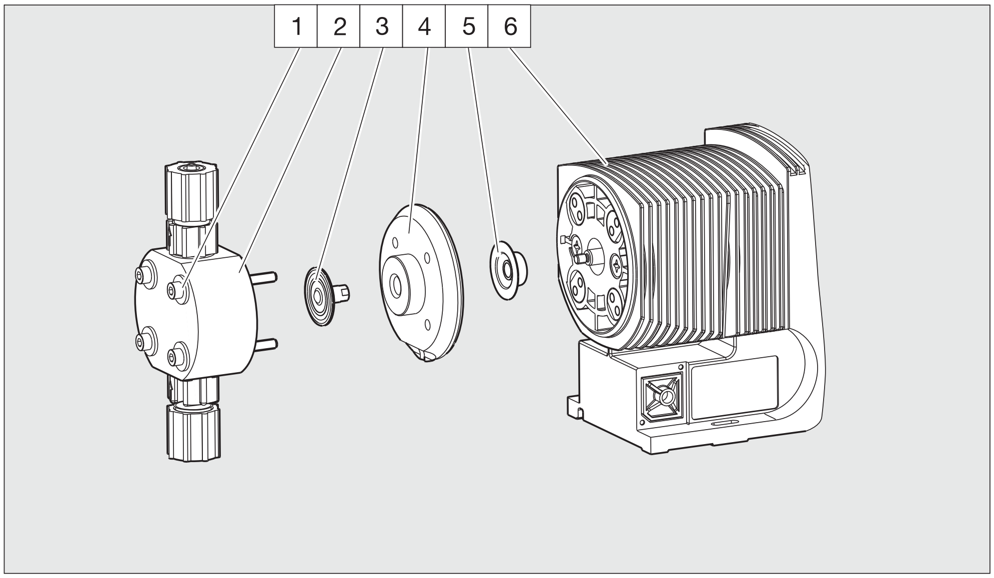


Fig. 21

1 Screws	4 Top plate
2 Liquid end	5 Safety diaphragm
3 Diaphragm	6 Pump housing

NOTE

- **Check the screw torques after 24 hours in operation**
- **For PP liquid ends check the screw torques again after three months.**

Screw torques: 4,5 to 5 Nm

Liquid ends - types 0220, 0232 and 0420

- ▶ Remove the metering head (2) with the screw (1) from the pump (see fig. 22).
- ▶ Only type 0232: Remove the screws of the set disk (4) below the diaphragm (3).
- ▶ The screws (1) should fit in the holes of the diaphragm (3), but not on the set disk.
- ▶ Hold the housing (6) in one hand and with the other hand, clamp the diaphragm (3) between the liquid end (2) and the top plate (4); release the diaphragm (3) from the drive spindle with a light anti-clockwise turn of the liquid end (2) and top plate (4).
- ▶ Remove the liquid end (2) with screws (1) from of the diaphragm and unscrew completely from the drive spindle.
- ▶ Remove the top plate (4) from the housing (6).
- ▶ Check the condition of the safety diaphragm (5) and replace it necessary.
- ▶ Push the safety diaphragm (5) only as far onto the drive axis until it lies flat on the pump housing (6) – no further!
- ▶ Screw the new diaphragm (3) carefully up to the stop on the drive axis – this must be exact to ensure correct metering!
- ▶ Check that the holes in the diaphragm are aligned with those in the pump housing.
- ▶ If not, start the pump and set the stroke length to 100 %.
- ▶ When the pump is running, turn the diaphragm (3) slowly in a clockwise direction until the four holes in the diaphragm are flush with those on the pump housing (6).
- ▶ Hold the diaphragm (3) in this position, set the stroke length to 0 % and stop the pump.
- ▶ Screw the diaphragm (3) tight once more.
- ▶ Position the top plate (4) on the pump housing (6).
- ▶ Only type 0232: Mount the set disk (4) with the screws.

IMPORTANT
- **The leakage hole must point downwards when the pump is fully assembled (see fig. 20).**
- **Position the top plate (4) correctly on the pump housing (6). Do not distort the top plate on the pump housing, otherwise the safety diaphragm (5) will not fit.**

▶ Lay the diaphragm (3) into the top plate (4).

▶ Hold the top plate and screw the diaphragm (3) in a clockwise direction until it is firmly in position (you will feel the resistance of the return spring).

IMPORTANT
- **Do not overtighten the diaphragm (3).**
- **The top plate (4) must remain in position to prevent the safety diaphragm (5) from distorting.**

▶ Position the liquid end (2) with the screws (1) on the diaphragm (3) and the top plate (4) (the priming connector must point downwards once the pump is fully assembled).

▶ Screw on screws (1) lightly and tighten (starting torque, see above).

▶ For coarse/fine bleed versions: ensure the liquid end cover engages in the liquid end, then push the coarse/fine bleed (knob) into the liquid end.

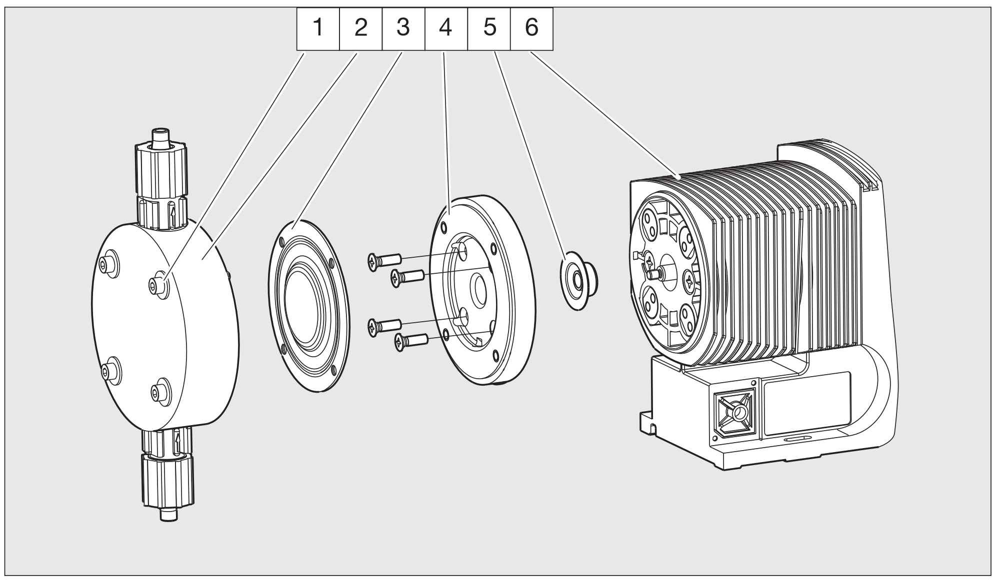


Fig. 22

1 Screws	4 Top plate
2 Liquid end	5 Safety diaphragm
3 Diaphragm	6 Pump housing

NOTE
- **Check the screw torque after 24 hours in operation!**
- **For PP liquid ends recheck the screw torque after three months!**

11 Troubleshooting

WARNING

- **Always take suitable precautions when using hazardous chemicals!**
- **Ensure the equipment is de-pressurised before working on the pump!**

gamma/ L does not prime despite full stroke and bleed function

Cause Crystalline deposits on the ball seat because valves have dried out

Remedy
- ▶ Remove the suction sleeve from the chemical supply container and rinse out the liquid end thoroughly
- ▶ If still unsuccessful, dismantle valves and clean (see section 9)

Fluid is seeping from the top plate

Cause The liquid end is not sealed against the pump diaphragm

Remedy
- ▶ Tighten screws in the liquid end (see section 9)
- ▶ If unsuccessful, replace the diaphragm (see section 10)

Green LED indicator (operating display) is not lit

Cause Incorrect or no mains voltage

Remedy
- ▶ Use the recommended mains voltage as given in the voltage specification on the nameplate

Error Messages

Red LED display is lit, "Error" appears and "MINIM" flashes in the display

Cause Fluid level in the chemical storage tank has reached "liquid level low, stage 2"

Remedy
- ▶ Fill the chemical supply container

Red LED display is lit, "Error" appears and "ANALG" flashes in the display

Cause gamma/ L is in "analogue" operating mode, a fault routine has been programmed in the ANALG menu and the operating current has fallen below 3.8 mA

Remedy
- ▶ Remedy low operating current
- ▶ Switch fault routine "OFF" (see Section 7.4.2.)

Red LED display is lit, "Error" appears and "CNTCT" flashes in the display

Cause gamma/ L is in "contact" or "batch" operating mode and the extended function "memory" has been set.
In addition a very large factor has been entered, too many contacts have been input or the P-key has been pressed too often, resulting in an overflow of the stroke memory.

Remedy
- ▶ Press the P-key, saved data will be deleted
- ▶ Change gamma/ L set up

Red LED display is lit, "Error" appears and "FLOW" flashes in the display

Cause Dosing monitor not properly connected

Remedy
- ▶ Connect dosing monitor properly
- ▶ Press P-key

Cause Dosing monitor has reported more defective strokes than have been set in the FLOW menu

Remedy
- ▶ Press P-key
- ▶ Investigate the cause and remedy

Red LED display is lit, "Error" appears and "Mem" flashes in the display

Cause Stroke memory full

Remedy
- ▶ Remove cause
- ▶ Press P-key (Consider the consequences this will have on your process)

Fault Signals

Yellow LED display is lit

Cause Liquid level in chemical storage tank has reached “liquid level low, stage 1”

Remedy ▶ Fill chemical storage tank

Yellow LED Display is lit and “calib” flashes

Cause The pump is calibrated and the stroke length deviates by more than ±10 % from the value at the time of calibration.

Remedy ▶ Reset the stroke length or calibrate the pump again to the desired stroke length

All other Errors

Please contact your ProMinent branch or representative!

12 Decommissioning and Disposal

Decommissioning

WARNING

- **When decommissioning the gamma/ L the housing and, in particular, the liquid end must be thoroughly cleaned to remove chemicals and dirt!**
- **Always take suitable precautions when using hazardous chemicals!**
- **Ensure that the equipment is de-pressurised!**

▶ Disconnect the gamma/ L from the power supply

▶ Empty the liquid end by turning the gamma/ L upside down and allow the feed chemical to pour out

▶ Rinse the liquid end with a suitable material, thoroughly rinse the liquid end after use with hazardous materials!

If decommissioning is only temporary, maintain the correct storage conditions:

Storage temperature:	-10 to +50 °C
Air humidity:	< 92 % relative humidity

Disposal

IMPORTANT

Electronic waste is classified as special waste!

Please observe all locally applicable directives!

13 Technical Data

13.1 Performance data and weights

gamma/ L at 180 strokes/minute and 100 % stroke length

Liquid end type	Max. feed rate at maximum operating pressure			max. feed rate at medium operating pressure			Connector size outer Ø x inner Ø	Suction-lift*	Priming-lift**	Admmis. priming pressure	Ship. Wt[1]
	bar	l/h	ml/str.	bar	l/h	ml/str.	mm	m Wg	m Wg	bar	approx. kg
1000	10	0.74	0.09	5	0.82	0.076	6x4	6	1.8	8	2.9 / 3.6
1601	16	1.1	0.10	8	1.4	0.13	6x4	6	2	8	2.9 / 3.6
1602	16	2.1	0.19	8	2.5	0.24	6x4	6	2	5.5	2.9 / 3.6
1005	10	4.4	0.41	5	5.0	0.46	8x5****	5	3	3	3.1 / 4.5
0708	7	7.1	0.66	3.5	8.4	0.78	8x5	6	2	2	3.1 / 4.5
0413	4	12.3	1.14	2	14.2	1.31	8x5	3	2	1.5	3.1 / 4.5
0220	2	19.0	1.76	1	20.9	1.94	12x9	2	2	1	3.1 / 4.5
1605	16	4.1	0.38	8	4.9	0.45	8x5****	4	3	3	4.5 / 5.9
1008	10	6.8	0.63	5	8.3	0.76	8x5	3	3	2	4.5 / 5.9
0713	7	11.0	1.02	3.5	13.1	1.21	8x5	3	3	1.5	4.5 / 5.9
0420	4	17.1	1.58	2	19.1	1.77	12x9	3	3	1	5.5 / 8.6
0232	2	32.0	2.96	1	36.2	3.35	12x9	2	2	0.8	5.5 / 8.6

gamma/ L with self-degassing liquid end *** at 180 strokes/minute and 100 % stroke length

Liquid end type	Max. feed rate at maximum operating pressure			max. feed rate at medium operating pressure			Connector size outer Ø x inner Ø	Suction-lift*	Priming-lift**	Admmis. priming pressure	Ship. Wt[1]
	bar	l/h	ml/str.	bar	l/h	ml/str.	mm	m Wg	m Wg	bar	approx. kg
1601	16	0.59	0.055	8	0.78	0.072	6x4	–	1.8	0.5	2.9
1602	16	1.4	0.13	8	1.74	0.16	6x4	–	2.1	0.5	2.9
1005	10	3.6	0.33	5	4.0	0.37	8x5	–	2.7	0.5	3.1
0708	7	6.6	0.61	3.5	7.5	0.69	8x5	–	2	0.5	3.1
0413	4	10.8	1.00	2	12.6	1.17	8x5	–	2.5	0.5	3.1
0220	2	16.3	0.31	8	3.8	0.35	8x5	–	3.0	0.5	4.5
1008	10	6.3	0.58	5	7.5	0.69	8x5	–	3.0	0.5	4.5
0713	7	10.5	0.97	3.5	12.3	1.14	8x5	–	2.5	0.5	4.5
0420	4	15.6	1.44	2	17.4	1.61	12x9	–	2.5	0.5	4.5

* Lift when suction line and liquid end are full

** Priming lift with clean and wetted valves, priming lift at 100% stroke length and free flow or opened bleed valve

*** The feed rate values are for minimum feed rates, based on water at 20° C

**** For material versions SST : 6 x 4 mm

[1] For material versions PPE, PPB, NPE, NPB, PVT, TTT/SST

[2] For material versions PPE, PPB, NPE, NPB

13.2 Dosing reproducibility

Standard Liquid ends

Dosing precision -5 to +10 % at max. stroke length and max. operating pressure for all materials.

Reproducibility ±2 % at constant conditions and minimum 30 % stroke length.

Self-degassing liquid ends

Since self-degassing liquid ends are filled with air bubbles when in contact with gaseous chemicals and when in operation, no dosing reproducibility values can be given.
The recommended minimum stroke length with self-degassing liquid ends is 50 %.

13.3 Viscosity

The liquid ends are designed for liquids up to a maximum viscosity of

- 200 mPas for standard liquid ends
- 500 mPas for valves with springs
- 50 mPas for self-degassing liquid ends

13.4 Materials Data Liquid ends

Version	Liquid end	Valves	Seals	Balls
PPE	PP	PP	EPDM	Ceramic
PPB	PP	PP	FPM	Ceramic
NPE	Acrylic glass	PVC	EPDM	Ceramic
NPE	Acrylic glass	PVC	FPM	Ceramic
PVT	PVDF	PTFE with carbon	PTFE	Ceramic
TTT	PTFE with carbon	PTFE with carbon	PTFE	Ceramic
SST	Stainless steel 1.4571	Stainless steel 1.4571	PTFE	Ceramic

FPM = Fluorine Rubber

Pump

Housing	Polyphenylene ether (PPE with glass fibre)
Cover	Polycarbonate
Electronics	Electronic components

13.5 Electrical Data

Version: 100 - 230 V ±10 %, 50/60 Hz

Varants 100 - 230 V/AC	gamma/ L M70	gamma/ L M85
Power rating	17 W	22 W
Rated current	0.7 A	1 A
Switch on peak current	15 A (for approx. 1 ms)	15 A (for approx. 1 ms)
Fuse	0.8 AT	0.8 AT

Note Fuses must display VDE, UL and CSA certification, e.g. type 19195 from Wickmann in accordance with IEC publication 127 - 2/3

13.6 Ambient conditions

Temperatures

Storage and transport temperatures: -10 to +50 °C
Feed chemical temperature: -10 to +35 °C
Ambient temperature when in operation: -10 to +45 °C (drive and control)

Maximum ambient temperatures for liquid ends depending on material type:

max. ambient temperature	PPE, PPB	NPE, NPB	PVT	TTT	SST
Long-term at max. operating pressure	50 °C	45 °C	50 °C	50 °C	50 °C
Short term (max. 15 min) at max. 2 bar	100 °C	60 °C	120 °C	120 °C	120 °C

* Under extreme conditions such as maximum dosing temperatures, maximum stroke frequency and maximum operating pressure, leakage can occur on the liquid end at an ambient temperature of 35 °C.

Climate

Permissible air humidity: 92 % relative humidity, not condensing
Moist and fluctuating air conditions: FW 24 in accordance with DIN 50016

13.7 Enclosure rating and safety class

Enclosure Rating

Contact and moisture enclosure rating:
IP 65 in accordance with IEC 529, EN 60529, DIN VDE 0470 Part 1

Safety Requirements

Safety Class 1 - Mains connection with earth lead

13.8 Compatibility

The hydraulic parts of the gamma/ L are identical to those of the Beta®.
The following components and accessories for pumps from the product ranges Beta®, CONCEPT, gamma-Classic and gamma are all compatible:

- gamma/Vario signal cable; 2-, 4- and 5 core for “external” function
- 2 stage float switch (gamma/Vario)
- Discharge tubing diameters
- Standard gamma connector set
- gamma wall bracket
- Chemical feed containers and mounting plates
- Total height (distance between suction and discharge connector)
- Distance between the connectors and locating holes on the pumps
- Accessories such as pressure back pressure valve, multifunctional valve, dosing monitor and rinsing equipment

PPE, PPB material versions

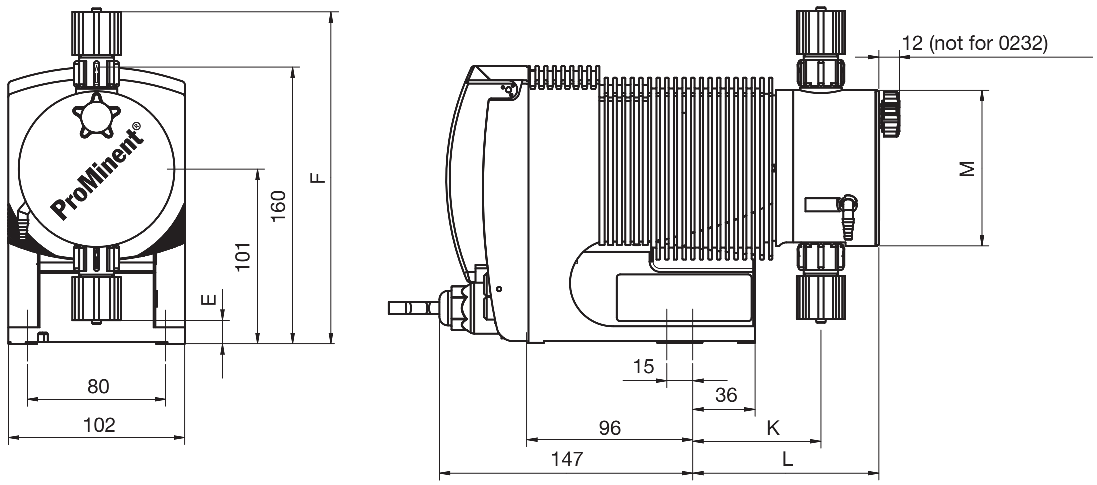


Fig. 23

Dimensions in mm

	gamma/ L M70 1000 - 1602	1005	0708 - 0413	0220	gamma/ L M85 1605	1008 - 0713	0420	0232
E	23	13	15	15	13	15	15	5
F	186	193	191	191	193	191	191	197
K	71	71	74	76	71	74	76	76
L	106	105	108	110	105	108	110	91
M	Ø 70	Ø 90	Ø 90	Ø 90	Ø 90	Ø 90	Ø 90	Ø 110

NPE, NPB material versions (non bleed)

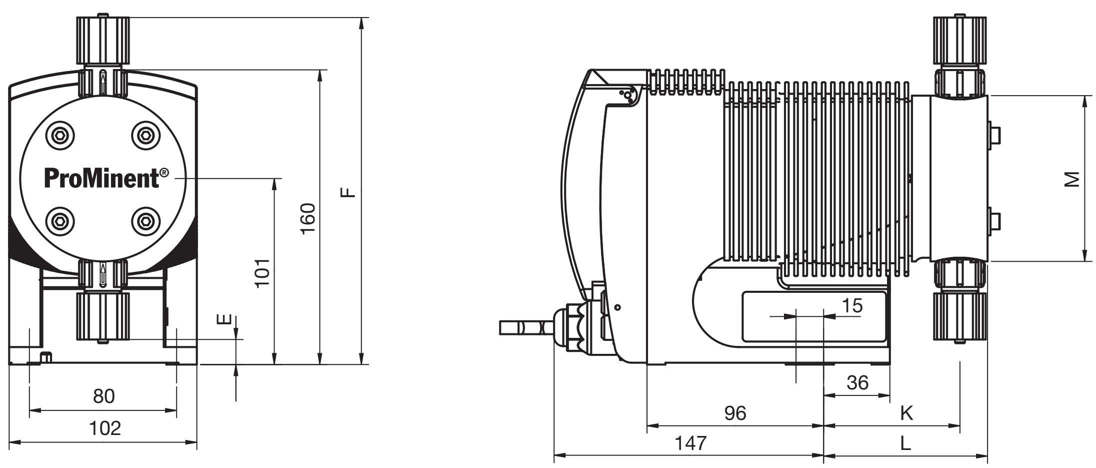


Fig. 24

Dimensions in mm

	gamma/ L M70 1000 - 1601	1602	1005	0708	0413 - 0220	gamma/ L M85 1605	1008 - 0713	0420	0232
E	25	23	16	15	15	16	15	15	5
F	177	179	188	189	189	188	189	189	199
K	77	77	74	74	76	74	74	76	76
L	92	92	89	89	91	89	89	91	91
M	62 (Ø 70)	66 (Ø 70)	Ø 90	Ø 90	Ø 90	Ø 90	Ø 90	Ø 90	Ø 110

NPE, NPB material versions (with bleed function)

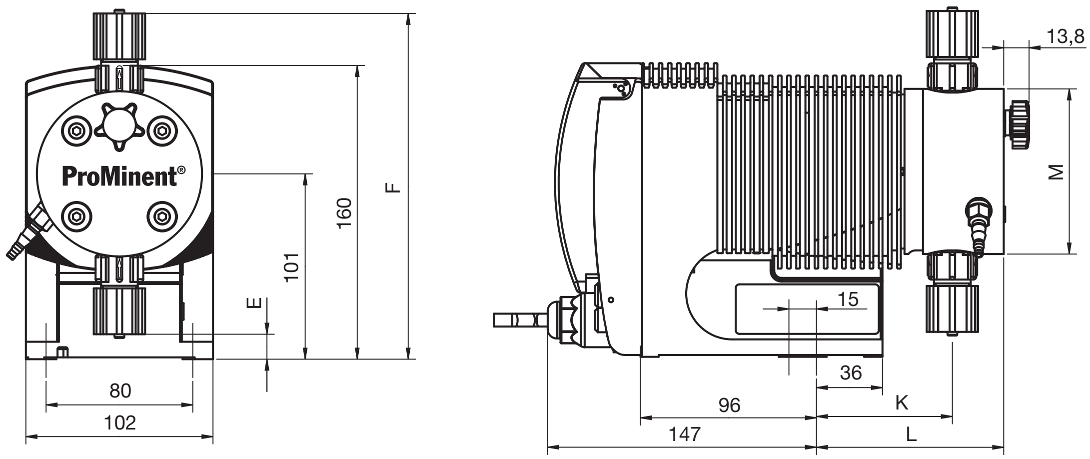


Fig. 25

Dimensions in mm

	gamma/ L M70 1000 - 1601	1602	1005	0708	0413 - 0220	gamma/ L M85 1605	1008	0713 - 0420	0232
E	25	23	16	13	15	16	13	15	5
F	177	179	188	189	189	188	189	189	199
K	77	77	74	74	76	74	74	76	76
L	105	105	102	102	104	102	102	104	105
M	62 (Ø 70)	66 (Ø 70)	Ø 90	Ø 90	Ø 90	Ø 90	Ø 90	Ø 90	Ø 110

PPE, PPB, NPE, NPB, SEK material versions

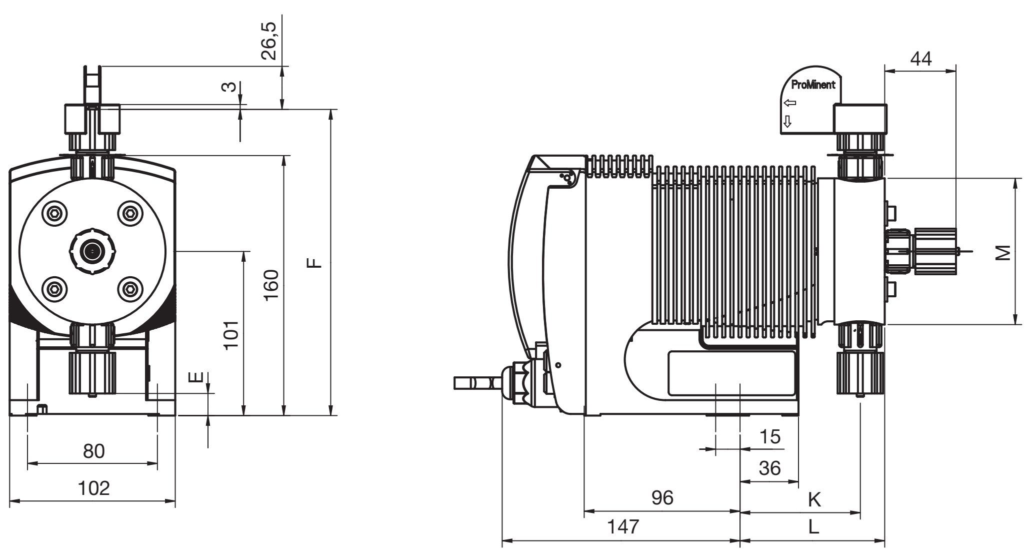


Fig. 26

Dimensions in mm

	gamma/ L M70 1601	1602	1005	0708	0413 - 0220	gamma/ L M85 1605	1008 - 0713	0420
E	25	23	16	15	15	16	15	15
F	177	179	188	189	189	188	189	189
K	77	77	74	74	76	74	74	76
L	92	92	89	89	91	89	89	91
M	62 (Ø 60)	66 (Ø 70)	Ø 90	Ø 90	Ø 90	Ø 90	Ø 90	Ø 90

PVDF material version

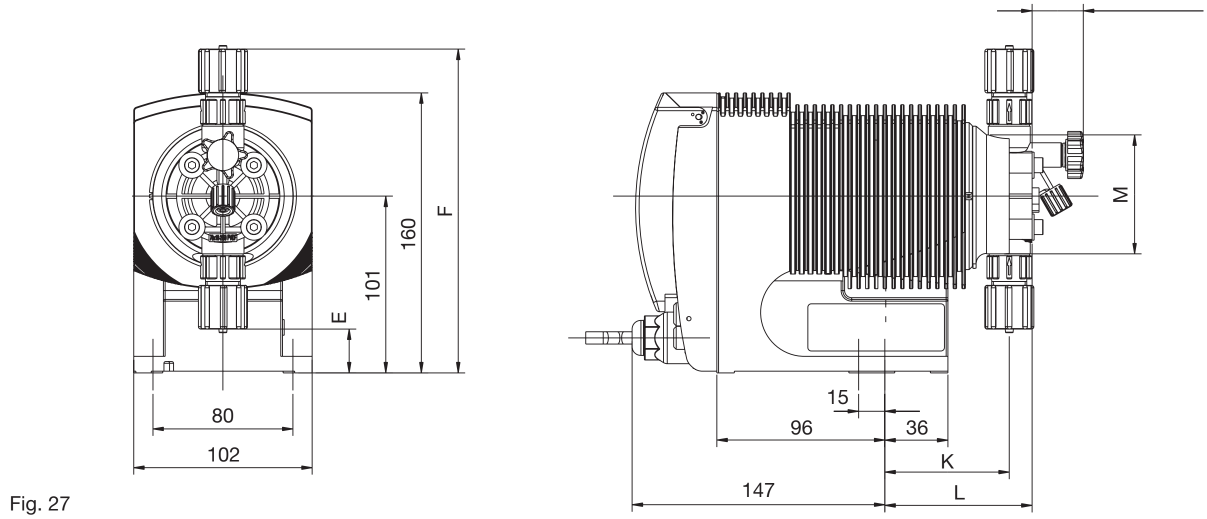


Fig. 27

Dimensions in mm

	gamma/ L M70 1000-1602	1005	0708-0413	0220	gamma/ L M85 1605	0408-0713	0420	0232
E	25	14	14	14	14	14	14	4
F	185	191	191	191	191	191	191	198
K	71	71	73	75	71	73	75	76
L	84	88	90	92	88	90	92	93
M	Ø 70	Ø 90	Ø 90	Ø 90	Ø 90	Ø 90	Ø 90	Ø 110

TTT material version

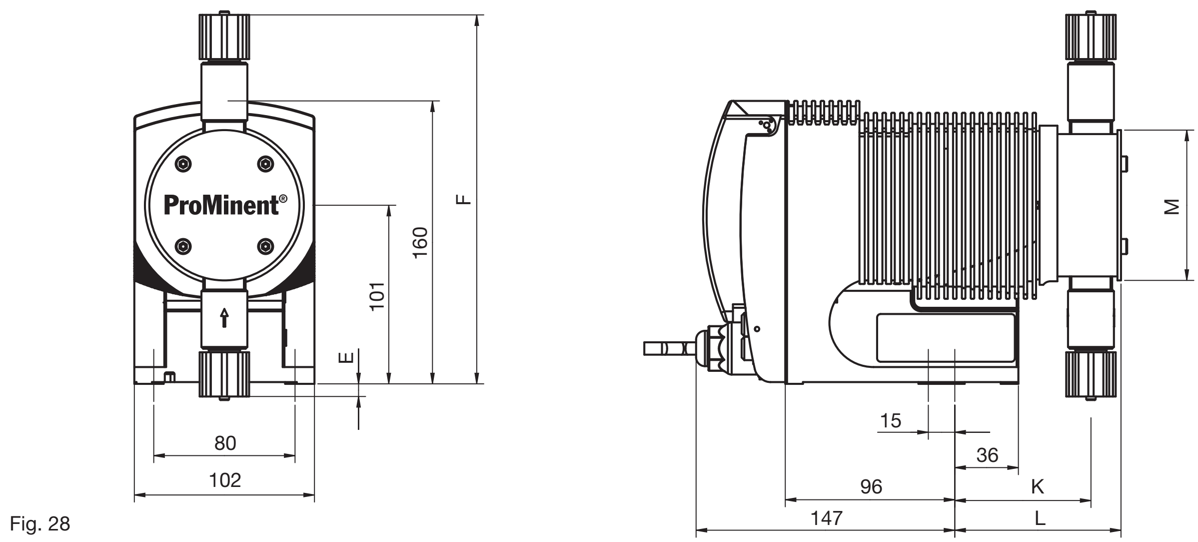


Fig. 28

Dimensions in mm

	gamma/ L M70 1000 - 1601	1602	1005	0708 - 0220	gamma/ L M85 1605	1008 - 0420	0232
E	32	25	23	-7	23	-7	-15
F	170	178	179	209	179	209	217
K	78	72	75	77	75	77	78
L	91	87	90	95	90	95	97
M	51 (Ø 60)	66 (Ø 70)	68 (Ø 80)	81 (Ø 85)	68 (Ø 80)	81 (Ø 85)	96 (Ø 100)

SST material version

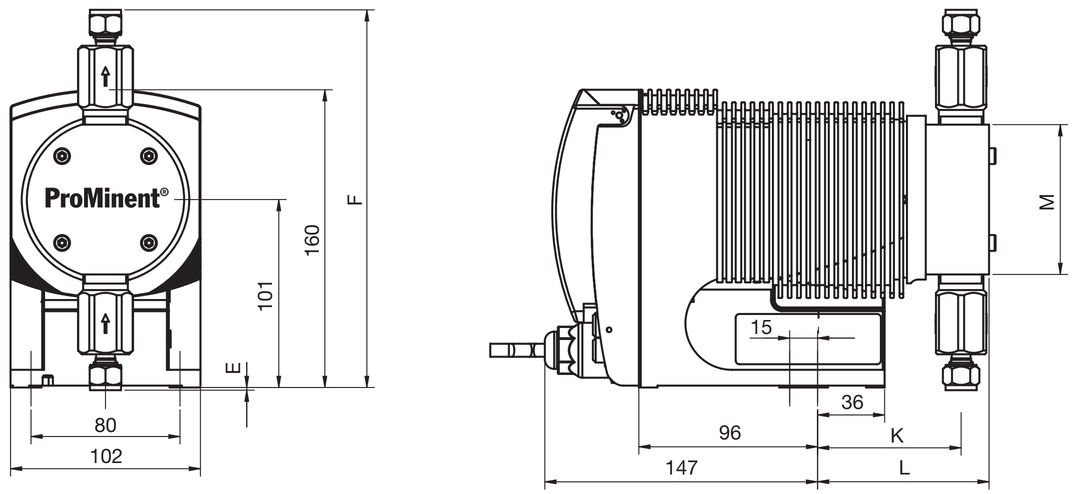
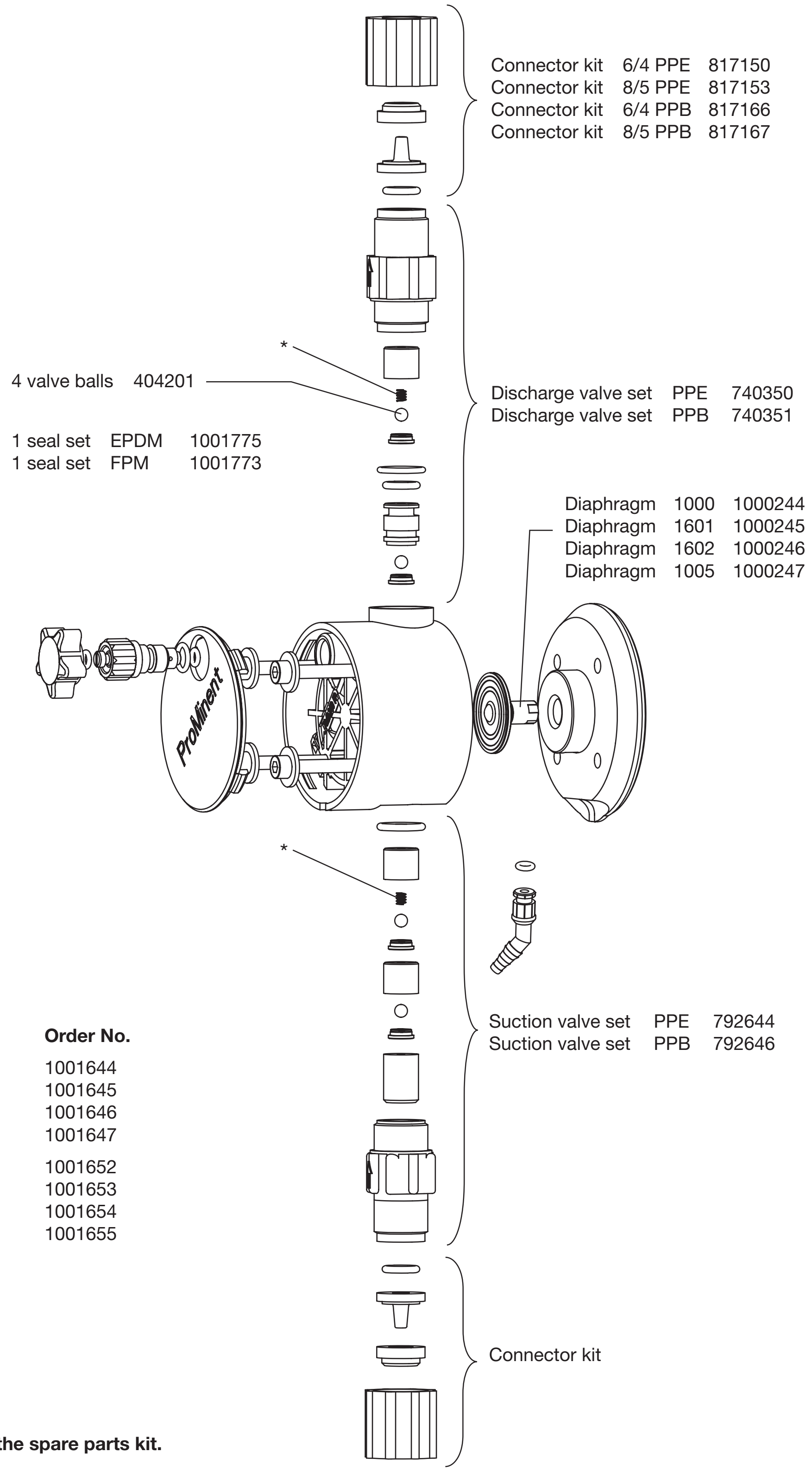


Fig. 29

Dimensions in mm

	gamma/ L M70 1000 - 1601	1602	1005	0708 - 0413	0220	gamma/ L M85 1605	1008 - 0713	0420	0232
E	40	33	31	-2	-3	31	-2	-3	-10
F	162	170	171	203	204	171	203	204	212
K	78	72	75	77	77	75	77	77	78
L	89	85	88	93	93	88	93	93	95
M	51 (Ø 60)	66 (Ø 70)	68 (Ø 80)	81 (Ø 85)	81 (Ø 85)	81 (Ø 80)	81 (Ø 85)	81 (Ø 85)	96 (Ø 100

Liquid end 1000 - 1005 (1605)
PP with coarse/fine bleed



Spare parts kits for:

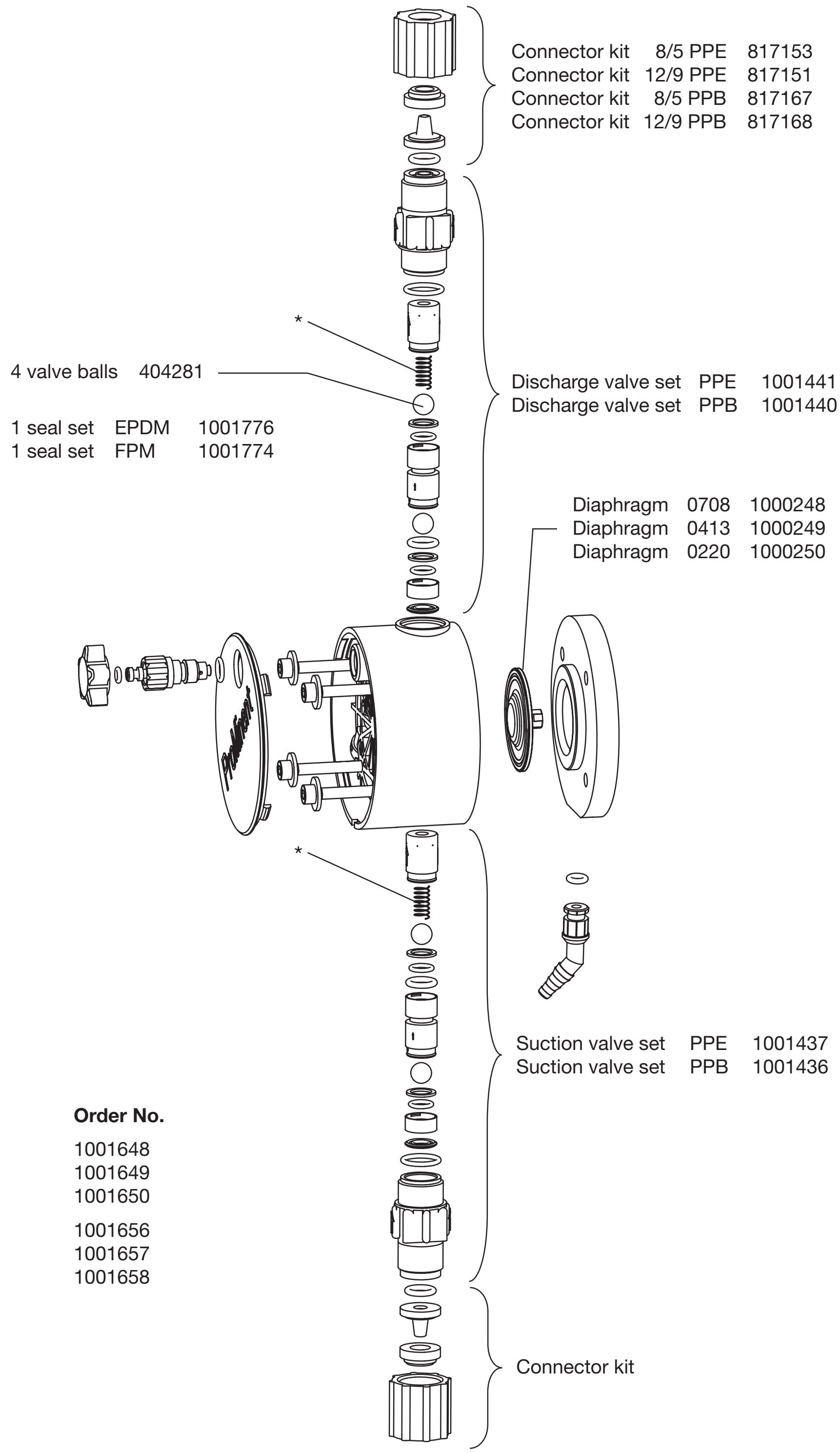
Type	**Material**	**Order No.**
1000	PPE	1001644
1601	PPE	1001645
1602	PPE	1001646
1005 (1605)	PPE	1001647
1000	PPB	1001652
1601	PPB	1001653
1602	PPB	1001654
1005 (1605)	PPB	1001655

The listed items are included in the spare parts kit.
*** Customer accessories**

Subject to technical alterations.

60_07-104_00_18-04_2

Liquid end 0708 (1008) - 0220 (0420)
PP with coarse/fine bleed



Spare parts kits for:

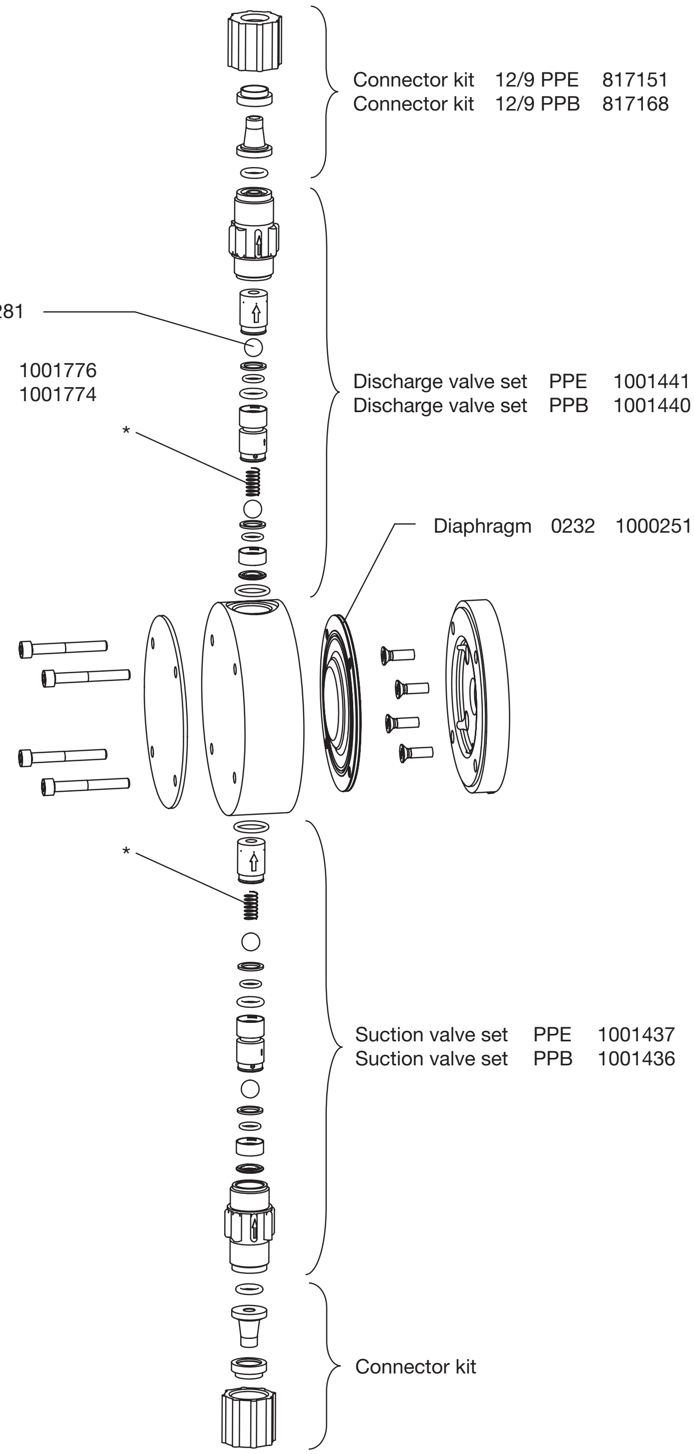
Type	**Material**	**Order No.**
0708 (1008)	PPE	1001648
0413 (0713)	PPE	1001649
0220 (0420)	PPE	1001650
0708 (1008)	PPB	1001656
0413 (0713)	PPB	1001657
0220 (0420)	PPB	1001658

The listed items are included in the spare parts kit.
*** Customer accessories**

Subject to technical alterations.

60_07-104_00_19-04_2

Liquid end 0232
PP without coarse/fine bleed



Spare parts kits for:

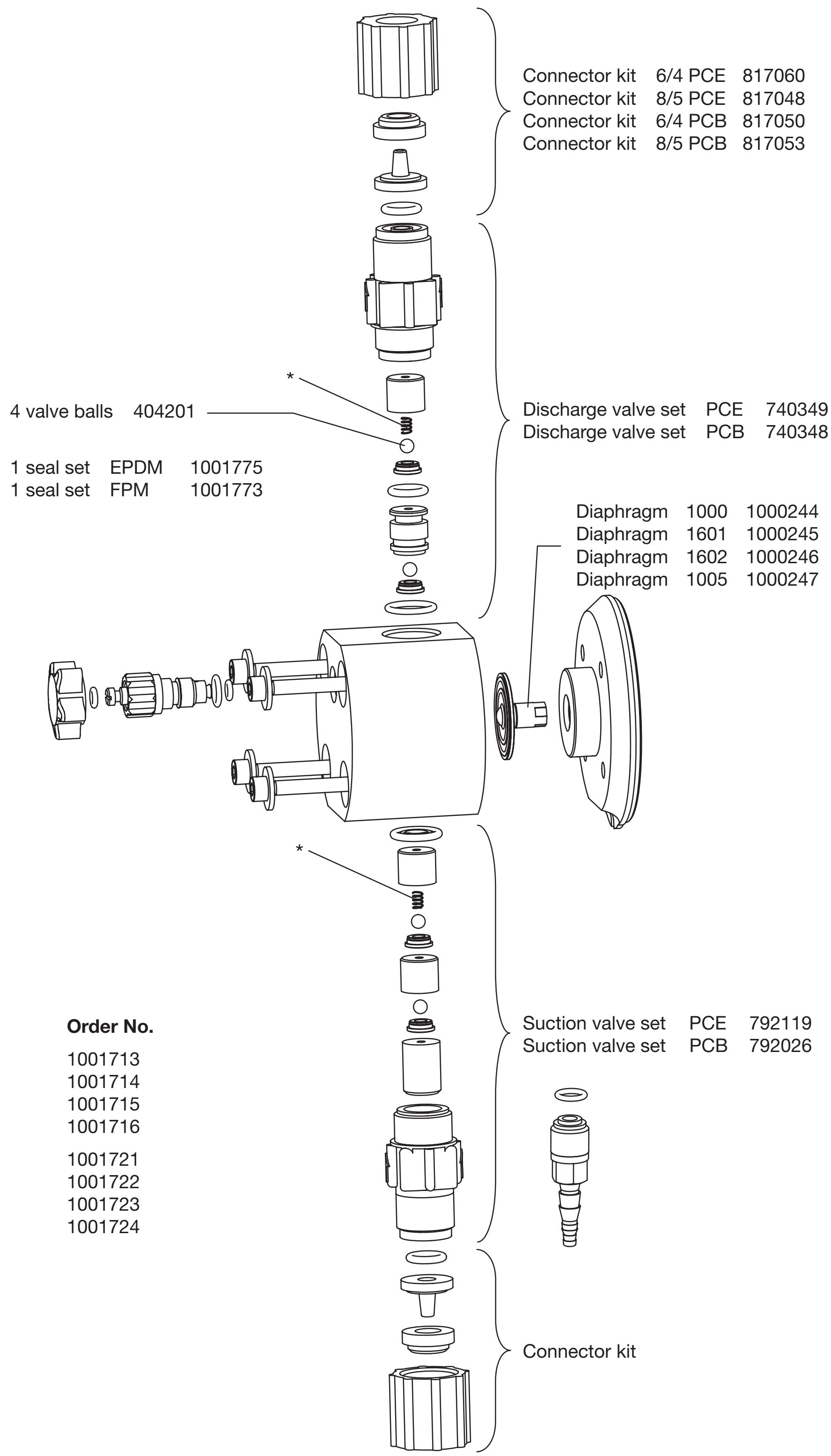
Type	**Material**	**Order No.**
0232	PPE	1001651
0232	PPB	1001659

The listed items are included in the spare parts kit.
*** Customer accessories**

Subject to technical alterations.

60_07-104_00_40-04_2

Liquid end 1000 - 1005 (1605)
NP with coarse/fine bleed



Spare parts kits for:

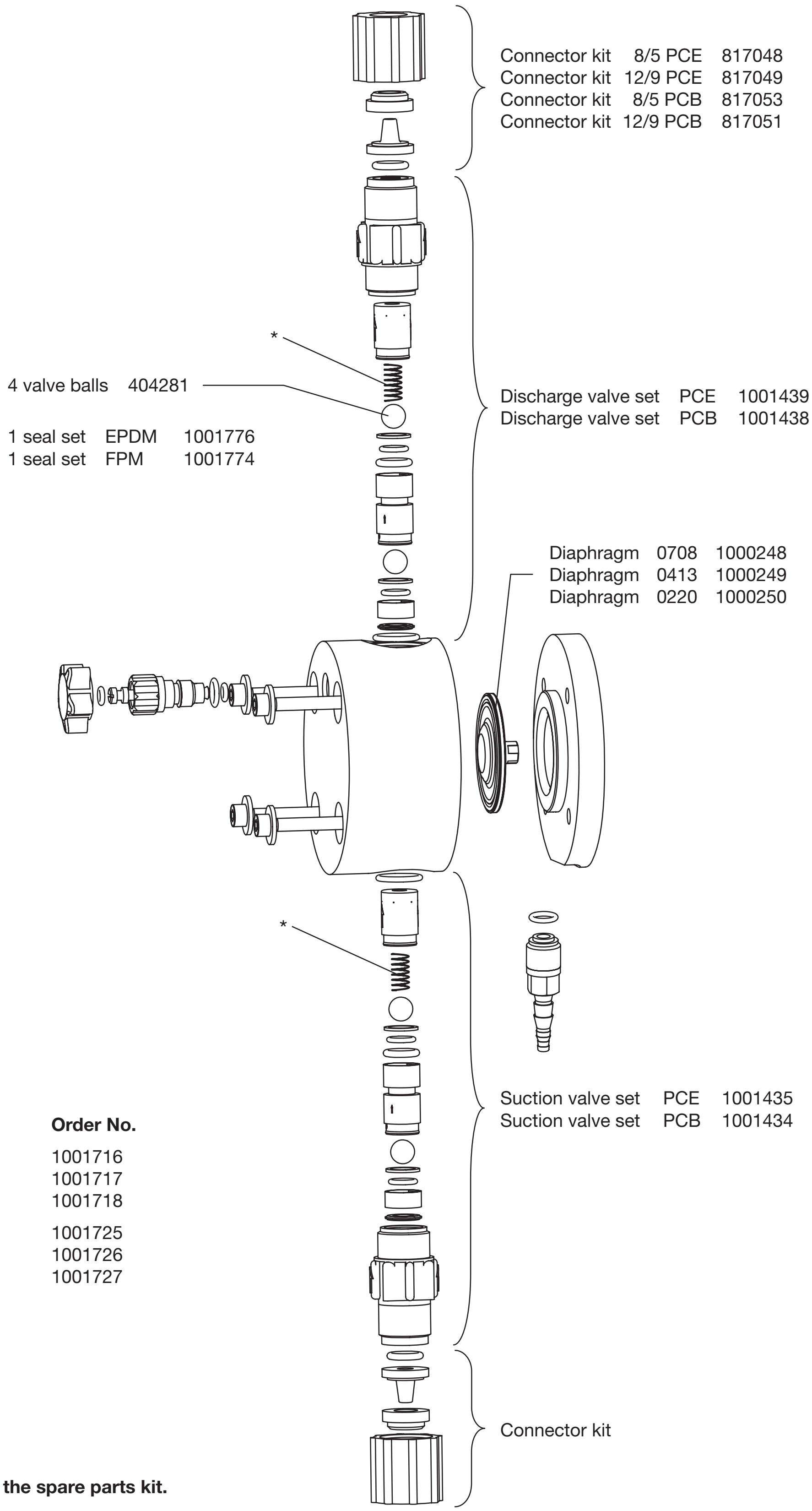
Type	**Material**	**Order No.**
1000	NPE	1001713
1601	NPE	1001714
1602	NPE	1001715
1005 (1605)	NPE	1001716
1000	NPB	1001721
1601	NPB	1001722
1602	NPB	1001723
1005 (1605)	NPB	1001724

The listed items are included in the spare parts kit.
*** Customer accessories**

Subject to technical alterations.

60_07-104_00_23-04_2

Liquid end 0708 (1008) - 0220 (0420)
NP with coarse/fine bleed



Spare parts kits for:

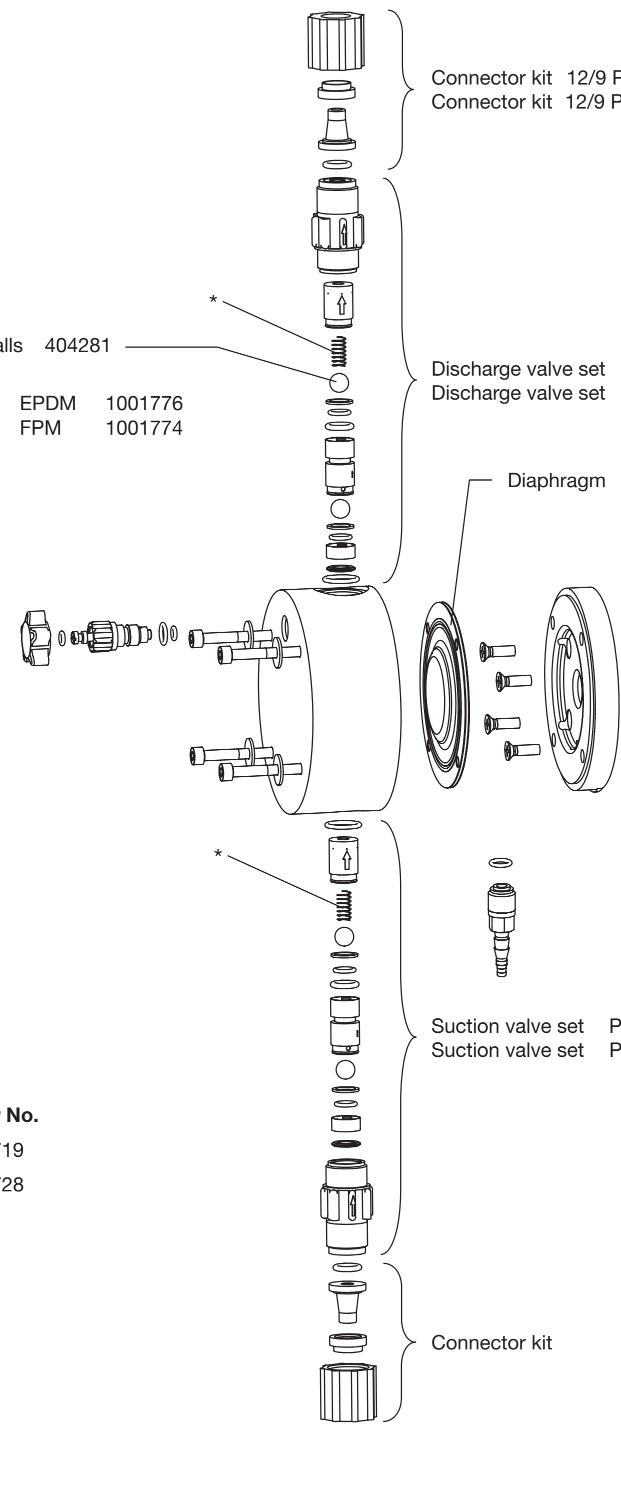
Type	**Material**	**Order No.**
0708 (1008)	NPE	1001716
0413 (0713)	NPE	1001717
0220 (0420)	NPE	1001718
0708 (1008)	NPB	1001725
0413 (0713)	NPB	1001726
0220 (0420)	NPB	1001727

The listed items are included in the spare parts kit.
*** Customer accessories**

Subject to technical alterations.

60_07-104_00_24-04_2

Liquid end 0232
NP with coarse/fine bleed



Spare parts kits for:

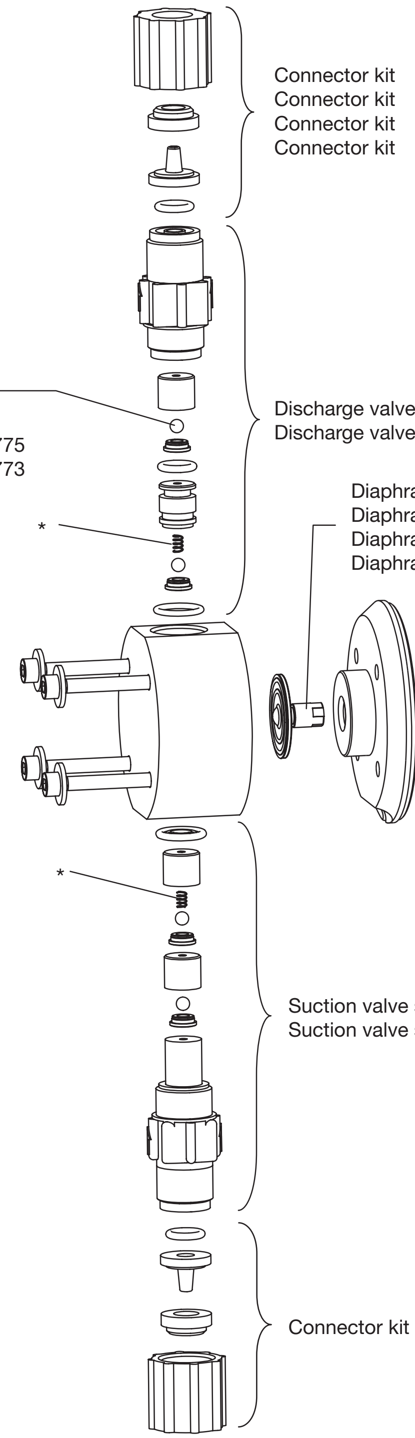
Type	Material	Order No.
0232	NPE	1001719
0232	NPB	1001728

The listed items are included in the spare parts kit.
*** Customer accessories**

Subject to technical alterations.

60_07-104_00_34-04_2

Liquid end 1000 - 1005 (1605)
NP without coarse/fine bleed



Spare parts kits for:

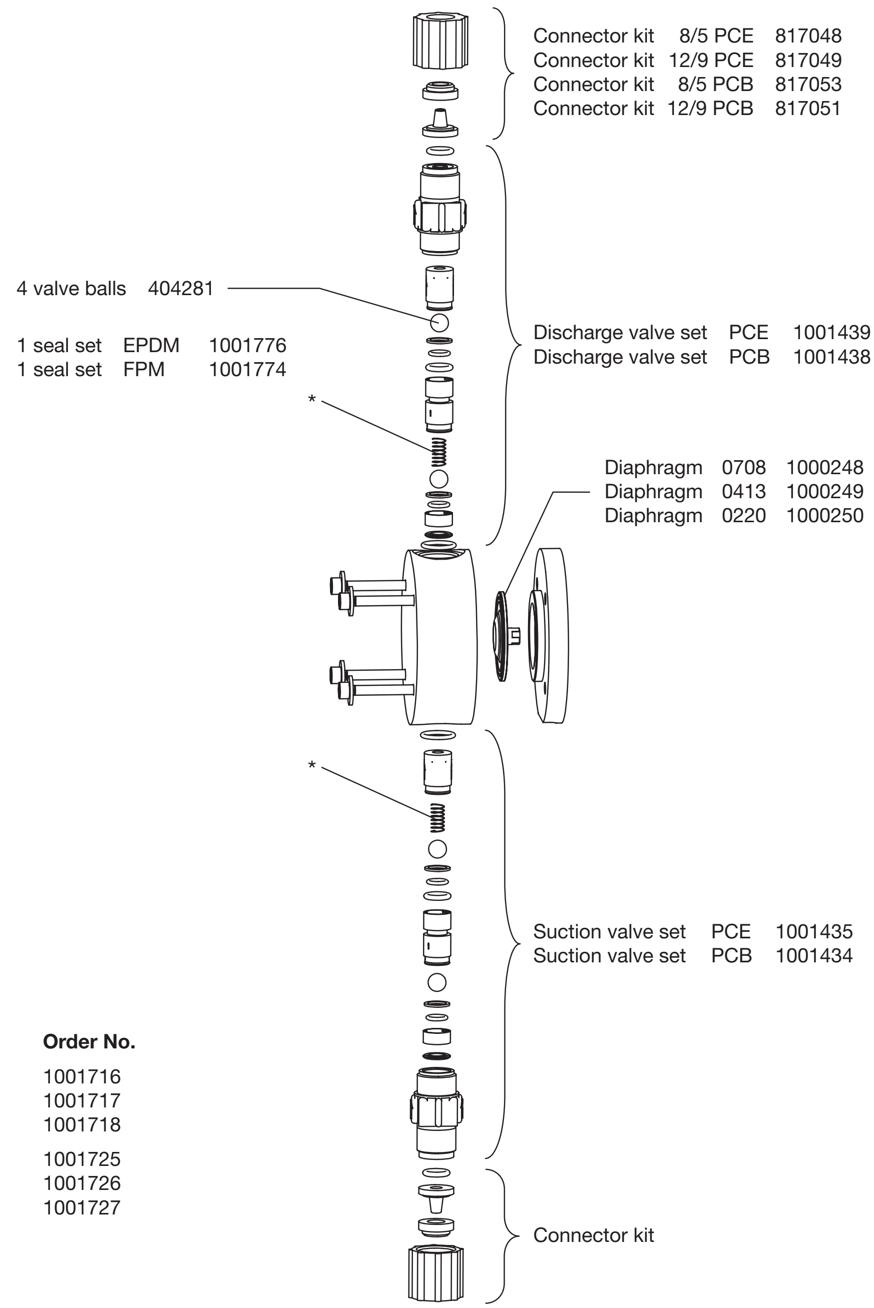
Type	**Material**	**Order No.**
1000	PCE / NPE	1001713
1601	PCE / NPE	1001714
1602	PCE / NPE	1001715
1005 (1605)	PCE / NPE	1001716
1000	PCB / NPB	1001721
1601	PCB / NPB	1001722
1602	PCB / NPB	1001723
1005 (1605)	PCB / NPB	1001724

The listed items are included in the spare parts kit.
*** Customer accessories**

Subject to technical alterations.

60_07-104_00_21-04_2

Liquid end 0708 (1008) - 0220 (0420)
NP without coarse/fine bleed



Spare parts kits for:

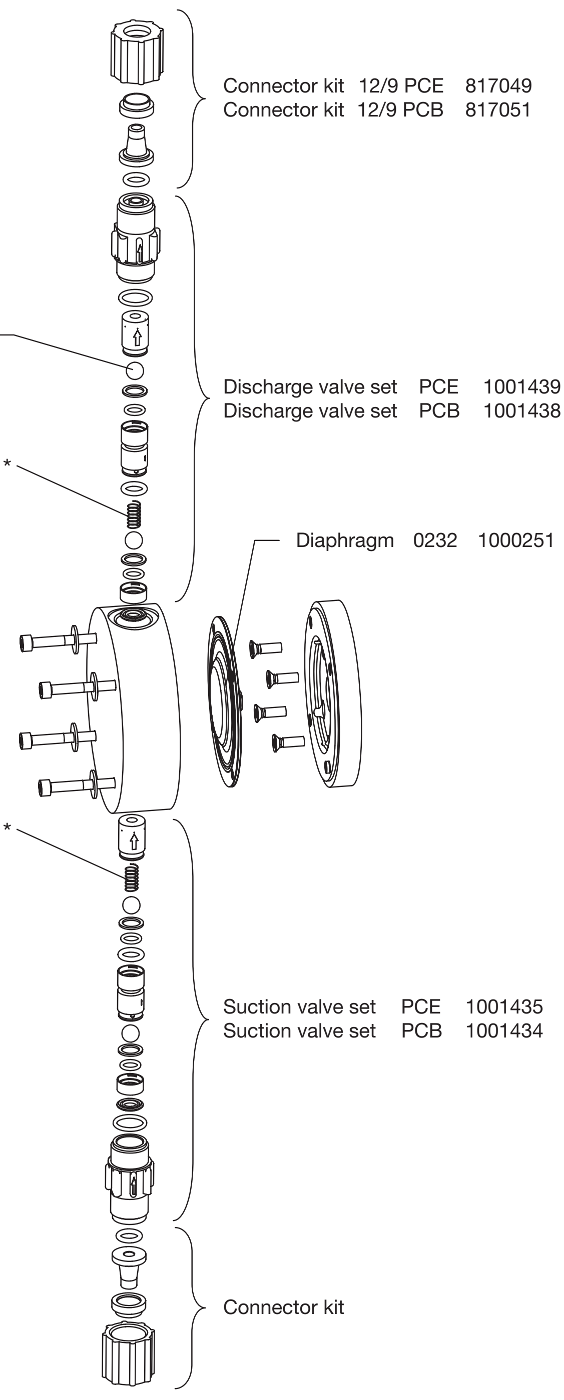
Type	**Material**	**Order No.**
0708 (1008)	NPE	1001716
0413 (0713)	NPE	1001717
0220 (0420)	NPE	1001718
0708 (1008)	NPB	1001725
0413 (0713)	NPB	1001726
0220 (0420)	NPB	1001727

The listed items are included in the spare parts kit.
*** Customer accessories**

Subject to technical alterations.

60_07-104_00_22-04_2

Liquid end 0232
NP without coarse/fine bleed



Spare parts kits for:

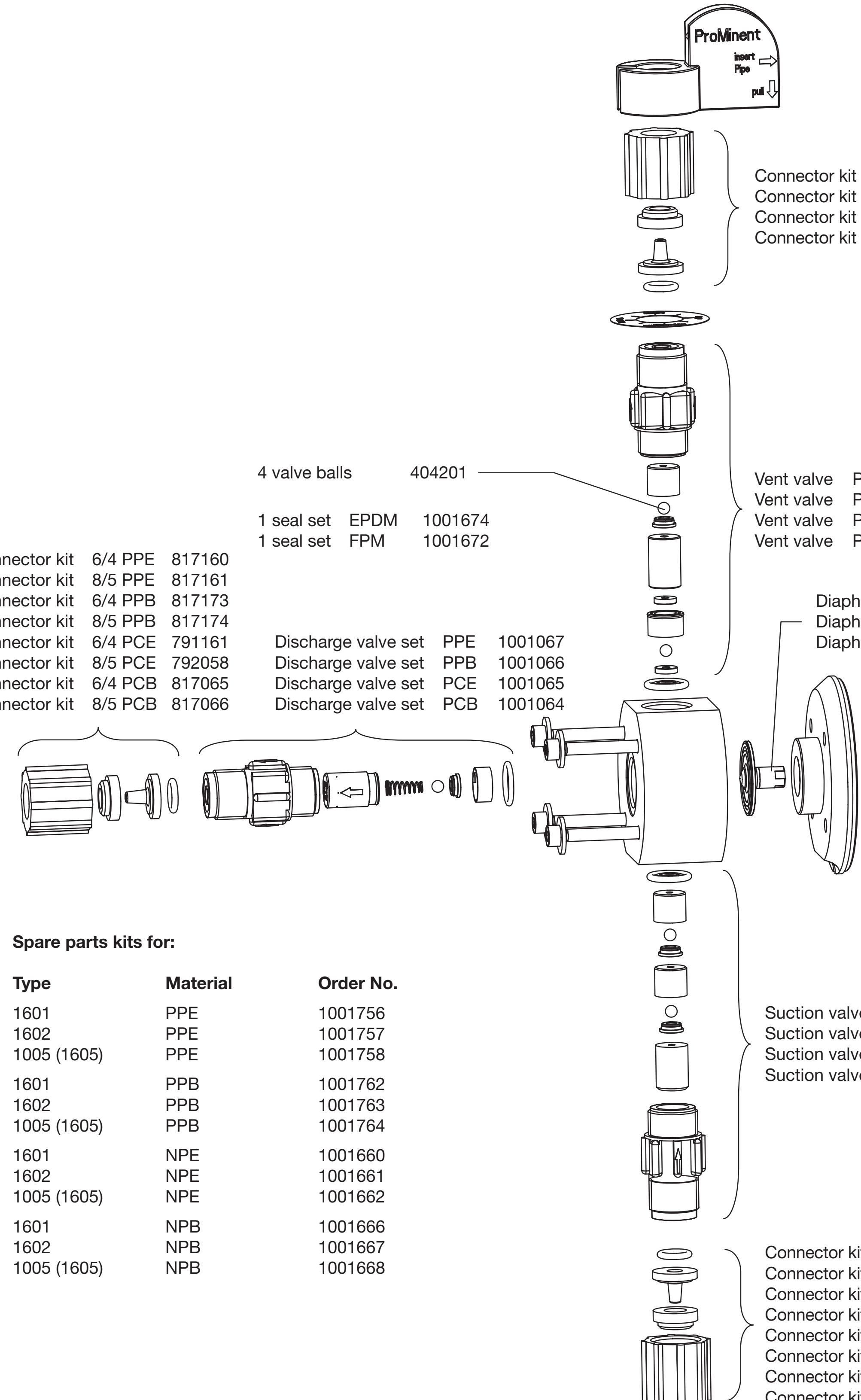
Type	**Material**	**Order No.**
0232	NPE	1001719
0232	NPB	1001728

The listed items are included in the spare parts kit.
*** Customer accessories**

Subject to technical alterations.

60_07-104_00_20-04_2

Liquid end 1601 - 1005 (1605)
PP / NP self-degassing



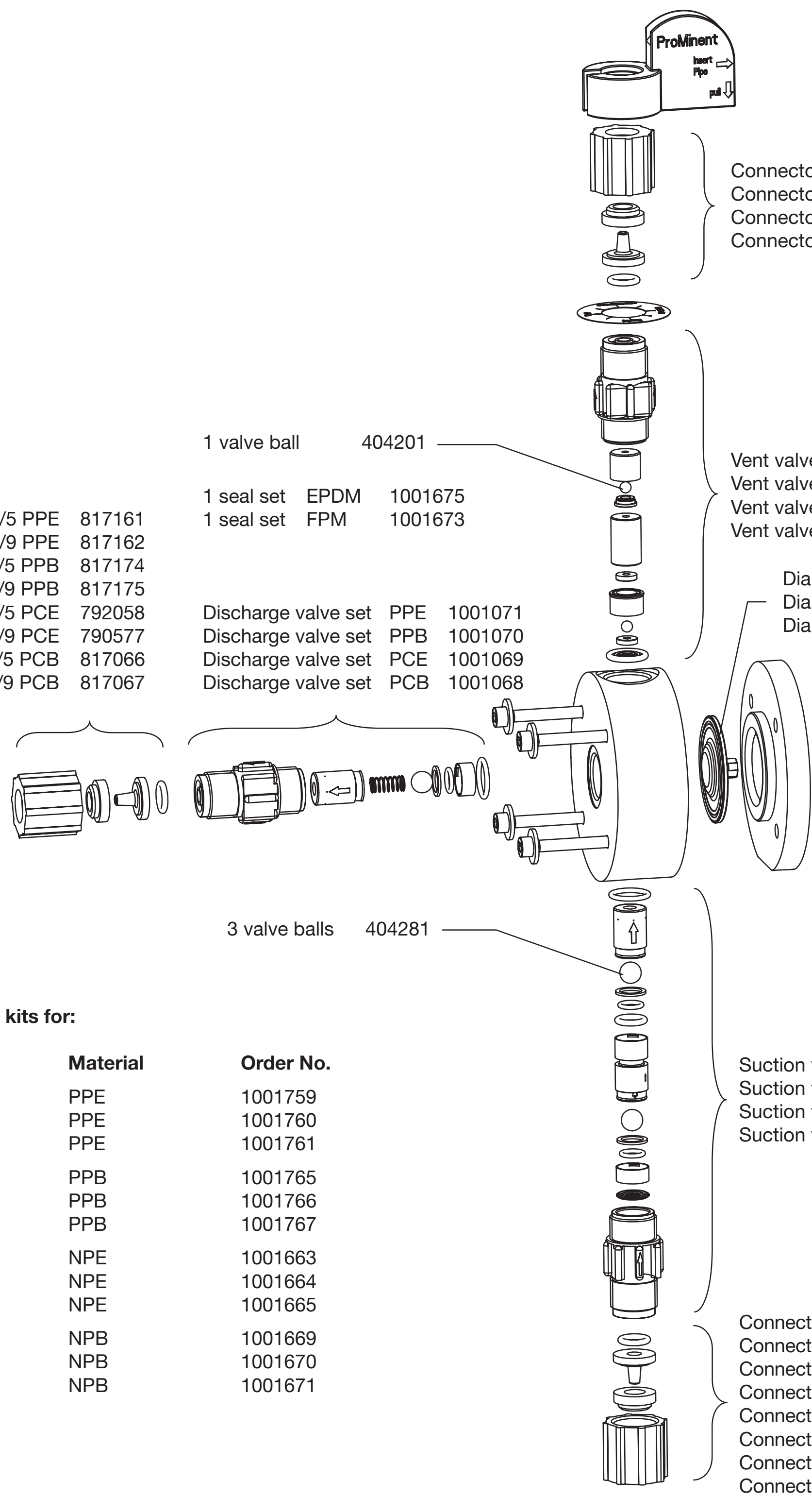
Spare parts kits for:

Type	**Material**	**Order No.**
1601	PPE	1001756
1602	PPE	1001757
1005 (1605)	PPE	1001758
1601	PPB	1001762
1602	PPB	1001763
1005 (1605)	PPB	1001764
1601	NPE	1001660
1602	NPE	1001661
1005 (1605)	NPE	1001662
1601	NPB	1001666
1602	NPB	1001667
1005 (1605)	NPB	1001668

The listed items are included in the spare parts kit.

Subject to technical alterations.

Liquid end 0708 (1008) - 0220 (0420)
PP / NP self-degassing



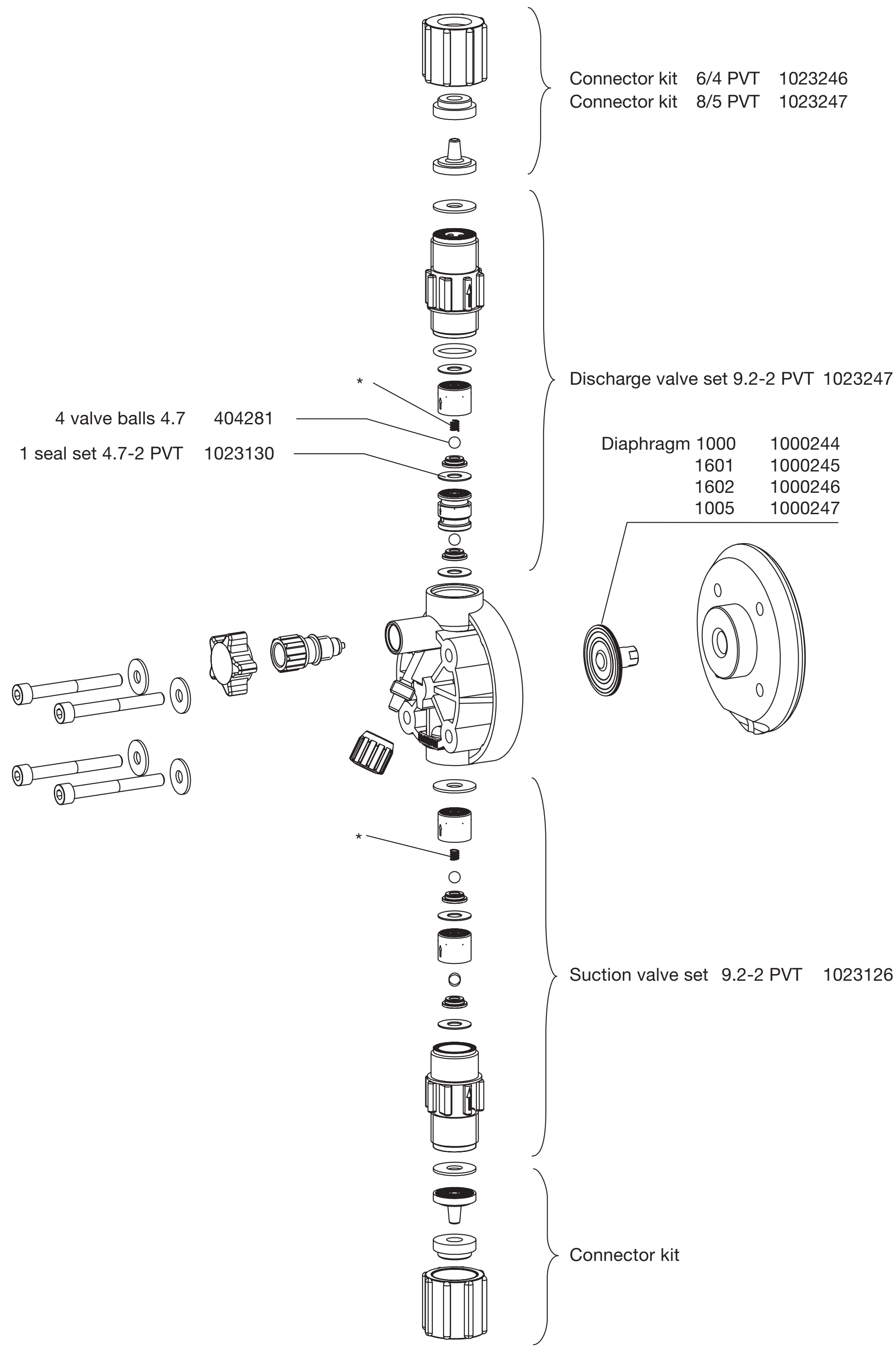
Spare parts kits for:

Type	Material	Order No.
0708 (1008)	PPE	1001759
0413 (0713)	PPE	1001760
0220 (0420)	PPE	1001761
0708 (1008)	PPB	1001765
0413 (0713)	PPB	1001766
0220 (0420)	PPB	1001767
0708 (1008)	NPE	1001663
0413 (0713)	NPE	1001664
0220 (0420)	NPE	1001665
0708 (1008)	NPB	1001669
0413 (0713)	NPB	1001670
0220 (0420)	NPB	1001671

The listed items are included in the spare parts kit.

Subject to technical alterations.

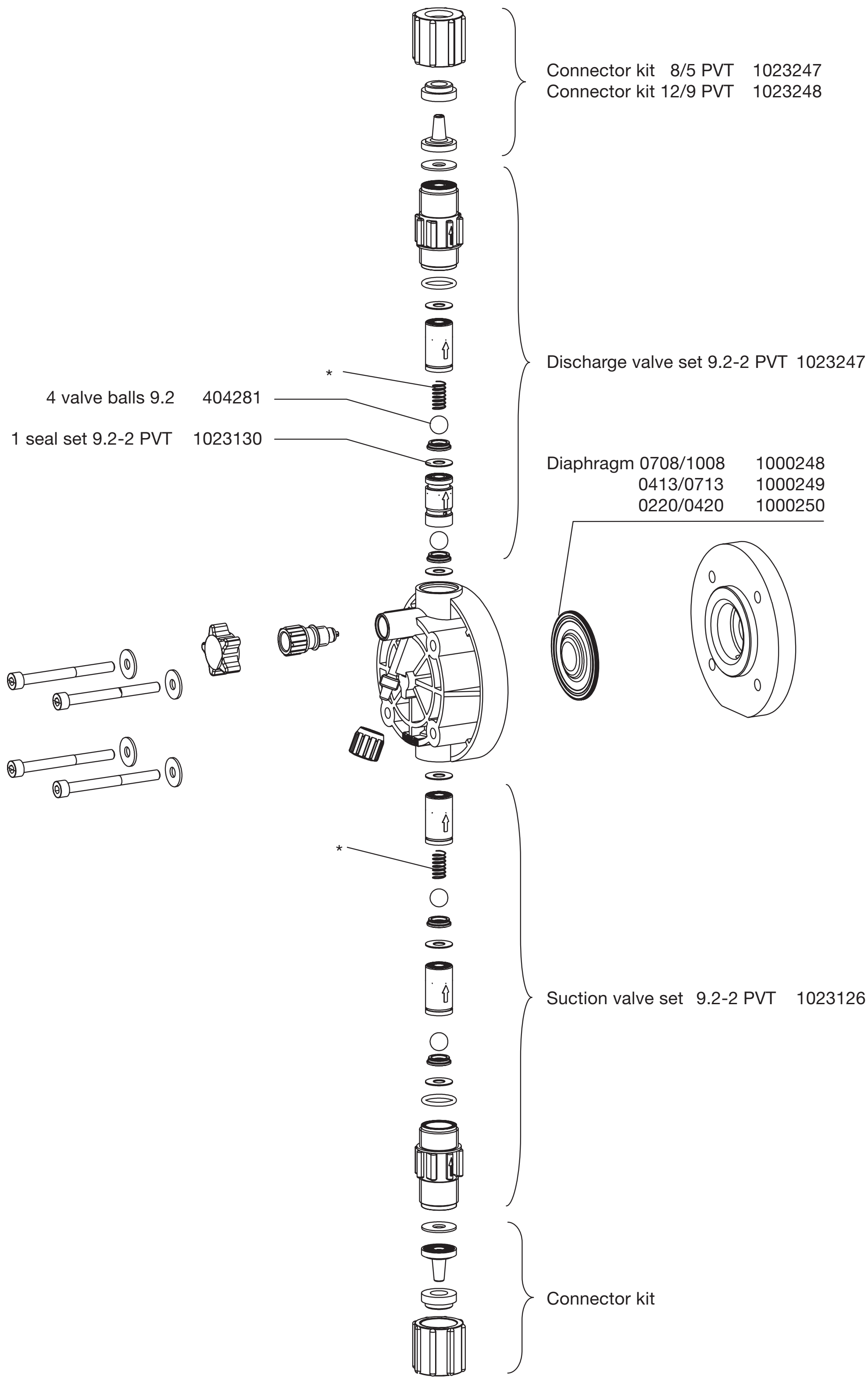
Liquid end 1000-1005 (1605)
PVT with bleed



The listed items are included in the spare parts kit.
*** Customer accessories**

Subject to technical alterations.

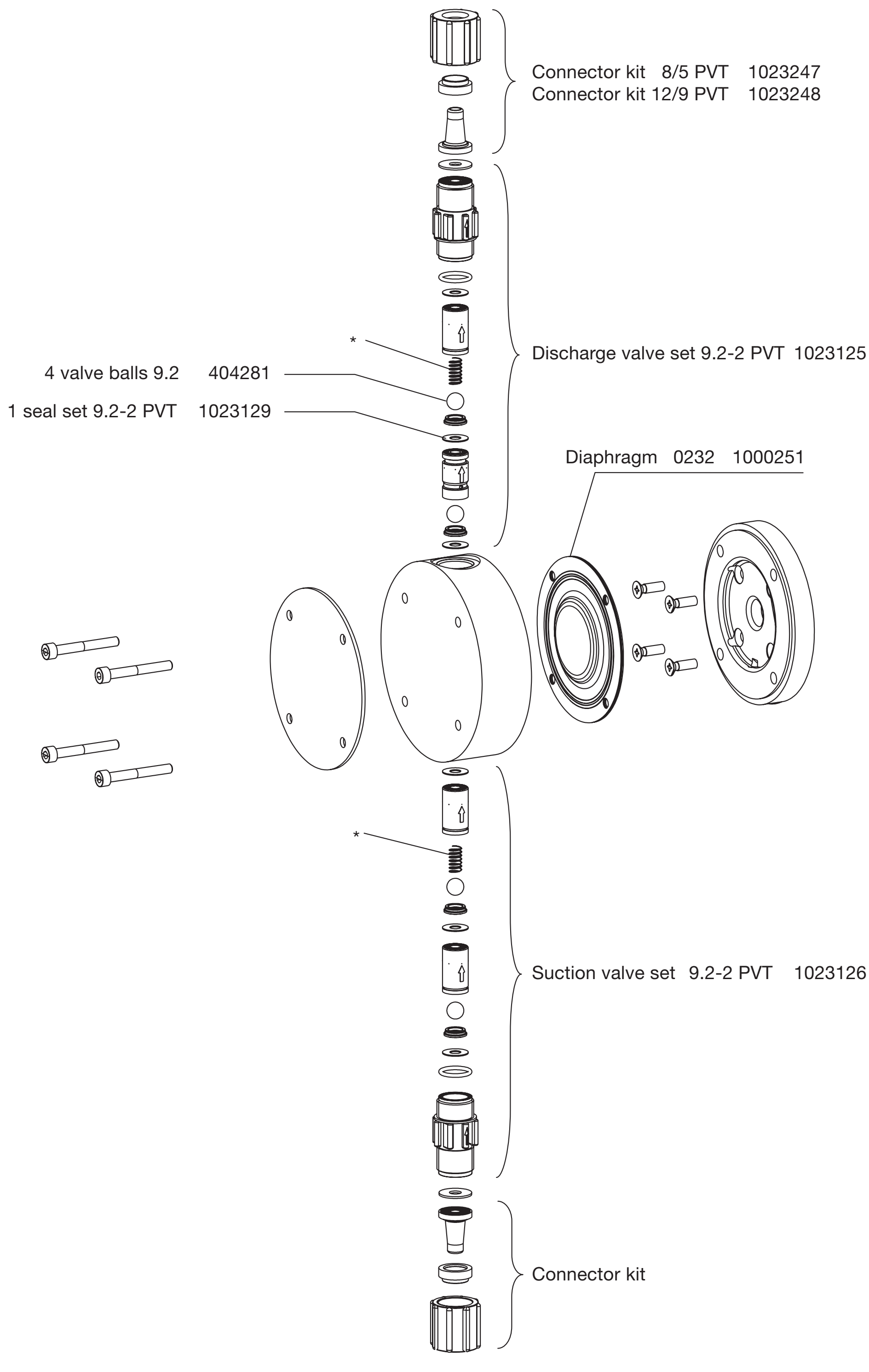
Liquid end 0708 (1008) - 0220 (0420)
PVT with bleed



The listed items are included in the spare parts kit.
*** Customer accessories**

Subject to technical alterations.

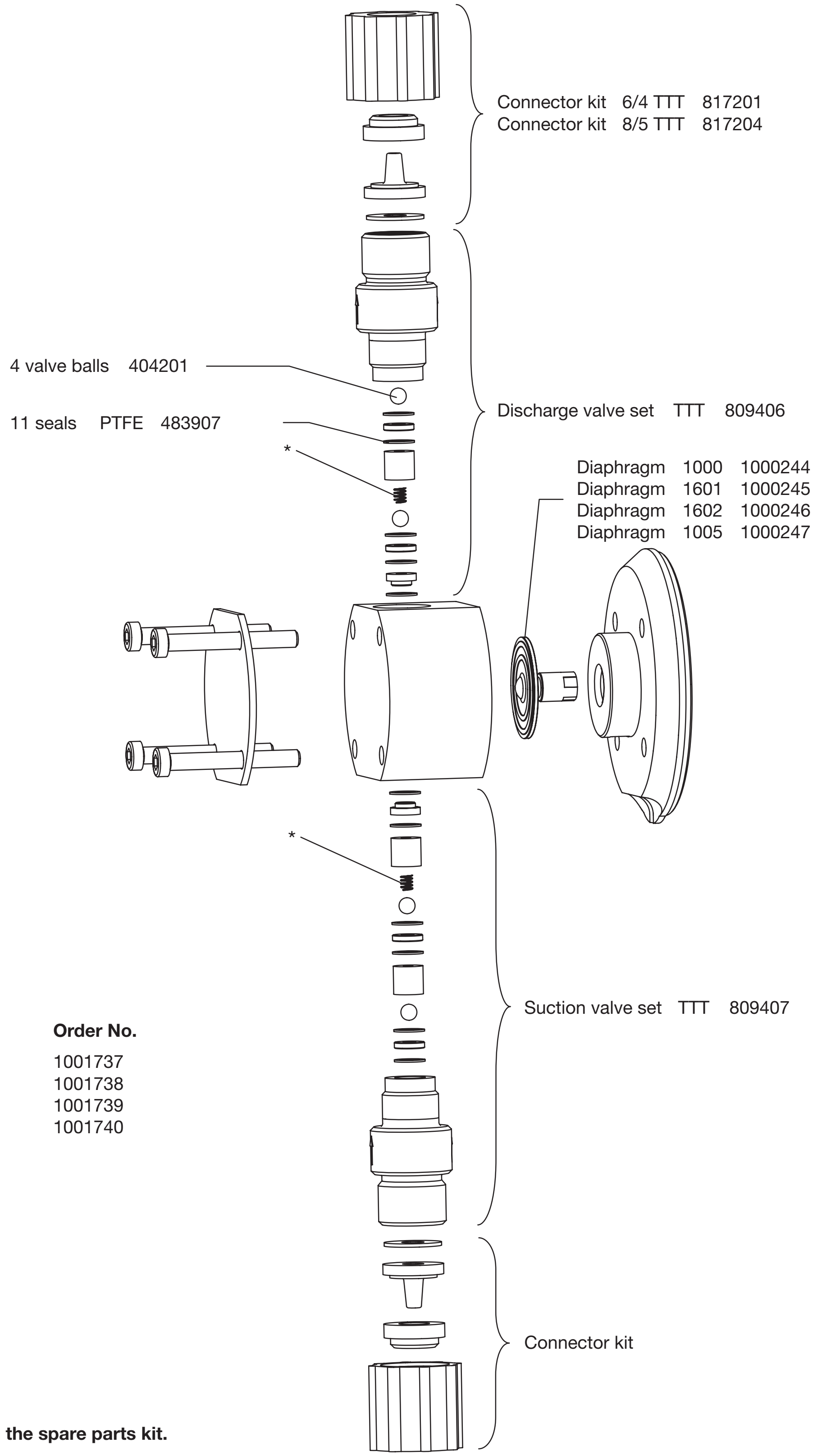
Liquid end 0232
PVT without bleed



The listed items are included in the spare parts kit.
*** Customer accessories**

Subject to technical alterations.

Liquid end 1000 - 1005 (1605)
TT



Spare parts kits for:

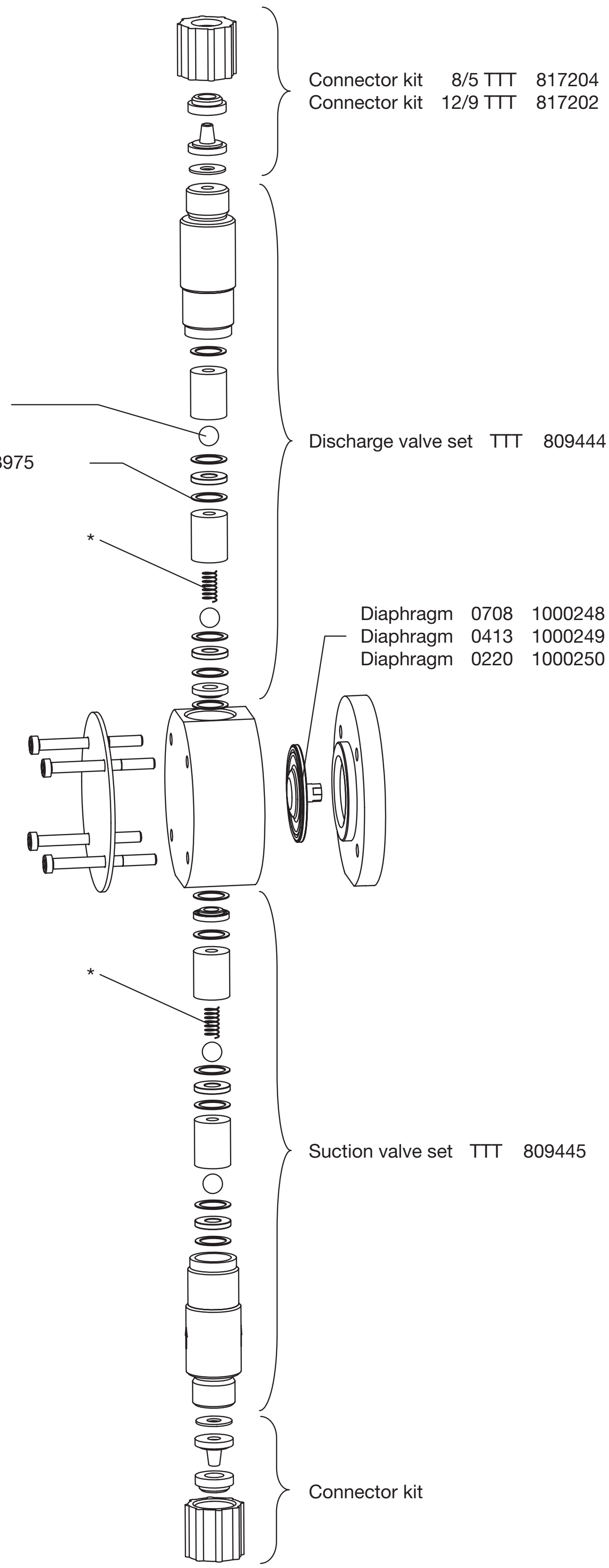
Type	Material	Order No.
1000	TTT	1001737
1601	TTT	1001738
1602	TTT	1001739
1005 (1605)	TTT	1001740

The listed items are included in the spare parts kit.
*** Customer accessories**

Subject to technical alterations.

60_07-104_00_29-04_2

Liquid end 0708 (1008) - 0220 (0420) TT



Spare parts kits for:

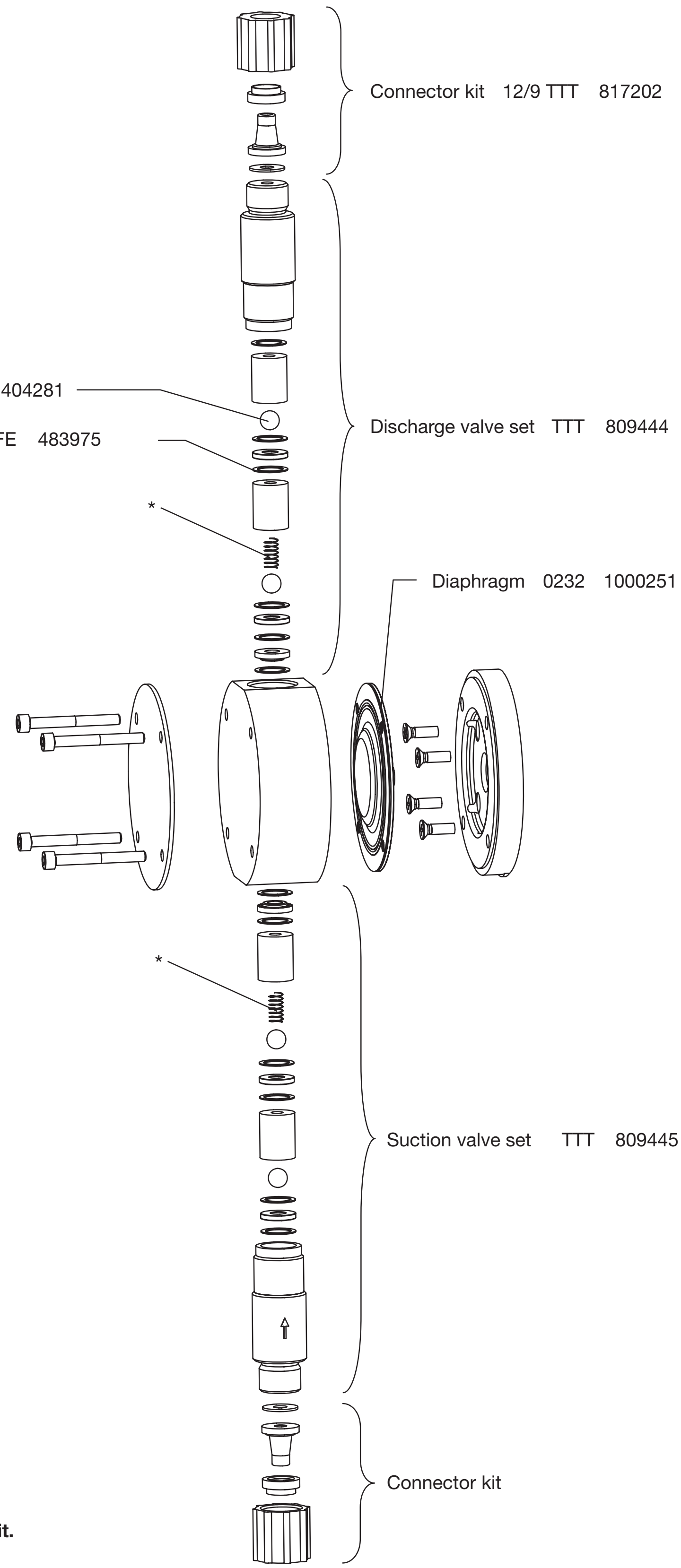
Type	Material	Order No.
0708 (1008)	TTT	1001741
0413 (0713)	TTT	1001742
0220 (0420)	TTT	1001754

The listed items without a suction valve or discharge valve are included in the spare parts kit.
*** Customer accessories**

Subject to technical alterations.

60_07-104_00_30-04_2

Liquid end 0232
TT



Spare parts kits for:

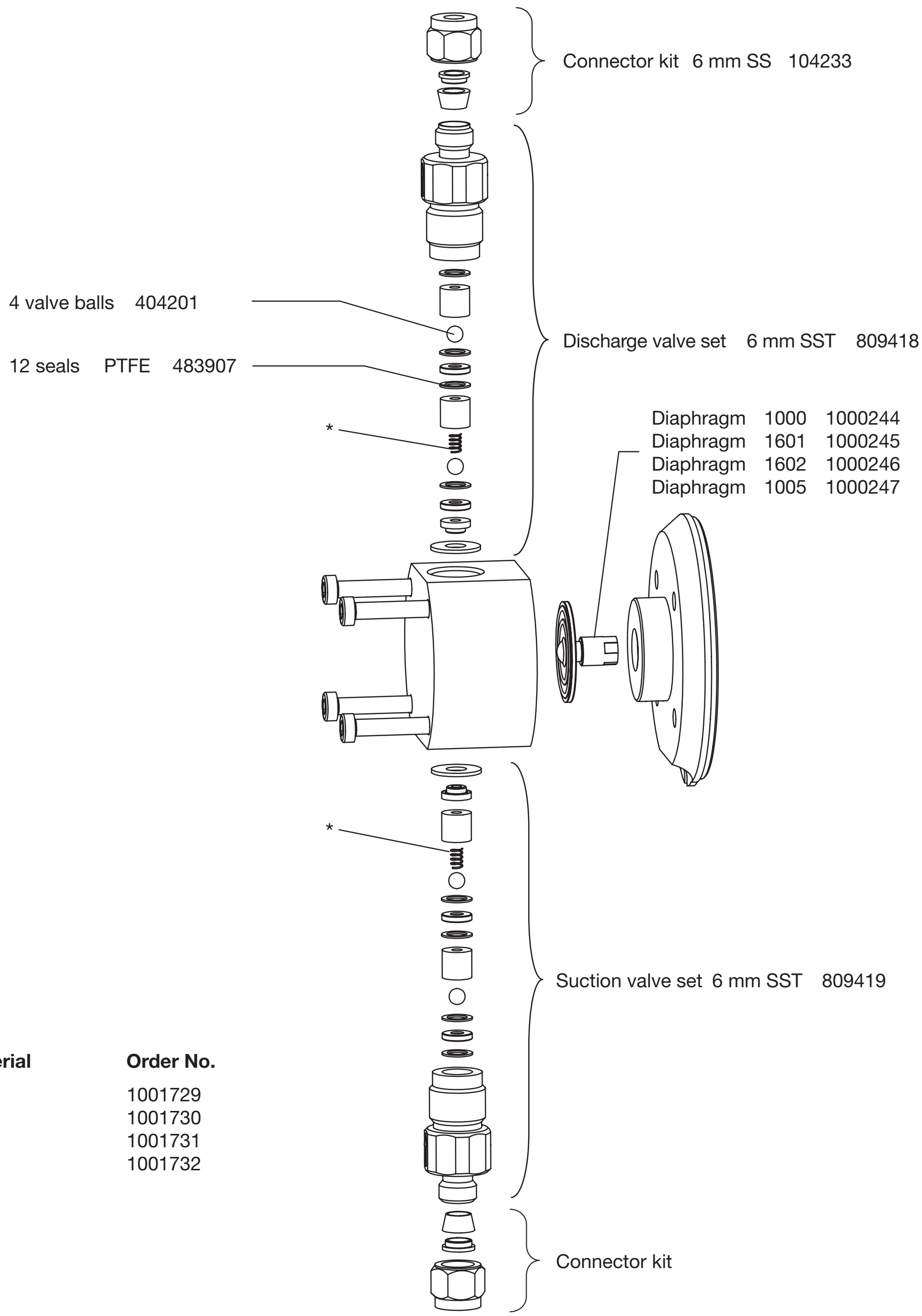
Type	Material	Order No.
0232	TTT	1001755

The listed items without a suction valve or discharge valve are included in the spare parts kit.
*** Customer accessories**

Subject to technical alterations.

60_07-104_00_35-04_2

Liquid end 1000 - 1005 (1605)
SS



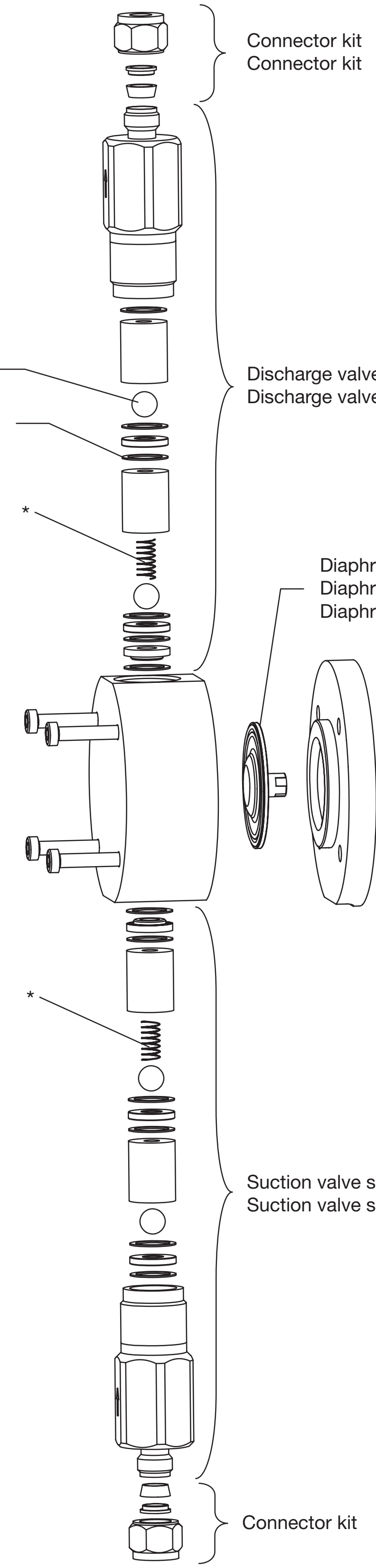
Spare parts kits for:

Type	Material	Order No.
1000	SST	1001729
1601	SST	1001730
1602	SST	1001731
1005 (1605)	SST	1001732

The listed items without a suction valve or discharge valve are included in the spare parts kit.
*** Customer accessories**

Subject to technical alterations.

Liquid end 0708 (1008) - 0220 (0420)
SS



Spare parts kits for:

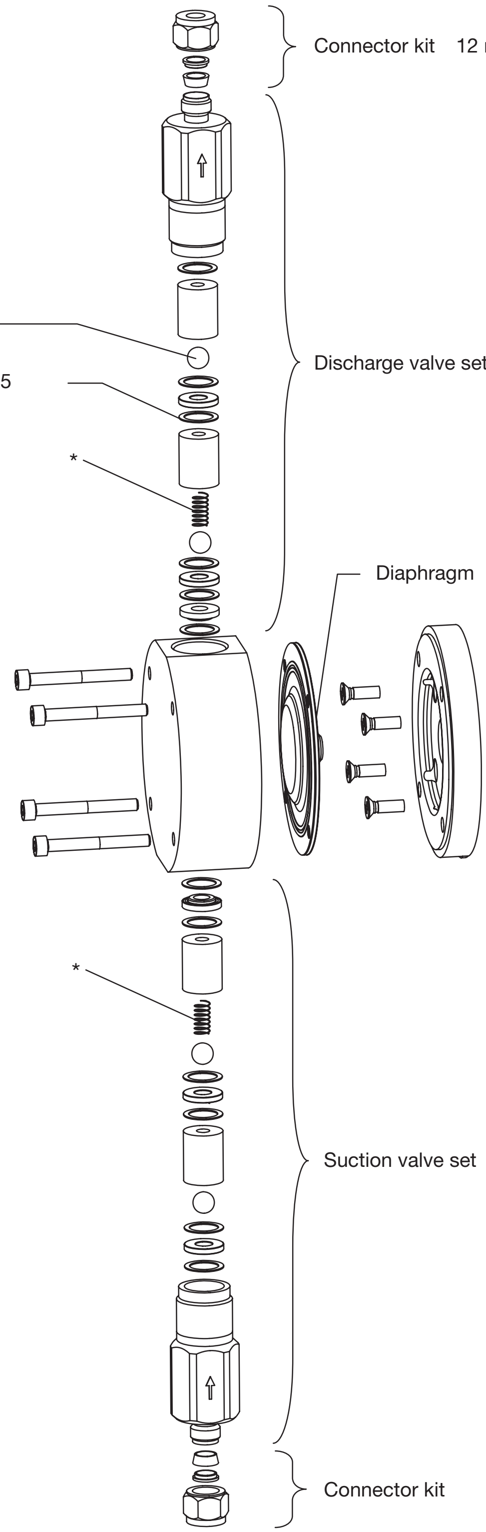
Type	Material	Order No.
0708 (1008)	SST	1001733
0413 (0713)	SST	1001734
0220 (0420)	SST	1001735

The listed items without a suction valve or discharge valve are included in the spare parts kit.
*** Customer accessories**

Subject to technical alterations.

60_07-104_00_26-04_2

Liquid end 0232
SS



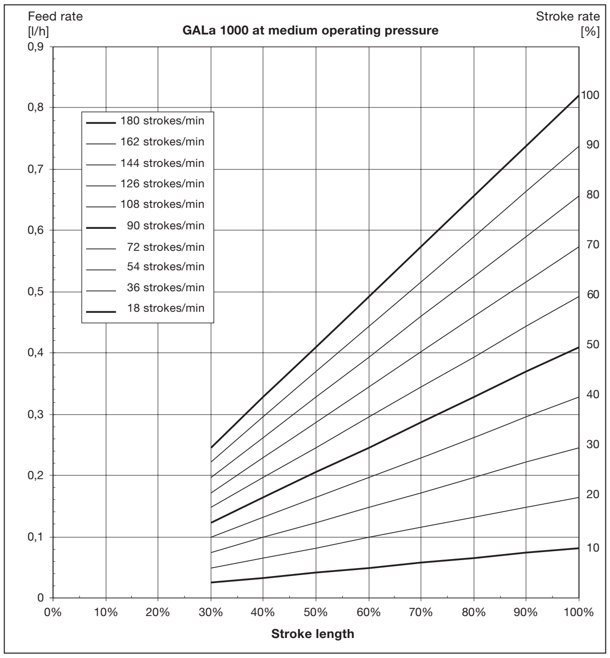
Spare parts kits for:

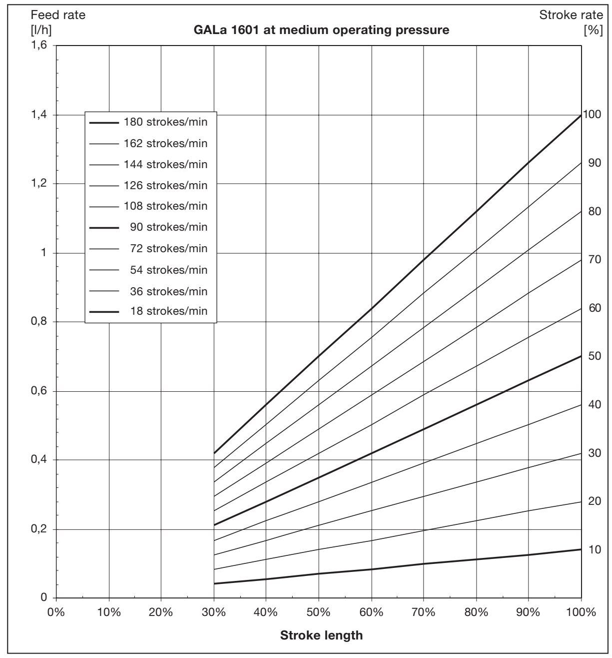
Type	**Material**	**Order No.**
0232	SST	1001736

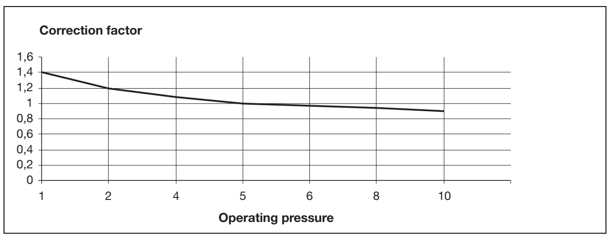
The listed items without a suction valve or discharge valve are included in the spare parts kit.
*** Customer accessories**

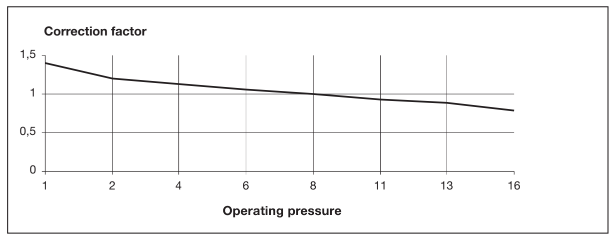
Subject to technical alterations.

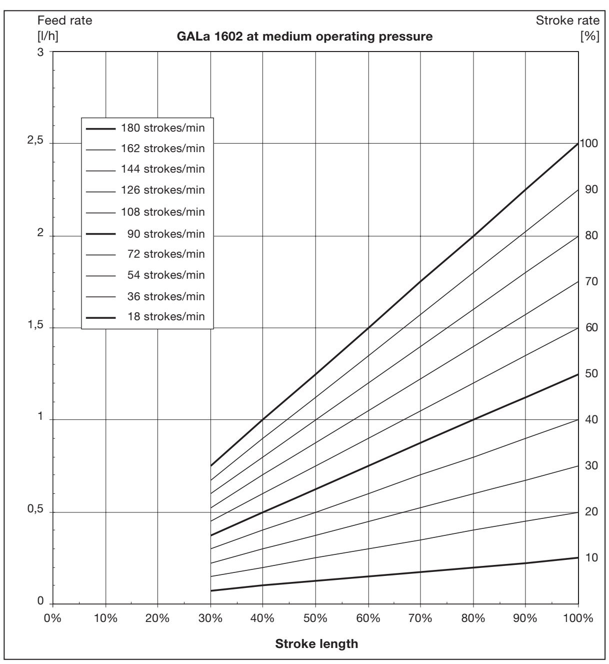
60_07-104_00_36-04_2

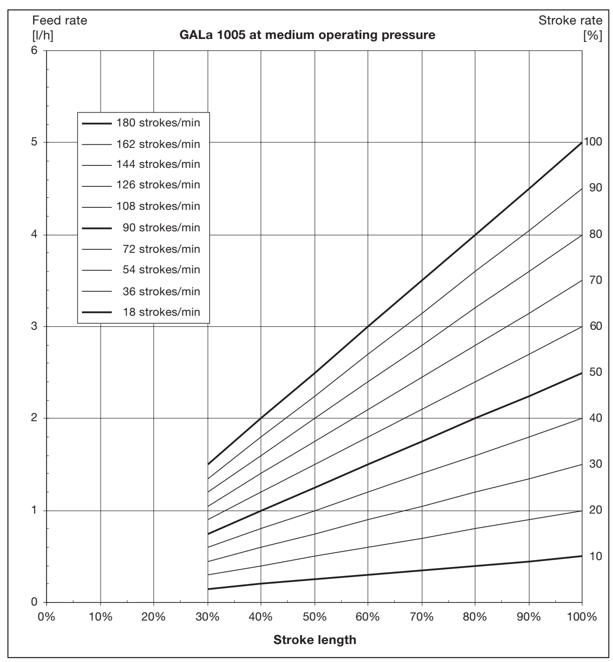

Feed rate
[l/h]
GALa 1000 at medium operating pressure
Stroke rate
[%]
0,9
0,8
0,7
0,6
0,5
0,4
0,3
0,2
0,1
0
180 strokes/min
162 strokes/min
144 strokes/min
126 strokes/min
108 strokes/min
90 strokes/min
72 strokes/min
54 strokes/min
36 strokes/min
18 strokes/min
100
90
80
70
60
50
40
30
20
10
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Stroke length

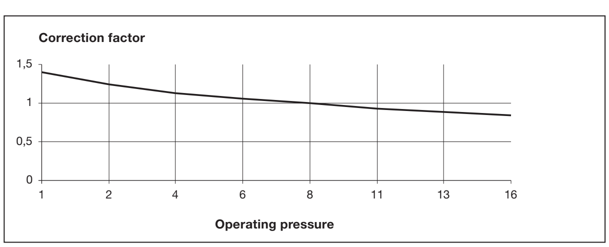

Feed rate
[l/h]
GALa 1601 at medium operating pressure
Stroke rate
[%]
1,6
1,4
1,2
1
0,8
0,6
0,4
0,2
0
180 strokes/min
162 strokes/min
144 strokes/min
126 strokes/min
108 strokes/min
90 strokes/min
72 strokes/min
54 strokes/min
36 strokes/min
18 strokes/min
100
90
80
70
60
50
40
30
20
10
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Stroke length


Correction factor
1,6
1,4
1,2
1
0,8
0,6
0,4
0,2
0
1
2
4
5
6
8
10
Operating pressure


Correction factor
1,5
1
0,5
0
1
2
4
6
8
11
13
16
Operating pressure


Feed rate
[l/h]
GALa 1602 at medium operating pressure
Stroke rate
[%]
3
2,5
2
1,5
1
0,5
0
180 strokes/min
162 strokes/min
144 strokes/min
126 strokes/min
108 strokes/min
90 strokes/min
72 strokes/min
54 strokes/min
36 strokes/min
18 strokes/min
100
90
80
70
60
50
40
30
20
10
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Stroke length


Feed rate
[l/h]
GALa 1005 at medium operating pressure
Stroke rate
[%]
6
5
4
3
2
1
0
180 strokes/min
162 strokes/min
144 strokes/min
126 strokes/min
108 strokes/min
90 strokes/min
72 strokes/min
54 strokes/min
36 strokes/min
18 strokes/min
100
90
80
70
60
50
40
30
20
10
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Stroke length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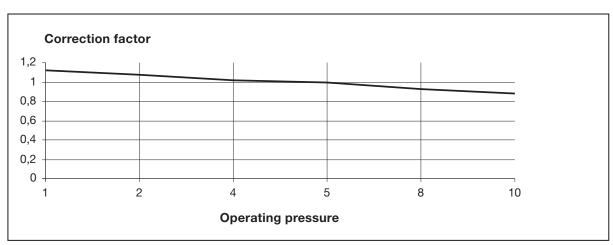
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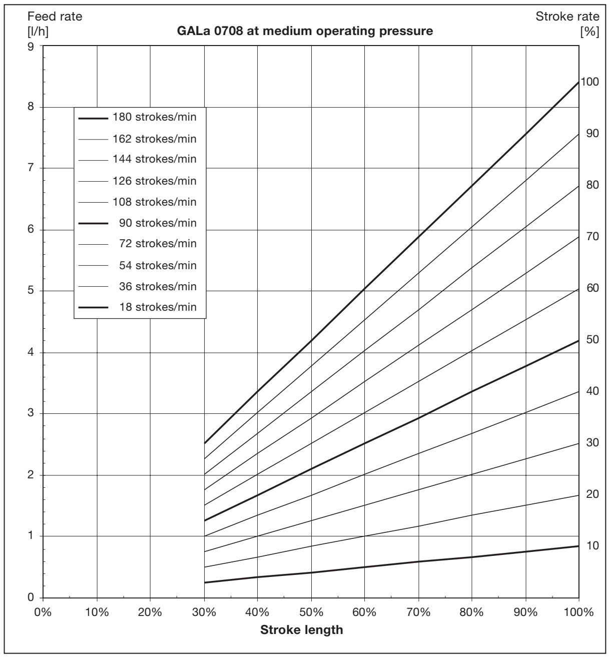
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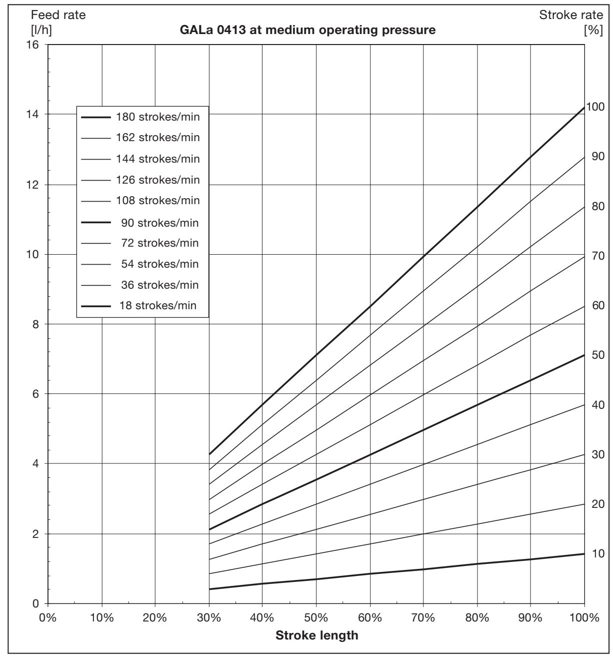
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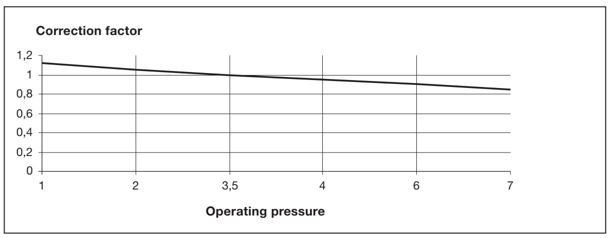
Stroke length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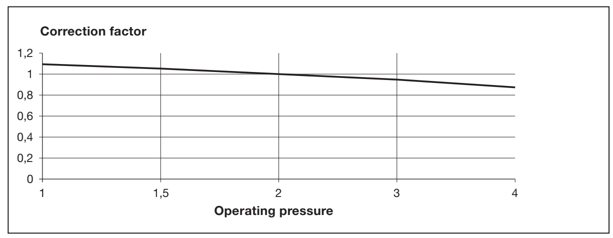
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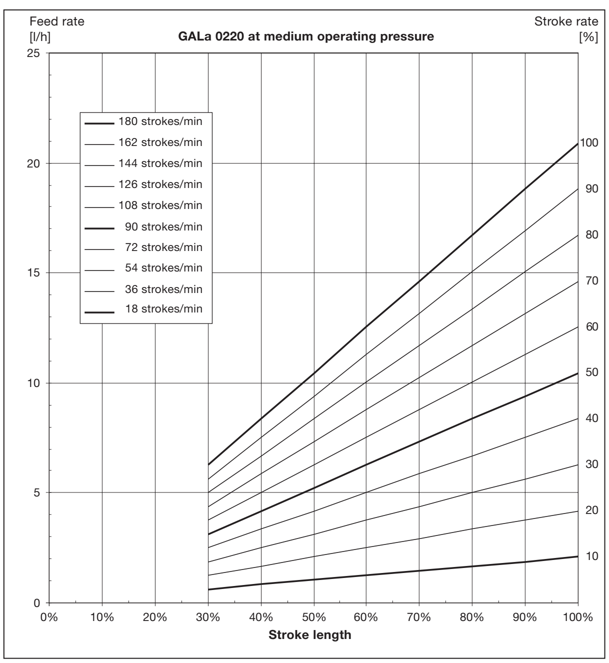
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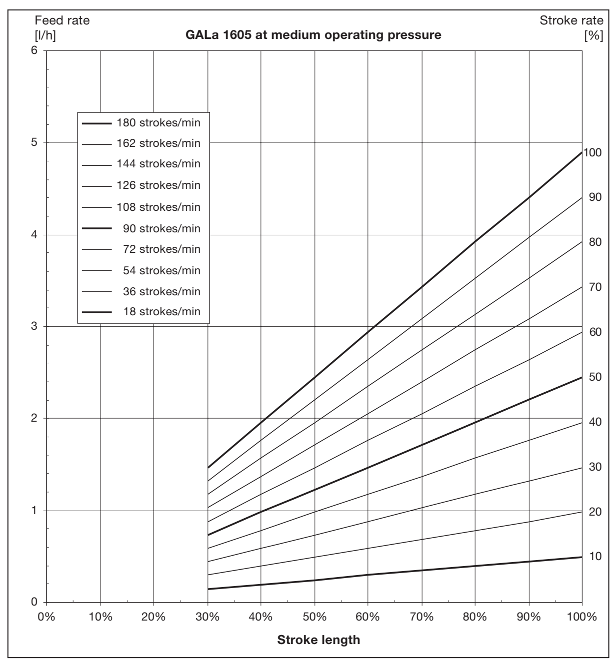
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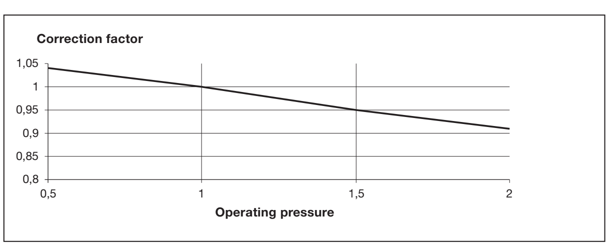
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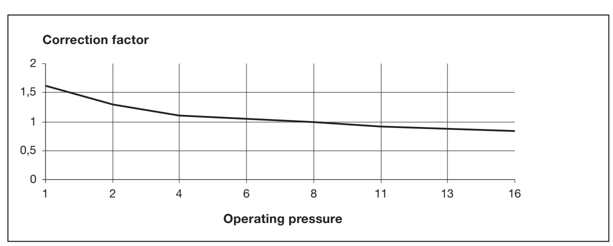
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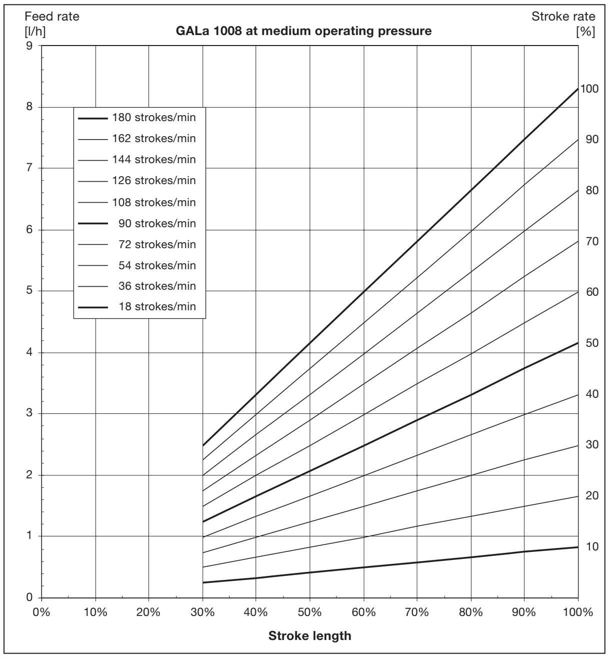
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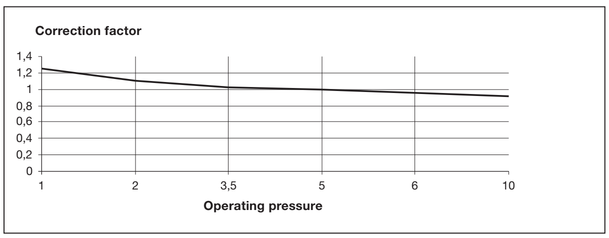
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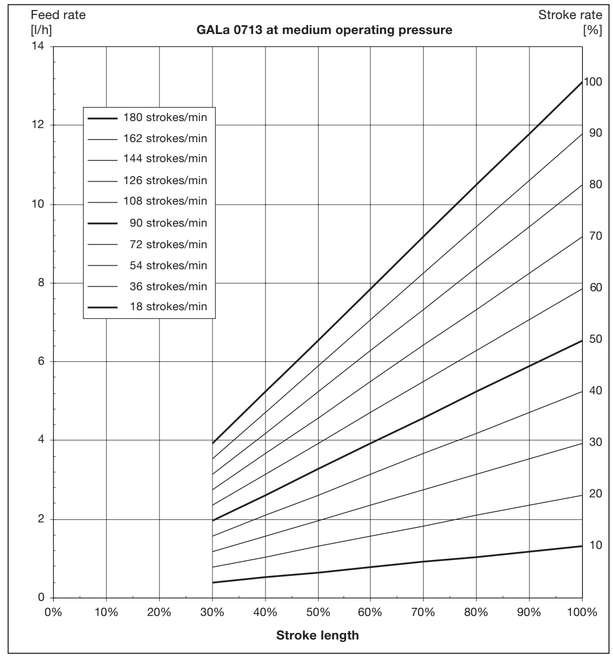
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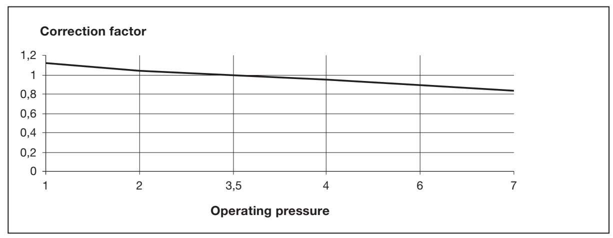
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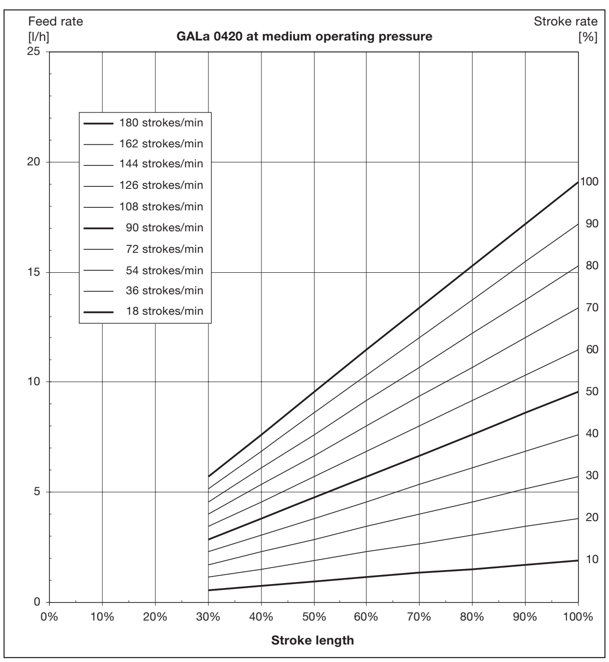
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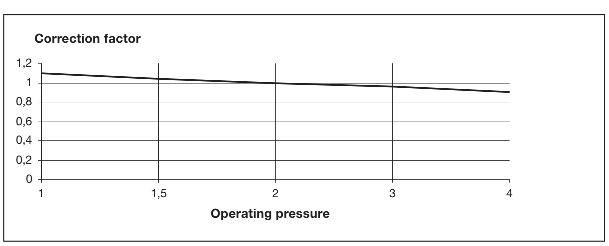
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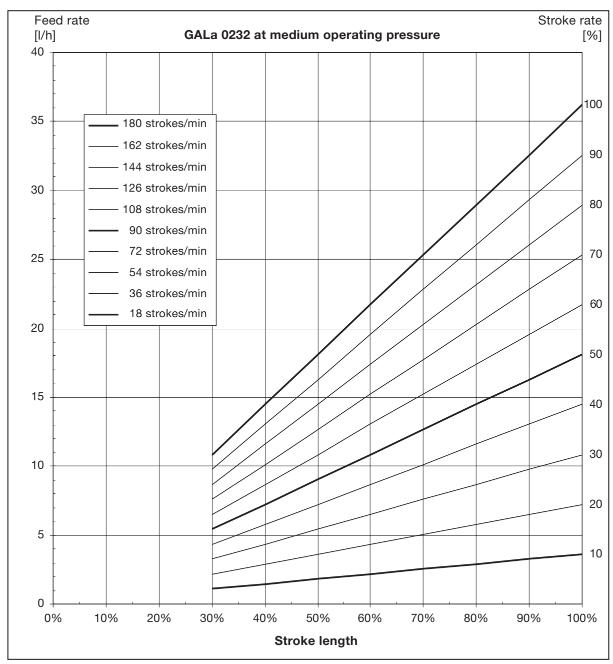
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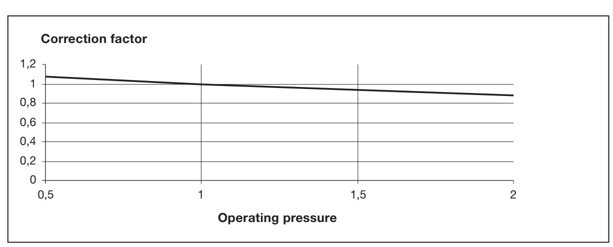
Correction factor
Operating pressure

EC Declaration of Conformity

We, **ProMinent Dosiertechnik GmbH**
Im Schuhmachergewann 5 - 11
D - 69123 Heidelberg

hereby declare that, on the basis of its functional concept and design and in the version brought into circulation by us, the product specified in the following complies with the relevant, fundamental safety and health stipulations laid down by EC regulations.
Any modification to the product not approved by us will invalidate this declaration.

Product description :	***Metering pump, series Gamma L***
Product type :	***GALa***
Serial number :	***see type identification plate on device***
Relevant EC directives :	***EC - machine directive 98/37/EC*** ***EC - low voltage directive 73/23/EEC*** ***EC - EMC - directive (89/336/EEC) subsequently 92/31 EEC***
Harmonised standards used, in particular :	***DIN EN 292-1, DIN EN 292-2, DIN EN 809*** ***DIN EN 60335-1, DIN EN 60335-2-41, DIN EN 50106*** ***DIN EN 50081-1/2, DIN EN 55011, DIN EN 61000-3-3*** ***DIN EN 50082-1/2, DIN EN 61000-4-2/3/4/5/6/11***
National standards and other technical specifications used, in particular :	***DIN VDE 0700 T1*** ***DIN VDE 0700 T41*** ***DIN VDE 0700 T500*** ***IEC 1000-3-3, IEC 1000-4-2/3/4/5/6/11***
Date/manufacturer´s signature :	***02. Nov 99***
The undersigned :	*Dr. Rainer V. Dulger, Executive Vice President R&D and Production*

Die ProMinent Firmengruppe / The ProMinent Group

Stammhaus / Head office

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$\frac{1}{1000}$ 100'   0.00101

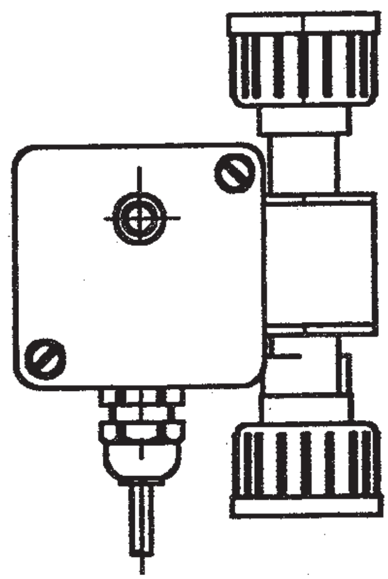
$\frac{1}{10^4}$ = 0,00011

ProMinent®
Dosierüberwachung
ProMinent Flow Control

TÜV CERT DIN EN ISO 9001 70 100 M 502

Betriebsanleitung
Instruction Manual

ProMinent®



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T.Nr./P.No. 981409   ProMinent Dosiertechnik GmbH · D-69123 Heidelberg · Germany   BA MAZ 007 1/97 G/GB

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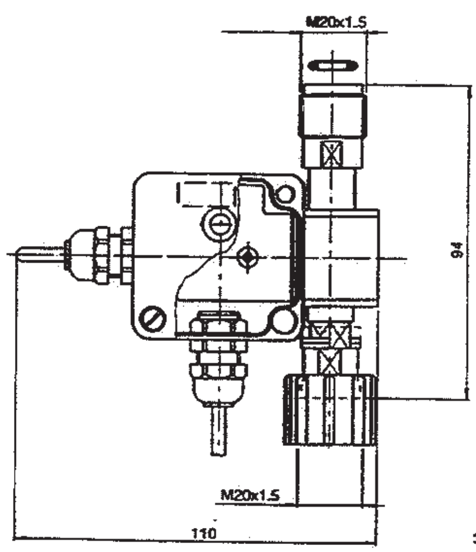


3079-4

1. Description of the metering monitor "flow control"

The "flow control" type metering monitor is a turn-key monitor with a switching amplifier and connection cable with four-pin circular connector to be directly connected to the solenoid-driven gamma/ 4 and gamma/ 5 metering pumps and the motor-driven Vario type metering pump. It is used for monitoring the stroke volume of the individual stroke according to the floating body principle.

The materials in contact with the media are PVC/Viton or PP/EPDM. Please consult the table with the technical data for information regarding the respective pumps for the individual sizes.

1.1 Functional description

With every discharge stroke, the float in the pipe is raised upwards and in doing so dips into the ring initiator, whereby the electronics send on a pulse to the pump and the red LED illuminates for the period the float is submerged.

The height of the ring initiator can be adjusted and so it can be adapted to different stroke volumes within the limits specified.

If the capacity drops by a certain degree (approx. 20-30 % of the set displacement volume) no more pulses are sent to the pump by the flow monitor. The pump recognises this as a metering error and after 8 missing acknowledged pulses, a fault annuciation is emitted.

For pump g/4-1601, the metering monitor can only function at a stroke length of ≥ 50% under an operating pressure of 16 bar due to the low flow rate. A stroke length of ≥ 30% is achieved at an operating pressure of 3 bar. For pumps g/4-1201, g/4-1002 and g/5-1602 the minimum stroke length is 45% at the respective maximum operating pressure.

When pumping highly viscous media, the electronic control system can be set in such a way that with the float submerged, pulses at a rate of 3 Hz are constantly issued (outsmart switching), as with highly viscous media there is no guarantee that the float will sink after each stroke, i.e. the float possibly remains submerged over a longer period.

Please note:
The pressure loss, in particular arising in the case of the gamma/ 5 pump due to the characteristic stroke curve (for media with a similar viscosity to water), can amount up to 2 bar for the largest gamma and Vario models, in the case of highly viscous media this figure can of course be higher.

This is to be taken into consideration when selecting the pump and the layout of the discharge lines with additional pressure losses.

Caution: The metering monitor is not a substitute for the float switch. Depending on the set stroke quantity and backpressure there may be no fault indication during air delivery. For this reason, a minimum operating pressure of approx. 1 bar is recommended. Install a level switch if low level is signalled. Magnetic or magnetisable components in the metered medium can cause faults.

2. Installation

2.1 Safety instructions

- The maximum permissible operating pressure for the pumps used may not be exceeded in any operating condition.
- The unions of the flow monitor as well as the connections to the discharge line must be free of leaks when operating under maximum operating pressure.

2.2 Installation

2.2.1 Metering monitor with M 20 x 1.5 connection

- The metering monitor may only be installed in a vertical position.
- Usually the metering monitor is assembled directly onto the delivery connection of the metering pump.
- Before assembly, check by shaking whether the float is moving freely and if necessary blow air through the flow monitor in order to release the float.
- Unscrew the connection set from the delivery connection.
- Mount flow monitor on the delivery connection and screw on connection set.
- Plug in the plug into the socket marked .

2.2.2 Metering monitor with R 5/8'' connection

- A set of adapters is necessary to connect a metering monitor with R 5/8" internal thread.

Connection size of pump	Appropriate set of adapters	
	PP	PVC
M 20 x 1.5 (6-12 mm)	81.71.54.8	81.70.54.0
R 3/4'' (DN 10)	80.52.80.5	80.52.78.9

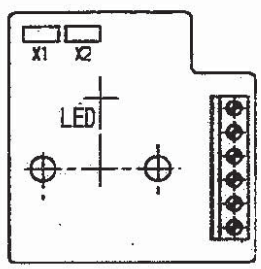
3. Initial operation

3.1 Safety instructions

- The maximum permissible operating pressure for the pumps used may not be exceeded in any operating condition.
- The unions of the flow monitor as well as the connections to the discharge line must be free of leaks when operating under maximum operating pressure.

3.2 Initial operation

- Deactivate the metering monitor on pump, see information in the operating manual of the corresponding pump.
- Start the metering pump.
- Supply the discharge line with the appropriate operating pressure.
- Set the capacity desired via the stroking rate or stroke on the pump.
- Bring the ring initiator into the upper most position until the stop; if no signal is issued in this setting with the pump operating, slowly push the ring initiator downwards until the red LED illuminates for a short time in pace with the metering strokes.
- Press the ring initiator a further 1 mm downwards.
- Reduce the stroke length as a test.
- At approx. 20–50 % reduced stroke length with max. flow and approx. 5–20 % reduced stroke length with min. flow the ring initiator should not issue any more pulses.
- Reset the stroke length to the setting desired. the ring initiator must once again issue pulses.
- If at high metering capacities double pulses should arise (LED illuminates several times in succession per metering stroke) this is not of any importance technically.
- Reactivate the metering monitor on pump.



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For media with a viscosity similar to water, both coding bridges X1 and X2 must be plugged in. For highly viscous media, X2 must be plugged in, not however X1, so that the outsmart switching is active.

4. Maintenance

The metering monitor is made from reliable and tried and proven components. The maintenance is thus essentially limited to observing that the metering monitor is operating correctly.

If it should be necessary to open the flow monitor, the inserts are to be unscrewed using pressure by hand. If it is not possible to unscrew them by hand, the flow monitor can be opened using two fork spanners (size 13 and 17).

When assembling the flow monitor, twist the insert parts by hand on the pipe and tighten about one quarter of a revolution with the fork spanners.

5. Technical data

5.1 Type overview

Operating range for pump type PP/NP/TT, minimum backpressure approx. 1 bar

Metering monitor		Part no.	For use for pump type		
flow Control Typ I, M 20 x 1.5	PP	792076.2	g/4 1601-1003	g/5 1602	
flow Control Typ II, M 20 x 1.5	PP	792077.0	g/4 0308, 0313	g/5 1605-1310	
flow Control Typ III, M 20 x 1.5	PP	792078.8	g/4 0215, 0223	g/5 0613-0423	Vario DN 10
flow Control Typ I, M 20 x 1.5	PVC	792073.9	g/4 1601-1003	g/5 1602	
flow Control Typ II, M 20 x 1.5	PVC	792074.7	g/4 0308, 0313	g/5 1605-1310	
flow Control Typ III, M 20 x 1.5	PVC	792075.4	g/4 0215, 0223	g/5 0613-0423	Vario DN 10
flow Control Typ I, R 5/8"	PP	807117.7	g/4 1601-1003	g/5 1602	
flow Control Typ II, R 5/8"	PP	807118.5	g/4 0308, 0313	g/5 1605-1310	
flow Control Typ III, R 5/8"	PP	807119.3	g/4 0215, 0223	g/5 0613-0423	Vario DN 10
flow Control Typ I, R 5/8"	PVC	807054.2	g/4 1601-1003	g/5 1602	
flow Control Typ II, R 5/8"	PVC	807058.3	g/4 0308, 0313	g/5 1605-1310	
flow Control Typ III, R 5/8"	PVC	807059.1	g/4 0215, 0223	g/5 0613-0423	Vario DN 10

5.2 Material specifications

The materials of the media-contaced parts are PVC/Viton or PP/EPDM

5.3 Dimensions and weights

Installed length R 5/8"
connection approx. 84 mm
Installed length M 20 x 1.5
connection approx. 94 mm
weight: approx. 200 gr

5.4 Electrical data

Supply voltage:	5V +/–5 %
Power drain (max.):	10 mA
Duration of periods with outsmart switching activated:	300 ms +/–150 ms
Pulse extension time:	80 ms +/–30 ms

5.5 Temperature specifications

– permis. storage temperature: –10 °C bis +50 °C
– permis. ambient temperature: –10 °C bis +45 °C
– permis. medium temperature
under max. operating pressure: –10 °C bis +35 °C (acc. to IEC 335-2-41)

6. Enclosure ratings maintained

IP 65 acc. to DIN VDE 0470 part 1, corresponds EN 60529 and IEC 529

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Plastics Limited

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MAINTENANCE & INSTALLATION INSTRUCTIONS
For Chemline Type 21 True Union Ball Valve Size 1/2"- 4"

Installation:

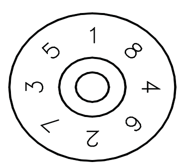
1. Make sure all surfaces are clear and free of debris prior to installing valve in pipeline. Pipeline should be empty at connection site.

2. Valve should be set to the closed position.

3. When installing valves with socket connections, ensure that only PVC solvent cement is used. Excessive use of cement can cause sticking in the valve interior, therefore use caution when applying cement, especially on vertical piping.

4. For threaded connections we recommend the use of sealing tape and, with the use of a strap wrench, to tighten no more than 2 full turns past finger-tight. Use of a pipe wrench can deform the pipe or union nut and cause damage to the valve and/or connection(s).

5. Flanged connections should be torqued evenly and in a symmetrical pattern with a torque wrench and as per the figure and chart below:



RECOMMENDED FLANGE BOLT TORQUES

VALVE SIZE	FLANGE	BOLT TORQUE	IN FT-LB	AXIAL MISALIGNMENT	PARALLELISM (INCH)
	PSI - 50	PSI - 100	PSI – 150		
1½	11	13	14	0.04	0.03
2	13	14	16	0.04	0.03
2½	13	14	16	0.04	0.03
3	18	20	22	0.04	0.03
4	20	20	22	0.04	0.04
5	22	15	29	0.04	0.04
6	25	15	32	0.04	0.04
8	25	32	40	0.06	0.04
10	25	32	40	0.06	0.04
12	29	36	43	0.06	0.04
14	32	36	43	0.06	0.04
16	36	[58-85 PSI]	58	0.06	0.04
18	36	[58-85 PSI]	-		
20	72	-	-		
24	72	-	-		

Maintenance Instructions Type 21 Ball Valve cont.

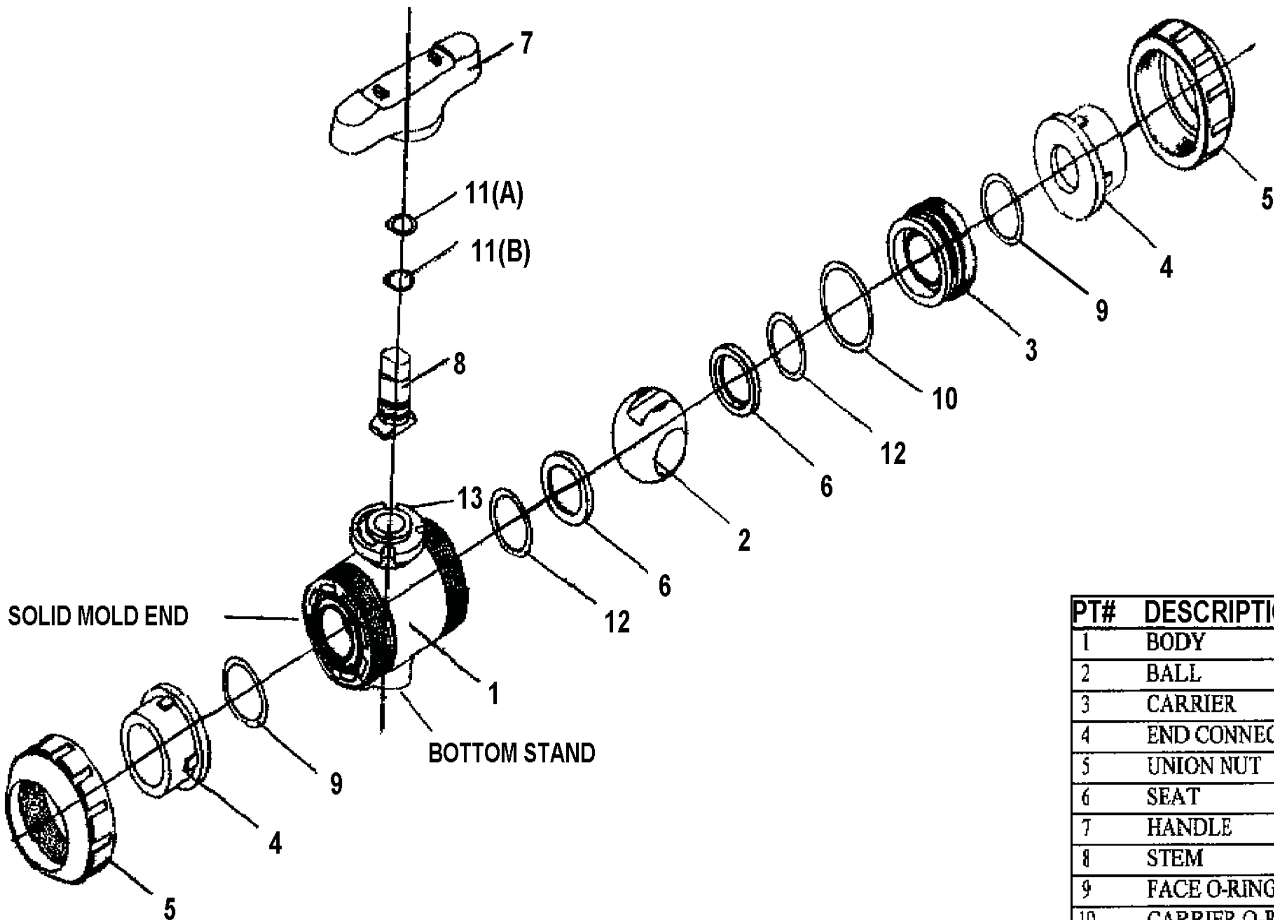
Maintenance:

Refer to **ASSEMBLY DRAWING T21V Rev. 0.** And proceed as follows:

1. Turn valve to the closed position.
2. Unscrew union nut (5) from both ends of valve.
3. Remove end connectors (4).
4. On solid mold end, remove face o-ring (9). This completely disassembles this end of valve.
5. Pull upward on handle (7) to remove.
6. On opposite end of valve, remove face o-ring (9) and use handle (7) as a spanner wrench to remove carrier (3).
7. Remove carrier o-ring (10).
8. Remove seat (6) and seat cushion (12) to expose ball (2).
9. Remove ball (2) by pushing from solid molded end of body.
10. Remove stem (6) by pushing it down into body (1).
11. Remove stem o-rings 11(A) and 11(B) from groves in stem.
12. Remove other seat (6) and seat cushion (12).
13. Inspect all parts for wear and replace as necessary.
14. Before re-assembling valve, lubricate all o-rings with Dow Corning III silicone compound or equivalent.
15. To re-assemble valve follow steps 1 through 10 in reverse order.

NOTE: If mounting actuator on mounting flange (13), make sure handle (7) is removed and stem (6) and actuator are aligned.

After replacing carrier (3), the face of the carrier should remain slightly projected from the end of the body. Make sure the ball rotates smoothly with only a touch of resistance.



PT#	DESCRIPTION	QTY	MATERIALS
1	BODY	1	PVC/PP/PVDF/CPVC
2	BALL	1	PVC/PP/PVDF/CPVC
3	CARRIER	1	CPE/EPDM/VITON/HYP.
4	END CONNECTOR	2	PVC/PP/PVDF/CPVC
5	UNION NUT	2	PVC/PP/PVDF/CPVC
6	SEAT	1	CPE/EPDM/CITON/HYP.
7	HANDLE	1	PVC/PP/PVDF/CPVC
8	STEM	1	PVC/PP/PVDF/CPVC
9	FACE O-RING	2	CPE/EPDM/VITON/HYP.
10	CARRIER O-RING	1	CPE/EPDM/VITON/HYP.
11(A)	STEM O-RING (Upper)	1	CPE/EPDM/VITON/HYP.
11(B)	STEM O-RING (Lower)	1	CPE/EPDM/VITON/HYP.
12	SEAT CUSHION	2	CPE/EPDM/VITON/HYP
13	MOUNTING FLANGE	1	PVC/PP/PVDF/CPVC

TITLE CHEMLINE TYPE 21 TRUE UNION BALL VALVE	SCALE		DATE	CHEMLINE PLASTICS	
	DR. BY				
REFERENCE SIZES 1/2" - 4"	CHKD BY			DWG. NO. T21V	REV. 0
	APP. BY				

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MAINTENANCE INSTRUCTIONS
For Chemline 3/8" - 1-1/2" SB Series Pressure Relief Valves

Installation:

1. Always mount a filter or strainer in the line immediately before the valve to avoid damage to the valve from dirt or particles. Valve is spring operated, therefore can be installed in any orientation.

2. **To adjust pressure use the adjustment screw (8) and a pressure gauge**.
   - the valve will be closed at the set pressure and will start to open when the operating pressure rises above the set pressure.
   - connect the compressed air supply to the inlet of the valve. Adjust the flow of the air to the desired set pressure by turning clockwise to increase the set pressure, counterclockwise to decrease it.
   - with the valve being closed, adjust the screw (8) until the valve starts to open. Fix the adjusting screw in place with the locking nut (9).

3. For installation in an application where the temperature is 0^{o} C or less. Check with Chemline Engineering
Technical staff prior to installation.

Maintenance

Refer to **ASSEMBLY DRAWING SB10/11 rev 0.** And proceed as follows.

1. Loosen and remove cap (10).

2. Loosen counter nut (9) and remove adjustment screw (8).

3. Remove body cap (12a), body bolt (12b), body nut (12c) and washer (12d).

4. Lift up and remove bonnet (2).

5. Remove pressure plate (7a) and ball bearing (7b) to reach relief spring (3).

6. Loosen piston screw (11), remove spring plate (6) and draw piston assembly (5) downward and out of body (1).
   Note: Piston assembly (5) is all parts (5a) outer piston assembly
   (5b) inner piston assembly
   (5c) seat
   (5d) piston o-ring

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MAINTENANCE & INSTALLATION INSTRUCTIONS
For Chemline 2” – 4” SB Series Pressure Relief Valves

Installation:

1. Always mount a filter or strainer in the line immediately before the valve to avoid damage to the valve from dirt or particles. Valve is spring operated, therefore can be installed in any orientation.

2. **To adjust pressure use the adjustment screw (8) and a pressure gauge**.
   - the valve will be closed at the set pressure and will start to open when the operating pressure rises above the set pressure.
   - connect the compressed air supply to the inlet of the valve. Adjust the flow of the air to the desired set pressure by turning clockwise to increase the set pressure, counterclockwise to decrease it.
   - with the valve being closed, adjust the screw (8) until the valve starts to open. Fix the adjusting screw in place with the locking nut (9).

3. For installation in an application where the temperature is 0^{o} C or less. Check with Chemline Engineering
Technical staff prior to installation.

Maintenance:

Refer to **ASEMBLY DRAWING SB1201 rev 0.** And proceed as follows:

1. Loosen and remove cap (10).

2. Loosen counter nut (9) and remove adjustment screw (8).

3. Remove body cap (12c), body nut and bolt (12a) and washer (12b).

4. Lift up and remove bonnet (2).

5. Remove pressure plate (7a) and ball bearing (7b) to reach relief spring (3).

6. Draw piston assembly (5) downward and out of body (1).
   Note: Piston assembly (5) is all parts (5a) outer piston assembly
   (5b) plug
   (5c) seat
   Piston assembly is removed from the body as a unit. It can then be further disassembled into the component parts listed above.

7. Remove diaphragm (4).

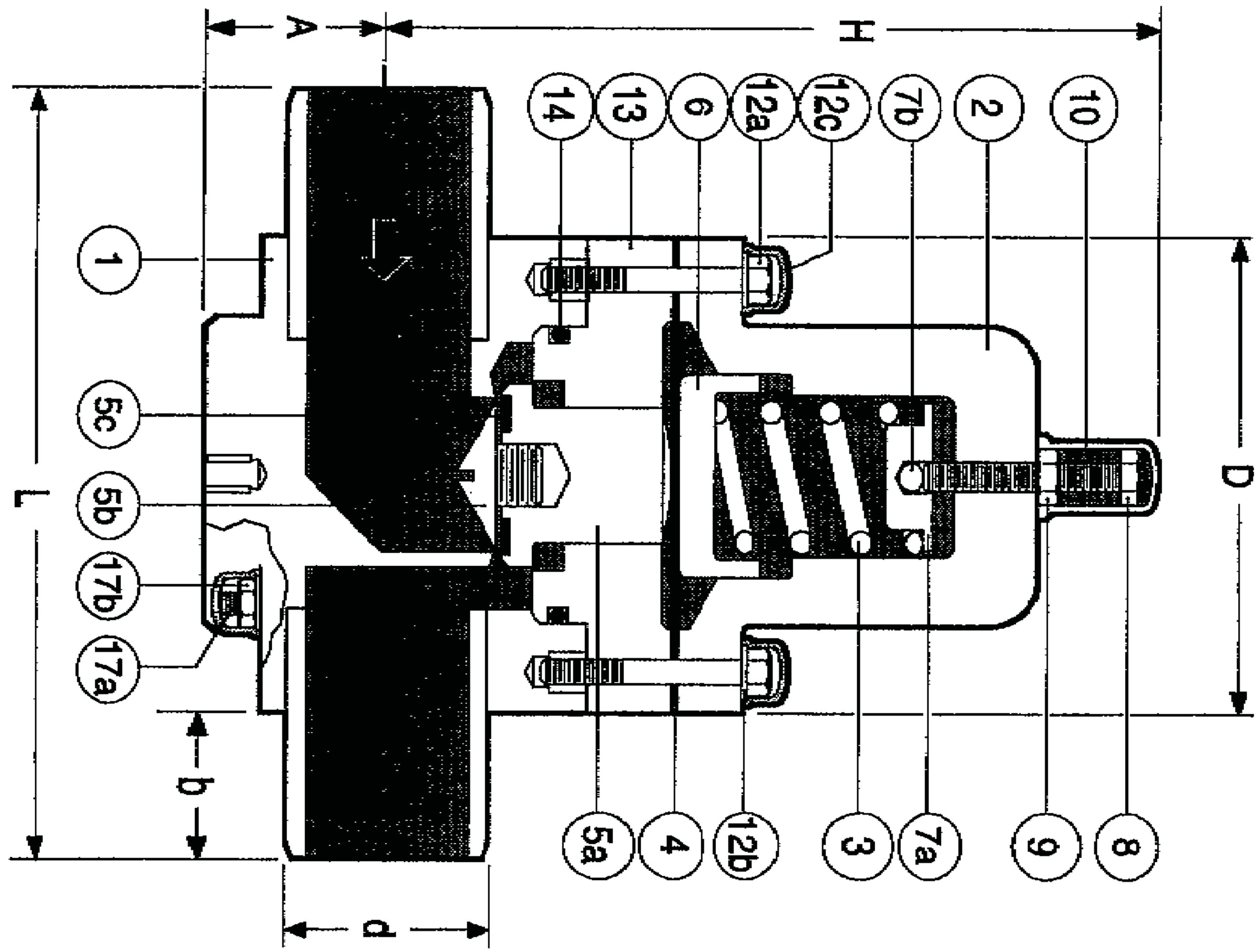
8. Remove seal (14) at intermediate flange (13).

9. Inspect all parts for wear and abrasion, replace seals, diaphragms etc. if necessary.

10. To re-assemble valve follow steps 1 through 10 in reverse order.

TROUBLESHOOTING

FAILURE		REASON	REPAIR
VALVE LEAKS AT DIAPHGRAM (4)		CLAMPING PRESSURE FOR DIAPHRAGM (4) TOO LOW.	TIGHTEN SCREWS (12)
PRESSURE RISES ABOVE SET PRESSURE	{A)	VALVE SEAT (5c) & SEALS (14) ARE DEFECTIVE	CHECK SEALS OF PISTON (5) BODY (14) - REPLACE
	(B)	DIAPHRAGM (4) LEAKING	REPLACE.
	(C)	PISTON (5) BORE AT BODY (1) DIRTY	DISMANTLE PISTON (5) AND CLEAN BORE
VALVE CLOSED (DOES NOT OPEN)		VALVE MOUNTED IN WRONG DIRECTION.	TURN VALVE IN DIRECTION OF ARROWS
FLUIDS PENETRATE ADJUSTING SCREW (8)		DIAPHRAGM (4) DEFECTIVE.	REPLACE DIAPHRAGM (4)
LEAKING AT PLUG AT VALVE BODY		O-RING SEAL LEAKING	DISMANTLE PLUG AND REPLACE SEAL



PART	DESCRIPTION	PCS
1	BODY	1
2	BONNET	1
3	RELIEF SPRING	1
4	DIAPHRAGM	1
5 (a)	OUTER PISTON	1
5 (b)	PLUG	1
5 (c)	SEAT	2
6	SPRING PLATE	1
7 (a)	PRESSURE PLATE	1
7 (b)	BALL BEARING	1
8	ADJUSTING SCREW	1
9	COUNTER NUT	1
10	CAP	1
12 (a)	BODY NUT & BOLT	4/6
12 (b)	BODY WASHER	4/6
12 (c)	BODY CAP	4/6
13	INTERMED. FLANGE	2
14	SEAL	2

TITLE	SCALE		DATE	CHEMLINE PLASTICS
CHEMLINE SB/12 SERIES	DR. BY			
REFERENCE	CHKD. BY			DWG. NO. SB1201 — REV. 0
PRESSURE RELIEF VALVES 2-4"	APP. BY			

Piston assembly is removed from body as a unit. It can then be further disassembled into the component parts listed above.

7 Remove diaphragm (4).

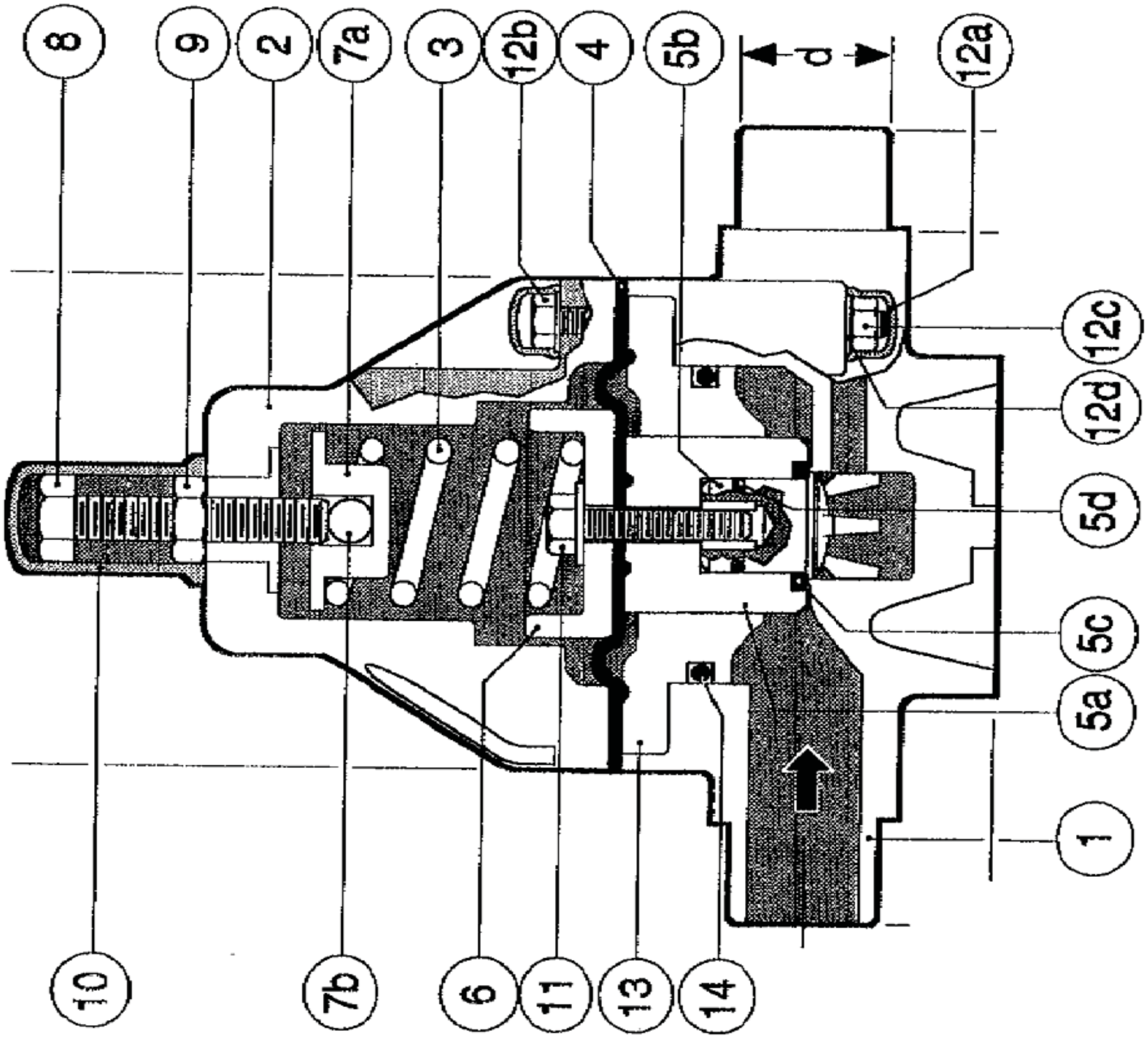
8. Remove seal (14) at intermediate flange (13).

9. Inspect all parts for wear and abrasion, replace seals, diaphragm etc. if necessary.

10. To re-assemble valve follow steps 1 through 9 in reverse order.

TROUBLESHOOTING

FAILURE		REASON	REPAIR
VALVE LEAKS AT DIAPHGRAM (4)		CLAMPING PRESSURE FOR DIAPHRAGM (4) TOO LOW.	TIGHTEN SCREWS (12)
PRESSURE RISES ABOVE SET PRESSURE	{A)	VALVE SEAT (5c) & SEALS (14) & (5d) ARE DEFECTIVE	CHECK SEALS OF PISTON (5) BODY (14) - REPLACE
	(B)	DIAPHRAGM (4) LEAKING	REPLACE.
	(C)	PISTON (5) BORE AT BODY (1) DIRTY	DISMANTLE PISTON (5) AND CLEAN BORE
VALVE CLOSED (DOES NOT OPEN)		VALVE MOUNTED IN WRONG DIRECTION.	TURN VALVE IN DIRECTION OF ARROWS
FLUIDS PENETRATE ADJUSTING SCREW (8)		DIAPHRAGM (4) DEFECTIVE.	REPLACE DIAPHRAGM (4)
LEAKING AT PLUG AT VALVE BODY		O-RING SEAL LEAKING	DISMANTLE PLUG AND REPLACE SEAL



Part	Description	Pcs
1	BODY	1
2	BONNET	1
3	RELIEF SPRING	1
4	DIAPHRAGM	1
5(a)	OUTER PISTON	1
	(PART OF ASSY)	
5(b)	INNER PISTON	1
	(PART OF ASSY)	
5(c)	SEAT	2
	(PART OF ASSY)	
5(d)	PISTON O-RING	2
	(PART OF ASSY)	
6	SPRING PLATE	1
7(a)	PRESS. PLATE	1
7(b)	BALL BEARING	1
8	ADJ. SCREW	1
9	COUNTER NUT	1
10	CAP	1
11	PISTON SCREW	1
12 (a)	BODY CAP	4/6
12 (b)	BODY BOLT	4/6
12 (c)	BODY NUT	4/6
12 (d)	BODY WASHER	4/6
13	INT. FLANGE	2
14	SEAL	2

TITLE CHEMLINE SB PRESSURE RELIEF VALVES	SCALE		DATE		CHEMLINE PLASTICS
	DR. BY				
REFERENCE 3/8" - 1-1/2"	CHKD. BY			DWG. NO. SB1011	REV. 0
	APP. BY				

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MAINTENANCE INSTRUCTIONS
For Chemline S.I. Series Gauge Isolator 1/4"- 1/2"

Maintenance:

Refer to **ASSEMBLY DRAWING GISI Rev 0.** And proceed as follows:

1. Gauge isolators can be mounted and mounted and filled with glycerine at Chemline prior to delivery, or isolators can be mounted and filled on site.

2. Remove isolator from valve.

3. To disassemble isolator remove gauge (4) from upper chamber (3).

4. Remove bolts, nuts and washers (5) and separate upper chamber (3) from lower chamber (1).

5. Drain glycerin (or other fluid) from both chambers (1 & 3), prior to removing diaphragm (2).

6. Check PTFE diaphragm (2) for wear and replace if necessary.

7. Refill upper chamber (3) and replace diaphragm (2).

8. To reassemble diaphragm follow steps 1 through 4 in reverse, to hand-tight plus ¼ turn.

DIMENSIONS (Inches)

Inlet Size 1/2
Instrument Connection 1/4

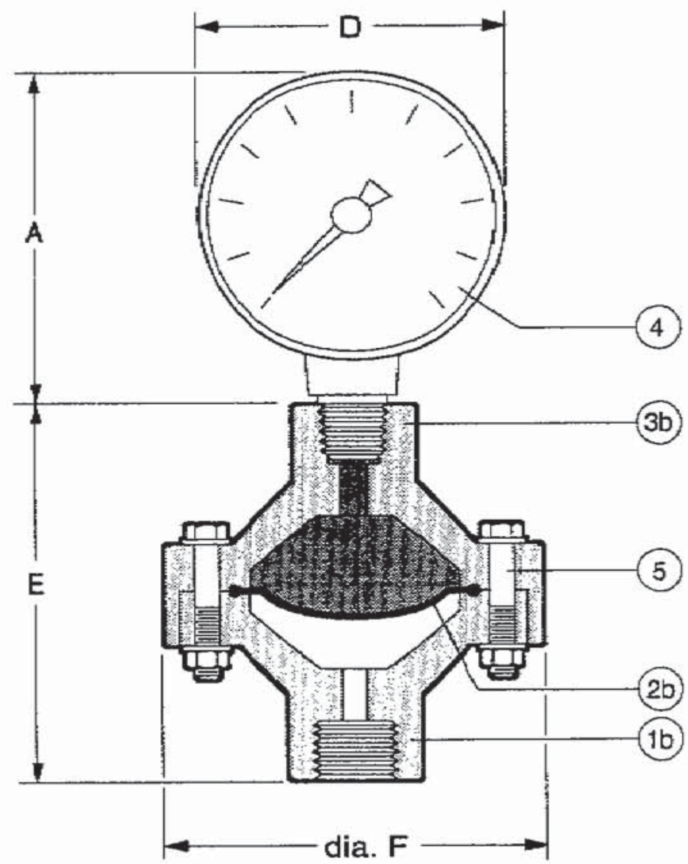
A	B	C	D	E	F
3.0	4.10	2.64	2.50	3.43	3.19

Gauge Isolators S.I. Series cont.

WORKING PRESSURES

TEMPERATURE				
F	C	PVC	PP	PVDF
0	-17	40	-	200
25	-4	130	70	200
50	10	180	130	200
75	24	185	150	200
100	38	160	140	200
125	51	110	120	180
150	66	-	90	160
175	79	-	60	130
200	93	-	-	100
250	120	-	-	60

PART	DESCRIPTION	QTY	MATERIAL
1	LOWER CHAMBER	1	PVC/PP/PVDF
2	DIAPHRAGM	1	TEFLON/PTFE
3	UPPER CHAMBER	1	PVC/PP/PVDF
4	OPTIONAL GAUGE	1	S.S. CASE
5	HEX BOLT/NUT/WASHERS	9	304 SS/M5x30



TITLE	SCALE		DATE	CHEMLINE PLASTICS	
CHEMLINE GAUGE ISOLATOR	DR. BY				
REFERENCE	CHKD. BY			DWG. NO.	REV.
S.I. SERIES 1/4 AND 1/2	APP. BY			GISI	0

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MAINTENANCE INSTRUCTIONS
For Chemline Ball Check Valves and Ball Foot Valves Sizes 1/2” to 4”

Maintenance

Refer to dwg. **APR-050** or **ASSEMBLY DRAWING BC-003 rev.0** and proceed as follows:

1. Loosen union nut (5) and remove valve from line.
(Note: make sure there is no pressure in line prior to removing valve.)

2. **Important** Hold seat/seal (3) in place while removing valve, as the seat, stop ring (6) and ball (2) may fall out.

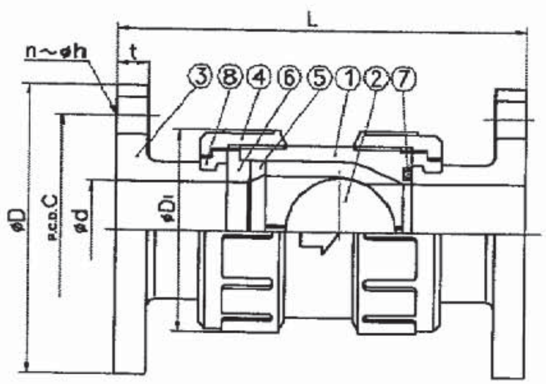
3. Remove seat (3), stop ring (6) and ball (2). Inspect for excessive wear. The ball should not show signs of wear or deformation.

4. When re-installing ball (2), stop ring (6) and seat (3), check inside body for any foreign debris that may have become lodged in the valve.

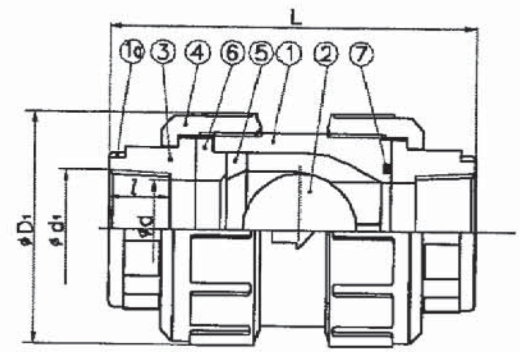
5. Replace union nut (5) and tighten.

6. For Foot Valves with strainer baskets, remove basket (7) and clean thoroughly.

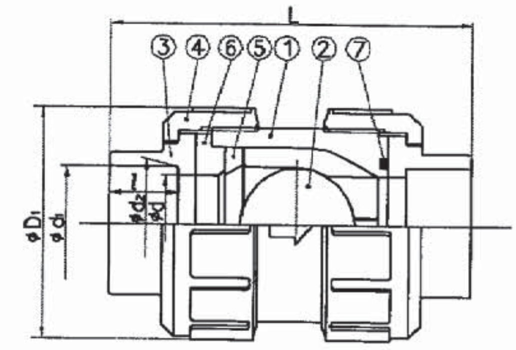
FLANGE END



THREAD CONNECTION



SOCKET CONNECTION



DIMENSIONS TABLE

NOMINAL SIZE		FLANGE □ ANSI 150LBS □ ANSI 125LBS D	C	n	h	L	t	□ THREAD d1	l	L	d	D1
½"	15	3.50	2.38	4	0.63	5.12	0.47	½– 14 NPT	0.59	3.39	0.59	1.89
¾	20	3.86	2.76	4	0.63	6.10	0.55	¾– 14 NPT	0.67	4.06	0.79	2.36
1	25	4.25	3.13	4	0.63	6.50	0.55	1 – 11½NPT	0.79	4.45	0.98	2.76
1¼	30	—	—	—	—	—	—	1¼– 11½NPT	0.87	5.00	1.22	3.78
1½	40	5.00	3.88	4	0.63	7.56	0.63	1½– 11½NPT	0.98	5.94	1.57	3.78
2	50	5.98	4.74	4	0.75	8.43	0.63	2 – 11½NPT	1.10	6.97	2.01	4.17

UNIT: inch

NOMINAL SIZE		SOCKET PVC . C-PVC □ ANSI SCH 40 d1	d2	l	L	□ ANSI SCH 80 d1	d2	l	L	PVDF □ ANSI d1	d2	l	L	PVDF,PP □ IPS d1	d2	l	L
½"	15	0.848	0.836	0.688	3.43	0.848	0.836	0.875	3.80	0.825	—	0.890	3.83	0.831	—	0.625	3.31
¾	20	1.058	1.046	0.719	3.86	1.058	1.046	1.000	4.41	1.030	—	1.015	4.49	1.041	—	1.000	4.43
1	25	1.325	1.310	0.875	4.37	1.325	1.310	1.125	4.88	1.300	—	1.140	4.98	1.305	—	0.815	4.35
1¼	30	1.670	1.655	0.938	4.92	1.670	1.655	1.250	5.55	1.650	—	1.265	5.58	—	—	—	—
1½	40	1.912	1.894	1.094	5.94	1.912	1.894	1.375	6.50	1.890	—	1.390	6.57	1.889	—	1.250	5.57
2	50	2.387	2.369	1.156	6.77	2.387	2.369	1.500	7.44	2.360	—	1.515	7.57	2.364	—	1.250	6.49

NOTE. The shape and appearance of assembly differ a little with nominal size compared to this drawing.

Part No. ____________

Body Material ____________

Elastomer Material ____________

End Connection ____________

Customer ____________

Customer PO# ____________

Chemline PS# ____________

No.	DESCRIPTION	No.REQ'D	MATERIAL	REMARKS
1a	RING	2	STAINLESS STEEL <SUS304>	C-PVC body,thread connection: used for ½"~1"
8	STOP RING (B)	2	PVDF	used for Flange end
7	O-RING	1	□EPDM, □FPM □others( )	
6	SEAT RING	1		
5	STOP RING (A)	1	□ PVC	
4	UNION NUT	2	□ C-PVC	
3	END CONNECTOR	2		
2	BALL	1	□ PP	
1	BODY	1	□ PVDF	

TRUE UNION BALL CHECK VALVE ASS'LY
□FLANGE END, □SOCKET CONNECTION, □THREAD CONNECTION
ANSI : ½ ~ 2"

DRAWN	LC	DATE	SCALE
CHECKED		09/28/99	~
APPROVED		DRAWING No. APR-050	△

CHEMLINE PLASTICS LTD.

ACCU-PULSE Installation and Operation Instructions

Chargeable Models

ACCU-PULSE Unit Information

Serial Number: ______________________ **Model Number:** ____________

Material of Construction: **Body:** ______________________
Bladder: ______________________

Pump Area & Number: ______________________
Date of Purchase: ______________________
Supplier: Company: ______________________
Contact: ______________________
Phone: ______________________

Notes:

- Primary Fluid Systems Inc. recommends installing a pressure relief valve such as TOP VALVE in all pump systems to ensure compliance with pressure limits on system equipment
- Mount ACCU-PULSE as close to pump discharge, inlet and/or quick closing valve as possible
- Temperature and pressure affect the strength and chemical resistancy of plastic and rubber; Consult Primary Fluid Systems Inc. for assistance
- Remove all pressure from ACCU-PULSE unit and pump system before attempting maintenance
- Do not exceed 150 PSI for standard models; 300 PSI for metallic units
- If a system pressure test is to be performed, ACCU-PULSE must be charged with 80% of the system test pressure, prior to test. This will avoid possible bladder damage.

Limited Warranty:

Primary Fluid Systems Inc. (Primary) warrants its products against defects in workmanship or materials for one (1) year under normal use.Primary's obligations and liabilities under this warranty shall be limited to replacement of the product, or a refund of an amount not to exceed the purchase price of the product(s) to which such warranty claim is made. Repairs or replacements are made subject to our inspection of the returned product(s). Primary's decision of one of these alternatives shall be the buyer's exclusive remedy.

This warranty does not extend to damage by corrosion or other decomposition by chemical action. Primary does not warrant damages caused by (a) improper use of the product, (b) unauthorized modification or attachment to product, (c) misuse, abuse, accident or negligent handling or installation of product, or (e) alterations or repairs made by purchaser.The materials of construction offered are recommendations subject in all cases to acceptance by purchaser. These recommendations do not constitute guarantee against corrosion or decomposition, but are based on previous experience and best available information of the industry.

Statements and instructions set forth herein are based on the best information and practices known to Primary, but it should not be assumed that every acceptable safety procedure is contained herein. Of necessity Primary cannot guarantee that actions in accordance with such statements and instructions will result in the complete elimination of hazards and it assumes no liability for accidents that may occur.

Except as specifically provided herein, Primary makes no warranty, representations, promise or guarantee, either express or implied, statutory or otherwise, with respect to the product and technical information including their quality, performance, merchantability, or fitness for a particular purpose.In no event will Primary be liable for indirect, special, incidental, economic, covert or consequential damages arising out of the use or inability to use the product, including without limitation, damages or costs relating to the loss of profits, business and goodwill even if advised of the possibility of such damages. In no event shall Primary's liability exceed the amount paid by you for the product.

The warranty and remedies set forth herein are exclusive and in lieu of all others, oral or written, express or implied. No Primary dealer, distributor, agent or employee is authorized to make any modification or addition to this warranty. This warranty gives you specific legal rights and you may also have other rights which vary from state to state.

PRIMARY FLUID SYSTEMS INC.
Call Toll Free 1-800-776-6580
Tel (905) 333-8743 Fax (905) 333-8746
E-Mail: primary@primary fluid.com
http: www.primaryfluid.com

Pump Discharge Installation: Chargeable Models

Step 1: Mounting Position

Mount ACCU-PULSE as close to the pump discharge as possible to absorb the pulse at its source. The pulsation dampener will optimally perform if mounted at the first 90 ° turn in the discharge piping. If using a flexible connector from the pump to your point of discharge, ACCU-PULSE should be hard piped to the pump discharge manifold, then continue with flexible tubing from dampener. Since pressure is equal in all directions, ACCU-PULSE can be installed in any position - vertically, horizontally, upside down. Primary Fluid Systems Inc. does recommend a vertical position for better draining of the unit.

Limitations for horizontal and upside down mounting include high specific gravity, high viscosity, settling of heavy material or possible air entrapment.

Step 2: Air Line Connection

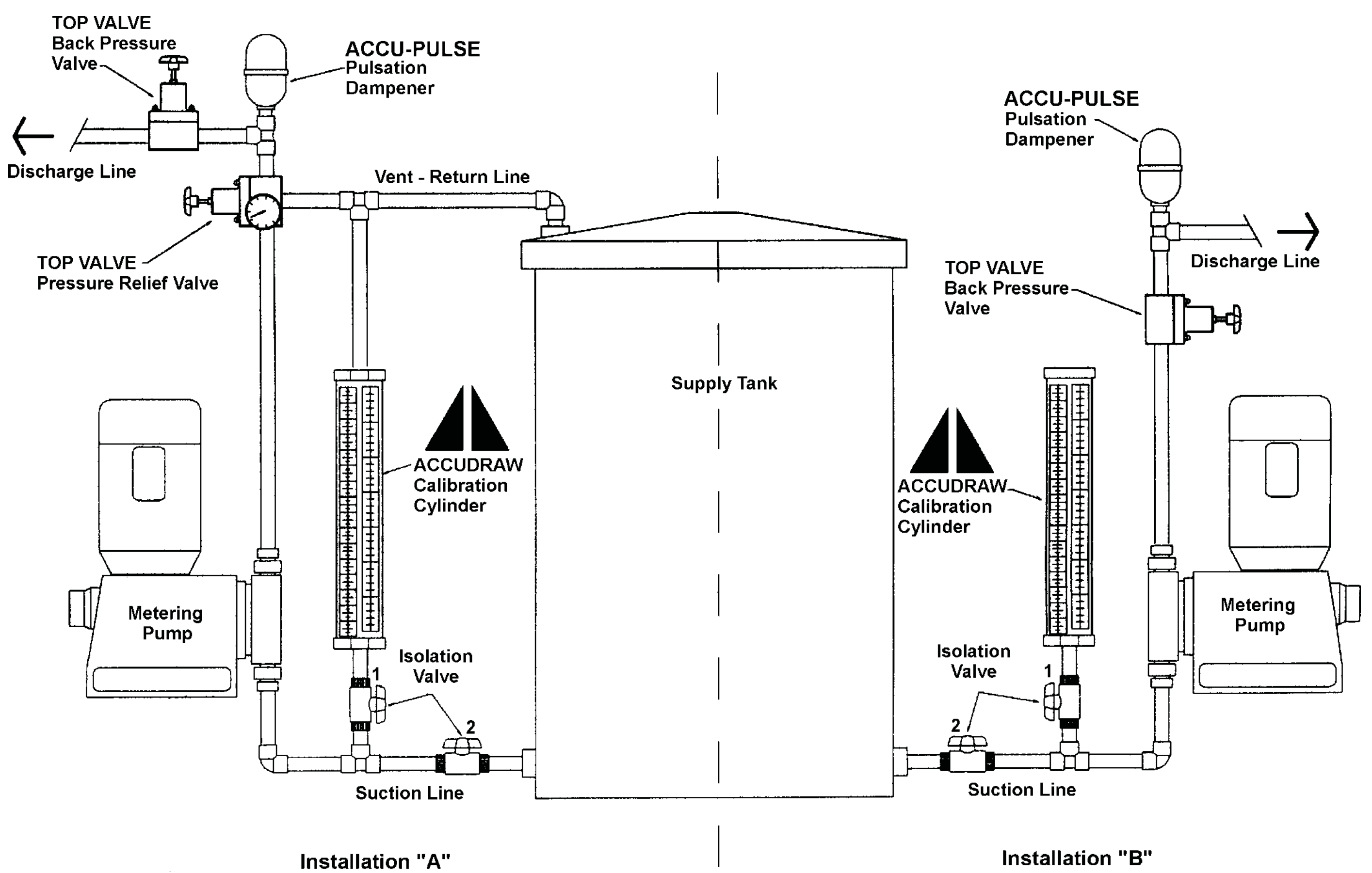
Chargeable models do not require an air line connection, the units must be charged with compressed air or nitrogen, using a hand pump, tank or compressor.

Step 3: Charging and Start Up

Prior to starting the pump, charge ACCU-PULSE with compressed air or nitrogen to approximately 70 to 85% of expected system pressure, to a maximum of 150 PSI for standard models; 300 PSI for metallic models. Start the pump to generate working or system pressure. Once working pressure is achieved, adjustment may be necessary; gradually increase or decrease the gas charge in the dampener by bleeding or filling through the gas valve. Allow the system to respond to each adjustment (this may take a minute or two) before continuing any further adjustments. Generally, pulsation is most effectively minimized when the gas charge is 80 to 85 % of system/pump discharge pressure. Pressure should be checked periodically. Recharge when necessary.

Typical Installations

The installations below are typical installation examples only. Consult your engineering department for the appropriate installation of your application or call the factory for advice.



ACCU-PULSE Safety Warnings

This dampener should only be installed and used by experienced and trained professional mechanics. Observe all safety warnings. Read all safety warnings and operating manuals before using or repairing this Pulsation Dampener (hereafter referred to as “dampener”).

General Safety

This dampener is not intended to be used as a stand alone machine. EU member states must note: Do not use this dampener before it is combined into another machine or assembly that complies with all relevant EU safety directives and that the assembler’s CE mark is affixed on completion.

The internal dampener pressure will equal the maximum fluid pressure of the system in which it is installed.

Do not exceed maximum pressure as stated on dampener tag. If tag is missing, do not use this dampener without consulting distributor or factory for maximum pressure rating.

Always make sure safety shut off valves, regulators, pressure relief valves, gauges etc. are working properly before starting system or assembly.

Always wear protective gloves, safety glasses, etc. when working on or near this dampener.

Before starting a system or assembly, make certain the discharge point of the piping system is clear and safe, and all persons have been warned to stand clear.

Always wear safety glasses when installing, charging or repairing this dampener.

Do not put your face or body near dampener when the system assembly is operating or dampener is pressurized.

Do not operate a dampener that is leaking, damaged, corroded or otherwise unable to contain internal fluid, air or gas pressure.

Do not pump incompatible fluids through the dampener. Consult your distributor or the factory if you are not sure of the compatibility of the fluids with the dampener materials.

Dampeners are designed to operate with compressed air or nitrogen. Other compressed gases have not been tested and may be unsafe to use in dampeners.

Bleed all pressure from system and dampener before removing equipment from the system.

Always shut off air supply, bleed internal dampener pressure and shut isolation valve before performing maintenance or repair on dampener.

Static spark can cause an explosion resulting in severe injury or death. Ground dampeners and pumping system when pumping flammable fluids.

Equipment Misuse Hazard

General Safety:
Any misuse of this equipment such as over pressurization, modifying parts, incompatible chemicals, using worn or damage parts or using gases other than air or nitrogen to charge dampener is not recommended. Any of these circumstances could result in serious bodily injury, death, fire, explosion or property damage.

Over-Pressurization:
Never exceed the maximum operating pressure recommended for the dampener model being used. Maximum operating pressure is stated on tag. Pressure limits are stated at 20°C / 70°F.

Temperature Limits
Do not exceed the recommended operating temperatures for the shell and elastomer materials, independently. Excessive temperature will result in dampener failure.
Temperature limits are stated at zero psig / bar.

Installation and Start Up Hazards:
Install dampener before charging or pressurizing.

Do not start system or assembly without first charging or pressurizing dampener. Failure to charge may result in damage to the elastomeric bladder.

Temperature & Pressure Hazard:
Temperature and pressure reduce the strength and chemical resistance of plastic, metal and rubber.

Charging / Pressurization:
Charge or pressurize the dampener with compressed air or nitrogen only. **Do NOT use oxygen.**

Dampener Bladder Failure:
Dampeners utilize an elastomeric membrane to separate system fluid from the air supply or gas charge. When this membrane ruptures, system fluid may be expelled from the air valve. Always perform preventive maintenance and replace elastomers before excessive wear occurs.

Maintenance Hazards:
Never over-tighten clamp bands. This may cause leakage of system fluid and damage to dampener shell.

3.3 Electromagnetic Flowmeter

ModMAG®

M-Series® | B-MAG Electromagnetic Flow Meters

M-Series® M2000

Electromagnetic Flow Meter

Badger Meter

MAG-UM-01272-EN-05 (February 2015)

User Manual

CONTENTS

SAFETY PRECAUTIONS AND INSTRUCTIONS

Some procedures in this manual require special safety considerations. In such cases, the text is emphasized with the following symbols:

Symbol	Explanation
⚠WARNING	Warning indicates the potential for severe personal injury, death or substantial property damage. Comply with the instructions and proceed with care.
⚠CAUTION	Caution indicates the potential for minor personal injury or property damage. Comply with the instructions and proceed with care.

SYSTEM DESCRIPTION

The Badger Meter M-Series® model M2000 electromagnetic flow meter is intended for fluid metering in most industries including water, wastewater, food and beverage, pharmaceutical and chemical.

The basic components of an electromagnetic flow meter are:

- The **detector**, which includes the flow tube, isolating liner and measuring electrodes.
- The **amplifier**, which is the electronic device responsible for the signal processing, flow calculation, display and output signals.

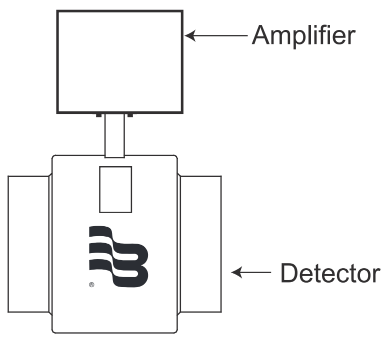


Figure 1: Amplifier and detector

The construction materials of the wetted parts (liner and electrodes) should be appropriate for the specifications on the intended type of service. We recommend that you review all of the compatibilities consistent with the specifications.

Each meter is factory tested and calibrated. A calibration certificate is included with each meter.

UNPACKING AND INSPECTION

Follow these guidelines when unpacking the M-Series equipment.

- If a shipping container shows any sign of damage, have the shipper present when you unpack the meter.
- Follow all unpacking, lifting and moving instructions associated with the shipping container.
- Open the container and remove all packing materials. Store the shipping container and packing materials in the event the unit needs to be shipped for service.
- Verify that the shipment matches the packing list and your order form.
- Inspect the meter for any signs of shipping damage, scratches, or loose or broken parts.

NOTE: If the unit was damaged in transit, it is your responsibility to request an inspection report from the carrier within 48 hours. You must then file a claim with the carrier and contact Badger Meter for appropriate repairs or replacement.

- All detectors with polytetrafluoroethylene (PTFE) liners are shipped with a liner protector on each end to maintain proper form of the PTFE material during shipping and storage.

NOTE: Do not remove the liner protectors until you are ready to install.

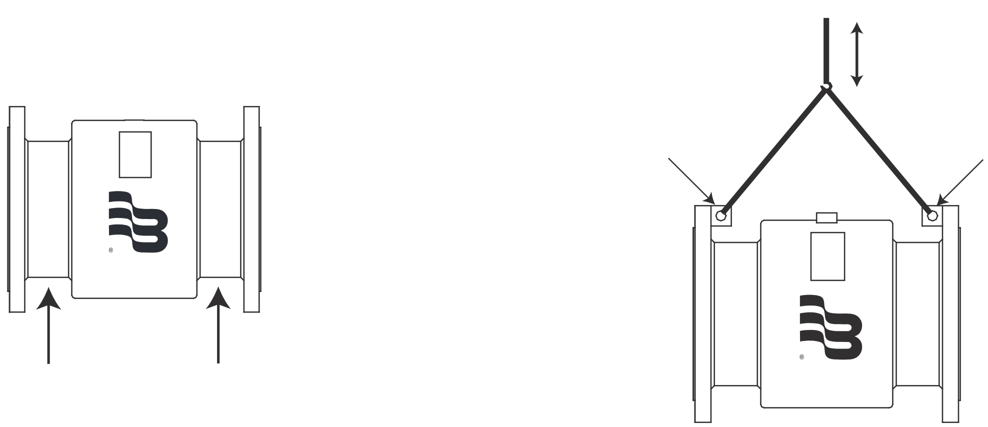
- Storage: If the meter is to be stored, place it in its original container in a dry, sheltered location. Storage temperature ranges are: –40…160° F (–40…70° C).

Rigging, Lifting and Moving Large Units

⚠CAUTION

When rigging, lifting or moving large units, follow these guidelines:

- DO NOT lift or move a meter by its amplifier, junction box or cables.
- Use a crane rigged with soft straps to lift and move meters with flow tubes that are between two inches and eight inches (50 mm and 200 mm). Place the straps around the detector body, between the flanges, on each side of the detector.
- Use the lifting lugs when lifting meter flow tubes that are 10 inches (250 mm) in diameter or larger.



Place straps between flanges.

Use lifting lugs with 10-inch or larger meters.

Figure 2: Rigging large units

- Use the sling-rigged method to lift large detectors into a vertical position while they are still crated. Use this method to position while they are still crated. Use this method to position large detectors vertically into pipelines.

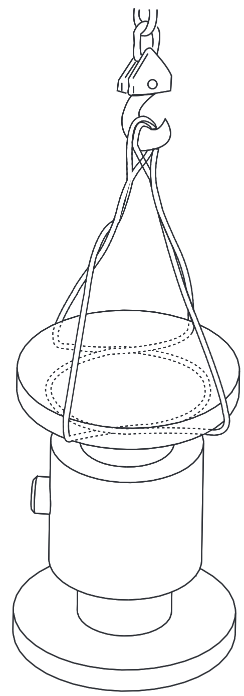
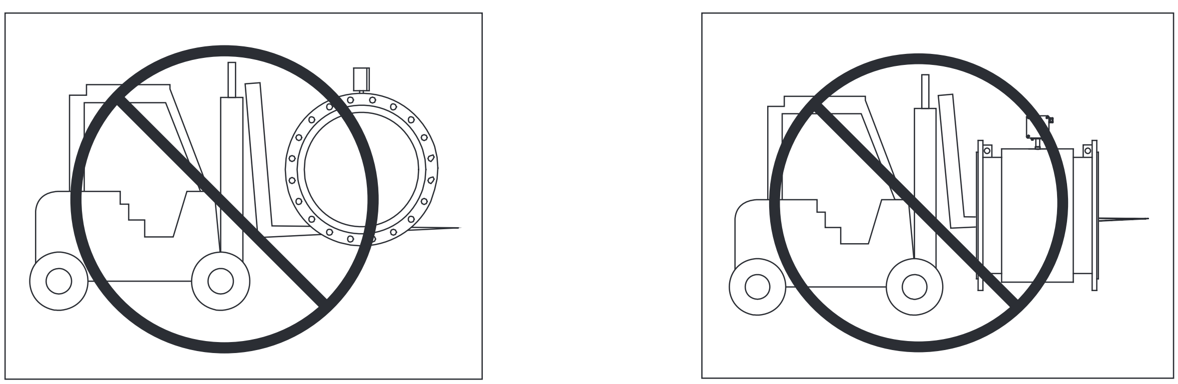


Figure 3: Sling-Rigged lifting methods

- Do not lift a detector with a forklift by positioning the detector body on the forks, with the flanges extending beyond the lift. This could dent the housing or damage the internal coil assemblies.
- Never place forklift forks, rigging chains, straps, slings, hooks or other lifting devices inside or through the detector's flow tube to hoist the unit. This could damage the isolating liner.



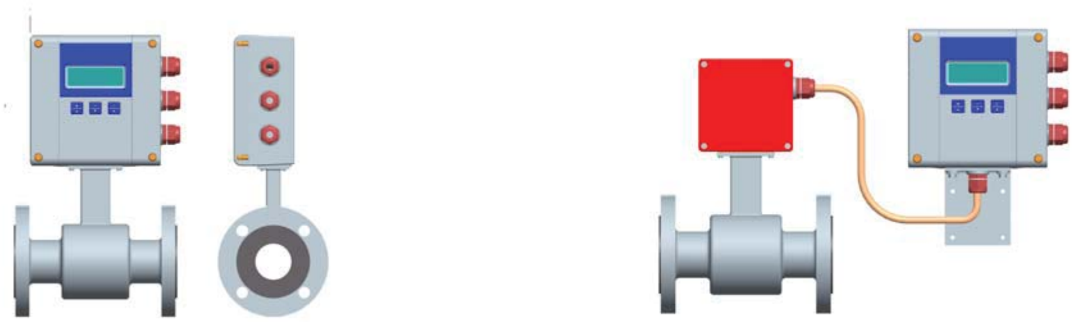
Do not lift detector with forklift.

Do not lift or rig lifting devices through detector.

Figure 4: Lifting and rigging cautions

METER LOCATION, ORIENTATION AND APPLICATIONS

The M2000 provides two amplifier mounting options: a meter mount option and a remote mount option.



Meter mount *Remote mount*

Figure 5: Amplifier mounting options

Remote Amplifier Outdoor Location

The amplifier can be installed and operated outdoors. However, it must be protected from the elements, as follows:

- The ambient environment/temperature rating for the unit is –4…140° F (–20…60° C).
- If an indoor location is within 500 feet (152 meters) of the detector, consider increasing the cable length and mounting the amplifier indoors.
- At minimum, fabricate a roof or shield over and/or around the amplifier to protect the LCD display screen from direct sunlight.

Pipelines and Fluid Flow

Take the following precautions during installation:

- Do not install the meter on pipes with extreme pipe vibrations. If pipes are vibrating, secure the piping with appropriate pipe supports in front of and behind the meter. If vibrations cannot be restrained, mount the amplifier in a remote location.
- Do not install the detector close to pipeline valves, fittings or impediments that can cause flow disturbances.
- For detectors with PTFE liners, do not install the detector on suction sides of pumps.
- Do not install the detector on outlet sides of piston or diaphragm pumps. Pulsating flow can affect meter performance.
- Avoid installing the detector near equipment that produces electrical interference such as electric motors, transformers, variable frequency, and power cables.
- Verify that both ends of the signal cables are securely fastened.
- Place power cables and signal cables in separate conduits.
- Place the meter where there is enough access for installation and maintenance tasks.

Meter Orientation

Mag meters can operate accurately in any pipeline orientation and can measure volumetric flow in forward and reverse directions as long as the pipe is completely full.

NOTE: A "Forward Flow" direction arrow is printed on the detector label.

Vertical Placement

Mag meters perform best when placed vertically, with liquid flowing upward and meter electrodes in a closed, full pipe.

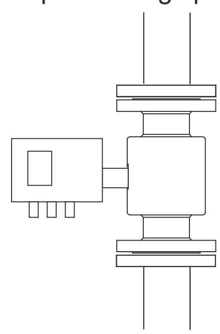


Figure 6: Vertical placement

Vertical placement allows the pipe to remain completely full, even in low flow, low pressure applications, and it prevents solids build-up, sediment deposit and accumulation on the liner and electrodes.

NOTE: Carefully observe the "Forward Flow" label on the meter body and install the meter accordingly. When installed vertically, rotate amplifier so that cable glands are facing down.

Horizontal Placement

M2000 meters are equipped with an *Empty Pipe Detection* feature. If an electrode mounted in the pipe is not covered by fluid for five seconds, the meter will display an Empty Pipe Detection condition. The meter will send out an error message and stop measuring flow. When the electrode is again covered with fluid, the error message disappears and the meter will begin measuring.

When installing the meter on a horizontal pipe, mount the detector to the pipe with the flow-measuring electrode axis in a horizontal plane (three and nine o'clock). This placement helps prevent solids build-up, sediment deposit and accumulation on the electrodes.

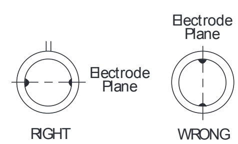


Figure 7: Horizontal placement

Straight Pipe Requirements

Sufficient straight-pipe runs are required at the detector inlet and outlet for optimum meter accuracy and performance. An equivalent of three diameters of straight pipe is required on the inlet (upstream) side. Two diameters are required on the outlet (downstream) side.

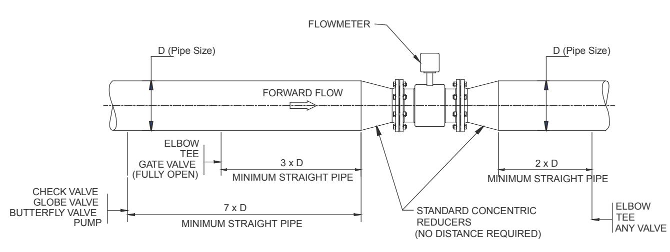


Figure 8: Straight pipe requirements

Pipe Reducer Requirements

With pipe reducers, a smaller meter can be mounted in larger pipelines. This arrangement may increase low-flow accuracy.

There are no special requirements for standard, concentric, pipe reducers.

Custom fabricated pipe reducers must have an approximate slope angle of 15 degrees to minimize flow disturbances and excessive loss of head. If this is not possible, install the custom pipe reducers as if they were fittings and install the required amount of straight pipe.

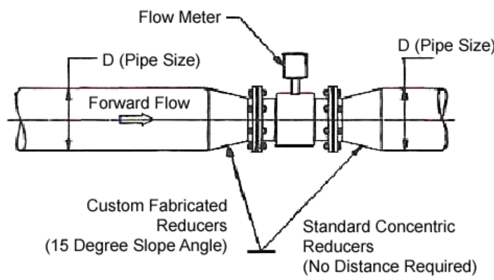


Figure 9: Pipe reducer requirements

Chemical Injection Applications

For water line applications with a chemical injection point, install the meter upstream of the injection point. This eliminates any meter performance issues.

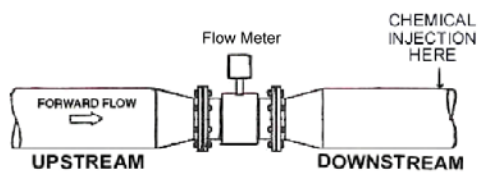


Figure 10: Chemical injection point upstream of meter

If a meter must be installed downstream of a chemical injection connection, the distance between the meter and the injection point should be between 50 and 100 feet (15 and 30 meters). The distance must be long enough to allow the water/chemical solution to reach the meter in a complete, homogeneous mixture. If the injection point is too close, the meter senses the two different conductivities for each liquid. This will likely result in inaccurate measurements. The injection method – spaced bursts, continuous stream of drips or liquid or gas – can also affect downstream readings by the meter.

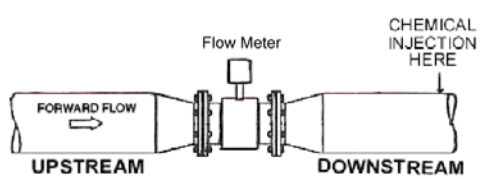


Figure 11: Chemical injection point downstream of meter

Sometimes, due to circumstances, it is difficult to specify the exact downstream placement distances. Contact Badger Meter Technical Support to review your application if necessary.

Partially-Filled Pipe Situations

In some locations, the process pipe may be momentarily only partially filled. Examples include: lack of back pressure, insufficient line pressure and gravity flow applications.

To eliminate these situations:

- Do not install the meter at the highest point of the pipeline.
- Do not install the meter in a vertical, downward flow section of pipe.
- Always position the ON/OFF valves on the downstream side of the meter.

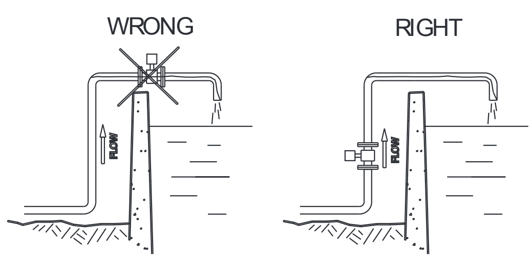


Figure 12: Incorrect meter placement

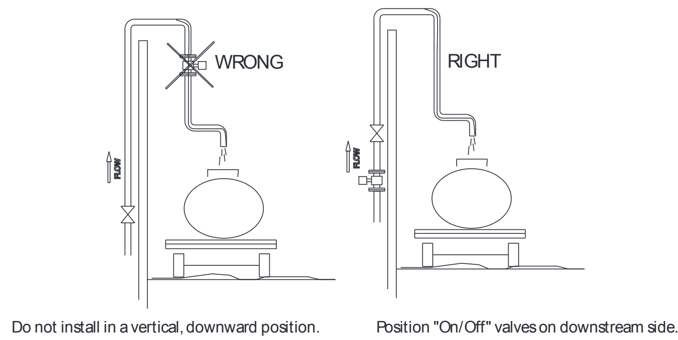


Figure 13: Position valves on downstream side

To minimize the possibility of partially-full pipe flows in horizontal, gravity or low pressure applications, create a pipe arrangement that ensures the detector remains full of liquid at all times.

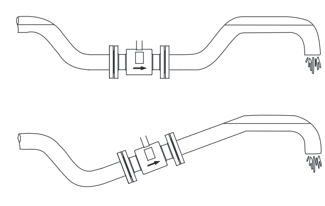


Figure 14: Pipe positioned to keep water in detector

METER GASKETS AND GROUNDING

Gasket and grounding requirements must be considered when determining the meter location, orientation and application.

Meter/Pipeline Connection Gaskets

You must install gaskets (not provided) between the detector's isolating liner and the pipeline flange to ensure a proper and secure hydraulic seal. Use gaskets that are compatible with the fluid. Center each gasket on the flange to avoid flow restrictions or turbulence in the line.

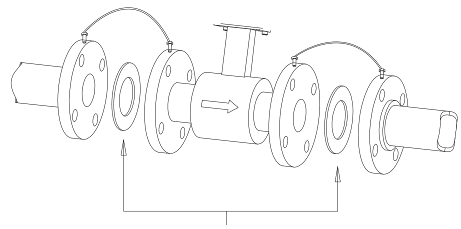


Figure 15: Meter/pipeline connection gaskets

During installation, do not use graphite or any electrically conductive sealing compound to hold the gaskets. This could compromise the accuracy of the measuring signal.

If you are using a grounding ring in the detector/pipeline connection, place the ring between two gaskets. (See *"Non-Conductive Pipe Grounding" on page 13*.)

Meter Grounding

Process pipeline material can be either electrically conductive (metal) or not electrically conductive (made of or lined with PVC, fiberglass or concrete).

IMPORTANT

It is essential that the mag meter amplifier's input ground (zero voltage reference) be electrically connected to the liquid media and to a good, solid earth ground reference.

Conductive Pipe Grounding

To achieve an adequate ground, the meter body MUST be electrically connected to the liquid media. The mag meter flanges are provided with grounding bolts for this purpose.

If the pipe material is electrically conductive, simply install grounding straps between these grounding bolts and the mating flanges.

To ensure a good electrical connection at the mating flanges, we recommend that you drill and tap the flanges and install a grounding screw (not provided).

These grounding straps must be copper wire, at least 12 AWG size. They must be connected on both sides (inlet and outlet) of the detector and to a local, earth ground.

Non-Conductive Pipe Grounding

IMPORTANT

If the process pipe is not electrically conductive (PVC, fiberglass, cement-lined pipes or any other non-conductive material) and the meter was not originally ordered with an optional grounding electrode, you must install a pair of grounding rings between the mating flanges at both ends of the meter. See the following illustration.

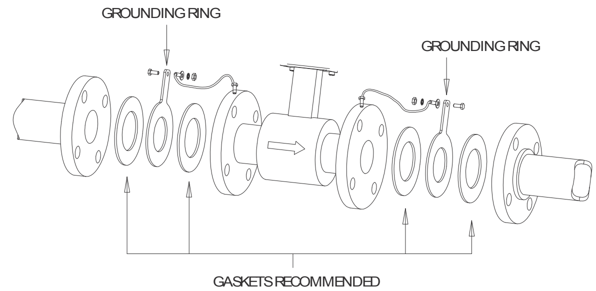


Figure 16: Non-conductive pipe grounding

In this case, the grounding straps should be connected to both of the grounding rings and to a good, solid earth ground. Grounding rings are available in stainless steel. If your fluid is too aggressive for stainless steel, order a meter with the optional grounding electrode in a material compatible with the fluid.

AMPLIFIER MOUNTING CONFIGURATION OPTIONS

There are two configuration options for mounting the amplifier. There are many options to accommodate a variety of meter-placement and environmental conditions.

Meter Mount Configuration

The meter mount configuration has the amplifier mounted directly on the detector. This compact, self-contained configuration minimizes installation wiring.

Remote Mount Configuration

The remote mount configuration places the amplifier at a location away from the fluid flow and detector. This is necessary in situations where process fluid temperature or the environment exceeds amplifier ratings.

The detector and amplifier are connected by wires, run through conduit, between junction boxes on the detector and the amplifier. The distance between the detector junction box and amplifier junction box can be up to 500 feet (152 meters). A remote mounting bracket is supplied.

Submersible Option

If you are installing the meter in a vault, you should order the remote amplifier option. You must not install the amplifier inside a vault. We also recommend ordering the remote meter package with the submersible option (NEMA 6P). This will eliminate any potential problems resulting from humidity or temporary flooding in the vault.

NOTE: The National Electronics Manufacturer's Association (NEMA) 6P enclosures are constructed for indoor or outdoor use to provide protection against access to hazardous parts; to provide a degree of protection against ingress of solid foreign objects and water (hose directed water and the entry of water during prolonged submersion at a limited depth); that provide an additional level of protection against corrosion and that will be undamaged by the external formation of ice on the enclosure.

WIRING

Wiring Safety

⚠WARNING

AT INSTALLATION, BE SURE TO COMPLY WITH THE FOLLOWING REQUIREMENTS:

- Disconnect power to the unit before attempting any connection or service to the unit.
- Do not bundle or route signal lines with power lines.
- Keep all lines as short as possible.
- Use twisted pair shielded wire for all output wiring.
- Observe all applicable, local electrical codes.

Opening the M2000 Cover

The M2000 amplifier's design lets you open the cover without completely removing it.

⚠WARNING

COVER IS ATTACHED WITH DISPLAY RIBBON CABLE.

To open the cover you will need a blade screwdriver.

Follow these steps:

1. Disconnect power to the unit.
2. Completely remove the two screws from either the left or the right side of the amplifier.
3. Loosen each of the remaining screws so that the round head of the screw clears the top edge of the cover.
4. Lift and pivot the cover into the open position.

Power Connections

External Disconnect

⚠CAUTION

- Install an external disconnect switch or circuit breaker that meets local standards.
- Position the M2000 in an accessible location.
- Position and identify the disconnect device so as to provide safe and easy operation.
- Label the disconnect device as being for the mag meter.

AC Power Wiring

For the AC power connections, use three wire-sheathed cable with an overall cable diameter of 0.2…0.45 inch (5…12 mm). For signal output, use 18…22 gauge (0.25…0.75 mm^2) shielded wire. Overall cable diameter between 0.12…0.35 inch (3…9 mm).

⚠CAUTION

TO PREVENT ACCIDENTS, CONNECT MAIN POWER ONLY AFTER ALL OTHER WIRING HAS BEEN COMPLETED.

The amplifier is a microprocessor device. It is important that the power supply be as "clean" as possible. Avoid using power lines that feed heavy loads: pumps, motors, *etc.* If dedicated lines are not available, a filtering or isolation system may be required.

Power wiring is the same for meter mount and remote mount amplifiers.

Remote Mount Installation

If you are installing the M2000 amplifier in a remote location, review the procedures in this section.

Mount Bracket to Amplifier

1. Align bracket-mounting holes with amplifier mounting holes.
2. Attach bracket to amplifier with supplied screws. Torque screws to 80 inch pounds.

Wiring Configuration

Wiring between the detector and the M2000 amplifier comes complete from the factory. If your installation requires the use of conduit, we recommend that you follow these steps when wiring the detector to the amplifier.

1. Remove the junction box lid. Carefully remove the wires connected to the terminal blocks that run to the M2000 amplifier. See the chart below for a reference of wire color to terminal connection.
2. Run cable through the conduit from the amplifier location while retaining the wiring of the cable to the amplifier, as supplied.
3. Complete conduit assembly on both ends and rewire the cable into the junction box as it was previously wired.

Wiring for Remote Configuration

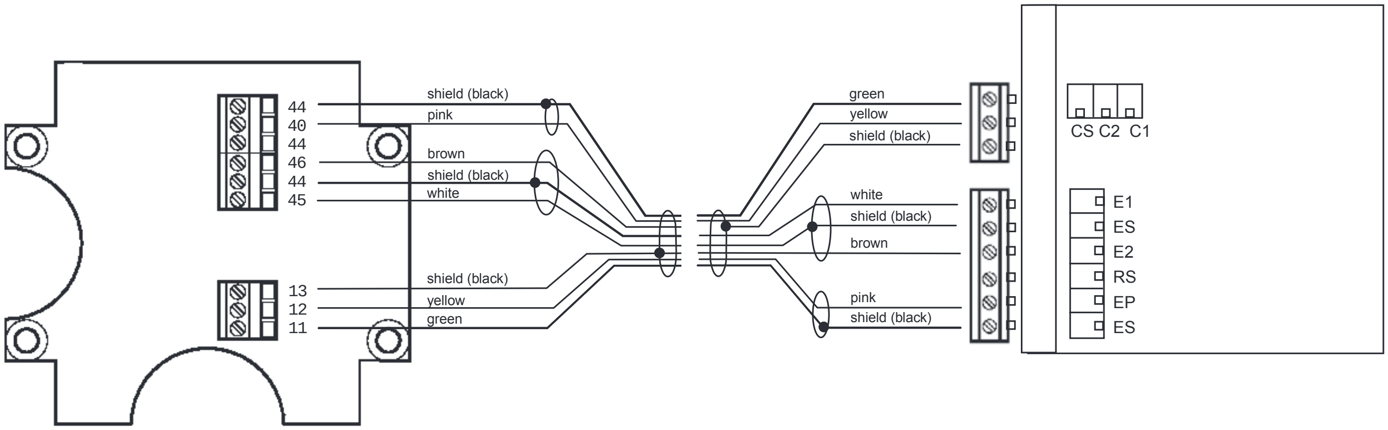


Figure 17: Wiring for remote configuration

Remote style M2000 amplifier models can be ordered with standard cables measuring 15, 30, 50,100 and 150 feet. In addition, cables up to 500 feet are available.

Junction Box			Amplifier
Connection No.	**Description**	**Wire Color**	**Connection**
11	Coil	Green	C1
12	Coil	Yellow	C2
13	Main Shield	Black (Red Ferrule)	CS
45	Electrode	White	E1
44*	Electrode Shield	Black	ES
46	Electrode	Brown	E2
40	**Empty Pipe**	Pink	EP
44*	**Empty Pipe Shield**	Black	ES

*Connections with the No. 44 are lying on the same potential.

Empty Pipe Detection Considerations

Take into account the following cable length and conductivity requirements, if you will be using empty pipe detection.

Cable Length (Feet)	Minimum Conductivity Required (µS/cm)
0*	5
100	20
500	100

*** Meter Mount**

CONFIGURING INPUT/OUTPUT (I/O)

This section describes wiring the following M2000 inputs/outputs:

- Analog output
- Digital input
- Digital outputs
- Communication

Once the sensor and the amplifier have been wired, wire any inputs and outputs to the M2000 amplifier.

Do not connect the main power connection until you have made all other wiring connections. Follow all of the safety precautions and local code to prevent electrical shock and damage to the electronic components.

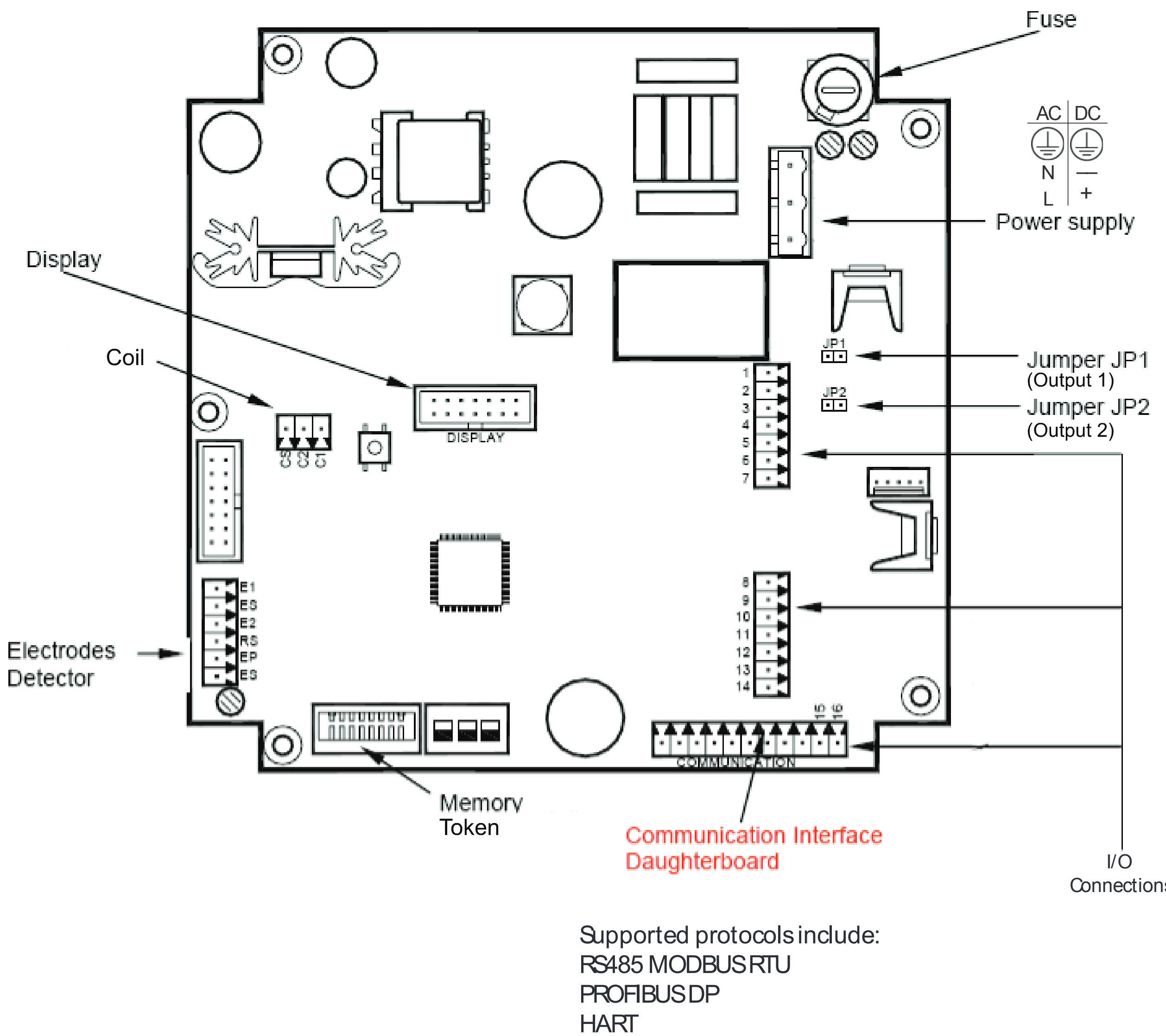


Figure 18: Configuring input/output

Input/Output	Description	Terminal
Analog Output	0…20 mA Resistive Load < 800 ohms 4…20 mA Resistive Load < 800 ohms 0…10 mA Resistive Load < 800 ohms 2…10 mA Resistive Load < 800 ohms	16 (+) 15 (–)
Digital Output 1	Passive max. 30V DC, 100 mA Active 24V DC, 50 mA (set Jumper JP1) Max. Frequency 10 kHz	1 (+) and 2 (–)
Digital Output 2	Passive max. 30V DC, 100 mA Active 24V DC, 50 mA (set Jumper JP2) Max. Frequency 10 kHz	3 (+) and 4 (–)
Digital Output 3	Passive Max 30V DC, 100 mA, 10 kHz Solid State Relay 48V AC, 500 mA, 1 kHz * Software configurable	10 (+) and 9 (–) 10 (+) and 11 (–)
Digital Output 4	Passive Max 30V DC, 100 mA, 10 kHz Solid State Relay 48V AC, 500 mA, 1 kHz * Software configurable	13 (+) and 12 (–) 13 (+) and 14 (–)
Digital Input	5…30V DC	8 (+) and 9 (–)
Communications (Port A)	RS232, configurable, MODBUS RTU, Remote Menu, or Primo 3.1 Emulation.	7 GND 6 Rx 5 Tx

Analog Output Wiring Diagram

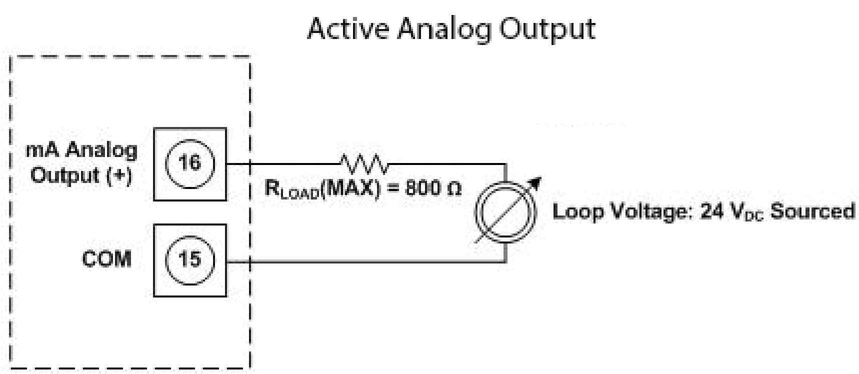
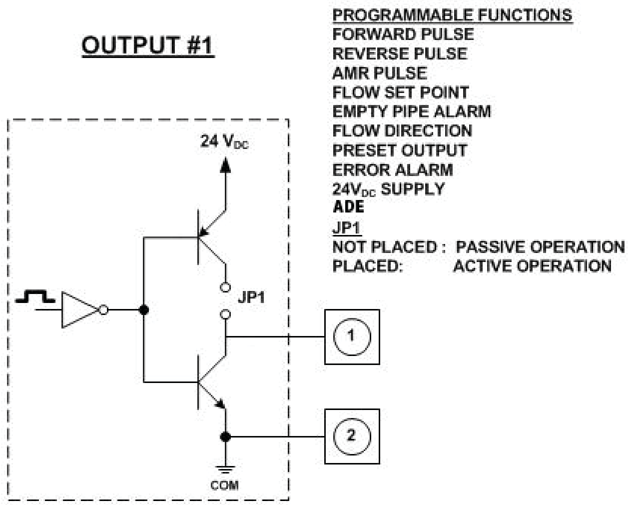
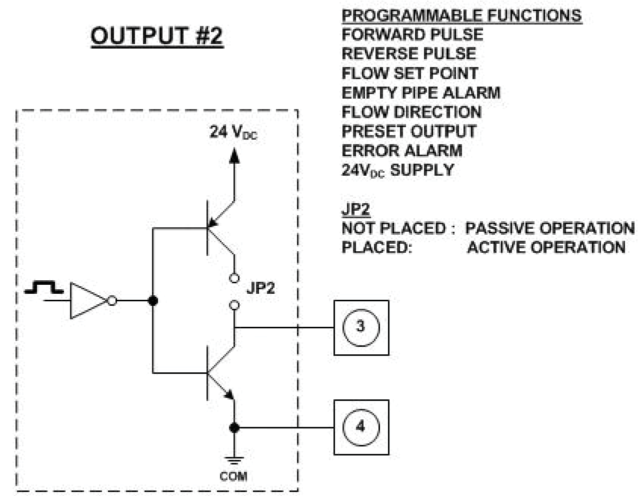
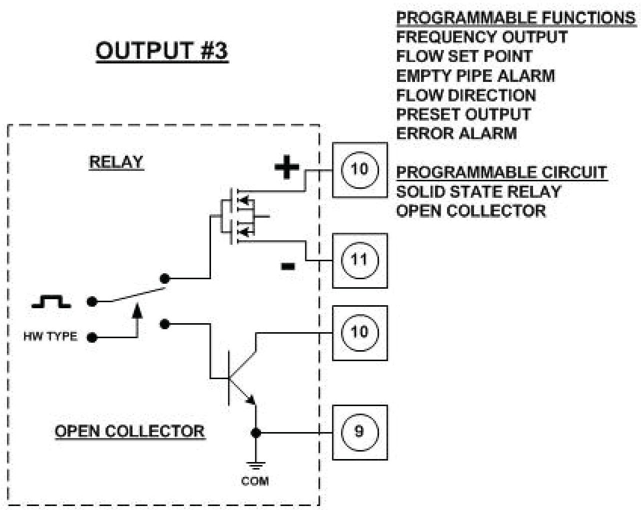


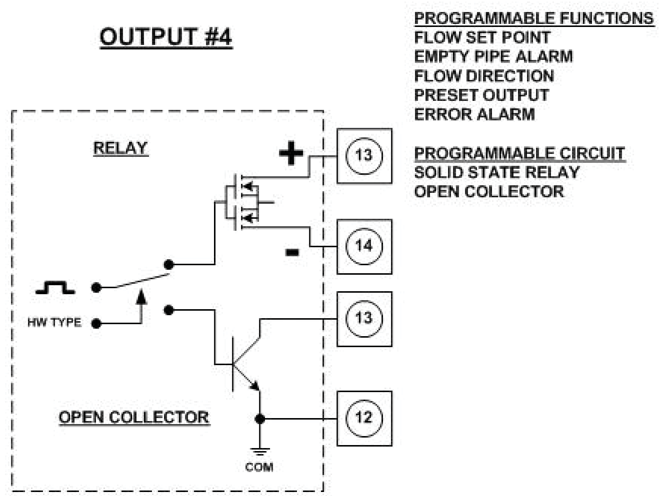
Figure 19: Analog output wiring diagram

Digital Output Wiring Diagrams

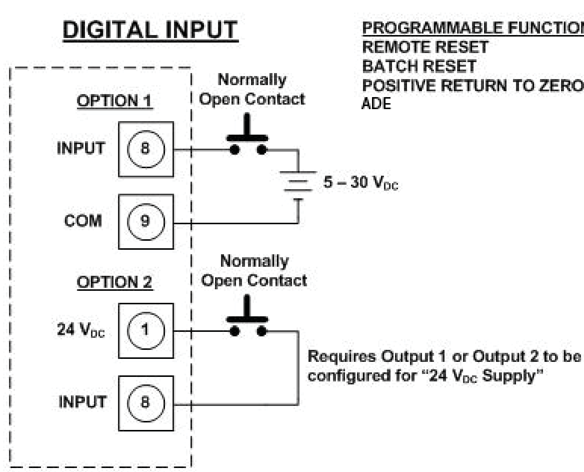








Digital Input Wiring Diagram



PROGRAMMING THE M2000

The M2000 amplifier comes preprogrammed from the factory. Typically, you will not need to do any additional programming. However, to take advantage of special features, you can program the meter for your specific needs. If you will be programming the meter, familiarize yourself with the M2000 Function Buttons and follow the procedures outlined below.

Displays

There are two types of displays on the M2000:

- Menu Selection
- Numeric Entry

Menu Selection Display

Menu selection displays will appear in the following format:

```
DISPLAY TITLE
>Menu Selection 1
 Menu Selection 2
DIRECTIONS LINE
```

Display format

```
START MENU
>Exit this Menu
 Main Menu
MORE: ↑,↓     ENTER:>
```

Example menu

The top line shows the title of the display screen. Below that are two visible menu selections. The bottom line provides directions for user input.

Typically, a menu contains more options than will fit in the two menu selection lines. Press the **[↑]** and **[↓]** buttons to scroll the display text up and down one line at a time. When the arrow is pointed to your desired menu option, press **[E]** to select the item and open its display.

Numeric Entry Display

Numeric entry displays will appear in the following format:

```
DISPLAY TITLE
   Description Line
    Numeric Value
DIRECTIONS LINE
```

Display format

```
LOW FLOW CUTOFF
 % of    300.000 GPM
       2.00%
CHG: +,-      NEXT:E
```

Example numeric entry display

The top line shows the title of the display screen. The second line is a description of the value. The third line shows the current value. The bottom line provides directions for user input.

NOTE: The bottom line of a numeric-value display provides prompts regarding the function of each button. The [+] or [–] button will change the value of the numeral. The [E] button will move the cursor one digit to the right. When the cursor is at the final, right-most digit, pressing [E] will reposition the cursor at the left-most digit. The bottom line display will change to reflect the new function of the [E] button. Press [E] to save the current entry. Press [+] to edit the current entry.

```
LOW FLOW CUTOFF
 % of    300.000 GPM
       3.00%
EDIT:+        SAVE:E
```

Details on how to change and set numeric values are described in the following section.

Function Buttons

All M2000 programming is accomplished using the three function buttons located on the front of the amplifier:

NOTE: Throughout this manual, the buttons will be referred to as: [↑] or [+] and [↓] or [–], depending on the context. The "Enter" button will be referred to as [E].

Consider the **[+ | ↑]** button as the "next step" or "scroll text up" button. During programming, pressing this button will go to the next menu selection, or increment a numeral.

Example 1: The illustration below shows the M2000 *Main Menu*. The selection arrow is pointing to the Exit this Menu selection.

To scroll up to the menu's next selection, press **[↑]** once. The menu text scrolls up to the next menu selection, *Main Menu*.

```
START MENU
>Exit this Menu
 Main Menu
MORE: ↑,↓     ENTER:>
```

Press [↑]

```
START MENU
> Main Menu
  Quick Setup
MORE: ↑,↓     ENTER:>
```

Example 2: Some procedures require you to enter a numeric value. The [+] button is used to increment the selected numeral. The illustration below shows the *Low Flow Cutoff* parameter display. Notice the cursor under the 2 in the ones' place. In this case, press **[+]** once to increment the numeral to the value of 3.00%.

```
LOW FLOW CUTOFF
 % of    300.000 GPM
       2.00%
CHG: +,-      NEXT:E
```

Press [+]

```
LOW FLOW CUTOFF
 % of    300.000 GPM
       3.00%
CHG: +,-      NEXT:E
```


Consider the Down Arrow [– | ↓] button as the "previous step" button. During a procedure, pressing this button will go to the menu's previous selection or decrement a numeral.

Example 1: The illustration below shows the M2000 *Main Menu*. The selection arrow is pointing to the Meter Setup selection. To scroll the text down to the menu's previous selection, Exit this Menu (which is not visible on the display), press **[↓]** once.

```
MAIN MENU
>Meter Setup
 Measurements
MORE: ↑,↓      ENTER:>
```

Press [↓]

```
MAIN MENU
>Exit this Menu
 Meter Setup
MORE: ↑,↓      ENTER:>
```

Example 2: For procedures that require you to enter a numeric value, the [-] button is used to decrement the selected numeral. The illustration below shows the *Low Flow Cutoff* parameter display. Notice the cursor under the 3 in the ones' place. In this case, press the **[-]** once to decrement the numeral to the value of 2.00 %.

```
LOW FLOW CUTOFF
 % of    300.000 GPM
        3.00%
CHG: +,-       NEXT:E
```

Press [–]

```
LOW FLOW CUTOFF
 % of    300.000 GPM
        2.00%
CHG: +,-       NEXT:E
```


The [E] button functions as an "Enter" button, or "cursor right" button.

Example 1: The illustration below shows the M2000 *Main Menu*. The selection arrow is pointing to the Meter Setup selection. Press **[E]** to select Meter Setup, and open the *Meter Setup* display.

```
MAIN MENU
>Meter Setup
 Measurements
MORE: ↑,↓      ENTER:>
```

Press [E]

```
METER SETUP
>Exit this Menu
 Scale Factor
MORE:↑,↓      ENTER:>
```

In cases where you are entering a numeric value, the [E] button does not function as the "Enter" button, but rather, will move the cursor to the right. When the cursor is at the right-most position, the [E] will now serve as the Enter key.

Example 2: The illustration below shows the *Low Flow Cutoff* display. The cursor is under the 3 in the ones' place. In this case, press **[E]** to move the cursor to the right one digit.

```
LOW FLOW CUTOFF
 % of    300.000 GPM
        3.00%
CHG: +,-       NEXT:E
```

Press [E]

```
LOW FLOW CUTOFF
 % of    300.000 GPM
        3.00%
CHG: +,-       NEXT:E
```

SECURITY

The M2000 security feature gives you the option to restrict access to the meter by way of a five-digit Personal Identification Number (PIN). The system administrator can set up a single PIN for each of the three different levels of access:

- **Administration** – allows access to all M2000 menu configuration screens.
- **Service** – allows access to service-level and user-level menu configuration screens.
- **User** – allows access only to user-level menu configuration screens.

Not all levels of access need to be set. If no PINs are set up, any M2000 user will have access to all functions.

NOTE: The security settings will also apply to remote access. All remote writes to the meter will be blocked unless the user is remotely logged in.

Setting the Administration PIN

Users logged in with the Administration PIN have access to all M2000 menu configuration screens.

To set the administrator's PIN, follow these steps from the *Advanced* menu:

1. Select **Security** to view the *Security* menu.
2. Select **Set Admin PIN** to view the *Admin PIN* display.
3. Set the five-digit PIN number to the desired value.
4. Press **[E]** to save the PIN and to return to the *Security* menu.

Setting the Service PIN

Users logged in with the Service PIN have access to service level menu configuration screens. Service users will not have access to administrative screens.

NOTE: In order to set a service-level PIN, you must first set up an administration PIN.

To set the service PIN, follow these steps from the *Advanced* menu:

1. Select **Security** to view the *Security* menu.
2. Select **Set Service PIN** to view the *Service PIN* display.
3. Set the five-digit PIN number to the desired value.
4. Press **[E]** to save the PIN and to return to the *Security* menu.

Setting the User PIN

Users logged in with this User PIN have access to user-level procedures. Users will not have access to administrative or service screens.

NOTE: In order to set a user-level PIN, you must first set up an administration PIN and a service PIN.

To set the user's PIN, follow these steps from the *Advanced* menu:

1. Select **Security** to view the *Security* menu.
2. Select **Set User PIN** to view the *User PIN* display.
3. Set the five-digit PIN number to the desired value.
4. Press **[E]** to save the PIN and to return to the *Security* menu.

Entering Your Personal Identification Number (PIN)

If your system has been set up with PIN security, you will need to enter a PIN to access programming functions. There are three possible access levels, each with its own unique PIN: User, Service and Administration. Your system administrator will provide you with the appropriate PIN.

NOTE: All PINs are factory set to 00000. At this setting, you will not be required to enter a PIN. If the system administrator has not set the PIN, pressing [E] from the *Start Screen* opens the *Main Menu*.
If you forget or misplace your PIN, call Badger Meter Customer Service to get a master password. When you call, have the security code that appears in the upper right corner of the *PIN Request* display.

Follow these steps to enter your PIN in the M2000:

1. At the *Main Menu*, press **[E]**. The *PIN Request* display opens.

```
PIN REQUEST   12345
 Please enter
    pin #:  00000
CHG:+,-       NEXT:E
```

Security Code

2. Press **[+]** to increment the numeral.
3. Press **[E]** to move the cursor to the next digit.
4. Repeat the steps to set each of the five digits to match your PIN.
5. Press **[E].** If you entered a valid PIN, the *Main Menu* opens indicating your level of access.

   If you entered the wrong PIN, you will see the following display:

```
    MENU ACCESS
      DENIED
```

- Press **[E]** to return to the *PIN Request* display.
- Repeat Steps 1 through 5.

NOTE: Be sure to log off when you have completed work with the M2000. Otherwise, there will be a five-minute delay between your last activity and the time when the M2000 will automatically log you off.

SETTING UP THE M2000 WITH QUICK SETUP

The M2000 provides you with a Quick Setup utility that allows you to set or change your Flow Units, Totalizer Units, Full Scale Flow and Low Flow Cutoff settings. To open the Quick Setup, select **Quick Setup** from the *Start Menu*.

Quick Setup

Flow Unit
[GPM]

Flow Unit lets you set the unit of measure for the flow rate and full scale flow.

To change the Flow Unit value, follow these steps from the *Quick Setup* menu.

1. Select **Flow Unit** to view the *Flow Unit* display.
2. Press **[↑]** or **[↓]** to position the arrow next to one of the following Flow Units:

Code	Flow Unit	Code	Flow Unit
LPS	Liters/Second	GPM	Gallons/Minute
LPM	Liters/Minute	GPH	Gallons/Hour
LPH	Liters/Hour	MGD	Mega Gallons/Day
M^3S	Cubic Meters/Second	IGS	UKG/Second
M^3M	Cubic Meters/Minute	IGM	UKG/Minute
M^3H	Cubic Meters/Hour	IGH	UKG/Hour
F^3S	Cubic Feet/Second	LbM	Pounds/Minute
F^3M	Cubic Feet/Minute	OPM	Ounces/Minute
F^3H	Cubic Feet/Hour	BPM	Barrels/Minute
GPS	Gallons/Second		

3. Press **[E]** to save the Flow Units setting.

Totalizer Unit
[USG]

Totalizer Unit establishes the units of measure for the totalizers.

To change the Totalizer Unit value, follow these steps from the *Totalizer Unit* display.

1. Press **[↑]** or **[↓]** to position the arrow next to one of the following Totalizer Units:

Code	Totalizer Unit	Code	Totalizer Unit
L	Liter	UKG	Imperial Gallon
HL	Hectoliter	Lb	Pound
M^3	Cubic Meter	Oz	Fluid Ounce
CFt	Cubic Feet	Aft	Acre Feet
USG	U.S. Gallon	BBL	Barrel
MG	Mega Gallon		

2. Press **[E]** to save the Totalizer Units setting.

<table>
<tr><th colspan="2">Quick Setup</th></tr>
<tr><td>Full Scale Flow</td><td>Full Scale Flow sets the maximum flow the system is expected to measure. This parameter has influence on other system parameters. These parameters include:
• Frequency Output – Full scale frequency is observed at full scale flow
• Low Flow Cutoff – Changes to full scale flow affect the measuring cut-off threshold of the meter
• Alarm Outputs – Changes to full scale flow adjusts the thresholds for generating set point alarms
• Pulse Outputs – Changes to full scale flow adjusts the pulse frequency and duty cycle
• Analog Outputs – Changes to full scale flow adjusts the interpretation of the analog output signal
Change the full scale flow based on the meter size and the application's requirements. Verify that the full scale flow falls within the meter's suggested flow range limits. In terms of flow velocity, the meter's limits are from 0.1 to 39.4 feet/second.
The full scale flow is valid for both flow directions.
NOTE: If the flow rate exceeds the full scale setting, an error message indicates that the configured full scale range has been exceeded. However, the meter will continue to measure. This will affect the latency of the pulse outputs and possibly cause overflow. Furthermore, the analog output may also be placed in alarm mode.
To set or change the Full Scale Flow, follow these steps from the Quick Setup menu:
1. Select Full Scale Flow to view the Full Scale Flow display.
2. Set the full scale flow value to the desired setting.
3. Press [E] to save the full scale flow value and return to the Measurements menu.</td></tr>
<tr><td>Low Flow Cutoff</td><td>Low Flow Cutoff defines the threshold at which flow measurement will be forced to zero. The cutoff value can be set from 0% to 10% of the full scale flow. Increasing this threshold will help prevent false readings during "no flow" conditions possibly caused by pipe vibration or inherent system noise.
To change Low Flow Cutoff, follow these steps from the Low Flow Cutoff display.
1. Set the Low Flow Cutoff value to the desired setting, between 0% and 10%.
2. Press [E] to save the value.</td></tr>
</table>

QUICK REFERENCE

- Main Menu
  - Meter Setup
    - Scale Factor
    - Empty Pipe Detect
    - Power Line Freq
    - Excitation Freq
    - Pipe Diameter
    - Detector Factor
    - Detector Offset
  - Measurements
    - Velocity Unit
    - Flow Unit
    - Totalizer Unit
    - Full Scale Flow
    - Low Flow Cutoff
    - Flow Direction
    - Damping Factor
  - Inputs/Outputs
    - Analog Output
    - Digital Input 1
    - Digital Output 1
    - Digital Output 2
    - Digital Output 3
    - Digital Output 4
    - Flow Simulation
  - Clear Totals
    - T1
    - T2
    - T+
    - T–
    - TN
    - PS
    - Tpwroff
  - Communications
    - Port A Settings
    - Port B Settings
    - Diagnostics
  - Advanced
    - Data Logger
    - Token Copy
    - ADE
    - Unit Multiplier
    - Backlight Control
    - Analog Calibrate
    - Software Filter
    - Empty Pipe Cal.
    - Security
  - Info/Help
    - Error Counts
    - Rollover Counts
    - Power Up Counter
    - Power Off Totalizer
    - Version Info
    - Serial Number
    - Meter Tag Name
    - Daughterboard Info
    - Polarization Volt
    - Restore Defaults
  - Language Select
    - English
    - Espanol

USING THE M2000 MAIN MENU PROGRAMMING OPTIONS

The following M2000 programming options are available from the *Main Menu*:

- *Meter Setup*
- *Measurements*
- *Inputs/Outputs*
- *Clear Totals*
- *Communications*
- *Advanced*
- *Info/Help*
- *Language Select*

In the section that follows, the applicable security level for each menu option is indicated as follows:

A	S	U
Administrative	Service	User

Options that can be set at *Quick Setup* are indicated with:

The factory default values are shown, enclosed in brackets.

NOTE: Options that are listed [Factory Set] should not be changed without specific directions from authorized Badger Meter personnel.

Meter Setup	
Scale Factor [0.0%] S	Changing the scale factor lets you adjust the meter's accuracy without disturbing factory-set parameters. You can tune the meter to meet changing application requirements. For example, if the meter is under registering by 0.5 percent then set the scale factor to +0.5%. If the meter is over registering by 0.5 percent then set the scale factor to –0.5%. To set the Scale Factor, follow these steps from the *Meter Setup* menu: 1. Select **Scale Factor**, to open the *Scale Factor* display. 2. Set the Scale Factor value to the desired setting. 3. Press **[E]**, to save the new value and return to the *Meter Setup* menu.
Empty Pipe Detect [Off] S	When set to On, Empty Pipe Detect indicates to the outputs and the display that the meter is not completely filled. When set to Off, empty pipe detect is disabled. Enabling empty pipe detect requires a one-time calibration. Calibration is described in the *Advanced* menu section under Empty Pipe Cal. To set Empty Pipe Detect, follow these steps from the *Meter Setup* menu: 1. Select **Empty Pipe Detect** to view the *Empty Pipe Detect* display. 2. Position the arrow next to **On** or **Off**. 3. Press **[E]** to save the Empty Pipe Detect On or Off and return to the *Meter Setup* menu.

<table>
<tr><th colspan="2">Meter Setup</th></tr>
<tr><td>Power Line Freq
[60 Hz]</td><td>Power Line Freq provides measuring immunity to industrial noise from a power supply feed.
To set Power Line Frequency, follow these steps from the Meter Setup menu:
Select Power Line Freq to view the Power Line Frequency display.
Position the arrow next to 50 Hz or 60 Hz.
Press [E] to save the power line frequency and return to the Meter Setup menu.</td></tr>
<tr><td>Excitation Freq
[Factory Set]</td><td>The Excitation Freq parameter is set at the factory. You can change Excitation Freq to configure the DC excitation of the coils. Supported frequencies are dependent on the configured power line frequency:<table><tr><th>50 Hz</th><th>60 Hz</th></tr><tr><td>1 Hz</td><td>1 Hz</td></tr><tr><td>3.125 Hz</td><td>3.75 Hz</td></tr><tr><td>6.25 Hz</td><td>7.5 Hz</td></tr><tr><td>12.5 Hz</td><td>15 Hz</td></tr></table>To change Excitation Frequency, follow these steps from the Meter Setup menu:
Select Excitation Freq to view the Excitation Frequency display.
Position the arrow next the desired frequency.
Press [E] to save the excitation frequency and return to the Meter Setup menu.</td></tr>
<tr><td>Pipe Diameter
[Factory Set]</td><td>The Pipe Diameter parameter is set at the factory. In the event the amplifier is replaced, verify that the pipe diameter matches the installed pipe size.
To change Pipe Diameter, follow these steps from the Meter Setup menu:
Select Pipe Diameter to open the Pipe Diameter display.
Position the arrow next to one of the pipe diameters.
Press [E] to save the pipe diameter and return to the Meter Setup menu.</td></tr>
<tr><td>Detector Factor
[Factory Set]</td><td>The Detector Factor parameter is set at the factory. This factor compensates for accuracy error as a result of the installed detector. If accuracy adjustment of the meter is required, please refer to the scale factor.
In the event the amplifier is replaced, this parameter must be reprogrammed with the original detector factor.</td></tr>
<tr><td>Detector Offset
[Factory Set]</td><td>The Detector Offset parameter is set at the factory. This parameter compensates for accuracy error as a result of the installed detector. If accuracy adjustment of the meter is required, please refer to the scale factor.</td></tr>
</table>

<table>
<tr><th colspan="2">Measurements</th></tr>
<tr><td>Velocity Units
[???]
</td><td>Velocity Units lets you set the …</td></tr>
<tr><td>Flow Units
[GPM]
</td><td>Flow Units lets you set the unit of measure for the flow rate and full scale flow. Changing the flow units parameter readjusts the full scale flow parameter. For example, changing from gpm to gps would change the full scale flow from 60 gpm to 1 gps.
To change the Flow Unit, follow these steps from the Measurements menu:
1. Select Flow Units to view the Flow Units display.
2. Position the arrow next to one of the following flow unit options:
<table>
<tr><td>Code</td><td>Flow Unit</td><td>Code</td><td>Flow Unit</td></tr>
<tr><td>LPS</td><td>Liters/Second</td><td>GPM</td><td>Gallons/Minute</td></tr>
<tr><td>LPM</td><td>Liters/Minute</td><td>GPH</td><td>Gallons/Hour</td></tr>
<tr><td>LPH</td><td>Liters/Hour</td><td>MGD</td><td>Mega Gallons/Day</td></tr>
<tr><td>M^3S</td><td>Cubic Meters/Second</td><td>IGS</td><td>UKG/Second</td></tr>
<tr><td>M^3M</td><td>Cubic Meters/Minute</td><td>IGM</td><td>UKG/Minute</td></tr>
<tr><td>M^3H</td><td>Cubic Meters/Hour</td><td>IGH</td><td>UKG/Hour</td></tr>
<tr><td>F^3S</td><td>Cubic Feet/Second</td><td>LbM</td><td>Pounds/Minute</td></tr>
<tr><td>F^3M</td><td>Cubic Feet/Minute</td><td>OPM</td><td>Ounces/Minute</td></tr>
<tr><td>F^3H</td><td>Cubic Feet/Hour</td><td>BPM</td><td>Barrels/Minute</td></tr>
<tr><td>GPS</td><td>Gallons/Second</td><td></td><td></td></tr>
</table>
3. Press [E] to save the flow units and return to the Measurements menu.</td></tr>
</table>

Measurements

Totalizer Unit
[USG]

The Totalizer Unit parameter establishes the units of measure for the totalizers.

To change the Totalizer Unit value, follow these steps from the *Measurements* menu:

1. Select **Totalizer Unit** to view the *Totalizer Unit* display.
2. Position the arrow next to one of the following totalizer units:

Code	Totalizer Unit
L	Liters
HL	Hectoliters
M^3	Cubic Meters
CFt	Cubic Feet
USG	U.S. Gallons
MG	Mega Gallons

Code	Totalizer Unit
UKG	Imperial Gallons
Lb	Pounds
Oz	Fluid Ounces
Aft	Acre Feet
BBL	Barrels

3. Press **[E]** to save the totalizer unit and return to the *Measurements* menu.

Full Scale Flow
[Factory Set]

The Full Scale Flow parameter sets the maximum flow the system is expected to measure. This parameter has influence on other system parameters. These parameters include:

- Frequency Output – Full scale frequency is observed at full scale flow
- Low Flow Cutoff – Changes to full scale flow affect the measuring cut-off threshold of the meter
- Alarm Outputs – Changes to full scale flow adjusts the thresholds for generating set point alarms
- Pulse Outputs – Changes to full scale flow adjusts the pulse frequency and duty cycle
- Analog Outputs – Changes to full scale flow adjusts the interpretation of the analog output signal

Change the full scale flow based on the meter size and the application's requirements. Verify that the full scale flow falls within the meter's suggested flow range limits. In terms of flow velocity, the meter's limits are from 0.1…39.4 feet/second.

The full scale flow is valid for both flow directions.

NOTE: If the flow rate exceeds the full scale setting, an error message indicates that the configured full scale range has been exceeded. However, the meter will continue to measure. This will affect the latency of the pulse outputs and possibly cause overflow. Furthermore, the analog output may also be placed in alarm mode.

To change the Full Scale Flow, follow these steps from the *Measurements* menu:

1. Select **Full Scale Flow** to view the *Full Scale Flow* display.
2. Set the full scale flow value to the desired setting.
3. Press **[E]** to save the full scale flow value and return to the *Measurements* menu.

<table>
<tr><th colspan="2">Measurements</th></tr>
<tr><td>Low Flow Cutoff
[0.2%]</td><td>Low flow cutoff defines the threshold at which flow measurement will be forced to zero. The cutoff value can be set from 0% to 10% of the full scale flow. Increasing this threshold will help prevent false readings during "no flow" conditions possibly caused by pipe vibration or inherent system noise.
To change the Low Flow Cutoff value, follow these steps from the Measurements menu:
1. Select Low Flow Cutoff to view the Low Flow Cutoff display.
2. Set the low flow cutoff value to the desired setting.
3. Press [E] to save the new low flow cutoff value.</td></tr>
<tr><td>Flow Direction
[Bi-Directional]</td><td>Flow Direction lets you set the meter to measure forward flow only (uni-directional) or both forward and reverse flow (bi-directional).
Uni-Directional
Flow is totalized in only one direction. The flow direction is indicated by the arrow printed on the detector label. Uni-directional measurements on the main display screen include:
• T1: Registers forward flow, resettable by menu or MODBUS RTU
• T2: Registers forward flow, resettable by menu, MODBUS RTU, or digital input configured for Remote Reset
Bi-Directional
Flow is totalized in both directions. Bi-directional measurements on the main display screen include:
• T+: Registers forward flow, resettable by menu or MODBUS RTU
• T–: Registers reverse flow, resettable by menu or MODBUS RTU
• TN: Registers total flow, T+ – T–, resettable by menu or MODBUS RTU

To change the flow direction follow these steps from the Measurements menu.
1. Select Flow Direction to view the Flow Direction display.
2. Select Uni-Directional or Bi-Directional.
3. Press [E] to save the flow direction and return to the Measurements menu.</td></tr>
<tr><td>Damping Factor
[No Damping]</td><td>The damping factor establishes the stability of the measured flow rate. If back and forth oscillations of the flow rate are observed during normal flow conditions, increase this value incrementally until the flow rate stabilizes. This parameter has no affect on the totalizers.
To change the Damping Factor value, follow these steps from the Measurements menu.
1. Select Damping Factor to view the Damping Factor display.
2. Select one of the following damping factors:
1 Second   10 Seconds
2 Seconds   20 Seconds
3 Seconds   30 Seconds
4 Seconds   No Dampening
5 Seconds
3. Press [E] to save the damping factor and return to the Measurements menu.</td></tr>
</table>

<table>
<tr><th colspan="3">Inputs/Outputs</th></tr>
<tr><td rowspan="2">Analog Output</td><td>Range
[4 to 20 mA]</td><td>The Analog Output parameter establishes the range of the analog output signal. To change Analog Output range, follow these steps from the Inputs/Outputs menu:
1. Select Analog Output to view the Analog Output display.
2. Select one of the following options:
• 4 to 20 mA
• 0 to 20 mA
• 2 to 10 mA
• 0 to 10 mA
3. Press [E] to save the analog output and return to the Inputs/Outputs menu:</td></tr>
<tr><td>Alarm Mode
[OFF]</td><td>This parameter configures the behavior of the analog output during alarm conditions. Three options exist for this parameter: OFF, LOW, and HIGH.
OFF: Analog signal is based on flow rate and always within the configured range
LOW: During alarm conditions, the analog signal will be 2 mA less than the configured lower range
HIGH: During alarm conditions, the analog signal will be 2 mA more than the configured upper range
For example, if the analog range is 4 to 20 mA and the alarm mode is set to HIGH, then during a full scale flow alarm condition, the analog output current will be 22 mA.
To change the analog output alarm mode, follow these steps from the Inputs/Outputs menu:
1. Select Alarm Mode to view the Alarm Mode display.
2. Select one of the following options:
• OFF
• LOW
• HIGH
3. Press [E] to save the alarm mode and return to the Inputs/Outputs menu.</td></tr>
<tr><td>Digital Input</td><td colspan="2">Digital Input lets you configure the functional operation of the digital input. The following functions are supported:
• Remote Reset – Clears totalizer T2 (uni-directional)
• Batch Reset – Resets batch totalizer PS to preset amount and clears T2 (uni-directional)
• Pos Zero Return – Forces flow rate to zero (does not totalize)
• ADE – Input configured for ADE operation. See "ADE Interface" on page 50.
To change Digital Input, follow these steps from the Inputs/Outputs menu:
1. Select Digital Input to view the Digital Input display.
2. Select the desired function.
3. Press [E] to save the digital input and return to the Inputs/Outputs menu.</td></tr>
</table>

Inputs/Outputs		
Digital Output	Pulses/Unit [1]	The Pulses/Unit parameter lets you set how many pulses per unit of measure will be transmitted to remote applications. For example, assuming the unit of measure is gallons: • Setting the Pulses/Unit to 1 will transmit 1 pulse every gallon • Setting the Pulses/Unit to 0.01 will transmit 1 pulse every 100 gallons You must configure pulses/unit if the function of the selected output is to be forward, reverse or AMR pulse. This parameter must be considered with the Pulse Width and Full Scale Flow parameters. The maximum pulse frequency is 10 kHz. The frequency is correlated with the flow rate. Violation of output frequency limits will generate a configuration error. To change the pulses/unit, follow these steps from the *Inputs/Outputs* menu: 1. Select **Digital Output 1** or **2** and press **[E]** to open the *Digital Output* menu. 2. From the *Digital Output* menu select **Pulses/Unit**, and press **[E]** to open the *Pulses/Unit* display. 3. Enter the pulses/unit value. Press **[E]** to save the new parameter and return to the *Digital Output* menu.
	Pulse Width [0 ms]	The Pulse Width parameter establishes the On duration of the transmitted pulse. The configurable range is from 0 to 1000 ms. • Non-zero pulse width configuration – the Off duration of the transmitted pulse is dependent on flow rate. The Off duration is to be at least the configured On duration. At full scale flow, the On duration equals the Off duration. The maximum configurable output frequency is limited to 500 Hz. • 0 ms pulse width configuration – the duty cycle of the transmitted pulse is at 50 percent allowing for a maximum configurable output frequency of 10 kHz. This parameter must be considered with the Pulses/Unit and Full Scale Flow parameters. The maximum pulse frequency is 10 kHz. The frequency is correlated with the flow rate. Violation of output frequency limits will generate a configuration error. To change the pulse width, follow these steps from the *Inputs/Outputs* menu: 1. Select **Digital Output 1** or **2** and press **[E]** to open the *Digital Output* menu. 2. From the *Digital Output* menu select **Pulse Width**, and press **[E]** to open the *Pulse Width* display. 3. Enter the pulse width value. Press **[E]** to save the new parameter and return to the *Digital Output* menu.

Inputs/Outputs		
Digital Output	Preset Amount [0.0]	Preset amount lets you set the reset value for the associated PS totalizer when the digital input is set to Batch Reset. To change the preset amount, follow these steps from the *Inputs/Outputs* menu: 1. Select **Digital Output 1**, **2, 3 or 4** and press **[E]** to open the *Digital Output* menu. 2. From the *Digital Output* menu select **Preset Amount**, and press **[E]** to open the *Preset Amount* display. 3. Enter the preset amount value. Press **[E]** to save the new parameter and return to the *Digital Output* menu. **NOTE:** You can only set one Preset Amount. If you set the Preset Amount for Digital Output 1, it will be the same for 2, 3 and 4.
	Set Point Min. [0%]	This parameter establishes, as a percentage of full scale flow, the threshold at which the output alarm will be activated. Flow rates below the threshold will activate the output alarm. To change the set point minimum, follow these steps from the *Inputs/Outputs* menu: 1. Select **Digital Output 1**, **2, 3 or 4** and press **[E]** to open the *Digital Output* menu. 2. From the *Digital Output* menu select **Set Point Min.**, and press **[E]** to open the *Set Point Min.* display. 3. Enter the set point minimum value. Press **[E]** to save the new parameter and return to the *Digital Output* menu.
	Set Point Max. [100%]	This parameter establishes, as a percentage of full scale flow, the threshold at which the output alarm will be activated. Flow rates above the threshold will activate the output alarm. To change the maximum set point, follow these steps from the *Inputs/Outputs* menu: 1. Select **Digital Output 1**, **2, 3 or 4** and press **[E]** to open the *Digital Output* menu. 2. From the *Digital Output* menu select **Set Point Max.** and press **[E]** to open the *Set Point Max.* display. 3. Enter the set point maximum value and press **[E]** to save the new parameter and return to the *Digital Output* menu.

Inputs/Outputs		
Digital Output	Output Type [1: Normally Open] [2: Normally Open] [3: Normally Open] [4: Normally Closed]	The Output Type parameter lets you set the output switch to normally open or normally closed. If normally open is selected, the output switch is open (no current) when the output is inactive, and closed (current flows) when the output is active. If normally closed is selected, the output switch is closed (current flows) when the output is inactive, and open (no current) when the output is active. To change the Output Type, follow these steps from the *Inputs/Outputs* main menu: 1. Select **Digital Output 1**, **2, 3 or 4** and press **[E]** to open the *Digital Output* menu. 2. From the *Digital Output* menu**,** select **Output Type** and press **[E]** to open the *Output Type* display. 3. Select **Normally Open** or **Normally Closed**. 4. Press **[E]** to save the new parameter and return to the *Digital Output* menu.
	Hardware Type [3: Open Collector] [4: Open Collector]	The Hardware Type parameter lets you select the type of hardware used to drive the output signal: either open collector or solid-state relay. To change the Hardware Type, follow these steps from the *Inputs/Outputs* main menu: 1. Select **Digital Output 3 or 4** and press **[E]** to open the *Digital Output* menu. 2. From the *Digital Output* menu select **Hardware Type**, and press **[E]** to open the *Hardware Type* display. 3. Select **Open Collector** or **Relay**. 4. Press **[E]** to save the new parameter and return to the *Digital Output* menu.
	Full Scale Frequency [3: 1000 Hz]	The Full Scale Frequency parameter establishes the full scale flow output frequency when the flow rate equals the configured full scale flow. To change the Full Scale Frequency, follow these steps from the *Inputs/Outputs* main menu: 1. Select **Digital Output 3** and press **[E]** to open the *Digital Output* menu. 2. From the *Digital Output* menu select **Full Scale Frequency**, and press **[E]** to open the *Full Scale Frequency* display. 3. Set the full scale frequency value to the desired setting. 4. Press **[E]** to save the new parameter and return to the *Digital Output* menu.

<table>
<tr><th colspan="3">Inputs/Outputs</th></tr>
<tr>
<td>Digital Output</td>
<td>Select Function
[1: Forward Pulse]
[2: Reverse Pulse]
[3: Frequency Pulse]
[4: Error Alarm]</td>
<td>Digital Output lets you configure the functional operation of the associated output. The following operations are supported:

Reverse Pulse – Generates pulses during reverse flow conditions.
Forward Pulse – Generates pulses during forward flow conditions.
Frequency Output – Generates pulses correlated to the absolute value of the flow rate.
Preset Output – Provides indication when preset batch amount has been realized.
Flow Set Point – Provides indication when flow rate exceeds thresholds defined by flow set points.
24V DC Supply – Provides constant 24 volts on output (forces output type to normally open).
Error Alarm – Provides indication when meter has error condition. Error conditions include, empty pipe error, full scale flow error, and detector error.
Flow Direction – Provides indication on current flow direction (Inactive = Reverse or No Flow, Active = Forward).
Empty Pipe Alarm – Provides indication when pipe is empty.
ADE – Provides meter information in digital format. See "ADE Interface" on page 50.

To change the Function Select, follow these steps from the Inputs/Outputs main menu:

Select Digital Output 1, 2, 3 or 4 and press [E] to open the Digital Output menu.
From the Digital Output menu choose Select Function, and press [E] to open the Select Function display.
Select the desired function.
Press [E] to save and return to the Digital Output menu.

</td>
</tr>
<tr>
<td>Flow Simulation
[Off]</td>
<td colspan="2">Flow Simulation provides output simulation based on a percentage of the full scale flow. Simulation will not accumulate the totalizers. The range of simulation includes –100% to 100% of the full scale flow.
The Flow Simulation Parameter lets you set the range of simulation in 10% increments.
To change the Flow Simulation, follow these steps from the Inputs/Outputs menu:

Select Flow Simulation to view the Flow Simulation display.
Click [+] to increment the percentage by 10, or click [–] to decrement the percentage by 10.
Press [E] to save the displayed setting and return to the Inputs/Outputs menu.

</td>
</tr>
</table>

Clear Totals	
T1	The uni-directional totalizer is reset within the menu manager or through remote communications. Clearing T1 also clears the associated rollover counter.
T2	The uni-directional totalizer is reset within the menu manager, through remote communications or with properly-configured digital input (function = remote reset). Clearing T2 also clears the associated rollover counter.
T+	The bi-directional forward flow totalizer is reset within the menu manager or through remote communications. Clearing T+ also clears the associated rollover counter.
T–	The bi-directional reverse flow totalizer is reset within the menu manager or through remote communications. Clearing T– also clears the associated rollover counter.
TN	The bi-directional net totalizer, when reset, clears both the forward and the reverse flow totalizers (T+ and T–). This is reset within the menu manager or through remote communications. Clearing TN also clears the associated rollover counter.
PS	The batch totalizer is reset to the configured preset amount value. It is reset within the menu manager, remote communications or through a properly-configured digital input (function = batch reset).
Tpwroff	The totalizer accumulating meter time without external power is reset with the menu manager or through remote communications.

Communication		
Port A Settings	Interface [MODBUS RTU]	The Interface parameter lets you configure how the RS232 communication port will be used. • MODBUS RTU • Remote menu (RDI – Remote Display Interface) • Primo 3.x • Disable port The remote menu interface will check for display updates once a second. If a change is detected, the display contents will be transmitted in ASCII format over the RS232 communication port. The remote menu interface also allows for menu navigation and control of the meter as if using the external push buttons. Keyboard control characters such as <UP>,<DWN>, and <ENTER> are supported to navigate the menus. The Primo 3.x interface will emulate the legacy Primo 3.x Protocol. This protocol will transmit an ASCII string in the following format every 500 ms: "RATE;0.0000; GPM; TOT1;150.0000; USG ; TOT2;150.0000; USG ;" – For Unidirectional Mode "RATE;0.0000; GPM; TOT+;10.0000; USG ; TOT-;50.0000; USG ;" – For Bidirectional Mode To change the Interface follow these steps from the *Port A Settings* menu: 1. Select **Interface** to view the *Interface* display. 2. Select the desired interface. 3. Press **[E]** to save and return to the *Port A Settings* menu.

Communication		
Port A Settings	Port Address [1]	This parameter establishes the MODBUS RTU address. MODBUS RTU requests will only be processed if the configured port address of the meter matches the request address found in the MODBUS RTU packet. The range of addresses supported by MODBUS RTU is 1…247. MODBUS RTU request packets with an address of 0 imply the packet is to be treated as a broadcast packet. To change the port address, follow these steps from the *Port A Settings* menu: 1. Select **Port Address** to view the *Port Address* display. 2. Select the desired port address **(1…247)**. 3. Press **[E]** to save the option and to return to the *Port A Settings* menu.
	External Port Address [1]	For PROFIBUS® use only. This parameter allows configuration of the PROFIBUS DP daughterboard address.
	Baud Rate [9600]	The following Baud Rates are supported • 9600 • 19200 • 38400 To change the baud rate, follow these steps from the *Port A Settings* menu: 1. Select **Baud Rate** to view the *Baud Rate* display. 2. Select one of the following baud rates: **9600**, **19200** or **38400**. 3. Press **[E]** to save the option and to return to the *Port A Settings* menu.
	Data Bits [8 bits]	The Data Bits parameter configures the port data bits. The following data bits are supported: • 8 bits • 7 bits • 5 bits To change the data bits, follow these steps from the *Port A Settings* menu: 1. Select **Data Bits** to view the *Data Bits* display. 2. Select one of the following: **8 Bits**, **7 Bits** or **5 Bits**. 3. Press **[E]** to save the option and to return to the *Port A Settings* menu.

<table>
<tr><th colspan="3">Communication</th></tr>
<tr><td rowspan="2">Port A Settings</td><td>Parity
[Even]</td><td>The following Parities are supported
Even
Odd
None
To change the parity, follow these steps from the Port A Settings menu:
Select Parity to view the Parity display.
Select one of the following: None, Even or Odd.
Press [E] to save the option and to return to the Port A Settings menu.</td></tr>
<tr><td>Stop Bits
[1 Stop Bit]</td><td>The Stop Bits parameter configures the port stop bits. The following stop bits are supported:
1 Stop Bit
2 Stop Bits
To change the stop bits, follow these steps from the Port A Settings menu:
Select Stop Bits to view the Stop Bits display.
Select one of the following: 1 Stop Bit, or 2 Stop Bits.
Press [E] to save the option and to return to the Port A Settings menu.</td></tr>
<tr><td>Port B Settings</td><td>Port Address
[1]</td><td>An additional communication port, known as Port B, is used to offer enhanced communications with the meter. This port is located on the 11-pin terminal of the PCB. Enhanced protocols like Hart, Profibus DP or Modbus RTU over RS485 are available.
In addition, this communication port has similar configurable properties as port A.
Refer to the following user manuals for additional information regarding the enhanced communication capabilities of the M2000.
HART®communication protocol.
PROFIBUS DP communication protocol.
MODBUS RTU communication protocol.</td></tr>
<tr><td>Diagnostics</td><td>Port Counters
[0]</td><td>Port counters are used for diagnostics when configured for MODBUS RTU. These counters are only cleared on power up.
<table>
<tr><th>Counter</th><th>Description</th></tr>
<tr><td>Pkts Processed</td><td>Number of packets processed by meter.</td></tr>
<tr><td>Broadcast Pkts</td><td>Number of broadcast packets (address = 0) processed by meter.</td></tr>
<tr><td>CRC Errors</td><td>Number of received packets with CRC error; packet is discarded.</td></tr>
<tr><td>Pkts Rcvd</td><td>Number of packets received with an address of the configured port address.</td></tr>
<tr><td>Pkts Sent</td><td>Number of packets transmitted in response to a received packet.</td></tr>
<tr><td>Parity Errors</td><td>Number of characters with parity errors (i.e., received character has a mismatch between the number of 1s and its parity bit); packet is discarded.</td></tr>
<tr><td>Framing Errors</td><td>Number of characters with framing errors (i.e. missing stop bit is not found – indicates that synchronization with the start bit has been lost and that the character is improperly framed); packet is discarded.</td></tr>
<tr><td>Overrun Errors</td><td>Number of characters received that were not processed due to degradation of system performance.</td></tr>
<tr><td>Break Detects</td><td>Number of detections that transmission line is locked (i.e., receive line is low for 10-bit transmissions following a missing stop bit).</td></tr>
</table></td></tr>
</table>

Advanced Features

Unit Multiplier
[Off]

The Unit Multiplier establishes the number of units of measure that have to accumulate before the display totalizers are updated. This is also known as setting the number of "dead" zeroes in the display totalizer. For example:

Unit Multiplier less than 1

Unit Multiplier	Example				
OFF	0.00000 USG	0.00012 USG	0.00123 USG	0.01234 USG	0.12345 USG
0.0001	0.0000 USG	0.0001 USG	0.0012 USG	0.0123 USG	0.1234 USG
0.001	0.000 USG	0.000 USG	0.001 USG	0.012 USG	0.123 USG
0.01	0.00 USG	0.00 USG	0.00 USG	0.01 USG	0.12 USG
0.1	0.0 USG	0.0 USG	0.0 USG	0.0 USG	0.1 USG

Unit Multiplier greater than or equal to 1

Unit Multiplier	Example				
OFF	0.00000 USG	1.23456 USG	12.34567 USG	123.4567 USG	1234.456 USG
1	0 USG	1 USG	12 USG	123 USG	1234 USG
10	0 USG	0 USG	10 USG	120 USG	1230 USG
100	0 USG	0 USG	0 USG	100 USG	1200 USG
1000	0 USG	0 USG	0 USG	0 USG	1000 USG

To change the Unit Multiplier, follow these steps from the *Advanced* menu:

1. Select **Unit Multiplier** to view the *Unit Multiplier* display.
2. Select the desired unit multiplier.
3. Press **[E]** to save the option and to return to the *Advanced* menu.

Backlight Control
[Timed Off]

You can set the meter's backlight to: Always On, Always Off and Timed Off.

When set to Timed Off, the backlight will automatically turn off after one minute of inactivity (no buttons pressed). Pressing any button will turn the backlight on, but will not immediately navigate the menu.

To change the backlight control, follow these steps from the *Advanced* menu:

1. Select **Backlight Control** to view the *Backlight Control* display.
2. Select the desired option.
3. Press **[E]** to save the option and to return to the *Advanced* menu.

Token Copy

Configuration	See the M2000 Store/Restore user manual for details on using the Token Copy features.
Store to Token	
Restore from Token	

ADE

Protocol Type	The protocol type enables the ADE interface. Selecting S1 or S2 will automatically configure the Digital Input and Digital Output #1 for ADE operation. Manually configuring the input and output for ADE operation is not allowed and will result in a on-screen error. See *"ADE Interface" on page 50* for further details. S1 – Standard ADE protocol S2 – Enhanced ADE protocol, provides additional digital information Disabled – disables and removed ADE configuration
Dial Type	4 – 8 dials

Analog Calibrate	Custom Settings [Zero Scale: 0 mA] [Full Scale: 0 mA]	To set the analog calibration custom settings, follow these steps from the *Advanced* menu: 1. Select **Analog Calibrate** to view the *Analog Calibrate* menu. 2. Select **Custom Settings** to view the *Custom Settings* display. 3. Select one of the following: • **Offset 4 mA** • **Offset 20 mA** 4. Configure desired offset. 5. Press **[E]** to save the option and to return to the *Custom Settings* menu. 6. Press **[E]** to return to the *Analog Calibrate* menu.
	Factory Settings [Factory Set]	To change the analog calibration factory settings, follow these steps from the *Advanced* menu: 1. Select **Analog Calibrate** to view the *Analog Calibrate* menu. 2. Select **Factory Settings** to view the *Factory Settings* display. 3. Select one of the following: • **Calibration Point A** • **Calibration Point B** 4. Set the calibration point to the measured output current. 5. Press **[E]** to save the option and to return to the *Factory Settings* menu. 6. Press **[E]** to return to the *Analog Calibrate* menu.

Advanced Features		
Software Filter	Description	The software filter operates as an acceleration filter. This filter when configured properly allows for filtering of fast changes in fluid flow. Generally, this filter is used in applications having highly conductive fluids. This filter is intended to help provide smoothing of the analog output and display fluctuations.
	Activation [Off]	The Activation parameter setting enables or disables the software acceleration filter. To change the Activation setting, follow these steps from the *Advanced* menu: 1. Select **Activation** from the *Advanced* menu. 2. Select the desired setting. 3. Press **[E]** to save the option and to return to the *Advanced* menu.
	Filter Delay [1]	The Filter Delay parameter lets you set the amount of time that the flow will be held constant once the filter is activated. The filter is activated by an acceleration component of the fluid exceeding the configured limit. To change the Filter Delay follow these steps from the *Advanced* menu: 1. Select **Filter Delay,** from the *Advanced* menu. 2. Select the desired setting. 3. Press **[E]** to save the option and to return to the *Advanced* menu.
	Acceleration Factor [1]	The Acceleration Factor parameter lets you set the maximum acceleration for a given pipe diameter and is dependent on the excitation frequency. The maximum fluid velocity is 12 m/s. The following equation defines the maximum fluid acceleration: Acceleration(MAX) = Acceleration Factor * 12 m/s * Pipe Area * Excitation Frequency / 1.5 If the realized fluid acceleration exceeds the configured maximum acceleration, fluid flow will be held constant for the time set at the Filter Delay parameter. To change the Acceleration Factor setting, follow these steps from the *Advanced* menu: 1. Select **Acceleration Factor** from the *Advanced* menu. 2. Select the desired setting. 3. Press **[E]** to save the option and to return to the *Advanced* menu.

Advanced Features		
Software Filter	Constant Flow [150 M^3/Sec^2]	During normal flow conditions, there is always a non-zero acceleration component. For example, if acceleration of the flow activates the filter, the meter will assume constant flow for the duration of the filter delay time unless the flow returns within limits. Properly configured, this parameter will help offset excessive impacts of the filter delay. The Constant Flow parameter lets you set the acceleration limit for constant flow. To change the Constant Flow setting, follow these steps from the *Advanced* menu: 1. Select **Constant Flow** from the *Advanced* menu. 2. Select the desired setting. 3. Press **[E]** to save the option and to return to the *Advanced* menu.
	Peak Detect [0 M^3/Sec^2]	Peak Detect offers a diagnostic view of the acceleration components observed during flow conditions. This parameter records the "high water mark" of the measured accelerations component. This value will help to properly configure the Acceleration Factor parameter. Generally, you will set the acceleration factor at about 75% of the Peak Detect measurement. To reset the Peak Detect setting, follow these steps from the *Advanced* menu: 1. Select **Peak Detect** from the *Advanced* menu. 2. Press **[+]** to reset. 3. Press **[E]** to return to the *Advanced* menu.
MDN Filter	Description	This software filter operates as a Median filter. This filter is very responsive and can be used to help stabilize flow measurements. This filer is enabled by selecting a non-zero filter size. Supported filter sizes are: • S5 - Size 5 • S7 - Size 7 • S9 - Size 9 The filter technique will use the median value of the last Sx samples used for determining flow measurement.:

Advanced Features

Empty Pipe Cal.

[Default]

Fluid conductivity impacts the performance of empty pipe measurements. If you require empty pipe detection, you should perform this empty pipe calibration procedure.

Before starting the empty pipe calibration, verify that empty pipe detection is enabled. Also, run both the empty pipe and the full pipe calibration procedures.

Calibrating an Empty Pipe

Before calibrating an empty pipe, verify that the pipe is empty.

To calibrate with an empty pipe, follow these steps from the *Advanced* menu:

1. Select **Empty Pipe Cal** to view the *Calibration* menus.
2. Select **Cal. Empty Pipe** to view the *Empty Pipe Calibrate* menu.
3. To enable calibration, place the cursor on the calibration enable line and press **[E]**.

```
EMPTY PIPE CALIBRATE
 Volts = 3.00
>Cal [ON]     E=OFF
 Exit with Save
```

4. Wait 30 seconds for voltage measurement to stabilize.
5. To save the setting, place the cursor on **Exit with Save** and press **[E]**.

Calibrating a Full Pipe

Before calibrating a full pipe, verify that the pipe is full.

To calibrate with a full pipe, follow these steps from the *Advanced* menu:

1. Select **Empty Pipe Cal** to view the *Calibration* menus.
2. Select **Cal. Full Pipe** to view the *Full Pipe Calibrate* menu.
3. Enable calibration by placing the cursor on the calibration enable line and press **[E]**.

```
FULL PIPE CALIBRATE
 Volts = 1.515
>Cal [OFF]     E=ON
 Exit with Save
```

4. Wait 30 seconds for voltage measurement to stabilize.
5. To save the setting, place the cursor on **Exit with Save** and press **[E]**.

Advanced Features		
Security	Set Admin PIN [00000]	Users logged in with this PIN will have access to all M2000 procedures. To set the administrator's PIN, follow these steps from the *Advanced* Menu: 1. Select **Security** to view the *Security* menu. 2. Select **Set Admin PIN** to view the *Admin PIN* display. 3. Set the five-digit PIN number to the desired value. 4. Press **[E]** to save the PIN and to return to the *Security* menu.
	Set Service PIN [00000]	Users logged in with this PIN will have access to all service level and user-level procedures. Service users will not have access to administrative procedures. To set the service PIN, follow these steps from the *Advanced* Menu: 1. Select **Security** to view the *Security* menu. 2. Select **Set Service PIN** to view the *Service PIN* display. 3. Set the five-digit PIN number to the desired value. 4. Press **[E]** to save the PIN and to return to the *Security* menu.
	Set User PIN [00000]	Users logged in with this PIN will have access to user-level procedures. User at this level will not have access to administrative or service procedures. To set the user's PIN, follow these steps from the *Advanced* Menu: 1. Select **Security** to view the *Security* menu. 2. Select **Set User PIN** to view the *User PIN* display. 3. Set the five-digit PIN number to the desired value. 4. Press **[E]** to save the PIN and to return to the *Security* menu.

Info/Help		
Error Counts [0] 	Description	This menu provides a diagnostic view of the meter's performance. Below are several system diagnostic counters and their definitions. Use discretion when interpreting these counters. These values could be altered during system setup or when using the verification device. We suggest that you reset these counters before you start monitoring your system and look for conditions possibly affecting performance.
	Detector	The number of times an invalid detector condition has been observed.
	Empty Pipe	The number of times an empty pipe condition has been observed by the meter.
	Full Scale	The number of times the flow has exceeded the full scale flow setting.
	Totalizer	The number of times the totalizers have exceeded limits of the meter.
	Pulse Sync.	The number of times the pulse outputs have fallen out of synchronization.
	ADC Interrupt	The number of times an analog input measurement has been missed.
	ADC Range	The number of times the analog input measurement range has been exceeded.
	System Error	A diagnostic system message indicating the reason for a system reset.
	System Resets	The number of times the meter has been reset.
	System Reset ID	Diagnostic information about a system reset as a result of expired internal timers.
	Token Errors	Indicates the number of parameter copies from a memory token that failed to be copied to the meter.

Info/Help	
Rollover Counts [0]	The number of times the totalizers have rolled over 9,999,999,999 (10 billion). As the meter rolls over, a status indicator appears in the display. When this occurs, we suggest that you record the totalizers and rollover counter and reset the totalizers. Resetting totalizers will also clear the rollover counter. For a meter configured in bidirectional mode, rollover is represented by the net totalizer (TN) as "*********". During this condition, the net totalizer (TN) can be calculated using the following equation: $T(FWD) = [(ROLLOVER_{T+} \times 10{,}000{,}000{,}000) + T+]$ $T(REV) = [(ROLLOVER_{T-} \times 10{,}000{,}000{,}000) + T–]$ $TN = T(FWD) – T(REV)$ *Where $ROLLOVER_{Tx}$ is the rollover count for the appropriate totalizer* For a meter configured in unidirectional mode, the totalizer can be calculated using the following equation: $T1 = [(ROLLOVER_{T1} \times 10{,}000{,}000{,}000) + T1]$ $T2 = [(ROLLOVER_{T2} \times 10{,}000{,}000{,}000) + T2]$ *Where $ROLLOVER_{Tx}$ is the rollover count for the appropriate totalizer*
PowerUp Counter [Not applicable]	The number of times that the unit has been powered on.
Power Off Totalizer [Not applicable]	The length of time that the unit has been without power.
Version Info [Not applicable]	The current software version.
Serial Number [Not applicable]	The manufacturing serial number in the format YYMM####. Where YYMM indicates year and month of manufacturing and #### indicates the sequence number.

Info/Help	
Meter Tag Name	For PROFIBUS – This parameter is only programmable over external PROFIBUS communications.
Daughterboard Information	Describes current version of attached daughterboard. **NOTE:** RS485 daughterboard is not recognized because it is a pass-through device rather than an intelligent protocol converter like Hart-to-MODBUS.
Polarization Voltage	Diagnostic voltage to help determine if the meter or application is performing optimally.
Restore Defaults [Not applicable] 	Restores all non-calibrated parameters to the factory defaults.

Language Select	
Language Select [English] 	The M2000 supports one alternate language along with English. This alternate language choice is set at the factory. The options are: Spanish, German, Czech or French. To select the language, follow these steps from the **Language Select menu**: 1. Select **English** or the **Alternate Language**. 2. Press **[E]** to save the selection.

ADE INTERFACE

This feature requires firmware version 1.10 or later. Reference Badger Meter P/N 6734-003 to obtain a firmware upgrade kit. Enabling the meter as an ADE register requires three settings, all within the advanced menu, to be configured.

- Unit Multiplier – Selects the resolution of the display totalizer.
- Protocol Type – Selects the type of information to be transmitted to the ADE transmitter.
- Dial Type – Enables ADE and selects the number of significant totalizer digits to transmit.

Changing the dial type from Disabled will automatically configure the necessary digital inputs/outputs. It is not allowed to manually change the digital inputs/outputs within the *Input/Outputs* menu. Below is a wiring diagram for connecting an ADE transmitter to the meter.

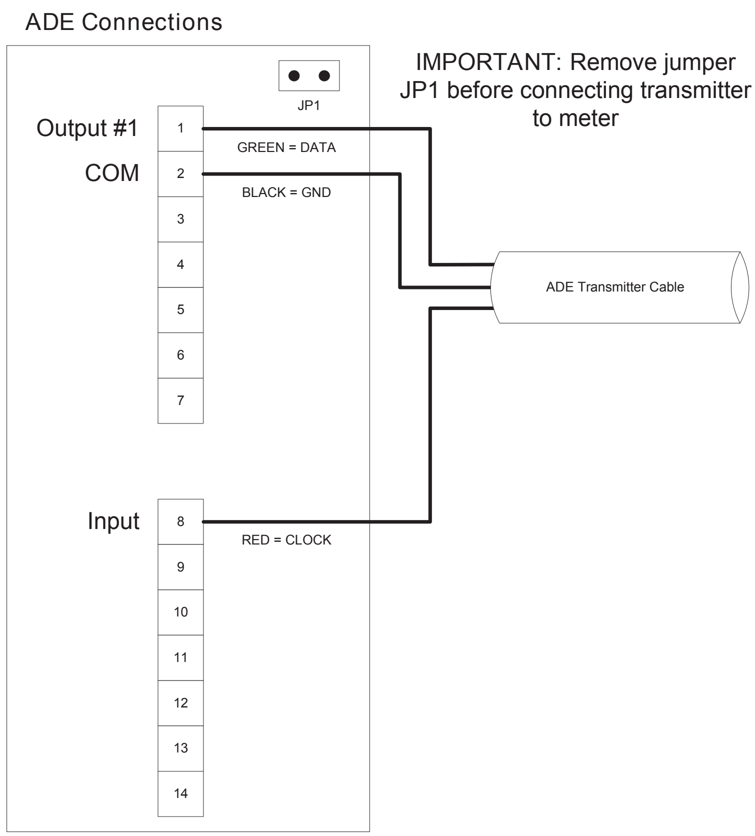


Figure 20: ADE interface

The following table demonstrates how the totalizers are displayed under various configurations of the Unit Multiplier (that is, resolution) and Dial Type. The non-shaded digits are transmitted as defined by the dial type.

For example, if the dial type is 4-dial and the resolution is 10000 then an arbitrary totalizer value of 99999999 is displayed on the meter as 9999**0000** and 9999 is transmitted to the receiving application. In this configuration it will take 10000 units (i.e. USG) before the display totalizer is updated to a new value. For this example the display totalizer will rollover to 0000**0000**.

Dial Type	Unit Multiplier (Resolution)	Display Digits									
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**0**
	10000			1	2	3	4	0	0	0	0
	1000				1	2	3	4	0	0	0
	100					1	2	3	4	0	0
	10						1	2	3	4	0
4 dial	1							1	2	3	4
	0.1						1	2	3	.	4
	0.01						1	2	.	3	4
	0.001						1	.	2	3	4
	0.0001					0	0	1	2	3	4
	10000		1	2	3	4	5	0	0	0	0
	1000			1	2	3	4	5	0	0	0
	100				1	2	3	4	5	0	0
	10					1	2	3	4	5	0
5 dial	1						1	2	3	4	5
	0.1					1	2	3	4	.	5
	0.01					1	2	3	.	4	5
	0.001					1	2	.	3	4	5
	0.0001					1	.	2	3	4	5
	10000	1	2	3	4	5	6	0	0	0	0
	1000		1	2	3	4	5	6	0	0	0
	100			1	2	3	4	5	6	0	0
	10				1	2	3	4	5	6	0
6 dial	1					1	2	3	4	5	6
	0.1				1	2	3	4	5	.	6
	0.01				1	2	3	4	.	5	6
	0.001				1	2	3	.	4	5	6
	0.0001				1	2	.	3	4	5	6
	10000	Not Applicable – Not enough display digits									
	1000	1	2	3	4	5	6	7	0	0	0
	100		1	2	3	4	5	6	7	0	0
	10			1	2	3	4	5	6	7	0
7 dial	1				1	2	3	4	5	6	7
	0.1			1	2	3	4	5	6	.	7
	0.01			1	2	3	4	5	.	6	7
	0.001			1	2	3	4	.	5	6	7
	0.0001			1	2	3	.	4	5	6	7

Dial Type	Unit Multiplier (Resolution)	Display Digits									
		1	2	3	4	5	6	7	8	9	0
8 dial	10000	Not Applicable – Not enough display digits									
	1000	Not Applicable – Not enough display digits									
	100	1	2	3	4	5	6	7	8	0	0
	10		1	2	3	4	5	6	7	8	0
	1			1	2	3	4	5	6	7	8
	0.1		1	2	3	4	5	6	7	.	8
	0.01		1	2	3	4	5	6	.	7	8
	0.001		1	2	3	4	5	.	6	7	8
	0.0001		1	2	3	4	.	5	6	7	8

It is important to understand that the totalizers will be represented in a manner equivalent to an actual ADE register. For example, 1 USG on a 4 dial will be transmitted/displayed as "0001". If in bidirectional mode, –1 USG will be transmitted/displayed as "9999".

The protocol type has two options:

- V1 – meter provides single totalizer, Tn (bi-directional) or T1 (uni-directional)
- V2 – meter provides extended information (For ORION Cellular, ORION Fixed Network (SE) or ORION Migratable (ME))

The additional information provided by protocol type V2 is only accessible for specific models of the ADE transmitter (i.e. ORION SE or ORION ME). The additional information of protocol type V2 includes, status information of the meter, meter identification, a second totalizer reading (T+ or T2), relative flow rate (0…100%), and flow direction.

STORE / RESTORE FEATURE

The Store/Restore feature is intended to save installation costs and reduce installation time. This feature is also intended to protect meter configuration and assure the operator that the meter is properly configured. Over time and handling of the meter, the meter configuration could change. The Store/Restore feature allows the meter to be quickly set to the operator's original configuration. Refer to the M2000 Store/Restore user manual for details on this feature.

DATA LOGGING FEATURE

The Data Logging feature records three types of events to a memory token:

- Totalizer/error events
- Configuration change events
- Startup events (power up, power down or reset events)

Each type of event is recorded into three separate files stored on the memory token. These files are extracted using the provided flow meter tool software over the RS232 communication link. Refer to the M2000 Data Logging user manual for details on this feature.

MAINTENANCE

Mandatory, routine or scheduled maintenance should not be required for the M2000 Mag Meter electronics or flow tube after proper installation.

However, some instances may require personnel to perform the following:

- Flow tube and electrode cleaning
- Fuse replacement
- Circuit board replacement

WARNING

- DISCONNECT MAIN POWER TO THE UNIT BEFORE ATTEMPTING ANY DEVICE MAINTENANCE OR CLEANING.
- DO NOT CLEAN COMPONENTS INSIDE THE AMPLIFIER OR JUNCTION BOX.

Cleaning the Flow Tube and Electrode

At times flow tube, electrodes, amplifier/junction box housings and the amplifier window may need periodic cleaning, depending on process fluid properties, fluid flow rate and surrounding environment.

Clean the flow tube and electrodes by following the material handling and cleaning procedures documented in Material Safety Data Sheet (MSDS) guidelines for the product(s) that were in contact with the flow tube and electrodes.

Should flow tube and/or electrode cleaning become necessary:

1. Disconnect detector from pipeline.
2. Clean electrodes according to MSDS guidelines.
3. Reconnect detector to pipeline.

Replacing the Fuse

WARNING

DISCONNECT MAIN POWER TO THE UNIT BEFORE ATTEMPTING ANY DEVICE MAINTENANCE. RISK OF ELECTRICAL SHOCK. REPLACE THE FUSE ONLY WITH 250V AC, 2 AMP, SLOW BLOW (5 X 20 MM). AUTHORIZED PERSONNEL MUST REPLACE FUSES.

Replacing the Circuit Board

Refer to the M-Series M2000 Interchangeability Procedure Application Brief for information on replacing circuit boards.

TROUBLESHOOTING

The M2000 mag meter is designed for many years of optimal performance. However, should it malfunction, there are certain things that we recommend you check before contacting our Technical Support department or your local Badger Meter Representative.

NOTE: If the fluid measured has a high concentration of conductive solids, deposits may accumulate on the internal liner walls and electrodes. These deposits will cause a reduction of the measuring output. Thus, Badger Meter recommends that you remove the meter and inspect the liner and electrodes after six months. If deposits are found, remove them with a soft brush. Repeat inspection process every six months or until an appropriate inspection cycle can be established for the specific application.

NOTE: Other general conditions include:

Description	Possible Cause	Recommended Action
Flow is present but display is "0"	Digital input is holding flow. Disconnected signal cable. Detector mounted opposite of the main flow direction (see arrow on the nameplate). Coil or electrode cables exchanged. Improper low flow cutoff or full scale flow.	Check signal cable. Turn detector by 180° or switch terminal E1 and E2 or reprogram to bidirectional mode. Check cable connections for cross wiring. Verify digital input configuration. Replace configuration defaults.
Inaccurate measuring	Improper calibration. Wrong calibration parameter. Pipe not fully filled, or air in pipe. Invalid fluid conductivity. Invalid fluid mixture.	Restore calibration defaults. Check the parameters (detector factor and size) according to supplied data sheet. Check if meter is completely filled with fluid. Purge line to eliminate air bubbles.
No display	No power. Incorrect power. Bad wiring connections. Blown fuse.	Apply power. Check power value. Replace fuse (2 amp, 250V AC, slow blow 5 x 20 mm). Check display ribbon cable.
Flow rate value known to be wrong	Detector factor. Deposits on electrodes and/or liner. Incorrect pipe size programmed.	Check value on label. Check and remove deposits. Check size if necessary.
Flow rate indication unstable	Cable issue. Grounding issue. Partially full pipe. Air in pipe. Amplifier location – outside electrical. Invalid fluid conductivity.	Make sure cable is shielded and not vibrating. Make sure meter is properly grounded to a good earth ground. Make sure pipe is full of fluid. Make sure fluid does not contain air bubbles. Make sure amplifier is not too close to sources of electrical interference.

Menu Manager Configuration Errors		
Error	**Description**	**Recommended Action**
100	**ADE: Configuration of the ADE interface is invalid.**	This error is displayed when an invalid modification to either of the following menu parameters is detected: Protocol Type, Dial Type, Unit Multiplier, Digital Input Function Type or Digital Output Function Type. 1. Configuring the M2000 as an ADE interface has the following limitations, Protocol Type V1 is only allowed if number of dials is less than 8. 2. The resolution of the totalizers (i.e. Unit Multiplier) must be set to something other than OFF. 3. For 8 dial configuration, a resolution of 10000 and 1000 are not supported. There are not enough display digits to accommodate 8 dials and greater than 100 units of resolution. 4. For 7 dial configuration, a resolution of 10000 is not supported. There are not enough display digits to accommodate 7 dials and greater than 1000 units of resolution.
101	**ADE: Enabling/Disabling ADE operation is invalid**	This error is observed when Digital input or output function is manually selected for ADE operation. Enabling or Disabling ADE operation can only be accomplished by setting the ADE protocol type.
110	**Output 1/2: Pulse Output Configuration Error**	This error is observed when improperly configuring either the full scale flow, pulse per unit, pulse width or digital output function type for pulse output operation. Preparing these parameters for pulse output operation (i.e. forward or reverse) has limitations that are monitored by the menu manager. This error can indicate the following configuration violations: 1. Pulse Frequency exceeds limits at full scale flow 2. Pulse duty cycle is less than 50% at full scale flow (i.e. pulse on time > pulse off time) 3. AMR Pulse Frequency exceeds limit at full scale flow The pulse frequency limit is 10 kHz when the pulse width is 0 (i.e. 50% duty cycle). The pulse frequency limit is 1 / (2 * Pulse Width) when the pulse width is non-zero in order to achieve a 50% duty cycle. For AMR operation, the frequency limit is 3 HZ. Follow these steps for configuring meter for pulse output operation: 1. Set PPU to zero for both output 1 and 2 2. If necessary, set full scale flow appropriately for application 3. Set PW as required by equipment receiving pulse transmissions from meter. Observe frequency limits for non-zero pulse widths. 4. Determine the desired pulse frequency at a typical flow rate (i.e. 1000 HZ @250 GPM 5. Calculate ratio of typical flow rate to full scale flow: ratio = typical flow rate / full scale flow (i.e. 250 GPM / 500 GPM = 0.5) 6. Calculate flow rate conversion factor: For GPM, conversion factor = 1/60, for GPH, conversion factor = 1/3600, for GPS, conversion factor = 1 7. Calculate PPU: PPU = (Desired pulse frequency at typical flow rate / ratio) / [Full Scale Flow * (conversion factor)]= (1000 / 0.5) / [500 * (1/60)] = 240 Pulse / Gallon 8. If an error is received consider reducing value of full scale flow and ensuring desired pulse frequency is within limits. Then redo steps 4-7 If not using the pulse outputs, set the pulses per unit to zero to allow for reconfiguration of the full scale flow. If it is required to use the pulse outputs, re-evaluate the pulse output configuration. Consider recording and clearing totalizers following pulse output configuration"
120	**Display: Totalizer Conversion Error – Totalizer cannot be properly converted for display**	This error is observed while trying to change the totalizer units. Limits of display will prevent improper configuration of the volume unit dependent on current totalizer values. Consider recording and cleaning totalizers prior to changing totalizer.
121	**Output 1/2: Pulse Output Configuration Error**	This error is observed when changing the totalizer units of measure. This error implies the pulse configuration exceeds limits (see error 110). Please note the pulses per unit is not automatically updated on volume unit reconfiguration. The pulses per unit should be manually changed to accommodate the desired units of measure. It may be necessary to set the pulses per unit to zero then change to the desired totalizer units.
140	**Output 3: Configuration Error – Full scale frequency exceeds limits of relay (1000 Hz)**	Reduce full scale frequency setting of output when hardware is configured for relay operation.
150	**Output 3: Configuration Error – Full scale frequency exceeds limits (10 kHz)**	Reduce full scale frequency setting of output when hardware is configured for open collector operation.
170	**Output 1/2: Output Type Configuration Error**	This error is observed when the function type is 24V DC and the output type is changed from Normally Open to Normally Closed. It is required for 24V DC output operation that the output type be Normally Open.

Menu Manager Configuration Errors		
Error	**Description**	**Recommended Action**
171	**Output 1/2: Output Type Configuration Error**	This error is observed when the function type is ADE and the output type is changed from Normally Open to Normally Closed. It is required for ADE operation that the output type be Normally Open
190	**Full Scale Flow: Entered Value exceeds limits**	Value entered exceeds the absolute maximum flow the meter supports. Reduce the value for this parameter or consider increasing pipe diameter.

Display Error / Status Messages		
Error Message	**Possible Cause**	**Recommended Action**
Err: Detector	No detector connection with amplifier.	Check detector and cable connections in accordance with this manual.
	Connection between amplifier and detector	Contact Technical Support.
	Supply voltage too low.	Contact Technical Support.
	Grounded coils in meter.	Contact Technical Support.
	Water in detector.	Contact Technical Support.
Err: Empty pipe	Pipe may not be full.	Make sure all trapped air is out of system. If fluid or fluid conductivity recalibrate the parameter.
Err: Full scale	Actual flow rate is exceeding programmed flow.	Reduce flow rate or increase the programmed full scale value by more than 5%.
Err: AD-Range	AD-Converter is exceeding signal limits.	Check the grounding scheme of the meter installation. See grounding section in this manual. Verify pipe is not empty.
Err: AD-INT	Initialization of AD-Converter unsuccessful.	Contact Technical Support.
Err: Rollover	Rollover counters have exceeded limit.	Clear all totalizers.
Err: Rollover Status	Totalizer rollover has occurred.	Reload totalizer then clear all totalizers.
Err: Simulation	I/O simulator is enabled.	Disable simulator in I/O menu.

SPECIFICATIONS

Flow Range	0.10…39.4 ft/s (0.03…12 m/s)
Accuracy	± 0.25 percent of rate for velocities greater than 1.64 ft/s (0.50 m/s) ± 0.004 ft/s (± 1 mm/s) for velocities less than 1.64 ft/s (0.50 m/s)
Repeatability	± 0.1%
Power Supply	**AC Power Supply:** 85…265V AC; Typical Power: 20V A or 15W; Maximum Power: 26V A or 20W **Optional DC Power Supply:** 10…36V DC; Typical Power: 10W; Maximum Power: 14W
Analog Output	4…20 mA, 0…20 mA, 0…10 mA, 2…10 mA (programmable and scalable) Voltage sourced 24V DC isolated. Maximum loop resistance < 800 ohms.
Digital Output	Four total, configurable 24V DC sourcing active output (up to 2),100 mA total, 50 mA each; sinking open collector output (up to four), 30V DC max, 100 mA each; AC solid-state relay (up to 2), 48V AC, 500 mA max
Digital Input	Max 30V DC (programmable – positive zero return, external totalizer reset or preset batch start)
Frequency Output	Scalable up to 10 kHz, open collector up to 1 kHz, solid-state relay
Misc Output	High/low flow alarm (0…100% of flow), error alarm, empty pipe alarm, flow direction, preset batch alarm, 24V DC supply, ADE
Communication	RS232 Modbus RTU; RS485 Modbus RTU, HART, Profibus DP require separate daughterboards
Pulse Width	Scalable up to 10 kHz, passive open collector up to 10 kHz, active switched 24V DC. Up to two outputs (forward and reverse). Pulse width programmable from 1…1000 ms or 50% duty cycle.
Processing	32-bit DSP
Empty Pipe Detection	Field tunable for optimum performance based on specific application
Excitation Frequency	1 Hz, 3.75 Hz, 7.5 Hz or 15 Hz (factory optimized to pipe diameter)
Noise Dampening	Programmable 0…30 seconds
Low Flow Cut-Off	Programmable 0…10% of maximum flow
Galvanic Separation	250V
Fluid Conductivity	Minimum 5.0 micromhos/cm
Fluid Temperature	**With Remote Amplifier:** PFA, PTFE & Halar 302° F (150° C) **With Meter-Mounted Amplifier:** Rubber 178° F, (80° C), PFA, PTFE & Halar 212° F (100° C)
Ambient Temperature	– 4…140° F (–20…60° C)
Relative Humidity	Up to 90 percent non-condensing
Flow Direction	Unidirectional or bidirectional two separate totalizers (programmable)
Totalization	Programmable/resettable
Units of Measure	Ounce, pound, liter, US gallon, imperial gallon, barrel, hectoliter, mega gallon, cubic meter, cubic feet, acre feet
Display	4 x 20 character display with backlight
Programming	Three-button, external manual or remote
Amplifier Housing	Cast aluminum, powder-coated paint
Detector Housing	Carbon steel welded
Pipe Spool Material	316 stainless steel
Flanges	**Standard**: ANSI B16.5 Class 150 RF cast steel; **Optional:** 300 lb cast steel, 316 stainless steel
Liner Material	PFA up to 3/8", PTFE 1/2…24", soft and hard rubber from 1…54", Halar® from 14…40"
Electrode Materials	**Standard:** Alloy C; **Optional:** 316 stainless steel, gold/platinum plated, tantalum, platinum/rhodium
Mounting	Meter mount or remote wall mount (bracket supplied)
Locations	Indoor and outdoor
Meter Enclosure Classification	NEMA 4X (IP66); **Optional:** Submersible NEMA 6P (IP67), remote amplifier required
Junction Box Enclosure Protection	For remote amplifier option: powder-coated die-cast aluminum, NEMA 4 (IP66)
Cable Entries	1/2" NPT cord grip (3)
Optional Stainless Steel Grounding Rings	**Meter Size** — **Thickness (of one ring)** Up through 10" — 0.135" 12…54" — 0.187"
NSF Listed	Models with hard rubber liner, 4" size and up; PTFE liner, all sizes
Token Features	Data Logging (Blue token); Store/Restore (Red token); Firmware Upgrade (Black token)

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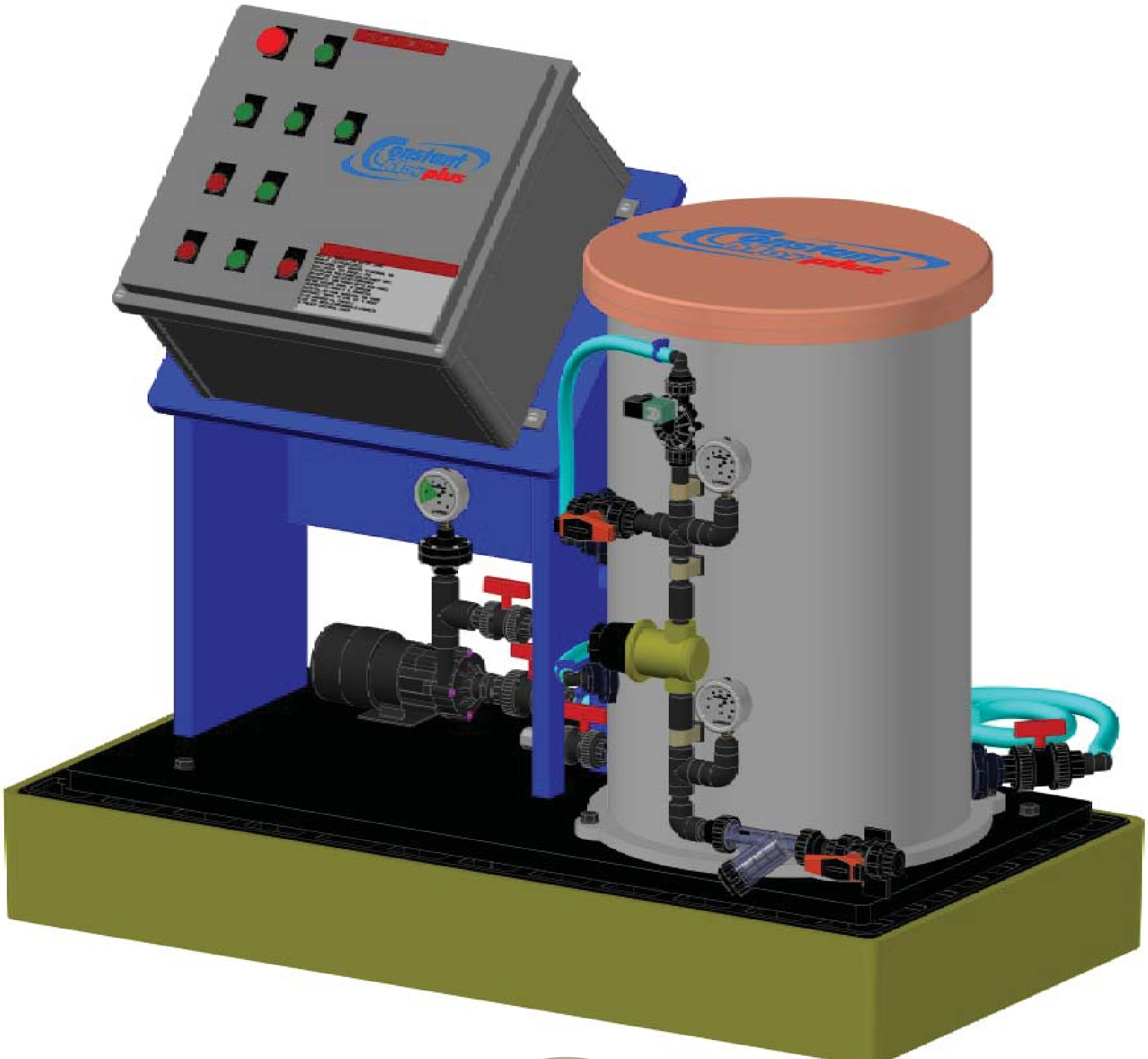
Briquette Chlorinator

Operator's Manual

Constant Chlor® Plus Model MC4-50



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Product Stewardship

MAKING THE WORLD A BETTER PLACE

Arch is committed to maintaining and improving our leadership in Product Stewardship. Our goal is to make health, safety, and environmental protection an integral part of a product's life cycle – from manufacture, marketing, and distribution to use, recycling, and disposal.

Successful implementation is therefore, a shared responsibility. Everyone involved with the product has responsibilities to address society's interest in a healthy environment and in products that can be used safely. We are each responsible for providing a safe workplace, and all who use and handle products must follow safe and environmentally sound practices.

For more information about our Product Stewardship Program, contact your Arch Representative.

Dealer Contact:

Table of Contents

Safety Precautions

The Constant Chlor® Plus Briquette Chlorinator is designed to pump calcium hypochlorite solution into pressurized systems. By nature, this application may present circumstances under which personal hazards can exist. All personnel who may have occasionally to install, operate or maintain these chlorination units should be provided with the opportunity to read this owner's manual or be advised of its contents. Awareness of potential hazards can prevent accidents and injury.

Danger from Handling Calcium Hypochlorite

Calcium hypochlorite in briquette or liquid form is hazardous. Suitable personal protective equipment should be used at all times to protect from liquid or vapor. Consult your employer. Refer to the Material Safety Data Sheet found at the back of this manual for additional information and precautions regarding the proper handling of calcium hypochlorite.

Damage from Pressurized Liquid

This system contains liquid and/or air under pressure. This presents the potential for unexpected discharge of liquid in a violent manner. In operation and servicing of the chlorination unit, all components and attached piping which contain liquid should be treated cautiously until it is known with certainty that they have been depressurized and drained.

Danger from Electrical Hazard

Since this unit includes electric components, the hazard of electrical shock can exist. Installation and wiring of electrical components should be in accordance with the applicable codes.

Operational Hazards

To avoid personal injury, the following guidelines should be adhered to:

1. Do not operate any system components with safety guards removed.
2. Always operate system with electrical component enclosures in place.
3. When venting pump heads or piping during start up, air and calcium hypochlorite will be discharged under pressure. Suitable caution should be taken to avoid contact with the liquid and to avoid spillage or spraying of liquid.
4. Any leakage or spillage of calcium hypochlorite should be cleaned up with out delay. See Material Safety Data Sheet found at the back of this manual.

Safety

1. Before operating this unit or attempting to service it, become familiar with the contents of this operator's Manual.
2. Observe all precautions established by plant safety procedures.
3. Observe all regulations and instructions provided at the end of this manual.
4. Do not paint over or remove name plates, labels or tags.
5. In disassembly of dosing pump, precautions should be taken for the possibility that a diaphragm rupture may have allowed calcium hypochlorite solution to enter the lubrication oil system.
6. If motor replacement is required, be certain that motor name plate is the same as the original motor.
7. Establishment of and adherence to a regular maintenance program (pg.16) can prevent problems by early detection of unusual conditions (e.g. unusual noise).

SECTION I. Introduction

Before You Begin Operation, be sure to read this entire manual over carefully.

NOTE: Please refer to the Material Safety Data Sheet at the back of this manual before proceeding. They outline safety measures that must be followed when handling Constant Chlor® Plus Briquettes. If any part of this profile is unclear to you, please contact Arch Chemicals at **(800) 478-5727.**

The Constant Chlor® MC4-50 utilizes patented spray technology to make a consistent solution of calcium hypochlorite that is used for disinfection process. The system uses a constant supply of pressurized water to spray a suspended bed of calcium hypochlorite. The calcium hypochlorite readily dissolves into a reservoir at a 1.5% available chlorine solution, which is ready to be pumped out for disinfection.

The system components of the Constant Chlor® MC4-50 are:

Inlet Supply Manifold

The water supply is controlled by a solenoid valve and a pressure regulator to ensure a constant water pressure of 45 psi *[3.10 bar]* supplied to the spray-tree. It is important to note that the water supply flow rate through the manifold is 1.0 gpm *[3.8 lpm]*. This is a constant flow rate at 45 psi *[3.10 bar]*. The feeder is sized so that the maximum solution output from Constant Chlor® is ~20 gph *[75.7 lph]*, or ~0.30 gpm *[1.1 lpm]*. This means that the Constant Chlor® produces fresh solution at a rate of about 2 times the maximum design withdrawal rate.

Dry Chemical Hopper

The chemical hopper is suspended above the spray-tree within the tank and is easily removed for preventive maintenance and system troubleshooting. The hopper has two handles that allow it to be removed without any hardware or tools required. A custom grid support holds the calcium hypochlorite briquettes above the spray–tree and allows the product to properly dissolve into the reservoir below.

Solution Reservoir

The solution levels are maintained by 3 Ultrasonic level switches. The LOWER switch is only deactivated during startup or if there is a system failure. Normally this switch valve will always be in the CLOSED/ON position while solution is in the tank. The MIDDLE switch is used to control in the supply water via opening and closing the solenoid on the Inlet Supply Manifold. As this solution lowers, it opens the solenoid and allows pressurized water into the spray manifold, which replenishes the solution and closes the MIDDLE switch. This represents a "TANK FULL" condition. The upper or HIGH Switch is an emergency overflow switch that is activated only in the event of a failure condition where the tank continues to fall. In the event of an overflow, the HIGH Switch will activate.

Control Panel

The Constant Chlor® MC4-50 has a UL 508A rated, NEMA 4x control panel with PLC. The standard inputs and outputs are listed in Section V. The control panel has 8 buttons, which have a range of system diagnostics and control features.

SECTION II. Specifications

Model MC4-50 - Chemical Injection Discharge System	
Operational	
Pressure Range	50 to 150 psig *[3.45-10.34 bar]*
Dry Chemical Capacity	75 lbs. *[34.02kg]*
Tank Size (Solution volume)	13 gallons *[49.2 liters]*
Available Working Solution	3 gallons *[11.4 liters]*
Water Inlet Size	1/2″ *[12.7mm]* inch FNPT
Solution Outlet (Injector) Size	1/2″ *[12.7mm]* inch MNPT
Operating Weight	240 lbs. *[108.86kg]*
Operating Temperature	40° to 105° F *[4.4° to 40.6° C]*
Feed Rates	
Chlorine Delivery Rate *(Note: Delivery rate is dependant on the Dosing Pump size.)*	1.0 - 50.0 lb. *[.45kg - 22.68kg]* AvCl/day with 70°F *[21.1° C]* inlet water temperature. 10% decrease for every 10°F *[5.5° C]* drop in inlet water temperature.
Pump Discharge Rate	0-25 gph *[0-94.6 lph]*
Shipping Data	
Shipping Weight	175 lbs. *[79.38kg]*
Shipping Dimensions	52″L x 27″W x 38″H *[132.1cm x 68.6cm x 96.5cm]*
Site Requirements	
Water Inlet	1.0 gpm @ 50-150 psig *[3.8 lpm @ 3.45-10.34 bar]*
Electrical	120V / 1ph / 60Hz - *(20 amp circuit)* 220-240V / 1ph / 60Hz - *(10 amp circuit)* 220-240V / 1ph / 50Hz - *(10 amp circuit)*
Recommended Space Requirements	
Recommended Clearance	84″ L x 48″ W x 60″ H *[213.4cm x 121.9cm x 152.4cm]*
Minimum Clearance	60″ L x 36″ W x 48″ H *[152.4cm x 91.4cm x 121.9cm]*

NOTE: We reserve the right to modify and improve our specifications at any time without notice

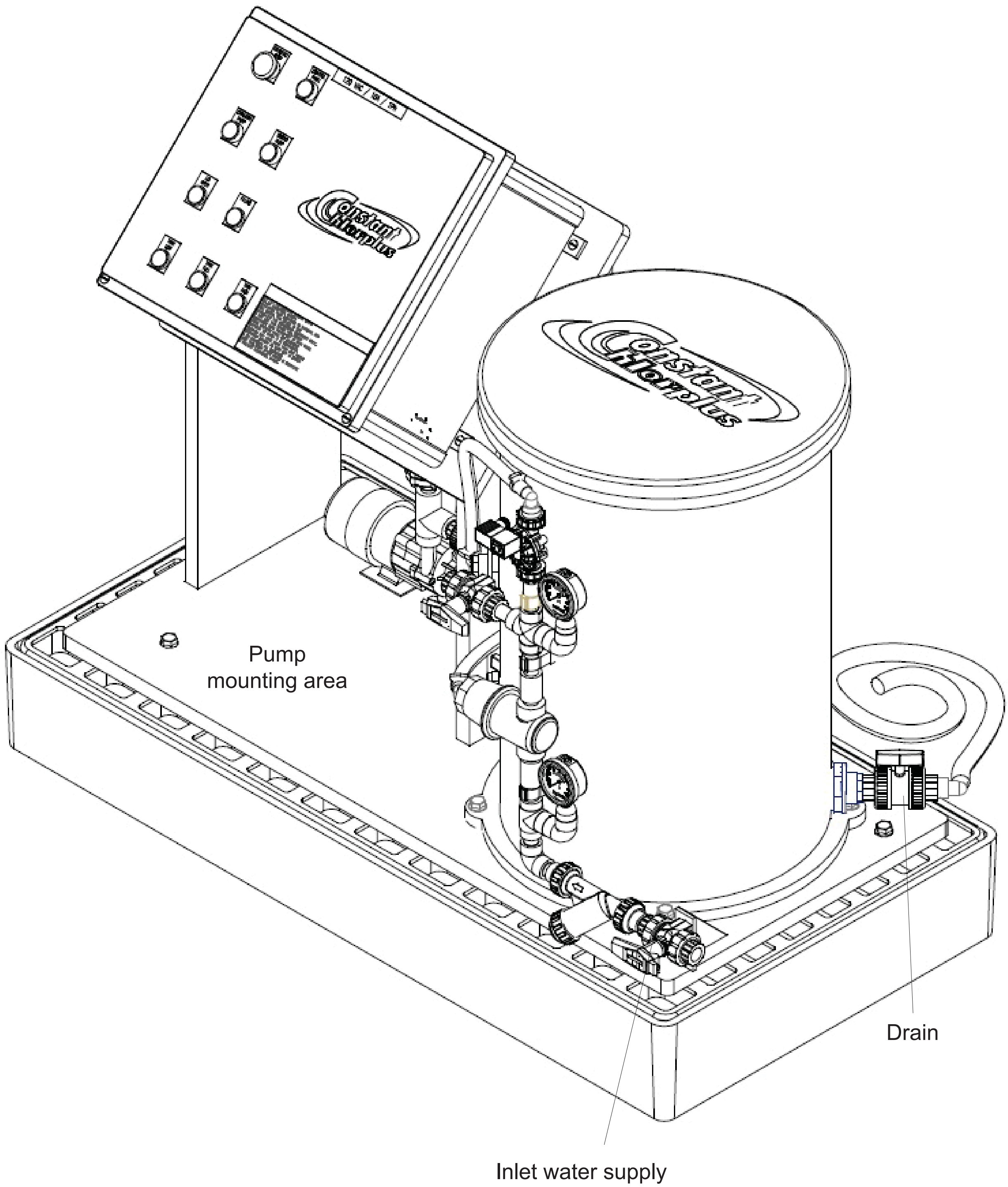

Pump
mounting area
Drain
Inlet water supply

figure 1B: System Layout - Front View

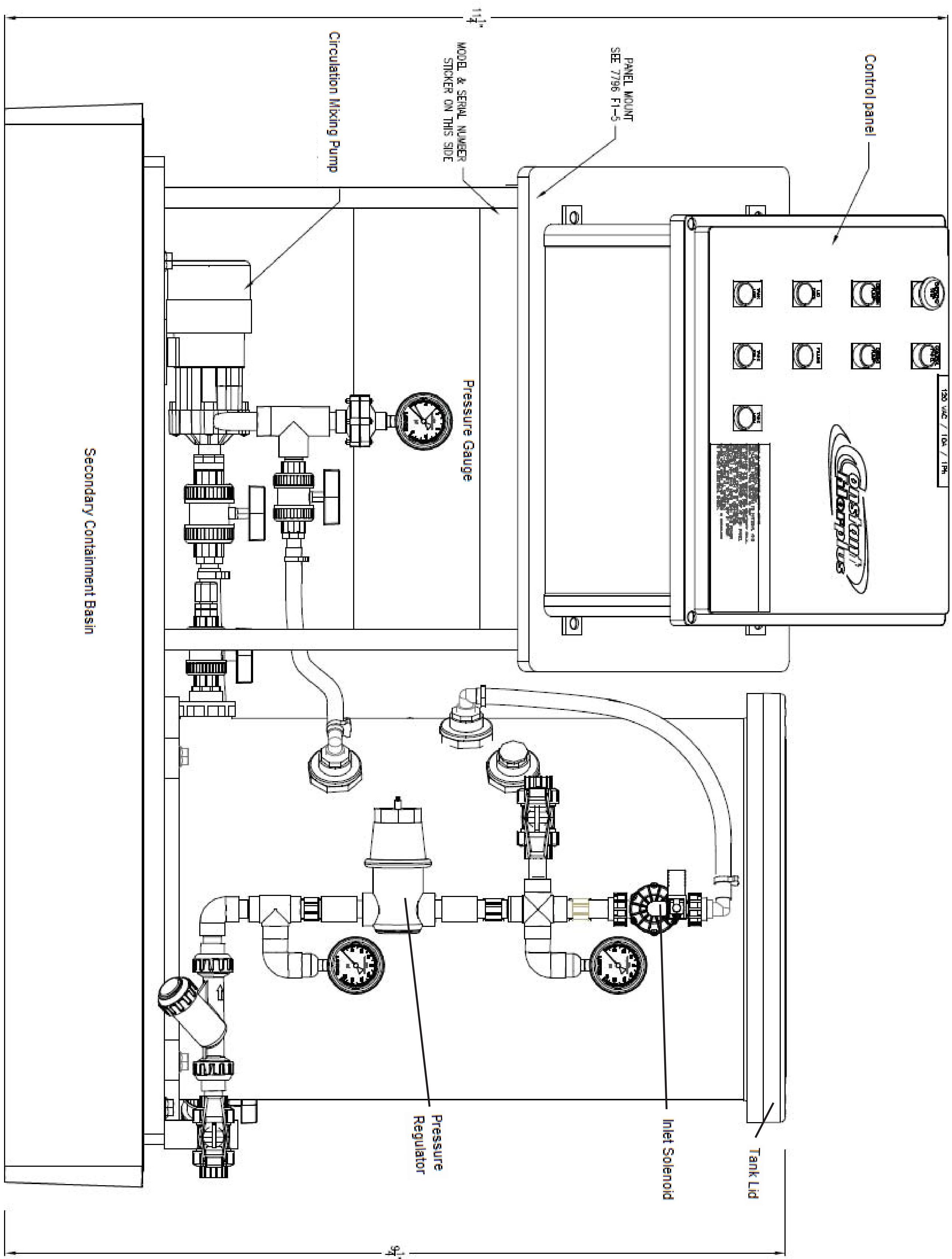
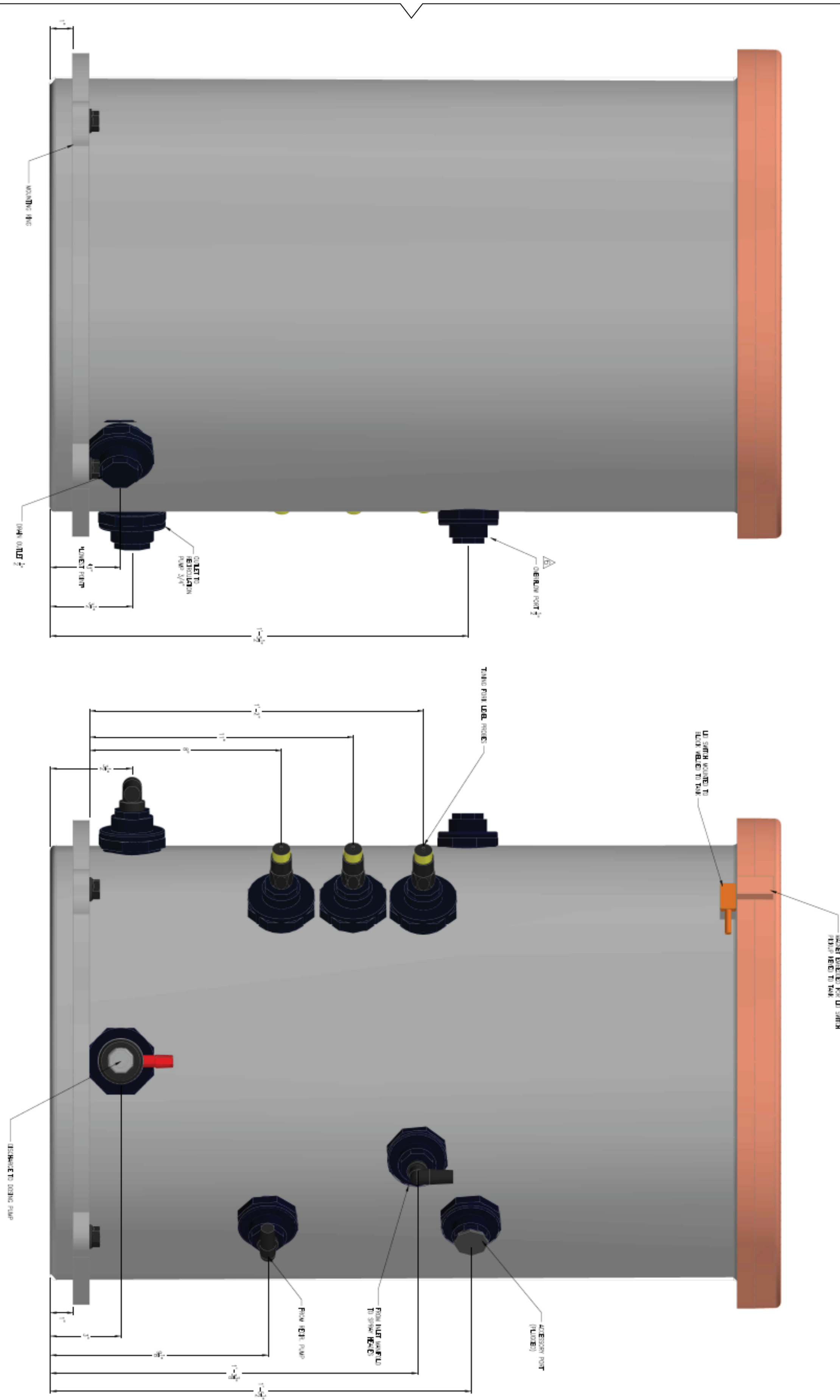


figure 2: Calcium Hypochlorite Tank



SECTION III. Preparation

A. Major System Components:

Please reference Figures 1A, 1B and 2 (pages 8) for layout drawings

a. Control Panel - Figure 1B (pg 8)

b. Pressure Gauge - Figure 1B (pg 8)

c. Circulation Mixing Pump - Figure 1B (pg 8)

d. Secondary Containment Basin - Figure 1B (pg 8)

e. Tank Lid - Figure 1B (pg 8)

f. Inlet Solenoid - Figure 1B (pg 8)

g. Pressure Regulator - Figure 1B (pg 8)

B. Equipment Supplied by Others

a. Metering Pump

b. Chemical injector

c. Tubing and fittings. 1/2″ *[12.7mm]* OD 3/8″ *[9.5mm]* ID polyethylene tubing is acceptable. 1.2″ *[12.7mm]* OD 1/4″ *[6.4mm]* ID braided plastic tubing is preferred. **DO NOT EXCEED 3/8" ID"** *[9.5mm]* **TUBING ON CHEMICAL INDUCTION LINE.**

d. Plastic check-valve at injection point

NOTE: Do not install a strainer of any type on the chemical injection line.

C. Arch Chemicals Technical Support

Arch Chemicals can provide startup support and training as well as troubleshooting for in-field applications. Please contact your Constant Chlor® distributor for more information on pricing and availability.

SECTION IV. Operation and Maintenance

A. Startup and Commissioning Checklist

Job Name:				
Equipment Type and Serial Number:				
No.	Items	Initials	Date	Comments
Pre-Install Checklist (Room)				
1	The installation has been checked by level or plumb bob or other method specified by installation drawings			
2	Is there a drain within ~10′ *[304.8cm]* of equipment			
3	Room has proper ventilation			
4	If required, Cl2 monitor is working correctly			
5	Room is climate controlled			
6	Enough space surrounding equipment for easy and safe access			
7	All accessories for the job have been installed on the vessel openings per the manufacturer's recommendations and engineering specifications			
Startup Checklist				
8	Spray tree installed and Spray Nozzles inside equipment are oriented directly upward and are not turned in any way			
9	No residual debris (plastic shavings, screws, etc) inside vessel			
10	All tubing and unions inside reservoir are installed correctly and not hindered in standard range of motion			
11	Flow directional arrows are pointed in the correct direction of flow on solenoid, inlet water supply, check valves, relief valves, ball valves			
Inlet Water Supply Line Checklist				
12	Is water Pressure constant? Any fluctuations in water pressure?			
13	Are the supply lines properly identified and tagged?			
14	Is supply line secure and not a tripping hazard?			
15	Inlet pressure gauge(s) are working correctly and inlet water pressure is operating at optimal 45 psi			

A. Startup and Commissioning Checklist (continued)

Job Name:				
Equipment Type and Serial Number:				
No.	**Items**	**Initials**	**Date**	**Comments**
Electrical and instrument Checklist				
16	All electrical wire (power supply, instrumental, etc) is secure and free from being a trip hazard			
17	All level sensors, lid switches, alarms have been tested and are operating correctly			
18	Lid Sensor shut-off is working			
19	Instruments are mounted and installed per specification			
20	All exposed electrical and instrument lines are protected and meet field conditions			
21	Components meet area electrical classification			
22	All electrical work performed by licensed electrician			
23	All field components have identification tags and all wire ends are labeled			
24	Correct measures have been taken to ensure electrical requirements are being met			
Chemical Dosing Pump Checklist				
25	The dosing pump is securely mounted to skid, floor, or wall			
26	Tubing is secure and length of the tubing is minimized (minimize peaks and valleys to prevent solids from settling). Tubing is free from kinks			
27	Tubing specifications are in accordance with manufacturer's recommendations			
28	Tubing is installed so that it is not liable to be damaged or cut			
29	If tubing is installed outdoors, it is insulated to preventing freezing			
30	No metal fittings used for connections and fittings are sealed and not leaking			
31	Discharge tubing is equipped with a back-flow prev. valve			
32	No inline/Y-Strainer used on feeder discharge			
33	Pressure-relief assembly installed and operating correctly			
34	Chemical injector – all plastic components and not leaking			
35	Dosing pump has been sized correctly (Maximum head capacity, discharge pressure, flow rate, electrical rating)			

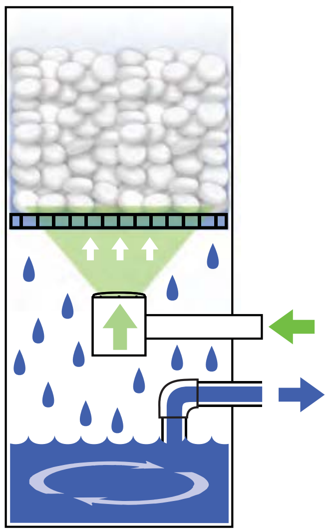
A. Startup and Commissioning Checklist (continued)

Job Name:				
Equipment Type and Serial Number:				
No.	Items	Initials	Date	Comments
Agitation Checklist				
36	Eductor nozzles are oriented downward and are not turned			
37	Recirculation pump is installed and mounted correctly below water level (flooded environment)			
38	When solution tank is full, tank is circulating correctly and pump is not airlocked			
39	All intake and return lines for recirculation setup are installed in the correct ports on the tank			
Equipment is ready for service when above complete				

B. Theory of Operation

Method of Operation

The Constant Chlor® Calcium Hypochlorite Briquette Chlorinator is a vertical spray technology and integrated solid suspension technology. The equipment utilizes patented spray technology to spray and saturate a well packed bed of briquettes to generate a solution of calcium hypochlorite in the reservoir, which ranges from 1.5-1.8% available chlorine, depending on temperature. This solution is then metered out via a chemical dosing pump for distribution into the system.



The patent spray technology utilizes a "spray-tree" or manifold which has specific nozzles attached to spray upwards into the suspended bed. The nozzles are vane-less, full cone and all plastic and the pattern of the spray is dependent on inlet water pressure. The height of the nozzle manifold from the bottom of the suspended bed is a critical parameter, as the spray pattern generated at 45 psi *[3.10 bar]* inlet water pressure penetrates the bed of calcium hypochlorite briquettes to a specified and acceptable depth. If the water pressure is not sufficient (<40 psi *[2.76 bar]*), the full-cone spray is not developed and not enough water contacts the briquette bed, which creates un-dissolved product and poor product performance. The unit is equipped with an inlet water pressure regulator to reduce water pressure in excess of 50 psi *[3.45 bar]* to the specified 45 psi *[3.10 bar]*.

All of the Constant Chlor® feeders are equipped with sensor actuated 24VDC solenoid to control the water flow into the feeder. Level sensors on the side of the tank provide alarms and feedback as to the solution level inside the reservoir. These level sensors maintain sufficient water levels inside the tank at all times. For Constant Chlor® feeders that are rated to deliver more than 50 lbs *[22.7kg]* available chlorine per day, the system is programmed with a timer that sprays the bed for 30 seconds and is off for 20 seconds. This timing mechanism allows the water contacting the bed of briquettes to saturate a boundary layer of the calcium hypochlorite product while the spray is off, and when the spray is turned back on, the saturated layer is easily washed away. This produces a consistent and concentrated solution of available chlorine.

The hopper containing the solid calcium hypochlorite briquettes is angled at 60º. The 60º angle allows the product to easily feed downwards as the product below is dissolved. The grid that supports the briquettes is a perforated sheet of PVC with 3/8" *[9.5mm]* holes. The pattern and thickness are critical and are integral to the spray technology. The lid for the hopper is equipped with an automatic shut-off switch that will terminate the spray cycle if the lid is opened.

Because the Constant Chlor® feeder generates a concentrated solution of calcium hypochlorite, a mixing mechanism is equipped inside the solution reservoir. This patent-pending technology enables the solution to be homogeneously mixed and prevents build-up of solids inside the equipment. The solution reservoir is equipped with a high-head capacity centrifugal pump that circulates and returns the solution through a mixing eductor nozzle designed to enhance mixing and particle suspension.

Because the Constant Chlor® feeders generate a concentrated solution of available chlorine, with high solid peristaltic pumps are generally used to dose the solution into the point of application. Typical feed rates are 10-40 gph *[37.9-151.4 lph]*, but some applications can deliver in excess of 200 gph *[757.1 lph]*. The low flow rates and high concentration enable precise control and constant chlorine residual. The chemical feed pumps are generally equipped with a pressure relief valve that can be routed back into the Constant Chlor® feeder if there is a problem with injection downstream. Correct chemical injectors and tubing size are critical in the application of the Constant Chlor® system. All plastic injectors, non-fouling tips, and 1/2" *[12.7mm]* OD (maximum) are all recommended, but not supplied with the equipment.

Overview of Operation

- Inlet raw water supply 1.0 gpm *[3.8 lpm]* at 45 psi *[3.10 bar]* or greater enters water supply manifold
- Solenoid valve opens, allowing pressurized water to spray bed of calcium hypochlorite briquettes, which are suspended over solution reservoir
- Calcium hypochlorite briquettes are dissolved, making a solution of available chlorine in the reservoir
- Level sensors turn on or turn off inlet solenoid valve
- Pump circulation system constantly mixes the solution in the reservoir
- Chemical dosing pump withdraws solution from the reservoir tank to point of application

C. Step-By-Step Start-Up

1. Before starting up, be sure to complete the Startup Commissioning Checklist in section A.
2. Inlet ball valve on the water supply line should be in the closed position.
3. For startup, it is best to fill the hopper approximately half full with Constant Chlor® Briquettes. (The first batch of solution will be ~0.10-0.50% weaker than the normal 1.50% available chlorine solution and will increase steadily as the bed conditions and the solution turns over).
4. Replace lid on unit.
5. Turn Power ON.
6. Slowly open the inlet ball valve to allow water to flow through the manifold. You will hear an audible clicking of the solenoid valve opening.
7. Check to make sure that pressure gauges are operating, indicating flow. The gauge on the left should read 45 psi *[3.10 bar]*.
8. The circulation pump should be OFF and as the tank begins to fill, the TANK LOW light will go off and the circulation pump will turn on
9. As the circulation pump develops head pressure to >5 psi *[0.34 bar]*
10. The tank will continue to fill until the TANK FULL light is ON.
11. Turn ON the chemical dosing (metering) pump on the control panel.

D. Recommended Maintenance Schedule

Parts to be Inspected and Cleaned	Alkalinity (ppm)	Frequency	Estimated Time
1. Support Grid and Level sensors 2. Spray Nozzle	50	Quarterly	2 hours
3. Supply and Discharge Lines and Pump Head of Chemical Dosing Pump	100	Monthly	
4. Chemical Injector 5. Plastic Eductor on Circulation Line	150	Bi-weekly	
6. Supply and Discharge Line and Pump Head of Circulation Pump 7. E-stop operation	200+	Weekly	

Important Note about Silica: Silica in excess of 25 ppm can contribute to scaling. Calcium silicate can form solid deposits in addition to calcium carbonate scale and can increase cleaning frequency even if alkalinity levels are low. There are a variety of methods to pre-treat and remove both carbonate alkalinity and silica, thereby reducing maintenance significantly. Please contact your Constant Chlor® distributor about pre-treatment options.

E. Preventative Maintenance Schedule

Item	Instruction	Check	Maintenance
Hopper Basket	Daily		Check briquette level and verify there is enough chemical to be fed until the next visit, if the outer bound briquette are moist, move the briquette to the center of the basket
Recirculation Pump	Daily		Check for leaks on line, verify pressure is above 3 psi as indicated on te pressure gauge, consider rebuild pump Wet end if pressure drops below 3psi
Dosing Pump Lines	Daily		Check all connections for leaks and part degradation.
Inlet Supply Solenoid Valve	Daily		Ensure solenoid coil is not hot to the touch and that valve does not make a rattling noise when energized.
Lid Sensor Shut-Off	Daily		Remove lid and make sure that "Lid Open" alarm is activated. When replaced, make sure that alarm is cleared.
Bulk-Head Fittings	Daily		Verify that there are no leaks at any of the bulkhead fittings.
Inlet Manifold	Daily		Verify that there are no leaks at any of the fittings.
Cal-Hypo Support Grid	See pg 17		Inspect grid for cleaning. Follow maintenance procedures for cleaning the grid if holes are fouled.
Chemical Injection point	See pg 17		Remove injector and inspect for solid build-up and scale. Follow maintenance procedure if fouled.
Tank Mixing Eductor	See pg 17		Visually inspect the 3/8" *[9.5mm]* mixing eductor in solution reservoir. Look to see if there are calcium deposits and follow maintenance procedures to clean.
Level Switches	See pg 17		When tank is empty, verify "Low Solution Level" light is ON. When tank is full, verify "Low Solution Level" is OFF and "Tank Full" is ON.
Spray Nozzles	See pg 17		With lid open and hopper removed, visually inspect spray nozzles for fouling. Make sure they are point upwards and level towards the grid.
Dosing Pump Lines	See pg 17		Verify that lines are free of solids and not fouled.
E-Stop Operation	See pg 17		Depress button and ensure that all functions on the unit STOP.
Inlet Supply Solenoid Valve	Quarterly		Check for an audible clicking when before going into "Filling" or "High Level" modes. Ensure solenoid coil is not hot to the touch and that valve does not make a rattling noise when energized.
Y-Strainer Inspection	Bi-Annual		Close water supply valve. Remove strainer and inspect for debris.
Recirculation Pump	Annually		Rebuild pump wetend
Inlet Supply Solenoid Valve	Every 2 years		Replace solenoid valve

F. Recommeded Cleaning Procedures

SAFETY NOTE: Please use Personal Protective Equipment (PPE) per the MSDS sheet when handling the Briquettes.

CAUTION! Make sure spray is turned off before opening the Hopper Lid.

DO NOT USE CONCENTRATED ACID TO CLEAN THE HOPPER OR GRID. Instructions for a dilute acid solution are provided below.

NOTE: It is recommended to let the briquette level drop as low as possible prior to cleaning the Hopper and grid.

Supplies needed:

- PPE – Gloves, Goggles, and Apron
- Clean 5 gallon plastic bucket
- Hose
- Drain line from base of feeder (routed to the drain)
- Muriatic Acid (Hydrochloric Acid), 20° Baume (32%)

Tank Cleaning

1. Allow hopper to empty as much as possible prior to cleaning.
2. Ensure that the point of application for the chlorine is turned off and not requiring chlorination.
3. Shut-off inlet ball valve on supply manifold.
4. Remove lid and hopper.
5. Disconnect the union for the spray manifold and remove the spray-tree and.
6. Connect tubing to drain line and route to drain.
7. Open drain ball valve and allow the solution to drain.
8. Rinse the feeder 2-3 times by using the hose to fill the tank and at the same time draining. Allow the feeder to completely drain. Remove as much residual solids and calcium hypochlorite residue as possible with the hose.
9. Prepare in the 5 gallon bucket a solution of weak acid by making a 3:1 solution of water to muriatic acid.

   CAUTION: ALWAYS ADD ACID TO WATER
10. Gently pour the solution of weak acid into the feeder tank. Add at least enough solution to SHUT-OFF the TANK LOW alarm. This will activate the circulation pump and mix the acid solution through the system. Allow to mix for 20 minutes and drain the system. Rinse one more time.

Chemical Dosing Pump and Injector Cleaning

11. Remove injector and disconnect tubing from injector.
12. Soak injector and suction and discharge tubing for chemical dosing pump in 3:1 solution of water to muriatic acid.

    CAUTION: ALWAYS ADD ACID TO WATER

Chemical Hopper Cleaning

13. Rinse the hopper prior to cleaning. In a cleaning pan, add a 3:1 water to acid solution to clean the grid and the spray-tree.

    CAUTION: ALWAYS ADD ACID TO WATER
14. Place the hopper in the pan so that the grid is submerged. Place spray-tree in pan too. Allow to sit for 20 minutes.
15. Rinse all components with fresh water and replace spray-tree, deflector shield, and hopper. Close drain and add briquettes.
16. Replace lid and open inlet ball valve.
17. Discharge according to local sewer discharge requirements.

G. Step-By-Step Shut-Down and Storage

When the chlorinator is going to be shut-down for extended periods of time (>3 weeks) the unit should be drained prior to shut-down. Allow the product in the hopper to empty. Follow the above section for rinsing and cleaning the hopper. The solution tank should also be drained and cleaned prior to shut-down.

1. Turn OFF the chemical dosing (metering) pump on the control panel. Follow manufacturer's recommended storage procedure for the chemical dosing (metering) pump. The dosing pump lines should be flushed prior to storage.
2. Close inlet water supply ball valve.
3. Drain the tank via the drain ball valve.
4. The TANK FULL light will turn off.
5. The TANK LOW light will turn on and the circulation pump will turn off.
6. Rinse and drain the feeder to ensure that the circulation lines and the circulation pump head do not contain residual calcium hypochlorite, as these can solidify over time.
7. If the unit is going to be stored or shipped in freezing conditions, make sure that the inlet manifold and solenoid do not contain water. This is best accomplished by disconnecting the tubing from the solenoid discharge (to the tank) and allowing it to drain. **DO NOT STORE UNIT WITH ANY RESIDUAL WATER INSIDE THE SYSTEM.**

SECTION V. Technical Data

A. Water Quality

Water chemistry changes from site to site and even season to season. It is important to understand how water chemistry effects the Constant Chlor® MC4-50. There are options for pre-treatment to remove impurities that can react inside the Constant Chlor® MC4-50. The main parameters that need to be identified are: carbonate alkalinity (hardness as CaCO-3), silica, iron, and manganese. Alkalinity and silica can react inside the Constant Chlor® MC4-50 and produce scale on the grid and the dosing lines. It is important to know the iron and manganese levels if pre-treatment such as reverse osmosis is used because these species can harm the RO membrane.

B. Operating Specifications

The system operates under the following conditions:

- Water supply at 45 psi *[3.10 bar]* and 1.0 gpm *[3.8 lpm]*
- Solution reservoir is non-pressurized
- 50 lbs *[22.7 kg]* available chlorine per day (75 lbs *[34.0 kg]* cal-hypo per day)
- 0-25 gph *[0-94.6 lph]* delivery of 1.5% available solution
- Solution is mixed using a centrifugal pump at 6 gpm *[22.7 lpm]* at 7 psi *[0.48 bar]*
- The solution reservoir contains 13 gallons *[49.2 liters]* of solution
- The working volume of solution is 3 gallons *[11.4 liters]*

C. Electronics Panel and PLC Information

- 120/240VAC, 60/50Hz, 15/10A, 1Phase
- 4 Normally Open Contact relays for Remote Interface. 1 Dry Contact for Remote Start of Dosing Pump
- 24VDC Control Power
- 8 Buttons / Indicators:
  - OFF/ON Indicator: Push-Button to turn the unit ON or OFF
  - LID OPEN: Prevents the unit from operating if lid is opened
  - TANK LOW: Solution inside tank is low, alarm condition
  - CIRCULATION PUMP: Circulation pump is interlocked with TANK LOW AND will not operate if TANK LOW alarm is activated. Push-Button to turn ON or OFF
  - DOSING PUMP: Chemical dosing pump is interlocked to the system. Will not pump if LOW CHLORINE SOLUTION alarm is activated. Remote or manual start capability. Push-Button to turn ON or OFF
  - FILLING: Indicates that the solenoid is energized and the unit is making solution
  - TANK FULL: The level sensor is engaged and the tank is full of chlorinated solution
  - E-STOP: Push-Button emergency stop for the unit. Turns OFF every function

SECTION VI. Troubleshooting

A. Guide

Trouble	Probable Cause	Remedy
Calcium Hypochlorite solution tank is empty and/or TANK LOW light is on.	Drain port may be open or leaking.	Check ensure fitting and connections are tight and not leaking.
	Inlet supply ball-valve may be closed.	Ensure valve is open.
	Inlet y-strainer may be plugged.	Perform preventive maintenance on y-strainer.
	High and low solution level switches may be inoperable.	Remove hopper, drain solution, and verify on control panel that both Tank Low is ON when down and OFF when in the up position. Check Tank full is OFF when down and ON when in up position.
	Lid switch may be malfunctioning or misaligned causing supply water to shut off.	Ensure lid is secure and in place.
	Bulkhead fitting may be leaking.	Check ensure fitting and connections are tight and not leaking.
Low Chlorine Residual Downstream (and solution level inside tank is at least half full).	Demand increase at point of application or increased flow.	Check to see if water flows or demand has increased.
	Water temperature has changed (colder).	Check records and sample water.
	Ensure pressure relief valve isn't partially open.	Verify that solution is not being returned to the feeder via the PRV.
	Is dosing pump rated to pump against system head pressure?	Check with dosing pump representative or literature.
	Clogged Injector.	Clean injector (see injector fouling remedy).
	Clogged dosing pump tubing.	Clean or replace tubing.
	Siphoning.	Ensure injection point is above feeder's height.

Trouble	Probable Cause	Remedy
Injector is fouling quickly.	Injector with metal fittings used - failing.	Replace injector with compatible material.
	High alkalinity in source water causing scale formation.	Setup a predictable PM Schedule.
	"Injector" is not setup with spring-gate or "duck-bill" type closed tips.	Standard tubing connected to the point of injection is insufficient. A chemical injector that prevents constant mixing at the tip is required.
	Low solution dosing velocity.	Decrease tubing size to increase solution velocity.
Dosing pump tubing is clogging up with white solids.	Extremely high alkalinity or silicates.	Install pre-treatment such as reverse osmosis, water softener, deionizer, etc.
	ID of tubing is too large, reduce diameter tubing.	Consult Installation Manual regarding proper tubing sizing.
	Agitation inside feeder is not working. Solids are forming and being pulled into the tubing.	Ensure circulation pump is working and providing >5 psi. Clean circulation system.
	Too many "peaks and valleys" in tubing run.	Avoid long vertical runs at pump discharge.
	Solids building up in base.	Remove solids by cleaning the unit.
Strong chlorine smell in utility room.	Feeder is overfilled and product is sitting too long in hopper.	Reduce amount of product in hopper by 50%. Install vent line in "Accessory port" and vent to outdoors (see Section B of this section).
	Hot, humid environment in utility room.	Ensure that storage and ventilation recommendations are being met. Follow above instructions as well.

B. Installing a Vent Line

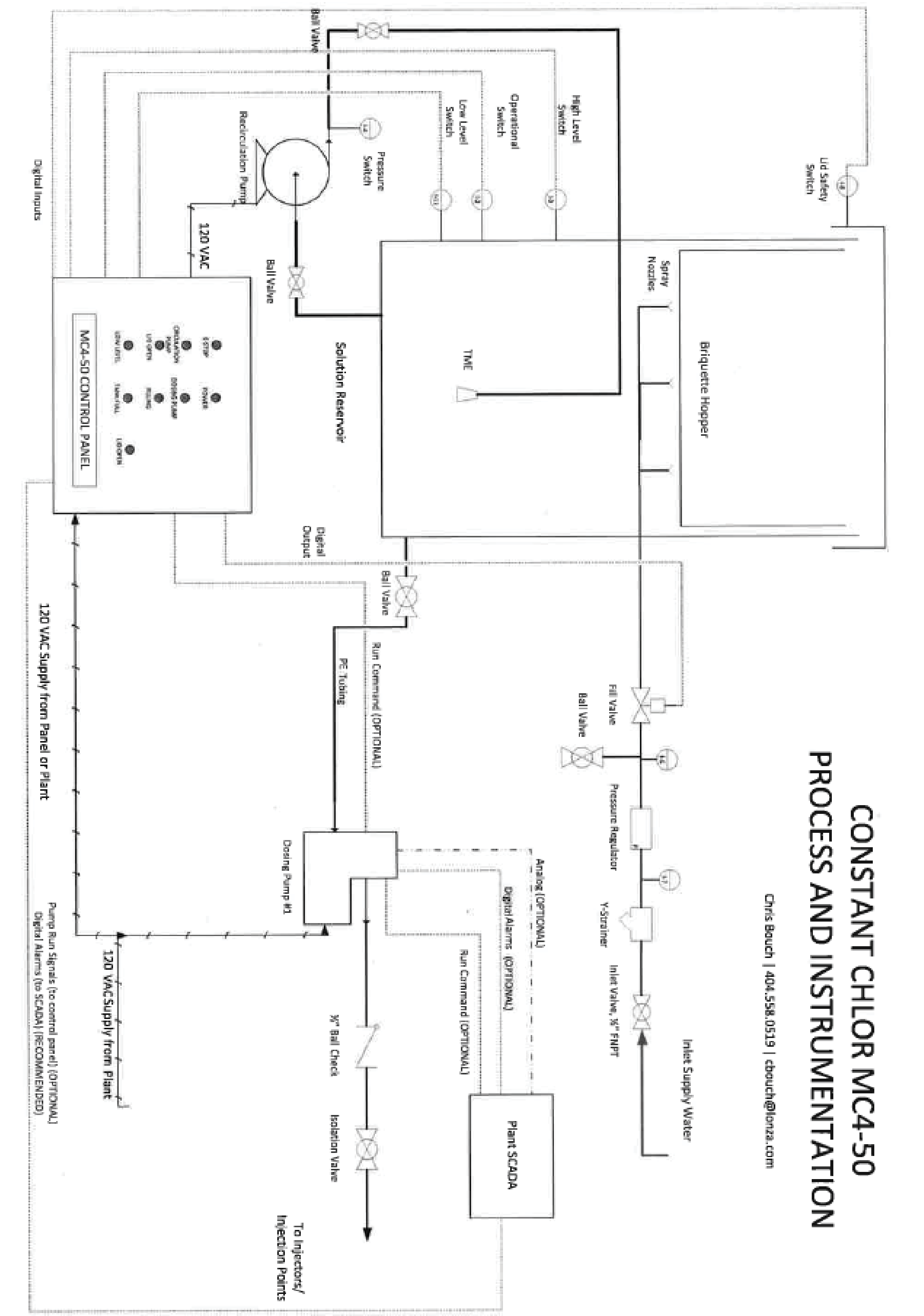
There are circumstances that require a vent line to be installed. Scenarios can vary from hot environments, to low feed rates. There is a 1/2" *[12.7mm]* FNPT bulkhead fitting labeled "Accessory Port" that can be seen in Figure 2. This can either be used as pressure relief return or a vent line. To install a vent line, you will need the following:

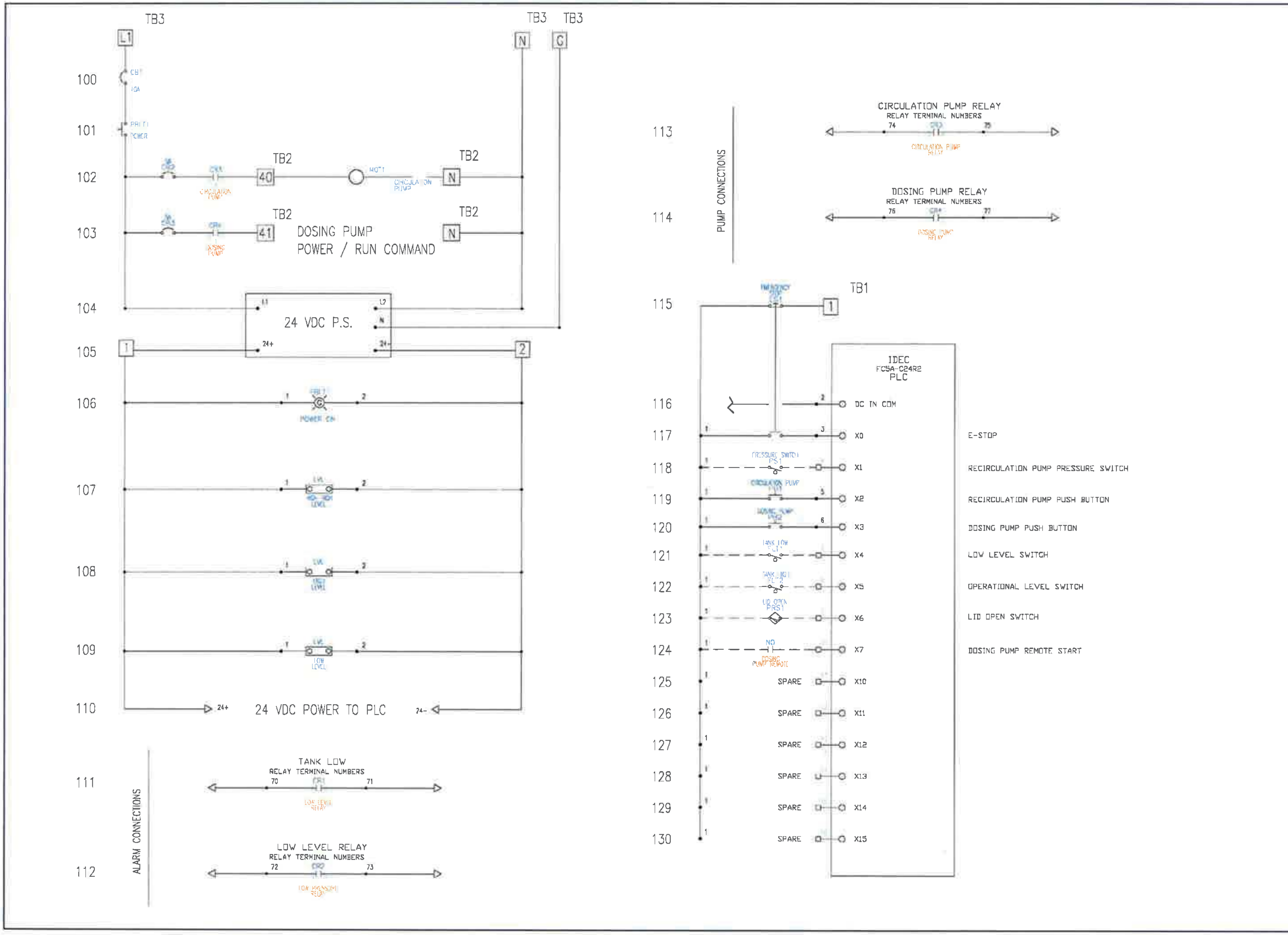
- 1/2" *[12.7mm]* MNPT barbed fitting
- 3/4" *[19.1mm]* OD tubing (preferably clear tygon)
- Teflon tape

Install tubing connector, and tubing. Run the tubing straight down towards the ground and preferably to a louver or vent to the outdoors. Ensure that tubing run stays flat on the ground and is not obstructed. The chlorine vapors are heavier than air and will gravity flow through the tubing as long as it is close to the ground.

SECTION VII. Engineering Drawings

A. P & ID

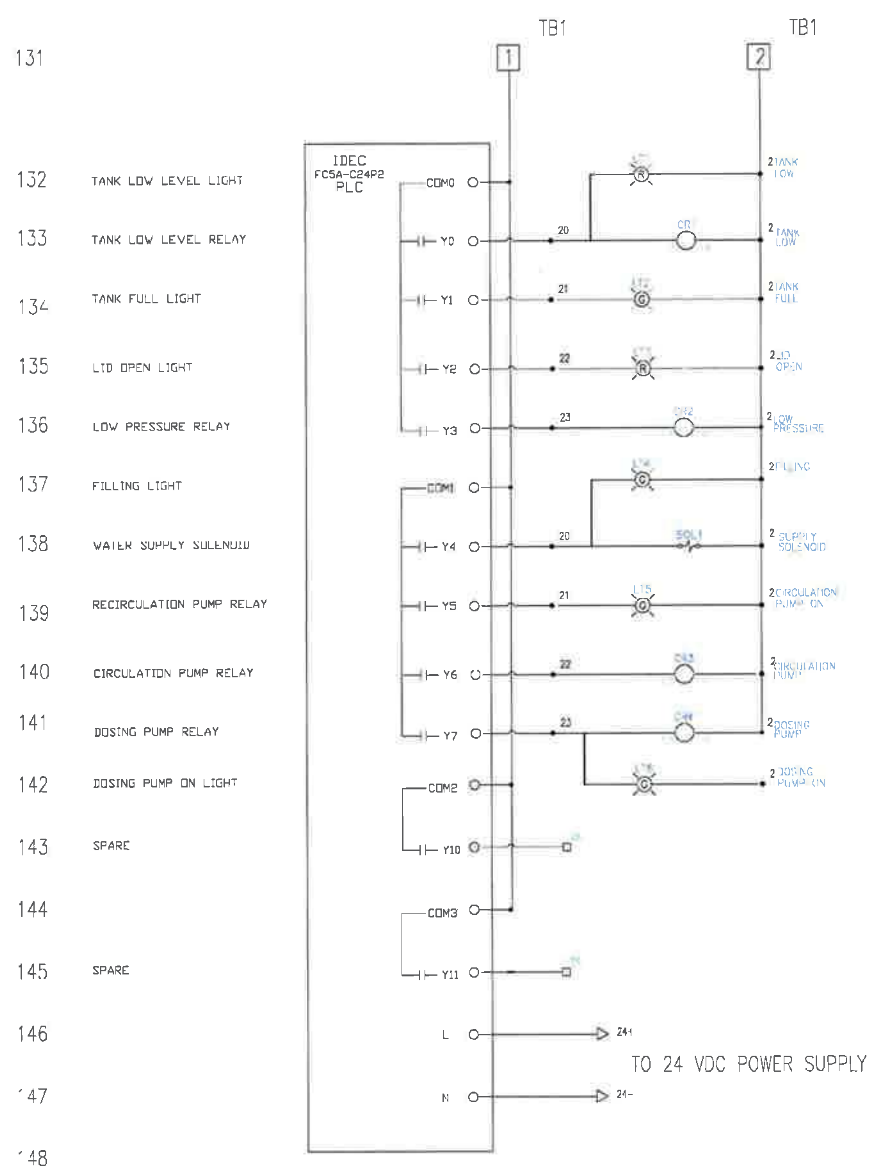


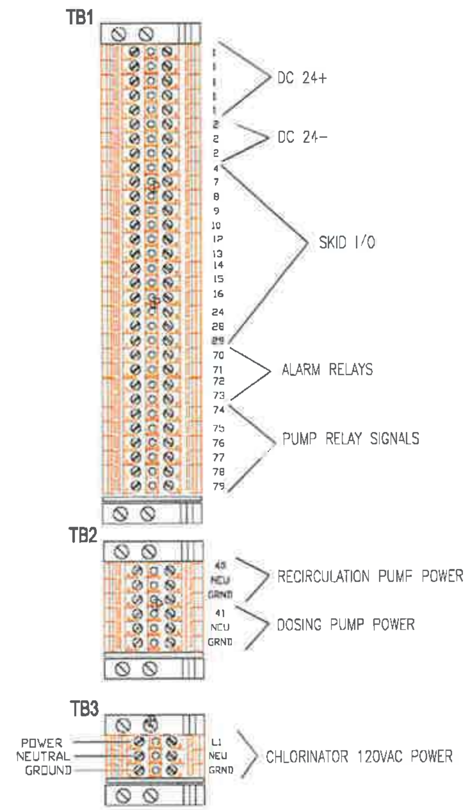


NO.	REVISION	DATE	BY
		4/8/13	CAD

CRIMPL FEEDER ELECTRICAL CONTROL PANEL WIRING MC4-50

DRAWN BY: C.BOUCH
CHECKED BY:
SCALE: NONE
DWG. NO. E-MC4-50-2





TAG	QTY	DESCRIPTION
	1	Non-metallic enclosure, NEMA 4X, top-hinge with locking screws, 18"x16"x10"
	1	w/coated steel back plane and DIN mounting rails.
PLC	1	Idec Microsmart PLC, FC5A-C24R2
	1	Power supply, Idec PS5R-SB24
CB1	1	Circuit protector, Idec NC1V11, 10 A
CB2	1	Circuit protector, Idec NC1V11, 5 A
CB3	1	Circuit protector, Idec NC1V11, 5 A
CR1,2	2	Power Relay, DPDT, Idec RH1BU-DC24V
CR3,4	2	Relay Socket, Idec SH1B-05
PB#	2	Illuminated push buttons, Idec HW1L-A1F10QD, w/momentary and latching blocks
ES1	1	E-stop mushroom push button, Idec HW1B-A4F11-R, w/latching block

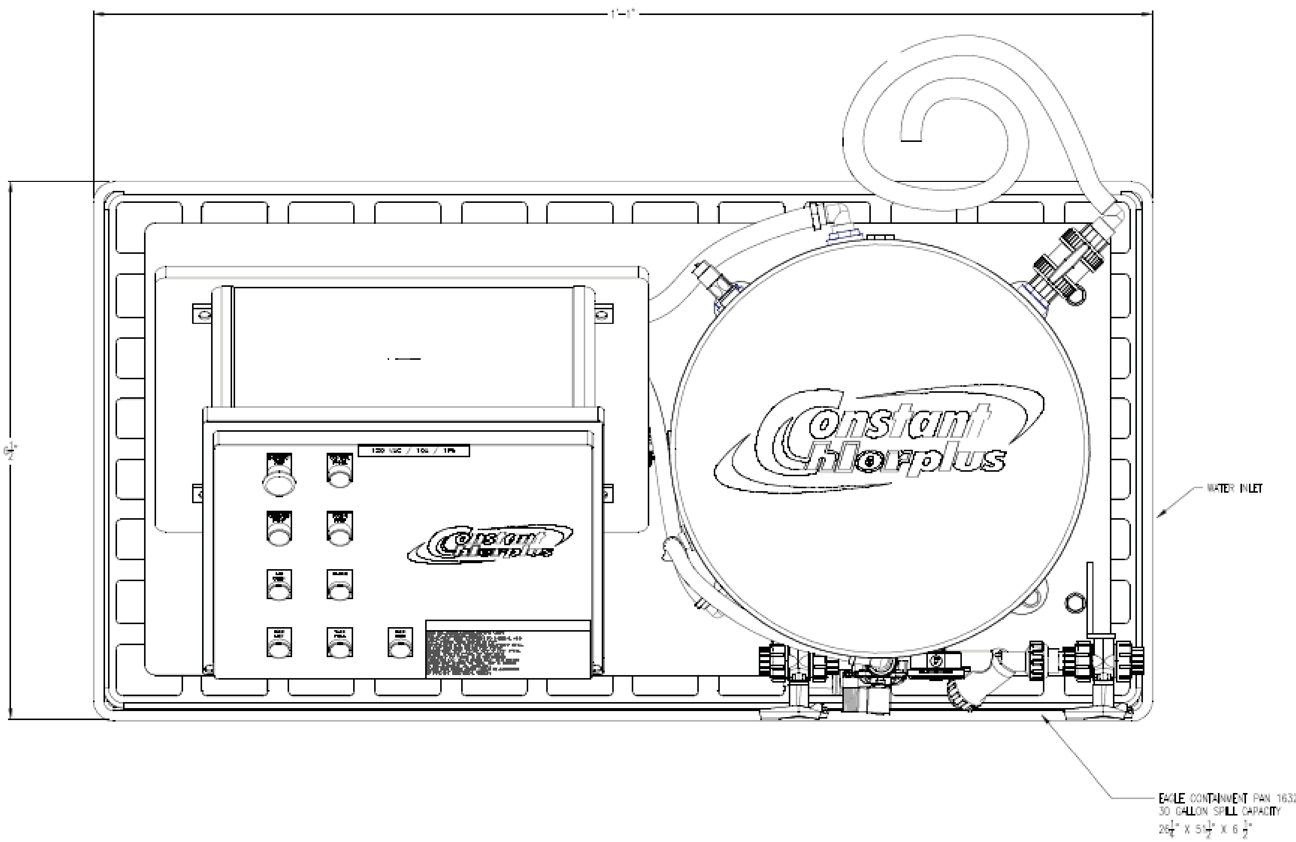
NO.	REVISION	DATE	BY

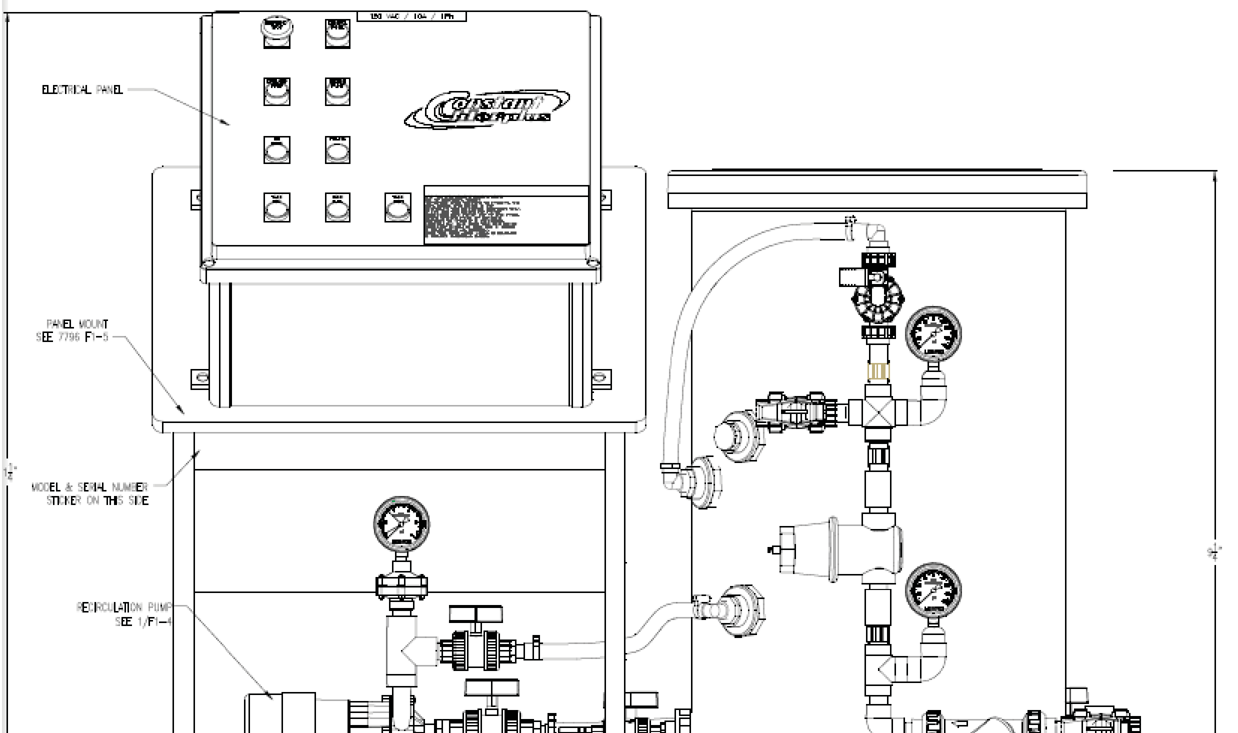
ARCH

CRIMPL FEEDER ELECTRICAL CONTROL WIRING MC4-50

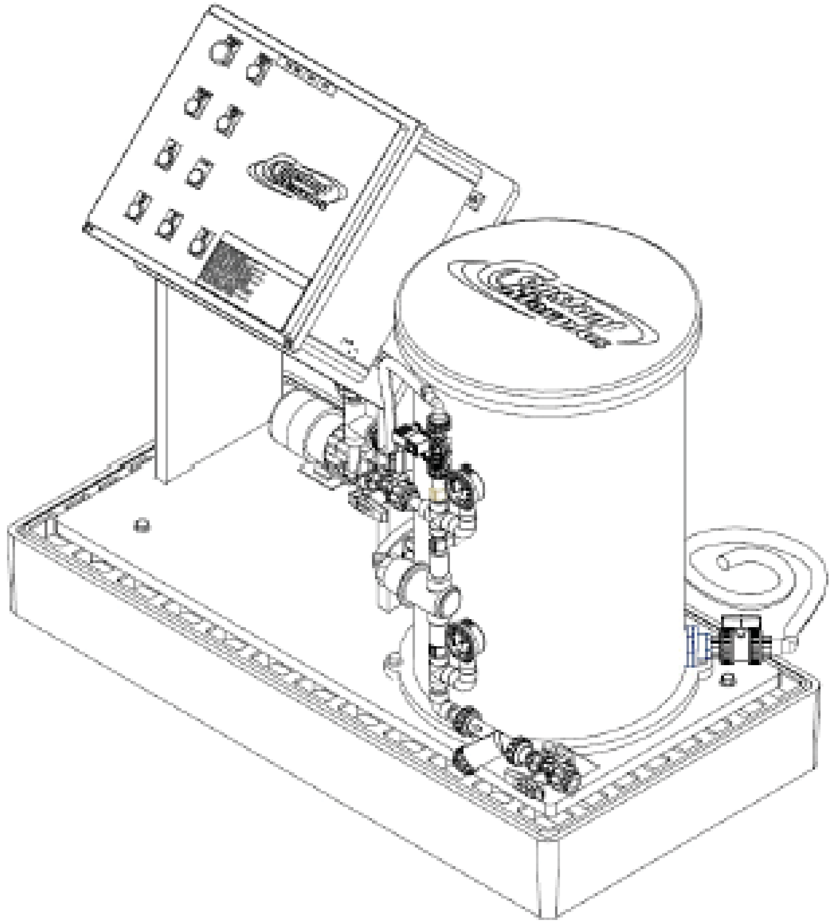
DRAWN BY: C.BOUCH
CHECKED BY:
SCALE: NONE
DWG. NO. E-MC4-50-3

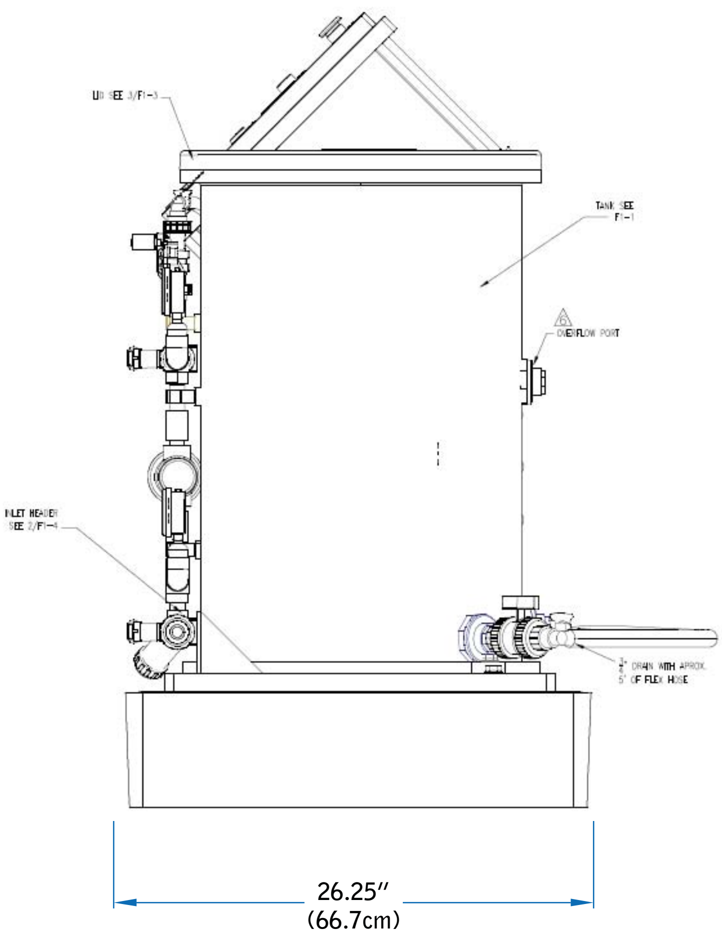
C. 2D Drawings





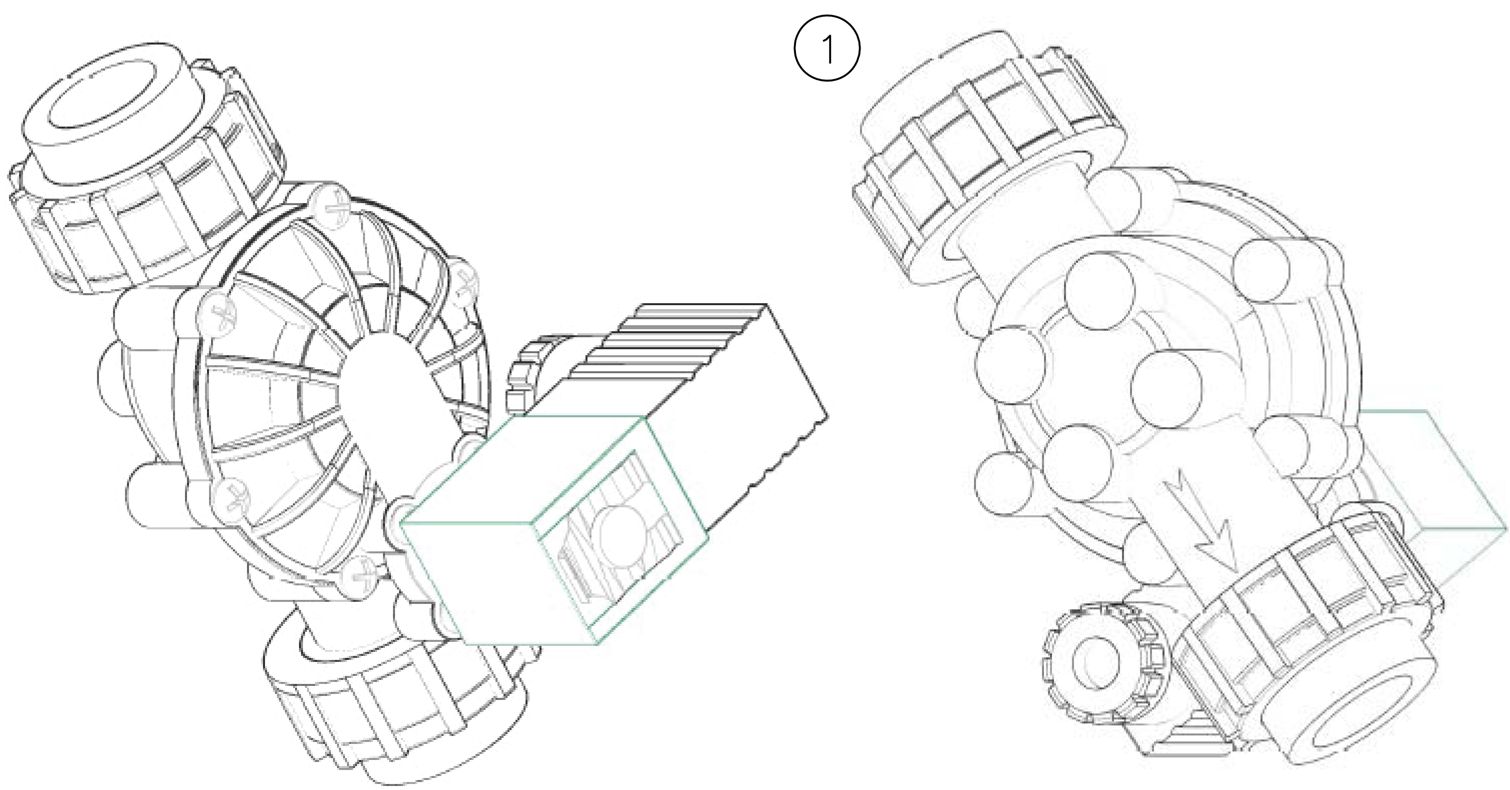
C. 2D Drawings (continued)

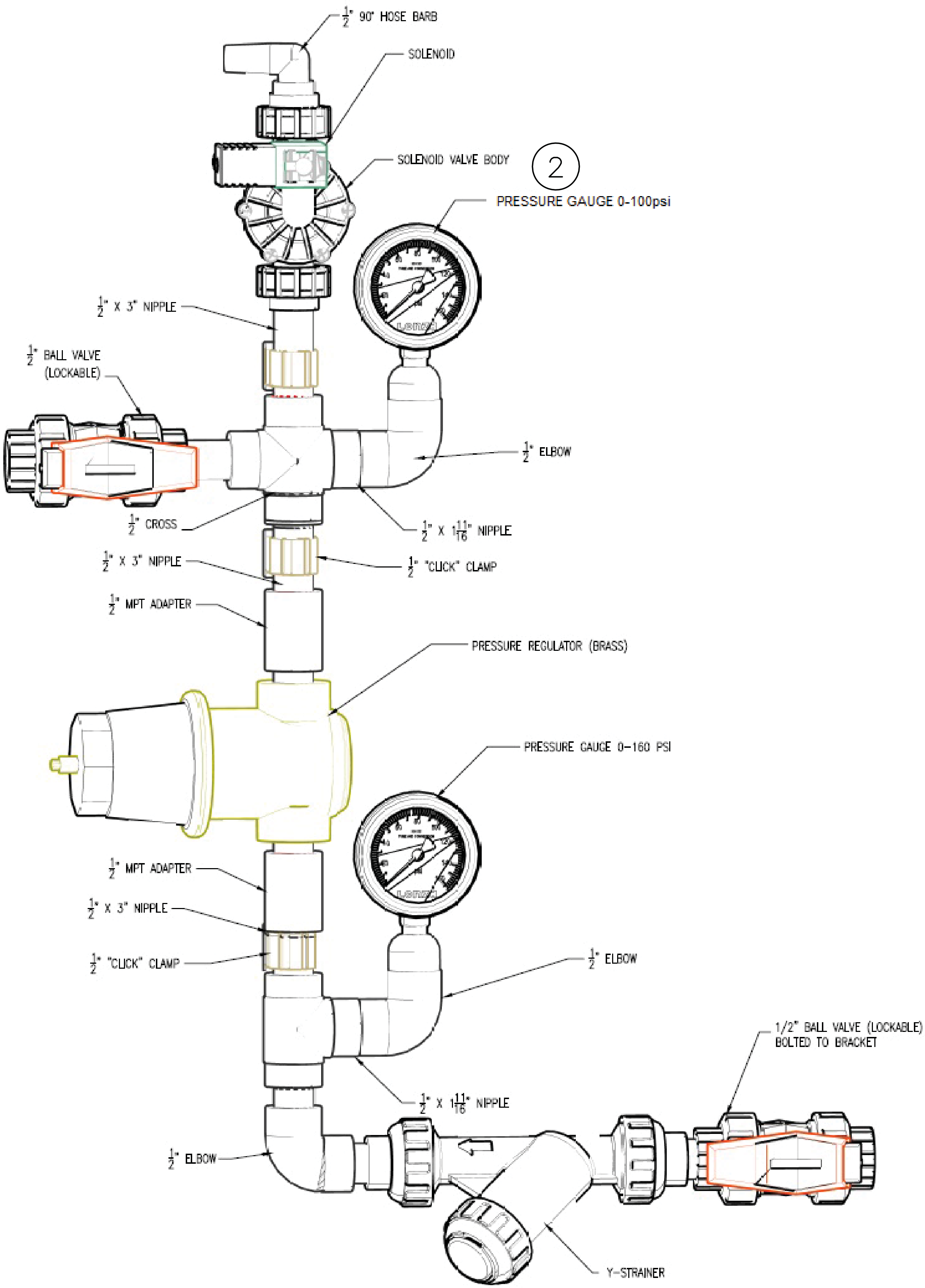


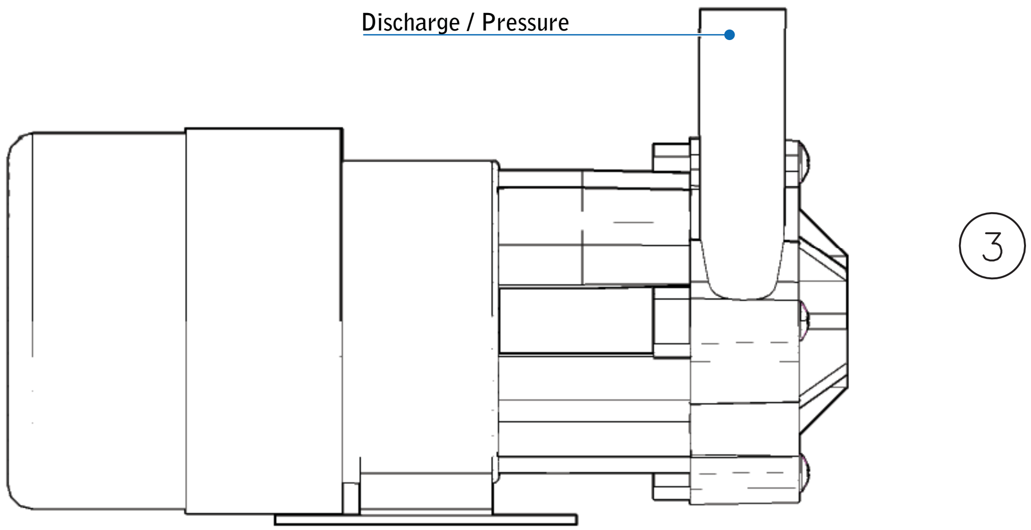


SECTION VIII. Exploded View and Parts List

No.	Description	Part Number
1	24V DC Solenoid valve (Recommended Spare)	79664
2	Inlet Manifold w/out solenoid	79519
3	Magnetic Drive Recirculation Pump	79520
4	Magnetic-drive Pump Wet End (Recommended Spare)	79521
5	Recirculation Re-build (No Pump) (Recommended Spare)	79522
6	Ultrasonic level Switch (switch-tek model: LU10-1405)	Non-SKU item
7	Spray Nozzle (1)	71617
8	Tank Mixing Eductor	79008
9	Basket with Grid (MC4-50 and MC4-50L)	79524
10	Lid with Contact	79564
11	Pre-Programmed PLC (Picture not shown)	79526
12	24VDC power supply, 120 watts, 5 amp (Picture not shown)	79527
13	Spray Tree Assembly (MC4-50 and MC4-50L) (Picture not shown)	79558
14	Lid Switch (Picture not shown)	79580

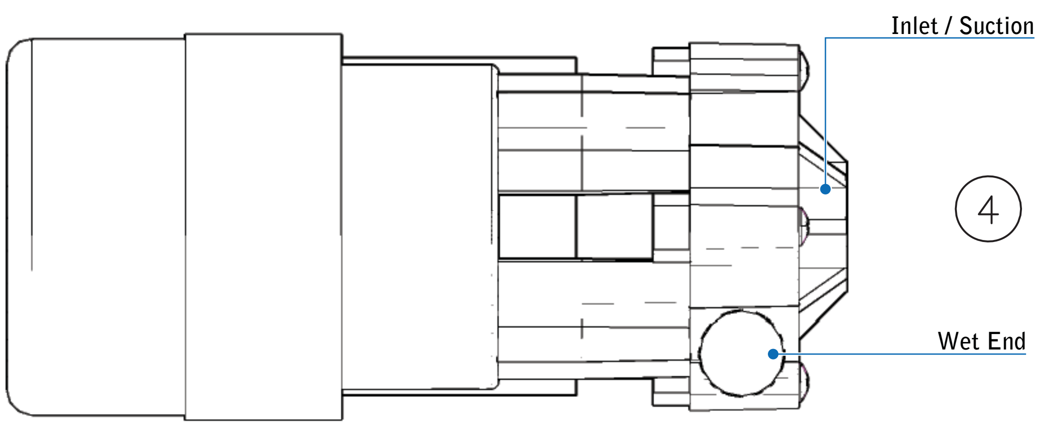



½" 90° HOSE BARB
SOLENOID
SOLENOID VALVE BODY
2
PRESSURE GAUGE 0-100psi
½" X 3" NIPPLE
½" BALL VALVE (LOCKABLE)
½" ELBOW
½" CROSS
½" X 1 11/16" NIPPLE
½" X 3" NIPPLE
½" "CLICK" CLAMP
½" MPT ADAPTER
PRESSURE REGULATOR (BRASS)
PRESSURE GAUGE 0-160 PSI
½" MPT ADAPTER
½" X 3" NIPPLE
½" "CLICK" CLAMP
½" ELBOW
1/2" BALL VALVE (LOCKABLE) BOLTED TO BRACKET
½" X 1 11/16" NIPPLE
½" ELBOW
Y-STRAINER



Front View

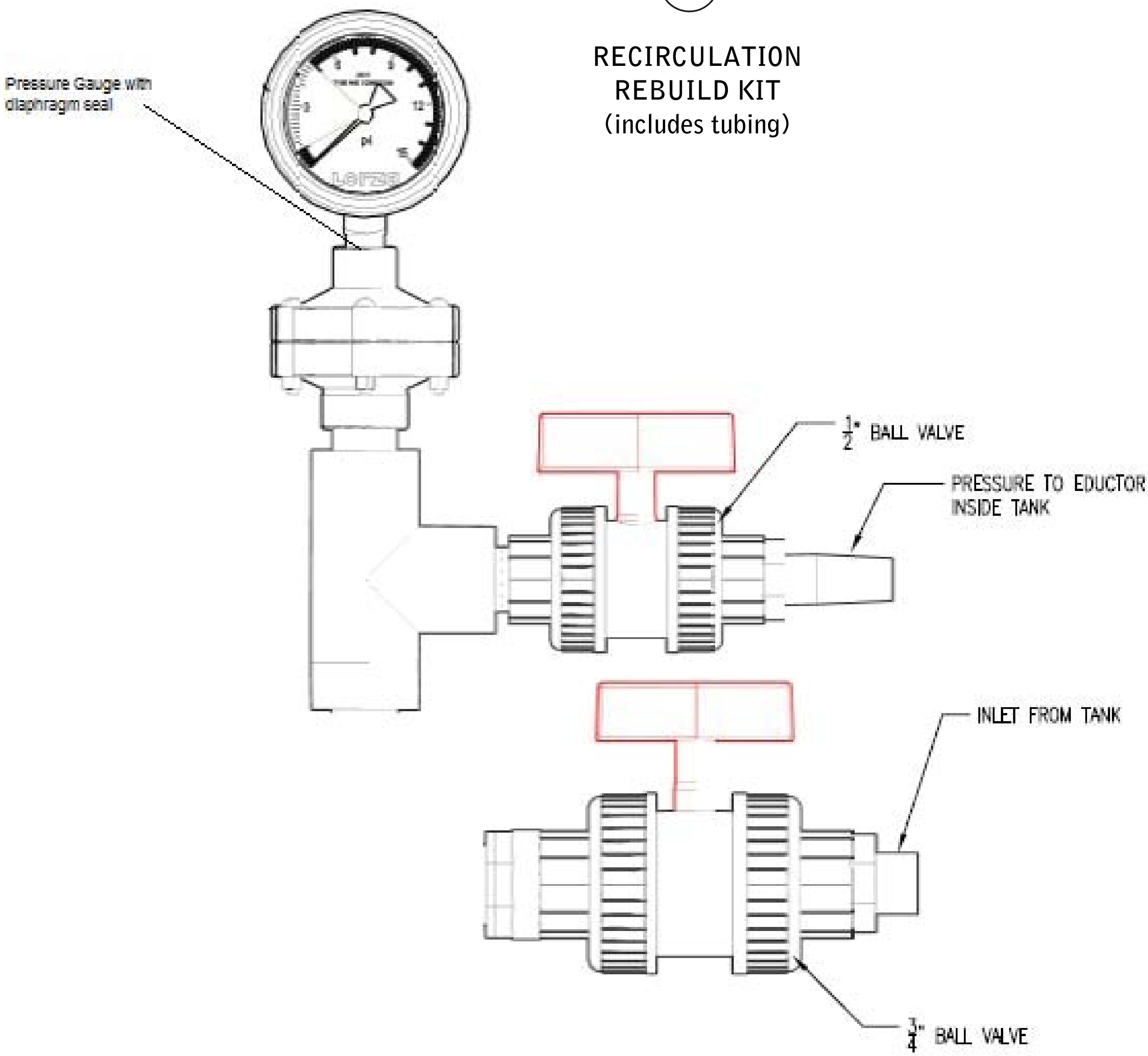
RECIRCULATION PUMP



Top View

5

RECIRCULATION REBUILD KIT
(includes tubing)



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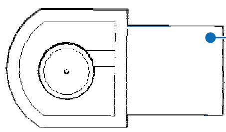

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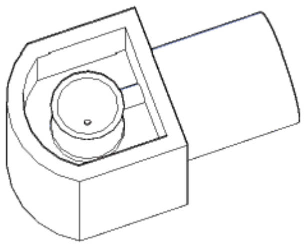

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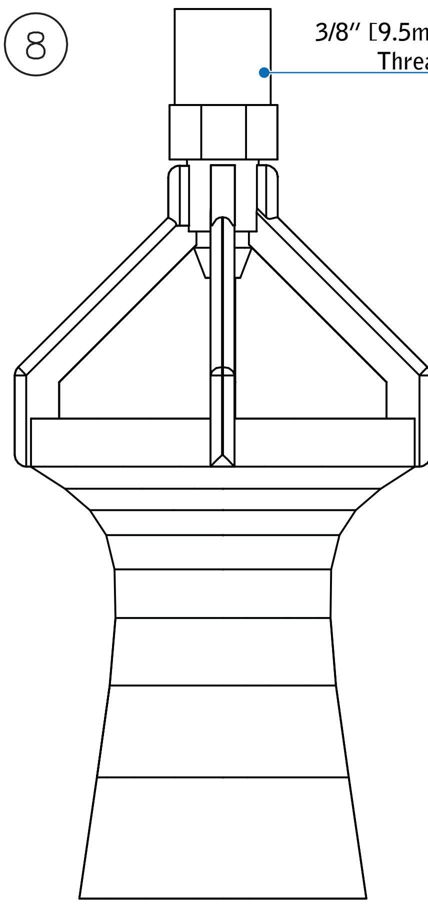

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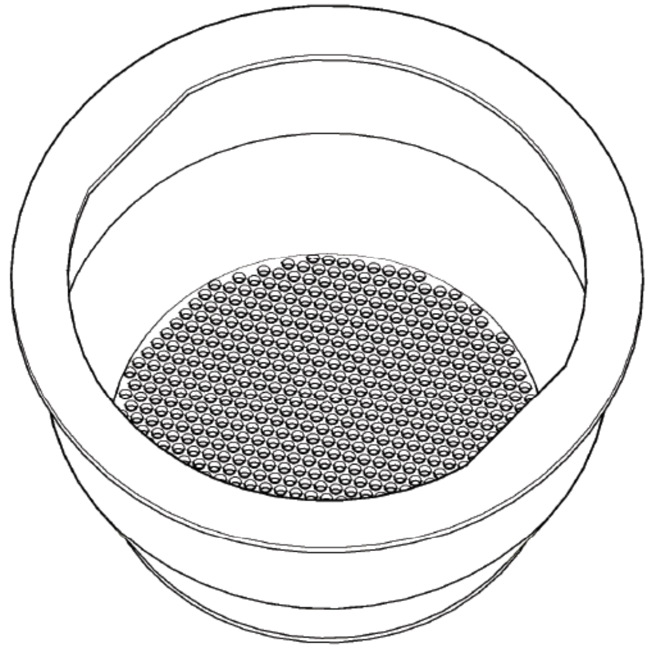

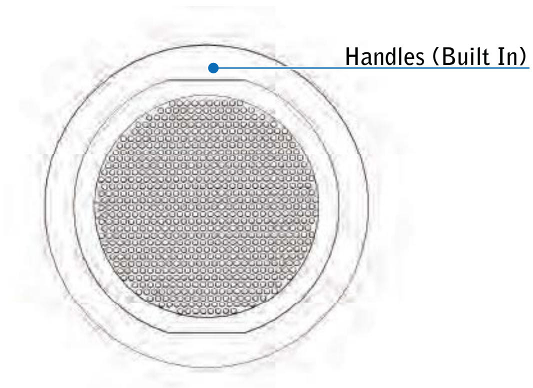

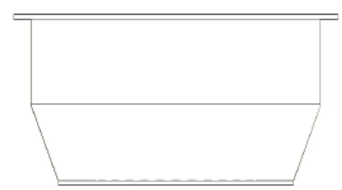

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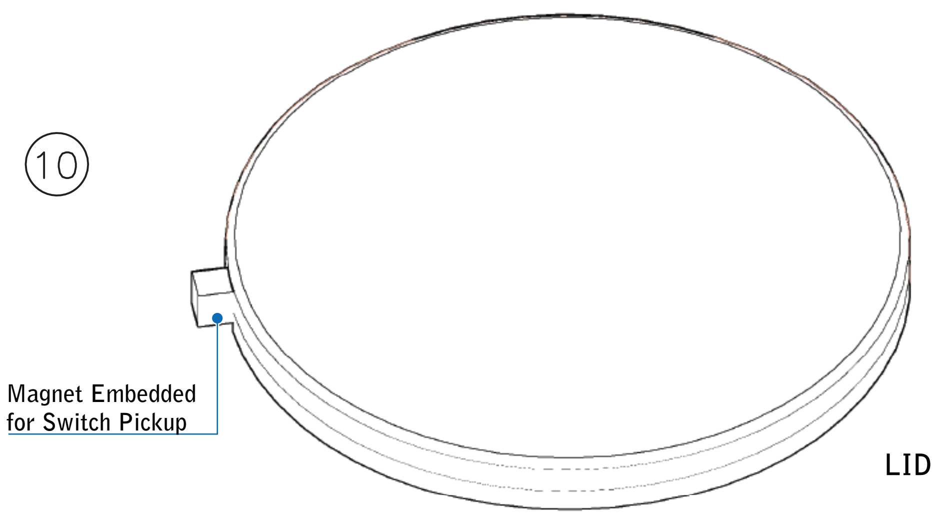


Arch Chemicals, Inc.

MATERIAL SAFETY DATA SHEET

FOR ANY EMERGENCY, 24 HOURS / 7 DAYS, CALL:	1-800-654-6911 (OUTSIDE USA: 1-423-780-2970)
FOR ALL TRANSPORTATION ACCIDENTS, CALL CHEMTREC®:	1-800-424-9300 (OUTSIDE USA: 1-703-527-3887)
FOR ALL MSDS QUESTIONS & REQUESTS, CALL:	1-800-511-MSDS (OUTSIDE USA: 1-423-780-2347)

PRODUCT NAME: **CONSTANT CHLOR® PLUS BRIQUETTES**
EPA Registration Number: 1258-1179

1. PRODUCT AND COMPANY IDENTIFICATION

Arch Chemicals, Inc.
501 Merritt 7 PO Box 5204
Norwalk, CT 06856-5204

REVISION DATE:	09/12/2011
SUPERCEDES:	04/29/2010
MSDS Number:	000000000844
SYNONYMS:	None
CHEMICAL FAMILY:	Hypochlorite
DESCRIPTION / USE	Sanitizer and Oxidizer
FORMULA:	Not Applicable/Mixture

2. HAZARDS IDENTIFICATION

OSHA Hazard Classification:	**Toxic by inhalation., Corrosive to eyes and skin, Lung toxin, Oxidizer**

Routes of Entry:	Inhalation, skin, eyes, ingestion
Chemical Interactions:	No known or reported interactions.
Medical Conditions Aggravated:	Asthma, respiratory and cardiovascular disease

<u>Human Threshold Response Data</u>

Odor Threshold	Approximately 1.4 mg/m3 (based on odor threshold of chlorine)
Irritation Threshold	Approximately 13-22 mg/m3 (based on irritation threshold of chlorine)

Hazardous Materials Identification System / National Fire Protection Association Classifications

Hazard Ratings :	Health	Flammability	Physical / Instability	PPI / Special hazard.
HMIS	3	0	1	
NFPA	3	0	1	OX

Immediate (Acute) Health Effects

Inhalation Toxicity: HARMFUL IF PRODUCT IS INHALED IN HIGH CONCENTRATIONS. CAUSES BURNS TO RESPIRATORY TRACT. Inhalation of dust or vapor from this product can be irritating to the nose, mouth, throat and lungs. In confined areas, mechanical agitation can result in high levels of dust, and reaction with incompatible materials (as listed in Section 10) can result in high concentrations of chlorine vapor, either of which may result in burns to the respiratory tract, producing lung edema, shortness of breath, wheezing, choking, chest pains, impairment of lung function and possible permanent lung damage.

Skin Toxicity: DRY MATERIAL CAUSES MODERATE SKIN IRRITATION. WET MATERIAL CAUSES SKIN BURNS. Dermal exposure to dry material causes moderate skin irritation characterized by redness and swelling. Dermal exposure to wet material can cause severe irritation and/or burns characterized by redness, swelling and scab formation. Prolonged skin exposure may cause permanent damage.

Eye Toxicity: CAUSES BURNS TO EYES. Severe irritation and/or burns can occur following eye exposure. Direct contact may cause impairment of vision and corneal damage.

Ingestion Toxicity: MODERATELY TOXIC IF SWALLOWED. CAUSES BURNS TO DIGESTIVE TRACT. Irritation and/or burns can occur to the entire gastrointestinal tract, including the stomach and intestines, characterized by nausea, vomiting, diarrhea, abdominal pain, bleeding, and/or tissue ulceration or perforation. Significant exposure to this material can lead to serious health effects and/or death.

Acute Target Organ Toxicity: This product is corrosive to all tissues contacted and upon inhalation, may cause irritation to mucous membranes and respiratory tract., The dry material is irritating to the skin. However when wet, it will produce burns to the skin.

Prolonged (Chronic) Health Effects

Carcinogenicity: This product is not known or reported to be carcinogenic by any reference source including IARC, OSHA, NTP or EPA.

Reproductive and Developmental Toxicity: No reproductive or developmental risk to humans is expected from exposure to this product.

Inhalation: Repeated inhalation exposure may cause impairment of lung function and permanent lung damage.

Skin Contact:	Effects similar to those from acute exposure. In addition, chronic exposure to wet material may cause effects secondary to tissue destruction.
Ingestion:	There are no known or reported effects from chronic ingestion except for effects similar to those experienced from single exposure. The acute corrosivity of this product, makes chronic ingestion of significant amounts unlikely.
Sensitization:	This material is not known or reported to be a skin or respiratory sensitizer.
Chronic Target Organ Toxicity:	There are no known or reported effects from repeated exposure except those secondary to burns.
Supplemental Health Hazard Information :	No additional health information available.

3. COMPOSITION / INFORMATION ON INGREDIENTS

CAS OR CHEMICAL NAME	CAS #	% RANGE
CALCIUM HYPOCHLORITE	7778-54-3	60 - 80
SODIUM CHLORIDE	7647-14-5	10 - 20
CALCIUM CHLORATE	10137-74-3	0 - 5
CALCIUM CHLORIDE	10043-52-4	0 - 5
CALCIUM HYDROXIDE	1305-62-0	0 - 4
CALCIUM CARBONATE	471-34-1	0 - 4
1,2,4-BUTANETRICARBOXYLIC ACID, 2-PHOSPHONO-, SODIUM SALT	40372-66-5	0.2 - 0.8

Water	7732-18-5	4.0 - 8.5

4. FIRST AID MEASURES

General Advice: Call a poison control center or doctor for treatment advice. For 24-hour emergency medical assistance, call Arch Chemical Emergency Action Network at 1-800-654-6911. Have the product container or label with you when calling a poison control center or doctor, or going for treatment.

Inhalation: IF INHALED: Move person to fresh air. If person is not breathing, call 911 or an ambulance, then give artificial respiration, preferably mouth-to-mouth if possible. Call a poison control center or doctor for further treatment advice.

Skin Contact: IF ON SKIN OR CLOTHING: Take off contaminated clothing. Rinse skin immediately with plenty of water for 15-20 minutes. Call a poison control center or doctor for treatment advice.

Eye Contact: IF IN EYES: Hold eye open and rinse slowly and gently with water for 15-20 minutes. Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye. Call a poison control center or doctor for treatment advice.

Ingestion: IF SWALLOWED: Call a poison control center or doctor immediately for treatment advice. Have person sip a glass of water if able to swallow. Do not induce vomiting unless told to do so by a poison control center or doctor. Do not give anything by mouth to an unconscious person.

Notes to Physician: Probable mucosal damage may contraindicate the use of gastric lavage.

5. FIRE FIGHTING MEASURES

Flammability Summary (OSHA): This product is chemically reactive with many substances. Any contamination of the product with other substances by spill or otherwise may result in a chemical reaction and fire., This product is a strong oxidizer which is capable of intensifying a fire once started., Product is not known to be flammable, combustible or pyrophoric.

<u>Flammable Properties</u>

Flash Point: Not applicable

Autoignition Temperature: Not applicable

Extinguishing Media: Water only. Do not use dry extinguishers containing ammonium compounds.

Fire Fighting Instructions: Use water to cool containers exposed to fire. See Section 6 for protective equipment for fire fighting.

Upper Flammable / Explosive Limit, % in air: Not applicable

Lower Flammable / Explosive Limit, % in air: Not applicable

6. ACCIDENTAL RELEASE MEASURES

Personal Protection for Emergency Situations:	Response to a large quantity spill (100 pounds or greater) or when dusting or decomposition gas exposure could occur requires the use of a positive pressure full face supplied air repirator or self contained breathing apparatus (SCBA), chemical resistant gloves, coveralls and boots. In case of fire, this personal protective equipment should be used in addition to normal fire fighter equipment.

<u>Spill Mitigation Procedures</u>

Air Release:	Vapors may be suppressed by the use of water fog. All water utilized to assist in fume suppression, decontamination or fire suppression may be contaminated and must be contained before disposal and/or treatment.
Water Release:	This product is heavier than water. This material is soluble in water. Monitor all exit water for available chlorine and pH. Advise local authorities of any contaminated water release.
Land Release:	Contact 1-800-654-6911 immediately. DANGER: All spills of this product should be treated as contaminated. Contaminated product may initiate a chemical reaction that may spontaneously ignite any combustible material present, resulting in a fire of great intensity. In case of a spill, separate all spilled product from packaging, debris and other material. Using a clean broom or shovel, place all spilled product into plastic bags, and place those bags into a clean, dry disposal container, properly marked and labeled. Disposal containers made of plastic or metal are recommended. Do not seal disposal containers tightly. Immediately remove all product in disposal containers to an isolated area outdoors. Place all damaged packaging material in a disposal container of water to assure decontamination (i.e. removal of all product) before disposal. Place all undamaged packaging in a clean, dry container properly marked and labeled. Call for disposal procedures.
Additional Spill Information :	Hazardous concentrations in air may be found in local spill area and immediately downwind. Remove all sources of ignition. Stop source of spill as soon as possible and notify appropriate personnel. Dispose of spill residues per guidelines under Section 13, Disposal Consideration. This material may be neutralized for disposal; you are requested to contact Arch Chemicals at 1-800-654-6911 before beginning any such procedure. FOR ALL TRANSPORTATION ACCIDENTS, CALL CHEMTREC: 1-800-424-9300 REPORTABLE QUANTITY: 10 lbs. (as calcium hypochlorite) per 40 CFR 302.4.

7. HANDLING AND STORAGE

Handling:	Avoid inhalation of dust and fumes. Do not take internally. Avoid contact with skin, eyes and clothing. Upon contact with skin or eyes, wash off with water. Remove contaminated clothing and wash before reuse.
Storage:	Keep product tightly sealed in original containers. Store product in a cool, dry, well-ventilated area. Store away from combustible or flammable products. Keep product packaging clean and free of all contamination, including, e.g. other pool treatment products, acids, organic materials, nitrogen-containing compounds, dry powder fire extinguishers (containing mono-ammonium phosphate), oxidizers, all corrosive liquids, flammable or combustible materials, etc.
Shelf Life Limitations:	Do not store product where the average daily temperature exceeds 95° F. Storage above this temperature may result in rapid decomposition, evolution of chlorine gas and heat sufficient to ignite combustible products. Shelf life (that is, the period of time before the product goes below stated label strength) is determined by storage time and temperatures. Store in a cool, dry and well ventilated area. Prolonged storage at elevated temperatures will significantly shorten the shelf life. Storage in a climate controlled storage area or building is recommended in those areas where extremes of high temperature occur.
Incompatible Materials for Storage:	Do not allow product to come in contact with other materials, including e.g. other pool treatment products, acids, organic materials, nitrogen-containing compounds, dry powder fire extinguishers (containing mono-ammonium phosphate), oxidizers, all corrosive liquids, flammable or combustible materials, etc. A chemical reaction with such substances can cause a fire of great intensity.
Do Not Store At temperatures Above:	Average daily temperature of 35° C / 95° F. Storage above this temperature may result in rapid decomposition, evolution of chlorine gas and heat sufficient to ignite combustible products.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Ventilation:	Local exhaust ventilation or other engineering controls are normally required when handling or using this product to keep airborne exposures below the TLV, PEL or other recommended exposure limit.

<u>Protective Equipment for Routine Use of Product</u>

Respiratory Protection :	Wear a NIOSH approved respirator if levels above the exposure limits are possible.
Respirator Type :	A NIOSH approved full-face air purifying respirator equipped with combination chlorine/P100 cartridges. Air purifying respirators should not be used in oxygen deficient or IDLH atmospheres or if exposure concentrations exceed ten (10) times the published limit.
Skin Protection :	Wear impervious gloves to avoid skin contact. A full impervious suit is recommended if exposure is possible to a large portion of the body. A safety shower should be provided in the immediate work area.
Eye Protection:	Use chemical goggles. Emergency eyewash should be provided in the immediate work area.
Protective Clothing Type:	Neoprene, Nitrile, Natural rubber (This includes: gloves, boots, apron, protective suit)

Exposure Limit Data

CHEMICAL NAME	CAS #	Name of Limit	Exposure
CALCIUM HYPOCHLORITE	7778-54-3	ARCH-ROEG*	1 mg/m3 TWA
CALCIUM HYPOCHLORITE	7778-54-3	NIOSH-IDLH	37 - 48 mg/m3 based on IDLH concentration of chlorine
CALCIUM HYDROXIDE	1305-62-0	ACGIH	5 mg/m3 TWA
CALCIUM HYDROXIDE	1305-62-0	OSHA Z1	15 mg/m3 TWA total dust
CALCIUM HYDROXIDE	1305-62-0	OSHA Z1	5 mg/m3 TWA respirable fraction
CALCIUM CARBONATE	471-34-1	OSHA Z1	15 mg/m3 TWA Total dust
CALCIUM CARBONATE	471-34-1	OSHA Z1	5 mg/m3 TWA respirable dust fraction

*ARCH-ROEG: Arch Recommended Occupational Exposure Guideline.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	solid
Form	Tablet
Color:	white
Odor:	Chlorine-like
Molecular Weight:	143.00
Specific Gravity :	Not applicable
pH :	10.4 - 10.8 (1% solution in neutral, distilled water) (@ 25 Deg. C)
Boiling Point:	Not applicable

Freezing Point:	Not applicable
Melting Point:	Not applicable
Density:	1.9g/cc
Vapor Pressure:	(@ 25 Deg. C) Not applicable
Vapor Density:	Not applicable
Viscosity:	Not applicable
Fat Solubility:	No data
Solubility in Water:	18 % (@ 25 Deg. C) Product also contains calcium hydroxide and calcium carbonate which will leave a residue.
Partition coefficient n-octanol/water:	Not applicable
Evaporation Rate:	Not applicable
Oxidizing:	Oxidizer
Volatiles, % by vol.:	Not applicable
VOC Content	Not applicable
HAP Content	Not applicable

10. STABILITY AND REACTIVITY

Stability and Reactivity Summary:	Product is not sensitive to mechanical shock or impact. Product is not sensitive to electrical static discharge. Product will not undergo hazardous polymerization. Product is an NFPA Class 3 oxidizer which can cause a severe increase in fire intensity. Not pyrophoric. Not an organic peroxide. If subjected to excessive temperatures, the product may undergo rapid decomposition, evolution of chlorine gas, and heat sufficient to ignite combustible substances. If product is exposed to small amounts of water, it can react violently to produce heat and toxic gases and spatter. Use copious amounts of water for fires involving this product.
Conditions to Avoid:	Do not store next to heat source, in direct sunlight, or elevated storage temperature. Do not store where the daily average temperature exceeds 95 °F. Prevent ingress of humidity and moisture into container or package. Always close the lid.
Chemical Incompatibility:	This product is chemically reactive with many substances, including, e.g., other pool treatment products, acids, organics, nitrogen-containing compounds, dry powder fire extinguishers (containing mono-ammonium phosphate), oxidizers, corrosive ,flammable or combustible materials. Do not allow product to contact any foreign matter, including other water treatment products. Contamination or improper use may cause a fire of great intensity, explosion or the release of toxic gases. If product is exposed to small amounts of water, it can react violently to produce heat and toxic gases and spatter.
Hazardous Decomposition Products:	Chlorine
Decomposition Temperature:	170 - 180 DEG°C - , 338 - 356 DEG°F-

11. TOXICOLOGICAL INFORMATION

Component Animal Toxicology
Oral LD50 value:

CALCIUM HYPOCHLORITE	LD50 (65% calcium hypochlorite) 850 mg/kg Rat
SODIUM CHLORIDE	LD50 = 3,000 mg/kg Rat
CALCIUM CHLORIDE	LD50 = 1,000 mg/kg Rat
CALCIUM HYDROXIDE	LD50 = 7,340 mg/kg Rat

Component Animal Toxicology
Dermal LD50 value:

CALCIUM HYPOCHLORITE	LD50 (65% calcium hypochlorite) > 2,000 mg/kg Rabbit
SODIUM CHLORIDE	LD50 > 10,000 mg/kg Rabbit
CALCIUM CHLORIDE	LD50 = 2,630 mg/kg Rat
CALCIUM HYDROXIDE	No data

Component Animal Toxicology
Inhalation LC50 value:

CALCIUM HYPOCHLORITE	Inhalation LC50 1 h (65% calcium hypochlorite), (Nose Only) = 2.04 MG/L Rat
CALCIUM HYPOCHLORITE	Inhalation LC50 4 h (65% calcium hypochlorite), (Nose Only) = 0.51 MG/L Rat
SODIUM CHLORIDE	Inhalation LC50 1 h > 42 MG/L Rat
CALCIUM CHLORIDE	No data
CALCIUM HYDROXIDE	No data

Product Animal Toxicity

Oral LD50 value:	LD50 Approximately 800 mg/kg Rat
Dermal LD50 value:	LD50 > 2,000 mg/kg Rabbit
Inhalation LC50 value:	Inhalation LC50 1.00 h (Nose Only) > 2.04 MG/L Rat Inhalation LC50 4 h (Nose Only) > 0.51 MG/L Rat

Skin Irritation:	DRY MATERIAL CAUSES MODERATE SKIN IRRITATION., WET MATERIAL CAUSES SKIN BURNS.
Eye Irritation:	Corrosive to eyes.
Skin Sensitization:	This material is not known or reported to be a skin or respiratory sensitizer.

Acute Toxicity: This product is corrosive to all tissues contacted and upon inhalation, may cause irritation to mucous membranes and respiratory tract.The dry material is irritating to the skin. However when wet, it will produce burns to the skin.

Subchronic / Chronic Toxicity: There are no known or reported effects from repeated exposure except those secondary to burns.

Reproductive and Developmental Toxicity: Calcium hypochlorite has been tested for teratogenicity in laboratory animals. Results of this study have shown that calcium hypochlorite is not a teratogen.

CALCIUM CHLORIDE: Not known or reported to cause reproductive or developmental toxicity.

Mutagenicity: Calcium hypochlorite has been tested in the Dominant lethal assay in male mice, and it did not induce a dominant lethal response. Calcium hypochlorite has been reported to produce mutagenic activity in two in vitro assays. It has, however, been shown to lack the capability to produce mutations in animals based on results from the micronucleus assay. In vitro assays frequently are inappropriate to judge the mutagenic potential of bactericidal chemicals due to a high degree of cellular toxicity. The concentration which produces mutations in these in vitro assays is significantly greater than the concentrations used for disinfection. Based on high cellular toxicity in in vitro assays and the lack of mutagenicity in animals, the risk of genetic damage to humans is judged not significant.

CALCIUM CHLORIDE: This product was determined to be non-mutagenic in the Ames assay. It was also shown to be non-clastogenic in the chromosomal aberration test.

Carcinogenicity: This product is not known or reported to be carcinogenic by any reference source including IARC, OSHA, NTP or EPA. One hundred mice were exposed dermally 3 times a week for 18 months to a solution of calcium hypochlorite. Histopathological examination failed to show an increased incidence of tumors. IARC (International Agency for Research on Cancer) reviewed studies conducted with several hypochlorite salts. IARC has classified hypochlorite salts as having inadequate evidence for carcinogenicity to humans and animals. IARC therefore considers hypochlorite salts to be not classifiable as to their carcinogenicity to humans (Group 3 Substance).

CALCIUM CHLORIDE: This chemical is not known or reported to be carcinogenic by any reference source including IARC, OSHA, NTP, or EPA.

12. ECOLOGICAL INFORMATION

Overview: Highly toxic to fish and other aquatic organisms.

Ecological Toxicity Values for: **CALCIUM HYPOCHLORITE**

Bluegill	-	(nominal, static). 96 h LC50 0.088 mg/l
Rainbow trout (Salmo gairdneri),	-	(nominal, static). 96 h LC50 0.16 mg/l
Daphnia magna,	-	(nominal, static). 48 h LC50 0.11 mg/l
Bobwhite quail	-	Dietary LC50 > 5,000 ppm
Mallard ducklings	-	Dietary LC50 > 5,000 ppm
Bobwhite quail	-	Oral LD50 3,474 mg/kg

Ecological Toxicity Values for: **CALCIUM CHLORIDE**

Bluegill	-	(nominal, static). 96 h LC50 = 10,650 mg/l
Mosquito fish	-	(nominal, static). 96 h LC50 = 13,400 mg/l
Fathead minnow (Pimephales promelas),	-	(nominal, static). 96 h LC50 = 4,630 mg/l
Daphnia magna,	-	(nominal, static). 48 h LC50= 2,770 mg/l
Ceriodaphnia dubia	-	(nominal, static). 48 h LC50= 1,830 mg/l
Nitzschia linearis (diatom)	-	(nominal, static). 5 day LC50 = 3,130 mg/l

13. DISPOSAL CONSIDERATIONS

CARE MUST BE TAKEN TO PREVENT ENVIRONMENTAL CONTAMINATION FROM THE USE OF THE MATERIAL. THE USER OF THE MATERIAL HAS THE RESPONSIBILITY TO DISPOSE OF UNUSED MATERIAL, RESIDUES AND CONTAINERS IN COMPLIANCE WITH ALL RELEVANT LOCAL, STATE AND FEDERAL LAWS AND REGULATIONS REGARDING TREATMENT, STORAGE AND DISPOSAL FOR HAZARDOUS AND NONHAZARDOUS WASTES.

Waste Disposal Summary : If this product becomes a waste, it meets the criteria of a hazardous waste as defined under 40 CFR 261 and would have the following EPA hazardous waste number: D001.If this product becomes a waste, it will be a hazardous waste which is subject to the Land Disposal restrictions under 40 CFR 268 and must be managed accordingly.

Disposal Methods : As a hazardous solid waste it should be disposed of in accordance with local, state and federal regulations.

Potential US EPA Waste Codes : D001

14. TRANSPORT INFORMATION

Land (US DOT):	UN1748 CALCIUM HYPOCHLORITE, DRY MIXTURE 5.1 III
Water (IMDG):	UN1748 CALCIUM HYPOCHLORITE, DRY MIXTURE, 5.1 III MARINE POLLUTANT
	Flash Point: Not applicable
Air (IATA):	UN1748 CALCIUM HYPOCHLORITE, DRY MIXTURE, 5.1 III
Emergency Response Guide Number:	ERG # 140
Transportation Notes:	Under specific circumstances, this product can ship under two transport exceptions, Limited Quantity or Consumer Commodity. See Bill of Lading for proper shipping description. REPORTABLE QUANTITY: 10 lbs. (Per 49 CFR 172.101, Appendix) Material is not regulated as a marine pollutant for ground transportation within the US if shipped in non-bulk packages.
EMS:	F-H, S-Q

15. REGULATORY INFORMATION

UNITED STATES:

Toxic Substances Control Act (TSCA):	This is an EPA registered pesticide.
EPA Pesticide Registration Number:	1258-1179
FIFRA Listing of Pesticide Chemicals (40 CFR 180):	This product is regulated under the Federal Insecticide, Fungicide and Rodenticide Act. It must be used for purposes consistent with its labeling.

Superfund Amendments and Reauthorization Act (SARA) Title III:

Hazard Categories Sections 311 / 312 (40 CFR 370.2):

Health	Immediate (Acute) Health Hazard
Physical	Fire Hazard

Emergency Planning & Community Right to Know (40 CFR 355, App. A):

Extremely Hazardous Substance Section 302 - Threshold Planning Quantity:

ZUS_SAR302	TPQ (threshold planning quantity)	None established

Reportable Quantity (49 CFR 172.101, Appendix):

ZUS_CERCLA	Reportable quantity	Calcium hypochlorite Value: 10lbs

ZUS_SAR302 Reportable quantity None established

Supplier Notification Requirements (40 CFR 372.45), 313 Reportable Components

ZUS_SAR313 De minimis concentration None established

Clean Air Act Toxic ARP Section 112r:
CAA 112R None established

Clean Air Act Socmi:
HON SOC None established

Clean Air Act VOC Section 111:
CAA 111 None established

Clean Air Act Haz. Air Pollutants Section 112:
ZUS_CAAHAP None established

ZUS_CAAHRP None established

CAA AP None established

State Right-to-Know Regulations Status of Ingredients

Pennsylvania:

CAS #	COMPONENT NAME
10137-74-3	CALCIUM CHLORATE
1305-62-0	CALCIUM HYDROXIDE
7778-54-3	CALCIUM HYPOCHLORITE

ZUSPA_RTK

Pennsylvania: Hazardous substance list
1989-08-11
CHLORIC ACID, CALCIUM SALT

Pennsylvania: Hazardous substance list
1989-08-11
CALCIUM HYDROXIDE

Pennsylvania: Hazardous substance list
1989-08-11
HYPOCHLOROUS ACID, CALCIUM SALT
Environmental hazard

New Jersey:

CAS #	COMPONENT NAME
10137-74-3	CALCIUM CHLORATE
1305-62-0	CALCIUM HYDROXIDE
7778-54-3	CALCIUM HYPOCHLORITE

ZUSNJ_RTK

New Jersey Right to Know Hazardous Substance List (RTK-HSL)
2007-03-01
CALCIUM CHLORATE   CHLORIC ACID, CALCIUM SALT

New Jersey Right to Know Hazardous Substance List (RTK-HSL)
2007-03-01
CALCIUM HYDROXIDE   CALCIUM HYDROXIDE (Ca(OH)2)   HYDRATED LIME

New Jersey Right to Know Hazardous Substance List (RTK-HSL)
2007-03-01
CALCIUM HYPOCHLORITE   HYPOCHLOROUS ACID, CALCIUM SALT   BLEACHING POWDER

Massachusetts:

CAS #	COMPONENT NAME
10137-74-3	CALCIUM CHLORATE
1305-62-0	CALCIUM HYDROXIDE
7778-54-3	CALCIUM HYPOCHLORITE

ZUSMA_RTK

Massachusetts Right to Know List of Chemicals and Hazard Classifications
1993-04-24
CALCIUM CHLORATE

Massachusetts Right to Know List of Chemicals and Hazard Classifications
1994-04-01
CALCIUM HYDROXIDE

Massachusetts Right to Know List of Chemicals and Hazard Classifications
1993-04-24
CALCIUM HYPOCHLORITE

California Proposition 65:

CAS #	COMPONENT NAME
ZUSCA_P65	None established

WHMIS Hazard Classification:

Ingredient Disclosure List (WHMIS)
2007-08-24
Threshold limits: 1 Weight percent
991
Calcium hydroxide

16. OTHER INFORMATION

MSDS REVISION STATUS :
SECTIONS REVISED: 1
Major References : Available upon request.

Limited Warranty

Limited Warranty

The Constant Chlor® Plus Briquette Chlorinator is warranted against any manufacturing defects in material or workmanship for a period of 12 months after installation or 18 months after shipping from Arch, whichever is earlier. This warranty applies only to the original end-user.

Service

For warranty service, contact the authorized Constant Chlor® Dealer in your area. Any defective part(s) covered by this warranty will be repaired or replaced, at Arch's discretion. Replacement may be with either new or reconditioned parts.

Exclusions

This warranty does not cover damage or failure due to accidents, fire, flood, or other acts of God. Nor does it cover damage or failure due to abuse, misuse, abnormal or improper use, neglect, improper maintenance, alterations or modifications by anyone other than Arch (unless specifically approved in writing by Arch), repairs by anyone other than an authorized Dealer, or ordinary wear and tear. Use of any Briquettes or other chemicals other than the Constant Chlor® Plus Briquettes designed for use with this chlorinator shall void this warranty.

Any transportation to and from an authorized Constant Chlor® Dealer is your responsibility.

Neither Arch nor its Dealers are responsible or liable for indirect, special, or consequential damages arising out of or in connection with the use or performance of the product or other damages with respect to loss of property, loss of revenues or profit by the owner. EXCEPT AS PROVIDED ABOVE, ARCH MAKES NO WARRANTIES. ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE IS SPECIFICALLY EXCLUDED.

NOTE: No modifications may be made to the chlorinator without prior written approval from Arch. Unauthorized modifications void any warranty. This Constant Chlor® Briquette Chlorinator is subject to one or more patents owned by Arch, and all rights in any modifications or improvements, including but not limited to any patents, copyrights, trademarks or trade secrets, belong exclusively to Arch.

For information, contact Arch Sales Office at 800-432-7223.

Lonza.
HTH® Water Products
1200 Bluegrass lakes Parkway
Alpharetta GA, 30004

www.archwaterworks.com/municipal

NOTES

NOTES

Lonza Emergency Action Network (LEAN)

The Lonza Emergency Action Network ("LEAN") is Lonza's emergency action system. Call the LEAN system at 1-800-654-6911) in North America, and at (Country Code for the United States) 423-780-2970 elsewhere in the world. The LEAN system is available 24 hours a day, 7 days a week for assistance with spills, injuries and emergencies of any kind. It uses computers and other systems to make Lonza's environmental, technical transportation, toxicological and other expertise about its products readily available to anyone needing assistance. The LEAN system also includes emergency response teams capable of providing on-site support throughout North America.

(800) 654-6911

(From outside North America, call after the country code for the US, 423-780-2970)

Additionally, in the event of an emergency, CHEMTREC (Chemical Transportation Emergency Center) should be contacted. CHEMTREC is a national center established by the Chemical Manufacturers Association (CMA) in Washington, DC, to relay pertinent emergency information concerning specific chemicals on request.

CHEMTREC has a 24-hour toll-free telephone number (800) 424-9300, intended primarily for use by those who respond to chemical transportation emergencies. CHEMTREC may also be accessed through the CMA website at www.cmahq.com.

Material Safety Data Sheets (MSDS) can be obtained by contacting (800)-511-MSDS.

Instruction Manual - MicroChem®2 Transmitter and Controller Series 4000

SEVERN TRENT SERVICES

These instructions describe the installation, operation and maintenance of the subject equipment. Failure to strictly follow these instructions can lead to an equipment rupture that may cause significant property damage, severe personal injury and even death. If you do not understand these instructions, please call Severn Trent Water Purification (STWP), Inc. for clarification before commencing any work at +1 215 997 4000 and ask for a Field Service Manager. Severn Trent Water Purification, Inc. reserves the rights to make engineering refinements that may not be described herein. It is the responsibility of the installer to contact STWP Inc. for information that cannot be answered specifically by these instructions.

Any customer request to alter or reduce the design safeguards incorporated into STWP Inc. equipment is conditioned on the customer absolving STWP Inc. from any consequences of such a decision.

STWP Inc. has developed the recommended installation, operating and maintenance procedures with careful attention to safety. In addition to instruction/operating manuals, all instructions given on labels or attached tags should be followed. Regardless of these efforts, it is not possible to eliminate all hazards from the equipment or foresee every possible hazard that may occur. It is the responsibility of the installer to ensure that the recommended installation instructions are followed. It is the responsibility of the user to ensure that the recommended operating and maintenance instructions are followed. Severn Trent Water Purification, Inc. cannot be responsible for deviations from the recommended instructions that may result in a hazardous or unsafe condition.

STWP Inc. cannot be responsible for the overall system design of which our equipment may be an integral part of or any unauthorized modifications to the equipment made by any party other that STWP Inc.

STWP Inc. takes all reasonable precautions in packaging the equipment to prevent shipping damage. Carefully inspect each item and report damages immediately to the shipping agent involved for equipment shipped “F.O.B. Colmar” or to STWP Inc. for equipment shipped “F.O.B Jobsite”. Do not install damaged equipment.

SEVERN TRENT SERVICES - COLMAR OPERATIONS
COLMAR, PENNSYLVANIA, USA
ISO 9001: 2008 CERTIFIED

It is mandatory to carefully read the present manual before operating any action of the instrument.

Do not install any equipment if damage is such that faulty operation is likely to result.
Carefully inspect all packing material before discarding it, to prevent loss of mounting hardware, accessories, spare parts or instructions.

All instructions given on any attached tag should be followed.

WARNING

To ensure safe operation of MicroChem®2 equipment carefully follow use and installation instructions and recommendations illustrated in this manual. Improper use of the equipment may damage the equipment and endanger the safety of the operating personnel.

WARNING

All MicroChem®2 electronics are shipped with voltage selection jumper set to the 220 Vac position. Set the voltage selection jumper to match the local power source.

WARNING

If the equipment is used in a manner NOT specified by Severn Trent or NOT included in the present document, the protection provided by the equipment may be impaired.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1 MODEL NUMBER BREAKDOWN

MicroChem®2 -- 4 -- D 2 1 --
T17M

Type of Instrument
Transmitter (NOTE 1) — B
Controller (NOTE 2) — D
Swimming Pool Controller (NOTE 3) — E

Series of Production - fixed code — 4

Channels
1 Channel — 1
2 Channel — 2
3 Channel — 3

Design Level - Fixed Mode — D

Voltage
110/220 + 10%, 50/60 Hz, Field selectable, shipped set for 220 Vac — 2

Mounting
Wall Mounting — 1

Serial Communication
RS 485 — 2
RS 422 (default when not specified) — 3
RS232 — 4

NOTES

1. Transmitter with the cleaning sequence enabled: alarm relays are possible only for Channels 1 and 2.
2. PID standard has 1 Channel; PID with Feed Forward requires two Channels installed: Channel 1 for the controlled variable, Channel 2 for the analog input 4-20 mA signal from the flow rate meter. A Third measurement-only sensor can be installed on Channel 3. A 2 channel instrument is also required if a PID output signal is configured on channel 1 and a retransmission of the measured value from the input signal on channel 1 is also required.

   The controller option D includes software for the instrument to average the input signals from 2 or 3 of the same type of sensor such as DO. The controller will then provide an output signal to control the blowers in an aeration basin based on the averaged signal. Any parameter the instrument is capable of receiving may be used with the averaging feature.
3. Swimming pool Controller is available in three different versions: pH and mV (ORP); pH and Cl; and pH, Cl and ORP. (In the latter case the controlled parameters are to be installed in Channels 1 and 3).

MODEL NUMBER BREAKDOWN (UK ORDERS ONLY)

MicroChem®2 Transmitter[1]

Description	Part Number
MicroChem®2 Transmitter – 1 Channel	01-4045
MicroChem®2 Transmitter – 2 Channel	01-4050
MicroChem®2 Transmitter – 3 Channel	01-4024

MicroChem®2 Controller[2]

Description	Part Number
MicroChem®2 Controller – 1 Channel	01-4013
MicroChem®2 Controller – 2 Channel	01-4015
MicroChem®2 Controller – 3 Channel	01-4018

MicroChem®2 Specific Controllers

Description	Part Number
MicroChem®2 Swimming Poop Controller[3] – Supplied as 2 Channel	01-4051
MicroChem®2 Aeration Basin Controller[4] – Supplied as 2 Channel	01-4052

MicroChem®2 Accessories

Description	Part Number
Sunshade Assembly – for wall mounting – 1T624B037U01	01-4055
Sunshade Assembly – for 2” Pipe mounting – 1T624B037U03	01-4056
S4000 Analog Board	71-4000

NOTE:

1 Supplied with software to initiate a sensor cleaning sequence activated by a relay.
Available with 1, 2 or 3 channels. When cleaning sequence is selected, alarm transmission is limited to channel 1 and channel 2 only. Relays are available for alarm transmission for channel 3 only if a cleaning sequence is not activated.

2 Combines a PID algorithm utilizing the sensor input signal or PID with Feed Forward control utilizing a 4-20mA input signal from a flow transmitter (channel 2). Control is achieved through a 4-20mA output or time proportional relay.
Available with 2 or 3 channels (only Channel 1 is for control).

3 Combines 2 PID control algorithms to control a swimming pool. pH is controlled on channel 1, ORP or Chlorine is controlled on a second channel. A third channel, in this case channel 2, can be used for ORP or chlorine not controlled on a channel 3.
Supplied as standard with 2 channels, a third channel is available if ordered with a S4000 Analog Board P/N 71-4000.

4 Specifically designed for O_2 control. Signals from up to three DO sensors are averaged and computed, and then processed through a PID algorithm. Supplied as standard with 2 channels, a third channel is available if ordered with a S4000 Analog Board P/N 71-4000.

2 INTRODUCTION

2.1 Glossary

Symbol	Meaning
~	ALTERNATING CURRENT SUPPLY ONLY
⎓	DIRECT CURRENT SUPPLY ONLY
	PROTECTIVE EARTH (ground) terminal Both direct and alternating current supply.
	EARTH (ground) terminal
	WARNING – Refer to the manual for instructions
	CAUTION - Risk of electric shock
	WEEE SYMBOL: indicates the separated collection of electric and electronic equipment at the end of life.

PARAMETER	SYMBOL
pH	pH
ORP (oxidation reduction potential)	mV
Dissolved Oxygen	O2
Residual Chlorine	Cl
Chlorine Dioxide	CD
Ozone	O3
Temperature	T
Bromine	Br
Fluoride	F
Ammonia	NH_3
Nitrate	NO_3
Conductivity*	mA

These symbols are also used in displayed indications.

NOTE: Chlorine (CL4000) and conductivity probes are available in units running software version 2.8 or higher.

*Sensors with a 4-20mA output can be fed into the MicroChem®2 and the signal displayed as either mA or, for certain common sensors, converted into actual units e.g. conductivity (µS). A list of the configurable units available is shown below:

Symbol	Unit
mA	Milliamp
%	Percent
ppm	parts per million
mg/l	milligrams per liter
g/h	grams per hour
l/s	liters per second
l/h	liters per hour
m^3/h	cubic meter per hour
°C	degrees centigrade
°F	degrees Fahrenheit
µS	microsiemens
mS	millisiemens
KPa	Kilopascals
MPa	Megapascals
PSI	pounds per square inch
GPM	gallons per minute
GPD	gallons per day
MGD	Megagallons per day
NTU	Nephelometric units
FTU	Formazin turbidity units
m	meters
ft	feet
in	inches

2.2 General Description

MicroChem®2 is a family of microprocessor based transmitters controllers for analytical values used in drinking water plants, and in swimming pools.

MicroChem2, using Severn Trent Water Purification probes, is able to measure simultaneously up to three of the following parameters:

pH, ORP, Dissolved Oxygen, Chlorine, Chlorine Dioxide, Bromine, Ozone, Analog signal 0/4-20 mA, Temperature (Pt100).

The type and number of sensors (max 3) can be freely chosen in any combination. The analytical values are retransmitted with 4-20 mA analog signal. New types of analysis can be added or modified in the field at any time. MicroChem2 automatically detects the number of installed sensors. All the measurements and the sample temperatures are displayed. The transmitter/controller has automatic temperature compensation.

The cleaning sequence time setting allows an easy sensors' maintenance.

The MicroChem2 Family includes 3 Types of instrument:

- **Transmitter** (Instrument Type 1)

A group of transmitters: single channel, dual channel and triple channel.

- **Controller** (Instrument Type 2)

PID controller for the installed Sensor, with specific algorithms for each type of measured parameter. It can accept an optional 4-20 mA signal from a flow-meter on channel 2. This second input can be used as Feed Forward input in the PID algorithm.

- **Swimming Pool Controller** (Instrument Type 3)

Available in three different parameter combinations:

- three channels (pH, mV, Cl parameters)
- two channels (pH and mV)
- two channels (pH and Cl).

It performs PID control of two channels: pH (on channel 1) and the sensor installed on channel 3.

2.3 Technical Specifications

- **Display:** digital LCD display, dot matrix, 16 + 16 characters, with back light.

- **Power supply,** selectable through a jumper on the power supply pc board (see Sect. 3.4.1):
  115 V~ (Vac) ±10%, 50/60 Hz
  230 V~ (Vac) ±10%, 50/60 Hz

- **Power consumption:** 20 VA.

- **Fuses:** T100mAL 250V @ 230 V~ (Vac)
  T200mAL 250V @ 115 V~ (Vac)

- **Electrical classification:** for non hazardous area.

- **Casing:** NEMA 4X, material GREENLAC reinforced with fiberglass (17%), White RAL 9010, Class VØ (in accordance to UL94)

- **IP protection:** IP65 whether power and signal cables respect the indications in the following section 3.4.1.1

- **Mounting:** refer to Section 3.2

- **Isolating level:** Signal inlet isolated at 2224Vrms referring to the power supply.

- **Analog outputs:**
  one for each installed channel (analog I/O pc board); separately selectable for each channel as 0-20 mA or 4-20 mA (to be specified in the order).

- **Galvanically isolated outputs:** Load 0-1000 Ohm, protected against short circuits.

- **Digital outputs:**
  . 7 relay outputs: 24 V ⎓ (Vdc), 115/230 V ~ (Vac), 3A max.
  . Individually settable as Normally Open (NO) or Normally Closed (NC)

- **Digital inputs:** 2 free contacts

- **Serial communication port:** RS232, RS422 and RS485 with RJ11 plug-in sockets. The protocol used is illustrated in a dedicated section (Sect. 11).

- **Alarm setting:** High and Low alarm for channel 1, 2 and 3. Separate levels for each channel are field selectable. Dead band freely selectable for each channel.

- **Measuring ranges:** field selectable for each channel within the limits indicated for each parameter, as follows in the table below:

PARAMETER	MINIMUM SPAN	RANGE	DEFAULT SETTING
pH	1.00 pH	0.00 - 14.00 pH	2.00 - 12.00 pH
mV	100 mV	-1500 - +1500 mV	-500 - +500 mV
O2	2.0 ppm	0.00 - 20.00 ppm	0.00 - 10.00 ppm
O3	0.25 ppm	0.00 - 10.00 ppm	0.00 - 1.00 ppm
Cl	0.25 ppm	0.00 - 10.00 ppm	0.00 - 1.00 ppm
CD	0.25 ppm	0.00 - 10.00 ppm	0.00 - 1.00 ppm
T	5 °C	0 - +100 °C	0 - +100 °C
mA	2 mA	0/4 - 20 mA	4 - 20 mA
Br	0.25 ppm	0 – 10.00 ppm	0 – 1.00 ppm
ORP	100 mV	-1500 to +1500 mV	-500 to +500 mV
µS	+/- 5% of probe range	0 – 10,000 µS	4 – 20 µS

- **Sensors with a 4 to 20 mA output** can be connected to the transmitter, the units range set and then the sensor output can be displayed on the screen.
- **Analog Input:** up to 3 sensors (any of pH, ORP, Dissolved Oxygen, Residual Chlorine, Chlorine Dioxide, Ozone, 0/4-20 mA analog signal and temperature (Pt100)
- **Weight:** 3 kg (6.6 lbs).
- **Outline dimensions:** 220 mm x 250 mm x 120 mm (8.7 x 9.8 x 4.7 in). Refer to picture 6 for details.
- **Stocking temperature limits:** -40 °C - +65 °C (-40 °F - 150 °F).
- **Operative temperature limits:** -10 °C - +50 °C (15 °F - 122 °F)
- **Thermal drift:** within 0.2% of full scale for a 10 °C (50° F) temperature variation.
- **Relative humidity:** 80 % with temperature up to 31 °C (88 °F), with linear decrease down to 50% with temperature 40 °C (104 °F).
- **Accuracy:** within ± 0.2 % of full scale.
- **Repeatability**: 0.05 % of span.
- **Stability:** 0.05% of span.
- **Transmitter response time:** measure is refreshed at each microprocessor scan cycle (100 msec).
- **Microprocessor scan cycle:** 100 msec.
- **Smoothing:** separately set for each channel inside Configuration menu.
- **Languages:** Italian, English, French, German, Spanish.

2.4 Hardware structure of the system

The MicroChem®2 hardware is modularly structured. The different p.c. boards are mounted in four separate layers, according to the following scheme:

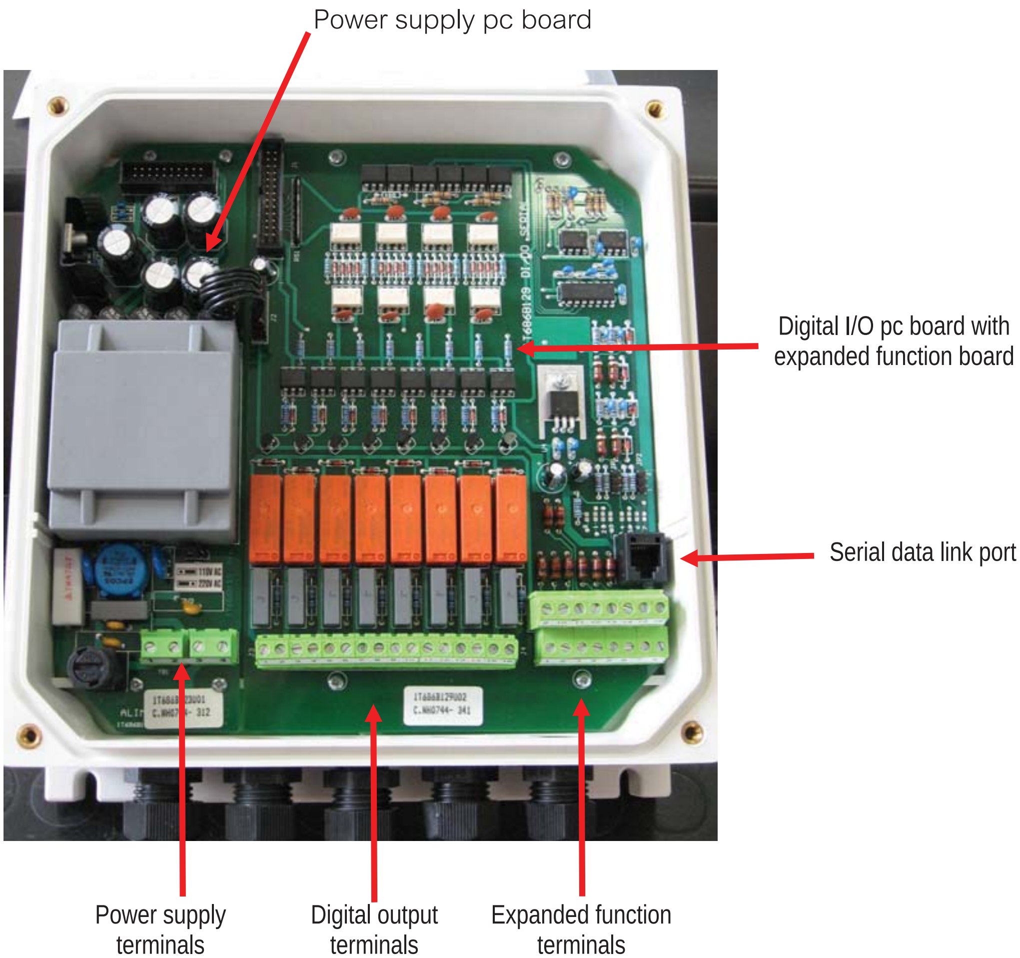


Figure 1 - First layer of p. c. board (bottom)

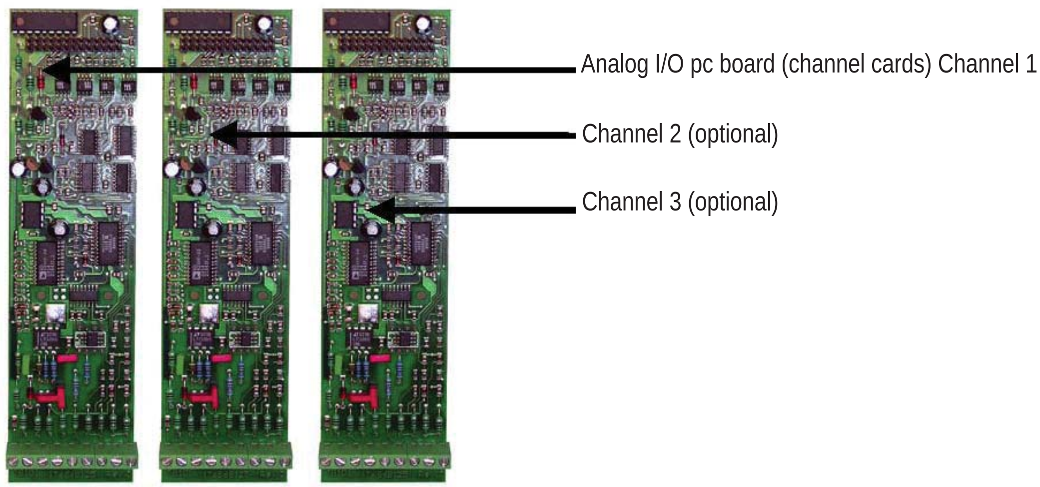


Figure 2 - Second layer of p. c. boards (Analog Input/Output)

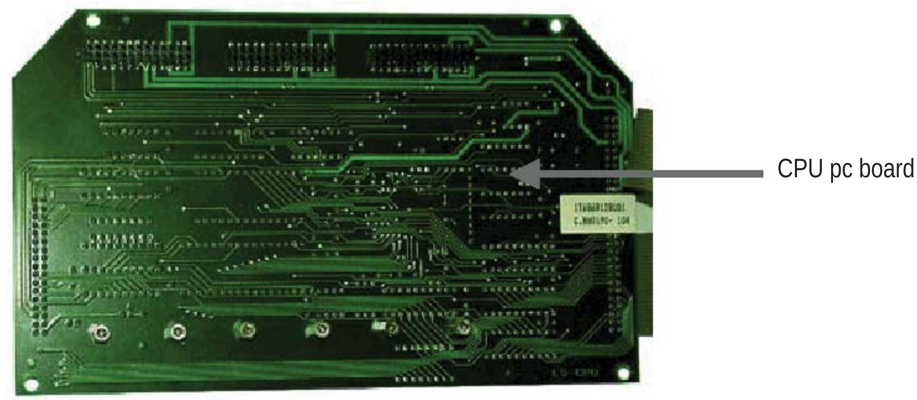


Figure 3 - Third layer of p. c. boards (Main Board)

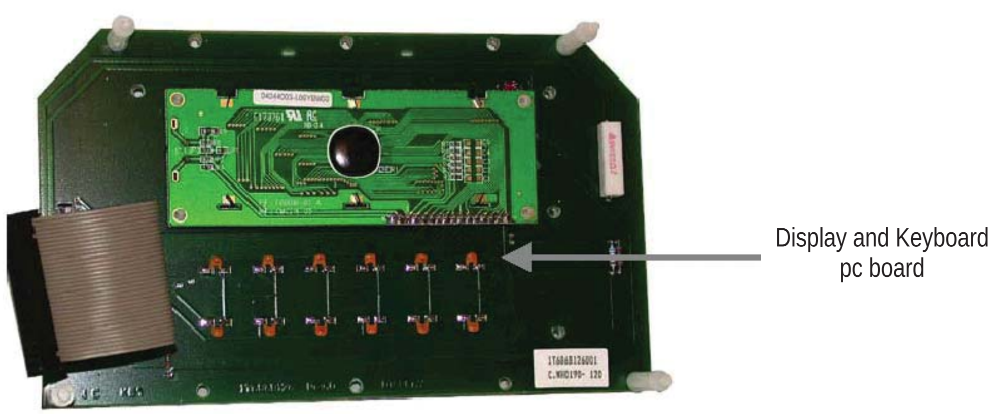


Figure 4 - Fourth layer of p. c. boards (Top)

3 INSTALLATION

3.1 Location

The transmitter location should meet the following requirements:

- the site of installation should be free of vibrations
- atmosphere should be free of corrosive substances
- enough space has to be left around the transmitter to allow easy operation and maintenance
- the transmitter should be mounted at a height of 1.6 m (64 in) from floor level to make normal reading and easier maintenance and calibration operations.
- in outdoors installations use of a sunshade is strongly recommended
- power supply matching the instrument tag should be available

3.2 Mounting

MicroChem®2 is supplied with the hardware for wall mounting.

3.2.1 Wall mounting

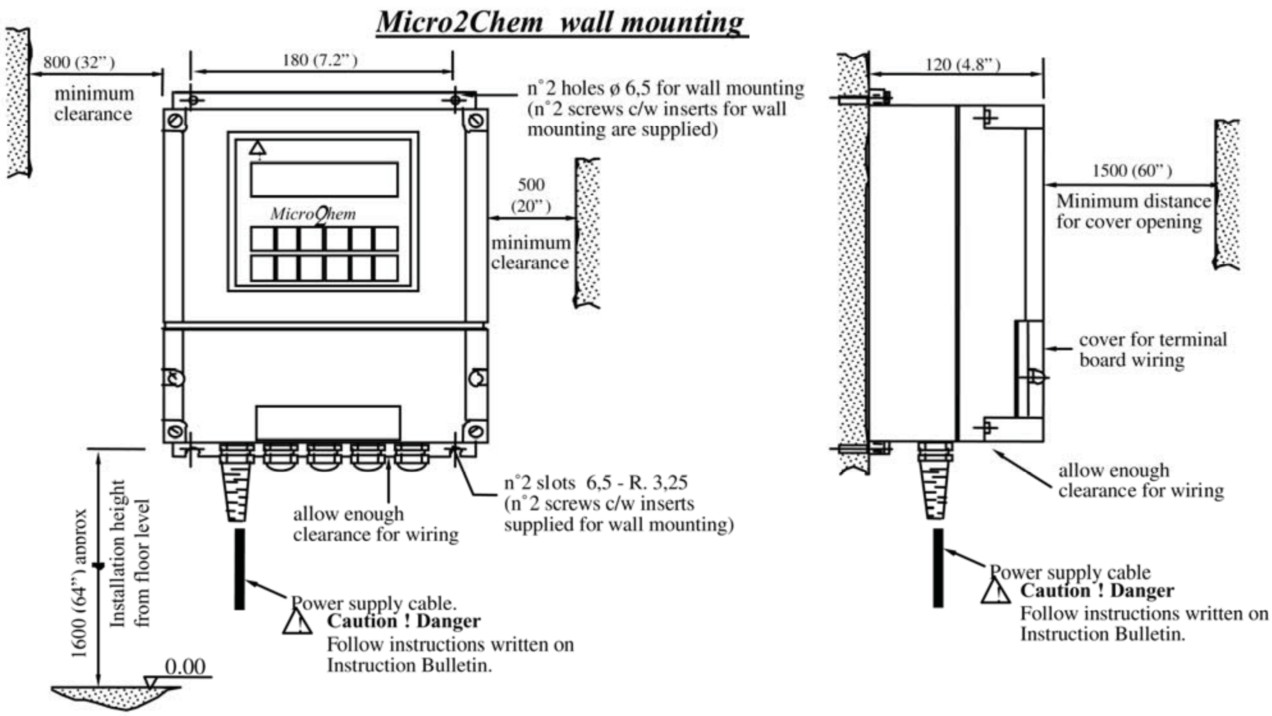


Figure 5 - Typical Wall-mounting Installations of MicroChem®2

3.3 Dimensions and mounting

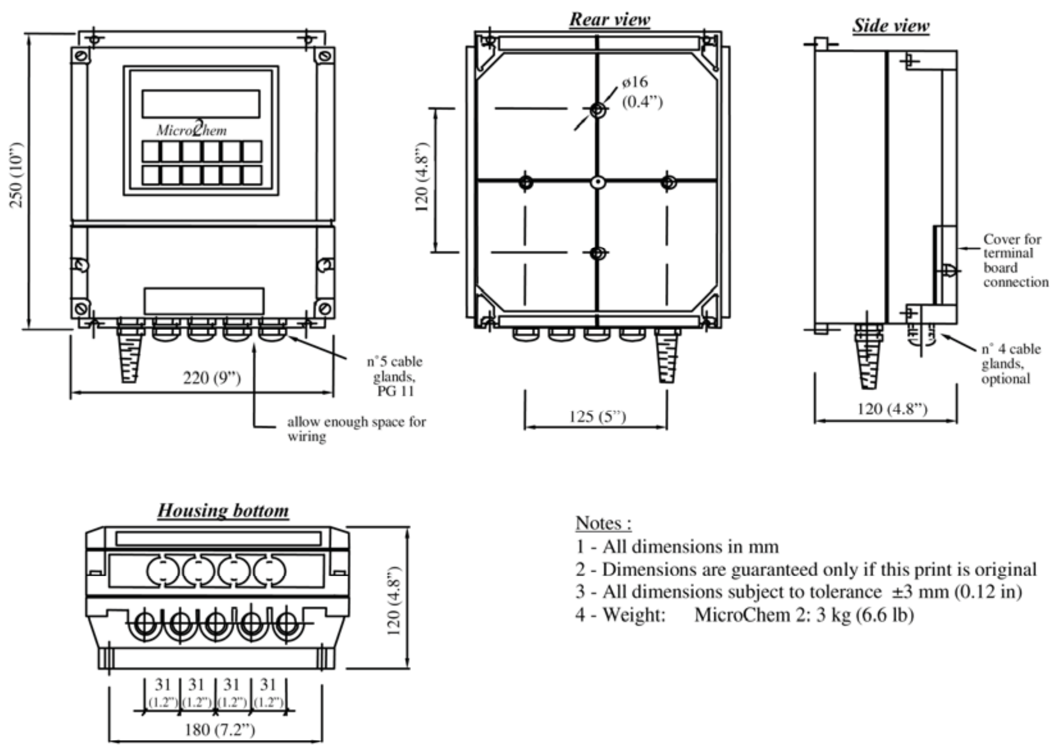


Figure 6 - MicroChem®2 dimensions

3.4 Electrical connections

3.4.1 Power supply p.c. board

Electrical Shock Hazard!

Remove power prior to servicing power supply board.

The power supply is connected to the terminal board TB1 (See Fig. 7).

The selection between the 115 V~ (Vac) or 230 V~ (Vac) power settings can be changed by moving a jumper (in position JP1) on the power supply pc board. Jumpers are represented in Fig. 7. The power supply is shipped with the voltage selector jumper in the 230 V~ (Vac) position. Should any modification be needed, proceed as per the following steps:

1. Always operate on an unpowered instrument.
2. Open the wiring access cover.
3. Locate the JP1 jumper on the power board (Fig. 7).
4. Set the jumper in the correct position using thin tapered pliers according to the input voltage required.
5. Insert the proper fuse F1 in the power supply depending on the voltage selector jumper position. (see below for details)
6. Connect power cable to Terminal board TB1 (Fig. 7). Reference Sections 3.4.1.1 and 3.4.1.2.
7. Close the cover.
8. It is now possible to connect the power to the instrument.

NOTE: Since the power supply is factory set for 230 V~ (Vac) operation, the T100 mA L fuse is installed in the power supply. The T200 mA L fuse has been provided with the instrument should a change of voltage be required during installation.

Fuse Rating: T100 mA L 250V @230V~ (Vac) Part Number: 1T151A003U06
T200mA L 250v @115V~ (Vac) Part Number: 1T151A003U09

CAUTION

Be sure to use the correct fuse rating when power supply setting is modified.

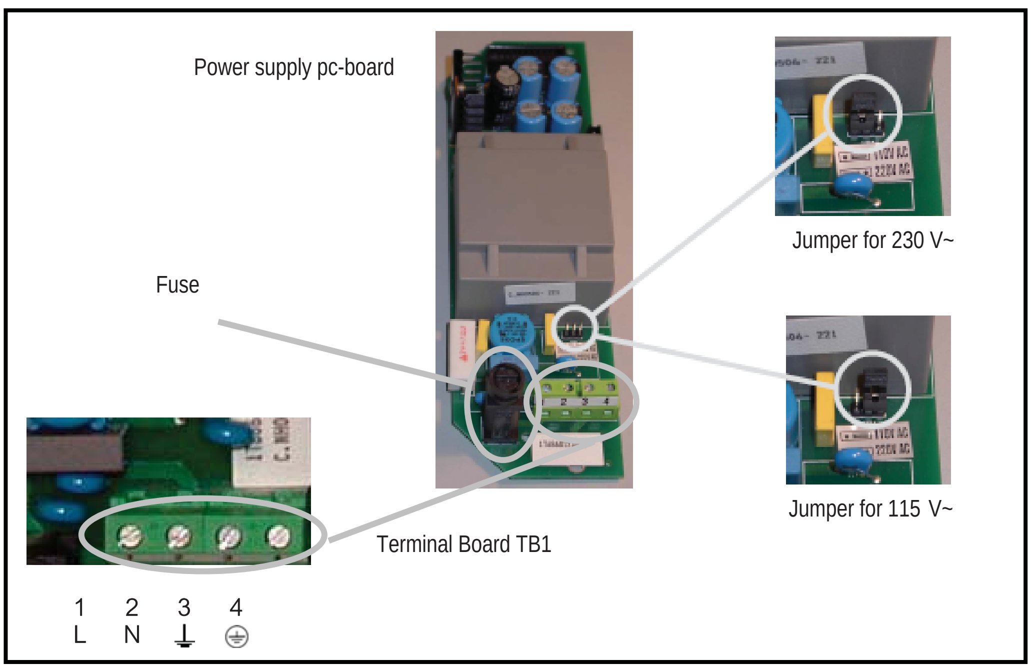


Figure 7 - Power supply selection

3.4.1.1 Power Cable

Power supply cable has to be supplied by the Customer and installed by qualified personnel.

The power supply cable has to satisfy the following requirements:

- Must be certified or approved by an official national/international testing bureau (IMQ, UL, CSA...) and according to the local law.
- Three-cores cable 16 AWG, (each core with section 1 mm^2 or 1.5 mm^2) and with specific colors required by local requirements.
- Must be suitable for ambient temperature up to 75°C (167°F)
- Must have a cross section of 6-10 mm to guarantee the casing IP65 protection.
- Must include ground wire that has to be properly connected.

3.4.1.2 Power cable installation

Electrical Shock hazard!
Power supply cables are connected to 115 V ~ (Vac)
or 230 V ~ (Vac)

Power cable inlet
The three-core power supply cable, as described in section 3.4.1.1, has to be wired to the board passing through the specific gland. The gland itself can not be removed as its specific action is to avoid cable abrasions and damages and to guarantee the IP protection.

The external wire sheathed shell should be removed for at least 1.5 inches (3-4 cm) from the termination to allow the three cores separation into the instrument while shell is kept in contact with the gland. Each wire shell is stripped for about .4 inches (1 cm) to allow for insertion into the power terminals.

Cable anchorage (Customer Care)
Cable anchorage must be designed to avoid stresses, included torsion stresses to the conductors at the point where they enter the transmitter. Cable anchorage has to satisfy the following requirements:

- Cable may not be secured by a screw acting directly on the cable itself.
- Never make knots on the cable itself.
- Cable anchoring must be designed to make cable replacement easy and safe.
- Cable has to be protected from any possible mechanical stress that may damage it or making it directly or indirectly dangerous.

Plug (not supplied)
The plug shall be certified and approved (IMQ, UL, CSA...) and have the ground connection.

CIRCUIT BREAKER (Customer care)

The instrument shall be equipped with a specific circuit breaker which have two main functions:

1. Main power supply disconnection
2. Over current protection.

Shall have the following characteristics:

- Shall be easily identifiable, easy to access and operate and shall be installed nearby the instrument.
- Shall be a certified and approved model according to the standard in use in the country where the instrument will be installed.
- Shall clearly indicate if the power is activated and present or not.
- Shall be specific characteristics for protective action (10A curve “C” type)
- When installed outdoor, shall have the appropriate IP protection rating.

3.4.2 Cable gland

MicroChem®2 is capable up to 9 holes that can be opened for electrical wires connection.
As standard 5 cable glands are installed on each unit.
Below, is an example of how to use the different cable glands (see Figure 8)

- 1 cable with three wires for power supply
- Cables from wet-end
- Cable for 4-20mA signal retransmission
- 10 cables for digital output (CCO1-7)
- Cables with two wires for digital input (CCI1-2)
- 1 cable RJ11 type for serial communication option.

RECOMMENDED: Do not put power supply cable alongside other cables.

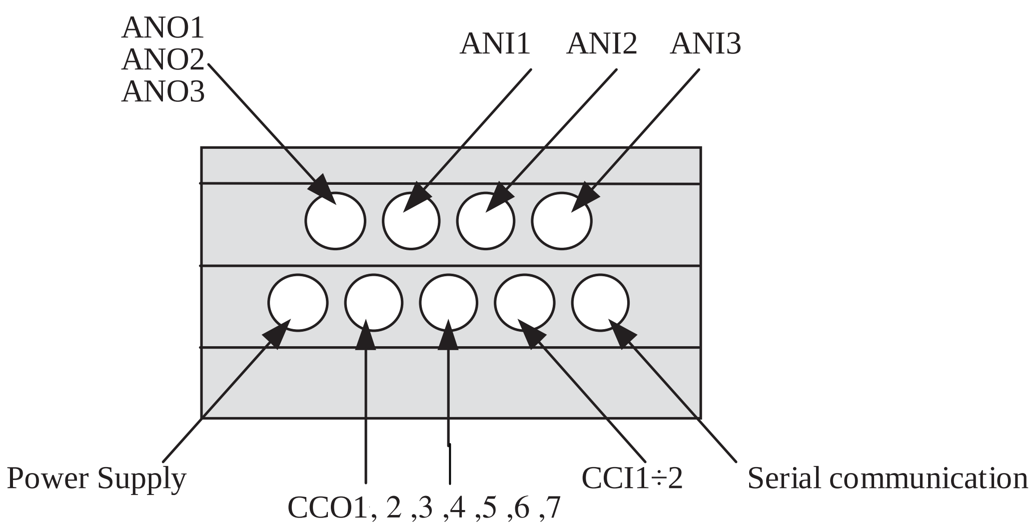


Figure 8 - Recommended use of cable glands

3.4.3 Digital I/O board

Characteristics of the cables for the input and output wiring are:

- Two wires shielded cable
- Two-cores, 18 AWG (0.5 - 1.0 mm^2)
- The shields have to be connected to ground shield terminal strip (⏚) on the MicroChem2 power supply board (see Fig. 7).
- Cables for digital outputs shall have an 80°C (176°F) rating.

3.4.3.1 Digital Outputs

Electrical Shock hazard!

Remove power from external circuits prior to connection or servicing of digital output terminals.

MicroChem®2 digital outputs are provided by 7 relays (physically 8 relays are installed but only 7 are available).

The function of each output contact depends on the type of instrument selected and its configuration. The different possibilities are detailed in the sections dedicated to each specific type of instrument. Figure 9 shows the terminal number assigned to each CCO on the I/O pc board.

The maximum rating of the relays are:

- Maximum Voltage: 24 V ⎓ (Vdc), 230 V ~ (Vac)
- Maximum Current: 3A

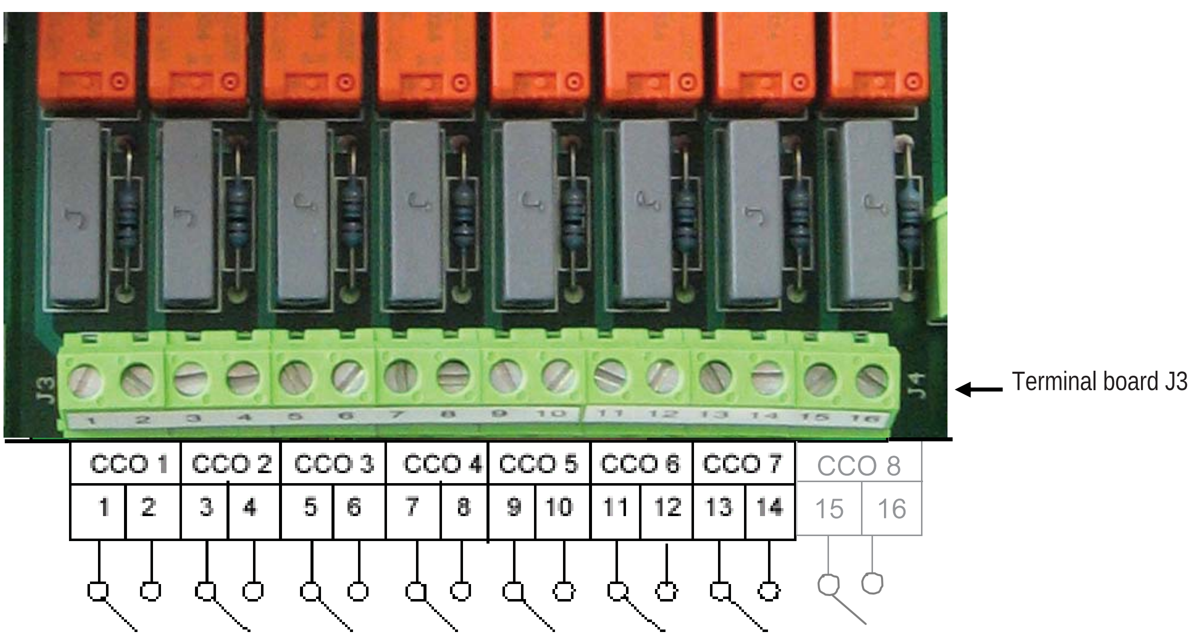


Figure 9 - Relays interconnection terminal barrier

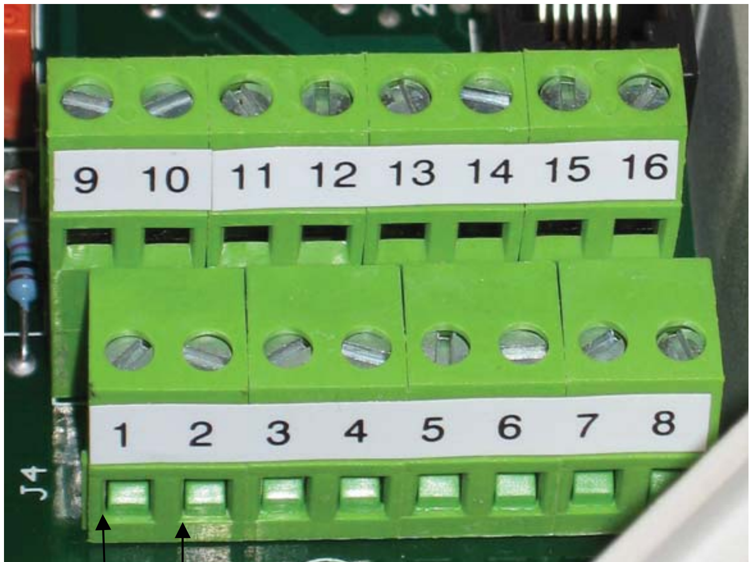
3.4.3.2 Digital input

MicroChem2 digital input (free contacts) are represented in Figure 10.

Terminal Board
J4

Expanded function
terminals

Digital
inputs



Digital input
(+)
1

Digital
input
(+)
2

Terminals: 3-8 not used
Terminals: 9-12 = +24V⎓
Terminals: 13-16 0v (common)

USE ANY ONE OF THE 0v (COMMON) TERMINALS
(13-16) TO TERMINATE THE DIGITAL INPUT (-) WIRES

Figure 10 - Digital inputs terminal barrier

3.4.4 Analog input/output board

Refer to each sensor Instruction Bulletin for the color/number codification of the sensors wires. The Pt100 shield and the sensor shield, if present, has to be connected to ground shield terminal ⏚, (see Fig. 7), inside MicroChem®2. Please notice that, for pH, ORP and O2 sensors it is recommended to fix the cable near the sensor so that it doesn't move at the outlet of the cable gland. The wear of the cable at that point is thus prevented.

The 0-20 mA or 4-20 mA signal INPUT is on terminals 5 and 6: when these terminals are used for the 0/4-20 mA INPUT, install a 100 Ω resistor (0.1 % accuracy) across terminals 5 and 6.
The units and range can be set within the channel configuration software and then the sensor output can be displayed on the screen – see section 2.2 for the range of units that can be selected.

NOTE: The CL4000 and conductivity probe cables 78-4001, 2 and 3 have a resistor built in to the lead so do not require a further resistor.

Use two cores shielded cables for 4-20 mA output signals, section of each conductor 18 AWG (0.5 - 1.0 mm^2); connect shields to the shield ground terminal ⏚ , (see Fig. 7) inside MicroChem®2.

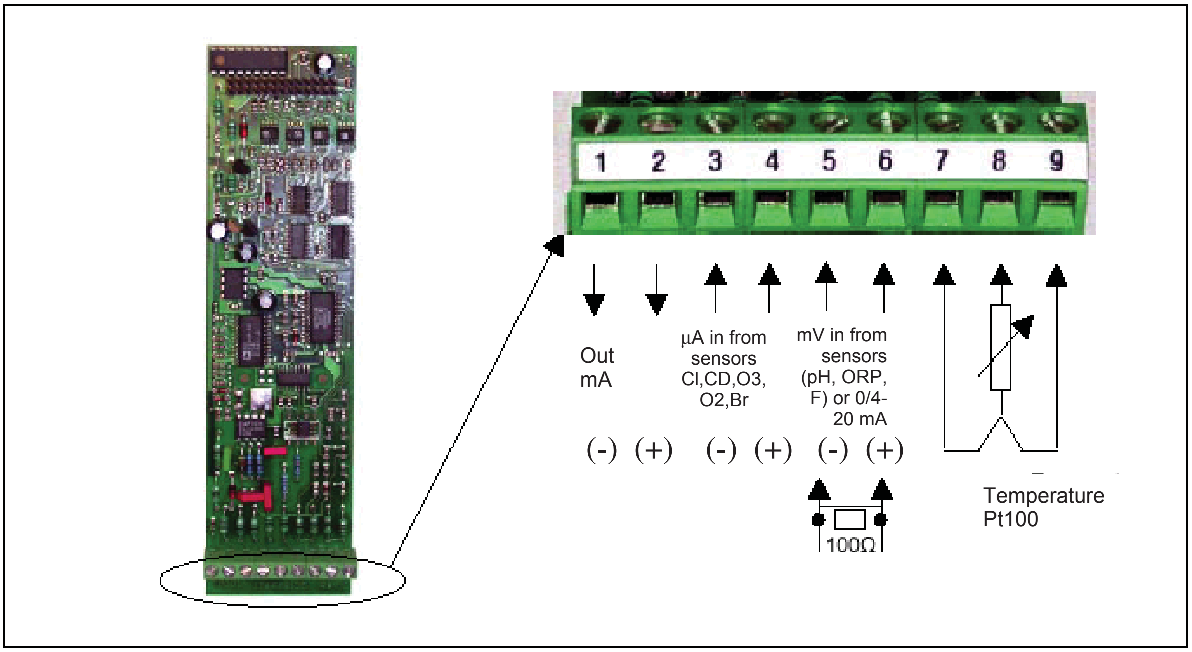


Figure 11 - Analog Input /Output terminal barrier

3.4.4.1 Temperature compensation

The temperature compensation Pt100 is not necessarily present in each sensor, in fact in some installations the different sensors are installed in the same cell, and therefore the reference temperature can be read from one input only, namely from the sensor connected to channel 1.

In the channel definition menu, when configuring channel 2 and 3, after the choice of the type of sensor, it is requested to specify if the reference temperature is to be "equal to first channel" or "independent". In the first case the reference temperature for that channel is taken from channel 1, in the second case it is read from its own PT100 thermistor which in this case must be present.

This option is not applicable for mA, ORP or Chlorine in CL4000 mode inputs measurements, as these parameters are not influenced by operating temperature or already compensated.

3.4.5 Serial communication board

MicroChem®2 supports serial communication standards RS232 and RS422/485 by connection of a modular telephone jack RJ11.

The 6 poles terminal board supports all three standards.

The pin-out of the RJ11 connectors and 6-pin terminal board is illustrated in Section 11.3 in this manual, dealing with the serial communication option.

4 SET-UP AND CONFIGURATION

4.1 Keyboard functionality

All the keys have dual functionality, except the ENTER key. Blue background keys are the ones whose second function is only used in Controllers options (instrument Type D, Type E). The selection between numbers and functions is automatically recognised by the instrument.

KEY	PRIMARY FUNCTION	SECONDARY FUNCTION
	MANUAL SELECTOR Selects manual mode in Controllers (instruments Type D, E).	0: digit zero when allowed
	DECREASE OUTPUT Decreases output in Controller (instruments Type D, E) when in manual mode.	1: digit 1 when allowed
	INCREASE OUTPUT Increases output in Controller (instruments Type D, E) when in manual mode.	2: digit 2 when allowed
	LIGHT Light up / down the display.	3: digit 3 when allowed
	MENU Calls for the menu and, inside a menu, cycles the parameters.	4: digit 4 when allowed
	ENTER: decimal point is not used; any parameter needing it already includes the decimal point in the correct position. Enter function: allows to enter the displayed menu or parameter; once entered the parameter, allows to modify it. A parameter can be changed (set) when the cursor appears on the display. Once the cursor has appeared, whether or not the parameter has been changed, the Enter key confirms the displayed value. In display mode Enter key allows to call the Warnings & Messages page.	None
	AUTOMATIC SELECTOR Selects Automatic operation mode in Controllers (instruments Type D, E).	5: digit 5 when allowed

	DECREASE SETPOINT Decreases Set Point in Controllers (instruments Type D, E).	6: digit 6 when allowed
	INCREASE SETPOINT Increases Set Point in Controllers (instruments Type D, E)	7: digit 7 when allowed
	WASH Starts a cleaning sequence when this option is activated and allowed (timers set at any value different from zero).	8: digit 8 when allowed
	CANCEL Cancel is used to modify a parameter wrongly written: when a parameter can be modified the cursor appears on the display; when the cursor is in the last right position pressing the Cancel key will delete the newly introduced value and allow to re-write a new one. Cancel is also used to load default parameters (Super-Reset, See Section 9.4).	9: digit 9 when allowed
	END End key in Display Mode allows to scroll different pages if present. In Menu Mode allows to step up menu.	-: negative sign when allowed

Table 1 - Keyboard functionality

Use of MENU, ENTER and END keys to move inside menus and change parameters:

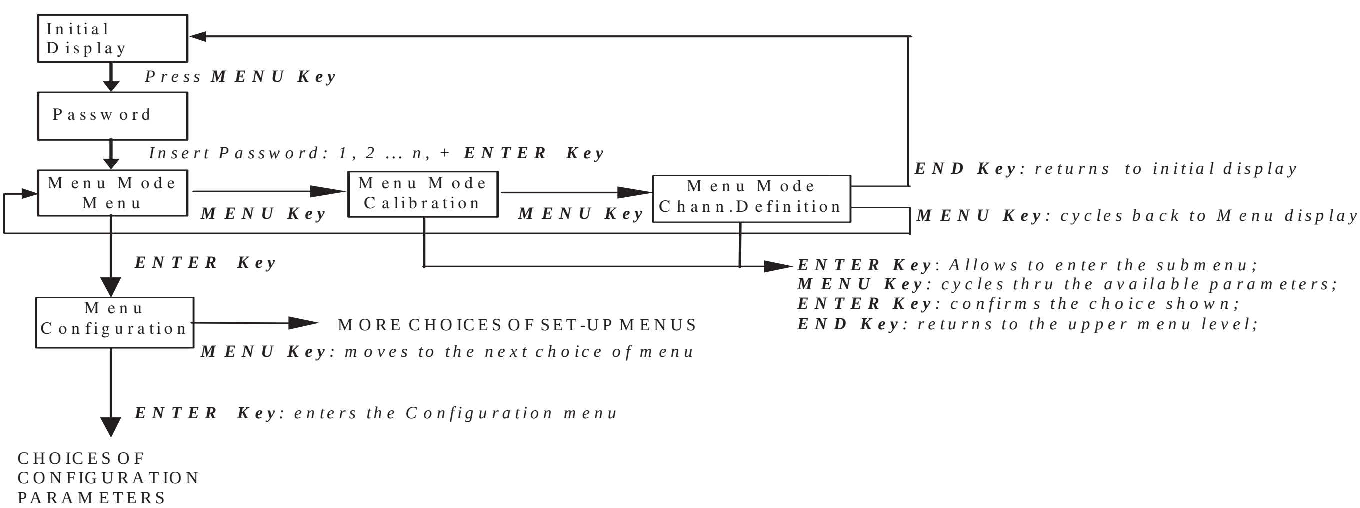


Figure 12 - Example of menus navigation

4.2 Display

The MicroChem®2 display shows the instantaneous value of the parameter measured, its identification symbol and the temperature of the sampled liquid. Here is an example of the standard one-channel display:

1	2	.	5	2		p	H		1	5	.	5		°	C

If the instrument is configured to support two sensors, the display shows on the top line the metered value and the temperature of parameter installed on Channel 1, and on the bottom line the metered value and the temperature of parameter installed on Channel 2. When three sensors are installed, the process values are displayed on two different pages. Press END key to toggle form one page to the other.

Channel 1 Measure	1	2	.	5	2		p	H		1	5	.	5		°	C	**Channel 1 Temperature**
Channel 2 Measure		0	.	1	1	4	O	3		0	.	1	5	8	C	l	**Channel 3 measure**

On the second page appears:

Channel 1 Measure	1	2	.	5	2		p	H		1	5	.	5		°	C	**Channel 1 Temperature**
Channel 2 Temperature		1	6	.	4		°	C		1	1	.	2		°	C	**Channel 3 Temperature**

When MicroChem2 is configured as a Controller, the process information is displayed on a dedicated page, as per following example:

Channel 1 measure (Process variable)	1	0	.	1	2		p	H		1	0	.	4		°	C	**Channel 1 Temperature**
Setpoint	1	2	.	0	0		S	P		1	6	%	O	U	T	A	**Output (%)- Aut./Man.**

4.3 Channel definition

This menu allows to select the type of sensor associated to each channel.

The Channel definition menus are in accordance to the number of the channels installed (e.g. if only Channel 1 is installed, only Channel 1 definition menu appears; if two channels are installed, both Channel 1 definition menu and Channel 2 definition menu will appear. The same principle applies for Channel 3).

Select the type of channel according to the sensor installed (see Section 2.1 for the symbols used).

NOTES:

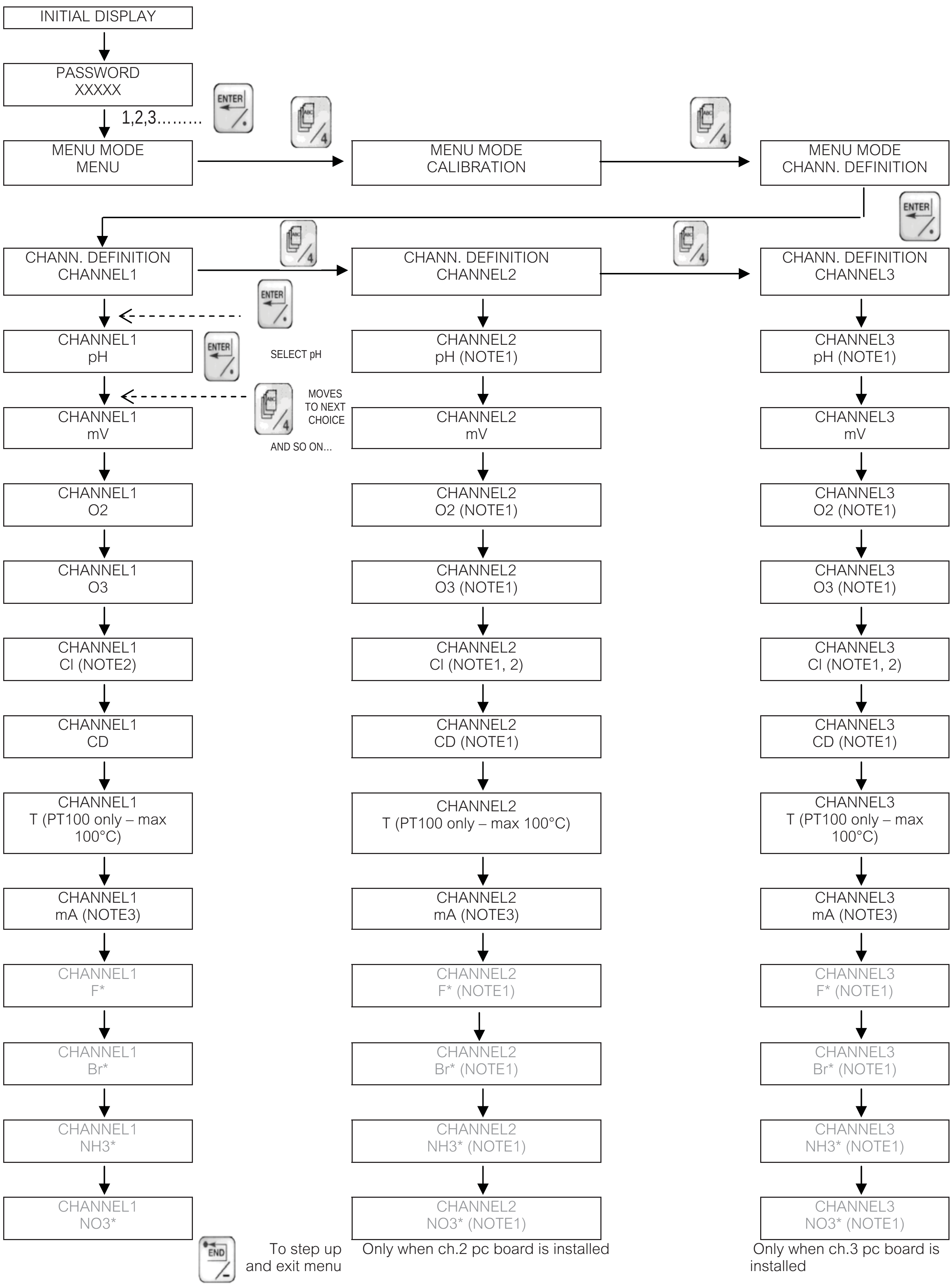
- When changing channel definition from one parameter to another, the MicroChem®2 transmitter/controller will set the alarm outputs and the PID parameters to the default values.
- At power-up, the instrument loads data in memory according to the last channel definition. When the Channel definition is modified, in order to have the new data properly stored, it is necessary to operate the Super-Reset procedure (See Section 9.4).

There are 3 different Channel definition menus depending on the type of instrument operating:
Channel definition – Transmitter: see section 4.3.1
Channel definition – Standard/Average controller: see section 4.3.2
Channel definition – Swimming pool controller: see section 4.3.3

4.3.1 Channel definition -Transmitter

(Please refer also to the menu trees in the appendices for an overview of how to navigate through the software).

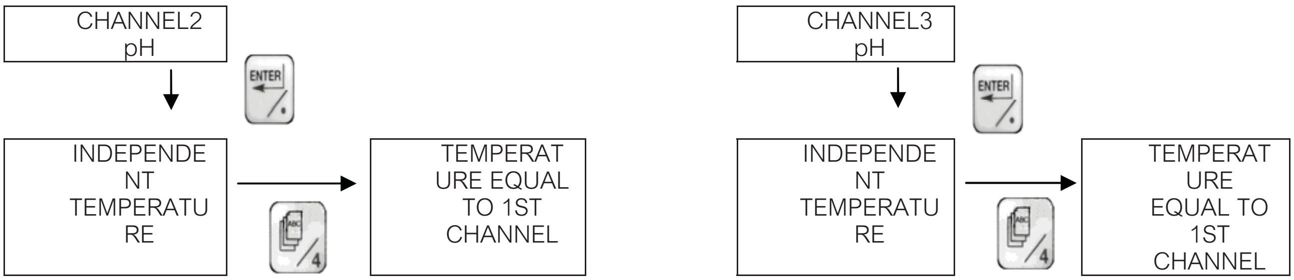
Please refer to step by step programming instructions in the appendix for instrument configuration examples.


INITIAL DISPLAY
PASSWORD
XXXXX
1,2,3………
ENTER
MENU MODE
MENU
MENU MODE
CALIBRATION
MENU MODE
CHANN. DEFINITION
ENTER
CHANN. DEFINITION
CHANNEL1
CHANN. DEFINITION
CHANNEL2
CHANN. DEFINITION
CHANNEL3
ENTER
CHANNEL1
pH
ENTER
SELECT pH
MOVES
TO NEXT
CHOICE
AND SO ON...
CHANNEL1
mV
CHANNEL1
O2
CHANNEL1
O3
CHANNEL1
Cl (NOTE2)
CHANNEL1
CD
CHANNEL1
T (PT100 only – max
100°C)
CHANNEL1
mA (NOTE3)
CHANNEL1
F*
CHANNEL1
Br*
CHANNEL1
NH3*
CHANNEL1
NO3*
CHANNEL2
pH (NOTE1)
CHANNEL2
mV
CHANNEL2
O2 (NOTE1)
CHANNEL2
O3 (NOTE1)
CHANNEL2
Cl (NOTE1, 2)
CHANNEL2
CD (NOTE1)
CHANNEL2
T (PT100 only – max 100°C)
CHANNEL2
mA (NOTE3)
CHANNEL2
F* (NOTE1)
CHANNEL2
Br* (NOTE1)
CHANNEL2
NH3* (NOTE1)
CHANNEL2
NO3* (NOTE1)
CHANNEL3
pH (NOTE1)
CHANNEL3
mV
CHANNEL3
O2 (NOTE1)
CHANNEL3
O3 (NOTE1)
CHANNEL3
Cl (NOTE1, 2)
CHANNEL3
CD (NOTE1)
CHANNEL3
T (PT100 only – max
100°C)
CHANNEL3
mA (NOTE3)
CHANNEL3
F* (NOTE1)
CHANNEL3
Br* (NOTE1)
CHANNEL3
NH3* (NOTE1)
CHANNEL3
NO3* (NOTE1)
END
To step up
and exit menu
Only when ch.2 pc board is installed
Only when ch.3 pc board is
installed

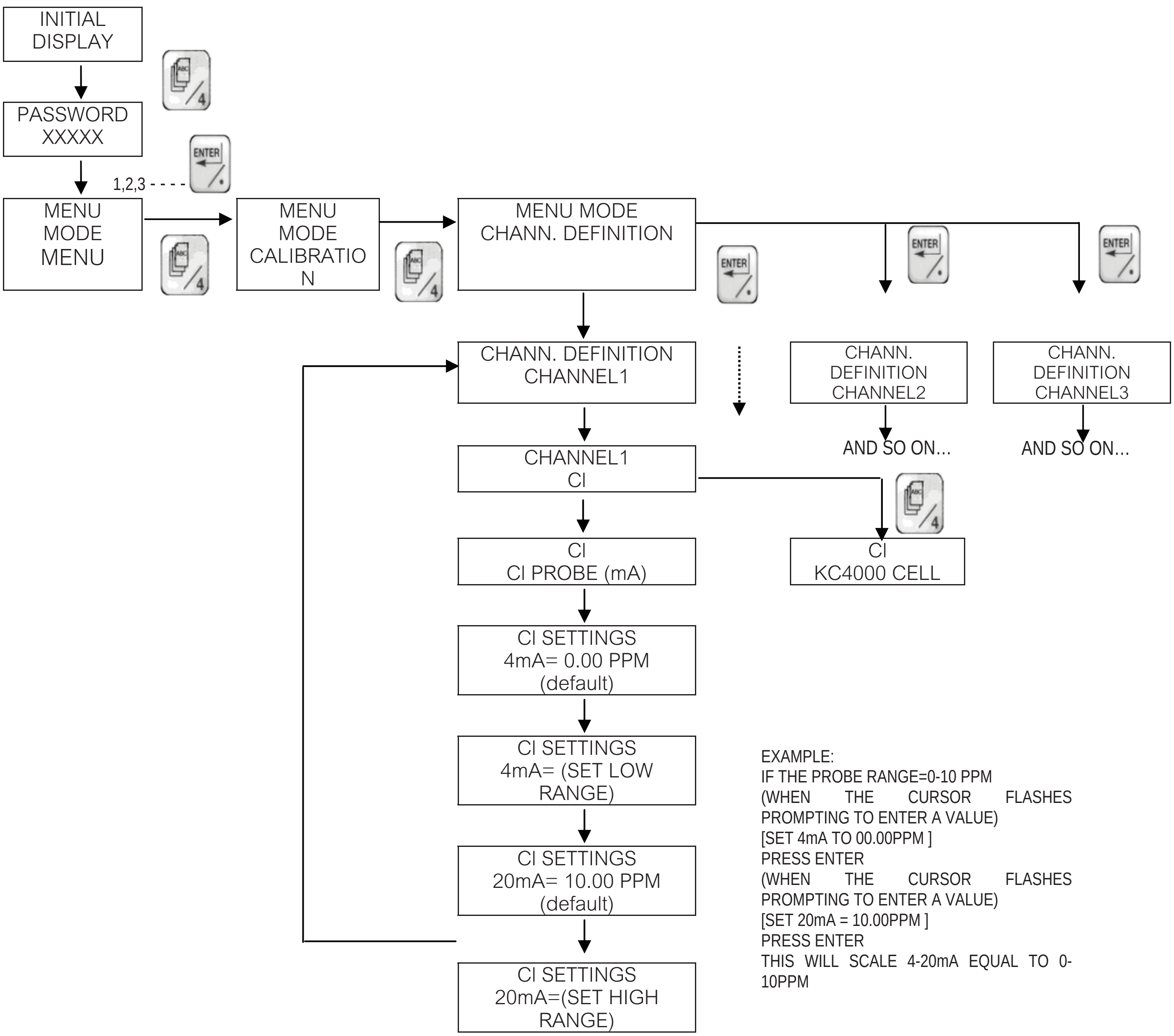
NOTES

* = Not available

NOTE 1: In 2nd and 3rd channel definition it's possible to choose between "Independent Temperature" or "Temperature equal to 1st channel":



NOTE 2: If chlorine (CL) is selected, the type of CL measurement must be defined as either a cell (KC4000) or a probe (CL4000). When CL4000 probes are selected, you will be prompted to enter the (4mA and 20mA) probe settings to match the range of the probe supplied with the system (i.e. 0-2 or 0-10 ppm):



EXAMPLE:
IF THE PROBE RANGE=0-10 PPM
(WHEN THE CURSOR FLASHES PROMPTING TO ENTER A VALUE)
[SET 4mA TO 00.00PPM]
PRESS ENTER
(WHEN THE CURSOR FLASHES PROMPTING TO ENTER A VALUE)
[SET 20mA = 10.00PPM]
PRESS ENTER
THIS WILL SCALE 4-20mA EQUAL TO 0-10PPM

NOTE 3: Sensors with a 4 to 20 mA output can be connected to the transmitter and the units and range can be set within the channel configuration software and then the sensor output can be displayed on the screen – see Section 2.1 for the range of units that can be selected.

CHANNEL 1 mA	CHANNEL2 mA	CHANNEL3 mA

mA:
mA

mA:
4mA = 4.0 mA (SET LOW RANGE)

mA:
20 mA = 20.0 mA (SET HIGH RANGE)

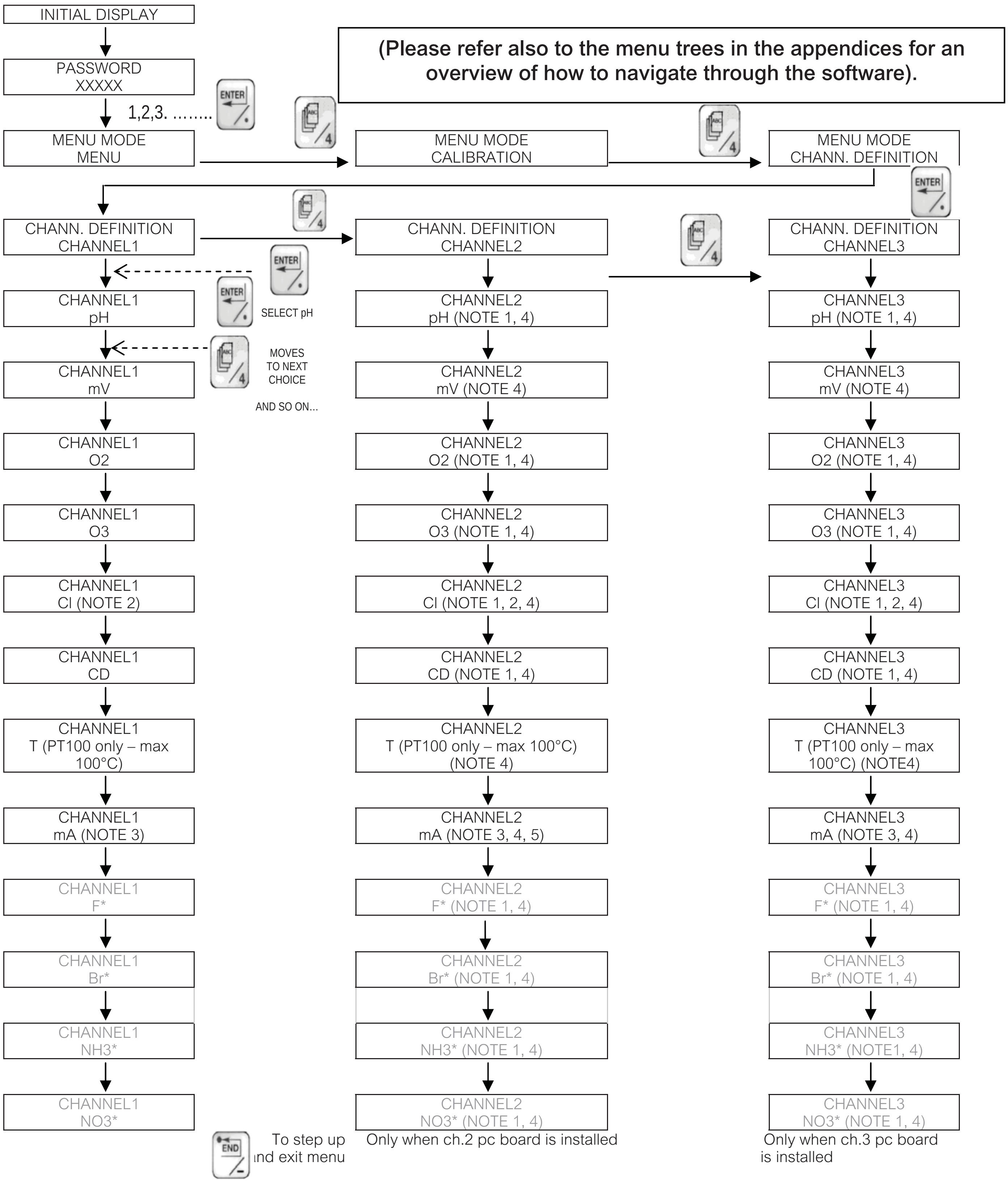
mA: %
mA: ppm
mA: Mg/l
mA: g/h
mA: l/s
mA: l/h
mA: m^3/h
mA: °C
mA: °F
mA: µS
mA: mS
mA: KPa
mA: MPa
mA: PSI
mA: GPM
mA: GPD
mA: MGD
mA: NTU
mA: FTU
mA: m
mA: ft
mA: in

mA:
4mA = 4.0 *units* (SET LOW RANGE)

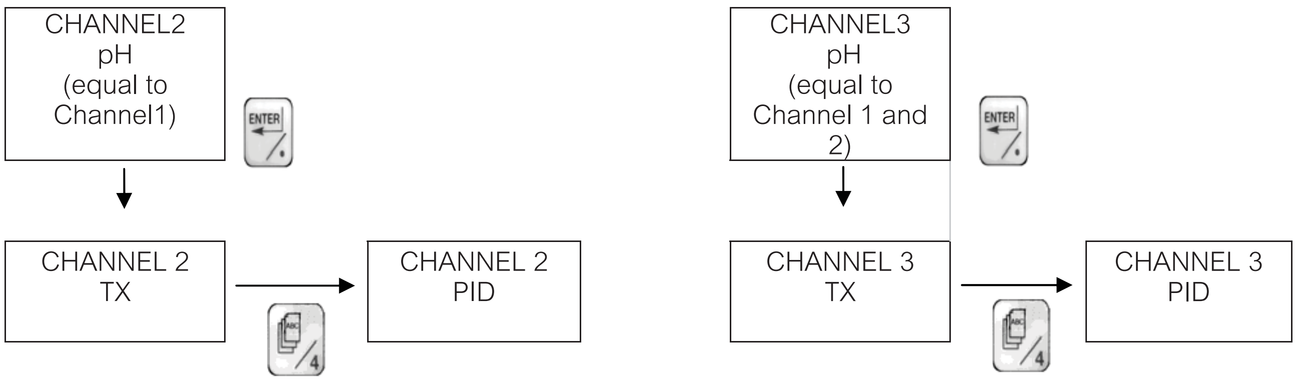
mA:
20 mA = 20.0 *units* (SET HIGH RANGE)

to step up and exit menu

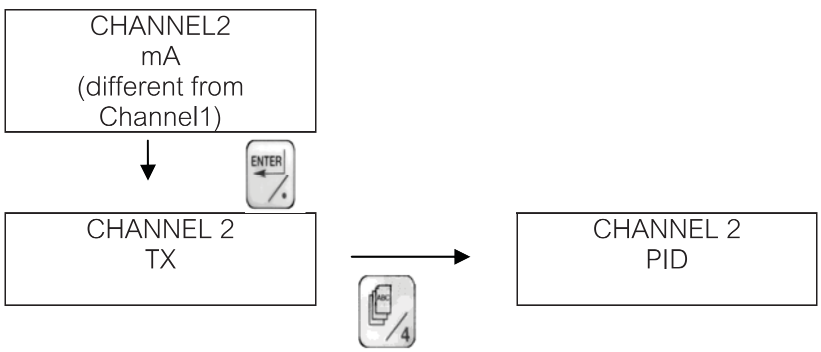
4.3.2 Channel definition-Standard/Average Controller



NOTES
* = Not available
NOTE 1, 2, 3: See NOTE 1, 2, 3 Section 4.3.1
NOTE 4: If channel 2 or channel 3 is selected equal to the first one, choose TX for stand alone channel or PID to include measurement into the computation of average process variable (PV)

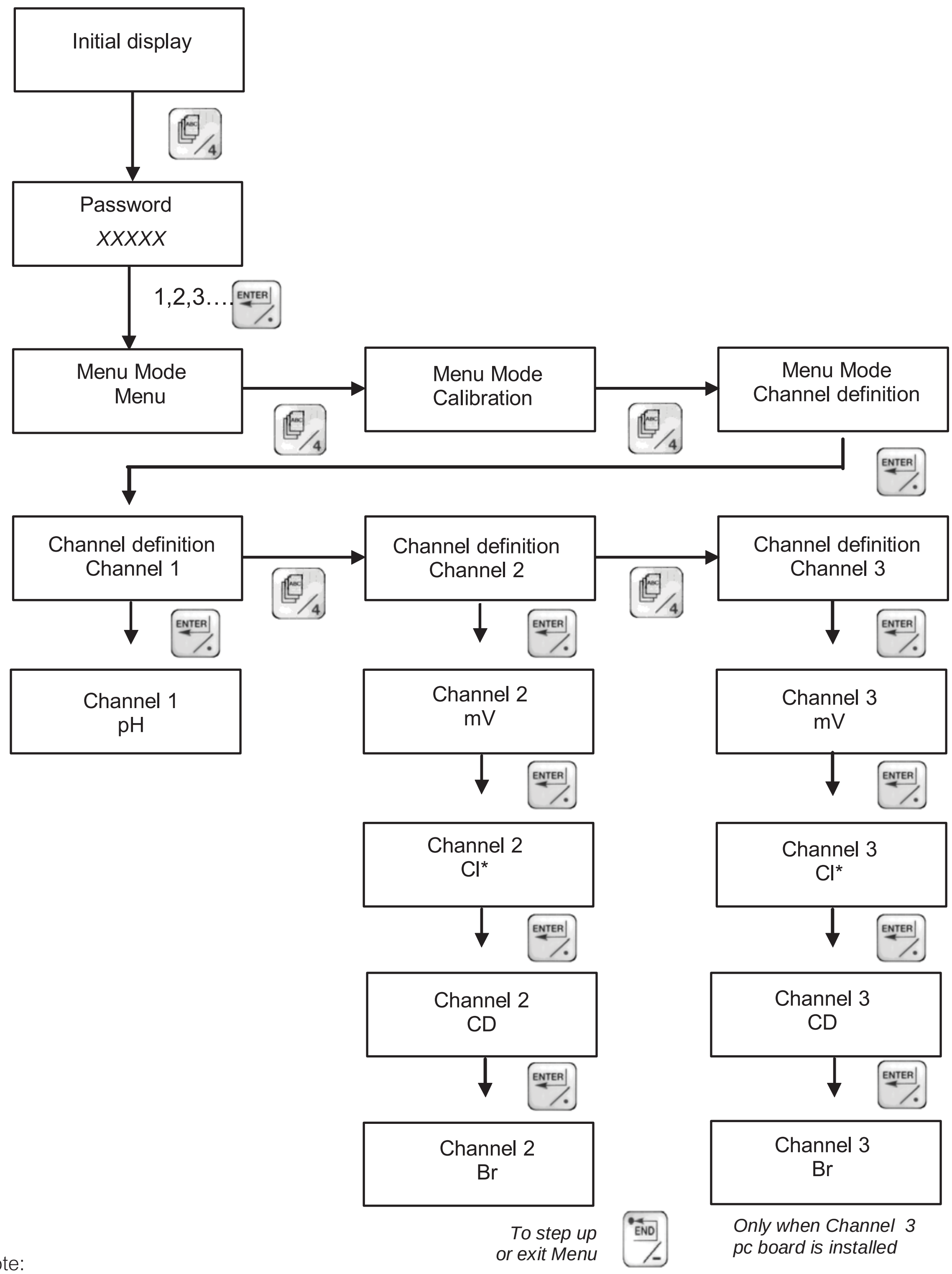


NOTE 5: If channel 2 is set as mA and different from the first channel, choose TX for stand alone channel or PID for feed forward flow rate value.



4.3.3 Channel definition-Swimming pool Controller

(Please refer also to the menu trees in the appendices for an overview of how to navigate through the software).



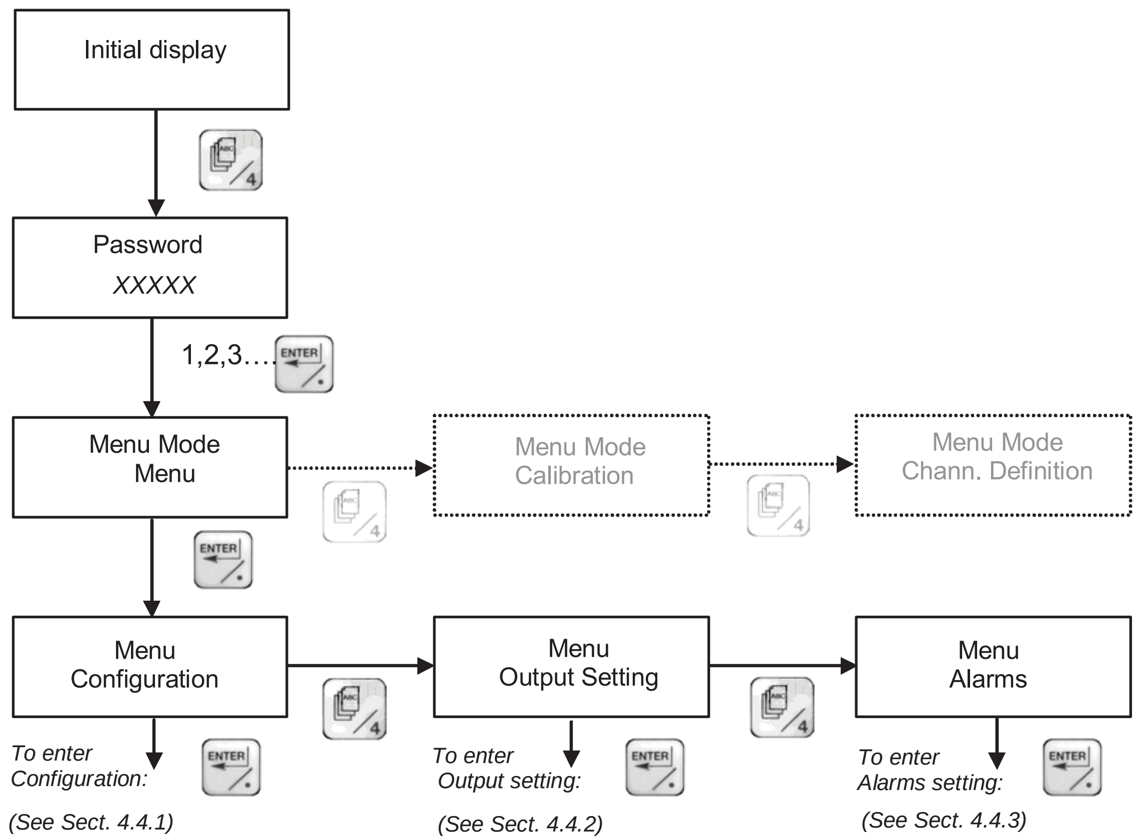
Note:
* = See Note 2 Section 4.3.1

4.4 Set-up menu

The set-up menu is structured in three different submenus and namely:

- Configuration: to set the general operating parameters of the instrument, see Sect. 4.4.1
- Output settings: to select 4-20 mA or 0-20 mA output for each channel, see Sect. 4.4.2
- Alarms: to set alarms level; see Sect. 4.4.3.

Each of them will be discussed in detail in the following pages.



4.4.1 Configuration

The configuration menu consents to set the general parameters of the instrument. Only those parameters which are pertinent to the selection made and to the hardware installed will appear in the menu. When a digital value is requested, pressing the ENTER key will cause a cursor to appear in the display: at this point a digital value may be entered using the second function of the keyboard pushbuttons. When ENTER key is pressed again, the value shown on the display will be confirmed, whether the latter has been modified or not.

Here is a description of the parameters appearing in the menu. A summary of the configuration menu flowchart follows in the next page.

4.4.1.1 Configuration parameters

Language: select the language of the displayed messages. Available languages: Italian, English, French, German, Spanish. Default: Selected language

Password: set the password, that is a numeric code composed of up to 5 characters. Default setting by Factory: 00000

Serial link: optional serial communication link
See Section 11 “Serial Communication” for detailed instructions

Cleaning: logical sequence for periodical cleaning of the sensors
See Section 4.4.1.3 for details

Temperature select: select measuring units for displayed temperature value: °C or °F; default: °C

Temperature set: define temperature at which operate temperature compensation when the thermistor is faulty; default: 20 °C (68°F)

Altitude: it appears when at least one channel is configured as O2. It's the altitude on sea level at which the instrument is installed. It must be set at start up and it does not need to be changed again. It is needed for automatic "in air" calibration procedure. Available units are feet (ft) and meter (m). Default Altitude: 200 m (666.6 ft)

CCI in ‘OR’: When CCI in OR option is chosen, if one or the other or both the CCI is/are closed the MicroChem2 freezes the output signals until CCI returns in the original state. See Section 5.2.3.3

Average: for dual/triple channels transmitters, with identical sensors installed; the transmitter computes the average of the two/three input signals. The choice is Average NO or Average YES; default is NO (the average is not computed)

Delta: for dual/triple channels transmitters, same installed parameter; the transmitter displays an alarm when the difference between the two/three measured values is higher than the set value allowed for the deviation. Default: 0.0 (the delta is not active)

Sigma: for triple channels controller, with identical sensors installed; the controller verifies if one of the three input signals is incorrect in comparison with the others. The choice is Sigma NO or Sigma YES; default is NO (the check is not activated)

K1, K2 selectable numeric thresholds determining if probe maintenance is requested. K1= maximum standard deviation value admitted. Default: 1.00; K2= maximum error value admitted for each probe. Default: 1.00;
Set numeric values in order to verify the following formulas:

$$= \bullet \overline{[\ (V_i - V_m)^2]/2}$$

If >K1 then verify for each probe:
If |Vi – Vsp| - |Vm – Vsp| > K2 then probe requires maintenance.
If not: probe works correctly.
(Vi= measured value; Vm= average value of the 3 measures; Vsp= set point value)
NOTE: the faulty condition message appears only on Alarms page (it is accessed by pressing the ENTER Key in display mode. See Sect. 9.2)

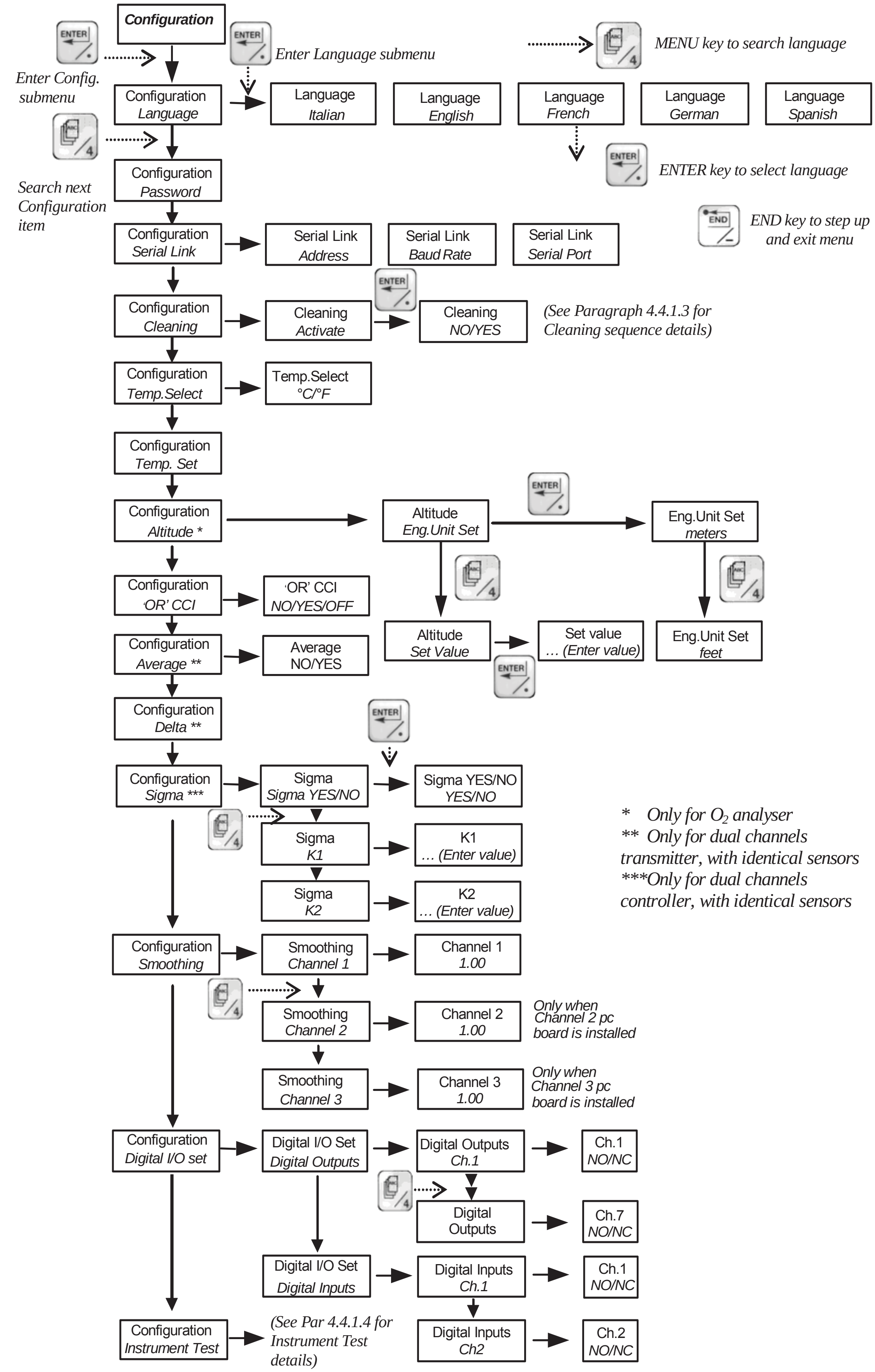
Smoothing: The number is the smoothing in seconds on the input signal. It can be separately set for the three channels. Allowed values are 0.00 - 10.00. Default: 1.0

Digital I/O Setting: allows to set the status of digital input and digital outputs: each CCI and each CCO can be separately set as NC or NO. Default: NO

Instrument test: see Section 4.4.1.4

4.4.1.2 Configuration menu flowchart

(Please refer also to the menu trees in the appendices for an overview of how to navigate through the software).


Configuration
Enter Config. submenu
Enter Language submenu
MENU key to search language
Configuration Language
Language Italian
Language English
Language French
Language German
Language Spanish
ENTER key to select language
Search next Configuration item
Configuration Password
END key to step up and exit menu
Configuration Serial Link
Serial Link Address
Serial Link Baud Rate
Serial Link Serial Port
Configuration Cleaning
Cleaning Activate
Cleaning NO/YES
(See Paragraph 4.4.1.3 for Cleaning sequence details)
Configuration Temp.Select
Temp.Select °C/°F
Configuration Temp. Set
Configuration Altitude *
Altitude Eng.Unit Set
Eng.Unit Set meters
Altitude Set Value
Set value … (Enter value)
Eng.Unit Set feet
Configuration 'OR' CCI
'OR' CCI NO/YES/OFF
Configuration Average **
Average NO/YES
Configuration Delta **
Configuration Sigma ***
Sigma Sigma YES/NO
Sigma YES/NO YES/NO
Sigma K1
K1 … (Enter value)
Sigma K2
K2 … (Enter value)
* Only for O_2 analyser
** Only for dual channels transmitter, with identical sensors
***Only for dual channels controller, with identical sensors
Configuration Smoothing
Smoothing Channel 1
Channel 1 1.00
Smoothing Channel 2
Channel 2 1.00
Only when Channel 2 pc board is installed
Smoothing Channel 3
Channel 3 1.00
Only when Channel 3 pc board is installed
Configuration Digital I/O set
Digital I/O Set Digital Outputs
Digital Outputs Ch.1
Ch.1 NO/NC
Digital Outputs
Ch.7 NO/NC
Digital I/O Set Digital Inputs
Digital Inputs Ch.1
Ch.1 NO/NC
Configuration Instrument Test
(See Par 4.4.1.4 for Instrument Test details)
Digital Inputs Ch2
Ch.2 NO/NC

4.4.1.3 Cleaning functionality

The cleaning functionality implemented in the MicroChem®2 supports a sequence of operations necessary to perform a periodical cleaning of the sensors. This function is always present in the software and can be enabled or disabled by a YES/NO selection in the configuration menu (default setting is NO).

When the selection is set to “YES”, the instruments activates the cleaning sequence and operates the output contact relays associated to CCO5 and CCO6 to drive the solenoid valves for the washing and rinsing lines (see Fig. 15). Each phase of the cleaning sequence requires a different timing, and this can be freely configured in parameters T1, T2, T3 and T4 (see Table 2 below for details). During the cleaning sequence active phases, the measure is frozen to the last valid value, and when instrument is operating as a Controller (T17MD4000, T17ME4000) the latter is automatically forced in manual mode.

The cleaning sequence can be started locally with a manual command by pressing Key 8 / WASHING, or it can be triggered automatically by setting proper values in the timers T1-T4.
There are two cleaning sequences designed to work in conjunction with optional STWP devices: sequence “A” (Water Analytic Unit) and sequence “B” (Sequential Cleaning Unit). Select “B” option and use the output contacts as directed in Figure 15 to drive the solenoid valves.

The cleaning sequence consists of the following four phases:

T1 - Analysis: Normal operation phase of the sensor that is the time period between the end of a cleaning sequence and the start of the next one in automatic mode. Allowed time values are 1 second to 30 hours. Typical value is 23.5 hours.

T2 – Washing: Phase to be used to wash the sensor with chemical detergent. Allowed values are 0-30 minutes. Typical value is 10 min.

T3 – Rinsing: Phase to be used to rinse the sensor with pressurized clean water. Allowed values are 0-30 minutes. Typical value is 10 min.

T4 – Pause: Pause period usually allowed to consent the sensor to recover sensibility before starting a new measure. Allowed values are 0-30 minutes. Typical value is 10 min.

PHASES	TIME	CCO5	CCO6	MESSAGE
T1 Analysis	T1	•	•	
T2 Washing	T2	O	•	WASH!
T3 Rinsing	T3	•	O	WASH!
T4 Pause	T4	•	•	WASH!
T1 Analysis	T1	•	•	

Legend:
O = open
• = closed

Table 2 - Sequence of cleaning phases

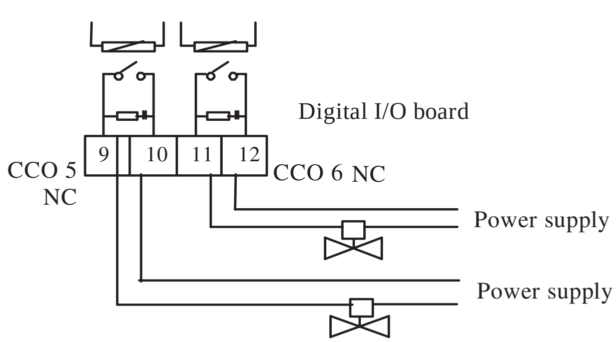
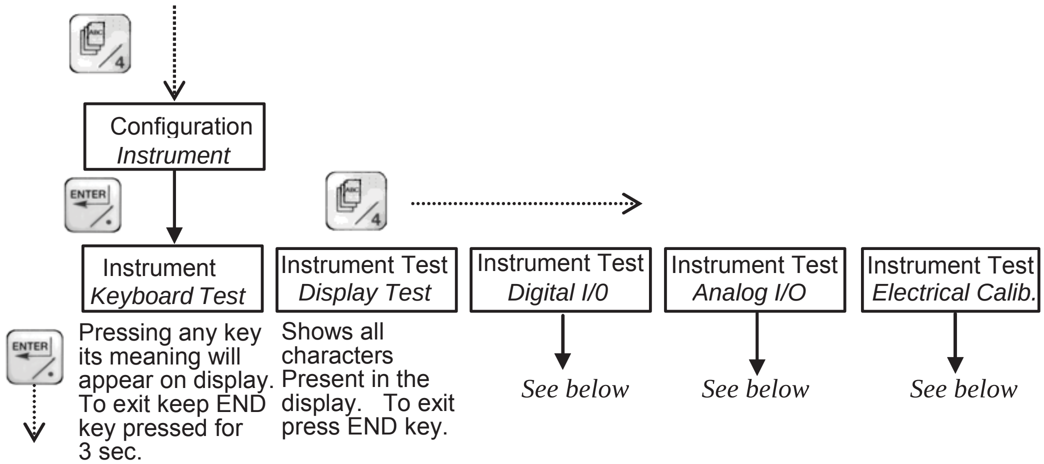


Figure 13 - Connection of solenoid valves

4.4.1.4 Instrument test

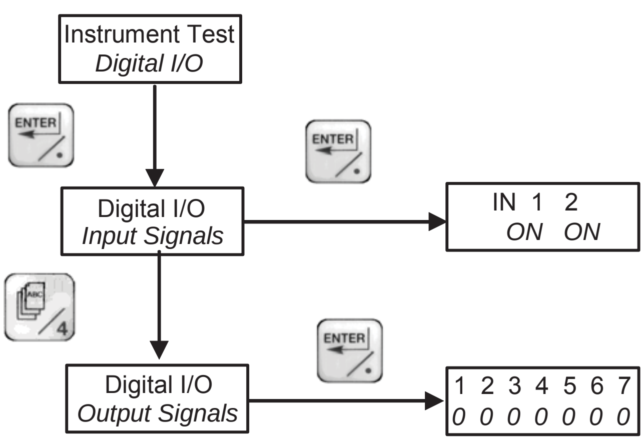
This submenu which is part of the Configuration menu, allows to perform self diagnostic routines on MicroChem®2 basic functions, sensor check and MicroChem2 electrical calibration:



- Keyboard test: pressing any key the display will show the corresponding number (0....9) or function (ENTER, END). To exit this submenu press END key and keep it pressed for 3 seconds, until the display shows - - -.

- Display test: once entered this submenu the display shows cyclically in all the 32 writing locations of the display all the characters present. To exit press END key.

- Digital I/O test: this submenu allows to verify the status and the correct functionality of the digital inputs and outputs:



Digital Input: Input signals submenu the display shows

" 1 2 "
" OFF OFF "

changing the status of one of the CCI by shorting the associated terminals (see Section 3.4.3.2) the display shows ON below the number of the associated CCI.

Digital Output: the display will show the status of the 7 output contacts (relay):

" 1 2 3 4 5 6 7 "
" 0 0 0 0 0 0 0 "

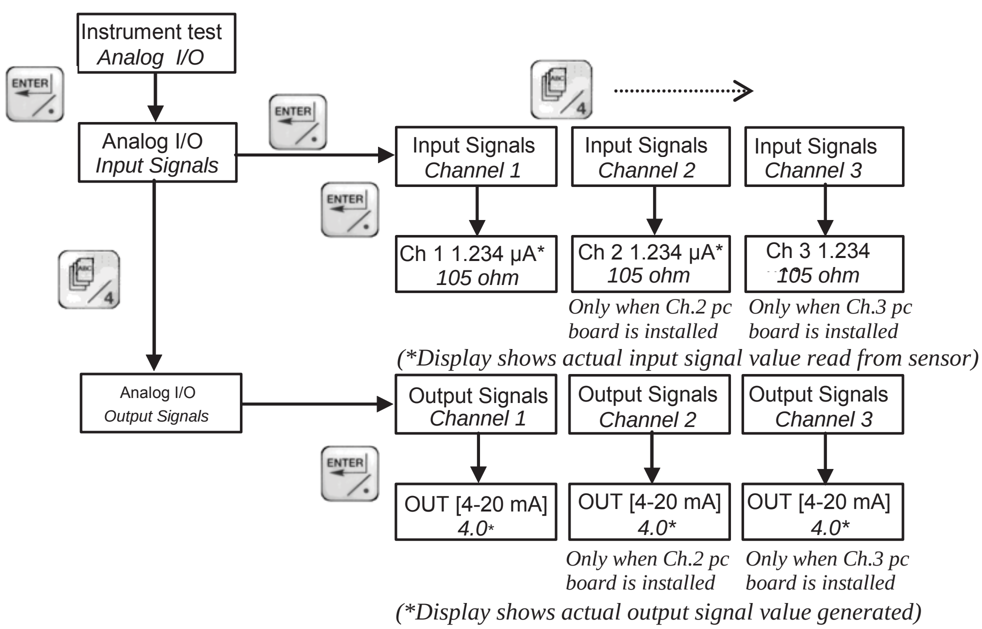
pressing the key corresponding to displayed number (from 1 to 7) the display will change the "0" in "1" or vice versa and the contact output status will change from “OPEN” to “CLOSE”: verify with an ohmmeter the status of the pertinent CCO (see hereafter terminal numbers correspondence).

Contact Number (CCO)	CCO1		CCO2		CCO3		CCO4		CCO5		CCO6		CCO7	
Terminal identification (TB J3)	1	2	3	4	5	6	7	8	9	10	11	12	13	14

Table 3 - CCO Terminal identification

- <u>Analog I/O test</u>: the Analog I/O test allows to verify the correct value of the input and output signals. In the analog “Input” mode, the display shows the value of the signal generated by the sensor and the pertinent Pt100, in order to verify the correct sensor operation in an easy and fast way.

  In analog output mode the instrument allows to check correct functionality of the 4-20 mA output: operating the OUT increase and OUT decrease keys the output value indicated on display can be changed and with a multimeter connected to the pertinent channel output [terminals 1(-), 2(+)] it can be verified that the current output changes accordingly.



- <u>Electrical Calibration</u>: The access to this menu is protected by a password that is only known to Severn Trent personnel, because the included parameters must never be tampered with.

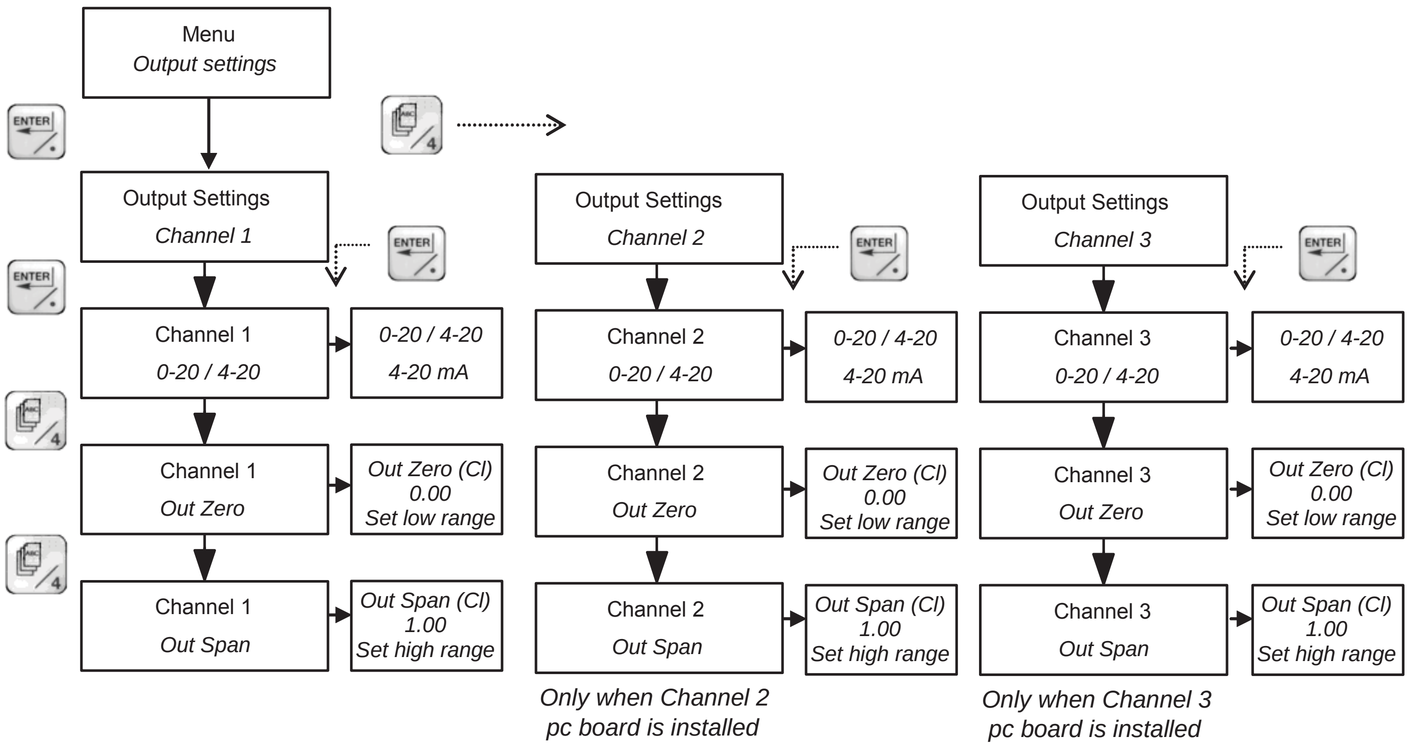
  The electrical calibration is only performed in the Factory at the end of manufacturing process.

4.4.2 Output setting

The Output Settings menu allows to set current output (0-20 or 4-20 mA), zero (Out Zero) and full scale (Out Max) values, in engineering units. Out Zero value corresponds to 0 mA or 4 mA (according to the output chosen) and the Out Full Scale value to 20 mA.

WARNING! **The 0 or 4 mA selection is a hardware/software setting made during manufacturing process. Set 0-20 mA or 4-20 mA accordingly. To modify output signal change Jumper JP1-JP2 as shown in Figure 14.**

(See Sect. 4.4 to get here)



In the following table the default values of Out Zero and Out Max are presented. Minimum span and maximum ranges are also presented.

Parameter	Unit	Out Zero	Out Max	Minimum Span	Maximum range
pH	pH	2.00	12.00	1.00	0.00-14.00
mV	mV	-500	+500	100	-1500-+1500
O2	ppm	0.00	10.00	2.0	0-20.00
O3	ppm	0.00	10.00	0. 25	0.00-10.00
Cl	ppm	0.00	10.00	0.25	0.00-10.00
CD	ppm	0.00	10.00	0.25	0.00-10.00
T	°C	0.00	100.0	5	0.00-+100
mA	See Section 2.1	4.00	20.0	2	(0) 4-20.0
Br	ppm	0.00	1.00	1.00	0.00 -10.00

Table 4 – Output max and min range

4.4.2.1 Output signal hardware modification 4-20 to 0-20 mA

To modify output signal from 4-20 to 0-20 mA make following hardware modification on Analog Input/Output board:

- Identify Jumper JP1 and JP2 on board (see figure below);
- Remove JP1 (cut copper, this jumper is factory-made by default);
- Install Jumper in JP2 position.

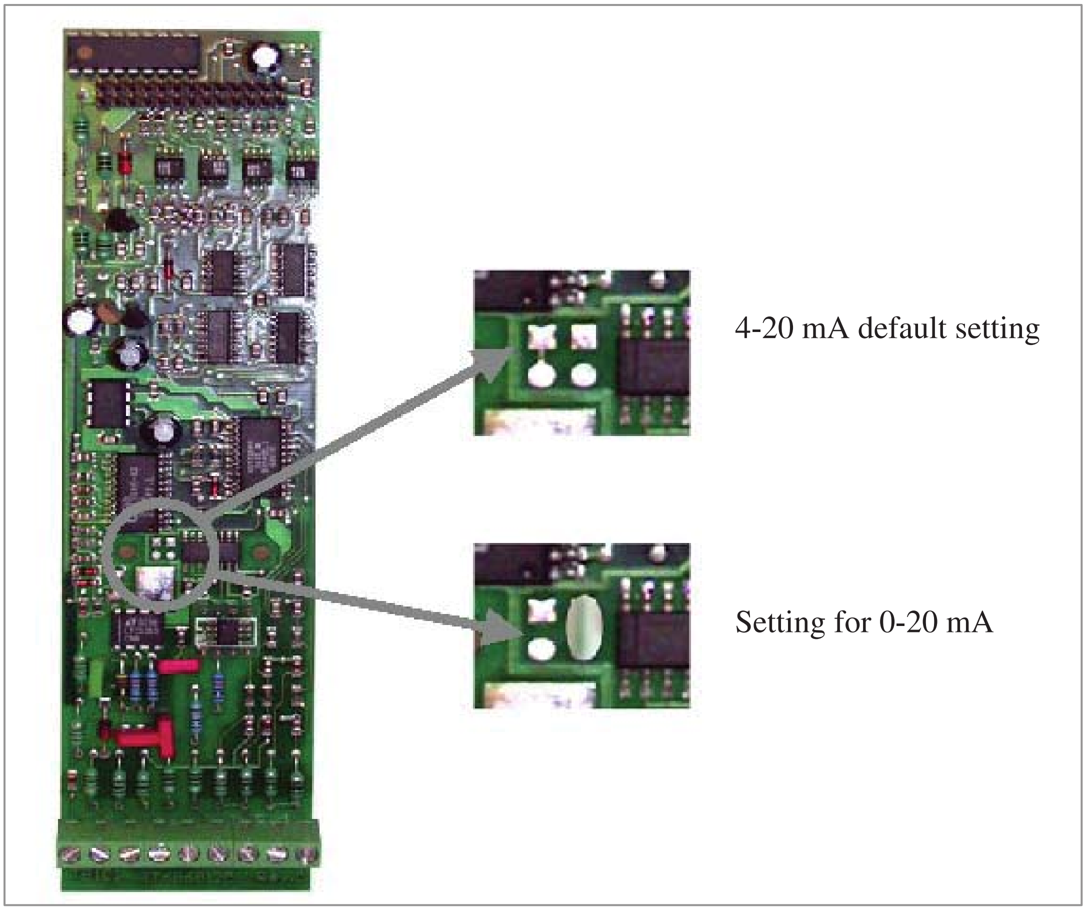


Figure 14 - Jumper position for 4-20 to 0-20 mA output signal modification

4.4.3 Alarms

This menu allows to set high and low alarm levels and the dead band. The alarm levels are freely selectable by the user. Select the channel and press Enter to select alarms and dead band. Default levels are automatically related to the set range of output: low alarm is set at 10 % of Out Zero and high alarm is set at 90 % of Out Max (see the following table for default alarm setting values).

Parameter	**Unit**	**Alarm**		
		low	***high***	***dead band***
pH	pH	3.00	11.00	0.00
mV	mV	-400	+400	0.00
O2	ppm	1.00	9.00	0.00
O3	ppm	0.10	0.90	0.00
Cl (KC4000)	ppm	0.10	0.90	0.00
Cl (CL4000 0-2 ppm)	ppm	0.20	1.80	0.00
Cl (CL4000 0-10 ppm)	ppm	1.00	9.00	0.00
CD	ppm	0.10	0.90	0.00
T	°C/°F	10.0	90.0	0.00
mA	mA	5.60	18.40	0.00

Table 5 – Default alarm setting

Dead band is useful to avoid a repeated switch on and off of an alarm condition. The operation principle is represented in Figure 15 below: if the measured value reaches the high alarm level, MicroChem®2 generates an alarm message, but a second alarm condition is triggered only after the measure lowers below the set dead band, and then rises again above the HI alarm level. A similar procedure of opposite sign is performed for low alarm.

To identify contacts for alarm retransmission, see the operation description for each instrument type in the following chapters.

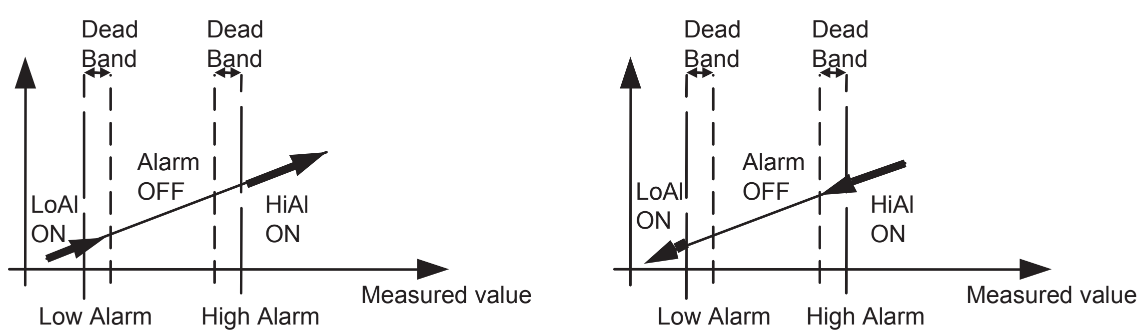


Figure 15 – Hi and LO alarm dead-band

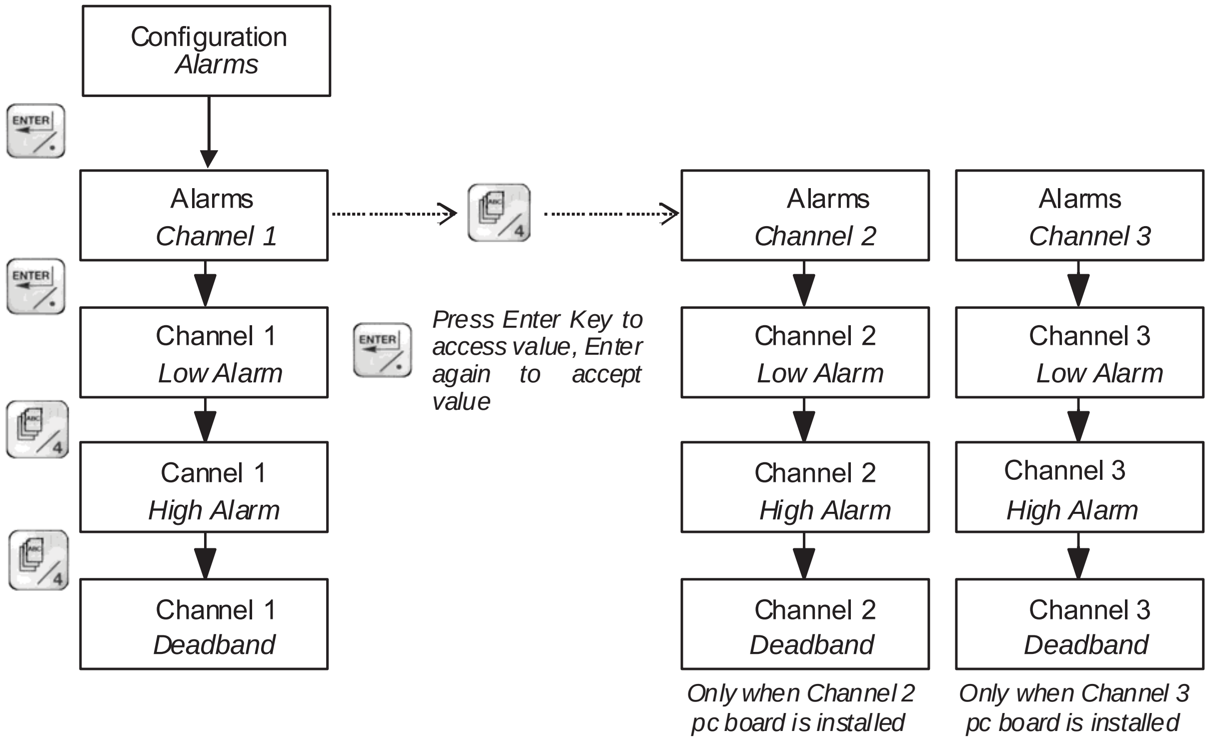
4.4.3.1 Alarm Display

When an alarm occurs, the display indication will flash on and off to signal the alarm condition.

By pressing the ENTER key, the alarm page will be called on display, and it will be possible to identify the channel and the alarm type .
See Sect. 9.2 for details.

4.4.3.2 Alarm setting Menu

(See Sect. 4.4 to get here)



5 FUNCTIONALITY

The different functionality of the instrument depends on the Model Number selected, and it can be classified in two main groups: Analyzer-Indicator-**Transmitter** or Analyzer-Indicator-Transmitter-**Controller.**

5.1 Transmitter

The transmitter can support up to three sensors, and the association of input/output signals depends on the configuration selected as per following tables.

Digital inputs:

CCI in 'OR' SELECTION	**CCI1**	**CCI2**
CCI in 'OR' = ***NO***	Freezes measured value of Channel 1	Freezes measured value of Channel 2 (Channel 3 alone cannot be frozen)
CCI in 'OR' = ***YES***	Freezes measured value of all Channels installed	Freezes measured value of all Channels installed
CCI in 'OR' = ***OFF***	CCI 1 inactivated	CCI 2 inactivated

Table 6 - Digital Inputs Functionality for Transmitter

Digital outputs:

Transmitter Type	**CCO1**	**CCO2**	**CCO3**	**CCO4**	**CCO5**	**CCO6**	**CCO7**
Without Cleaning	HI Alarm Ch. 1	LO Alarm Ch. 1	HI Alarm Ch. 2 (1)	LO Alarm Ch. 2 (1)	HI Alarm Ch. 3 (2)	LO Alarm Ch. 3 (2)	Watch dog
With Cleaning	HI Alarm Ch. 1	LO Alarm Ch. 1	HI Alarm Ch. 2 (1)	LO Alarm Ch. 2 (1)	Washing command	Washing command	Watch dog

Table 7 - Digital Outputs Functionality for Transmitter

Analog Signal output 0/4-20 mA:

Instrument	Channel 1	Channel 2	Channel 3
Transmitter	Retransmission of analysis value for Sensor on Ch. 1	Retransmission of analysis value for Sensor on Ch. 2 (1)	Retransmission of analysis value for Sensor on Ch. 3 (2)

Table 8 - Analog Outputs Functionality for Transmitter

(1) – Only when Channel 2 is installed
(2) – Only when Channel 3 is installed

5.2 Controller

The control strategies offered by the MicroChem®2 are basically:

- Standard PID Controller, with Feed Forward option
- Swimming Pool Controller
- Average Controller between 2 or 3 equal probes

These will be discussed in detail in the following paragraphs.

NOTE: MicroChem2 controller type must be specified at time of order. Hardware changes are required to convert from a standard transmitter to a standard PID controller or to a swimming pool controller.

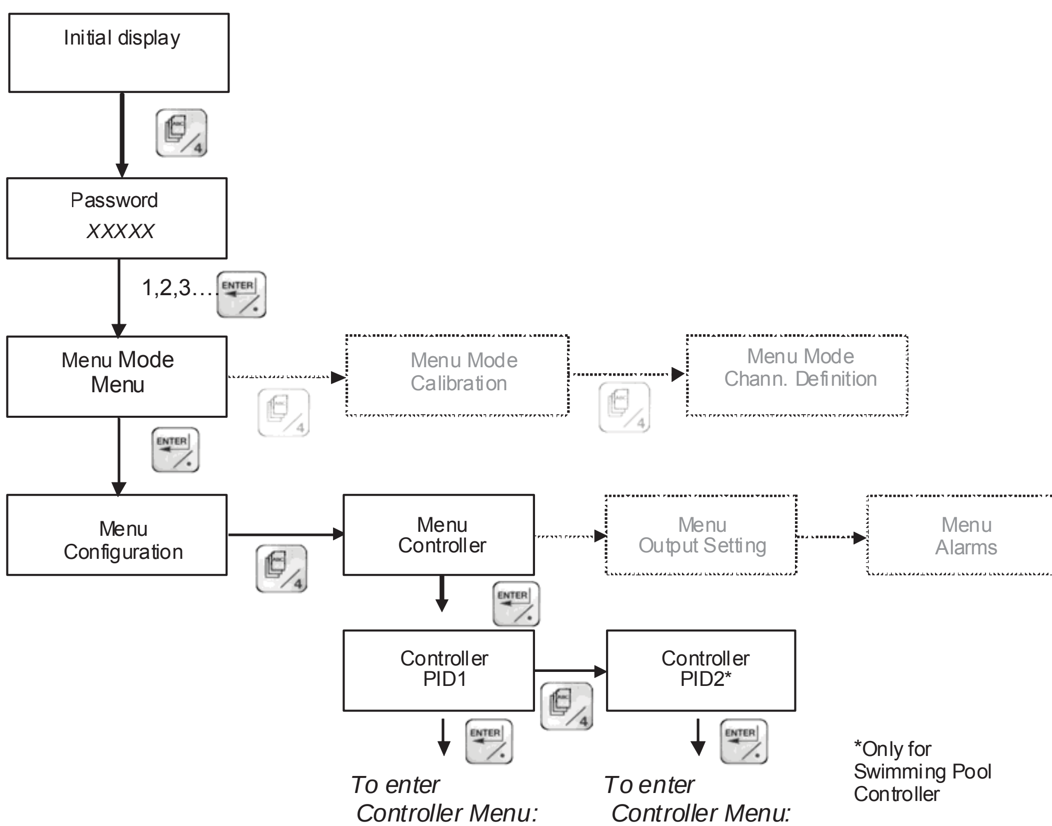
5.2.1 General description

The PID Controller of the MicroChem2 is usable in the majority of process applications. The controller calculates an output based on the difference between the analytic measure (Process Variable, PV), and a Set-point (SP) value, it calculates an Output (OUT), that is applied to a final control element (e. g. dosing pump) to restore actual process value to the set-point demand. The output is calculated with the PID algorithm, which has Proportional, Integral and Derivative actions. The effect these terms have on the calculated output is determined by the PID configuration.

The Controller can work in Automatic or Manual mode, pushing numbers 0 or 5. The Manual mode let the user modify the output manually, whereby the PID calculated output is not used. The output is driven with push-buttons 1 (decrease) and 2 (increase). The Automatic mode is selected pushing button 5. The set-point is modified with the push-buttons 6 (decrease) and 7 (increase). The output signal to drive the control element can be either a 4-20 mA analog signal or two contacts (increase-decrease). The user can choose to control the final element according to the characteristics of the device used.

5.2.2 Controller's Parameters

When the instrument is operating as a controller the following menu becomes accessible:



Entering the Controller Menu the accessible parameters are presented as per the following table:

1 - General Parameters (valid for all control strategies)		
Description	***Symbol***	***Configuration***
4/20 mA / Contacts	-	Selection of controller output as analog 4/20 mA signal or Contact closure (See 5.2.2.5). Default: 4 – 20 mA
Proportional Band	PB	Numeric entry in % (Integer positive) Default: 100% - Range: 0% - 999%
Time Reset or Integral action	TR	Numeric Entry in minutes per repetition Default: 0 min/rep – Range 0 -999.99 min/rep
Manual Reset (Active when TR=0)	MR	Numeric entry in % Default: 50% - Range 0-100%
Derivative	TD	Numeric Entry in minutes Default: 0 min – Range 0 -99.99 min
Process Variable (display only)	PV	Engineering units
Set Point	SP	Engineering units Default: 0.00
Control zone	CZ	Numeric entry in Engineering units Default: 0.00 - Range: 0.0 - 99999.99
Direct/Reverse Action	RSW	D = Direct; R = Reverse. Default = Reverse
Span	SPAN	Controller Span Default = According to channel configuration
(Feed Forward parameters appear here if this option has been selected. - See Section 2 below)		
High limit on controller's output	OH%	Numeric entry in % Default: 100% - Range 0-100%
Low limit on controller's output	OL%	Numeric entry in % Default: 0% - Range 0-100%

2 - Feed Forward action (this function available only when option is activated – See Par. 5.2.2.2)		
Limit output as function of flowrate?	OHLP	Enter No/Yes Default: No
Factor to compute Max output based on Flowrate value	FFH	Numeric entry in %/100 Default: 1.5 - Range: 0 - 999.99
Factor to compute Min output based on Flowrate value	FFL	Numeric entry in %/100 Default: 0.50 - Range: 0 - 999.99
Absolute High limit on output when limits based on flowrate are active	Absolute Max.	Numeric entry in % Default: 100% - Range 0-100%
Gain factor applied on flowrate signal	GAIN	Numeric entry in % Default: 100% - Range 0-999.99%

3 – Time Sampling and/or Flow Pacing Controller (Process with dead time - this menu available only when Chlorine input Channel is selected – See Par. 5.2.2.3)		
Sampling based on flow?	TATP	Enter No/Yes Default: No
Scaling factor for flow	K	Numeric entry in Engineering units Default: 0.0 - Range: 0 - 999999.9
Active time	Att.	Numeric Entry in minutes Default: 0.0 min – Range 0- 99999.99 min

Total Cycle time (or volume)	Cycle	Numeric Entry in minutes (or units sample) Default: 0.0 min - Range: 0 - 99999.99 min
4 - pH/ORP control (this parameter compares when pH/ORP is selected – See Par. 5.2.2.4)		
Squared error control band	Dead Band	Numeric entry in % Default: 100% - Range 0-100%

5 - Contact output controller – (this menu available when option is selected - See Par. 5.2.2.5)		
Frequency / Relay	DIGITAL OUTPUT S	Function not supported at this time, leave always the selection "Relay"
Gain	GAIN	Numeric entry in %/100 Default: 1.00 - Range: 0 - 99.99
Dead Zone	DZ	Numeric entry in Engineering units Default: 0 - Range: 0 - 99999.99
Cycle time	TIME CYCLE SEC	Numeric Entry in seconds Default: 0 sec - Range: 0 - 99999 sec

6 – Swimming Pool Controller / Dual PID – (See Par. 5.2.4)
When this option is implemented, the menu offers a choice of PID2 in addition of PID1. The parameters of PID2 are identical to those of PID1, except for the option not compatible with this configuration, and namely those of items 2-Feed Forward and 4-pH/ORP (which is on PID1).

Table 9 - Controller Parameters

5.2.2.1 PID Parameters

The MicroChem2 is capable of Proportional (P), Proportional Integral (PI) and Proportional Integral Derivative (PID) control. To do so, a chip written with controller software must be inserted in an open slot on the control board. Recall that each of the three channels has the ability to accept a 4-20mA input, a micro-amp input, or a mV input. The instrument also has digital relay contact outputs CCO1 through CCO7, which have different functions depending on how the instrument is configured. Each of the three channels also has a 4-20mA output.

4-20mA/Contacts
4-20mA/Contacts is selected to determine if the instruments will function as a PID controller or as a Relay Contacts controller. As a PID controller, the instrument sends a control signal to the equipment being controlled using its 4-20mA output. Contact relays CCO1 through CCO6 are used to provide Hi and Lo alarms. 4-20 mA output is set by default. Refer to Section 5.2.2.5.

NOTE: If you wish to control a given parameter and want to forward the measured value (via a 4-20 mA output) being controlled, a 2 channel system is required. The analog input on channel 1 will be the measured value. The analog output on channel 1 will be the control signal. The analog output on channel 2 configured as mA will be the retransmitted signal from the channel 1 input. The analog input on channel 2 can be a flow signal coming from a flow meter or not used. If contact closure control output is selected, a second channel is not needed for retransmission.

As a Relay Contacts controller, the control signal is sent via digital relay control contacts outputs, CCO3 and CCO4. CCO5 and CCO6 are used for washing if selected. Hi and Lo alarms are provided by CC01 through CCO6 depending on the configuration and the number of channels. Please refer to 5.2.3.4, Table 12.

Proportional Action (PB)
Percent Proportional Band is the full scale through which the error signal (the difference between the process variable and the setpoint) must vary to cause a full scale output variation due only to proportional control mode response. In Proportional Action there is a comparative relationship

between the controller loop output signal magnitude and the calculated error, which is the difference between the process variable and the setpoint.

Proportional Band determines the size of the incremental changes the controller makes. To set PB:

- Fast response to the error — if you want a small change in the process variable to cause a large response, set PB to a small number (a high Gain). If too low of a number is selected, the control action will change rapidly and may cause overshoot of the set point.
- Slow response to error — if you want a large change in the process variable to cause a small response, set PB to a large number (a small Gain). This will cause the control signal output to change in small steps taking longer to eliminate the error. This will lessen the possibility of an overshoot but will take longer to eliminate the error.

When setting PB you are telling the controller what percentage of the difference between the set-point and the process variable you want to use as steps to eliminate the error. Each step is equal to 100% divided by the % of the PB. If for example the PB setting is 200%, you are telling the controller to make incremental changes of 100/200 or 1/2 of the error. As the error decreases, so do the incremental changes

Minimum PB value is 0% (high Gain) and maximum value is 999% (small Gain)

Integral Action (TR)
Integral Action augments proportional action to cause a PID control loop to drive its final control element until the deviation is completely eliminated. In other words, TR produces a corrective signal proportional to the error and length of time the controlled variable is different from the set-point.

As in the last example, if PB is set at 200% the incremental change the controller will make is equal to 1/2 of the error. So if you set your TR to 5 minutes, every 5 minutes the controller will compare the set-point to the process variable and regulate the pump to turn on to eliminate 1/2 of the error. As the error is reduced the incremental change the controller makes is also reduced. This is actually done continuously, not in discrete steps as inferred above. Suggested range of values are 0.02 min/repetition (fastest response) to 30 min/rep (slowest).

To determine the TR value you need to measure the elapsed time between making a change to the process and the MicroChem2 reacting to this change.

For example in the case of a Chlorine Residual Analyzer, the equipment should be installed such that the system lag time is 3 to 5 minutes between chemical injection and residual analyzer detection of a change. Once the system is operational, change the chemical feed rate and start a stopwatch. When the analyzer displays the change in the process variable, stop the watch. Add 5 to 10 seconds to the time and this will now be the TR time to enter into the MicroChem2.

NOTE: Integral action is activated when sampling is not based on flow. TATP (see Section 5.2.2.3) must be set to NO, which is the default. If TATP is set to YES, then sampling is based on flow and TR has no meaning.

Derivative Action (TD)
Derivative action augments proportional action by responding to the rate of change of the process variable. It is used to make each controller PID loop more responsive to sudden process disturbances. The derivative time in minutes is the amount of time by which the proportional action (or proportional plus integral action) is advanced. The minimum value for derivative action is 0.01 minutes for the fastest response, and the maximum value is 8 minutes for the slowest response.

Control Zone (EZ)
This parameter is used to avoid continuous control adjustments for small fluctuation from set-point. If for example set-point is set to 7 and CZ = 1, control action is not active in the range 6.5 -7.5.

Manual Reset (MR)
This parameter represents the integral action set manually. It is activated by setting TR parameter to "0".

Direct/Reverse Action (RSW)
Direct/Reverse Action is used to have the controller respond directly or oppositely to the change in your process variable. For example if you are adding sulfur dioxide to lower your residual and you are measuring your residual to control the sulfur dioxide, set the RSW to direct. If you are controlling your residual by adding chlorine, set RSW to reverse.

Span
Span is the measuring range used by controller. This value is typically set to the maximum ranger of the sensor connector to Channel 1.

Output High and Low Limits(OH and OL)
Output High and Low Limits represent the absolute high and low limits at which you want the controller to run. If for example, you are using a pump with a higher capacity than your process requires and there is the possibility that you can overdose, you will need to set the OH to prevent this from occurring. Ranges for OH and OL are both 0-100%.

5.2.2.2 Feed Forward (FF) Configuration

The instrument will activate this function only if it detects the presence of a 4-20 mA input signal connected to Channel 2.

Feed Forward is used to modify the controller's output as a function of the flow rate. If the process flow rate is variable, the software will take the flow rate signal input from channel 2 and the measured value input from channel 1 to compute the PID output. The 4-20mA input flow rate signal is generated by an external flow meter connected to Channel 2.

To use this strategy you will need to do the following: The flowmeter must be connected to channel 2 and defined as mA. mA needs to be further defined as MODE PID, which is the default under the mA Channel Definition to take the flow into consideration.

MODE PID -- When the instrument is defined as MODE PID for flow proportional control, it allows the instrument to adjust the PID control signal depending upon the flow signal and the measured value of the process. MODE PID allows access to the feed forward control parameters OHLP, FFH, FFL and ABS Max. Please refer to the Controller Software Menu Tree Appendix D and the Step by Step instructions to easily navigate through the software.

MODE TX – is used when Channel 2 is not used to retransmit the 4-20 mA output signal from Channel 1 or when feed forward action is not desired. When MODE TX is selected Channel 2 can be used to independently measure another parameter.

NOTE: MODE PID and MODE TX only appear on Channel 2 and only if the instrument is configured as a controller.

Limit Factor as a Function of Flow Rate? (OHLP is set to NO):

A. If OHLP is set to **No** then FFH, FFL, and MAX ABS are off. OHLP controls the limit functions with respect to the flow signal. To mask the flow signal the Gain would also need to be set to 0.

Limit Factor as a Function of Flowrate? (OHLP)

B. If OHLP is set to **Yes** – The MicroChem2 calculates output limits as a function of the instantaneous flow rate. If Feed Forward control is implemented through the automatic detection of the 4-20mA input signal on Channel 2 configured as PID, the standard High(OH) and low(OL) limits on the controllers output are automatically disabled to allow for flow proportional control.

See 5.2.2.1 PID Parameters – Output High and Low Limits. Maximum and Minimum Output Limits as a function of flow rate must be determined to prevent over dosing or under dosing the process.

Maximum Output Limit as a Function of Flow Rate (FFH) – The Maximum output limit is calculated by multiplying the FFH by the Flow Rate. FFH is determined based on plant experience. If for example you have an oversized pump you would consider the overdosing possibility.

Minimum Output Limit as a Function of Flow Rate (FFL) – The Minimum Output Limit is calculated by multiplying the Flow Rate by the Feed Forward Low Factor.

Flow Rate is 20%	Flow Rate is 20%
FFH is 1.5	FFL is 0.5
Output limit is 20% x 1.5 = 30%	Output limit is 20% x 0.5 = 10%

Absolute High Limit on Output when limit based on flow rate is active (ABSOLUTE MAX) – The Max ABS parameter sets the absolute maximum limit on the output when the limits are based on flow. When OHLP is set to Yes, then OH and OL are not engaged and MAX ABS is used instead.

Gain – When using the Feed Forward control strategy, Gain is the factor applied to the flow rate signal contribution to control the coarse dosing and limit the flow action of the PID. In other words, Gain is the ratio of how much to open the valve or turn on the feed pump with respect to the process flow signal.

Example assuming no limits of FFH AND FFL

@100% Gain	@ 50% Gain
FF min in 0% at 4.00mA	FF min in 0% at 4.00mA
FF max is 100% at 20mA	FF max is 50% at 20mA

NOTE: If a 4-20mA input is connected to Channel 2, and FF control is not desired, set OHLP to NO, set GAIN to 0, and the PID output will be based on the residual value only.

5.2.2.3 Time Sampling and/or Flow Pacing Controller

The Time Sampling and/or the Flow Pacing menu is made available automatically when the MicroChem®2 detects that a Chlorine input channel has been selected. When a process has dead time, which is often the case for Chlorine dosage, it can best be controlled with this strategy using either Time Sampling or Volume Pacing. Time Sampling or Flow/Volume Pacing control updates the PID function on a periodic basis for a specific length of time or amount of flow.

Time Sampling (TATP) is enabled by setting the TATP parameter to NO. TATP is an Italian acronym. The TATP parameter asks the question, is sampling based on flow?

When TATP is set to NO, the PID control output is updated based on Time, the Active (Att) and Cycle parameters.

Scaling Factor for Flow (K) Although the K parameter is available in the menu, it has no effect on Time Sampling and should be set to 0.

Active Time (Att) – Active time is defined as the amount of time that the PID is engaged and applied to the control output. Active Time – is a sample and hold control strategy used in a batch system i.e. in a contact tank, with a given volume of water. Set Active Time in whole minutes. The analyzer will not accept fractions of a minute.

Cycle Time (Cycle) Cycle Time sampling is defined as the total amount of Active time plus wait time. A "W" will appear on the bottom right corner of the display to indicate that the system is in wait mode. During the wait time the microprocessor does not update the residual portion of the PID output. For continuous PID control, set the Active time larger than the Cycle time. Set Cycle Time in whole minutes. The analyzer will not accept fractions of a minute.

Cycle Time	
ATT	**Wait "W" Time**

Flow or Volume Pacing is enabled by setting the TATP parameter to YES. When TATP is set to YES, the PID control output is updated based on flow volume. To use Volume Pacing:

1. Channel 1 is configured for the specific parameter being measured and controlled. The 4-20mA output on channel 1 is used to provide the PID control signal.
2. The analog input for Channel 2 must be configured to 4-20mA, which further asks to configure channel 2 to Mode PID or Mode TX. Select Mode PID.

Scaling Factor for Flow (K) – The scaling factor (K) for flow is used by the MicroChem® 2 software to calculate the flow.

- set K factor to the flowmeter's full-scale value expressed in cubic meters (m3/h).
- K factor can be set between 0 and 17000 m3/h.

1 m^3/h=	6340.129 gallon/day
	219.9692 gallon/hr
	3.666153 gallon/minute

Active Time (ATT) – The ATT Parameter is defined as the Period (in m^3) that the PID is updated during the cycle and applied to the control output signal.

Cycle (for Flow) – is defined as the total volume of process flow expressed in cubic meters (m^3) for a complete cycle. A "W" will appear at the bottom right corner of the display to indicate the system is in the wait mode. During the wait time the microprocessor does not update the residual portion of the PID output.

Cycle Volume	
ATT	**Wait "W" Volume**

5.2.2.4 Error Squared Controller (pH and ORP Applications)

When the instrument detects that pH or ORP sensor has been selected for the controller, it enables a special PID algorithm with an "Error Squared" function. The error squared function is applied only within a band defined in the "BAND" parameter of the controller's configuration menu. When the error is outside this band, the effective error is a linear response (see Figure 16).

If "BAND" parameter is set to "0", then the controller operates like a standard PID controller.

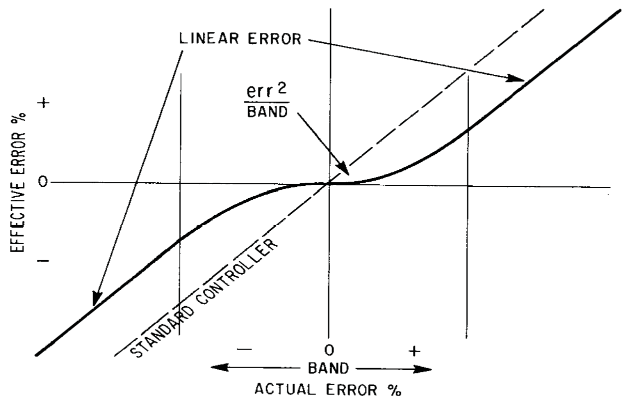


Figure 16 - Error versus control band

5.2.2.5 Contacts Output Controller

Contact output control is particularly suitable when using a dosing pump controlled by contacts (rather than 4-20mA analog signal) or for operation with an electrically motorized control valve.

NOTE: When the contact closure routines are being used the cycle time (Section 5, Table 9 - Control Parameters, number 6 - Contact output controller must be set (i.e. not left at 0).

Gain - For controllers operating in the contacts mode, the PID algorithm is NOT active and the output is calculated using the Gain parameter (similar in function to the proportional term in PID).

NOTE: The main screen still shows the calculated PID output even though it is not used in contact closure mode - ignore this.

The algorithm works by looking at how far away from the setpoint the measurement is and then switching the dosing pump on for a period of time (switched on for longer when the setpoint is a long way away).

1) A small percentage of deviation of the process variable will cause a full scale output if the gain is set to a low number, increasing the possibility of an overshoot.
2) A large percentage of deviation of the process variable will cause a small scale output if the gain is set to a high number decreasing the possibility of an overshoot. This will require the pump to operate more frequently in smaller steps as the instrument attempts to bring the measured value to the set point value.

Dead Zone (DZ) - Dead Zone parameter represents the range around the setpoint where control action has no effect. Similar to Deadband, this function is used when the process variable is near the setpoint when using the Contacts Output Controller. So, when the difference between the process variable and setpoint is lower than this value the contacts are kept open.

Time Cycle - When using contact closures for control, the amount of time the contact closure is closed is the amount of time the pump is on or the valve is open.

% output duty cycle (% time pump is on) = % deviation from setpoint x gain

e.g.: If the setpoint is 3 mg/l and the signal measured is 2 mg/l then the % deviation from the setpoint = (3-2)/3 = 1/3 = 33%

If the time cycle is set to 20 seconds and the gain =1, then in the 20 second period the contact closure will be on for 33% of 20 seconds (6.7 seconds).

If after this 20 seconds period the measurement is now 2.5 mg/l the new % deviation from the setpoint = (3-2.5)/3 = 17%. The contact closure will now be on for 17% of 20 seconds, i.e. 3.5 seconds.

By changing the gain to say 2, then the contact will be on for longer; 3.5 x 2 = 7 seconds, getting to the set point faster but possibly overshooting slightly.

The contacts used by the controller to drive the final element are assigned as per the following table:

PID 1		PID 2 (only for Swimming Pool Controller	
CCO 3	CCO 4	CCO 5	CCO6
Decrease	Increase	Decrease	Increase

Table 10 – Contacts Output Controller Assignment

5.2.3 Standard Controller

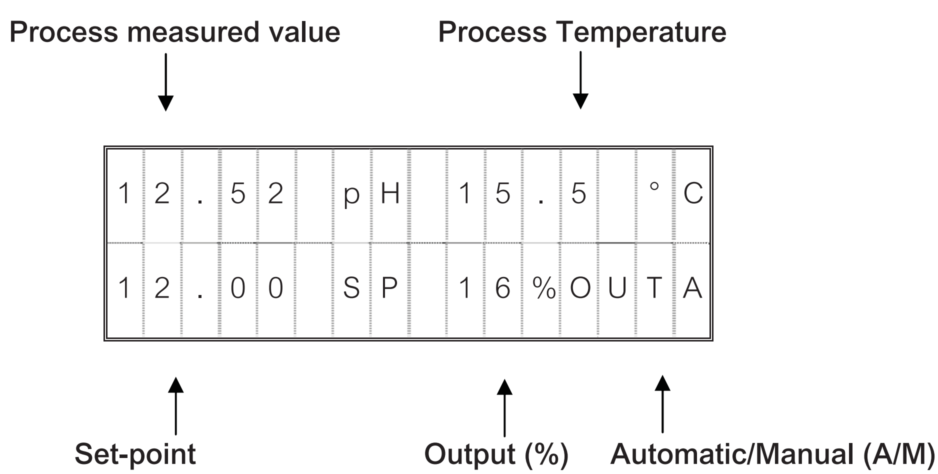
This section deals with the functionality which is specific of the standard controller.

5.2.3.1 Standard Controller Display

The standard controller display shows the following values:

- instantaneous value of process variable measure
- process variable temperature (not present for ORP or CL4000 sensor)
- set-point
- output signal value
- Controller status: A/M (A = Automatic, M = Manual).

Fields of display are configured as in the following draft:



If the instrument is configured to perform additional functions beside operating as a controller, for example to monitor another parameter with a second or third sensor installed on channel 2 or 3, the indication of these values can be called on display by pressing the key END, which will cycle through the different display available, and eventually back to the controller display.

5.2.3.2 Standard Controller Analog Output assignment

The assignment of the analog output signals depends on the number of channels installed and on the type of configuration selected for the controller output, whether it is to operate on a 4-20 analog signal or on contacts closure, as per the following table:

Type of Controller	Output option	4-20 mA Channel 1	4-20 mA Channel 2	4-20 mA Channel 3
Controller with 1 Channel installed	Analog output	PID Control output	---	---
	Contacts output	Measured value retransmission of Channel 1 analysis		
Controller with 2 Channels installed	Analog output	PID Control output	Measured value retransmission of Channel 1 analysis (1)	---
	Contacts output	Measured value retransmission of Channel 1 analysis	Measured value retransmission of Channel 2 analysis (1)	
Controller with 3 Channels installed	Analog output	PID Control output	Measured value retransmission of Channel 1 analysis (1)	Measured value retransmission of Channel 3 analysis
	Contacts output	Measured value retransmission of Channel 1 analysis	Measured value retransmission of Channel 2 analysis (1)	

(1) If the two sensors/channels are identical, and the PID option is selected on Channel 2, the output becomes the average of the two measured values

Table 11 - Std Controller Analog Outputs

5.2.3.3 Standard Controller Digital Input assignment

The Digital Input functionality is identical for all type of instrument selected, as per following table:

CCI in 'OR' SELECTION	CCI1	CCI2
CCI in 'OR' = ***NO***	Freezes measured value of Channel 1	Freezes measured value of Channel 2 (Channel 3 alone cannot be frozen)
CCI in 'OR' = ***YES***	Freezes measured value of all Channels installed	Forces to 0 PID1 output signal
CCI in 'OR' = ***OFF***	CCI1 inactivated	CCI2 inactivated

Table 12 - Digital Input Functionality for Controller

5.2.3.4 Standard Controller Digital Output assignment

The assignment of the digital output signals depends on the number of channels installed, on the type of configuration selected, for the controller output, whether it is to operate on a 4-20 analog signal or on contacts closure, and on the cleaning option configuration, as per the following table:

Controller Type	CCO1	CCO2	CCO3	CCO4	CCO5	CCO6	CCO7
Controller without Cleaning Analog output PID	HI Alarm Ch. 1 (1)	LO Alarm Ch. 1 (1)	HI Alarm Ch. 2 (2)	LO Alarm Ch. 2 (2)	HI Alarm Ch. 3 *(if Ch. 3 installed)*	LO Alarm Ch. 3 *(if Ch. 3 installed)*	Watch dog
Controller without Cleaning Contacts out PID	HI Alarm Ch. 1 (1)	LO Alarm Ch. 1 (1)	PID control output (*decrease*)	PID control output (*increase*)	HI Alarm Ch. 3 *(if Ch. 3 installed)*	LO Alarm Ch. 3 *(if Ch. 3 installed)*	Watch dog
Controller with Cleaning Analog output PID	HI Alarm Ch. 1 (1)	LO Alarm Ch. 1 (1)	HI Alarm Ch. 2 (2)	LO Alarm Ch. 2 (2)	Washing command *(See Par. 4.4.1.3)*	Washing command *(See Par. 4.4.1.3)*	Watch dog
Controller with Cleaning Contacts out PID	HI Alarm Ch. 1 (1)	LO Alarm Ch. 1 (1)	PID control output (*decrease*)	PID control output (*increase*)	Washing command *(See Par. 4.4.1.3)*	Washing command *(See Par. 4.4.1.3)*	Watch dog

(1) If two/three identical sensors/channels are installed, and PID option is selected on Channel 2/3, the alarm is based on the average of the two/three measured values
(2) If two/three identical sensors/channels are installed, and PID option is selected on Channel 2/3, the alarm is triggered by the first of the two/three measured values that reaches the alarm level configured (first-out functionality).

Table 13 - Std. Controller Digital Output assignments

5.2.4 Swimming Pool Controller

The Controller for swimming pool is a flexible instrument dedicated to the control of the principal parameters in the swimming pool: pH, ORP and Residual Chlorine. It is available in two different versions: two channels (pH + chlorine and pH + ORP) and three channels (pH, chlorine and ORP).

If the instrument has two channels, the dual controllers operate on the two channels installed. If the instrument has three channels, the control is operated on pH (channel 1) and on measure installed on channel 3 (see Section 2.5, for the position of channel 3). If ordered as a three channel instrument, Channel 2 will be available to measure the parameter not controlled via PID on Channel 1 and 3.

With this option, the Controller menu offers two submenus. PID 1 is associated with the configuration of pH control on channel 1, PID 2 with the configuration of either chlorine or ORP.

5.2.4.1 Swimming Pool Controller Display

MicroChem2 supports three different displays. The main one is meant to monitor the process and it shows the controlled variables measured, pH and ORP/chlorine. The secondary displays let the user modify set-point and output (in Manual mode) of pH and ORP/chlorine. To toggle from one display to the other, press the END key.

Main display (fields of display are assigned as in the following draft):

- measures of pH/ORP/chlorine
- temperature of the pH sensor

Channel 1 (pH) **Channel 3 (CL)**

1	2	.	5	2		p	H		1	1	.	2		C	l
	5	4	4		O	R	P		1	5	.	5		°	C

Channel 2 (pH) **Temperature (of the pH probe)**

Secondary displays:

- measure of a single sensor (pH/ORP/chlorine)
- sample temperature
- set-point
- Output (%)
- Mode: A/M (A = Automatic, M = Manual).

Measure **Temperature**

1	2	.	5	2		p	H		1	5	.	5		°	C
1	2	.	0	0	S	P		1	0	0	%	O	u	t	A

Set-point **Output and Mode: Automatic/Manual (A/M)**

5.2.4.2 Swimming Pool Controller Analog Output assignment

The assignment of the analog output signals depends on the number of channels installed and on the type of configuration selected for the controller output, whether it is to operate on a 4-20 analog signal or on contacts closure, as per the following table:

<table>
<tr><th>Type of Controller</th><th>Output option</th><th>4-20 mA Channel 1</th><th>4-20 mA Channel 2</th><th>4-20 mA Channel 3</th></tr>
<tr><td rowspan="2">Controller with 2 Channels installed</td><td>Analog output</td><td>PID1 Control output</td><td>PID2 Control output</td><td rowspan="2">---</td></tr>
<tr><td>Contacts output</td><td>Measured value retransmission of Channel 1 analysis (pH)</td><td>Measured value retransmission of Channel 2 analysis</td></tr>
<tr><td rowspan="2">Controller with 3 Channels installed</td><td>Analog output</td><td>PID1 Control output</td><td rowspan="2">Measured value retransmission of Channel 2 analysis</td><td>PID2 Control output</td></tr>
<tr><td>Contacts output</td><td>Measured value retransmission of Channel 1 analysis (pH)</td><td>Measured value retransmission of Channel 3 analysis</td></tr>
</table>

Table 14 - Swimming Pool Controller Analog Outputs

If the 4-20 mA output is used to providing a PID control signal, the 4-20mA output is not available for transmission of the actual measurement value. However, if the control is done by activating the CC03, 04, 05, 06 contact closure (see 5.2.2.5) then the 4-20mA output is available and can transmit the measurement signal

5.2.4.3 Swimming Pool Controller Digital Input Assignment

The Digital Input functionality is identical for all type of instrument selected, as per following table:

CCI in 'OR' SELECTION	CCI1	CCI2
CCI in 'OR' = ***NO***	Freezes measured value of Channel 1[1]	Freezes measured value of Channel 2 [1] (Channel 3 alone cannot be frozen)
CCI in 'OR' = ***YES***	Freezes measured value of all Channels installed[1]	Forces to 0 PID1 & PID 2 output signals[2]
CCI in 'OR' = ***OFF***	CCI1 disabled	CCI2 disabled

Table 15 - Digital Input Functionality for Swimming pool Controller

NOTES:

1 Freezing the channels is typically used when performing maintenance.

2 As a safety precaution, as a swimming pool controller, the measurement is still made and displayed on the swimming pool controller

5.2.4.4 Swimming Pool Controller Digital Output assignment

The assignment of the digital output signals depends on the number of channels installed, on the type of configuration selected for the controller output, and whether it is to operate on a 4-20 mA analog signal or on contacts closure, as per the following table:

Controller Type	CCO1	CCO2	CCO3	CCO4	CCO5	CCO6	CCO7
Controller with 2 Sensors Analog out PID1& 2	HI Alarm Ch. 1	LO Alarm Ch. 1	HI Alarm Ch. 2	LO Alarm Ch. 2	----	----	Watch dog
Controller with 2 Sensors Contact out PID1or 2	HI Alarm First-out Ch. 1/2	LO Alarm First-out Ch. 1/2	PID1 control out (*decrease*)	PID1 control out (*increase*)	PID2 control out (*decrease*)	PID2 control out (*increase*)	Watch dog
Controller with 3 Sensors Analog out PID1& 2	HI Alarm Ch. 1	LO Alarm Ch. 1	HI Alarm Ch. 2	LO Alarm Ch. 2	HI Alarm Ch. 3	LO Alarm Ch. 3	Watch dog
Controller with 3 Sensors Contact out PID1or 2	HI Alarm First-out Ch. 1/2/3	LO Alarm First-out Ch. 1/2/3	PID1 control out (*decrease*)	PID1 control out (*increase*)	PID2 control out (*decrease*)	PID2 control out (*increase*)	Watch dog

Table 16 - Swimming Pool Controller Digital Output assignments

5.2.5 Average Controller

The average controller is dedicated to processes that need high reliability of the analysis values. MicroChem®2 supports two or three identical sensors and the calculated average value is used in the PID algorithm as process variable. In function of the difference between the average value (Process Variable, PV), and a Set-point (SP) value, an Output (OUT) signal is calculated, that is applied to a final control element to restore process analysis to the set-point value. The output is calculated with the PID algorithm, which has Proportional, Integral and Derivative terms. The effect these terms have on the output calculation is determined by the PID configuration selections.

The average value control strategy is activated by selecting “YES” in the *“Average”* parameter appearing in the Channel definition menu when two or three identical channels are configured.

5.2.5.1 Average Controller Display

MicroChem2 supports two different displays. The main one shows the values used in the PID algorithm: the average measured value, the average value of the temperature, the set-point and the output. The three secondary displays show the measure and the temperature of each of the three probes. To toggle from a display to another, press the END key.

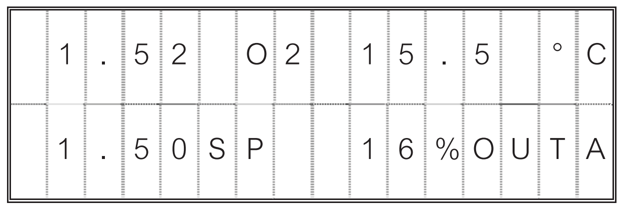
Main display:

- average measured value, used in the PID algorithm
- average value of temperature
- set-point
- output (%)
- A/M (A = Automatic, M = Manual).

Display fields are illustrated below:

Average value of measure (i.e. O2)

Average Temperature



Setpoint

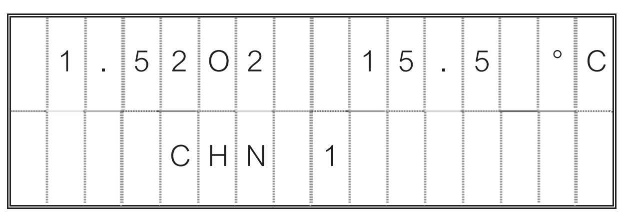
Output (%) and Automatic/Manual (A/M)

Secondary display:

- measure of each single probe
- temperature
- channel number on display

Instantaneous measure

Temperature



Channel being displayed

5.2.5.2 Average Controller Digital Input assignment

The Digital Input functionality is identical for all type of instrument selected, as per following table:

CCI in 'OR' SELECTION	CCI1	CCI2
CCI in 'OR' = ***NO***	Freezes measured value of Channel 1	Freezes measured value of Channel 2 (Channel 3 alone cannot be frozen)
CCI in 'OR' = ***YES***	Freezes measured value of all Channels installed	Freezes measured value of all Channels installed
CCI in 'OR' = ***OFF***	CCI1 disabled	CCI2 disabled

Table 17 - Average Controller Digital Inputs assignment

5.2.5.3 Average Controller Analog Output assignment

The assignment of the analog output signals depends on the number of channels installed and on the type of configuration selected for the controller output, whether it is to operate on a 4-20 analog signal or on contacts closure, as per the following:

Type of Controller	Output option	4-20 mA Channel 1	4-20 mA Channel 2	4-20 mA Channel 3
Controller with 2 Channels installed	Analog output	PID Control output	Measured value retransmission of Channel 1 analysis (1)	---
	Contacts output	Measured value retransmission of Channel 1 analysis	Measured value retransmission of Channel 2 analysis (1)	
Controller with 3 Channels installed	Analog output	PID Control output	Measured value retransmission of Channel 1 analysis (1)	Measured value retransmission of Channel 3 analysis
	Contacts output	Measured value retransmission of Channel 1 analysis	Measured value retransmission of Channel 2 analysis (1)	

(1) If the PID option is selected on Channel 2, the output becomes the average of the two measured values

Table 18 - Average Controller Analog Output assignments

5.2.5.4 Average Controller Digital Output assignment

The assignment of the digital output signals depends on the number of channels installed, on the type of configuration selected, for the controller output, whether it is to operate on a 4-20 analog signal or on contacts closure, and on the cleaning option configuration, as per the following table:

Controller Type	CCO1	CCO2	CCO3	CCO4	CCO5	CCO6	CCO7
Controller without Cleaning Analog output PID	HI Alarm Ch. 1 (1)	LO Alarm Ch. 1 (1)	HI Alarm Ch. 2 (2)	LO Alarm Ch. 2 (2)	HI Alarm Ch. 3 *(if Ch. 3 installed)*	LO Alarm Ch. 3 *(if Ch. 3 installed)*	Watch dog
Controller without Cleaning Contacts out PID	HI Alarm Ch. 1 (1)	LO Alarm Ch. 1 (1)	PID control output (*decrease*)	PID control output (*increase*)	HI Alarm Ch. 3 *(if Ch. 3 installed)*	LO Alarm Ch. 3 *(if Ch. 3 installed)*	Watch dog
Controller with Cleaning Analog output PID	HI Alarm Ch. 1 (1)	LO Alarm Ch. 1 (1)	HI Alarm Ch. 2 (2)	LO Alarm Ch. 2 (2)	Washing command *(See Par. 4.4.1.3)*	Washing command *(See Par. 4.4.1.3)*	Watch dog
Controller with Cleaning Contacts out PID	HI Alarm Ch. 1 (1)	LO Alarm Ch. 1 (1)	PID control output (*decrease*)	PID control output (*increase*)	Washing command *(See Par. 4.4.1.3)*	Washing command *(See Par. 4.4.1.3)*	Watch dog

(1) If two/three identical sensors/channels are installed, and PID option is selected on Channel 2/3, the alarm is based on the average of the two/three measured values.
(2) If two/three identical sensors/channels are installed, and PID option is selected on Channel 2/3, the alarm is triggered by the first of the two/three measured values that reaches the alarm level configured (first-out functionality).

Table 19 - Average Controller Digital Output assignments

6 CALIBRATION

Calibration is required to align the sensor sensitivity. This operation is necessary at the start-up of the instrument and at periodical intervals. New sensors have to be let in operation for at least 24 hours, to allow the electrode to recover complete sensitivity, before performing the calibration procedure.

The calibration procedure must be accomplished having the sensor and the MicroChem®2 connected and powered.

WARNING

6.1 Calibration Procedure

When the instrument is powered up or when a channel is changed, the following message is displayed:

-calib-

To access the calibration procedure press the button MENU and insert the password, as shown in the diagram at Paragraph 6.1.2.
If problems are encountered during the calibration procedure, pressing the END key the calibration procedure is aborted and the display returns to the main menu.

If the calibration procedure is aborted, the read out of value may become unreliable.

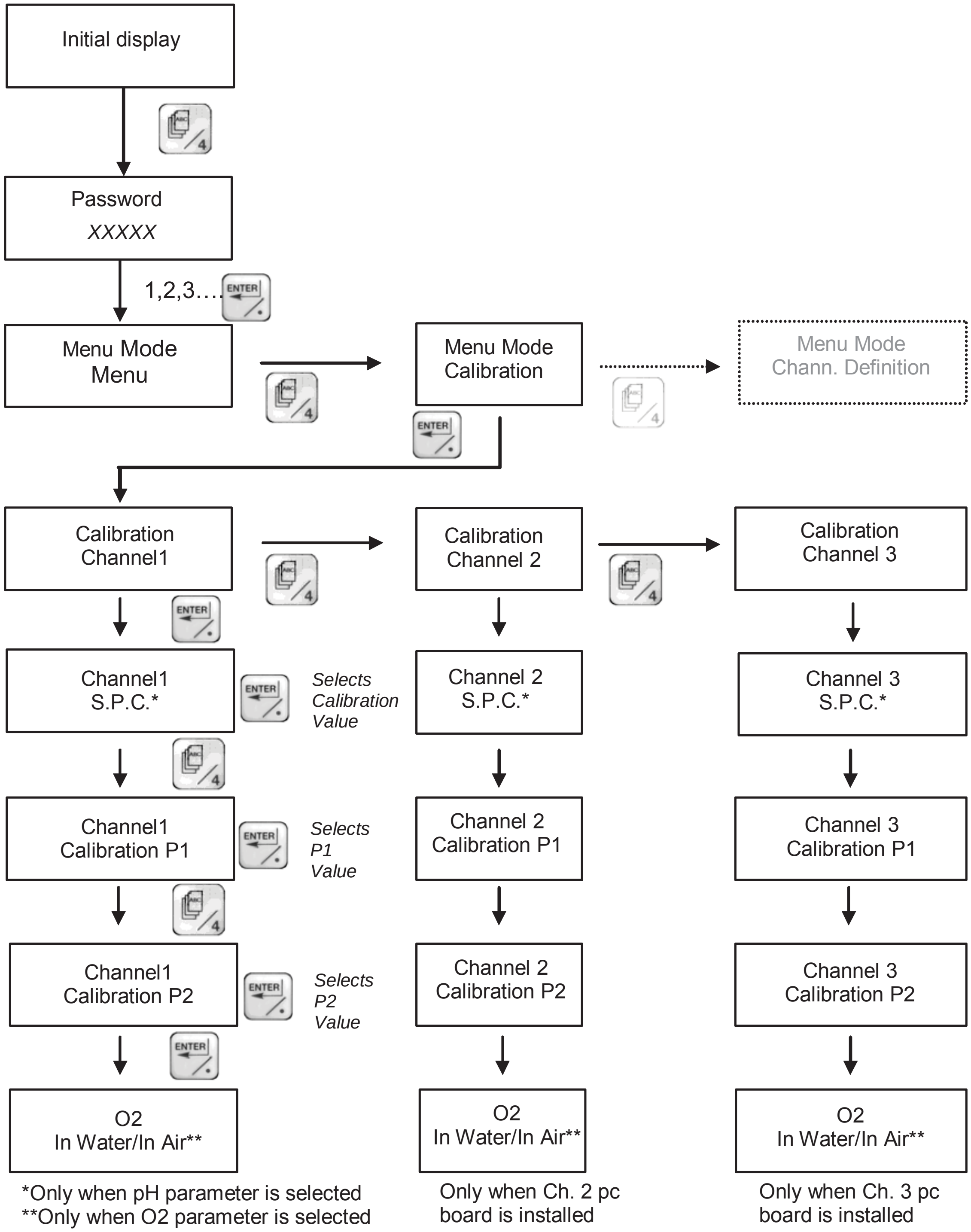
WARNING

6.1.1 Calibration Menu

Calibration menu allows a dual point calibration procedure for the analyzers. In every dual point calibration, the first number (P1) is the lower value point, and the second (P2) is the higher value point. The instrument has P1 and P2 values assigned by default, as shown in the table 18. P1 and P2 values can be changed by the user and have to be distant enough. Single point calibration (S.P.C.) is available for pH analyzer. For O2 analyzer two calibration procedures are available: calibration in air and calibration in water.

Parameter	**P1 point value**	**P2 point value**
pH	7.00	4.00
mV	-500	+500
O2	0.00	10.00 (in water)
O3	0.00	1.00
Cl	0.00	1.00
CD	0.00	1.00
T	0.00	100.00
mA	4.00	20.00
Br	0.00	1.00

Table 20 - Default calibration values



6.1.2 pH Sensor Calibration

The calibration procedure is necessary to standardise the sensor sensitivity.
The double point calibration gives the maximum accuracy because it allows to set both the slope and the offset of the curve giving displayed pH value as a function of the mV from the probe (sensitivity), pH = f (mV).

The first point can be calibrated by 7 pH buffer solution and the second point can be calibrated by 4 pH buffer solution. Capsules for buffer solution's preparation can be optionally supplied by STWP; however the operator can use other commercially available buffer solutions.

6.1.2.1 Double point calibration

The calibration procedure involves a series of operation on the pH probe and the transmitter. The following description indicates step by step the calibration procedure, with the buffer solution supplied by STWP.

To operate the calibration the following material is required:
- two plastic or glass beakers
- capsules for buffer solution pH 7 and pH 4
- de-mineralised water

BUFFER SOLUTIONS PREPARATION

Severn Trent Services optionally supplies a calibration kit (P/N 1T141B008U02)

50 capsules of standard buffer solution pH7
50 capsules of standard buffer solution pH4
50 capsules of standard buffer solution pH9

Each of these capsules is suitable to prepare 100 ml of solution.

If the sensor is new and has been dry stored, leave it immersed in water for 24 hours to allow the hydration of the glass sensitive membrane and of the porous diaphragm. If it has been wet stored half an hour is enough for the stabilization.

Prepare the buffer solution in volumetric flasks: for the preparation of each buffer solution put one capsule into the flask. Add about 100 ml of distilled water in the flask and stir carefully till the capsule is completely dissolved. Put the two standard buffer solutions (pH 7 and pH 4) in two beakers in a sufficient amount to cover the sensor. Wash the probe with de-mineralised water, dry it and dip it in the standard pH 7 buffer solution. Stir the probe gently in the solution to decrease the stabilization time.

1. Press the MENU key to enter the Instrument Calibration submenu and enter the CALIBRATION menu and then the channel of the pH probe. The display will show:

X	X	.	X	X		p	H			2	3	.	5	°	C
P	1	:							Y	Y	.	Y			

P1 indicates the first point of calibration at HIGHER pH (pH 7). XX.XX is not a REAL pH value, but it shows when stability of measure has been reached. YY.Y is a value set at the last calibration and can be freely modified according to the chosen buffer solution.

2. Press ENTER and insert the correct value. Wait 3 minutes after the measure in XX.XX has stabilised (XX.XX is stable).
3. Press ENTER to save the value (press END if you don't want to save the value).
If the following message appears: **-Bad Input!-**
It means the buffer solution is bad since the mV generated are too close.
4. Pass on to the second point (P2) of calibration pressing the MENU key. Take the sensor out of the pH 7 standard buffer solution, rinse it thoroughly with de-mineralised water, dry it and immerse it in the pH 4 buffer solution. Stir the probe gently in the solution to decrease the stabilization time.
5. Wait till the value in XX.XX is stabilized (XX.XX is stable) and correct the pH value in YY.Y.
6. Confirm by pressing the ENTER key. Previously stored values are overwritten in non volatile memory.
7. To start the measure press the END key and the display will show the actual measured value.

6.1.2.2 Single point calibration (S.P.C.)

The single point calibration may be performed ONLY IF A DOUBLE POINT CALIBRATION HAS ALREADY BEEN PERFORMED. The single point calibration is a fast procedure to correct the sensitivity of an instrument leaving it working in field; however it's less accurate than the double point calibration and must be performed as near as possible to the pH value of the process liquid. The single point calibration corrects the intercept of the pH = f(mV) curve, but doesn't vary its slope.

To perform the single point calibration:

1. Measure the pH value of the process fluid near the location of the sensor (if it is constant during the time interval needed for the calibration).
2. Insert the pH value in YY.YY. Entering the Calibration menu the following display will appear:

X	X	.	X	X		p	H			2	3	.	5	°	C
p	H		S	P	C	:		Y	Y	.	Y	Y			

When a double point calibration is performed the S.P. C. value is forced to 0.00.

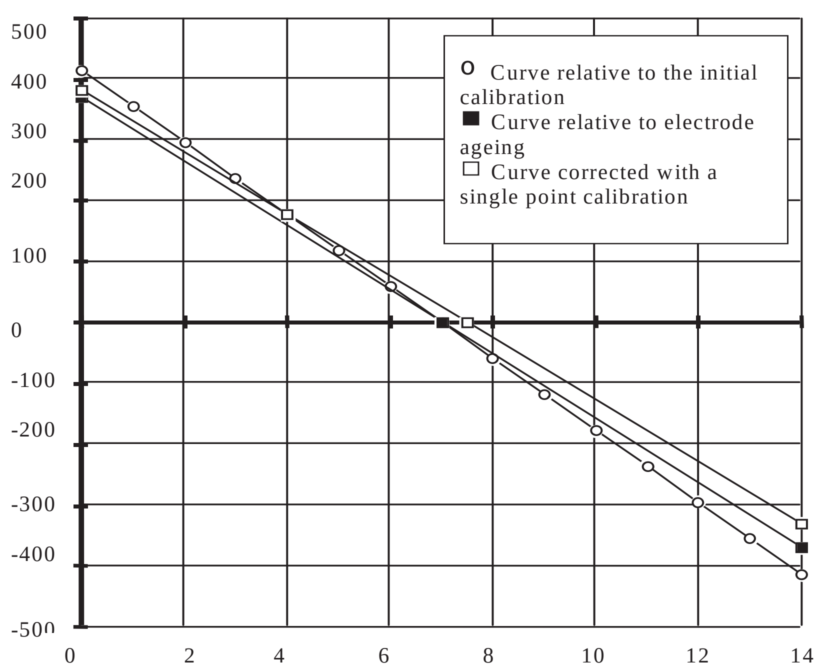


Figure 17 - pH Calibration curves examples

NOTE: Single point calibration corrects the sensitivity in the zone where the correction is made. It is therefore necessary to operate single point calibration as near as possible to the process fluid pH value.

IMPORTANT: THESE CURVES ARE ONLY A THEORETICAL REPRESENTATION, NOT BASED ON EXPERIMENTAL VALUES.

6.1.3 ORP Sensor Calibration

The calibration procedure is necessary to standardize the sensor sensitivity. The double point calibration gives the maximum accuracy because it allows to set both the slope and the offset of the curve giving displayed ORP value as a function of the mV from the probe (sensitivity).

STWP does not supply ORP buffer solution, they are however easily available on the market.
The calibration of ORP analyzer is not usually required, however the two point calibration procedure is foreseen in the transmitter software.

NOTE: Calibration procedures are different if the arrangement “oxidation potential with negative value” or “oxidation potential with positive value“ is used. Both are described in the following pages.

The calibration procedures involve both the electronic transmitter and the sensor. The following description indicates step by step the double point calibration procedure:
To operate the calibration the following material is necessary:

- two plastic or glass beakers
- standard ORP solutions

Put the two standard ORP solutions in two beakers in a sufficient amount to cover the sensor. Wash the probe with de-mineralised water, dry it and dip it in the first buffer solution. Stir the probe gently in the solution to decrease the stabilization time.

6.1.3.1 "OXIDATION potential with NEGATIVE values" arrangement

P1 will be the value of the oxidant standard solution, and P2 the value of the reducing standard solution. In case both the standard solution have the same sign, P1 will be the standard solution with the lower value.

Press the MENU key to enter the Instrument Calibration submenu and enter the CALIBRATION menu and then the channel of the ORP probe. The following display will appear:

X	X	.	X	X		R	X			2	3	.	5	°	C
P	1	:							Y	Y	.	Y			

P1 indicates the first point of calibration. XX.XX is not a REAL value, but it shows when stability of measure has been reached. YY.Y is a value set at the last calibration and can be freely modified according to the chosen buffer solution. Press ENTER and insert the correct value. Wait about 3 minutes after the measure in XX.XX has stabilised (XX.XX is stable), then press ENTER to save the value (press END if you don’t want to save the value).

Pass on to the second point (P2, higher value) of calibration pressing the button MENU. Take the sensor out of the first standard solution rinse it thoroughly with de-mineralised water, dry it and immerse it in the second standard solution. Stir softly but continuously the probe: in this way a shorter stabilization time would be required.

Wait till the measure is stabilized (no more variations of XX.XX shown on the display). If needed, correct the ORP value pressing the ENTER key and inserting the correct value, according to the second buffer solution ORP value. If you want to save these values push the ENTER key. If you don't want to save above mentioned calibration parameters press END. If the ENTER key is pressed new calibration data are overwritten to previously stored values in not volatile memory.

To start the measure press the END key and the display will show the measured value.

NOTE: The calibration procedure can be performed also at two values which are outside from the measuring range selected, depending on the buffer solutions which are available for the calibration.

6.1.3.2 "OXIDATION potential with POSITIVE values" arrangement

Calibration is similar to the previous one but P1 is the value of the reducing standard solution, and P2 the value of the oxidant standard solution. In case both the standard solution have the same sign, P1 will be the standard solution with the lower value.

6.1.4 Chlorine/ Chlorine Dioxide/ Ozone/ Bromine - KC4000 Cell or CL4000 Probes

The calibration procedure is necessary to stabilize the sensor sensitivity. The calibration procedure sets both the slope and the offset of the curve giving the chlorine/chlorine dioxide/ozone/bromine concentration as a function of the µA from the cell/probe (sensitivity).

Severn Trent Services analyzers allow an easy two point calibration and the two points can be freely chosen, provided they are distant enough and inside the selected measuring range. In this way the instrument is given all the parameters it needs to fix the calibration curve. The calibration procedures involve both the transmitter and the sensor.

If the cell is new or recently cleaned, leave it working for 24 hours so that the electrodes can gain the correct sensitivity.

The following description indicates step by step the calibration procedure:

1. **P1 — Low Calibration:** Enter the Instrument Calibration submenu and using the menu key, change the channel for calibration and press ENTER until the following display appears (Refer to Section 6.1.1):

X	X	.	X	X	X	C	L[1]			2	3	.	5	°	C[2]
P	1	:							Y	Y	.	Y			

NOTES:
1 = The name of the sensor chosen in the channel definition will appear where Cl is displayed.
2 = The temperature will appear if a temperature sensor is installed

P1 indicates the first point in calibration (the lower point). XX.XXX is the measured parameter concentration reading. This reading is based upon calibration parameters previously stored. XX.XXX serves as an indication of the stability of the measure. 0.000 is a default ppm value recommended but can be freely changed. YY. Y is a value set at the last calibration and can be freely modified.

NOTE: P1 calibration is only necessary for the initial calibration to set the zero point. When performing a recalibration it is only necessary to RESET the P2.

2. To zero the instrument, supply sample water from a point prior to adding the disinfection agent. In the case of chlorine measurement a dechlorinating filter can be inserted in the sample line to remove chlorine during the calibration procedure. Turn on the supply of zero process water to the measuring cell. Let the system stabilize until XX.XXX is stable (15-20 minutes can be required).
3. Take a water sample and perform an analysis to determine residual concentration.
4. Press enter and input YY.Y value according to the measured sample value (Typically 0.00)
5. Confirm entered data with ABC key

6. **P2 — High Calibration:** Press the ABC button to pass on the second point (P2) calibration:

X	X	.	X	X	X	C	L[1]			2	3	.	5	°	C[2]
P	2	:							Y	Y	.	Y			

NOTES:
1. The name of the sensor chosen in the channel definition will appear where CL is displayed.
2. The temperature will appear if a temperature sensor is installed.

P2 – High Calibration – P2 indicates the second point in the calibration (the higher point)
XX.XXX is the measured parameter concentration reading. This reading is based upon calibration parameters previously stored. XX.XXX serves as an indication of the stability of the measure. YY.Y is a value set at the last calibration and can be freely modified.

7. Allow a sample flow to the cell (with a concentration as near as possible to the chosen full scale) and let it stabilize (stabilization time depends on the plant configuration, 10 – 15 minutes may be required).

8. Take a water sample and perform an analysis to determine residual concentration.

9. Press ENTER and insert the correct high calibration point value (according to the value on step 8).

10. Press ENTER again to confirm. Press END key to return to measure mode.

WARNING

It is advisable to repeat the calibration after 24 hours and after 2/3 days.

6.1.5 Dissolved oxygen calibration

The calibration procedure is necessary to standardize the sensor sensitivity. The calibration procedure allows to set both the slope and the offset of the curve giving the dissolved oxygen concentration as a function of the µA from the cell (sensitivity). This analyzer allows an easy two point calibration and the two points can be freely chosen; usually the calibration is performed at 0 ppm O2 and either at the saturation point of water in the conditions (altitude, temperature) of the process or at the sample dissolved oxygen concentration measured with a O2 meter. In this way the instrument has all the parameters to fix the calibration curve.

The calibration procedures involve both the transmitter and the sensor. The following description indicates step by step the calibration procedure:

Prepare the sensor as described in Instruction Bulletin T17DO4000, then leave it working for approx. 2 hours so that the system can gain the correct sensitivity.

WARNING

When the sensor is disconnected from the transmitter and then reconnected, it polarises and generates a signal that is much higher than normal signal. The transmitter may in this case indicate a fixed value higher than the f.s. value. The reading becomes normal when the input signal returns to normal limits.

WARNING

It is advisable to repeat the calibration after 24 hours and after 2/3 days.

6.1.5.1 Calibration in water

Press the MENU key to enter the Instrument Calibration submenu and enter the CALIBRATION menu and then the channel of the ORP probe. Select “Calibration IN WATER”. The following display will appear:

X	X	.	X	X		O	2			2	3			°	C
P	1	:							Y	Y	.	Y			

P1 indicates the first point in calibration, XX.XX is a dissolved oxygen concentration reading. This reading, is not a REAL value, but it's based upon calibration parameters previously stored. XX.XX serves as an indication of the stability of the measure. 0.00 is a default ppm value and can be freely changed. YY.Y is a value set at the last calibration and can be freely modified.

Fill a beaker with distilled water and add about 1 g of sodium sulphite (Na_2SO_3). Let the salt dissolve and immerse the probe being careful not to damage the membrane and the electrode. Let the measure stabilise and confirm the zero ppm pushing the ENTER key.

If you want to save the value press ENTER. If you don't want to save the above mentioned calibration parameters press END. So forth, previously stored parameters aren't destroyed and they remain still valid for the computation (if the range setting has not been changed).

If **-Bad Input!-** appears, a second calibration attempt should be made. The probe may need additional time to stabilize. If the **-Bad Input!-** continues, check the probe membrane, connections, channel definitions, etc.

Pass on to the second point (P2) of calibration pressing the button MENU. Immerse the probe in the sample and wait till XX.XX is stabilized. Measure the dissolved oxygen concentration in the sample. Correct the displayed ppm value according to the O_2 value found in the sample.

Alternatively perform a calibration in water saturated with air: fill a vessel with distilled water and inject air for at least 10 minutes. Keep the dissolved oxygen probe immersed in the solution (be careful not to damage membrane and electrode). Once the reading has stabilized, read the temperature of the process from the instruments display. Table 21 can be used to determine the concentration of the saturated solution by looking up the current altitude and sample temperature. Once XX.XX is stable, enter the correct value in YY.YY and press the Enter key to save the result.

T °C	T °F	L.M. Sea Level	120m 390ft	240m 779ft	365m 1185ft	490m 1591ft	610m 1980ft	750m 2435ft	850m 2760ft	975m 3166ft	1100m 3571ft
0	32	14,60	14,40	14,10	13,90	13,70	13,50	13,20	12,90	12,70	12,50
1	33,8	14,20	14,00	13,80	13,60	13,30	13,10	12,90	12,60	12,40	12,20
2	35,6	13,90	13,70	13,40	13,20	13,00	12,90	12,60	12,30	12,10	11,80
3	37,4	13,50	13,30	13,10	12,90	12,70	12,40	12,20	12,00	11,80	11,50
4	39,2	13,20	12,90	12,70	12,50	12,30	12,10	11,90	11,70	11,40	11,20
5	41	12,80	12,60	12,40	12,20	12,00	11,80	11,60	11,40	11,10	10,90
6	42,8	12,50	12,30	12,10	11,90	11,70	11,50	11,30	11,10	10,90	10,70
7	44,6	12,20	12,00	11,80	11,60	11,40	11,20	11,00	10,80	10,60	10,40
8	46,4	11,90	11,70	11,50	11,30	11,10	10,90	10,70	10,50	10,30	10,10
9	48,2	11,60	11,40	11,20	11,10	10,90	10,70	10,50	10,30	10,10	9,90
10	50	11,30	11,10	10,90	10,80	10,60	10,40	10,20	10,00	9,90	9,70
11	51,8	11,10	10,80	10,60	10,50	10,30	10,10	9,90	9,70	9,60	9,40
12	53,6	10,80	10,60	10,40	10,30	10,10	9,90	9,70	9,50	9,40	9,20
13	55,4	10,60	10,30	10,20	10,00	9,80	9,70	9,50	9,40	9,20	9,10
14	57,2	10,40	10,10	10,00	9,80	9,70	9,50	9,30	9,20	9,00	8,90
15	59	10,20	9,90	9,80	9,60	9,50	9,30	9,10	9,00	8,80	8,70
16	60,8	10,00	9,70	9,60	9,40	9,30	9,10	8,90	8,70	8,60	8,50
17	62,6	9,70	9,50	9,40	9,20	9,10	8,90	8,70	8,60	8,40	8,40
18	64,4	9,50	9,40	9,20	9,10	8,90	8,80	8,60	8,50	8,30	8,20
19	66,2	9,40	9,20	9,00	8,90	8,70	8,60	8,40	8,30	8,10	8,00
20	68	9,20	9,00	8,80	8,70	8,50	8,40	8,20	8,10	7,90	7,80
21	69,8	9,00	8,80	8,60	8,50	8,30	8,20	8,00	7,90	7,70	7,60
22	71,6	8,80	8,70	8,50	8,40	8,20	8,10	7,90	7,80	7,60	7,50
23	73,4	8,70	8,50	8,30	8,20	8,00	7,90	7,70	7,60	7,40	7,30
24	75,2	8,50	8,30	8,10	8,00	7,80	7,70	7,50	7,40	7,20	7,10
25	77	8,40	8,20	8,00	7,80	7,70	7,60	7,40	7,30	7,10	7,00
26	78,8	8,20	8,00	7,80	7,70	7,50	7,40	7,20	7,10	6,90	6,80
27	80,6	8,10	7,90	7,70	7,60	7,40	7,30	7,10	7,00	6,80	6,70
28	82,4	7,90	7,70	7,60	7,40	7,30	7,20	7,10	6,90	6,80	6,70
29	84,2	7,80	7,60	7,50	7,30	7,20	7,10	7,00	6,80	6,70	6,60
30	86	7,60	7,40	7,10	7,10	7,00	6,90	6,80	6,60	6,50	6,40

Table 21 – DO concentration in air saturated water as function of temperature and altitude

NOTE: * This table is referred to distilled water with no chlorides
* The atmospheric pressure at sea level is considered at 760mmHg
* The air is considered water saturated
* The error, using dry air, is negligible:

Example: at 25°C at sea level with relative humidity of 50%, the error is 0.15 ppm O_2, and with dry air the error is 0.3 ppm O_2.

6.1.5.2 Calibration in air

From the CALIBRATION menu, choose “Calibration IN AIR”. Calibrate P1 (zero) as described before.

Pass on to the second point (P2) of calibration pressing the button MENU. The following display will appear:

Y	Y	.	Y	Y		O	2			1	4	.	9	°	C
X	X	.	X	X			<	O	2	>					

Where YY.YY is the value of saturation of oxygen in air at the temperature measured by the thermo-resistance and at the set altitude.

Proceed in this way for the calibration IN AIR of P2: lift the O2 sensor and fix it suspend in air, keeping it over a vessel containing water (the sensor must not be in contact with the water). This operation allows to simulate a condition of "air saturated with water". Avoid direct exposition of the sensor to the sunlight that may increase too much the temperature on the point where the temperature compensation element is inserted. Wait 5' that the value in XX.XX is stable, then confirm the value determined via software displayed in YY.YY pressing ENTER. To pass to the display mode press the END key.

6.1.6 Calibration of Sensors with a mA input (e. g. Conductivity)

The calibration procedure is necessary to maximize sensor accuracy. The calibration procedure is very similar to the calibration procedure of any other of the sensors attached to the MicroChem®2.

The calibration procedure sets both the slope and the offset of the curve giving the sensor concentration (in chosen units) as a function of the mA input from the sensor.

Two calibration solutions are required – a low (P1) and a high (P2). The actual calibration procedure depends on the sensor used. Detailed below is a description of a typical calibration sequence for the 4-20mA input conductivity probes supplied by Severn Trent Services.

Prepare the two calibration solutions. If the sensor is new or has been stored dry please leave it immersed in water for 2 hours before calibrating. Another calibration is recommended 24 hours later.

1. Prepare the two calibration solutions and put enough of each in a beaker or bottle (it needs to cover the bottom 50 mm (2 inches) of the probe).

2. Press the MENU key on the transmitter. Enter the password and then press Enter to get to the Calibration submenu. Enter this screen and use the Menu key to scroll to the channel to be calibrated. Use the Enter key to select this channel. The Menu key can be used to scroll to either the measure P1 (low standard) or P2 (the high calibration standard). Enter the P1 screen. The display will show:

X	X	.	X	X		µ	S[1]			2	3	.	5	°	C
P	1	:							Y	Y	.	Y	Y		

1= Units will depend on those set by the customer – see Section 4.3.1

P1 indicates the first point of calibration at the LOWER concentration. XX.XX is the current value. It is useful as it shows when measurement stability has been reached. YY.YY is the value set at the last calibration and can be freely modified.

3. Place the probe in the P1 calibration standard. Press the ENTER key on the transmitter and insert the correct value. Wait 2 minutes or until the reading has stabilized (XX.XX is stable), then confirm by pressing the ENTER key to save the value or reject by pressing the END key.

4. Proceed to the second point (P2) by pressing the MENU key. Take the probe out of the low standard, rinse it with demineralized water, and put it in the high standard ensuring the bottom 50mm (2 inches) of the probe is covered. Wait 2 minutes or until the measured reading (XX.XX) has stabilized and type in the correct standard value in YY.YY. Confirm by pressing Enter or reject by pressing End.

5. To start the measurement press the End key repeatedly until you are in run mode, and put the probe back into the sample stream.
   If at anytime during the calibration procedure the following message appears:

   -Bad Input!-

   It means there was not enough difference in signal seen between standards. This message can be overwritten by pressing the END key. However the standards should be replaced and the probe recalibrated.

7 START UP

WARNING

If the equipment is used in a manner NOT specified by Severn Trent or NOT included in the present document, the protection provided by the equipment may be impaired.

CAUTION

Transmitter casing must be properly closed before being powered up

Before proceeding with the start-up, it is recommended to verify the following points:

- Verify that the installation has been performed according to the section 3.3 of the present manual.
- Verify that the power supply is in accordance with the value indicated in the instrument label.
- Verify that the electrical wiring has been properly completed according to the recommendations mentioned in section 3.4 of the present document.
- Verify that power-up of the instrument will not cause any uncontrolled action related to the items eventually connected to the output signals (i.e. dosing pumps, operating valves, fume extractors).
- Verify that the probes connected to the instrument are properly installed and wired according to the instructions indicated in the specific probe instruction manual.

7.1 Preliminary operations

7.1.1 Getting started

Power the transmitter up and perform the following steps:

1. Turn on power supply;
2. Enter Configuration menu and set the desired language for the display messages;
3. If the displayed measured value is not in agreement with the connected sensor(s) enter the Channel Definition menu, and set, for each installed channel, the correct type of measure (Refer to Sect. 4.3).
4. Verify that the selected measuring ranges correspond to the desired values; if not, modify ranges as needed.
5. If the alarm levels are required at values that are not the 10 % and 90 % of measuring range, enter the Alarms menu and set Low Alarm and High Alarm level as required. (Refer to Sect. 4.4.3).
6. Verify that all Configuration parameters are set as required (See Sect. 4.4 to 4.4.1.3).
7. If a Dissolved Oxygen Sensor (O2) is installed, set the installation altitude value, to allow automatic calibration in air.
8. Once the sensor(s) sensitivity is stabilised the calibration procedure(s) has to be performed to standardize the transmitter together with the connected sensor(s).
9. During the first 4 days of operation, it is suggested to verify every day the reading of the analyzer, and repeat calibration if necessary.
10. Now the analyzer is in operation. It is important to repeat periodically the maintenance procedures detailed in the instruction manual pertinent to each sensor.

7.1.2 Personalization of Parameters

1. If the Input / Output digital contacts are used, enter the Configuration menu and set the NO or NC status of the contact as desired.
2. It is important to remember that any device connected to the digital output must be arranged in order to operate in fail safe condition.
3. If the Serial Communication option has been selected, enter the Configuration menu and set the desired instrument address, baud rate and selected communication port.
4. Select the desired engineering unit for the temperature indication.
5. If it is desired to operate the controller with the average value of 2 or 3 identical sensors, select PID in the Channel installation menu.
6. If it is desired that the transmitter calculates the difference between two identical sensors input values, set a value in the "Delta" parameter.
7. If required, select a dumping value for each channel input.
8. Modify the "Password" in the Configuration menu, if it is desired to set a personalised access code.

7.2 Controller PID tuning

The PB, TR, and TD constants are preset to the default values shown in Table 7. If desired the control action setting can be optimized by using a trial and error method as outlined below.

1. Set process to approximately normal conditions in MANUAL.
2. Preset constants to some acceptable starting point for the process. For example

   PB = 500
   TR = 100
   TD = 0
3. Switch Controller to AUTO mode.
4. Decrease the PB setting to ½ the previous value. Then, alter the set point 2% by pressing one of the set point pushbuttons.
5. Check that the process indication value does not oscillate.
6. Continue to decrease the PB setting by a factor of 2, altering the set point between steps until a point is reached where process cycling is just evident. Then increase the PB setting by a factor of 2.
7. Introduce Automatic Reset slowly by decreasing TR until cycling starts.
8. Increase TR to approximately 1,5 times the value obtained in 7) above.

When PID tuning constants have been selected, the controller is ready for on-stream operation. Optional PID tuning methods may be desired for slow response processes. Consider recording all tuning parameters in the instruction manual for future reference should it become necessary to reprogram the instrument.

8 MAINTENANCE

MicroChem®2 housing can be externally cleaned with a cloth slightly wetted with alcohol and water, paying attention not to damage the keyboard.

Do not use acids or chemicals solvents for MicroChem2 cleaning.

CAUTION

8.1 Periodical operations

All analyzers need cleaning of the sensors at periodical intervals that depend on type of sensor and process characteristics. For further details refer to the specific sensor Instruction Manual. The analyzers also need periodical check of sensitivity and calibration if required.

8.1.1 Automatic sensitivity check during dual point calibration

During dual point calibration, MicroChem2 performs an automatic sensor sensitivity check. If the sensitivity is too low the display will show the message “Bad In”. Refer to the instruction manual. pertinent to each specific sensor for details on how to fix the problem. If the message “Fault” appears the signal generated by the sensor is abnormally high. Refer to the instruction manual pertinent to each specific sensor for details on how to fix the problem.

8.1.2 Sensor signal check

The signal generated by the sensor and by the temperature sensing element can be directly read (in μA or mV and in •) on MicroChem2 display simply by entering the Analog I/O, input signals submenu, under Instrument Test submenu. This is a very easy way to define if the sensor is correctly working just verifying its signal and comparing it to a lab analysis of the measured value. See the pertinent instruction manual for nominal signal to be expected from each type of sensor.

8.1.3 Other checks

Accessing to the menu at section INSTRUMENT TEST, is possible to verify the instrument features. Refer to section 4.4.1.4. for further details.

9 ERROR MESSAGES & TROUBLESHOOTING

Different levels of messages are generated by the instrument at need.

9.1 Messages

At power up, the instrument shows the following sequence of messages:

"MicroChem II"
"S.Rel...."
"Transmitter"

9.1.1 Operation messages

Messages displayed during operation to clarify what MicroChem2 is doing.

"Loading default database"

is shown when a reset has been performed. After few seconds the instrument goes to normal display mode.

"-calib-"

is shown when the instrument is powered up and when a Channel has been changed. After some seconds the instrument goes to normal display mode.

"---wash---"

flashing is displayed when the instrument is performing a cleaning sequence. "---wash---" is alternated to a value that is the last measure before the starting of the cleaning sequence.
Both the displayed measure and the 4-20 mA output signals are frozen at that last value.

"Access denied"

is displayed when the inserted password is not correct.

"password"

is displayed when the menu key is pressed: the correct password must be entered in order to access the menu.

9.1.2 Error messages

These messages are displayed when something is not correct in the unit.

"Error, no analog input"

is displayed when analog I/O pc board are missing (or contact in their connectors is failing).

"Bad In"

is displayed if the input signal generated by the sensor is too low, that is the sensitivity is too low.

"Fault"

is displayed if the signal generated by the sensor is too high.

"RTFault"

is displayed when the Thermo resistance is faulty and the instrument is currently using the default temperature value

"Red LED lit (Watchdog)"

When Red LED watchdog is lit it means the microprocessor circuit is faulty.

9.2 Alarms page

It is accessed by pressing the Enter key in display mode.

If no alarm or no abnormal condition is present the display will show nothing.

The following messages are displayed with the indicated meaning:

A1L = low alarm on channel 1
A2L = low alarm on channel 2
A3L = low alarm on channel 3

A1H = high alarm on channel 1
A2H = high alarm on channel 2
A3H = high alarm on channel 3

AML = low alarm on average value

AMH = high alarm on average value

Ch1 Bad = Bad value on channel 1
Ch2 Bad = Bad value on channel 2
Ch3 Bad = Bad value on channel 3

=•= = the value set for delta has been overcome

AVE = the instrument is computing the average of two measures (same parameter) and the averaged value is indicated on the first line of the display instead of the measure of the first channel

BLK = When CCI in OR parameter is set to YES it means that output(s) is (are) frozen because either CCI1 or CCI2 or both is (are) closed.

RUN = When CCI in OR parameter is set to YES it means that output(s) is (are) working (not frozen) because CCI1 and CCI2 are both open.

9.3 Troubleshooting

SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
RT fault	Faulty thermistor or Incorrect connection	Replace thermistor assembly or Make correct connections
Low	Incorrect Calibration	Repeat calibration
Watchdog led lights	General fault	Super-Reset
Menu access denied	Wrong password	Super-Reset
Unstable measure	Incorrect Calibration	Repeat calibration
Erratic or absent analog output	Incorrect pc board or CPU calibration	Super-Reset or Replace pc board
Inaccurate PID regulation	PID parameters erratic configuration	Control PID parameters
Instrument doesn’t light up	Boken fuse or erratic electrical connections	Control fuse or electrical connections
Erratic measure reading	Incorrect electrical connection Incorrect calibration CPU fault	Control electrical connections Perform calibration Super-Reset

9.4 Super-Reset

Super-Reset procedure returns MicroChem®2 to the factory default. Alarms, timers, password, digital output settings, engineering units and all other parameters have to be verified or reconfigured and channels calibration must be operated before using it in the process.

Super-Reset has to be operated:

- After an hardware upgrade
- To return password at default “00000”
- When a software problem occurs
- When Watch Dog led lights

How to operate:

- Switch the power supply OFF
- While keeping CANCEL button pressed, switch the power ON
- “Loading default database” will appear on display
- MicroChem2 is reconfigured to the default values

10 PARTS LIST

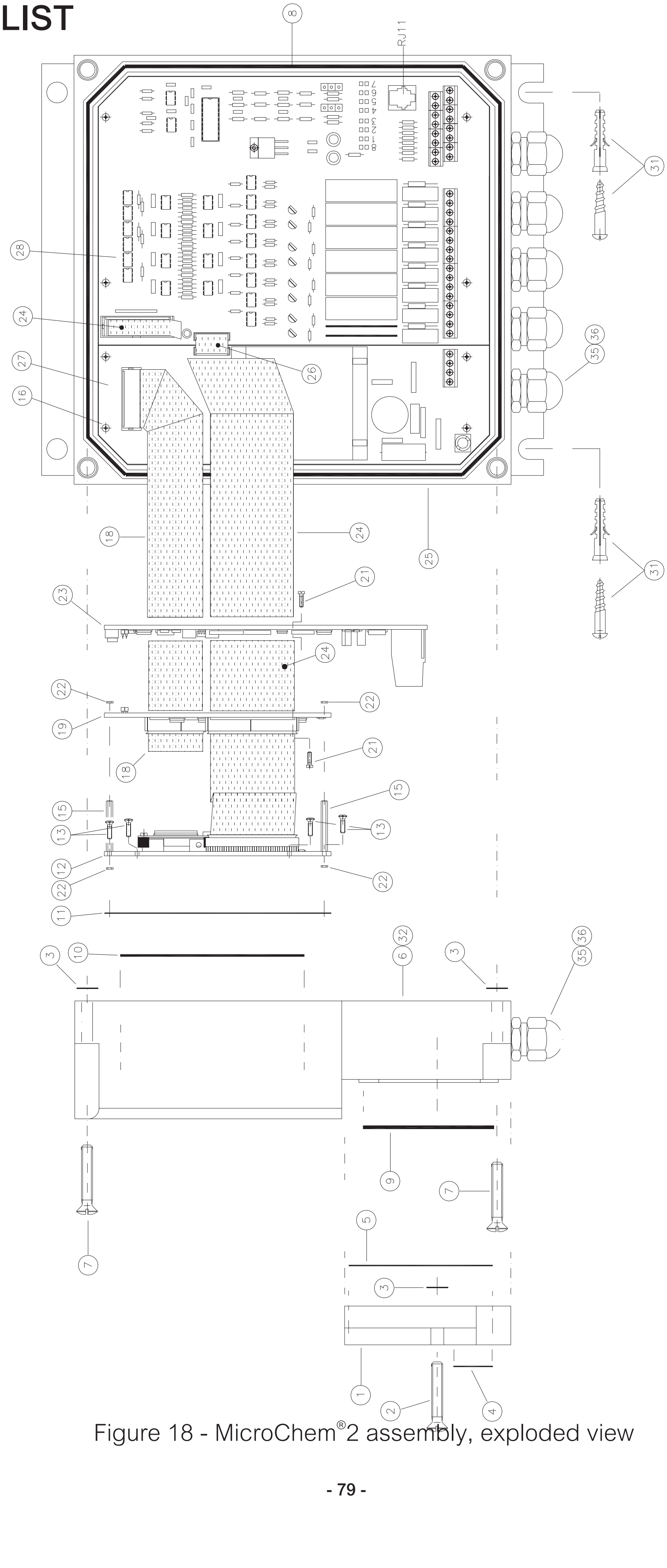


Figure 18 - MicroChem®2 assembly, exploded view

10.1 MicroChem®2 assembly, Parts List

ITEM	DESCRIPTION	PART NUMBER
1	Wire terminal cover	1T324C018U01
2	Screw M5 x 20	1T005L007T60
3	"O" Ring (Buna)	101A702U01
4	Warning label	1T338D152U01
5	Wiring label	1T338D151U02
6	Front cover	1T612B057U01
7	Screw M5 x 25	1T005L008T60
8	"O" Ring (Buna)	1T101A014U01
9	"O" Ring (Buna)	1T101A015U01
10	"O" Ring (Buna)	1T101A016U01
11	Membrane keypad	1T338D153U01
12	Display board	1T686B126U01
13	Screw with auto-thread mod. KB 30x10	1T094L001U06
14	/	/
15	Spacer length 22 mm	1T104D089U01
16	Screw with auto-thread mod. KB 30x8	1T094L001U05
17	/	/
18	Flat cable CPU/ Power supply board	1T677B117U01
19	CPU board	1T686B128U06
20	/	/
21	Screw M3 x 6	1T003E013T60
22	Screw nut M4 nylon	1T082A105N00
23	I/O analog board	1T686B125U01
24	Flat cable I/O CPU	1T677B118U01
25	Bottom enclosure	1T612B058U01
26	Flat cable Power supply I/O analog board	1T677B115U01
27	Power supply board, 115 VAC	1T686B123U11
	Power supply board, 230 VAC	1T686B123U10
28	Digital I/O board + expanded function board RS 232	1T686B129U22
28	Digital I/O board + expanded function board RS 422	1T686B129U24
28	Digital I/O board + expanded function board RS 485	1T686B129U23
29	Cable gland PG11	1T104B018U02
30	PG11 insert disk	1T114C006U03
31	Mounting kit transmitter box	1T614B017U01
	PIC for Mod. T17MD4000, controller	1T699B018U01
	PIC for Mod. T17ME4000, swimming pool controller	1T699B019U01
	Fuse F1 – 230 V~	1T151A003U06
	Fuse F1 – 115V~	1T151A003U09

11 SERIAL COMMUNICATION

NOTE: This section applies only to instruments equipped with the optional Serial Communication P.C. Board.

11.1 Standard of Communications

Two digital communication standards are supported by the serial communication board of MicroChem®2, one port is an RS232 serial interface and the other is an RS 422/485 serial interface. Only one port at a time can be activated, and the selection of the desired standard is made via software at the Configuration Menu.

The Factory default setting is RS 422/485, which allows up to a maximum of 32 instruments to be connected to the same Data-link, where each instrument must have a unique address number ranging from 00 to 31 (Factory setting is 00).

The RS 232 standard can be selected for a peer to peer communication mode.
Transmission speed can be adjusted between 1200 and 28800 baud in the Configuration Menu; default setting is 28800, asynchronous by character.

One character can be defined as either one of the following two modes:

Mode 1 - (Standard PC mode - Default setting by Factory):
- 1 Start bit;
- 8 Data Bits – the Least Significant Bit (LSB) is transmitted first;
- 1 Stop Bit.

Mode 2 - (Optional setting):
- 1 Start bit;
- 8 Data Bits – the Least Significant Bit (LSB) is transmitted first;
- 1 Even Parity bit
- 1 Stop Bit.

NOTE: When operating in RS232 mode, the character definition must be set as Mode 1.
Mode 2 is active optionally only when operating in RS485.
To modify this selection, enter the Configuration menu and select the RS485 mode: the menu will ask to select Mode 1 or Mode 2. When Mode 1 is selected and the communication is to work in RS232, remember to set RS232 again in the menu after having selected "Mode 1" from the RS485 menu.

11.1.1 Software characteristics

1. All transactions are initiated by the Host: The MicroChem2 can only work as a ***responder*** to Host commands (Interrogate or Change).
2. All MicroChem2 begin their response within 10 ms after the end of the transmission by the Host, otherwise a faulty transmission may be assumed.
3. The maximum number of data bytes per message is 32 (decimal).
4. Data type are made up of 1 (logical), 2 (integer), 4 (floating point) bytes or string type, with string length bytes, according to Intel Format.

11.1.2 Communication Protocol

The communication protocol requires the Host to initiate all transactions. There are two basic categories of message types: *Interrogate*, which is used to read data from an addressed MicroChem2, and *Change*, which is used to alter a value in an addressed MicroChem2. The addressed instrument decodes the message and provides an appropriate response.

The protocol definitions for the message types are provided in the following table:

Message Field Definition		
Symbol	***Title***	***Definition***
SOH	Start of Header	This character, 7E, denotes the beginning of a message
I.A.	MicroChem®2 Address	The address of the MicroChem2 responding to the transaction. It must be within a range of 00-1F (00-31 decimal).
CMD	Command	Is the operation to be performed or a description of the message that follows the Command-I.A. byte. The Command-I.A. byte has two fields: the Command field (3 bits), and the I.A. field (5 bits). There are the following commands type: Interrogate Change Acknowledge Response The command descriptions are covered in the following section.
NUM	Number	The number of data bytes transferred or requested. The NUM must be in a range of 00-32 decimal.
LO-ADD	Lower Address Bits	The least significant 8 bits of a 16 bit address in the MicroChem2 database (*)
HI-ADD	Higher Address Bits	The most significant 8 bits of a 16 bit address in the MicroChem2 database (*)
DATA		An 8 bit data type
XXXX		Represents a variable number of data bytes
LRC	Longitudinal Redundancy Character	Is a character written at the end of the message that represents the byte content of the message and is checked to ensure data was not lost in transmission. Is the sum of all bytes Modulo 256 of the message not including the SOH character or its own bit setting (LRC)

Table 22 - Message field definition

(*) The addresses of the single variables to be accessed in the MicroChem2 database are listed in the following pages.

11.1.3 Message Types and Commands Description

The types of messages that are sent between the host and the MicroChem2 are formatted as follows:

Host to MicroChem2

1. Interrogate – This message requests up to 20_H consecutively stored bytes, beginning at the specified memory address location of the addressed MicroChem2.
   01111110 E0H + I.A. NUM LO ADD HI ADD LRC

2. Change – This message sends up to 20 bytes of new data to the addressed MicroChem2.
   01111110 A0H + I.A. NUM LO ADD HI ADD Data 1 XXXXXXX Data N LRC

3. Acknowledge – This message signals the addressed MicroChem2 that it's last echoed change message was received correctly; the MicroChem2 performs the change requested.
   01111110 80H + I.A.

MicroChem®2 to Host

1. Response – This message furnishes the data requested by the INTERROGATE command of the Host. It is also used to echo back the previous CHANGE message of the Host.

   01111110 20_H + I.A. NUM LO ADD HI ADD Data 1 XXXXXXX Data N LRC

11.2 Communication Transaction Examples

11.2.1 Transaction A Example

Host requests 9 bytes of data beginning at hexadecimal memory address 1000 from the MicroChem2 at data-link address 03:

1. Host sends **interrogate** message:

01111110	11100011	00001001	00000000	00010000	11111100	
SOH	Command	NUM	LO ADD	HI ADD	LRC	
	+ I.A.					

2. MicroChem2 sends **response** message:

01111110	00100011	00001001	00000000	00010000	XXXX XXXX XXXX	LRC
SOH	Command	NUM	LO ADD	HI ADD	Data 1 ………..Data 9	
	+ I.A.					

11.2.2 Transaction B Example

Host sends two bytes of new data, to be loaded into the MicroChem2 at data-link address 03 beginning at hexadecimal memory address 1000_H:

1. Host sends **change** message:

01111110	10100011	00000010	00000000	00010000	00001000	00001100	11001001
SOH	Command	NUM	LO ADD	HI ADD	Data 1	Data 2	LRC
	+ I.A.						

2. MicroChem2 sends **response** message:

01111110	00100011	00000010	00000000	00010000	00001000	00001100	01001001
SOH	Command	NUM	LO ADD	HI ADD	Data 1	Data 2	LRC
	+ I.A.						

3. Host sends **acknowledge** message:

01111110	10000011
SOH	Command
	+ I.A.

4. MicroChem2 performs the change requested at end of the current program scan.

NOTE: Database address table is shown at the end of this section.

11.3 Serial link signal connection

The MicroChem®2 optional serial communication P.C. Board is equipped with modular telephone RJ11 type jack supporting both for RS 232 and RS 422/485 standards:

RJ11 TELEPHONE SIGNAL CONNECTION JACK LAY-OUT:			
Pin N.	**RS 232**	**RS 422**	**RS 485**
1	GND Ground	GND Ground	GND Ground
2	Rx IN Data transmission from PC	Tx + Data transmission to PC, +	-
3	Tx OUT Data transmission to PC	Tx – Data transmission to PC, -	-
4	-	Rx + Data transmission from PC, +	Tx Rx +
5	-	Rx – Data transmission from PC, -	Tx Rx -
6	GND Ground	GND Ground	GND Ground

Table 23 - RJ11 Jack serial Communication connector pin-out

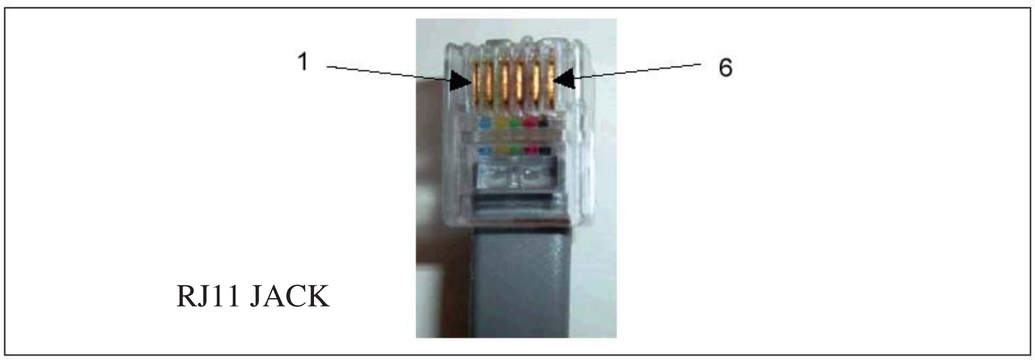


Figure 19 - RJ11 Connector layout

For RS232 and RS485 use shielded cables, two-cores twisted pair wire, section 0.5 ÷ 1.0 mm^2.
For RS422 use shielded cable, 4 cores, twisted pairs wire, section 0.5 ÷ 1.0 mm^2.
Connect shields to the ground shield terminal strip inside MicroChem2.

11.4 Data-link Terminator

The datalink impedance should be 110 Ohm. When the serial communication standard is selected as RS422 or RS485, and more than one MicroChem®2 are installed on the same datalink, it is necessary to activate a terminator resistance, which is available on the serial communication board.

This operation is to be made only on the last MicroChem2 connected on the serial link.
If the host computer serial port is already equipped with a 220 Ohm resistor, then an identical resistor is to be activated in parallel to obtain a 110 Ohm loop impedance. If no such resistor is present on the Host side, then a 110 Ohm resistor is selected on the MicroChem2 serial board.

The terminator resistance selection is made by installing a jumper on JP1 or JP2 for RS422 or RS485 respectively: the 110 Ohm resistor is selected by jumper between pin 1-2, while the 220 Ohm resistor is selected by jumper between pin 2-3.

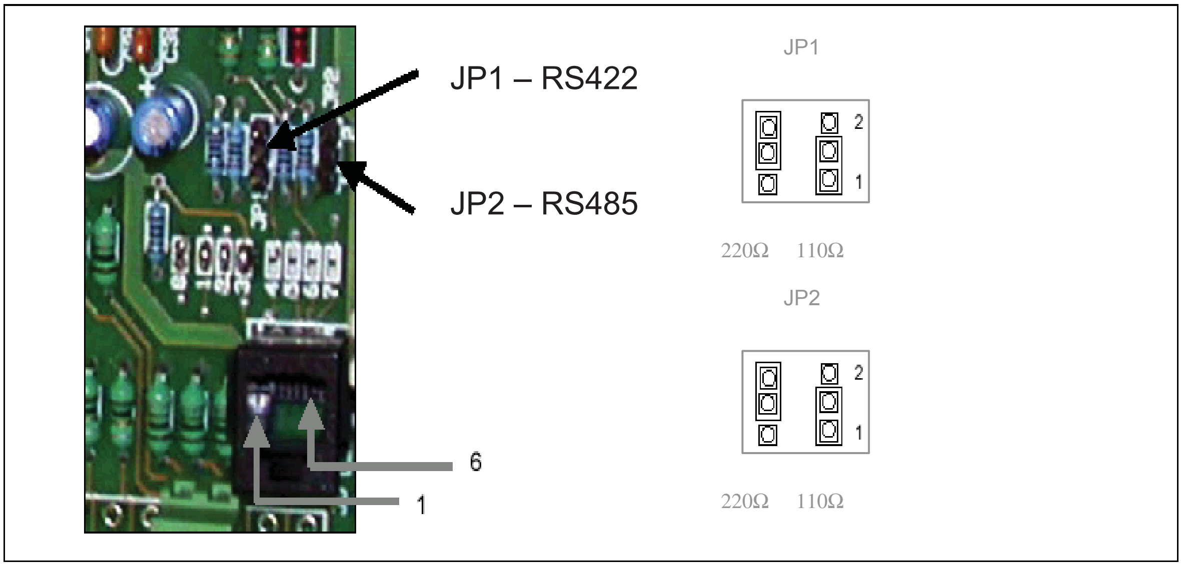


Figure 20 - Data link configuration

Please NOTE:
- to select RS232 weld jumpers onto position 1, 2, 3 and 8.
- to select RS485 weld jumpers onto position 6, 7 and 8.
- to select RS422 weld jumpers onto position 4, 5, 6, 7 and 8.

11.5 MicroChem®2 Memory Map

Increment: (figures between brackets '[x]' indicate the number of similar variables repeated).

Char	type:	1 byte
int	type:	2 bytes
float	type:	4 bytes
string	type:	1 byte x string length

Type	Hex addr.	Name	Description
Char	0X0000	PgmMode	Program mode (0-4) Transmitter, Washing, Regulator…
Char	0X0001	Lng	Language in use
String [6]	0X0002	AccCode[6]	MicroChem2 Password
String [4]	0X0008	TermAddr[4]	Serial line address
Char	0X000C	SerSpeed	Serial line speed
Char	0X000D	SerType	Serial line type
Float	0X000E	Altitude	Altitude where MicroChem2 is mounted
Char	0X0012	CCIinOR	Set for CCI in OR mode
Char	0X0013	Average	Set for Average count
Float	0X0014	Delta	Delta limit
Float	0X0018	pH_offset[3]	Offset for PH (SPC), for 3 channels
Float	0X0024	P1[3]	Calibration P1 value for 3 channels
Float	0X0030	P2[3]	Calibration P2 value for 3 channels
Float	0X003C	P1U[3]	User Calibration P1 value for 3 channels
Float	0X0048	P2U[3]	User Calibration P2 value for 3 channels
Char	0X0054	Light	Set when back-light is ON
Char	0X0055	T_Units	Temperature units
Float	0X0056	DefTemp	Default temperature for termo-compensation
Char	0X005A	AltUnits	Altitude Units meters/feet
Char	0X005B	Sigma	Sigma enabled or not
Float	0X005C	sK1	Sigma K1 parameter
Float	0X0060	sK2	Sigma K2 parameter
Float	0X0064	Hyst[3]	Smoothing for each channel
String [9]	0X0070	wT[4]	Wash Wash Timers T1-T4
Float	0X0094	Out_LO[3]	Min. output value for 3 channels
Float	0X00A0	Out_HI[3]	Max. output value for 3 channels
Char	0X00AC	DacType[3]	Type of DAC output
Char	0X00AF	wType	Wash Type T17AU / T17SU
Float	0X00B0	AlLO[3]	Alarms low level
Float	0X00BC	AlHI[3]	Alarms high level
Float	0X00C8	AlBA[3]	Alarms Band
Float	0X00D4	DO_AIR[3]	Set when O2 is in air
String [3]	0X00E0	Res	Reserved
Char	0X00E3	SerMode	Type of RS485/422 serial line
Char	0X00E4	CCIO	0 = No I/O Board, 1 = Yes I/O Board
Char	0X00E5	DoWash	When set, TX has washing
Char	0X00E6	PidType	Determine program PID mode
String [2]	0X00E7	Res	Reserved
Char	0X00E9	UnEng[3]	Engineering unit mA
Char	0X00EC	Type Cl[3]	Chlorine type input
Float	0X00EF	LLmA[3]	mA low limit
Float	0X00FB	LLCl[3]	Chlorine low limit
Float	0X0107	HLCl[3]	Chlorine high limit
Float	0X0113	LLmVCl[3]	mV Chlorine low limit
Float	0X011F	HLmVCl[3]	mV Chlorine high limit
Char	0X012B	EnPID1	enable PID1
Char	0X012C	EnPID2	enable PID2
Int	0X012D	FFPID	Enable FFPID
Int	0X012E	ChInst[3]	Channel installed
Int	0X0134	ChMode[3]	Channel Mode
Float	0X013A	PV[3]	Process value
Float	0X0146	Temp[3]	Temperature value

Table 24 - General Data Memory Map

PID1	Hex addr.	Name	Description
String [2]	0X0152	Reserved	Reserved
Float	0X0154	PB	Proportional Band
Float	0X0158	TR	Reset Time
Float	0X015C	MR	Manual Reset
Float	0X0160	TD	Derivative Action
Float	0X0164	SP	Set Point
Float	0X0168	CZ	Control Zone
Char	0X016C	RSW	Direct/Reverse Action
Char	0X016D	OHLP	Flow dependent limits
Float	0X016E	SPAN	Span
Float	0X0172	FF HIGH	High output limit calculation factor
Float	0X0176	FF LOW	Low output limit calculation factor
Float	0X017A	FF ABS MAX	High output limit
Float	0X017E	FF GAIN	Flow rate gain
Float	0X0182	OH	Output high limit
Float	0X0186	OL	Output low limit
Float	0X018A	K	Scaling factor for flow
Float	0X018E	TATT	Activation time
Float	0X0192	TCYC	Cycle time
Float	0X0196	LH	Reserved
Float	0X019A	LL	Reserved
Float	0X019E	B	Reserved
Int	0X01A2	CT	Reserved
Float	0X01A4	CG	Reserved
Float	0X01A8	DZ	Reserved
Char	0X01AC	TATP	Reserved
Char	0X01AD	CY	Reserved
Char	0X01AE	PA	Reserved
Char	0X01AF	Reserved	Reserved

Table 25 - PID1 Data Memory Map

PID 2	Hex addr.	Name	Description
String [2]	0X01B0	Reserved	Reserved
Float	0X01B2	PB	Proportional Band
Float	0X01B6	TR	Reset Time
Float	0X01BA	MR	Manual Reset
Float	0X01BE	TD	Derivative Action
Float	0X01C2	SP	Set Point
Float	0X01C6	CZ	Control Zone
Float	0X01CA	SPAN	Span
Float	0X01CE	OH	High output limit
Float	0X01D2	OL	Low output limit
Float	0X01D6	TATT	Activation time
Float	0X01DA	TCYC	Cycle time
Float	0X01DF	LH	Reserved
Float	0X01E2	LL	Reserved
int	0X01E6	CT	Reserved
Float	0X01E8	CG	Contact Gain
Float	0X01EC	DZ	Reserved
Char	0X01F0	CY	Reserved
Char	0X01F1	TATP	Reserved
Char	0X01F2	PA	Reserved
Char	0X01F3	RSW	Reserved
Int	0X01F4	Seq_Lav	Actual washing phase
String[10]	0X01F6	T_Lav	Washing time
int	0X0200	CCO[8]	CCO state
int	0X0210	CCI[8]	CCI state
float	0X0220	PID_Dev[2]	PID 1,2 DEV
float	0X0228	PID_Out[2]	PID 1,2 OUT
float	0X0230	PID_FF[2]	PID 1,2 FF
float	0X0238	HiAl [3]	HI Alarm Channel 1-3
float	0X0244	LowAl [3]	LO Alarm Channel 1-3
int	0X0250	PID_ AM[2]	PID1,2 Auto/Manual

Table 26 - PID2 Data Memory Map

12 APPENDIX

12.1 APPENDIX A – WEEE Compliant

Severn Trent Water Purification S:pA., as manufacturer of the electronic instrument described in the present manaul (MicroChem®2 line) is registered at the WEEE register (Waste Electric and Electronic Equipment).

Member registration WEEE number: IT11040000007171

12.2 APPENDIX B – Step by Step Programming Instructions

Please Refer to 4.3 Channel Definition

The keys used to define the channels are:

ABC – moves you laterally through the software

Enter – moves you down into the software holding the Enter key is also used to display an alarm condition.

End – moves you up in the software. End is also used to toggle the process display conditions from channels 1, 2, 3 if they are installed

The following procedure is to configure a transmitter to analyze Chlorine on channel 1 using CL4000 probes:

Press ABC, see Password:/ Flashing Cursor

Type in 00000

Press Enter, see ------ Menu Mode ------/ Menu

Press ABC, see ------ Menu Mode ------/Calibration

Press ABC until you see - Menu Mode/Channel Definition

Press Enter, see Channel Definition/ Channel 1

Press Enter see Channel 1/ CL

Press ABC until you see Channel 1/CL. (Continual pressing of ABC will rotate/move you laterally through the various parameters that the MicroChem2 is capable of measuring CL, CD, T, mA, F, Br, NH_3, NO_3, pH, O_2, mV, and O_3.

NOTE: mA allows you to drill down another level. Then pressing ABC will rotate/move you laterally through mA, %, ppm, mg/l, g/h, L/s, L/h, m^3/h, °C, °F, µS, mS, Kpa, Mpa, PSI, GPM, GPD, MGD, NTU, FTU, m, ft, in.)

Press Enter, see CL/ KC4000 Cell

Press ABC, see CL/CL probe [mA]

Press Enter, see CL Settings/ 4mA = 0.00ppm (This is the low range of your chlorine probe)

Press Enter and Enter 00.00. You will see a flashing cursor.

Press Enter, see CL Settings 20mA = 10.00 ppm

Press Enter, see the flashing cursor, enter the upper limit of the range for the Chlorine probe.

Press Enter, see Channel Definition/ Channel 1

Press End two times and see the display for what is being measured on channel 1

Continual pressing of the End key will toggle through the process measurement screens for the number of channels that are installed and configured.

Please refer to 4.4.1 Set Up/ Instrument Configuration

The keys used to define the channels are:

ABC – moves you laterally through the software

Enter – moves you down into the software. Holding the Enter key is also used to display an alarm condition.

End – moves you up in the software. End is also used to toggle the process display conditions from channels 1, 2, 3 if they are installed.

The following procedure is to set the instruments basic configuration.

Please refer to 4.4.1.1 (Configuration Parameters)

Press ABC, see Password:/ flashing cursor and enter 00000

Press Enter, see ------ Menu Mode ------/ Menu

Press Enter, see Menu/ Configuration

Press Enter, see Configuration/ Language

Press Enter, see English

Continual pressing of the ABC key will rotate you through the languages that are available

When you see English press the End key twice, see Menu/ Configuration

Serial Link — Please refer to 4.4.1.1

The serial communications link to be used by the analyzer. This also requires a hardware change. Please refer to 4.4.2.1, Figure 8

At the process display screen

Press ABC, see Password:/ flashing cursor and enter 00000

Press Enter, see ------Menu Mode ------/ Menu

Press Enter, see Menu/ Configuration

Press Enter, see Configuration/ Language

Press ABC until you see Configuration/ Serial Link

Press Enter, see Serial Link/ Address

Press Enter, see Address/ 00 If using RS422 or RS485 you must identify the address of this instrument. RS422 and RS485 are used to link up to 31 instruments. Please refer to section 11 in the instruction manual. If you wish to identify the instrument press the Enter key and you will get a flashing cursor. Enter the numeric value to identify the instrument and press the Enter key.

Cleaning — Please refer to 4.4.1.3

To wash and rinse the sensors

Press ABC, see Password:/ flashing cursor and enter 00000

Press Enter, see ------Menu Mode ------/ Menu

Press Enter, see Menu/Configuration

Press Enter, see Configuration/Language

Press ABC until you see Configuration/Cleaning

Press Enter, see Cleaning/Activate

Press Enter, see Activate/NO

Press ABC, see Activate/Yes

Press Enter, see Cleaning/Activate

Press ABC - see Cleaning/A or B, You must choose B.

Press Enter - see A or B/A

Press ABC - see A or B/A

Press ABC - see A or B/B

Press Enter - see Cleaning A or B

Press ABC - see Cleaning/Cleaning T1. This is the time period between the end of a cleaning sequence and the start time of the next one.

Press Enter - see Cleaning T1/00:00:00. This represents hours, minutes and seconds between cleanings.

Press Enter - see Cleaning T1/flashing cursor

Insert desired time between cleanings

Press Enter - see Cleaning/Cleaning T1

Press ABC - see Cleaning/Cleaning T2

Press Enter - see Cleaning T2/00:00:00. This represents the length of time for washing. Hours have no meaning. You can set cleaning to 30 minute maximum.

Press Enter - see Cleaning T2/flashing cursor

Insert desired time per T2

Follow the same sequence for T3 (Rinse Time) and T4 (Pause Time after cleaning for sensor recovery sensibility) if needed

Continual pressing of the End Key will bring you back to the process measuring display

Temperature Select °C or °F— Please refer to 4.4.1.1

Press ABC, see Password:/ flashing cursor and enter 00000

Press Enter, see ------Menu Mode ------/ Menu

Press Enter, see Menu/ Configuration

Press Enter, see Configuration/ Language

Press ABC until you see Configuration/ Temp. Select

Press Enter, see Temp. Select/ °C, another press of the ABC key will toggle you to °F

Press End until you see Menu/ Configuration

Temperature Set — Please refer to 4.4.1.1

This is a safety feature to tell the instrument the temperature to be used if the thermistor is faulty

Press ABC, see Password:/ flashing cursor and enter 00000

Press Enter, see ------Menu Mode ------/ Menu

Press Enter, see Menu/ Configuration

Press Enter, see Configuration/ Language

Press ABC until you see Configuration/ Temp. Set

Press Enter, see Temp. Set/ 20.00

Press Enter, see Temp. Set/ with the flashing cursor. Enter the value of the temperature you wish

Press the End Key until you return back to the process measurement display

Altitude (only used for Dissolved Oxygen) — Please refer to 4.4.1.1

This only appears when one of the channels is defined O2

Press ABC, see Password:/ flashing cursor and enter 00000

Press Enter, see ------Menu Mode ------/ Menu

Press Enter, see Menu/ Configuration

Press Enter, see Configuration/ Language

Press ABC until you see Configuration/ Altitude

Press Enter, see Altitude/ Eng. Unit Set

Press Enter, see Eng. Unit Set/ Meters by pressing ABC, and Enter you can select altitude in feet rather than meters

Press Enter see Altitude/ Eng. Unit Set

Press ABC, see Altitude/ Set Value

Press Enter, see Set Value/ Ft = 656.20

Press Enter, see Set Value/ Ft = 656.20 with a flashing cursor

Enter the altitude at your plant location and press Enter

Press the End Key until you return back to the process measurement display

CCI in OR — Please refer to 4.4.1.1

This function is used during cleaning to freeze the display.

Press ABC, see Password:/ flashing cursor and enter 00000

Press Enter, see ------Menu Mode ------/ Menu

Press Enter, see Menu/ Configuration

Press Enter, see Configuration/ Language

Press ABC until you see Configuration/ OR CCI

Press Enter, see OR CCI/ NO

Press ABC, see OR CCI/ YES and press Enter to freeze the display of the analyzer.

Press the End key until you return back to the process measurement display

Average — Please refer to 4.4.1.1

This function is used if you have a 2 or a 3 channel instrument and 2 of the channels are configured to test the same parameter.

Press ABC, see Password:/ flashing cursor and enter 00000

Press Enter, see ------Menu Mode ------/ Menu

Press Enter, see Menu/ Configuration

Press Enter, see Configuration/ Language

Press ABC until you see Configuration/ Average

Press Enter, see Average/ NO

Pressing the ABC key will let you toggle between Average/ NO and Average/ Yes

Press the End key until you return back to the process measurement display

Delta — Please refer to 4.4.1.1

This function is used with 2 channel transmitters when both channels are configured to test the same parameter. It will cause an alarm if the difference between the two channels is greater than the set value.

Press ABC, see Password:/ flashing cursor and enter 00000

Press Enter, see ------Menu Mode ------/ Menu

Press Enter, see Menu/ Configuration

Press Enter, see Configuration/ Language

Press ABC until you see Configuration/ Delta

Press Enter, see Delta/ 0.000

Press Enter to see the flashing cursor and enter the desired Delta value31

Press Enter, see Configuration/ Delta

Press the End key until you return back to the process measurement display

Smoothing — Please refer to 4.4.1.1

This function lessens the degree of measurement fluctuation seen on the display

Press ABC, see Password:/ flashing cursor and enter 00000

Press Enter, see ------Menu Mode ------/ Menu

Press Enter, see Menu/ Configuration

Press Enter, see Configuration/ Language

Press ABC until you see Configuration/ Smoothing

Press Enter, see Smoothing/ Channel 1. Press ABC to toggle between channels

Press Enter, see Channel 1/ 1.00.

Press Enter to see the flashing cursor. Set the smoothing to 30. This is a good place to start.

Press Enter to see Confirm, see Smoothing/Channel 1.

Press the End key until you return back to the process measurement display

Digital Input and Digital Output Settings — Please refer to 4.4.1.1 and 4.4.1.4

Each analyzer has 2 digital inputs CCI 1 and CCI 2. Each analyzer also has 7 digital outputs also referred to as Digital Relay Contact Closures. Each input and output is configured separately as normally opened (NO) or normally closed (NC).

Press ABC, see Password: / flashing cursor and enter 00000

Press Enter, see ------Menu Mode ------/ Menu

Press Enter, see Menu/ Configuration

Press Enter, see Configuration/ Language

Press ABC until you see Configuration/ Digital I/O Set

Digital Outputs:

Press Enter, see Digital I/O Set/ Digital Outputs

Press Enter, see Digital Outputs/ Ch. 1

Press ABC to rotate through channels 1 through 7 (CCO1 through CCO7)

Press Enter, see Ch. 1/ NO. Toggle between NO and NC by pressing the ABC key

Digital Inputs:

Press End until you see Digital I/O Set/ Digital Outputs. Press the ABC key to toggle between Digital Inputs and Digital Outputs

Press Enter, see Digital Inputs/ Ch. 1

Press ABC to toggle between channels 1 and 2

Press Enter, see Ch. 1/ NO. Toggle between NO and NC by pressing the ABC key

Output Setting – Please refer to 4.4.2 (Output Setting)

Press ABC, see Password:/flashing cursor and enter 00000

Press Enter, see ------ Menu   Mode------/ Menu

Press Enter, see Menu configuration

Press ABC until you see Menu/Output Settings

Press Enter, see Output Settings/Channel 1

Press Enter, see Channel 1/0-20/4-20

Press Enter, see 0-20/4-20/4-20mA. Press Enter to confirm. The output setting for the instrument is now configured for 4-20mA.

Press ABC, see Channel 1/Out Zero

Press Enter, see Out Zero/0.00

Press Enter, see a flashing cursor. The number entered will correspond to the 4.0 mA output signal.

Press Enter, see Out Zero

Press ABC, see Channel 1/Out Span

Press Enter, see Out Span = 10.00

Press Enter, see the flashing cursor, enter the upper limit of your probe that you wish to correspond to 20.00 mA

Press Enter, see Out Span

Press End once, see Menu/Output Settings

Press End again and see -----Menu Mode-----/Menu

Press End again – will show the process display screen

Setting Alarms - Please refer to 4.4.3

The keys used to set the alarms are:

ABC – moves you laterally through the software

Enter – moves you down into the software. Enter is also used to display an alarm condition.

End – moves you up in the software. End is also used to toggle the process display conditions from channels 1, 2, 3 if they are installed

The Alarms Menu is used to set the alarms for each parameter the instrument is capable of analyzing. Alarms default to the default settings in 4.4.3 Table 4.

Low and High Alarms

To change the alarm settings:

Press ABC, see Password: / flashing cursor and enter 00000

Press Enter, see ------Menu Mode ------/ Menu

Press Enter, see Menu/ Configuration

Press ABC key to rotate to Alarms

Press Enter, see Alarms/ Channel 1

Press Enter, see Channel 1/ Low Alarm

Press Enter, see Low Alarm/ 1.000

Press Enter to see the flashing cursor and enter the desired low alarm value

Press the End Key see Menu/ Alarms

Press Enter, see Alarms/ Channel 1

Press Enter, see Channel 1/ Low Alarm

Press ABC, see Channel 1/ High Alarm

Press Enter, see High Alarm/ 9.000

To change the High Alarm press Enter and the flashing cursor will appear. Enter the desired value.

Press the End key until the measuring process display appears

Dead Band – Please refer to 4.4.3

Dead Band is used to avoid the alarms from oscillating around the Lo and Hi alarm set points

Press ABC, see Password: / flashing cursor and enter 00000

Press Enter, see ------Menu Mode ------/ Menu

Press Enter, see Menu/ Configuration

Press ABC until you see Menu/ Alarms

Press Enter, see Alarms/ Channel 1

Press Enter, see Channel 1/ Low Alarm

Press ABC until you rotate to Dead band

Press Enter, see Dead band/ 0.000

Press Enter, see Dead band/0.000 with the flashing cursor. Enter the desired value. Then press the End key until the measuring process display appears

ANALYZER CALIBRATION

The following procedure is to configure the instrument to analyze Chlorine on channel 1

The keys used to calibrate the instrument are

ABC – moves you laterally through the software

Enter – moves you down into the software. Enter is also used to display an alarm condition

End – moves you up in the software. End is also used to toggle the process display conditions from channels 1, 2, 3 if they are installed

Probe Calibration - General - Please refer to 6.1.1 for Calibration Menu

Calibration - Please refer to 6.1.4 for Chlorine Calibration

Press ABC, see Password:/ Flashing Cursor. Insert 00000

Press Enter, see ------Menu Mode ------/ Menu

Press ABC, until you see ------Menu Mode ------/Calibration

Press Enter, see Calibration/ Channel 1

Press Enter, see Channel 1/ Calibration P1

NOTE: P1calibration is only necessary for the initial calibration to set the zero point. When performing recalibration it is only necessary to set the P2; skip to the P2 calibration (4 lines below)

Press Enter, see the low calibration value/ P1: 0.000

Press Enter, see the flashing cursor and enter the calibration value (for your low sample that has been stripped of chlorine using a carbon filter)

Press Enter, see Channel 1/ Calibration P1

Press ABC, see Channel 1/ Calibration P2

Press Enter, see the high chlorine calibration value/ P2: 10.00

Press Enter, see the flashing cursor and enter the P2 value based on testing such as with DPD or titration

Press Enter, see Channel 1/ Calibration P2:

Press End 3 times to take you to the process measurement display

AUTOMATIC CONTROL METHODS: (Available in instruments configured as controllers)

A. RESIDUAL PID CONTROLLER PROPORTIONAL BAND (PB) - Please refer to 5.2.2, Table 9.

1. Press ABC key – see Password with a flashing indicator. Press Zero Key and enter 00000.

2. Press Enter, see ------ Menu Mode ------/ Menu

3. Press Enter, see Menu/Configuration
4. Press ABC and scroll to Menu / Controller
5. Press Enter to Controller / PID 1
6. Press Enter, see PID1 General/ 4-20 / Contacts
7. Press Enter, see 4-20 / Contacts / 4-20 mA. This is the default. In order to use the general PID parameters, the instrument must be set to 4-20.
8. Press Enter, see PID / General 4-20 / Contacts
9. Press ABC, see PID1 General/ PB
10. Press Enter, see PB/100. This is the default for PB.
11. Press Enter again to get the flashing cursor to allow you to change the Proportional Band.
12. Insert 250, press Enter and see PID1 General/ PB

TIME RESET/INTEGRAL ACTION (TR) - Please refer to 5.2.2, Table 9

13. Press ABC, see PID1 General/ TR m/r
14. Press Enter see TR m/r / 0.00
15. Press Enter to show the flashing cursor
16. Enter the previously determined TR value. If a higher number than the range is inserted, the instrument defaults to 30 minutes
17. Press Enter to confirm the value and see PID1 General/ TR m/r

MANUAL RESET (MR) - Please refer to 5.2.2.1, Table 9

18. Press ABC and see PID1 General/ MR %

Skip this function. Manual reset is rarely used. To use Manual Reset you must set TR = 0. It represents the output of the controller when the PV is in the Control Zone; when the PV is almost equal to the Set Point.

DERIVATIVE ACTION (TD) - Please refer to 5.2.2.1, Table 9

19. Press ABC and see PID1 General/ TD m

Skip this function, it is rarely used. It is used to allow for sudden changes in the PV

PROCESS VARIABLE (PV) - Please refer to 5.2.2.1, Table 9

20. Press ABC and see PID1 General/ PV
21. Press Enter and see PID1 PV: the analysis and the current Process Variable will be indicated at the top left of the display
22. Press End and see PID1 General/ PV

SET POINT (SP) - Please refer to 5.2.2.1, Table 9

23. Press ABC and see PID1 General/ SP

SP is the Set Point for the desired PV

24. Press Enter and see SP/ 0.00
25. Press Enter to see the flashing cursor and enter the desired Set Point for the process.
26. Press Enter and see PID1 General/ SP

NOTE: The Set Point can be adjusted manually using the blue buttons.

CONTROL ZONE (CZ) - Please refer to 5.2.2.1, Table 9

27. Press ABC and see PID1 General/ CZ

    Control Zone is used to avoid continuous control adjustments for small fluctuations from Set Point. Please refer to 5.2.2.1 for an explanation of Control Zone

28. Press Enter twice to see the flashing cursor and enter the desired value
29. Press Enter and see PID1 General/ CZ

DIRECT/REVERSE ACTION (RSW) - Please refer to 5.2.2.1 for an explanation of DIRECT/REVERSE ACTION (RSW).

30. Press ABC and see PID1 General/ RSW D/R
31. Press Enter and see RSW D/R/ Reverse
32. Press Enter to confirm and see PID1 General/ RSW D/R

SPAN - Range of Wet End/Probe

33. Press ABC and see PID1 General/ SPAN
34. Press Enter and see SPAN/ X.XX – see the numeric indication of the process variable.
35. Press Enter to see the flashing cursor and enter the desired range for the controller based on (in the case of chlorine using a CL4000 probe) the range of the probe
36. Press Enter to confirm and see PID1 General/ SPAN

HIGH LIMIT OUTPUT (OH)

37. Press ABC and see PID1 Limits/ OH%
38. Press Enter and see OH%/ 100.00
39. Press Enter again and see the flashing cursor, and enter the upper limit of the process
40. Press Enter to confirm and see PID1 Limits/ OH %

LOW LIMIT OUTPUT (OL)

41. Press ABC and see PID1 Limits/ OL %
42. Press Enter and see OL%/ 0.00
43. Press Enter to see the flashing cursor. Insert the desired low limit
44. Press Enter to confirm and see PID1 Limits/ OL%
45. Press End until you return to the process analysis/controller screen

Once the Process Variable is running as desired press the Blue 5 Key to switch to Automatic Mode

A.FEED FORWARD ACTION - Please refer to 5.2.2.2

Limit output as a function of Flowrate (OHLP)

A 2 channel unit is required

Channel 2 must previously have been configured as mA and further defined as mode PID

B.FEED FORWARD CONTROL - Please refer to 5.2.2.2

1. Press ABC, see Password/flashing cursor and enter 00000
2. Press Enter, see ------Menu Mode ------/ Menu
3. Press Enter, see Menu/Configuration

4. Press ABC, see Menu/Controller
5. Press Enter, see Controller/PID1
6. Press Enter, see PID General/4-20/Contacts
7. Press ABC, see PID1 General/PB. Continue to press ABC until PID1 Feed Flow/OHLP   NO/YES appears on the display
8. Press Enter, see OHLP   NO/YES/NO
9. Press ABC, see OHLP   NO/YES/YES. OHLP must be set to Yes to limit the output as a function of the flow rate.

FACTOR TO COMPUTE MAX OUTPUT BASED ON FLOWRATE (FFH) - Please refer to 5.2.2.2

10. Press Enter, see PID1 Feed Forw./OHLP   NO/YES
11. Press ABC, see PID1 Feed Forw./FFH
12. Press Enter, see FFH 1.50. This is the default
13. Press Enter, see FFH/flashing cursor
14. Enter the desired numeric value
15. Press Enter, see PID1 Feed Forward/FFH

FACTOR TO COMPUTE MINIMUM OUTPUT BASED ON FLOWRATE VALUE (FFL) - Please refer to 5.2.2.2

16. Press ABC, see PID1 Feed Forward/FFL
17. Press Enter, see FFL 0.50. This is the default value
18. Press Enter, see FFL/flashing cursor
19. Enter the desired numeric value
20. Press Enter, see PID1 Feed Forward/FFL

ABSOLUTE HIGH LIMIT ON OUTPUT WHEN LIMITS BASED ON FLOWRATE ARE ACTIVE (MAX. ABS) - Please refer to 5.2.2.2

21. Press ABC, see PID1 Feed Forward/Absolute Max
22. Press Enter, see Absolute Max/100.00. This is the default value
23. Press Enter, see Absolute Max/flashing cursor
24. Enter the desired Absolute Max value
25. Press Enter, see PID1 Feed Forward/Absolute Max.

GAIN FACTOR APPLIED ON FLOW RATE SIGNAL (GAIN) - Please refer to 5.2.2.2

26. Press ABC, see PID1 Feed Forward/Gain
27. Press Enter, see Gain/100.00. This is the default value
28. Press Enter, see Gain/flashing cursor
29. Enter the desired value
30. Press Enter, see PID1 Feed Forw./Gain
31. Press End until you return to the process analyzer/controller screen
32. Once the process is running as desired, press the Blue 5 Key to switch to automatic mode.

C. TIME SAMPLING OR FLOW-PACING CONTROLLER (TATP)- Please refer to 5.2.2.3

Define Channel 1 as chlorine or another parameter. The 4-20 mA output provides PID control. The channel definition for Channel 2 must be configured to 4-20 mA and further configured to mode PID.

TIME SAMPLING (TATP) - Please refer to 5.2.2.3

1. Press ABC, see Password:/flashing cursor and Enter 00000.
2. Press Enter, ---Menu Mode---/ Menu
3. Press Enter, see Menu/Configuration
4. Press ABC, see Menu/Controller
5. Press Enter, see Controller/PID1
6. Press Enter, see PID1 General/4-20/Contacts
7. Press ABC until you see PID1 Chlorine/TATP NO/YES
8. Press Enter, see TATP NO/YES/NO
9. Press ABC, see TATP NO/YES/YES
10. Press Enter, see PID1/Chlorine/TATP NO/YES, then OH and OL are not engaged, Absolute Max is used.

SCALING FACTOR FOR FLOW (K) - Please refer to 5.2.2.3

11. Press ABC, see PID1 Chlorine (if configured)/K
12. Press Enter, see K/O.O. This is the default value. K is not used in Time Sampling.
13. Press End and see PID1 Chlorine (if configured as such)/K

ACTIVE TIME (ATT) - Please refer to 5.2.2.3

14. Press ABC, see PID 1 Chlorine/ATT.
15. Press Enter, see ATT/0.00. This is the default value.
16. Press Enter, see ATT/flashing cursor.
17. Enter the desired numeric value
18. Press Enter, see PID1 Chlorine/ATT (if configured as such)

CYCLE (FOR FLOW) - Please refer to 5.2.2.3

19. Press ABC, see PID1 Chlorine/Cycle
20. Press Enter, see Cycle/0.00. This is the default value.
21. Press Enter, see Cycle/flashing cursor.
22. Enter the desired Cycle time.
23. Press Enter, see PID1 Chlorine/Cycle.
24. Press End until you return to the process analyzer/controller screen.
25. Once the process is running as desired, press the Blue 5 key to switch to automatic mode.

TIME CYCLE - Please refer to 5.2.2.3 - PID must be defined as Contacts instead of 4-20mA.

3. Press Enter, see ---Menu Mode---/ Configuration
4. Press ABC, see Menu/Controller
5. Press Enter, see Controller/PID1
6. Press Enter, see PID1 General/4-20/Contacts

7. Press Enter, see 4-20/Contacts/4-20mA
8. Press ABC, see 4-20/Contacts/Contacts
9. Press Enter, see PID1 General/4-20/Contacts
10. Press ABC until you see PID1 Contacts/Time Cycle sec
11. Press Enter, see Time Cycle sec/0. This is the default value
12. Press Enter, see Time Cycle sec/flashing cursor
13. Enter the desired value
14. Press Enter, see PID1 Contacts/Time Cycles sec
15. Press End until you return to the process Analyzer/Controller screen
16. Once the process is running as desired, press the Blue 5 key to switch to the automatic mode.

E. ERROR SQUARED CONTROLLER - Please refer to 5.2.2.4

Channel 1 must be defined for pH or mV

Set Point (SP) and process variable (PV) must have been previously defined

1. Press ABC, enter 00000
2. Press Enter, see ---Menu Mode---/ Menu
3. Press Enter, see Menu/Configuration
4. Press ABC, see Menu/Controller
5. Press Enter, see Controller/PID1
6. Press Enter, see PID1 General/4-20/Contacts
7. Press Enter, see 4-20/Contacts/4-20mA
8. Press End, see PID1 General/4-20/Contacts

DEAD BAND

9. Press ABC until you see PID1 pH/Dead Band
10. Press Enter, see Dead Band/100.00, this is the default value.
11. Press Enter, see Dead Band/flashing cursor
12. Enter the desired value
13. Press Enter, see PID1 pH/Dead Band
14. Press End until you return to the process Analyzer/Controller screen

F. CONTACT OUTPUT CONTROLLER - Please refer to 5.2.2.5

1. Press ABC, see Password:/flashing cursor and enter 00000
2. Press Enter, see ---Menu Mode---/ Menu
3. Press Enter, see Menu/Configuration
4. Press ABC, see Menu/Controller
5. Press Enter, see Controller/PID1
6. Press Enter, see PID1 General/4-20/Contacts
7. Press Enter, see 4-20/Contacts/4-20mA
8. Press ABC, see 4-20/Contacts/Contacts
9. Press Enter, see PID1 General/4-20/Contacts
10. Press End twice, see Menu/Controller

11. Press Enter, see Controller/PID1
12. Press Enter, see PID1 General/4-20/Contacts

GAIN - Please refer to 5.2.2.5

13. Press ABC until you see PID1 Contacts/Gain
14. Press Enter, see Gain 1.00, this is the default value.
15. Press Enter, see Gain/flashing cursor
16. Enter the desired Gain value.
17. Press Enter, see PID1 Contacts/Gain

DEAD ZONE (DZ) - Please refer to 5.2.2.5

18. Press ABC, see PID/Contacts/DZ
19. Press Enter, see DZ/0.00, this is the default value.
20. Press Enter, see DZ/flashing cursor
21. Enter the desired value.
22. Press Enter, see PID1 Contacts/DZ

TIME CYCLE - Please refer to 5.2.2.5

23. Press ABC, see PID1 Contacts/Time Cycle Sec
24. Press Enter, see Time Cycle sec 10, this is the default value.
25. Press Enter, see Time Cycle sec/flashing cursor
26. Enter the desired value
27. Press Enter, see PID1 Contacts/Time Cycle sec
28. Press the End key until you return to the process Analyzer/Controller screen.

12.3 APPENDIX C - Analyzer/Transmitter Software Menu Tree

- **Menu**
  - Configuration
    - Language
      - Italian
      - English
      - French
      - German
      - Spanish
    - Password
      - 00000 (Default)
    - Serial Link
      - Address
      - Baud Rate
      - Serial Port
    - Cleaning (when cleaning software option is installed)
      - Activate
        - No
        - Yes
          - A or B
            - A (not used)
            - B
              - Cleaning T1
              - Cleaning T2
              - Cleaning T3
              - Cleaning T4
    - Temp Select
      - C
      - F
    - Temp Set
      - 20.00
    - OR CCI
      - No
      - Yes
      - Off
    - Average (multichannel units with two or more identical channels)
      - No
      - Yes
    - Delta (multichannel units with two or more identical channels)
      - (enter value)
    - Smoothing
      - Channel
        - 1.00
    - Digital I/O Set
      - Digital Outputs
        - Channel
          - NO
          - NC
      - Digital Inputs
        - Channel
          - NO
          - NC

12.4 APPENDIX C (continued)

- Instrument Test
  - Keyboard Test
  - Display Test
  - Digital I/O
    - Input Signals
    - Output Signals
  - Analog I/O
    - Input Signals
      - Channel
    - Output Signals
      - Channel
  - Electric Calib. (Factory use only)
- Output Settings
  - Channel
    - 0-20/4-20
    - Out Zero
    - Out Span
- Alarms
  - Channel
    - Low Alarm
    - High Alarm
    - Deadband

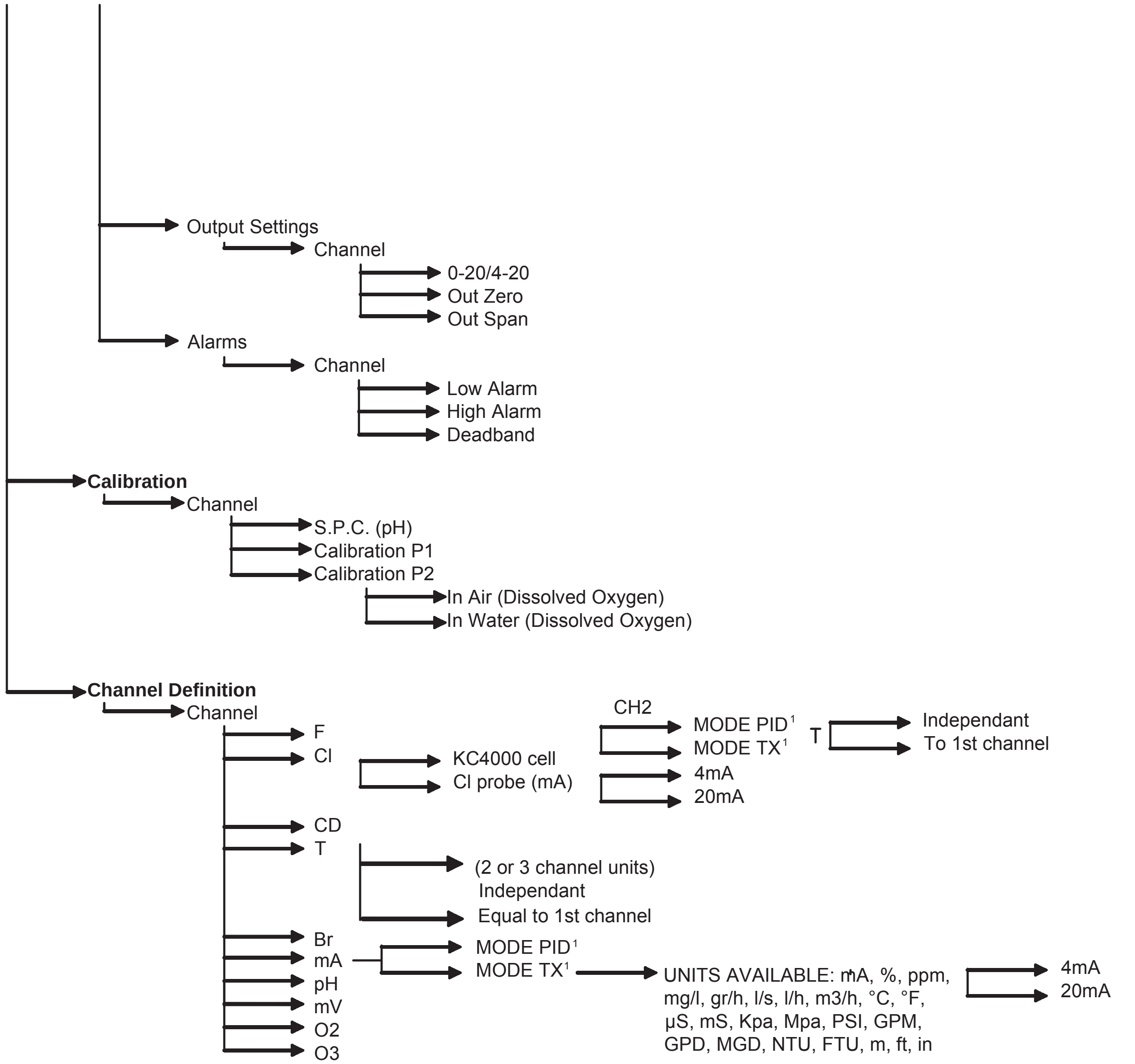
- **Channel Definition**
  - Channel
    - F
    - Cl
      - KC4000 cell
      - Cl probe (mA)
        - T
          - Independant
          - Equal to 1st channel
        - 4mA
        - 20mA
    - CD
    - T (2 or 3 channel units)
      - Independant
      - Equal to 1st channel
    - Br
    - mA
      - UNITS AVAILABLE: mA, %, ppm, mg/l, gr/h, l/s, l/h, m3/h, °C, °F, µS, mS, Kpa, Mpa, PSI, GPM, GPD, MGD, NTU, FTU, m, ft, in
        - 4mA
        - 20mA
    - pH
    - mV
    - O2
    - O3
- **Calibration**
  - Channel
    - S.P.C. (pH)
    - Calibration P1
    - Calibration P2
      - In Air (Dissolved Oxygen)
      - In Water (Dissolved Oxygen)

12.4 APPENDIX D - Standard/Average Controller Software Menu Tree

- **Menu**
  - Configuration
    - Language
      - Italian
      - English
      - French
      - German
      - Spanish
    - Password
      - 00000 (Default)
    - Serial Link
      - Address
      - Baud Rate
      - Serial Port
    - Cleaning
      - Activate
        - No
        - Yes
          - A or B
            - A (not used)
            - B
              - Cleaning T1
              - Cleaning T2
              - Cleaning T3
              - Cleaning T4
    - Temp Select
      - C
      - F
    - Temp Set
      - 20.00
    - OR CCI
      - No
      - Yes
    - Average (multichannel units with two or more identical channels)
      - No
      - Yes
    - Sigma
      - Yes
      - No
      - K1
      - K2
    - Delta (multichannel units with two or more identical channels)
      - (enter value)
    - Smoothing
      - Channel
        - 15
    - Digital I/O Set
      - Digital Outputs
        - Channel
          - NO
          - NC
      - Digital Inputs
        - Channel
          - NO
          - NC
    - Instrument Test
      - Keyboard Test
      - Display Test
      - Digital I/O
        - Input Signals
        - Output Signals
      - Analog I/O
        - Input Signals
          - Channel
        - Output Signals
          - Channel
      - Electric Calib. (Factory use only)
  - **Controller**
    - PID 1
      - 4-20/Contacts
        - 4-20
          - PB
          - TR m/r
          - MR%
          - TD m
          - PV
          - SP
          - CZ
          - RSW D/R
            - Reverse
            - Direct
          - Span
          - OHLP
          - FFH
          - FFL
          - ABS MAX
          - Gain
          - OH%
          - OL%
          - (if CH1 = CL, CD) if CH1 = pH, mV
          - TATP Deadband
          - K
          - ATT.
          - Cycle

(OHLP, FFH, FFL, ABS MAX, Gain:) Available when 2nd channel configured as a Feed Forward Controller by defining channel 2 as mA.

12.4 APPENDIX D (continued)



NOTE 1: ONLY APPEARS ON CHANNEL 2.
SEE SECTION 5.2.2.2.

MODE PID ALLOWS INSTRUMENT TO ADJUST CONTROL SIGNAL BASED ON FLOW RATE AND THE MEASURED VALUE OF THE PROCESS.

MODE TX ALLOWS THE MEASUREMENT OF THE OTHER UNITS AVAILABLE WHEN CHANNEL 2 IS DEFINITED AS mA.

12.5 APPENDIX E - Swimming pool Controller –Software Menu Tree-

- **Menu**
  - Configuration
    - Language
      - Italian
      - English
      - French
      - German
      - Spanish
    - Password
      - 00000 (Default)
    - Serial Link
      - Address
      - Baud Rate
      - Serial Port
    - Cleaning
      - Activate
        - No
        - Yes
          - T17AU or T17SU
            - T17SU
            - T17AU
              - Cleaning T1
              - Cleaning T2
              - Cleaning T3
              - Cleaning T4
    - Temp Select
      - C
      - F
    - Temp Set
      - 20.00
    - OR CCI
      - No
        Yes
        Off
    - Smoothing
      - Channel
        - 1.00
    - Digital I/O Set
      - Digital Outputs
        - Channel
          - NO
          - NC
      - Digital Inputs
        - Channel
          - NO
          - NC
    - Instrument Test
      - Keyboard Test
      - Display Test
      - Digital I/O
        - Input Signals
        - Output Signals
      - Analog I/O
        - Input Signals
          - Channel
        - Output Signals
          - Channel
      - Electric Calib. (factory use only)

- **Controller**
  - PID 1
    - 4-20/Contacts
      - Contacts
      - 4-20
    - PB
    - TR m/r
    - MR%
    - TD m
    - PV
    - SP
    - CZ
    - RSW D/R
      - Reverse
      - Direct
    - Span
    - OH%
    - OL%
    - Deadband
  - PID 1
    - 4-20/Contacts
      - Contacts
      - 4-20
    - PV
    - SP
    - RSW D/R
    - SPAN
    - pH Deadband
    - Digital Ouputs
      - Relays
        - Gain
        - DZ
        - Time Cycle sec
      - Frequency
        - Gain
        - Low Limit
        - Number of Pulses
  - PID 2
    - 4-20/Contacts
      - Contacts
      - 4-20
    - PB
    - TR m/r
    - MR%
    - TD m
    - PV
    - SP
    - CZ
    - RSW D/R
      - Reverse
      - Direct
    - Span
    - OH%
    - OL%
    - PID1 Chlorine
      - TATP
        - yes
        - no
      - K
      - ATT.
      - Cycle
  - PID 2
    - 4-20/Contacts
      - Contacts
      - 4-20
    - PV
    - SP
    - RSW D/R
    - SPAN
    - pH Deadband
    - Digital Ouputs
      - Relays
        - Gain
        - DZ
        - Time Cycle sec
      - Frequency
        - Gain
        - Low Limit
        - Number of Pulses
- Output Settings
  - 0-20/4-20
  - Out Zero
  - Out Span
- Alarms
  - Channel
    - Low Alarm
    - High Alarm
    - Deadband
- **Channel Definition**
  - Channel 1
    - pH
  - Channel 2
    - Cl
      - KC4000 cell
      - Cl probe (mA)
        - 4mA
        - 20mA
    - mV
    - Temperature (2 or 3 channel units only)
      - Independent
      - Equal to 1st
- **Calibration**
  - Channel
    - S.P.C. (pH)
    - Calibration P1
    - Calibration P2
      - In Air (Dissolved Oxygen)
      - In Water (Dissolved Oxygen)

Design improvements may be made without notice.
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Instruction Manual –
MicroChem®2 Chlorine Probes
Series CL4000

DE NORA

These instructions describe the installation, operation and maintenance of the subject equipment. Failure to strictly follow these instructions can lead to an equipment rupture that may cause significant property damage, severe personal injury and even death. If you do not understand these instructions, please call De Nora Water Technologies for clarification before commencing any work at 215-997-4000 and ask for a Field Service Manager. De Nora Water Technologies, Inc. reserves the rights to make engineering refinements that may not be described herein. It is the responsibility of the installer to contact De Nora Water Technologies, Inc. for information that cannot be answered specifically by these instructions.

Any customer request to alter or reduce the design safeguards incorporated into De Nora Water Technologies equipment is conditioned on the customer absolving De Nora Water Technologies from any consequences of such a decision.

De Nora Water Technologies has developed the recommended installation, operating and maintenance procedures with careful attention to safety. In addition to instruction/operating manuals, all instructions given on labels or attached tags should be followed. Regardless of these efforts, it is not possible to eliminate all hazards from the equipment or foresee every possible hazard that may occur. It is the responsibility of the installer to ensure that the recommended installation instructions are followed. It is the responsibility of the user to ensure that the recommended operating and maintenance instructions are followed. De Nora Water Technologies, Inc. cannot be responsible for deviations from the recommended instructions that may result in a hazardous or unsafe condition.

De Nora Water Technologies, Inc. cannot be responsible for the overall system design of which our equipment may be an integral part of or any unauthorized modifications to the equipment made by any party other that De Nora Water Technologies, Inc.

De Nora Water Technologies, Inc. takes all reasonable precautions in packaging the equipment to prevent shipping damage. Carefully inspect each item and report damages immediately to the shipping agent involved for equipment shipped “F.O.B. Colmar” or to De Nora Water Technologies for equipment shipped “F.O.B Jobsite”. Do not install damaged equipment.

De Nora Water Technologies, COLMAR OPERATIONS
COLMAR, PENNSYLVANIA, USA
ISO 9001: 2008 CERTIFIED

TABLE OF CONTENTS

1 INTRODUCTION

1.1 General Description

This manual describes the general description, installation, operation and maintenance of the CL4000 Chlorine probes and accessories.

Chlorine is the most common chemical used in disinfection of municipal drinking water, cooling towers and many industrial applications. Once added to water the chlorine will react with chemicals already in the water forming combined chlorine or stay available as free chlorine.

A chlorine measuring system incorporating the CL4000 chlorine probes, connected to the MicroChem®2 transmitter, provides automatic measurement/control of chlorine dosage in such systems. The CL4000 chlorine probe measures free chlorine.

The transmitter is part of the MicroChem®2 series, which is capable of supporting up to three of the following measurements in all possible combinations: Dissolved Oxygen, Chlorine Dioxide, Residual Chlorine, Bromine, Ozone, ORP, Temperature, pH, Iodine and Conductivity. For a description and instructions regarding the transmitter see the MicroChem®2 transmitter instruction manual.

The chlorine probes are 3 electrode amperometric cells covered with a permeable membrane. The probe exterior is manufactured from a durable PVC and stainless steel and has a diameter of 25mm (1 inch). The probes are engineered to fit a specially designed flow cell.

De Nora Water Technologies chlorine probes can be used without the need for pH compensation.

All the CL4000 probes are designed to run without the need for reagents. The probes have no moving parts and are designed to require minimal maintenance.

Figure 1 - Chlorine Probe

1.2 Safety

The recommended operating procedures have been designed with careful attention to safety. De Nora Water Technologies has made formal safety reviews of the initial design and any subsequent changes. This procedure is followed for all new products and covers areas in addition to those included in applicable safety standards.

Observe the following safety precautions:

a. Observe all safety warnings marked on the equipment. These warnings identify areas of immediate hazard, which could result in personal injury, or loss of life.
b. Do not use this equipment for any purpose other than described in this manual.
c. Disconnect power prior to making any terminal connections within the enclosure.
d. Use the recommended connection procedures described in Section 2 of this manual.

This equipment should only be installed by suitably qualified personnel.

1.3 Chlorine Probes, Cables, Accessories and Consumables

Chlorine Probe 0-2 ppm, pH tolerable 4.0 - 9.5 (Note 1,2)	23183
Chlorine Probe 0-5 ppm, pH tolerable 4.0 - 9.5 (Note 1,2)	23184
Chlorine Probe 0-10 ppm, pH tolerable 4.0 - 9.5 (Note 1,2)	23185
4 Foot Cable (Note 3)	78-4001
12 Foot Cable (Note 3)	78-4002
40 Cable (Note 3)	78-4003
Sample/Drain Tubing, CLEAR, 3/16” ID X 5/16” OD	R-376
Flow Through Cell with integral shut off valve (Note 4)	23411
Flow Through Cell and Flow Control Kit (Note 4, 6)	23449
Sample Flow Control Kit (Note 7)	23318
Flow Control Panel Kit (Note 6)	23451
Y Strainer 80 mesh, Max Inlet 75 PSIG	22901
Pressure Reducing Valve Kit, 0-25 PSIG, Max Inlet 300 PSIG w/15 PSIG Gauge & Bracket	23425
Flow Meter Assembly w/Rate Valve, 0-10 GPH	23426
Flow Switch (Note 7)	22896
Carbon Dechlorinating Filter (Note 9)	23450
Annual Maintenance Kit for:	
01-4030 and 01-4031 Probes Includes: PN 77-4005 and PN 94-2135	10-4001
23183, 23184, 23185, 01-4032 and 01-4033 Probes Includes: PN 77-4004 and PN 94-2136	10-4002
01-4034 and 01-4035 Probes Includes: PN 77-4004 and PN 94-2137	10-4003
M48 Membrane Cap to fit 23183, 23184, 23185, 01-4032, 01-4033, 01-4034 and 01-4035 Probes	77-4004
M20 Membrane Cap to fit 01-4030 and 01-4031 Probes	77-4005
G-Holder for 23183, 23184, 23185, 01-4032 and 01-4033 Probes	77-4017
Electrolyte Solution (100ml) for 01-4030 and 01-4031 Probes	94-2135
Electrolyte Solution (100ml) for 23183, 23184, 23185, 01-4032 and 01-4033 Probes	94-2136
Electrolyte Solution (100ml) for 01-4034 and 01-4035 Probes	94-2137

Notes:

1. The MicroChem2 Transmitter/Controller must be fitted with the expanded function board (P/N 1T686B129U12, U13 or U14) in order to provide power to the probe and the software must be Version 2.8 or above. Consult factory on upgrading earlier versions of microchem2 transmitter/controllers to the latest revision.
2. 23183, 23184, and 23185, probes with 3-electrode sensor for the measurement of free available chlorine. Temperature compensated (0 to 40°C). pH tolerable within the operating range 4 to 9.5.
3. Cable 78-4001, 78-4002 or 78-4003 must be used for probe to function properly.
4. Flow cell 23411 includes a low pressure fitting (installed) and is also provided with a back pressure fitting to prevent the formation of air bubbles in the probe chamber at sample pressures of 6-8 PSIG (0.4-0.5 bar).
5. Flow Control Kit (P/N 23318) improves flow and pressure control of CL4000 probes. It includes a PRV Kit (P/N 23425), Flow Meter Assembly (P/N 23426), 10 ft of tubing and connectors.
6. The Flow Control Panel Kit (P/N 23451) (26" H X 28” W X 0.5" thick) is predrilled and tapped for mounting the Microchem2 and 2 acrylic flow cells for chlorine or for use with pH, conductivity, or ORP 12mm probes and is supplied with mounting hardware.
7. Flow Switch: dry contact opens on loss of sample flow.
8. Dechlorinating Filter provides a chlorine free sample stream, used for calibrating the MicroChem2.

1.4 Technical Data / Specifications

Quality Management System:	The design & manufacturing process of De Nora Water Technologies are certified to ISO9001.	
Range:	0 - 2 mg/l, 0 -5 mg/l or 0 - 10 mg/l (probe dependant)	
Type of measurement:	Free chlorine	
Temperature Compensation:	Internal	
Speed of Response:	Ninety (90)% step change < 2 minutes.	
Ambient/sample Temp:	32 °F - 104 °F (0 °C - 40 °C)	
Limit of Detection:	Probe, chlorine, 0-2 ppm : 0.01 ppm Probe, chlorine, 0-5 ppm : 0.03 ppm Probe, chlorine, 0-10 ppm : 0.05 ppm	
Reproducibility:	0.05 mg/l	
Accuracy:	± 5% of range	
Sample Inlet Pressure:	0 to 8 psi (0 to .5 bar)	
Sample Temperature:	32 °F - 104 °F (0 °C - 40 °C)	
Sample Flow:	8 gph (30 liters per hour)	
Electrodes:	Working Electrode - gold	
	Counter Electrode - stainless steel	
	Reference Electrode: Silver/Silver-Chloride	
pH:	Chlorine: independent of pH (pH 4 to pH 9.5) Signal loss is 5% per pH unit (pH greater than 7)	
Dimensions:	In flow cell:	14.6” (h) x 2.25” (dia) 370mm x 55 mm
	Probe alone	1” (dia) x 9” (l), 25mm (dia) x 230mm (l)
Weight:	probe and flow cell	1lb (450g)
Connectors:	2 x compression fitting for flexible tubing ID 3/16”, OD 5/16”	
Cable:	Various lengths available	
Sample Limitations:	Samples containing particles 100 microns (0.004 inches) in diameter and larger may require pre-filtration. There should be no surfactants in the water.	
Ammonia Interference:	CL4000 probes in the presence of ammonia will measure free and/or combined chlorine.	
Permanganate Interference:	1 ppm permanganate = 0.5 ppm chlorine	

1.5 Principle of Operation

The chlorine probes are amperometric cells covered with a permeable membrane. The probes are engineered to fit a specially designed flow cell.

A sample of liquid is delivered to the input (bottom) of the flow cell at an approximate rate of 500 ml/min.

The sample passes the membrane on the tip of the membrane cap. Chlorine diffuses through the membrane and into the internal filling solution where a small DC current is generated between the stainless steel counter electrode and gold working electrode in direct linear proportion to the amount of residual present in the sample. A third reference electrode establishes a constant potential on the gold working electrode to provide an accurate and stable residual signal.

The signal is amplified and transmitted to the MicroChem®2 transmitter/controller via the sensor cable. The probe needs to be loop powered. This power is generated within the MicroChem®2 and supplied to the probe in the same cable which transmits the residual signal.

All the CL4000 chlorine probes are designed to run without the need for reagents. The probes have no moving parts and are designed to require minimal maintenance.

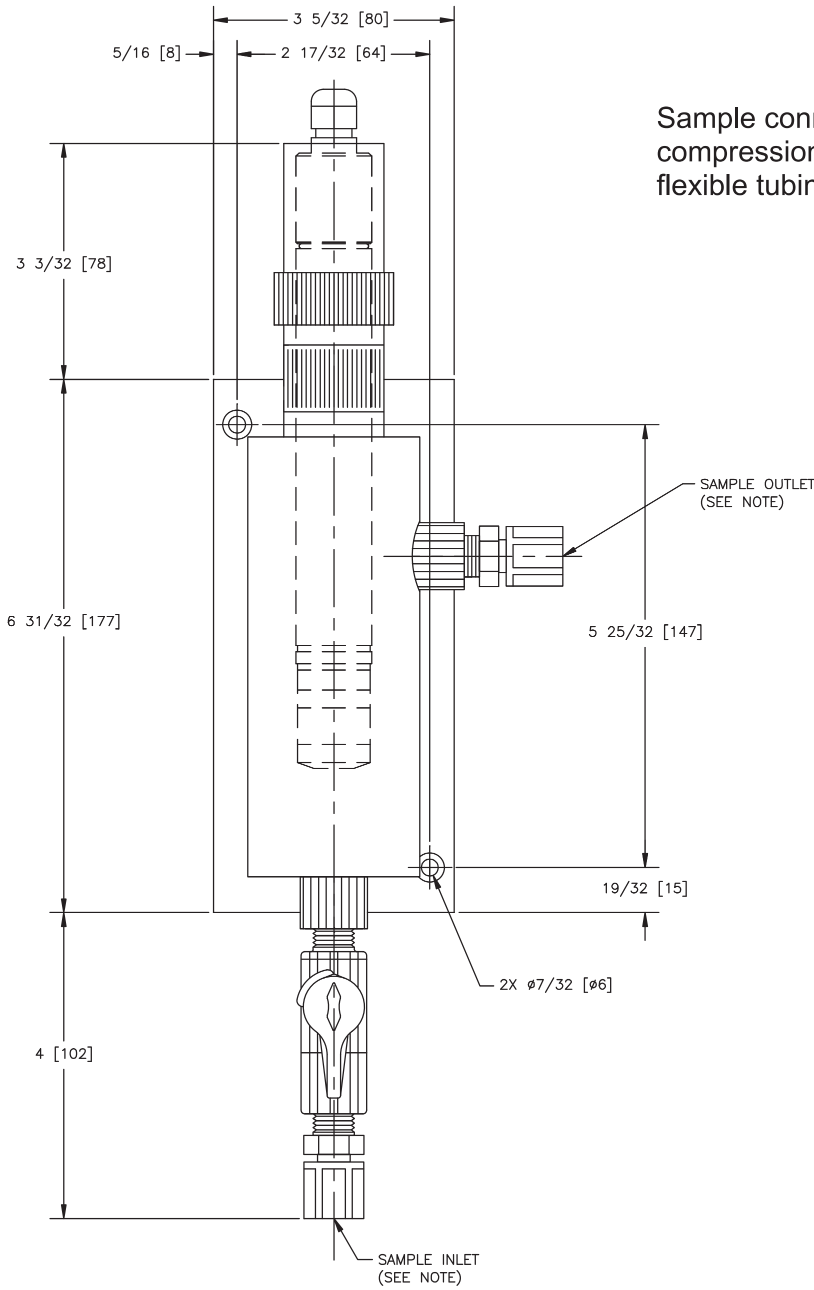
2 INSTALLATION

2.1 General

Remove the instrument from its box and carefully inspect each item and report damages immediately. The box will include the chlorine probe (electrode shaft, top cap and membrane cap), electrolyte bottle and a sheet of blue abrasive paper.

The chlorine probes are designed for general duty indoor installation. Outdoor installation is possible if the instrument is shielded from dripping water and not mounted in direct sunlight. Ensure that the process and environmental conditions are within specified limits (see specification).
Excessive heat and vibration will affect the sensors.

2.2 Mounting Dimensions



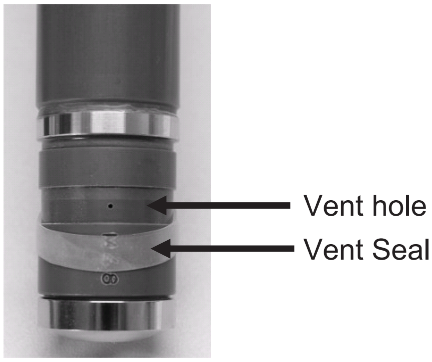
Sample connectors are compression fitting, requiring flexible tubing 3/16" ID x 5/16" OD

Figure 2 - Mounting Dimensions

2.3 Chlorine Probes

WARNING
Do not touch the electrode finger (see Figure 3)
Do not touch the bottom of the membrane cap (see Figure 3)

To assemble the probes for use:



When removing the membrane cap, move the vent seal away from the vent hole to allow air into the membrane cap. Not doing so may cause a vacuum to form and damage the membrane.

Fill the membrane cap to the top with electrode filling solution (note each electrode has a specially formulated filling solution which is unique to that sensor – see parts list for details). Tap the side of the membrane cap to remove any air bubbles that may have formed in the solution.

Reposition the vent seal, making sure that the vent hole is completely covered.

Fill up the G-holder with filling solution. Be careful that there are no bubbles.

Hold the electrode shaft upright and push the electrode finger carefully into the filled G-holder.

While holding the electrode shaft vertically with the G-holder in place, screw the filled membrane cap back on to the electrode shaft. Make sure not to press on the vent ring seal or cover the area of the vent hole with a finger when installing the membrane cap. Excess filling solution will escape from top or the vent in the membrane cap. Rinse off any filling solution that may have escaped during the installation with clean water.

Note: The G-holder is supplied and required for use with the chlorine probes and with the annual maintenance kits containing the M48 membrane cap. See parts list for details.

Note: When unscrewing the filled membrane cap from the electrode shaft, first remove the vent seal and ensure that the vent is not covered by a finger (air needs to be allowed through the vent hole to equalize the pressure).

Note: Make sure the membrane cap is tightly fastened to the electrode shaft ensuring that no gap remains between the electrode shaft and the membrane cap.

Note: It is best to wait 1 - 4 hours before the first calibration is performed. After one day repeat the calibration. See the MicroChem®2 electronics manual for calibration instructions.

Note: Calibration must be made with a continuous flow of liquid at 500 mL/min across the cell membrane.

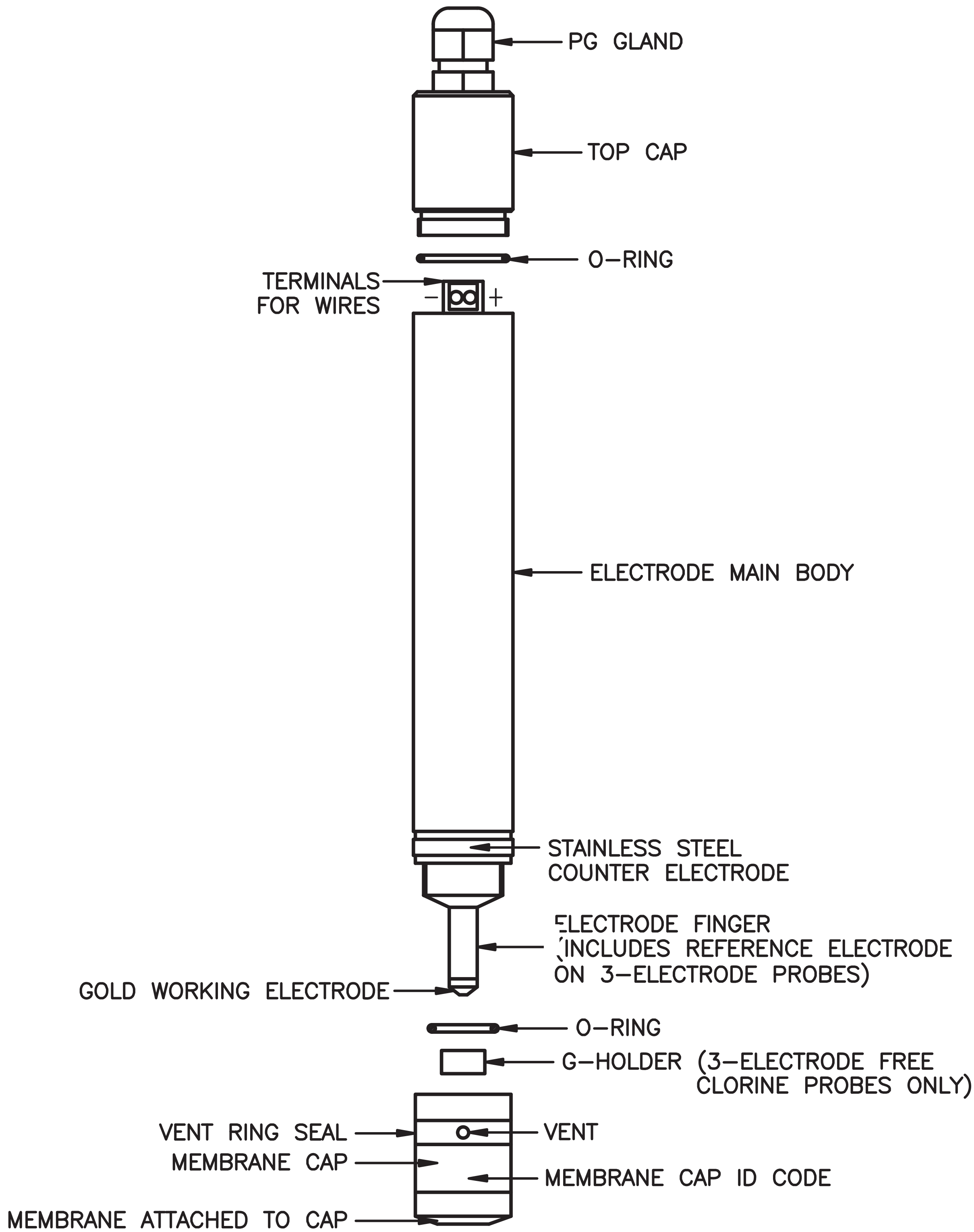


Figure 3 - Chlorine Probe Components.

2.4 Flow Cell

The probe is inserted through a fitting which includes a slide ring and o-ring. Loosen or disassemble the fitting to allow the probe to slide through the o-ring. The fitting may include a cap through which the probe cable must be fed. **Position the probe so it is about 1 inch (25 mm) from the bottom of the cell.** Tighten the fitting into the housing to compress the o-ring around the probe, providing a seal.

The inlet valve may be used to provide control the flow to the probe. It should be full open if the sample stream is controlled by other components.

The adapter to be used on the outlet from the cell and is dependent on the sample supply. The sample flow as noted in the section 1.4 is required. Excessive air in the sample may adversely affect the readings. The small orifice adapter may be used to provide back pressure to keep the air from outgasing from the sample stream.

2.5 Flow Regulation Components (See Figure 4)

To provide a sample to be measured for chlorine content with reduced potential for erratic readings and calibration problems, it is highly recommended that some or all of the components in Figure 4 are incorporated in the sample line. The Y-strainer is for particulate removal. The flow switch provides alarm when flow is not present. The remaining components through the back pressure assembly will ensure that you are providing the proper flow and pressure to allow optimum analysis. The back pressure assembly is used in applications where air bubbles effervesce from the sample.

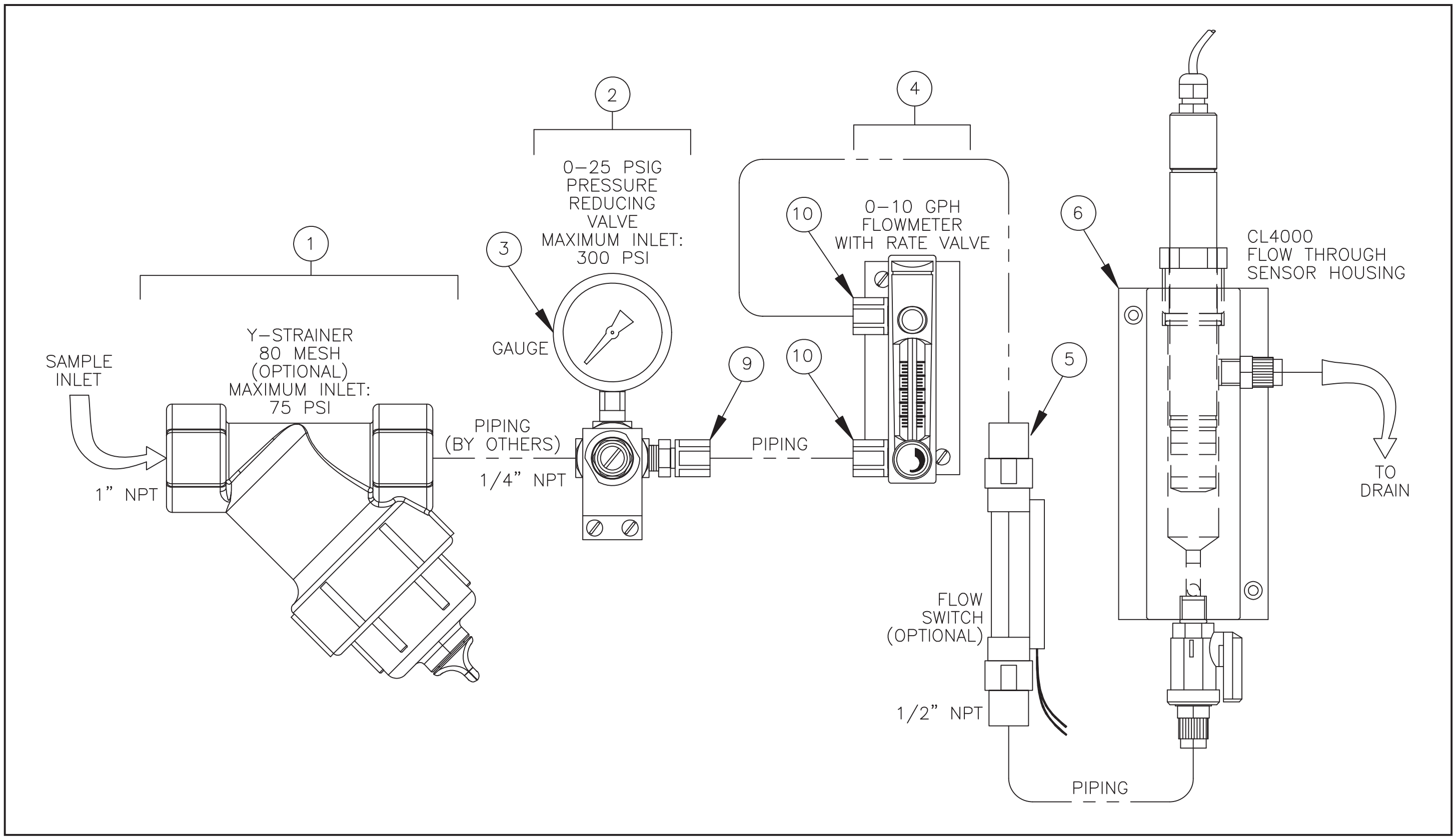


Figure 4 – Arrangement, Piping, CL4000 Sensor

Key	**Part Number**	**Description**
1	22901	Y-strainer - (optional) for particulate removal
2	22832 (See Note 1)	Pressure Reducing Valve, 0-25 PSIG
3	23101 (See Note 1)	Pressure Gauge, 0-15 PSIG, ¼" NPT SS
4	22834 (See Note 1)	Flowmeter with Rate Valve, 0-10 GPH
5	22896 (See Note 2)	Flow Switch
6	23411	CL4000 Flow Cell
9	23102	Fitting, ¼ MNPT x 5/16 Tube
10	23104	Fitting, 1/8 MNPT x 5/16 Tube 90 Deg

Notes:

1. Included in Flow Control Kit P/N 23068
2. Used to indicate if sample flow is present. For connection to external device or alarm contact.

2.6 Electrical

The chlorine probes are connected to the transmitter analog board at pin 5 and 6 AND to the 24v power supply terminals (see Figure 5). For more details on the analog board see the transmitter manual.

WARNING
The transmitter power **MUST** be switched **OFF** before the probe is attached.

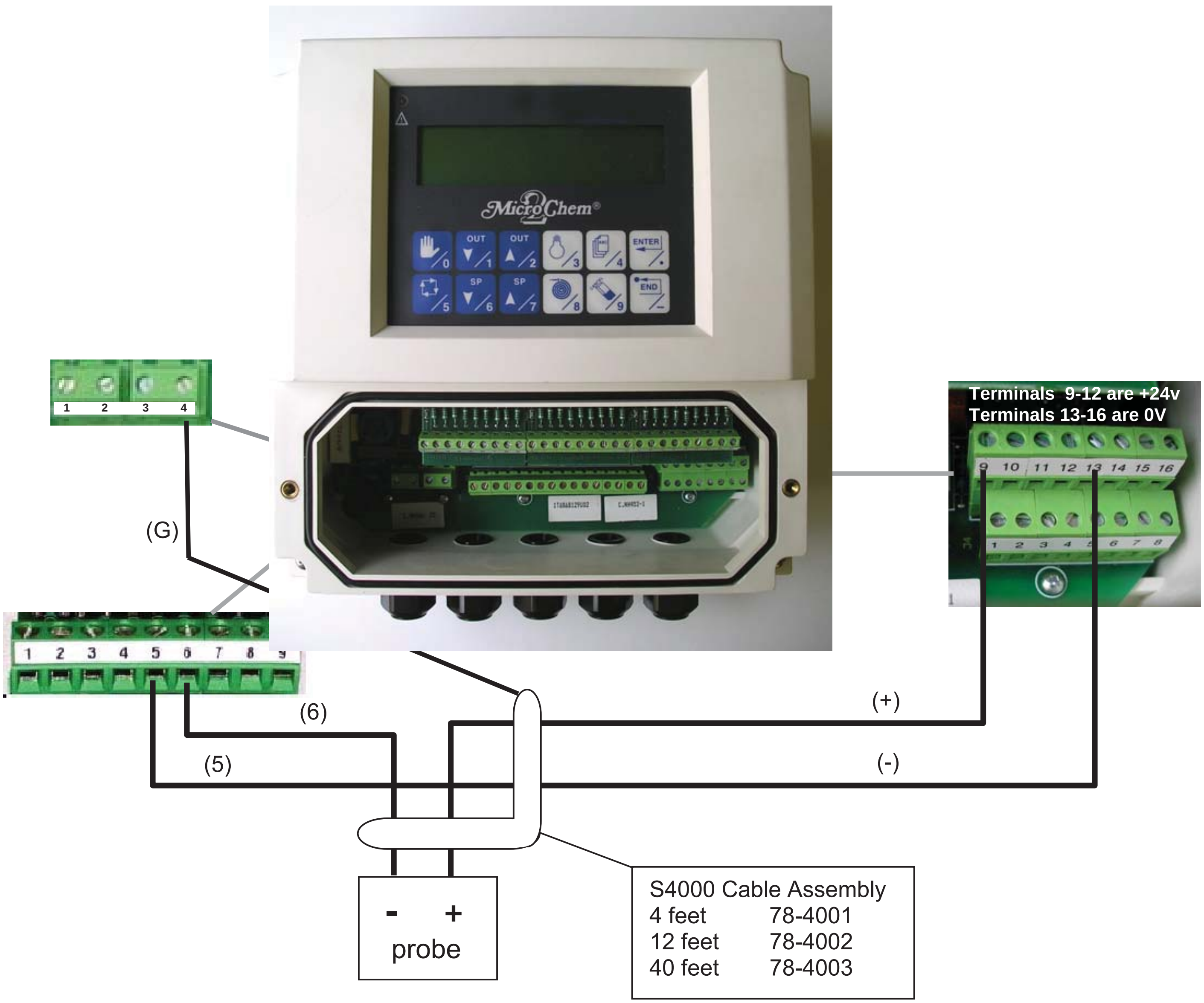


Figure 5 - Probe Cable Connections

WARNING
For proper operation of the chlorine probe, one of the above listed cable Assemblies must be used.

3 STARTUP

1. Check that the entire installation is connected properly. Check the electrode is properly connected via the supplied cable.
2. Configure the transmitter channel that the probe is connected to for CL (Chlorine). Select CL probe (mA) as the probe type. Set the probe range (0-2, 0-5 or 0-10 ppm) as indicated on the chlorine probe label. Refer to the MicroChem®2 Transmitter instruction manual for additional start-up information.
3. A calibration must be performed. Please find the instructions related to the procedure in the MicroChem®2 instruction bulletin.
4. Output from CL4000 probes is never below 3.8 mA. At start-up, the probes may have an output as low as 2 to 2.5 mA, but will rise to about 4 mA after half an hour. If output is less, the electrolyte will need to be changed and the gold probe cleaned. Momentary power losses will also result in low output, but will increase in about 30 minutes.

4 MAINTENANCE

4.1 Periodic Functional Check

The MicroChem®2 analyzer, like other analyzers, should be checked once per week to assure the best measurement accuracy.

4.2 Electrode Maintenance

There is very little maintenance required on a chlorine electrode. Periodically the electrode should be removed, and rinsed with de-ionised water.

CAUTION
Do not touch the tip of the electrode.

4.2.1 Electrode Membrane

The membrane cap needs to be replaced periodically (typically annually). The internal filling solution needs to be replaced at the same time (section 2.3)
Note: pay particular attention to the notes on removing the membrane cap.

If the membrane gets coated it is possible to clean it. Very carefully swirl the membrane in a 1% hydrochloric acid solution.

4.2.2 Cleaning the electrode surfaces

If the electrode has been stored for a long period of time the (gold) working electrode surface may become tarnished and require polishing.

Empty out the internal filling solution – (section 2.3). Dry the electrode finger carefully using a clean dry cloth .Holding the blue abrasive paper flat on a clean dry surface and holding the electrode body vertically move the tip of the electrode across the paper two or three times. Refill and reattach the membrane cap. (see section 2.3)

5 TROUBLE SHOOTING PROCEDURE

PROBLEM	PROBABLE CAUSE	CORRECTIVE ACTION
No indication	No power supply to the transmitter	Power the transmitter up or check the power supply fuse. Check power supply jumper setting.
Reading on Display is not in agreement with the chlorine level present in the sample	Faulty transmitter	Verify transmitter (especially analogue board)
	The sensor is not continuously in contact with the sample	Modify sensor installation
	The connection between the sensor and the transmitter is not correct.	Make correct connections
	Membrane is split or coated; internal filling solution contaminated or depleted	Replace membrane and filling solution
	The working electrode may be tarnished	Clean the electrode surface
	The chlorine cell has been selected rather than the chlorine probe. (RT Fault will be displayed with this error)	Reprogram the transmitter software
	The wrong chlorine range has been set up	Reprogram the transmitter software
Reading on Display is fluctuating or erratic	Not properly calibrated	Recalibrate P2
	Chlorine level is fluctuating	Check the process
	Sample flow rate is too low or variable	Resolve flow problems. Add Pressure Regulator and Flow meter for sample control.
	The sensor is not continuously in contact with the sample	Modify sensor installation
	Air bubbles in the sample	Eliminate the air bubbles or modify the installation
“RTD” Fault displayed	Incorrect chlorine channel definition – Wrong chlorine input selected	Refer to transmitter instruction manual. Select chlorine probe channel definition.

Design improvements may be made without notice.

Represented By:

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3.6 Recorder

invensys

Eurotherm

nanodac™

User Guide

nanodac™ recorder/controller
Versions 3 and later

HA030554/5
Feb 2012

Declaration of Conformity

Manufacturer's name:	Eurotherm Limited
Manufacturer's address:	Faraday Close, Worthing, West Sussex, BN13 3PL, United Kingdom
Product type:	Recorder / controller
Models:	nanodac Status level A1 and above
Safety specification:	EN61010-1: 2001
EMC emissions specification:	EN61326-1: 2006 Class B (100 to 230V ac supply) EN61326-1: 2006 Class A (24V ac/dc supply)
EMC immunity specification:	EN61326-1: 2006 Industrial locations

Eurotherm Limited hereby declares that the above products conform to the safety and EMC specifications listed. Eurotherm Limited further declares that the above products comply with the EMC Directive 2004/108/EC, and also with the Low Voltage Directive 2006/95/EC.

Signed: K Shaw Dated: 11/11/10

Signed for and on behalf of Eurotherm Limited.
Kevin Shaw
(R&D Director)

CE

IA249986U790 Issue 2 Oct 10 (CN26774)

Restriction of Hazardous Substances (RoHS)

Product group nanodac

Table listing restricted substances

Chinese

限制使用材料一览表

产品 nanodac	有毒有害物质或元素					
	铅	汞	镉	六价铬	多溴联苯	多溴二苯醚
印刷线路板组件	X	O	O	O	O	O
附属物	O	O	O	X	O	O
显示器	O	O	O	O	O	O
O	表示该有毒有害物质在该部件所有均质材料中的含量均在SJ/T11363-2006标准规定的限量要求以下。					
X	表示该有毒有害物质至少在该部件的某一均质材料中的含量超出SJ/T11363-2006标准规定的限量要求。					

English

Restricted Materials Table

Product nanodac	Toxic and hazardous substances and elements					
	Pb	Hg	Cd	Cr(VI)	PBB	PBDE
PCBA	X	O	O	O	O	O
Enclosure	O	O	O	X	O	O
Display	O	O	O	O	O	O
O	Indicates that this toxic or hazardous substance contained in all of the homogeneous materials for this part is below the limit requirement in SJ/T11363-2006.					
X	Indicates that this toxic or hazardous substance contained in at least one of the homogeneous materials used for this part is above the limit requirement in SJ/T11363-2006.					

Approval

Name:	Position:	Signature:	Date:
Martin Greenhalgh	Quality Manager	Martin Greenhalgh	11th APRIL 2010

IA029470U790/1 (CN26215)

nanodac Recorder/Controller

User Guide

List of sections

Associated documents

HA028838 Printable version of iTools Help
HA025464 EMC installation guidelines
HA027962 Printable version of 'Review' Help

Application notes

HA030817U001 Archiving data from the nanodac recorder/controller
HA030817U002 Heat/Cool with carbon potential or oxygen level monitoring
HA030817U003 Heat only temperature control and carbon potential control
HA030817U004 Virtual channels using the nanodac recorder/controller.

Software effectivity

This manual refers to instruments fitted with software version 3.0.
Software versions 2.20 onwards are 'backwards compatible' so that it can be used on all hardware versions of the unit.
Previous software versions are not compatible with instruments with hardware status greater than 2.
The status level may be found on the instrument label and consists of a letter indicating software status followed by a numeral indicating the hardware status (e.g. 'B2')

nanodac Recorder/Controller

User Guide

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SAFETY NOTES

WARNINGS

1. Any interruption of the protective conductor inside or outside the apparatus, or disconnection of the protective earth terminal is likely to make the apparatus dangerous under some fault conditions. Intentional interruption is prohibited.
2. Live sensors: The unit is designed to operate if the temperature sensor is connected directly to an electrical heating element. It must be ensured that service personnel do not touch connections to such inputs whilst the inputs are live. With live sensors, all cables, connections and switches for connecting the sensor must be mains rated for use in 240V Cat II.
3. Grounding the temperature sensor shield: Where it is common practice to replace the temperature sensor whilst the instrument is live, it is recommended that the shield of the temperature sensor be grounded to safety earth, as an additional protection against electric shock.
4. The instrument must not be wired to a three-phase supply with an unearthed star connection, because, under fault conditions, such a supply could rise above 240V RMS with respect to ground, thus rendering the instrument unsafe.

Notes:

1. Safety requirements for permanently connected equipment state:
   a. A switch or circuit breaker shall be included in the building installation.
   b. It shall be in close proximity to the equipment and within easy reach of the operator.
   c. It shall be marked as the disconnecting device for the equipment.
2. Recommended external fuse ratings are: 2A Type T 250V.

1. This instrument is intended for industrial temperature and process control applications within the requirements of the European directives on safety and EMC.
2. Installation may be carried out only by qualified personnel.
3. To prevent hands or metal tools coming into contact with parts that are electrically live the instrument must be installed in an enclosure.
4. Where conductive pollution (e.g. condensation, carbon dust) is likely, adequate air conditioning/filtering/sealing etc. must be installed in the enclosure.
5. The mains supply fuse within the power supply is not replaceable. If it is suspected that the fuse is faulty, the manufacturer's local service centre should be contacted for advice.
6. Whenever it is likely that protection has been impaired, the unit shall be made inoperative, and secured against accidental operation. The manufacturer's nearest service centre should be contacted for advice.
7. If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment might be impaired.
8. The unit must be wired according to the instructions in this manual.
9. Before any other connection is made, the protective earth terminal shall be connected to a protective conductor. The mains (supply voltage) wiring must be terminated in such a way that, should it slip, the Earth wire would be the last wire to become disconnected. The protective earth terminal must remain connected (even if the equipment is isolated from the mains supply), if any of the I/O circuits are connected to hazardous voltages*.
   The protective earth connection must always be the first to be connected and the last to be disconnected.
   Wiring must comply with all local wiring regulations, e.g. in the UK, the latest IEEE wiring regulations (BS7671) and in the USA, NEC class 1 wiring methods.
10. Signal and supply voltage wiring should be kept separate from one another. Where this is impractical, shielded cables should be used for the signal wiring.

* A full definition of 'Hazardous' voltages appears under 'Hazardous live' in BS EN61010. Briefly, under normal operating conditions, hazardous voltages are defined as being > 30V RMS (42.2V peak) or > 60V dc.

SAFETY NOTES (Cont.)

11. The maximum continuous voltage applied between any of the following terminals must not exceed 240Vac.
    1. Relay output to logic, dc or sensor input connections
    2. Any connection to ground.

    The ac supply must not be connected to sensor input or low-level inputs or outputs.
12. Over temperature protection: A separate over-temperature protection unit (with an independent temperature sensor) should be fitted to isolate the process heating circuit should a fault condition arise.

    Alarm relays within the recorder/controller do not give protection under all fault conditions/
13. In order to allow the power supply capacitors to discharge to a safe voltage, the supply must be disconnected at least two minutes before the instrument is removed from its sleeve. The touching of the exposed electronics of an instrument which has been removed from its sleeve should be avoided.
14. Instrument labels may be cleaned using iso-propyl alcohol, or water or water-based products. A mild soap solution may be used to clean other exterior surfaces.

USB DEVICE PRECAUTIONS

Note: the use of U3 USB Flash drives is not recommended.

1. Precautions against electrostatic discharge should be taken when the instrument terminals are being accessed. The USB and Ethernet connections are particularly vulnerable.
2. Ideally, the USB device should be plugged directly into the instrument, as the use of extension leads may compromise the instrument's ESD compliance. Where the instrument is being used in an electrically 'noisy' environment however, it is recommended that the user brings the USB socket to the front of the panel using a short extension lead. This is because the USB may 'lock up' or reset in noisy environments and the only means of recovery is to remove the device, then re-insert it. For memory sticks, EMC-related failure during a write operation might cause corruption of the data held on the stick. For this reason, the data on the memory stick should be backed up before insertion and checked after removal.
3. When using a USB extension cable, a high quality screened cable must be used. The total length of USB cable between the device and the USB port must not exceed 3 metres (10 ft.)
4. Most barcode readers and keyboards are not designed for use in industrial EMC environments, and their operation in such environments may result in impaired performance of the recorder/controller.

32-BIT RESOLUTION

Floating point values are stored in IEEE 32-bit single precision format. Values which require greater resolution than is available in this format are rounded up or down.

SYMBOLS USED ON THE RECORDER LABELLING

One or more of the symbols below may appear as a part of the recorder labelling.

	Refer to manual for instructions		Risk of electric shock
	This unit is CE approved		Precautions against static electrical discharge must be taken when handling this unit
	C-Tick mark for Australia (ACA) and New Zealand (RSM)		Ethernet connector
C US LISTED	Underwriters laboratories listed mark for Canada and the U.S.A.		USB connector
40	For environmental reasons, this unit must be recycled before its age exceeds the number of years shown in the circle.		Protective conductive terminal (Safety Earth)

1 INTRODUCTION

This document describes the installation, operation and configuration of a paperless graphic recorder/controller. The instrument comes, as standard with four input channels and is equipped, for secure archiving via FTP transfer and/or to USB memory stick.

1.1 UNPACKING THE INSTRUMENT

The instrument is despatched in a special pack, designed to give adequate protection during transit. Should the outer box show signs of damage, it should be opened immediately, and the contents examined. If there is evidence of damage, the instrument should not be operated and the local representative contacted for instructions. After the instrument has been removed from its packing, the packing should be examined to ensure that all accessories and documentation have been removed. The packing should then be stored against future transport requirements.

2 INSTALLATION

CAUTION

Before installation, ensure that the specified instrument supply voltage matches the facility supply.

2.1 MECHANICAL INSTALLATION

Figure 2.1 gives installation details.

2.1.1 Installation procedure

1. If it is not already in place, fit the IP65 sealing gasket behind the front bezel of the instrument.
2. Insert the instrument through the panel cutout, from the front of the panel.
3. Spring the retaining clips into place, and secure the instrument by holding it firmly in place whilst pushing both clips towards the rear face of the panel.
4. The protective membrane can now be removed from the display.

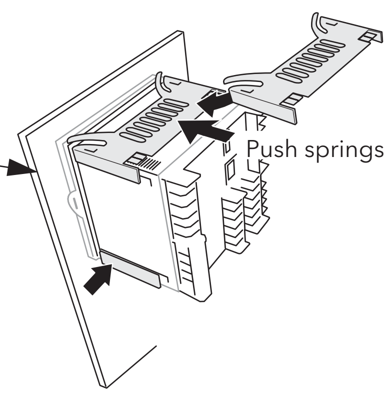


Figure 2.1.1 Securing the instrument

2.1.2 Demounting

WARNING

Before removing the supply voltage wiring, isolate the supply voltage and secure it against unintended operation.

1. Isolate the mains supply and secure it against accidental operation. Remove all wiring and the USB device and Ethernet cable (if any).
2. Remove the retaining springs by unhooking them from the sides using a small flat-blade screwdriver.
3. Pull the instrument forwards out of the panel.

Note: See section C1 (Battery replacement) for a more detailed description

2 MECHANICAL INSTALLATION (Cont.)

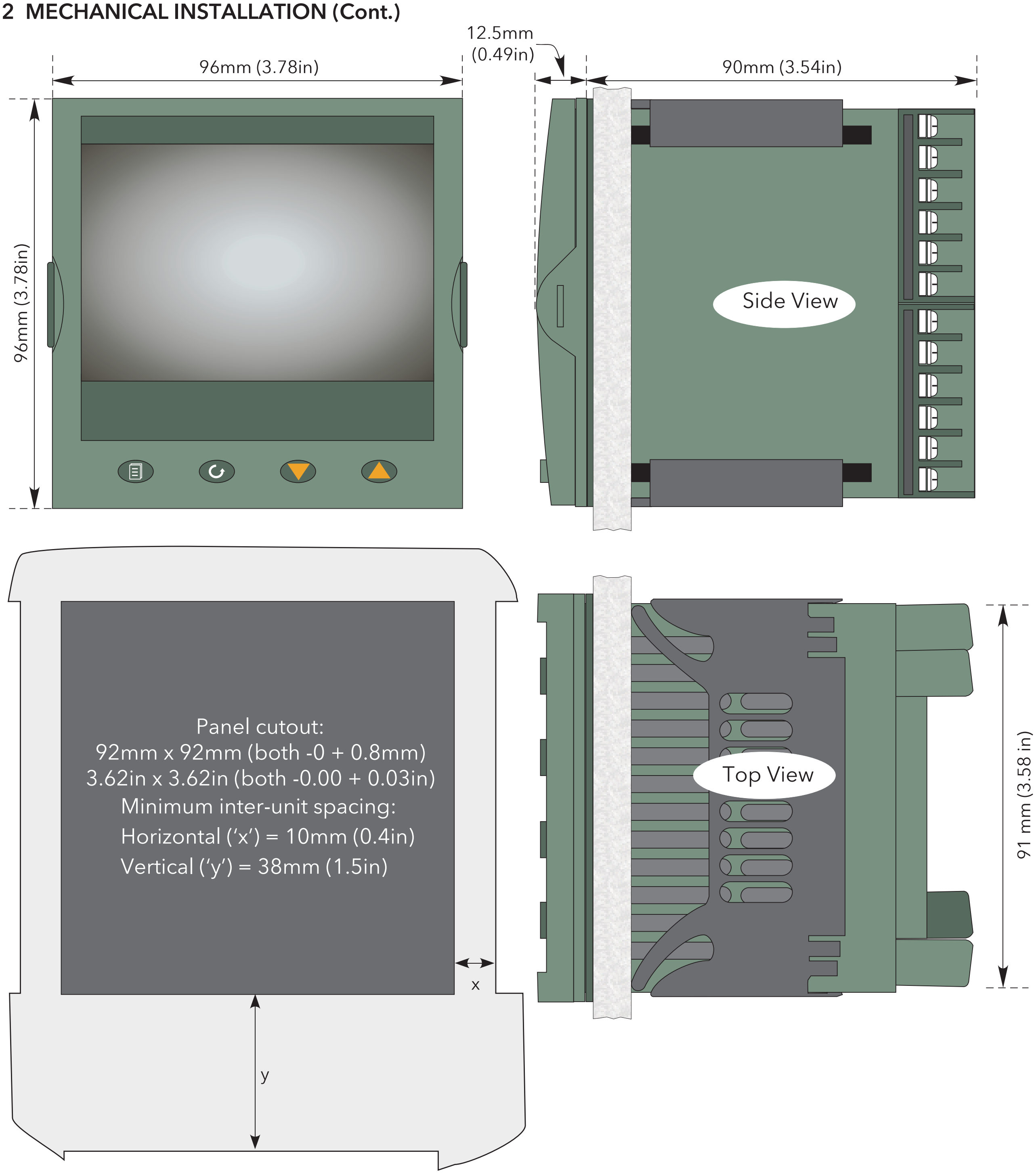


Figure 2.1a Mechanical installation details (standard case)

2.1 MECHANICAL INSTALLATION (Cont.)

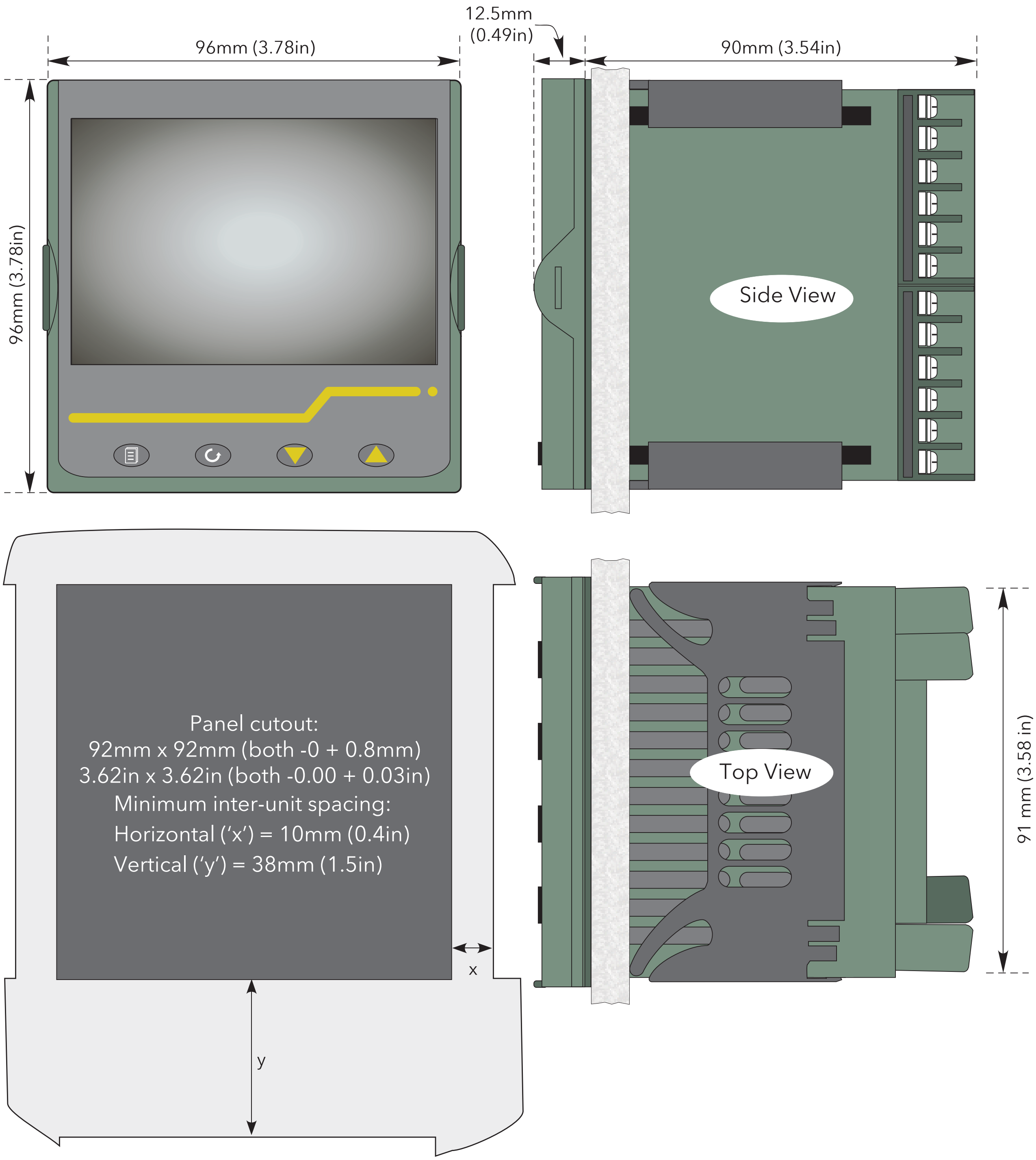


Figure 2.1b Mechanical installation details (wash down case option)

2.2 ELECTRICAL INSTALLATION

Figure 2.2 shows the locations of the various user terminations along with signal and supply wiring pinouts.

2.2.1 Termination details

The screw terminals accept single wires in the range 0.21 to 2.08 mm^2 (24 to 14 AWG) inclusive, or two wires each in the range 0.21 to 1.31 mm^2 (24 to 16 AWG) inclusive.

Screw terminals should be tightened to a torque not exceeding 0.4Nm (3.54 lb in)

2.2 ELECTRICAL INSTALLATION (Cont.)

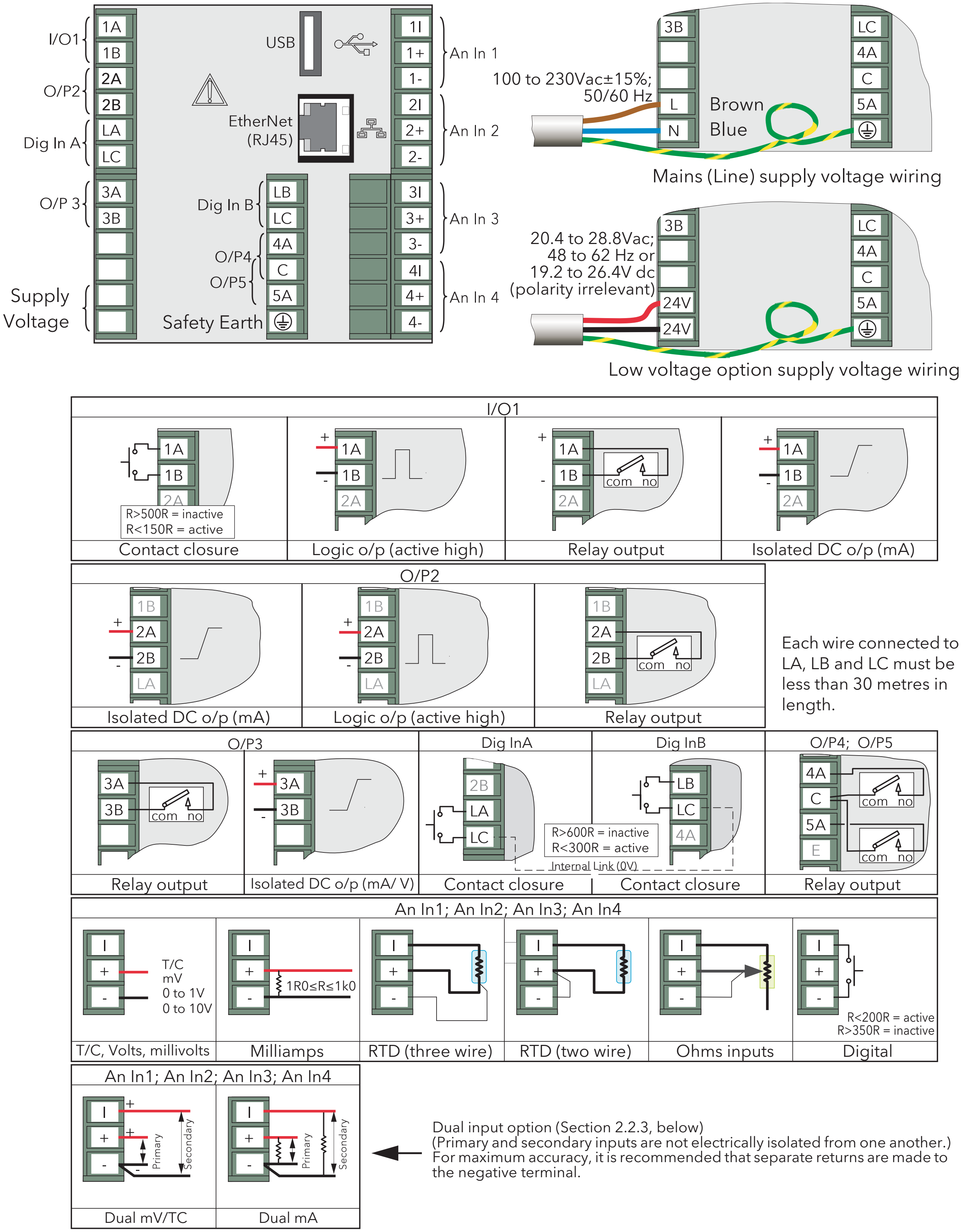


Figure 2.2 Connector locations and pinouts (rear panel)

2.2.2 Low Voltage option

This option allows the use of a low voltage ac or dc 24 V supply. The specification in Appendix A gives full details. The polarity of the dc supply connection is not important - it may be connected either way round.

2.2.3 Dual input option

This is a cost option, enabled on a channel-by-channel basis by means of entering the relevant password in the 'Feature3 Pass' field in Instrument.Security menu described in section 4.1.6.

For each enabled channel, a pair of thermocouple, mV or mA inputs can be connected to the instrument. These inputs are called 'primary' and 'secondary', and are terminated at the analogue input terminals (An In1 to An In 4) as shown in 'figure 2.2, above. The primary inputs 1 to 4 are assigned to channels 1 to 4, as normal. Each secondary input must be soft wired to a maths channel configured as Operation = 'Copy' if it is to be recorded/displayed/alarmed etc.

> Note: Due to the nature of the input circuit, a large offset may appear for secondary thermocouple inputs. This offset can be removed only by using the input adjust feature described in section 4.1.9. Because of this offset, the dual thermocouple input option is not suitable for AMS2750D applications

Soft wiring is described in Section 7.

Maths channels are described in section 4.5.1.

Channel configuration is described in section 4.4.1.

Input adjust is carried out as described in section 4.1.9

SAMPLE RATE

For dual input channels, both primary and secondary sample rate is reduced to 4 Hz (250ms) from the normal 8Hz (125ms).

SENSOR BREAK DETECTION

Input sensor break detection is not supported for secondary inputs. The internal circuit acts as a 'pull up' on the secondary input which therefore saturates high in the event of a sensor break.

DUAL MILLIAMP INPUT OFFSET CORRECTION

If 'Dual mA' is selected as input type, then an automatic offset correction will be made, according to the shunt value entered in channel configuration.

INPUT RANGE LIMITATION

There is no 10V range associated with the secondary input. Any input greater than +2V or less than -2V is deemed to be 'bad range'.

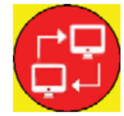
2.2.4 Modbus Master communications

The master instrument can be connected directly to up to two slaves using standard ethernet network cable either directly (single slave only) or via a hub or switch (one or two slaves). In either case, 'straight through' or 'crossover' cable may be used. The cable is terminated at the RJ45 socket at the rear of the unit.

2.2.5 EtherNet/IP

The Client and Server are connected in the same way as described above for Modbus Master communications, except that there can be only one client and one server.

3 OPERATION



On power up a default or custom (section 4.1.5) splash screen appears and remains visible whilst the unit is initialising. If during this process a network broadcast storm is detected, the unit stops, displaying a network failure icon until the broadcast storm has cleared, after which the initialisation process resumes.

3.1 INTRODUCTION

The operator interface consists of a display screen and four push buttons.

3.1.1 Display screen

The display screen is used both to display channel information (in one of a number of display modes), and to display the various configuration screens which allow the user to setup the recorder to display the required channels, to set up alarms and so on. Display modes are described in section 3.4, below; configuration is described in section 4.

In display mode, the screen is split horizontally into three areas (figure 3.1.1)

1. a faceplate giving channel details.
2. the main display screen showing channel traces etc.
3. the status area, displaying instrument name, the current time and date and any system icons.

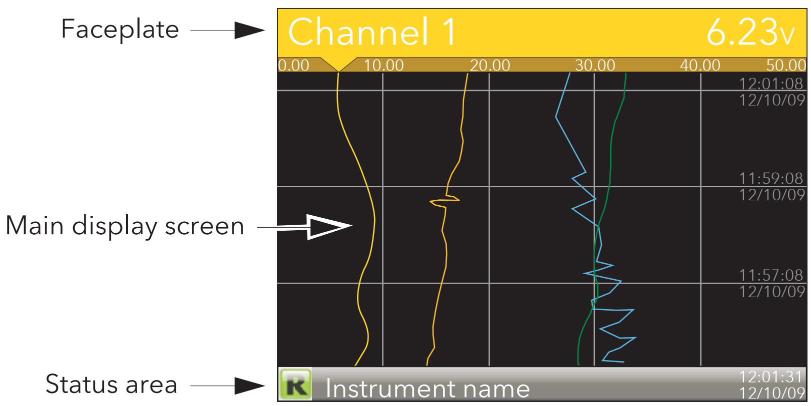


Figure 3.1.1 Display mode screen (vertical trend)

In configuration mode, the entire display screen is devoted to the selected configuration menu.

3.1.2 Navigation pushbuttons

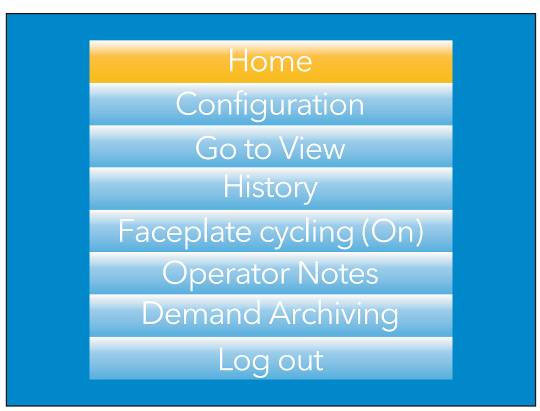


Figure 3.1.2 Top level menu (Engineer level access)

There are four navigation buttons, called 'Page', 'Scroll', 'Lower' and 'Raise' located below the screen. The general properties of these buttons are described in the remainder of this section, but some have additional, context sensitive functions, which, for the sake of clarity are not described here but in the relevant sections (e.g. 'Message summary') of the manual.

3.1.2 NAVIGATION PUSHBUTTONS (Cont.)

PAGE BUTTON 

From any non-configuration page, pressing this push button causes the top level menu (figure 3.1.2) to appear. The figure shows the menu for a user logged in with 'Engineer' level access. Other access levels may have fewer menu items.

Within configuration pages, the Scroll button can be used as an enter key to select lower menu levels. In such cases the page button is used to reverse this action, moving the user up one menu level per operation.

SCROLL BUTTON 

From trending pages, operation of the scroll push-button scrolls through the channels enabled in the group. The Faceplate cycling 'Off' selection can be used to keep a particular channel permanently displayed, and the scroll pushbuttons can then be used to select channels manually.

In configuration pages, the scroll key operates as an 'enter' key to enter the next menu level associated with the highlighted item. Once the lowest menu level is reached, operation of the scroll key allows the value of the selected item to be edited by the relevant means (for example, the raise/lower keys, or a keyboard entry).

The 'Page' key is used to move the user back up the menu structure, until the top level menu is reached, when the scroll key can be used again to return to the Home page.

The scroll button is also used to initiate user wiring as described in section 7

RAISE/LOWER BUTTONS  

Within trending displays, the Raise and Lower keys can be used to scroll through the enabled display modes in the sequence: vertical trend, horizontal trend, vertical bargraph, horizontal bargraph, numeric, vertical trend... and so on.

Within configuration pages, these pushbuttons act as cursor keys, allowing, for example, the user to highlight menu items for selection using the scroll button, and in many cases allowing the user to select one from a number of alternative values within menu items. Theses keys are also used to navigate through the virtual keyboards (section 3.6) and number pads used to enter text or numeric strings.

3.1.3 On screen help

The top level configuration menu includes contextual help text on the right-hand half of the screen. Mostly this text fits within on screen height. Where this is not the case, the text can be moved up or down the screen by holding the Page button operated whilst using the up and down arrows to move the text.

The down arrow moves the text upwards on the screen; the up arrow moves it downwards.

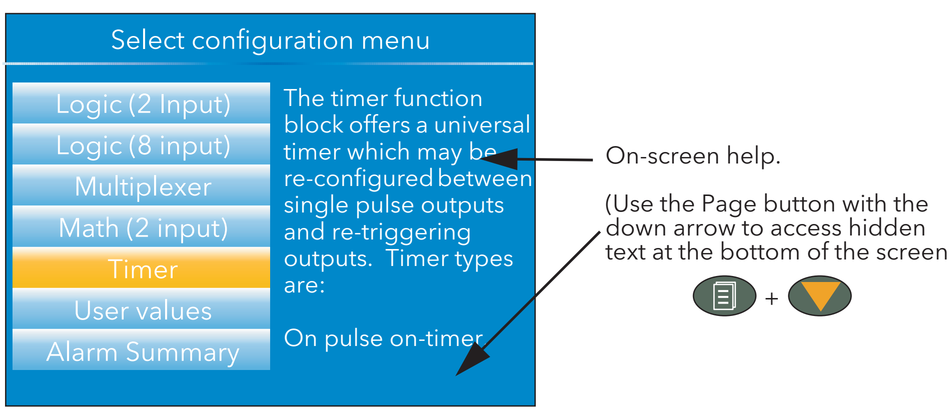


Figure 3.1.3 On-screen help (typical)

3.2 PROCESS VARIABLE DISPLAY

As discussed above, the operator interface consists of a display screen and associated push buttons. The display screen shows process variables in one of a number of formats, or operational details (notes or alarm history for example), or configuration details for use in setting up the recorder to produce the required displays and history formats. The remainder of section three discusses the process variable displays, alarm displays and so on; configuration details are to be found in section 4.

> Note: Some of the items below can be selected for use only by users with a suitable permission level as set up in the 'Instrument' 'Security' menu described in section 4.1.6

Figure 3.2 below, depicts a typical trend display and gives details of the various areas of the display page.

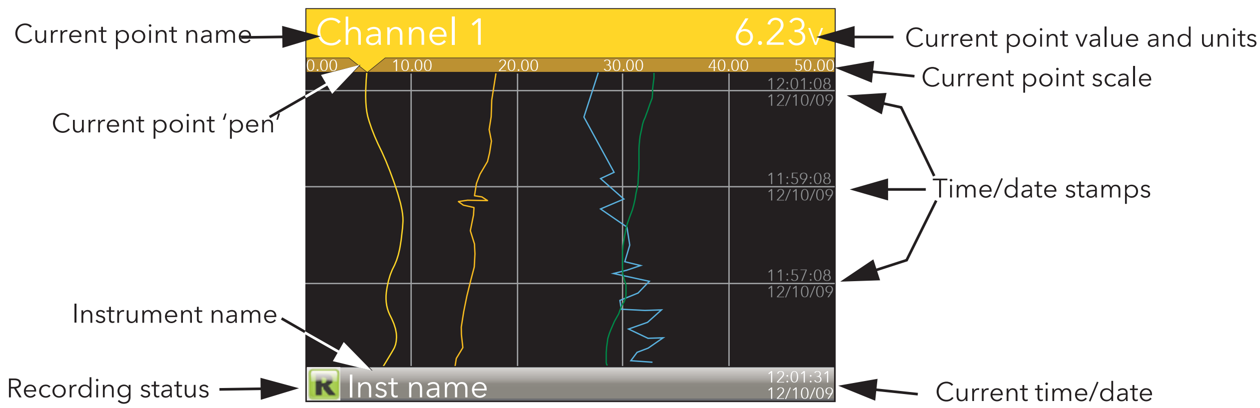


Figure 3.2 Typical display screen (Vertical trend)

Figure 3.2 shows a vertical trend page. Operating the Raise/Lower push-buttons allows the user to scroll through the other display modes: Horizontal trend, Vertical bargraph, horizontal bargraph, numeric, vertical trend... and so on. All these display modes are described in section 3.4, below.

A display mode can also be selected from the Top level menu 'Go To View' item which appears when the 'Page' key is operated.

The scroll button can be used to scroll through the points in the group, overriding the 'Faceplate Cycling' on or off selection

3.2.1 Alarm icons

> Notes:
> 1. A full discussion of alarms is given in the Channel Configuration section of this manual (section 4.4.3)
> 2. Trigger alarms do not display threshold marks or bars, or faceplate symbols

The alarm icons shown below appear in some display modes. The icons on a channel faceplate show the status of that channel's alarm(s), as follows:

Icon is flashing	alarm is active but unacknowledged or it is an Auto alarm which is no longer active but which has not been acknowledged
Icon steadily illuminated	the alarm is active and has been acknowledged.

Alarm thresholds and deviation alarm bars appear for horizontal and vertical trend modes. For deviation bars, the bar stretches from (Reference - Deviation) to (Reference + Deviation). Vertical and Horizontal bargraph modes display only absolute alarm symbols.

3.2.1 ALARM ICONS (Cont.)

Absolute High
Absolute Low
Deviation High
Deviation Low
Deviation Band
Rising Rate of change
Falling Rate of change
Digital High
Digital Low

Table 3.2.1 Alarm icons

3.2.2 Status bar Icons

The following items can appear in a dedicated window immediately to the left of the time and date, at the bottom right-hand corner of the display. The width of this window expands as the number of icons increases, and the instrument name is truncated, as necessary, to make room.

SYSTEM ALARMS

This indicator appears, flashing, if any one or more of the alarms listed below is active. The System Alarms summary page (accessed from 'Go to View in the top level menu) allows the user to view such system alarms as are active. It is not possible to 'acknowledge' system alarms

Archive Disabled	An unattended archiving strategy has temporarily been disabled.
Archiving Failed	An unattended archiving strategy has failed to complete.
Archiving Timeout	A configured archiving strategy has timed out.
Battery failure	Indicates that the battery is approaching the end of its useful life, or that it is missing or is completely exhausted. Immediate battery replacement is recommended (Appendix C; section C1).
Broadcast Storm detected	Networking is limited until the storm has passed.
Clock failure	The internal clock was found to be corrupt at power up, or that the time has never been set. Time is forced to 00:00 1/1/1900. Can be caused by battery failure, in which case a battery failure message appears. The error is cleared by setting the time and date.
Channel error	Indicates a hardware failure in the channel circuit or in the internal cold junction temperature measurement.
Database failure	Corrupted EEPROM or flash memory.
DHCP Server failure	For units with 'IP Type' set to 'DHCP' (Network.Interface configuration) this alarm occurs if the instrument is unable to obtain an IP address from the server.
FTP Archiving file lost	A file has been deleted that had not yet been archived. Possible causes: Communications with the server could not be established,; archive is disabled; archive rate too slow.
FTP Archiving to slow	The archive rate is too slow to prevent the internal memory from overflowing. The recorder effectively switches to 'Automatic' (Section 4.2.2) to ensure that data is not lost.

(Continued)

3.2.2 STATUS BAR ICONS (Cont.)

FTP Primary Server Failure	This error occurs if the recorder fails to establish connection with the primary server, after two attempts. After the second attempt fails, the recorder attempts to establish connection with the secondary server instead. Primary and secondary server details are entered in the Network.Archiving area of configuration (Section 4.2.2).
FTP Secondary Server Failure	This error occurs if the recorder fails to establish connection with the secondary server, after two attempts. Primary and secondary server details are entered in the Network.Archiving area of configuration (section 4.2.2).
Maths channel failure	Appears if, for example, the divisor of a divide function is zero.
Media archiving file lost	A file has been deleted that had not yet been archived. Possible causes: Memory stick missing, full or write protected; archiving has been disabled; archiving rate too slow.
Media archiving to slow	The archive rate is too slow to prevent the internal memory from overflowing. The recorder effectively switches to 'Automatic' (Section 4.2.2) to ensure that data is not lost.
Media full	Archive storage device is full. The alarm becomes active only when an archive is in progress.
Media missing	No archive storage device present when archive attempted.
Non-volatile memory failure	RAM copy of non-volatile parameters is corrupted.
Non-volatile Write Frequency warning	One or more parameters are being written frequently to non-volatile memory. If this continues, it may lead to 'memory depletion' (i.e. the memory will no longer be able to store values correctly). A common cause of this problem is frequent writes over Modbus comms.
Recording failure (message)	Message explains reason for failure.
USB overcurrent	USB power fault - too much current (i.e. >100mA) is being drawn by a USB device.
Wiring failure	The user wiring has failed to verify, i.e. one or more wires has been detected that does not have both a source and a destination defined. This may be the result, for example, of power loss during a download from iTools.

CHANNEL ALARM 

This indicator appears if any channel (including channels not in the display group) is in an alarm state. The symbol is illuminated continuously if all alarms are acknowledged or flashes if any one or more alarms is unacknowledged. Alarms are acknowledged from the Root menu 'Alarm summary' item as described in section 3.3.3 or in the Channel configuration area (Section 4.4.3) if the user's access permission is appropriate.

USB

This icon appears whenever a memory stick (max. capacity 8GB) or other supported USB device (section 8) is plugged into the USB port at the rear of the recorder.

When data transfer is in progress between the instrument and the memory stick, the icon changes to a 'busy' version.

CAUTION

The Memory stick must not be removed while archiving (demand or automatic) is in progress, as to do so may irreparably damage the file system of the memory stick, rendering it unusable. It is recommended that all archiving be suspended before the memory stick is removed.

	Memory stick fitted
	Transfer in progress

FTP ICON 

The FTP icon appears whenever transfer activity is taking place.

3.2.2 STATUS BAR ICONS (Cont.)

RECORD ICON

One of four icons appears at the bottom left corner of the display to indicate recording status.

Record 

This indicates that the recorder is recording the items selected in the Group Recording area of configuration (section 4.3).

Stopped 

This means that 'Enable' has been set to 'no' in the Group Recording area of configuration (section 4.3). Trending is not affected.

Paused (Suspended) 

This means that recording has been paused by a wire to the Suspend parameter (Group Recording area of configuration (section 4.3)) going true (high). Trending is not affected.

In Configuration 

The recorder has been placed in configuration mode either at the user interface, or via iTools. Recording is stopped until the recorder is no longer in configuration mode. For each non-recording state (Stopped, Paused or In Configuration). A new history file is created when the unit comes out of configuration mode.

Note: For recording to be enabled, configuration status must be 'logged out' both at the instrument and at iTools.

MESSAGE ICON

This 'envelope' icon appears when a message is generated and it remains on display until the Message Summary is accessed, when it is removed from the display until the next new message is generated.

AUTOTUNE ICON 

For instruments fitted with the Loop option, this symbol appears during the Autotune process.

3.2.3 Breaks in recording

Breaks in recording can be caused by the unit being powered down, by the user entering configuration mode or when the recorder time is changed manually. In vertical and horizontal trend modes, a line is drawn across the width/height of the chart to indicate that recording has been interrupted.

On power up, a red line is drawn across the chart. In 'History', if messages are enabled the message:

`Date Time System power up`

is printed on the chart, together with the configuration and security revisions.

On exiting configuration mode, a blue line is drawn on the chart and in 'History', if messages are enabled, the messages:

`Date Time Logged out.`

`Date Time Config Revision: N was N-1` (assuming a configuration change was made)

`Date Time Logged in as: Engineer`

appear on the chart.

When the instrument time is changed (manually - not through daylight saving action) a green line is drawn on the chart and in 'History', if messages are enabled, the message:

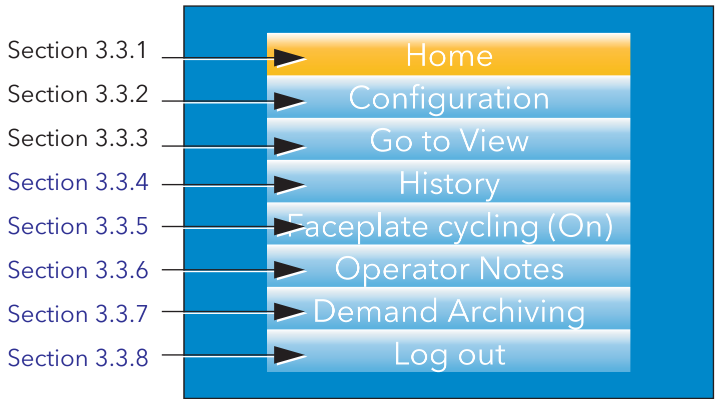
`Date Time Time/Date changed`

appears on the chart.

3.3 TOP LEVEL MENU

This menu appears when the page key is operated from any non-configuration page. The menu items displayed depend on the access permission of the user. One of the menu items is highlighted, and if the scroll key is operated, then it is the highlighted item that is 'entered'.

Figure 3.3 shows the top level menu for Engineer level access.



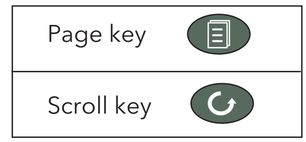


Figure 3.3 Top level menu

3.3.1 Home

Operating the scroll key whilst 'Home' is highlighted causes a return to the 'Home' page. By default, this is the vertical trend mode, but the mode can be changed in 'Instrument.Display' configuration (section 4.1.3)

3.3.2 Configuration

Operating the down arrow key highlights the 'Configuration' item. Operating the Scroll key enters the configuration submenu described in section 4 of this manual.

Note: 'Configuration' appears only if the user has an appropriate access level.

3.3.3 Go to View

Operating the scroll key whilst the 'Go to view' item is highlighted, calls the Go to view submenu (figure 3.3.3a). This allows the user to view channel alarms, system alarms, messages or to select a different display mode.

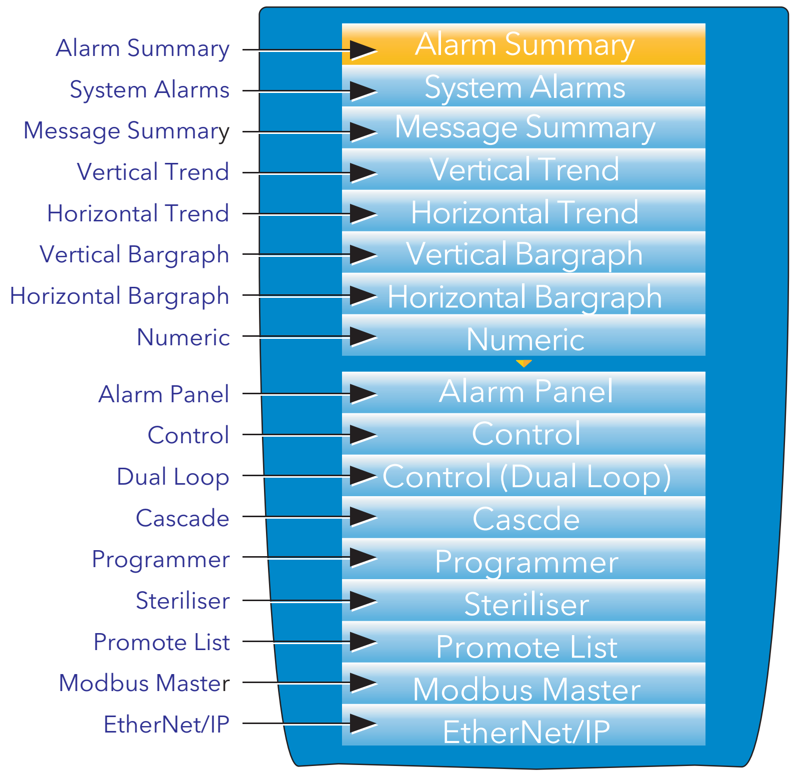


Figure 3.3.3a Go to view submenu

Notes:

1. If an option (e.g. 'Steriliser') is not fitted, its display mode does not appear in the list.
2. Some display modes must be enabled in Instrument.View configuration (section 4.1.3) before they become available.

3.3.3 GO TO VIEW (Cont.)

ALARM SUMMARY

For each active alarm, this page displays the channel identifier with alarm number (e.g. C1(2) = channel 1; alarm 2), the channel descriptor, the alarm threshold the current process value and an alarm type symbol.

To return to the top level menu, operate the Page key.

Notes:
1. The background colour to the channel ID is the same as that chosen for the channel.
2. A prefix 'C' in the channel ID means that this is a measuring channel; A prefix 'V' means that this is a virtual channel (i.e. a totaliser, counter or maths channel)

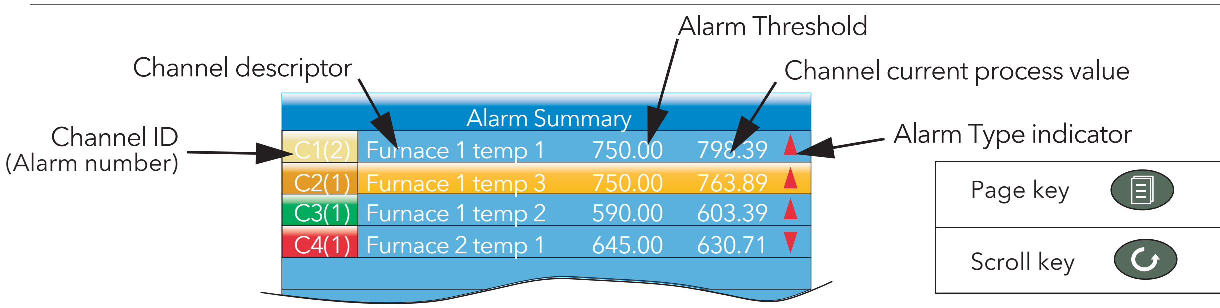
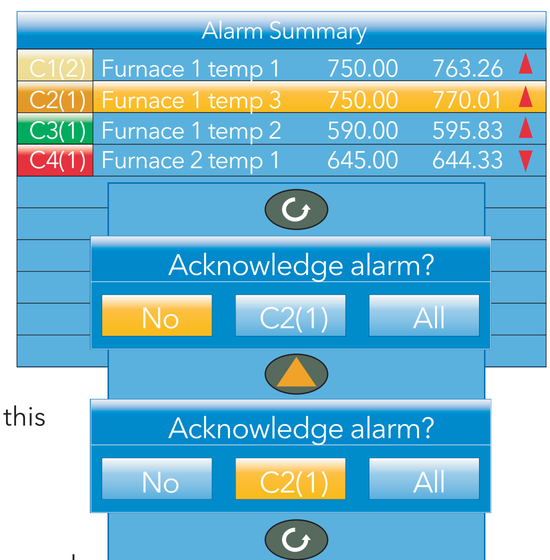


Figure 3.3.3b Alarm summary page with acknowledge confirmation display

ALARM ACKNOWLEDGEMENT

To acknowledge an alarm from this view:

1. Use the up and down arrows to highlight the required alarm



2. Operate the scroll button. The 'Acknowledge alarm' window appears.
3. Use the up arrow to highlight the relevant field (C2(1) in this example), or 'All' if all alarms are to be acknowledged.
4. Operate the scroll key to confirm. If the alarm fails to respond, this may be due to the fact that it has been configured as a 'Manual' alarm, and the trigger has not yet returned to a 'safe' (non-alarm) state, or it could be that the instrument is in a logged out state.

SYSTEM ALARMS

Operating the scroll button whilst the 'System Alarms' field is highlighted displays a list of all currently active system alarms. Section 3.2.2 contains a list of system alarms and their interpretations. To return to the top level menu, operate the Page key.

A further operation of the scroll button displays a 'Help Information' page, giving the reason for the high-lighted alarm.

Operate the scroll button again to return to the system alarm display.

3.3.3 GO TO VIEW (Cont.)

MESSAGE SUMMARY

Operating the scroll key whilst the 'Message summary' field is highlighted displays the10 most recent messages.

Operating the scroll key whilst a message is highlighted shows the selected message in more detail (and using the up/down keys allows the other messages to be scrolled through). Whilst in this mode, operating the scroll key again, allows the user to choose to jump to the message's location in trend history mode (section 3.5) or to return to the summary page.

By default, the interface is set up such that:

1. all message types are included
2. the up and down arrow keys cause the highlighted selection to move up or down by one message at a time.

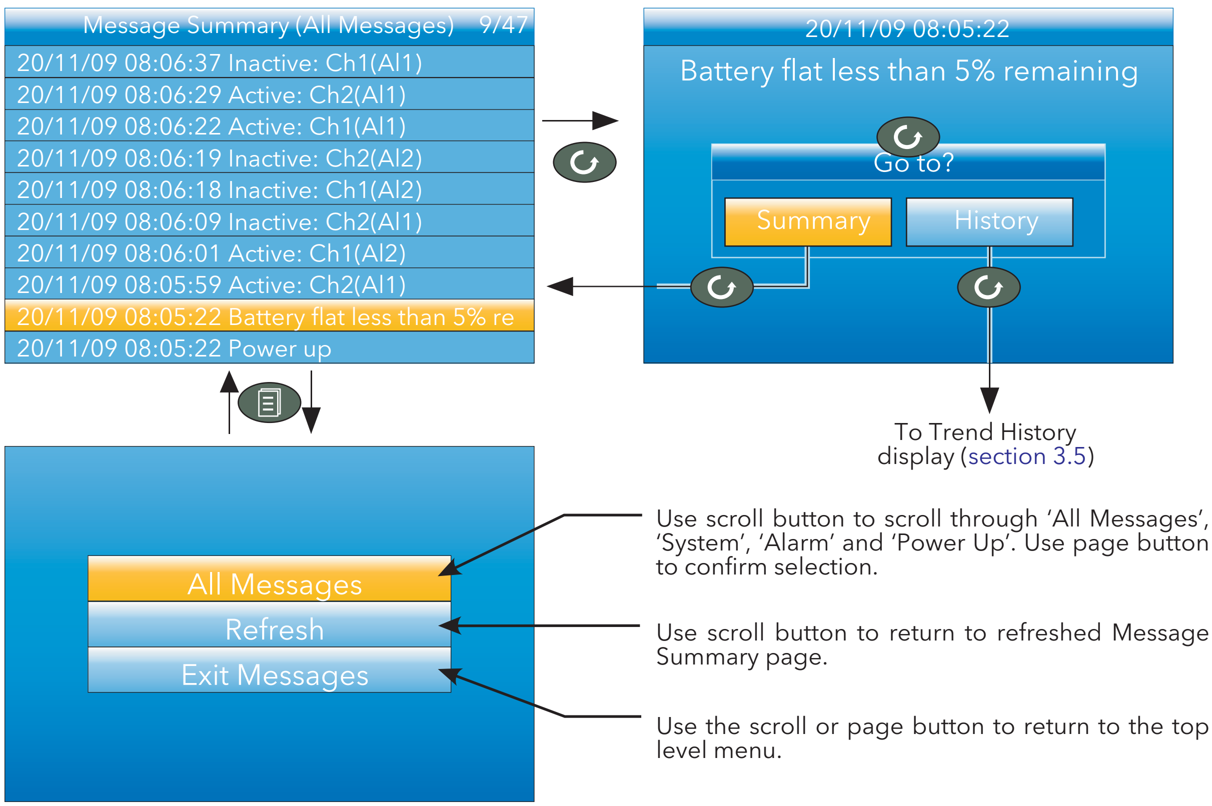


Figure 3.3.3c Message summary features

MESSAGE FILTERS

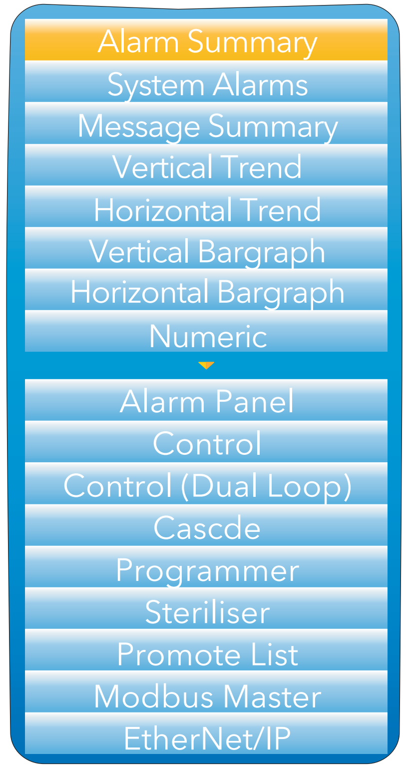
All Messages	Causes all messages to be displayed on the screen.
System	Shows only system alarms
Alarm	Shows only channel alarms
Power up	Shows only power up messages
Login/out	Limits the display to Log in and Log out events.

3.3.3 GO TO VIEW (Cont.)

DISPLAY MODE SELECTION

Use the up/down arrow buttons to highlight the required display mode. Once the required display mode is highlighted, operation of the scroll button causes the recorder to leave the 'Go to View' menu and to display channel values in the selected mode. See section 3.4 for a description of the various display modes.

Alternatively the up and down arrow buttons can be used from any of the display modes to cycle through the available modes in the order listed in the figure.



Notes:
1. If an option (e.g. 'Steriliser') is not fitted, its display mode is not available for selection.
2. Some display modes must be enabled in Instrument.Display configuration (section 4.1.3) before they become available.

3.3.4 History

This top level menu item allows the user to switch from real-time trending to review mode, where channel values, messages, alarm triggers etc. can be viewed back as far as the last significant configuration change. History mode is fully discussed in section 3.5.

3.3.5 Faceplate Cycling on/off

For the purposes of this document the channel whose faceplate is currently displayed and whose 'pen' symbol is visible is called the 'Active' channel.

By default, the recorder scrolls through all the channels in the display group, with each channel becoming the active channel in turn. This top level menu 'Faceplate Cycling' item allows the user to inhibit this scrolling action such that the currently active channel remains active permanently, or until a manual scroll is performed using the scroll button (or until Faceplate Cycling is re-enabled).

'Faceplate Cycling' is highlighted by using the up/down arrow buttons. Once highlighted, the status can be changed from 'On' to 'Off' or vice-versa using the scroll button. Operation of the 'Page' button returns the user to the trend display.

3.3.6 Operator Notes

This area allows up to 10 notes to be created when logged in as Engineer, using either the text entry techniques described in section 3.6, or 'iTools' described in section 6. Once logged out, operating the scroll button whilst a note is highlighted calls a selection box allowing the user either to send that note to the chart, or to write a Custom Note.

CUSTOM NOTE

The Custom Note is written using the text entry techniques described in section 3.6. Once the note is complete, operation of the page button calls a confirmation display. The down arrow is used to highlight 'Yes', and when the scroll key is then operated, the message is sent to the chart. This custom message is not retained for further use, so if it is required on a regular basis, it is suggested that one of the Operator Notes 1 to 10 be configured (Engineer access level required) so that it may be used instead.

Note: Each note can contain up to 100 characters.

3.3.7 Demand Archiving

This allows a user, with a high enough access level, to archive a selected portion of the recorder history, either to a 'memory stick' plugged into the USB port at the rear of the recorder (Local Archiving), or to a pc, by means of the FTP protocol (Remote Archiving). The archived data remains in the flash memory of the instrument. When the flash memory is full, new data causes the oldest file(s) to be discarded.

The up and down arrow keys are used to navigate to the required field.

3.3.7 DEMAND ARCHIVING (Cont.)

ARCHIVE MENU

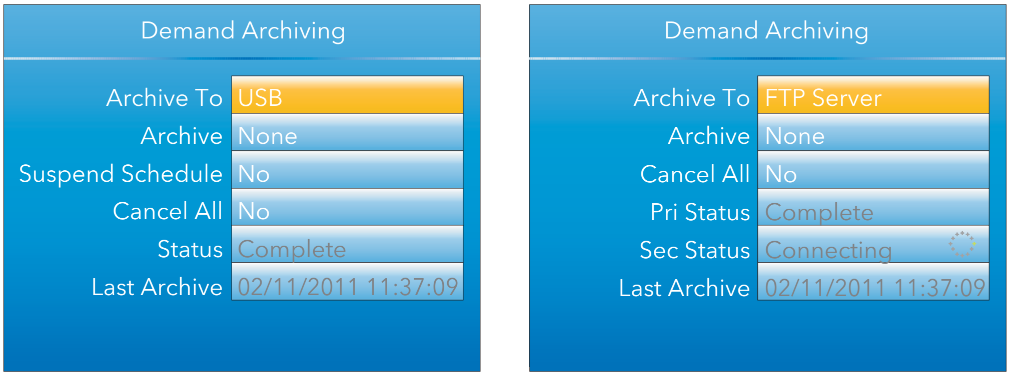


Figure 3.3.7 Demand Archiving menu (Local Archiving on left; Remote Archiving on right)

Archive To	With this item highlighted, the scroll button and the up/down arrows can be used to select 'USB' or 'FTP Server'. For 'USB', the archive will be made to the rear USB memory stick. For 'FTP Server' the archive will be made to the Primary or Secondary server (configured in the Network.Archive area of configuration described in section 4.2.2). For more details about remote archiving, see 'Remote archiving', below.
Archive	In a similar way, select the archive period: None: No archiving to take place. (Not editable when logged out) Last Hour: Archives all files created within the last 60 minutes. Last Day: Archive all files created in the last 24 hours. Last Week: Archives all files created in the past seven days. Last Month: Archives all files created in the past 31 days. Archive All: Archives all the files in the recorder's history. Bring To Date: Archives all files created or updated since the 'Last Archive' date and time.
Suspend Schedule	When set to 'Yes', automatic (scheduled) archiving is stopped, once the transfer of the current file is complete. Suspend Schedule must be set to 'No' again, to restart the suspended archive. Suspend can be used to allow the memory stick to be removed and re-fitted safely.
Cancel All	When set to 'Yes', this cancels USB archiving activity immediately, or cancels FTP archiving once transfer of the current file (if any) is complete.
Last Archive	Shows the date and time at which the last archive (demand or automatic) was attempted. If a demand archive is requested, or is in operation when an automatic archive is triggered, the automatic archive takes precedence.
Status	For Archive to USB only 'Complete' means that no archiving is currently taking place. 'Transferring' indicates that an archiving is in progress. Accompanied by an animated circular display. 'Suspended' means that archiving has been suspended as requested.
PriStatus	For Archive to FTP Server only, this shows the transfer status between the instrument and the primary host computer.
SecStatus	For Archive to FTP Server only, this shows the transfer status between the instrument and the secondary host computer.

3.3.7 DEMAND ARCHIVING (Cont.)

FTP SERVER ARCHIVING

This allows the archiving of recorder files to a remote computer via the RJ45 type connector at the rear of the recorder, either directly or via a network.

In order to carry out a successful transfer:

1. Details of the remote host must be entered in the Network.Archive area of configuration (section 4.2.2).
2. The remote computer must be set up as an FTP server. Help from the user's IT department may be necessary in order to achieve this. Appendix C, Section C2 to this manual suggests one way, using Filezilla.
3. The remote computer must also be set up to respond to 'pings'. This is because the instrument pings the host whilst establishing connection, and if it does not receive a response the archive attempt fails.

When accessing files using Microsoft® Internet Explorer, the address (URL) field can be in one of two formats:

1. ftp://<instrument IP address>. This allows a user to log in as the anonymous user (if the recorder has any account with the user name set to 'anonymous' with a blank password.
2. ftp://<user name>:<password>@<instrument IP address> to log in as a specific user.

For IE5 users, Microsoft® Internet Explorer displays, by default, history files only. To quit the history folder, either uncheck the Tools/Internet Options/Advanced/Browsing/'Enable folder view for FTP sites' option, or check the Tools/Internet Options/Advanced/Browsing/'Use Web based FTP' option.

REVIEW SOFTWARE

'Review' is a proprietary software package which allows the user to extract 'archive' data from one or more suitable instruments* and to present this data on a host computer, as if on a chart, or as a spreadsheet. The host computer must be set up as an ftp server (see Appendix C section C2 for a description of one way of doing this).

As described in the Review help system, 'Review' allows the user to set up a regular transfer of data (using ftp) from connected instruments into a database on the pc, and then from this database to the chart or spreadsheet. The chart/spreadsheet can be configured to include one or more 'points' from one or all connected instruments (where a 'point' is an umbrella term for channel, totaliser, counter etc.).

It is also possible to archive instrument history files to a memory stick, Compact Flash card etc. (depending on instrument type) and to use this to transfer the data to the pc.

Each type of instrument has its own remote user name and password configuration - for this instrument, the user name and password are both 'history and they are not editable.

*Suitable instruments are connected instruments, the archive files of which have the suffix '.uhh'.

3.3.8 Login

Login allows the user to enter a password in order to gain access to areas of the unit's configuration which are not available when the user is logged out.

LOGGED OUT ACCESS LEVEL

Logged out mode allows the user to select viewing mode, to view history, to view alarms, to toggle faceplate cycling on and off, to send notes, to suspend/resume USB archiving and to access the login process.

OPERATOR ACCESS LEVEL

In addition to the logged out features, Operator access level allows the user to acknowledge alarms, to edit notes and to perform demand archive operations.

By default, no password is required in order to enter Operator level, but a password can be set either at Supervisor level or at Engineer level.

3.3.8 LOGIN (Cont.)

SUPERVISOR ACCESS LEVEL

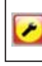
In addition to the logged out level function, this access level allows the user to view the recorder's configuration, and to edit some values (such as alarm thresholds). By default, there is no password required to enter Supervisor level, but a password can be set in the Instrument area of configuration, either at Supervisor level or at Engineer level.

ENGINEER ACCESS LEVEL

This allows full access to all areas of the recorder configuration. The default password is 100, but this can be edited in the Instrument area of configuration (section 4.1.5).

Note: recording is stopped for as long as the user is logged in at Engineer level, even if the recorder is not being configured. This is indicated by the Record icon at the bottom left corner of the process value display screen being replaced by the Configuration (wrench) icon.

 Record icon

 Configuration icon

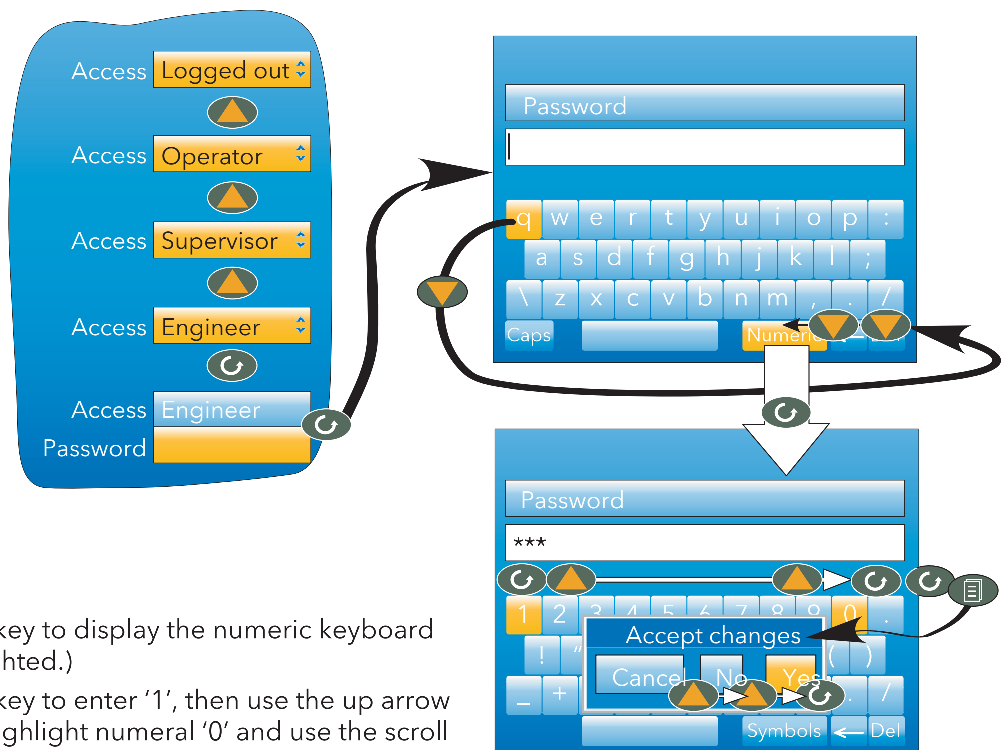
LOGIN PROCEDURE

From the top level menu, use the up or down arrow keys as often as necessary in order to highlight 'Login', and then operate the Scroll key to produce the 'Access Logged out' display.

Note: this procedure describes how to login to an access level with a password associated with it. For non-password protected logins, the user needs only to select the required access level, and press the scroll key.

To log in as Engineer (password = 100):

1. Operate the up arrow key three times, to display 'Engineer'.
2. Press the scroll key to call the 'alpha' keyboard, with the letter 'q' highlighted.
3. Use the down arrow key three times to highlight 'Numeric'.
4. Operate the scroll key to display the numeric keyboard (numeral '1' highlighted.)
5. Operate the scroll key to enter '1', then use the up arrow key nine times to highlight numeral '0' and use the scroll key twice to enter '0' 0', completing the password of 100.
6. Use the Page key to call the confirmation display.



7. If the password entry is as required, use the up arrow twice (or the down arrow once) to highlight the word 'Yes' and operate the scroll key to confirm. The top level configuration menu appears. Otherwise, 'Cancel' can be used to clear the entry in order to start again, or 'No' can be used to quit login.

3.4 DISPLAY MODES

The following subsections describe the various display modes available to the user. By default, the 'Home' display mode is 'Vertical Trend', but this can be edited as a part of 'Instrument.Display' configuration. This configuration area also allows the user to disable one or more display modes should they not be required.

The current display mode can be chosen either by using the top level menu 'Go to View' item or, from any display mode, by scrolling through the enabled modes using the up or down arrow button.

Details of the various display modes are to be found in the following subsections:

Vertical trend ....section 3.4.1
Horizontal trend ....section 3.4.2
Vertical bargraph ....section 3.4.3
Horizontal bargraph ......section 3.4.4
Numeric ....section 3.4.5
Alarm panel ....section 3.4.6
Control loop 1/2 ....section 3.4.7
Cascade...section 3.4.8
Programmer (inc. future trend) ....section 3.4.9
Steriliser...section 3.4.10
Promote list......................................section 3.4.11
Modbus Master ....section 3.4.12
EtherNet/IP ....Section 3.4.13

3.4.1 Vertical trend

In this mode, channel values are traced as though on a chart rolling downwards (i.e with the latest data at the top). The chart speed, and the number of major divisions are configured in the 'Group.Trend' area of configuration (section 4.3.1). By default, the chart background is black, but this can be changed to white or grey in the 'Instrument' 'Display' area of configuration (section 4.1.3).

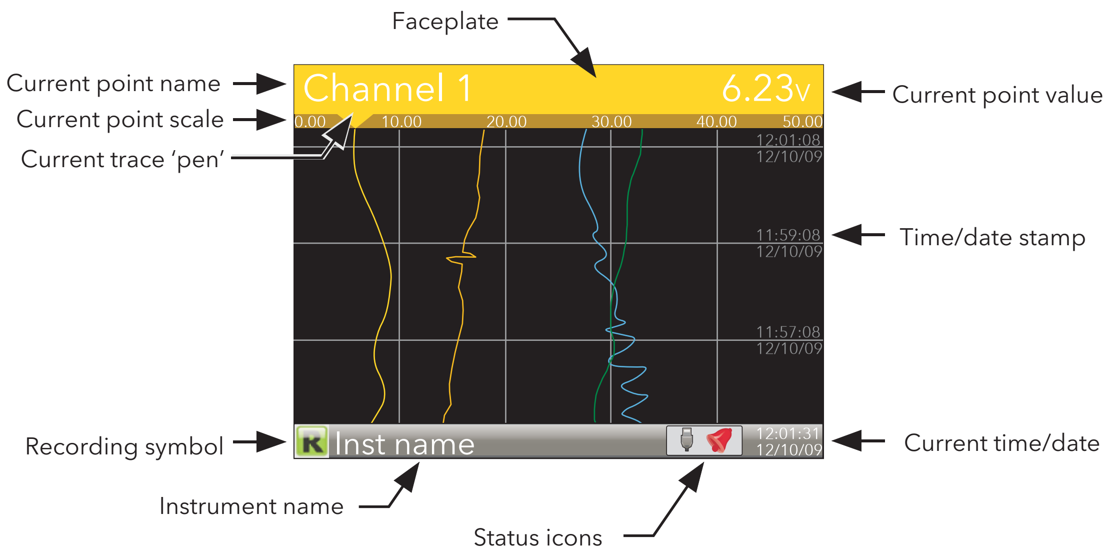


Figure 3.4 Vertical trend mode display elements

One of the channels is said to be the 'current' or 'scale' channel. This channel is identified by its pen icon being displayed, and by the channel descriptor, dynamic value and its scale being displayed on a 'faceplate' across the width of the display, above the chart.

Each channel in the Group becomes the 'current' channel in turn, for approximately five seconds -i.e. the channels are cycled through, starting with the lowest numbered channel. Once the final channel in the Group has ben displayed for five seconds, the first channel is returned-to and the process repeats. This scrolling behaviour can be enabled/disabled from the top level menu 'Faceplate Cycling (Off)' item described in section 3.3.5.

The scroll button can be used to cycle through the channels manually in both Faceplate cycle on and off modes.

Use of the up arrow button causes the next enabled display mode to be entered (default = horizontal trend).

The page key calls the top level menu.

3.4.2 Horizontal Trend mode

This view is similar to the vertical trend mode described in section 3.4.1 above, except that the traces are produced horizontally rather than vertically. Initially, as each channel appears, its scale appears at the left edge of the display (as shown below), but in order to show the maximum amount of trend data, the scale is overwritten after a few seconds.

By default, after a few seconds, the 'chart' expands leftwards to hide the scale. This feature can be disabled in the Instrument.Display area of configuration (section 4.1.3, H.Trend scaling) so that the scale is permanently on display.

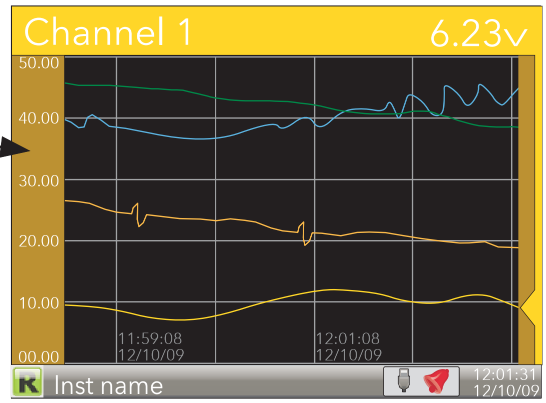


Figure 3.4.2 Horizontal trend display mode

Note: Timestamps appear to the right of the gridline to which they relate

Use of the up arrow button causes the next enabled display mode to be entered (default = vertical bargraph). Use of the page key calls the top level menu.

3.4.3 Vertical Bargraph mode

This display mode shows the channel values as a histogram. Absolute alarm threshold values appear as lines across the bars, grey if the alarm is not triggered; red if the alarm is triggered. Alarm symbols appear for active alarms.

Bargraph widths for four to six channels divide the width of the display screen equally between them. For one and two channels, the width is fixed, and the bars are centred on the screen. Figure 3.4.3 shows some examples (not to the same scale).

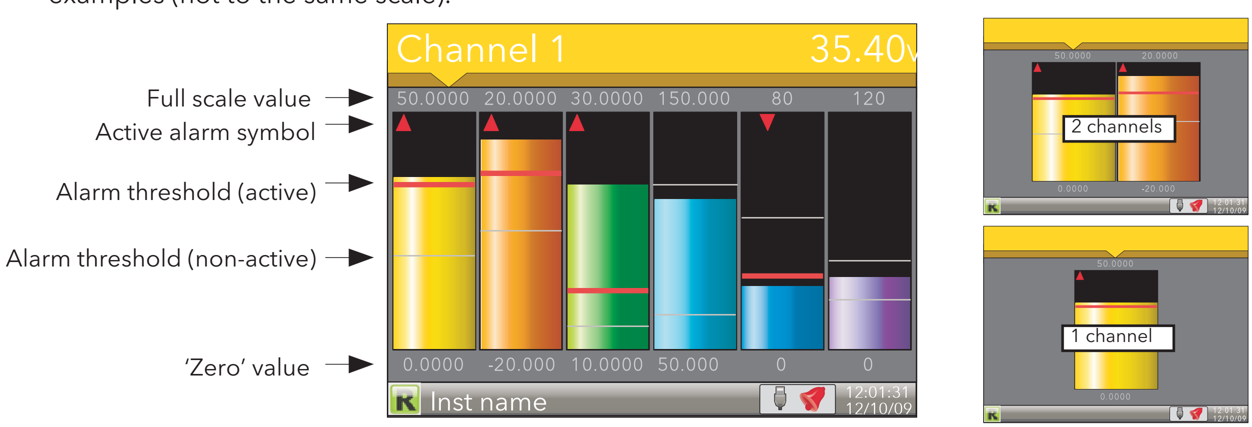


Figure 3.4.3 Vertical bargraph display mode

Use of the up arrow button causes the next enabled display mode to be entered (default = horizontal bargraph). Use of the page key calls the top level menu.

3.4.4 Horizontal Bargraph mode

Similar to the Vertical bargraph mode described in section 3.4.3, above, but includes channel descriptors.

The scroll button toggles the text between point descriptor (as shown) and point value.

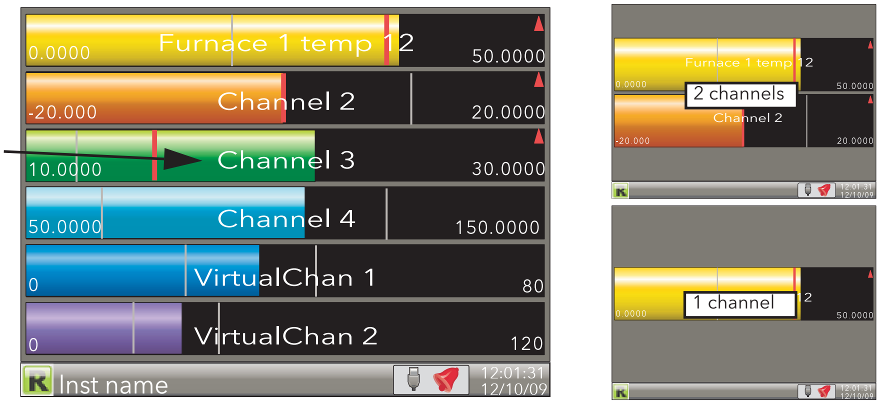
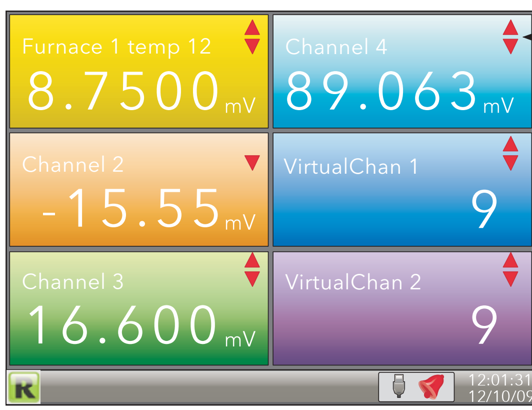


Figure 3.4.4 Horizontal bargraph mode

Use of the up arrow button causes the next enabled display mode to be entered (default = numeric).
Use of the page key calls the top level menu.

3.4.5 Numeric mode

Shows the enabled channels' values along with their descriptors and with indications of the type(s) of alarm configured for each channel.



Alarm type indication (table 3.2.1)

Figure 3.4.5a Numeric display mode (six enabled channels)

The figure above shows an example where the Trend group contains six channels. Figure 3.4.5b shows how the display appears for trend groups with fewer than six channels configured

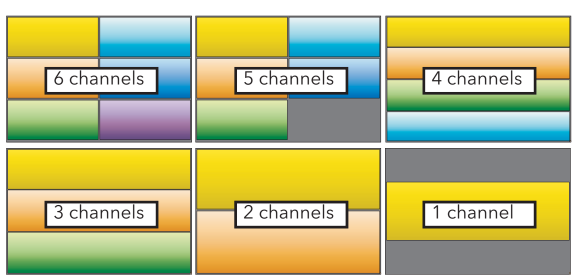


Figure 3.4.5b Display layout for different numbers of channels

The up arrow button returns to the vertical trend display mode; the page key calls the top level menu.

3.4.6 Alarm panel

This display appears only if enabled in the Instrument Display configuration (section 4.1.3) Alarm panel mode shows current value and alarm status for each channel enabled in the Trend Group. The status is shown in two ways, by the colour of the relevant bar, and by the alarm status indicators.

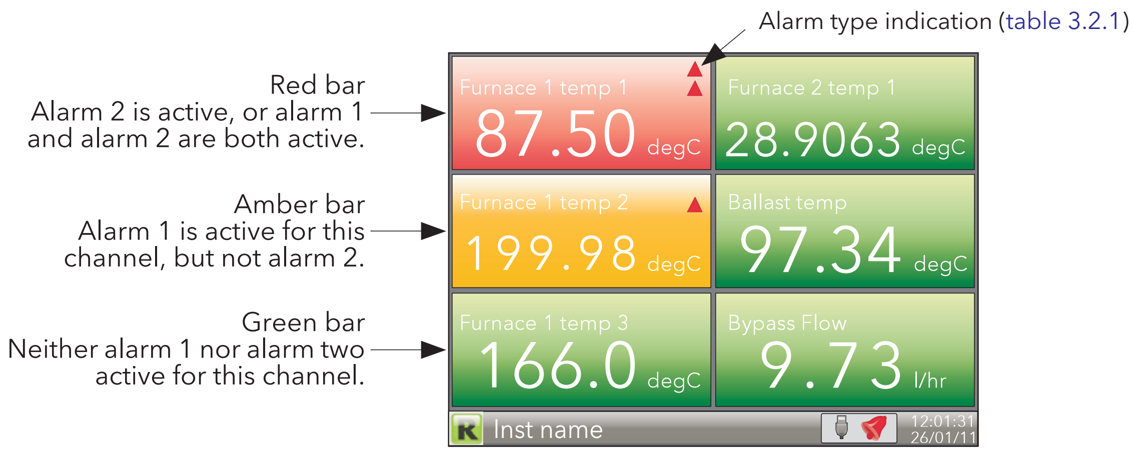


Figure 3.4.6a Alarm panel display (six channels)

The figure above shows an example where the Trend group contains six channels. Figure 3.4.6b shows how the display appears for trend groups with fewer than six channels configured.

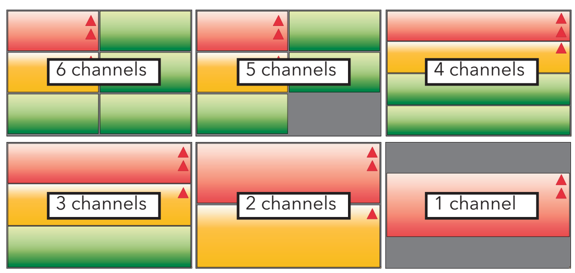


Figure 3.4.6b Alarm panel display layouts for trend groups with fewer than six channels

3.4.7 Control Loop1/Loop2

These displays appear only if the controller option is enabled (section 4.1.6).

The loop display modes are interactive, in that the setpoint, the Auto/Manual mode and the Manual Output value can be edited from the user interface. Full configuration is carried out in the Loop setup menus (section 4.6) and a fuller description of control loops is to be found as Appendix B to this manual.

Figure 3.4.7 depicts a single loop display and the dual loop display. The up and down arrow keys are used as normal to scroll through Loop1, Loop2 and Dual loop pages.

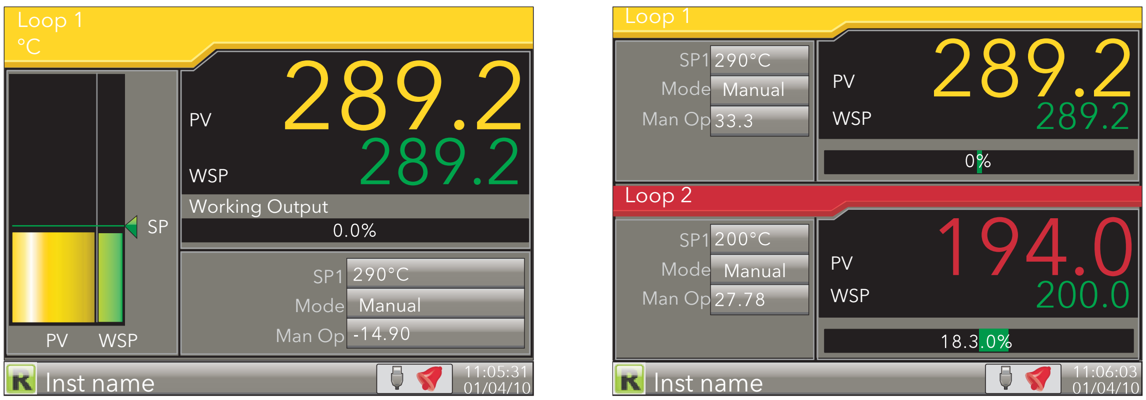
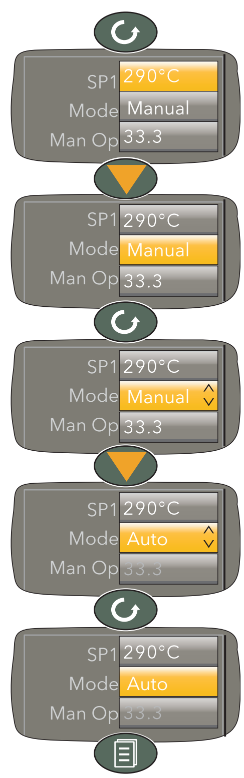


Figure 3.4.7 Loop displays

Note: The colours associated with the loops are those of the channels to which they are wired.

EDITING TECHNIQUES



1. With the loop page on display, operate the Scroll key. This highlights the first editable item (SP1). The scroll order includes both loop1 and loop 2 parameters in the dual loop display.

2. Use the up and down arrow keys to select the required field for editing. When the required field is highlighted, operate the scroll key again, to enter edit mode.

3. Use the up/down arrows to edit the current setting.

4. Operate the scroll key to confirm the edit.

5. Select a further parameter for editing, or operate the page key to return to normal operation.

Note: Edit permissions for Setpoint and Auto/Manual are set in the Loop Setup configuration menu (section 4.6.2).

3.4.8 Cascade display mode

This display mode appears only if 'Cascade' has been enabled in the Instrument.Display area of configuration (section 4.1.3). See also Advanced Loop configuration (section 4.7)

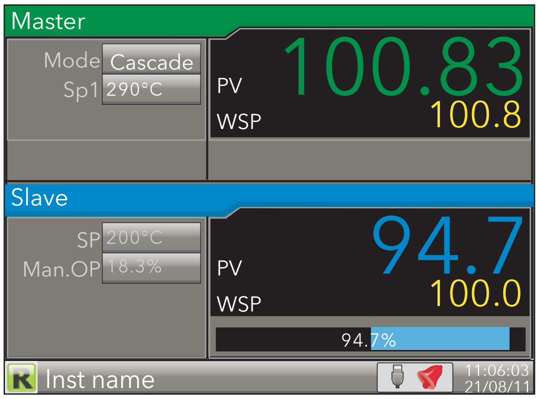


Figure 3.4.8a Cascade display mode

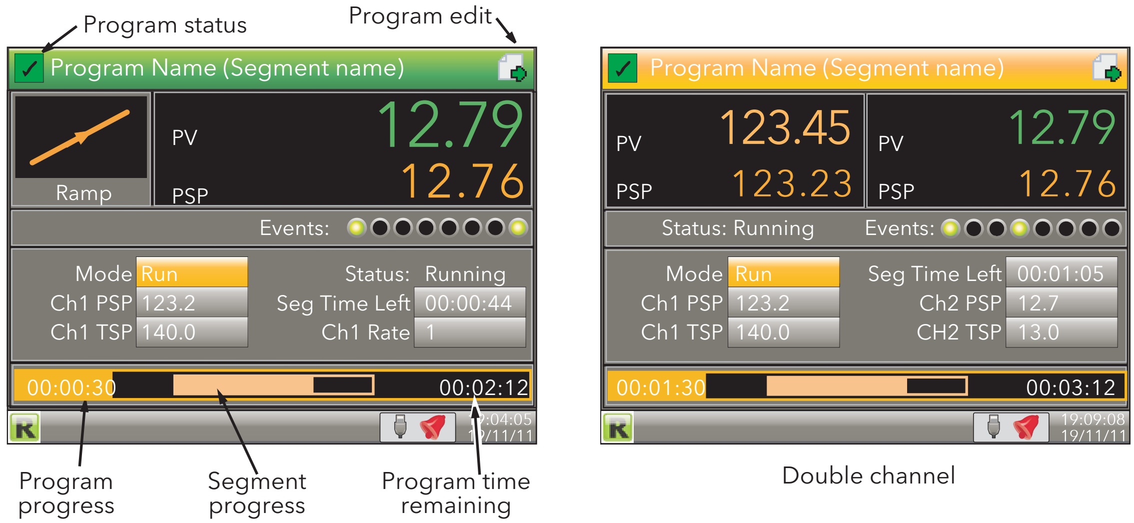
Operating the scroll button highlights the Master 'Mode' field. Operating the scroll button again, enters edit mode allowing the user to use the up/down arrow buttons to scroll through the available modes. Once the required mode appears, a further operation of the scroll button confirms the entry and quits edit mode.

Once out of edit mode, the down arrow key can be used to select Master 'SP1', Slave 'SP' and Slave 'Man OP'. The Mode selected determines how many of these items are editable by the operator.

Mode	Cascade: The master loop is in auto mode and provides the slave setpoint. Changing modes causes the slave to switch to the local slave setpoint. Slave: A simple single loop controlling with a local setpoint. Manual: Provides a single manual % power output.
SP1	Setpoint 1 is the primary setpoint of the controller. If the controller is in automatic control mode, then the difference between the setpoint and the process variable (PV) is continuously monitored by the control algorithm. The difference between the two is used to produce an output calculated to bring the PV to the setpoint as quickly as possible without causing overshoot.
SP	The slave setpoint, either local (Manual or Slave mode) in which case it can be edited, or supplied by the master loop (Cascade mode), in which case it is not editable.
Man.OP	The percentage output power to be applied when in Manual mode (100% = full on; 0% = off).

Note: The default loop names ('Master' and 'Slave') can be replaced by user-entered strings of up to 10 characters in Advanced Loop Setup configuration (section 4.7.2).

3.4.9 Programmer display mode



Single channel

Double channel

Figure 3.4.9a Programmer displays (typical)

This display mode (if enabled - see section 4.1.3) allows the user to monitor the progress of a single or dual-channel setpoint program, and if logged-in as 'Operator*', to reset or run the program. The program itself is created in the Program edit page (described below) and in Programmer configuration (section 4.8 or 'iTools').

*Note: Operator is the default access level - to edit, see ' Prog Mode Access' in section 4.8.3)

The displays contain the following features:

Program name — This is the name of the loaded program. If the program has been modified since being saved, an asterisk (*) appears after the name. Default background colour shown. This colour changes to that assigned to the input channel when this is configured.

Segment name — This is the name of the current segment. If not named in Segment configuration, then the segment number appears instead.

Program status — At the top right hand corner of the display, this can be any one of the following:

The program is running (or ran last time) without any PV 'Alarm' events or user intervention.

The user has intervened in the running of the program, by placing it in 'hold' or 'reset', or by advancing a segment, or by adjusting a duration, target setpoint, ramp rate or time-to-target value.

A PV 'Alarm' Event has activated. A PV 'Alarm' Event is an absolute high/low or a deviation alarm on the PV input.

There is no program loaded, or if a program is loaded, it has not yet run.

Program edit — This icon appears for users with appropriate access permissions, to indicate that setpoint programs can be configured (as described in Program edit, below).

Segment type — For single channel displays, this indicates the type of segment currently being run:

Dwell. The segment value remains constant for the duration of the dwell period.

End (dwell). Displayed on completion of the program. The segment value remains at the final value until reset

End (reset). Displayed on completion of the program. The program resets.

Ramp. The segment value ramps at a fixed rate or over a fixed period to the Target setpoint. Ramp up icon shown; ramp down is similar but inverted.

Step. The segment value switches immediately to the new Target setpoint. Step down shown; step up similar but inverted.

Wait. The segment value remains constant until the wait criteria are satisfied.

3.4.9 PROGRAMMER DISPLAY MODE (cont.)

PV	The current process value of the signal wired to Ch1(2) PV Input.
Ch1(2)PSP	This is the output setpoint from the programmer for the channel. In reset this value tracks the configured servo parameter.
Ch1(2)TSP	The channel target setpoint. The target set-point may be edited while the program is in hold (in such cases, for ramp rate segments the time remaining is recalculated.
Events	Up to eight events can be configured in the Program Edit page. Any one or more of these events may be deemed to be active for the duration of each individual segment.
Mode	Shows the current run mode of the program. If the user has the correct access level, the mode can be set to 'hold', reset' etc. by using the scroll key twice (first to highlight the run mode, then again to enter edit mode) and then using the up/down arrow keys to select the required mode. Run, reset, hold etc. can also be selected by inputs from other parameters, switch inputs etc.
Status	Shows the status of the current segment.
Ch1 Rate	The channel 1 rate-of-change of segment value for 'Rate' ramp segments.
Ch1 Time	Shows the channel 1 duration configured for the segment to ramp, dwell etc. for 'Time' ramp segments. For two-channel programs, see the note below.
Seg Time Left	Shows the time that the segment has to run before completion.
Program progress	The numerals show program elapsed time, and the bar gives an indication of progress so far. For two-channel programs, see the note below.
Segment progress	For each segment as it runs, this gives a visual indication of the proportion of total segment time which has elapsed so far. For two-channel programs, see the note below.
Program time remaining	Shows the time remaining until the program completes. For two-channel programs, see the note below.

Note: For two-channel programs, in 'Hold' mode, the 'program progress', 'segment progress' and 'program time remaining' areas of the display are replaced by 'Ch1 Time' and 'Ch2 Time', as shown below.

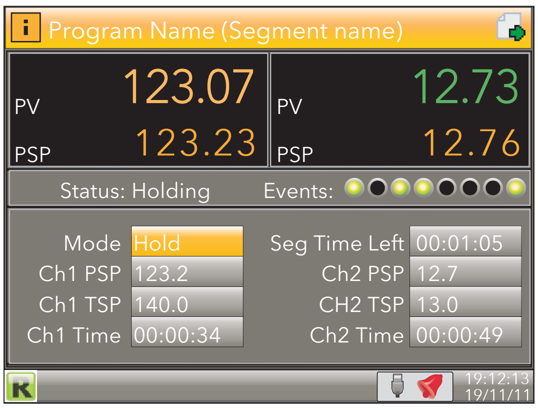


Figure 3.4.9b two channel program in Hold mode

3.4.9 PROGRAMMER DISPLAY MODE (cont.)

PROGRAM RUN/RESET/HOLD

Programs can be controlled by users with the correct access level (defined in Programmer configuration - section 4.24). The display page is placed in edit mode by operation of the scroll key ('Mode' highlights). A second operation of the scroll key followed by operation of the up/down arrows allows the user to select 'Run', 'Hold' or 'Reset'. A further operation of the scroll key initiates the selected action.

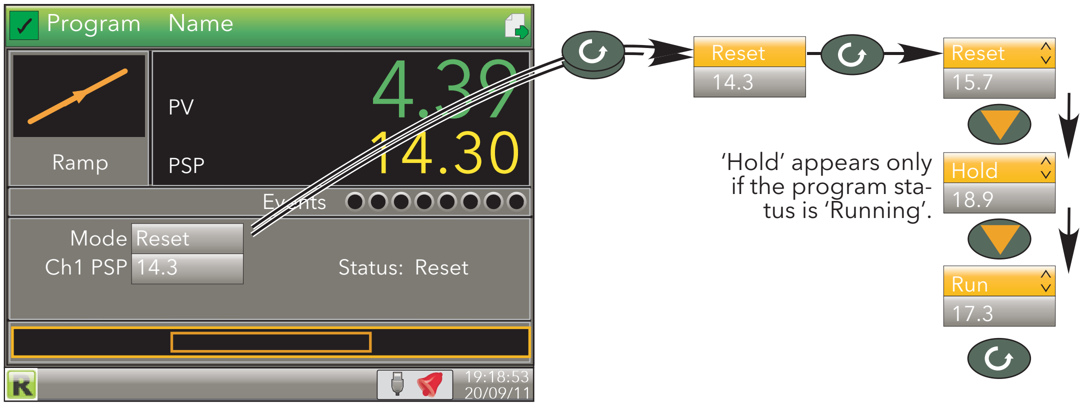


Figure 3.4.9c Setting the Mode

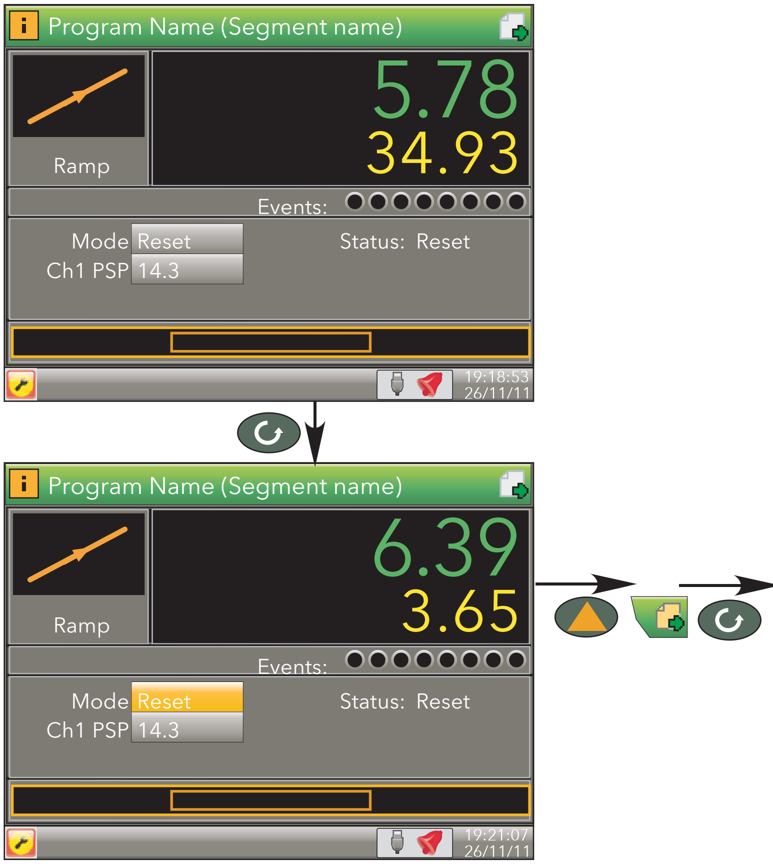
Notes:

1. These functions can also be carried out by wiring relevant inputs to the 'Run', 'Hold' or 'Reset' parameters in Programmer configuration (section 4.8).
2. The user must have either 'Logged off', 'Operator' or 'Supervisor' level access as defined in 'Prog Mode Access' in the Programmer.Setup menu described in section 4.8.3 . The program cannot run if the unit is logged into at 'Engineer' level.

3.4.9 PROGRAMMER DISPLAY MODE (cont.)

PROGRAM EDITING

The program edit page is accessed by operating the scroll button once to highlight the Mode, then using the up arrow key to highlight the page symbol at the top right hand corner of the display and then the scroll button again to enter the program editor.



By default, Program Edit is available only to users with Supervisor or Engineer level access. The required access level can be edited in Programmer.Set Up configuration as described in section 4.8.3.

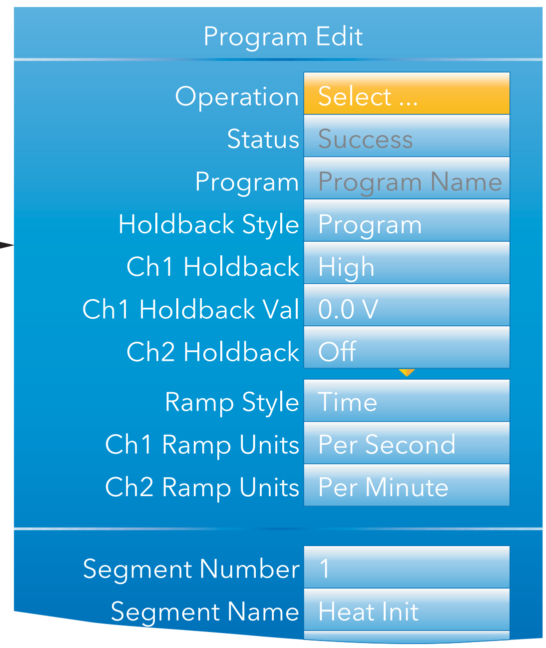


Figure 3.4.9d Access to the program editor

As can be seen from the figure above, the initial Program Edit page is divided into two areas - the top part contains program details; the lower part (figure 3.4.9f) contains individual segment details. The editable items that appear in the program details area depend on the features enabled in the Programmer Features configuration menu (section 4.8.1).

Note: Access to some program operations is restricted to users with the correct access level, as defined in the 'Prog Mode Access', the 'Prog Edit Access' and the 'Prog Store Access' parameters in the Programmer.Set Up area of configuration described in section 4.8.3. Access to some items also depends on whether or not the program is running.

3.4.9 PROGRAMMER DISPLAY MODE (cont.)

PROGRAM DETAILS

Operation	This allows the user to select one of the following (see also 'Program Store, below): Load. Opens the program store and allows the user to select a program to be loaded. The program must have the same number of channels as defined in Programmer.Set Up (section 4.8.3). Store. Allows the current program to be saved to the internal program drive. Delete. Allows the selected program to be deleted. Delete All. Deletes all programs. Copy. Copies the selected program for 'pasting' either from the internal drive to the USB device, or vice-versa. Copy All. As above, for 'Copy', but copies all the programs in the selected directory.

Note: If a 'Store', 'Copy' or 'Copy All' operation would result in there being a total of more than 100 program files in the internal drive, the operation fails and an error message is displayed.

Status	Success. Previous operation was successful. Failed. Previous operation failed. Loading. The program is loading. Copying. The program copy process is underway. Deleting. The relevant program is being deleted.
Program	The name of the program currently loaded.
Holdback Style	Appears only if 'Holdback' is enabled in the Programmer Features configuration (section 4.8.1). See also 'Holdback', below. Program: Holdback applies to all appropriate segments. Per Segment: Holdback enabled on a segment by segment basis as described in 'Segment configuration below.
Ch1 Holdback	Appears only if 'Holdback Style' (above) is set to 'Program'. Off: Holdback is disabled Low: Holdback is entered when PV < (PSP - Holdback Value) High: Holdback is entered when PV > (PSP + Holdback Value) Band: Holdback is entered when PV < (PSP - Holdback Value) or PV > (PSP + Holdback Value)
Ch1 Holdback value	The value to be used in triggering holdback.
Ch2 Holdback	As for Ch1 Holdback, above but for channel 2. Appears only if 'Channels' is set to '2' in Programmer Set Up configuration (section 4.8.3).
Ch2 Holdback value	As for 'Ch1 Holdback value', above, but for channel 2. Appears only if 'Channels' is set to '2' in Programmer Set Up configuration (section 4.8.3).
Ramp Style	Ramp style applies to all ramp segments in the program. Ramp Style can be edited only when the program is in Reset mode. Setpoints, rates, times etc. are set in the individual segment configurations Rate. A Ramp Rate segment is specified by a target set-point and the rate at which to ascend/descend to that set-point. Time. A Ramp Time segment is specified by a target set-point and a time in which to achieve that set-point.
Ch1 Ramp Units	Select 'Per Second', 'Per Minute' or 'Per Hour' for ramp timing units. Ramp Units can be edited only when the program is in Reset mode.
Ch2 Ramp Units	As for 'Ch1 Ramp Units' above. Appears only for two channel programs and allows different ramp units to be selected for the two channels, if required. Ramp Units can be edited only when the program is in Reset mode.

3.4.9 PROGRAMMER DISPLAY MODE (cont.)

PROGRAM DETAILS (Cont.)

HOLDBACK

Holdback pauses the program (freezes the Programmer setpoint (PSP) and the time remaining parameters) if the difference between the Process value (PV) and the PSP exceeds a user-specified amount (Holdback value). The program remains paused until the PV returns to within the specified deviation.
In ramp or step segments, holdback indicates that the PV is lagging the SP by more than the specified amount and that the program is waiting for the process to catch up. In a dwell segment, holdback is used to guarantee that a work piece stays at set-point within a specified tolerance for the specified dwell duration.

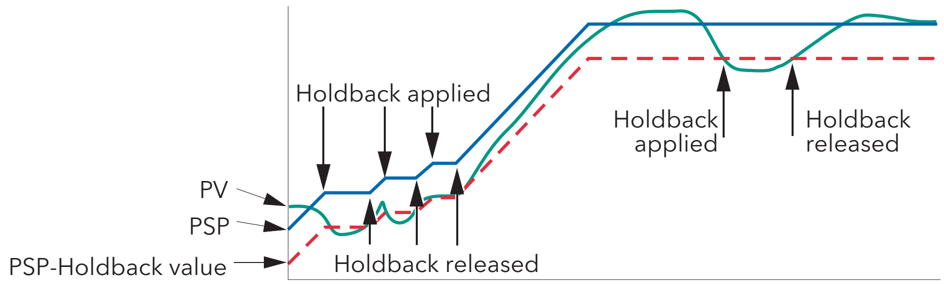


Figure 3.4.9e Holdback

SEGMENT CONFIGURATION

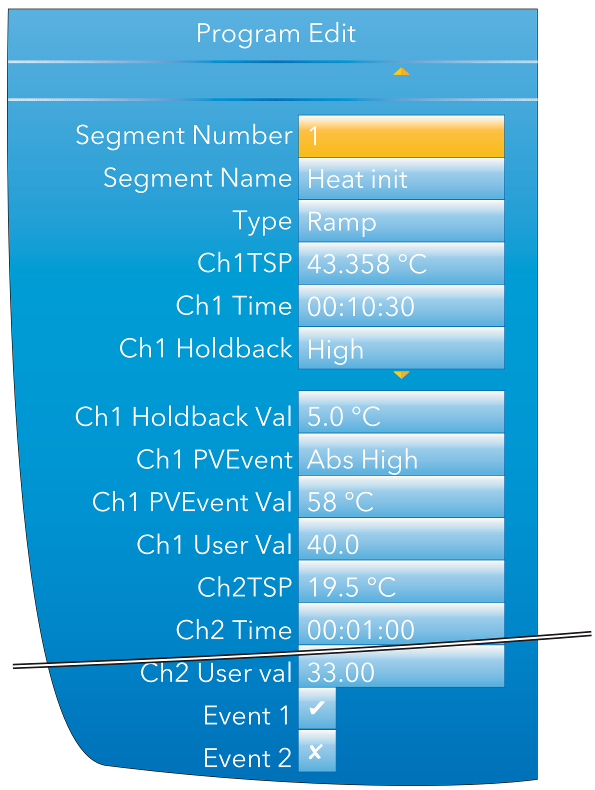


Figure 3.4.9f Segment configuration

Segment Number	Select the relevant segment for configuration.
Segment Name	Enter a segment name of up to 20 characters. This name will be truncated on the display page if it, together with the program name, are too long to fit the width of the display area.

3.4.9 PROGRAMMER DISPLAY MODE (cont.)

SEGMENT CONFIGURATION (Cont.)

Type	Select a segment type. Default is 'End'. Ramp. For any program, Ramp segments can be either 'Ramp Rate' segments or 'Ramp Time' segments according to the 'Ramp Style' setting described above. See also 'Ch1(2) Time' or 'Ch1(2) Rate', below. Dwell. The setpoint is maintained at its current value for the period defined in 'Duration' (see below). Step. A step segment allows a step change to be entered for the target set-points Ch1 TSP and Ch2 TSP. Wait. A wait segment causes the program to wait for a certain event to occur before continuing. See 'Wait For', below. Go Back. A Go Back segment allows a specifiable number of iterations to be performed of a group of segments. This could be used, for example, to cycle an entire program by having a Go Back segment immediately before the end segment and specifying segment 1 as the 'Go Back To' point. Setting 'Cycles' to 'Continuous' causes the program to loop indefinitely, until interrupted by the user. 'Nested' loops are not permitted i.e. 'Go Back' is not available as a segment type for segments inside an existing GoBack loop. End. The final segment of a program allows the user to select 'Dwell' or 'Reset' as the action to be taken at the end of the program (see 'End Type', below)
Ch1(2) TSP	Target setpoint. The value that Ramp or Step segments seek to attain, for channel 1(2).
Ch1(2) Rate	For Ramp Rate segments, this specifies the speed at which the process value ramps towards the target, for Channel 1(2). The ramp units (per second, per minute, per hour) are set in Ch1(2) ramp units described above.
Ch1(2) Time	For Ramp Time segments, this allows the user to specify the time to be taken by the segment for the process value to reach the target.
Duration	For Dwell segments, this allows the entry of the time for which the segment dwells.
Go Back To	For 'Go Back' segments, this defines the number of the segment to which the program is to return.
Cycles	The number of times the 'Go Back' instruction is to be carried out. If set to 'Continuous', the program continues until the user intervenes to stop it.
End Type	Allows the user to select the action to be taken at the end of the program: Dwell: the set-point is maintained indefinitely and event outputs remain at their configured state. Reset: the set-point reverts to the value used by the control loop before the program was started and the event outputs return to their default states.
Wait For	Digital High: Wait segments can be configured to wait for 'Wait Digital' to go 'high' before allowing the program to continue. Analog 1(2): The segment waits for 'Wait Analog1(2) to meet an Absolute High or Low, or Deviation High or Low condition before allowing the program to continue. Analog Both: As Analog 1(2) above, but waits for both Channels' conditions to be true before continuing.

Note: 'Wait Digital', Wait Analog 1' and 'Wait Analog 2' parameters are configured in the Programmer.Set Up menu described in section 4.8.3.

Ch1 Wait	Select 'Abs High', 'Abs Low', 'Dev High' or 'Dev Low' as the wait criterion for channel 1. Appears only if 'Wait For' (above) is set to 'Analog 1' or 'Analog Both'.
Ch2 Wait	Select 'Abs High', 'Abs Low', 'Dev High' or 'Dev Low' as the wait criterion for channel 2. Appears only if 'Wait For' (above) is set to 'Analog 2' or 'Analog Both'.
Ch1(2) Wait Val	Enter the trigger value for 'Ch1(2) Wait'
Ch1(2) Holdback	Select 'Off', 'Low', High', or 'Band' (see description in Program details above).
Ch1(2) Holdback Val	The value to be used in triggering holdback.

3.4.9 PROGRAMMER DISPLAY MODE (cont.)

SEGMENT CONFIGURATION (Cont.)

Ch1(2) PV Event — Appear only if 'PV Events' have been enabled in the Programmer Features menu (section 4.8.1). A PV Event (an analogue alarm on the channel PV) is available for each channel in every segment (excluding Wait and Go Back segment types). The following PV Events are supported:
Off: The PV Event is disabled
Abs High: The event is triggered when the channel PV exceeds PVEvent Val for the relevant channel.
Abs Low: Triggered when the channel PV becomes less than PVEvent Val for the relevant channel.
Dev High: This event is triggered when the channel PV exceeds (PSP + PVEvent Val) for the relevant channel
Dev Low: Triggered when the channel PV becomes less than (PSP - PVEvent Val) for the relevant channel.
Dev Band - This event is triggered when the channel PV differs from the PSP by more than the configured deviation value (either above or below)
In the following example, in segment 1 Ch1 PV Event has been configured as Dev Band and in segment 2 it has been configured as an Abs low:

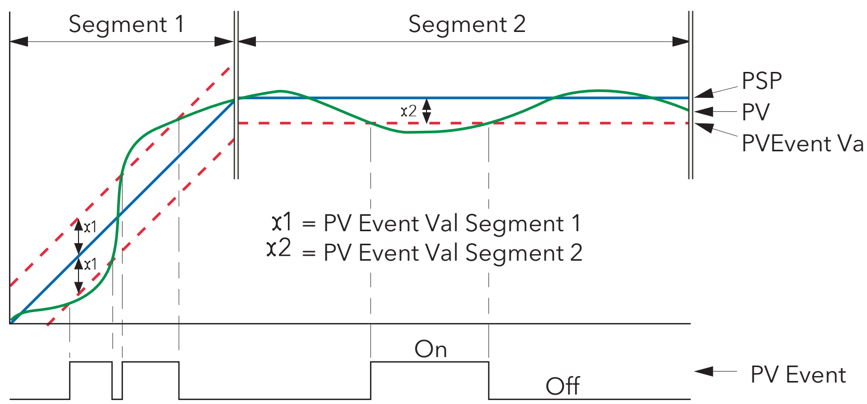


Figure 3.4.9g PV Events

Ch1 PVEvent Val — Appears only if 'Ch1 PVEvent' is not 'Off'. Sets the level at which Ch1 PV Event becomes active.

Ch2 PVEvent Val — Appears only if 'Ch2 PVEvent' is not 'Off' and if 'Channels' is set to '2' in Programmer Set Up configuration (section 4.8.3). Sets the level at which Ch2 PV Event becomes active.

Ch1 (2) Event Use — When PV events become active, they can be used either to Trigger a secondary process or as a simple analogue alarm on the PV input. Appears only if the relevant PV Event parameter is not set to 'Off'.

Ch1 (2) User Val — Specifies the User Value for this segment, for channel 1(2). Appears only if 'User Value' has been enabled in the Programmer Features menu (section 4.8.1).
The example below (from iTools) shows this parameter wired to the trigger 1 input of the Custom Messages block, so that, if a User value >0 is entered, then every time the segment runs, Custom message 1 is generated.

Event 1 to 8 — The number of Events available (Max Events) is defined in Programmer Set Up configuration (section 4.8.3). Enabling an event causes the relevant indicator on the display page to be illuminated for the duration of the segment. As with 'User Val', above, Events can be wired to the inputs of other parameters if required.

3.4.9 PROGRAMMER DISPLAY MODE (cont.)

SEGMENT CONFIGURATION (Cont.)

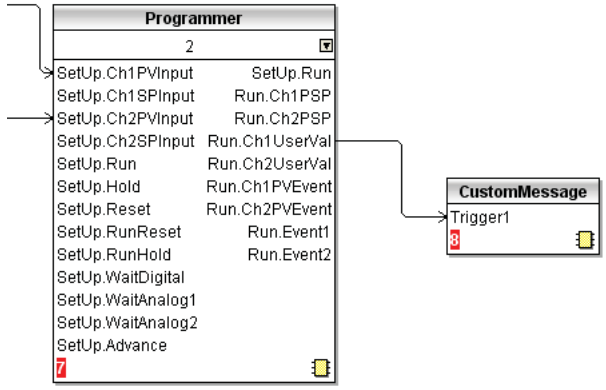


Figure 3.4.9h iTools example showing Ch1 UserVal being used to trigger custom message 1.

FUTURE TREND DISPLAY MODE

If enabled in Instrument.Display configuration (section 4.1.3), this allows the user to view the actual value of the PSP alongside the expected value, so the two can be compared to see how the process is performing.

Future trend is an enhancement of the horizontal trend mode, with the display being divided into two parts, with the instantaneous current value located at the divide, with past trends to the left and the next few program segments to come, to the right.

Notes:
1. For the future trend mode to appear, the programmer must be wired to the loop or advanced loop feature.
2. Both historic and future trends move from right to left with the present anchored at the screen centre.
3. The amount of history and of future trending displayed on the screen depends on the trend interval set in Group.Trend configuration (section 4.3.1)

Figure 3.4.9i shows a typical future trend display

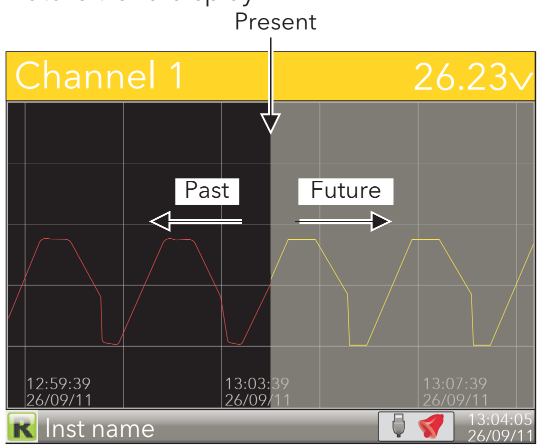


Figure 3.4.9i Future trend display

3.4.9 PROGRAMMER DISPLAY MODE (cont.)

PROGRAM STORE

Note: The access levels required for the operations described below are configured in the Programmer Set Up menu 'Prog Edit Access' and 'Prog Store Access' parameters, described in section 4.8.3.

The program store allows access to the instrument's local program storage area and to programs stored on a USB memory stick (if any) and to those stored in a pc (if any), via FTP. Programs may be saved to (Stored) or retrieved from (Loaded) from the program store, or they can be copied or deleted.

Selecting any of the program operations (except 'Delete All'), from the Program Edit page (Engineer access level required) opens the file explorer page. Figure 3.4.9j depicts this page, with just a couple of example entries after a 'Load' operation has been requested.

On entry, use the up/down arrow button to select 'User', 'USB' or 'FTP' (selection highlights yellow), then use the scroll button to confirm. Use the up/down arrow buttons to select the required file, and then use the scroll button again to confirm. Other operations are similar.

The file explorer supports 100 entries, which may be directories or files.

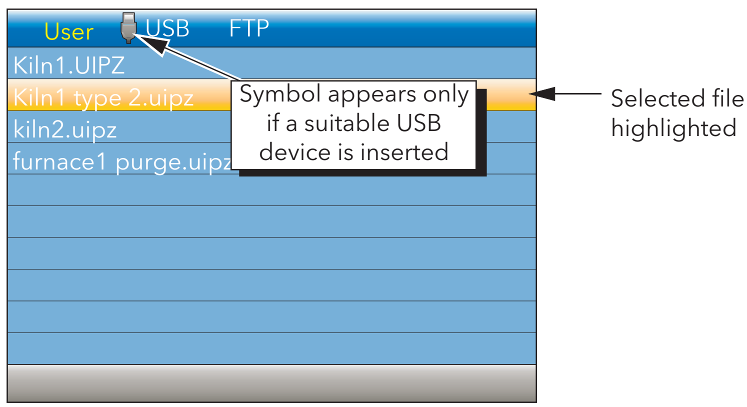
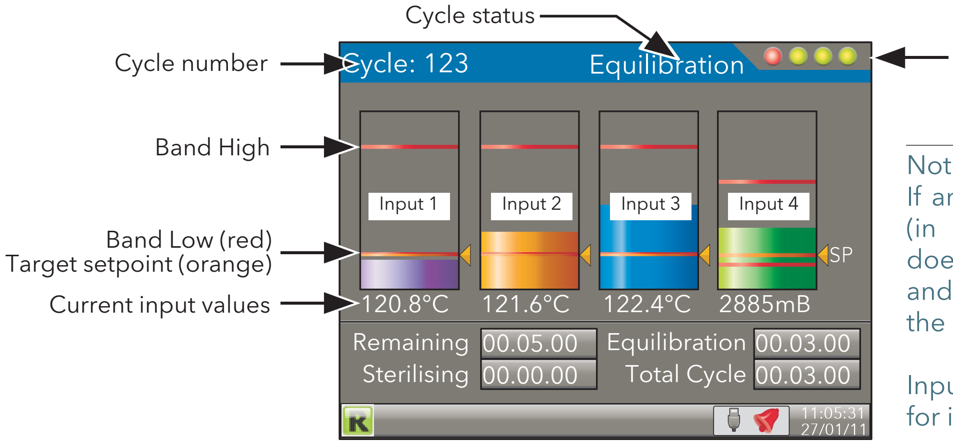


Figure 3.4.9j Program store display

Note: A 'busy' icon (rotating green flash) appears whilst directory listings are being accessed.

3.4.10 Steriliser display mode

This display mode appears only if the Steriliser option is fitted and if the display mode has been enabled in the Instrument Display configuration (section 4.1.3) Steriliser configuration parameters are to be found in section 4.16



Note:
If any input is configured 'Off' (in Steriliser configuration), it does not appear in the display, and the other inputs occupy the screen width equally.

Input status beacons are black for inputs configured 'Off'

Figure 3.4.10a Steriliser display mode (typical) (four inputs)

OPERATION

A sterilising cycle cannot be initiated whilst the unit is in Configuration (Engineer) mode.

A steriliser cycle is started by setting its relevant 'Start' input to 'Yes' for the duration of the cycle. The cycle waits (status 'Waiting') until input 1 reaches its setpoint, at which point the cycle enters the equilibration period (status 'Equilibration'), and remains there until all the configured inputs are valid. The cycle then enters the sterilising period and stays in this mode until the sterilising period has expired (status 'Passed') or until one of the inputs becomes invalid (status 'Failed') for longer than its configured 'Failure Dwell' time.

Note: The cycle stops (status 'Failed') if the trigger source is removed.

TERMINOLOGY

Holding time	Most operating cycles have a stage in which the load must be exposed to sterilisation conditions for a specified length of time, known as the 'Holding time'.
Equilibration time	The holding time (above) is preceded by a period during which, although the sterilising condition is present in the chamber, the load has not yet attained that temperature due to its thermal inertia. 'Equilibration time' is defined as the time between the attainment of sterilisation temperature in the chamber, and the attainment of that temperature in all parts of the load.
Bands	For steam and dry heat sterilisers, sterilisation conditions are specified by a sterilisation temperature band, defined by a minimum acceptable temperature (known as the sterilisation temperature) and a maximum allowable temperature. A sterilisation band is normally quoted for each steriliser type.

BEACONS

There are four input status beacons near the top right hand corner of the display, one for each input.

During equilibration, the beacons are flashing red for inputs that have not attained the Target setpoint, and go green when the target setpoint is reached, remaining green even if the input value rises above the Band High value The beacons revert to red if input falls below* the target setpoint.

During sterilisation, the beacons go red for any input whose value rises above Band High or falls below* setpoint for a duration exceeding the configured 'Failure Dwell' period.

Beacons are black for inputs that are configured as 'Off'.

* 'rises above' for input types 'Falling Pressure' or 'Fall Air Detect'

3.4.10 STERILISER DISPLAY MODE (Cont.)

DISPLAYED INFORMATION

Cycle	A five-digit counter to indicate the total number of cycles started.
Status	Wait start: The initial state at power up. This status remains until the first cycle is initiated Waiting: Waiting for input 1 to reach its target setpoint. The cycle then enters Equilibration. Equilibration: Currently in the equilibration period, during which the cycle waits until all inputs have reached sterilisation conditions. Sterilising: Currently in the decontamination phase Passed: The cycle has completed successfully Failed: The cycle has failed either through one or more inputs becoming invalid, or because the 'Start' signal was removed. Test cycle: A test cycle is in progress
Remaining	The sterilising time remaining for the current cycle. Display field is replaced by 'Target Time' (below) when the cycle is not running.
Target time	The intended sterilisation time. This can be configured by operating the scroll button twice (once to highlight the field, and again to enter edit mode), and then using the up and/or down arrows to edit the time. Use the Scroll button again to quit edit mode, and the page key to 'unhighlight' the field. Replaced by 'Remaining' (above) when the cycle is running.
Equilibration	The equilibration time period for the current cycle
Sterilising	The time for which the load has currently been at sterilisation conditions
Total Cycle	The elapsed time since the initiation of the current cycle. This time increments from the time the cycle is triggered until the time the trigger is removed.
Input values	Temperature are required in °C; pressure inputs in mBar. If necessary, maths channels and user values can be used to convert from other units (see 'Note' overleaf).

STERILISING CYCLE DIAGRAM

Figure 3.4.10b, below, shows a steriliser cycle in diagrammatic form.

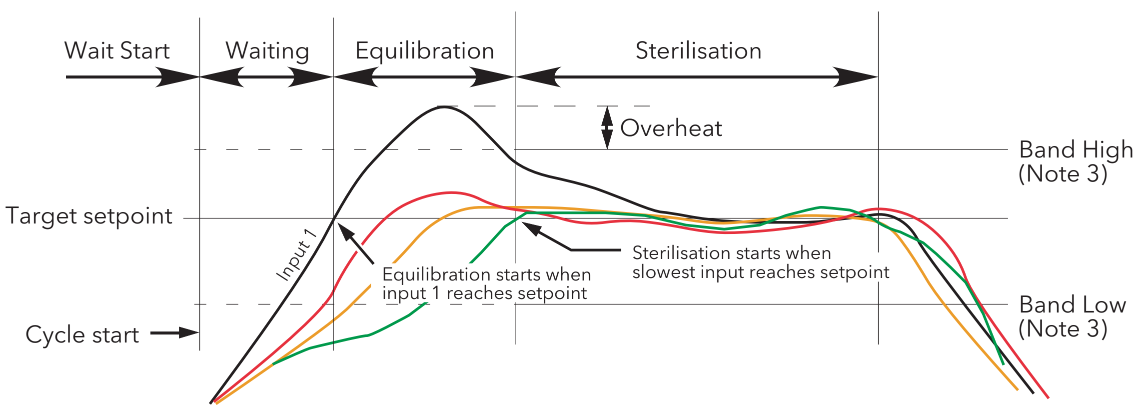


Figure 3.4.10b Steriliser cycle

Notes:
1. For temperature inputs in most applications, the Setpoint value is the same as the Band Low value For the sake of clarity, this is not as shown in the figure above.
2. For the sake of clarity all four inputs in the figure above are shown with the same Band High, Band Low and Setpoint value. This would not be unusual for temperature units, but the pressure input would normally have a different set of values from temperature inputs.
3. Band High and Band Low are effective only during Sterilisation phase.

3.4.10 STERILISER DISPLAY MODE (Cont.)

APPLICATION DETAILS

Figure 3.4.10c shows a typical steriliser application, with temperature and pressure signals from the sterilisation chamber being applied directly to the rear terminals of the controller/recorder, and control signals connected from the controller to both the chamber and the controller/recorder.

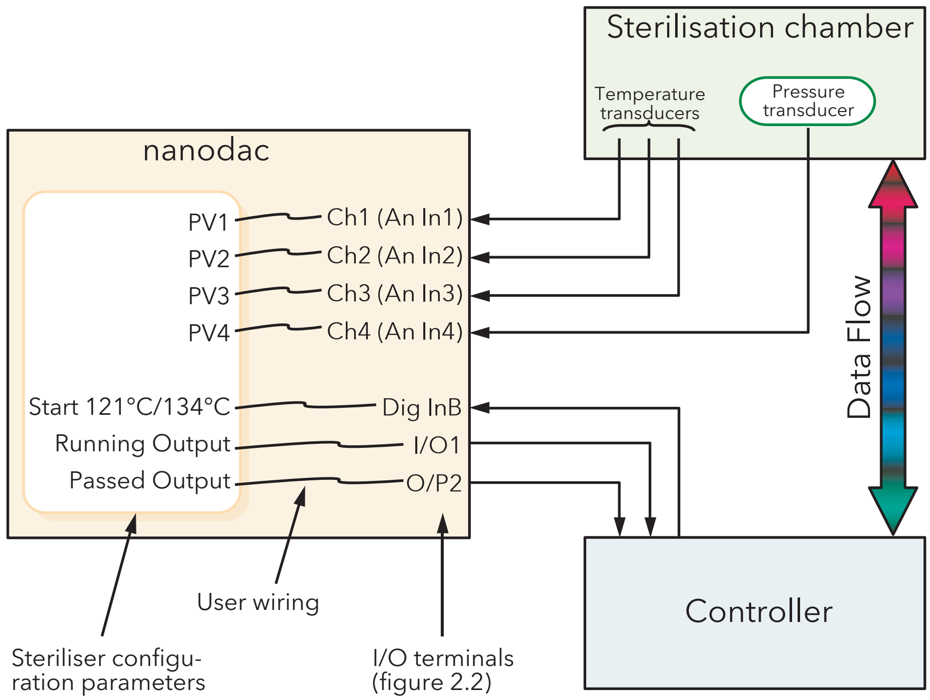


Figure 3.4.10c Typical steriliser application

Analogue inputs 1 to 3 receive signals from temperature transducers (typically thermocouples) within the chamber. These inputs are internally connected to channels 1 to 3 respectively, allowing transducer type, ranges, alarms etc. to be configured (section 4.4). Inputs are assumed to be degrees Celsius*.

The pressure transducer is connected to channel 4 and can be configured in the same way. The input is assumed to be in milliBar. Other pressure inputs should be converted using virtual channels*.

PV1 to PV4 in the Steriliser configuration is software wired (section 7) to Ch 1 to Ch4.

Start cycle input and the 'Running Output' and 'Passed Output' signals are software wired to suitable DIO terminals, for connection to the Controller.

*Note: For Fahrenheit inputs, use one virtual channel to subtract 32, and a second to divide the result by 1.8 (where 32 and 1.8 can be configured as user values). Similar techniques should be used to convert pressure input units if necessary.

TEST CYCLES

A 'Test' cycle is initiated by initiating a 121°C cycle and a 134°C cycle simultaneously. A test cycle allows the user to check actual performance against expected performance.

3.4.10 STERILISER DISPLAY MODE (Cont.)

F_0

F_0 is a means of calculating 'equivalent time at sterilising temperature' for temperatures below, at and above sterilizing temperature, using the equation below.

$$F_0 = \text{Sterilisation time} \times 10^{\frac{Temp - Ts}{Z}}$$

Where:

Sterilisation time	Depends on the application, typically 15 minutes at Ts = 121°C
Temp	The value of the temperature measuring input.
Ts	Desired Sterilising temperature
Z	Temperature interval representing a factor-of-10 reduction in killing efficiency. Z = 10 for steam sterilising (F_0), or Z=20 for dry heat sterilising (FH). Z = 10 for thermal disinfection (A_0).

To ensure that steriliser loads which contain materials with different thermal inertias are thoroughly sterilised, a number of sensors are located withing the load. The F value should be calculated using the sensor closest to that part of the load which has the highest thermal inertia. For maximum accuracy, the temperature sensor should be calibrated and the input adjust function used to compensate for any inaccuracy found.

F0 calculation examples

For all the examples following, the following are assumed: Sterilisation time = 15 minutes; Sterilisation target temperature =121°C and Z = 10.

1. For an actual sterilising temperature of 111°C

$$Fval = 15 \times 10^{\frac{111-121}{10}} = 15 \times 10^{\frac{-10}{10}} = 1.5\,\text{minutes}$$

Which means that 15 minutes at 111°C is equivalent to 1.5 minutes at 121°C

2. For a sterilising temperature of 121°C

$$Fval = 15 \times 10^{\frac{121-121}{10}} = 15 \times 10^{\frac{0}{10}} = 15\,\text{minutes}$$

Which means that the sterilising temperature is ideal (by definition)

3. For a sterilising temperature of 124°C

$$Fval = 15 \times 10^{\frac{124-121}{10}} = 15 \times 10^{\frac{3}{10}} = 15 \times 1.995 = 29.925\,\text{minutes}$$

Which means that 15 minutes at 124°C is equivalent to nearly 30 minutes at 121°C.

Normally sterilising temperatures would not remain constant at temperatures below or above the target value, so the above equations are illustrative only of the facts:

1 Temperatures below the target have some killing efficacy

2 Temperatures above the target value have a greater killing efficiency, so that the sterilising time can be reduced.

In order to calculate the value dynamically, the instrument uses the equation:

$$Fval_t = Fval_{t-1} + T \times 10^{\frac{ma_t - \text{Target temp}}{Z}}$$

where

$Fval_t$	= F value this iteration
$Fval_{t-1}$	= F value last time
T	= Iteration period (minutes)
ma_t	= input temperature value this iteration
Target Temp	= 121°C for F_0, 170°C for F_H, 80°C for A_0
Z	= 10°C for F_0, 20C for F_H, 10°C for A_0

3.4.11 Promote list

This display page allows the user to display up to 10 of the parameters that appear anywhere in the operator interface. The parameters can be selected only by using iTools, as described below.

Notes:
1. 'Promote List' must be enabled (in 'Instrument.Display' configuration), before it appears in the 'Go to View' list.
2. There are more parameters visible in iTools than appear at the operator interface. If non-operator interface parameters are selected for inclusion in the promote list, they do not appear.
3. If parameters which appear only in certain circumstances are selected, then they appear in the promote list only when they appear in the Operator interface. For example, a channel PV is not visible unless that channel is enabled (i.e. it is not 'Off').

PARAMETER SELECTION

1. Open iTools and scan for the instrument, (see section 6).
2. Once the instrument has been found, stop the scan. When the instrument has synchronised, click on the 'Access' button near the top of the display to set the unit into configuration mode (a password may be required).
3. Click on the '+' sign to the left of the Instrument folder in the tree list (left-most pane) to expand the folder. Double-click on 'Promote List', to display the Promote list in the main pane. The list contains 20 entries, 1 to 10 being for parameters, 11 to 20 being available to the user to add descriptors for parameters 1 to 10 respectively.
4. Expand further folders, as necessary, to access the required parameters, and click-drag these parameters into the promote list. Enter a descriptor for the parameter if the default is not as required. As each parameter is dragged into the list, it appears in the Promote list.
5. If the parameters are modified at the operator interface, the changes are reflected in iTools, and vice-versa.
6. Once all the parameters have been added, it is recommended that the Access button be used to quit configuration mode, as otherwise it will not subsequently be possible to quit from the operator interface.

Figure 3.4.11 shows typical displays.

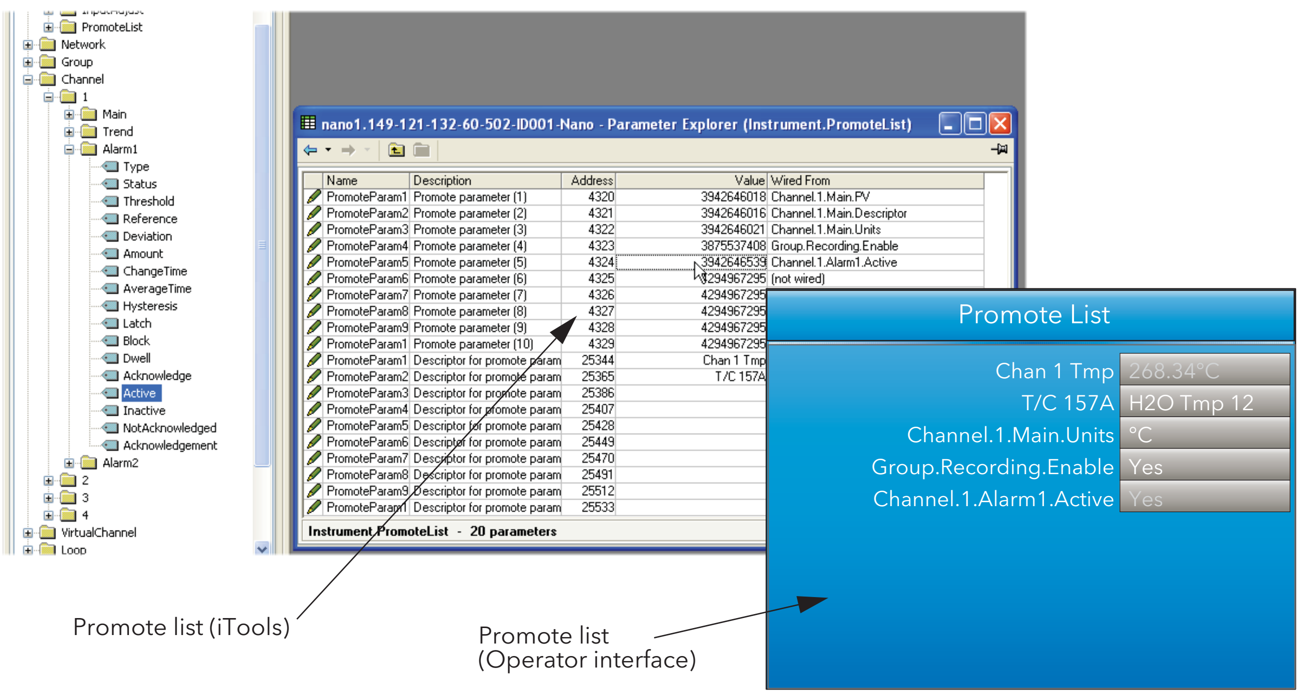


Figure 3.4.11 Promote list displays.

3.4.12 Modbus Master display mode

This display mode consists of two pages, as shown below.

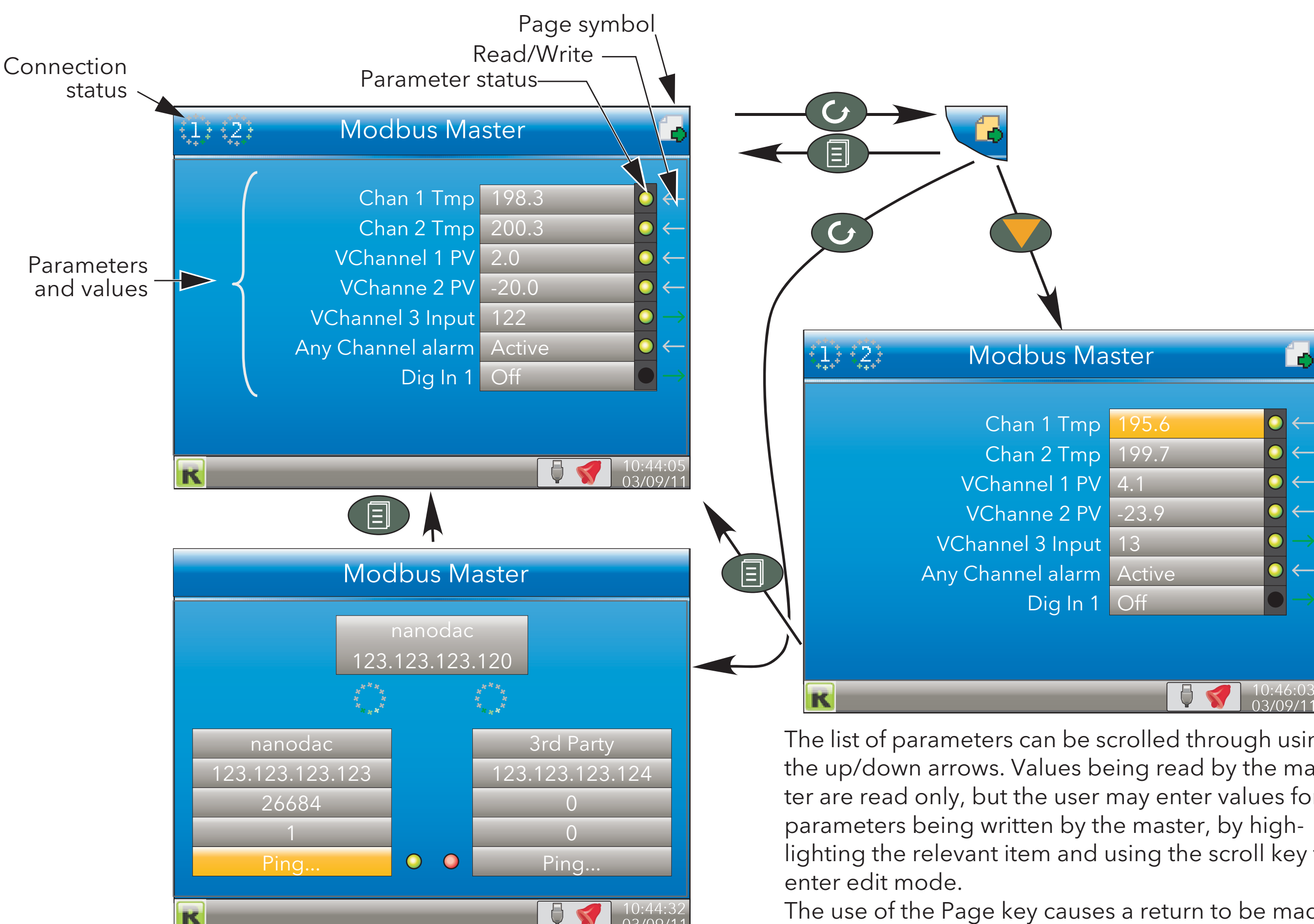
Page one opens by default and shows the first eight parameters being read from (left pointing arrow) or written to (right pointing arrow) the relevant slave. These items are configured in the Modbus Master configuration described in section 4.9. Hidden parameters may be viewed by operating the scroll key, then using the arrow keys to scroll through the list. A green arrow means that the item may be edited by the user when logged in.

A pair of animated indicators in the top left-hand corner of the screen show the connection status of the two possible slaves. A green moving 'streak' indicates that successful communications are being carried out. A red flashing circle indicates that there is a break in the transmission line or that the slave is switched off. A grey, non-animated display indicates that that slave has not yet been configured as a part of the communications link (i.e it is 'off line').

A 'traffic light' indicator appears to the right of each parameter. Green indicates that the parameter is being read from or written to successfully. Orange indicates that a write of the value is pending. Red indicates that there is an error and that no value is currently being read or written; the value displayed is the last good value read or written depending on whether the data item is a read or write. If the indicator is black, the parameter is 'off'.

Operation of the scroll key highlights the page symbol in the top right-hand corner of the screen, and a further operation of the scroll key calls page two to the screen.

Page two contains the IP address of the Modbus master and of any slaves connected to it, together with some diagnostic information, as described in 'PING DETAILS' below.



The list of parameters can be scrolled through using the up/down arrows. Values being read by the master are read only, but the user may enter values for parameters being written by the master, by highlighting the relevant item and using the scroll key to enter edit mode.

The use of the Page key causes a return to be made to the initial Modbus Master display.

Figure 3.4.12a Modbus Master display pages

3.4.12 MODBUS MASTER DISPLAY MODE (Cont.)

PING DETAILS

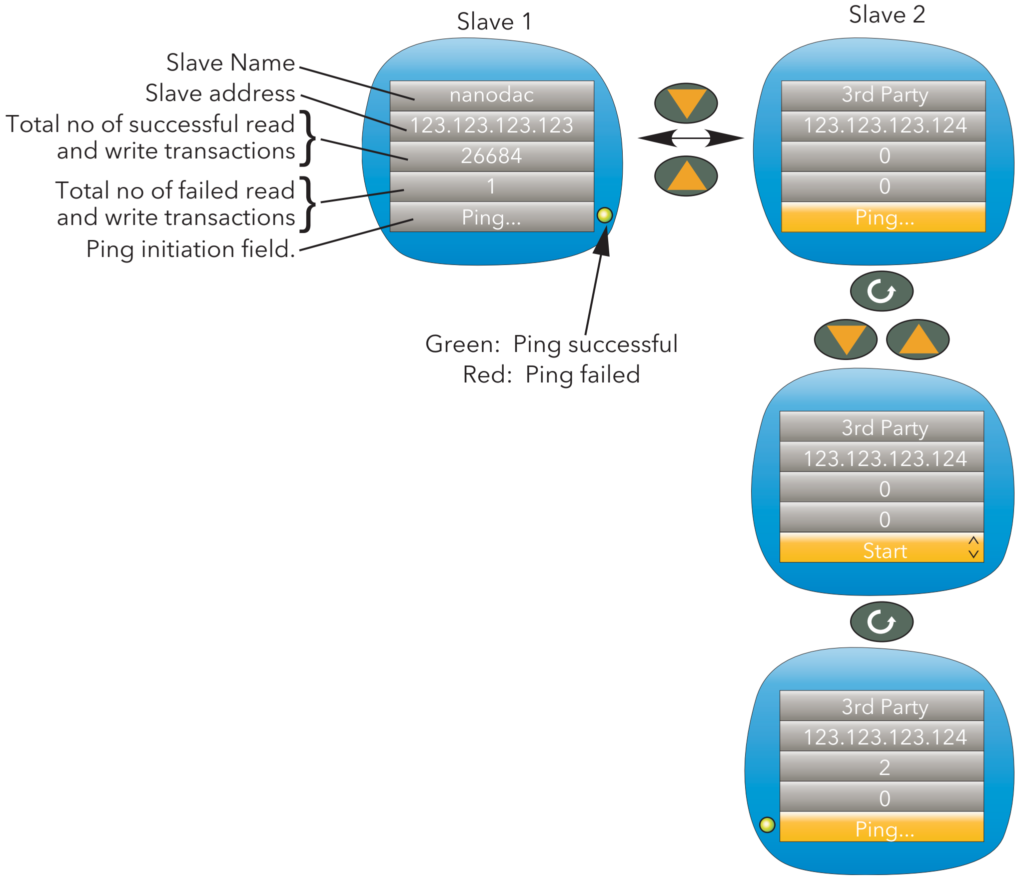


Figure 3.4.12b Slave 2 ping initiation (Slave 1 similar)

The 'Ping...' field of the first slave is highlighted by default. As shown above, the down (or up) arrow can be used to highlight the 'Ping...' field of the other slave instead.

Once the relevant 'Ping...' field is highlighted, the scroll key can be used to enter edit mode and the up/down arrow key used to select 'Start'. A further operation of the scroll key initiates the 'Ping' and if this is successful, a green indicator appears alongside the field (and the text returns to 'Ping...'). If the Ping is unsuccessful, then the indicator is coloured red.

The up or down arrow can now be used to return to slave 1, or the page key can be used to return to the previous parameter display page.

As shown in the figure above, some diagnostic information is given. This includes the total number of successful attempts that the master has made to communicate with the relevant slave, and the total number of failed attempts. Fuller diagnostic details are to be found in the Modbus Master Communications configuration description (section 4.9)

3.4.13 EtherNet/IP display mode

This display mode appears only if enabled in Instrument.Display configuration (Section 4.1.3) and is used to display the input and output parameters assigned to the Client and Server input and output tables. Parameters which have been configured with descriptors are identified by these descriptors instead of their 'opc' names (shown below).

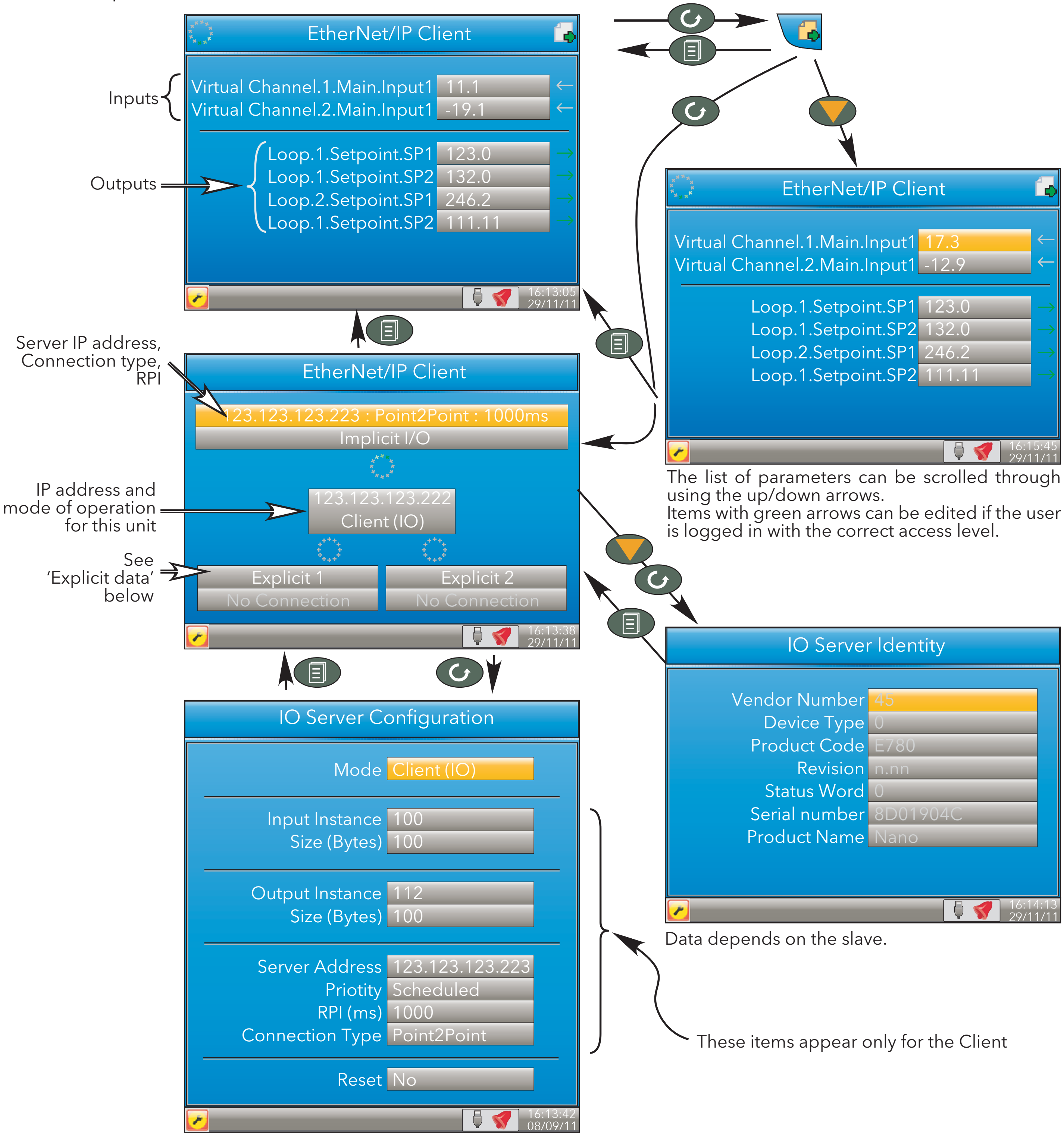


Figure 3.4.13a Typical EtherNet/IP display

3.4.13 ETHERNET/IP DISPLAY MODE (Cont.)

If the EtherNet/IP option is fitted, the nanodac can be configured as either a client (master) or a server (slave) (see section 4.10). The client and server displays are identical except that the configuration area of the client display is more extensive than that of the server display.

Figure 3.4.13a, above shows a typical set of display pages for an EtherNet/IP client.

CONFIGURATION OF IMPLICIT INPUT/OUTPUT TABLES

Configuration of the input and output tables is carried out by:

a. Entering the parameters to be read by the client into the server output table.

b Entering the destination parameter into the equivalent location in the client input table.

c. Entering the parameters to be written by the client into the client output table.

d Entering the destination parameter into the equivalent location in the server input table.

The example in figure 3.4.13b attempts to show this (using the nanodac as the client) in graphical form, using just a few parameters (there can be up to 50 in each table).

Client (nanodac) input table

Virtual Channel.1.Main.Input1	I/P1
Virtual Channel.2.Main.Input1	I/P2
Virtual Channel.3.Main.Input1	I/P3
Virtual Channel.4.Main.Input1	I/P4
	etc.

Server output table

O/P1	Out Parameter 1
O/P2	Out Parameter 2
O/P3	Out Parameter 3
O/P4	Out Parameter 4
etc.	

Client (nanodac) output table

User Values.1.Value	O/P1
Channel.1.Alarm1	O/P2
	etc.

Server input table

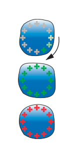
I/P1	In Parameter 1
I/P2	In Parameter 2
etc.	

Figure 3.4.13b Input/Output table entries

Notes:

1. Channel values from the Server can be 'wired' into nanodac Virtual channel inputs (as shown above) so that they can be traced and/or recorded. In such cases the virtual channel 'Operation' must be set to 'Copy' (see section 4.5.1).
2. Inputs and outputs would normally be given suitable descriptors (e.g. 'Reset timer' instead of 'Channel.1.Alarm1').

CONNECTION STATUS INDICATOR



A circular status indicator appears in a number of the EtherNet/IP display pages. This indicator can indicate the following states:

Green rotating 'flash': the instrument is on line and at least one CIP connection is established.

Green flashing circle: the instrument is on line but no CIP connections have been established.

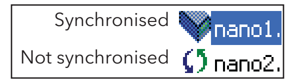
Red flashing circle: there is a break in the physical connection between the client and the server, or the remote unit is switched off or is initialising.

3.4.13 ETHERNET/IP DISPLAY MODE (Cont.)

Adding parameters to the input and output tables can be achieved only through the proprietary software package 'iTools', running on a pc. The following description assumes that the user is familiar with 'iTools'. Section 6 of this manual shows how to set up an iTools link to the unit and the iTools on-line help system and its pdf version (HA028838) should be referred-to as necessary.

Note: the client/server and the pc must all be on the same network.

Once iTools has started up and the 'Scan' process has 'found' the relevant instrument, the scan process should be stopped and the instrument (s) allowed to synchronise. (The scan may be left to run its course, but the speed at which iTools operates is reduced for the duration of the scan process.)



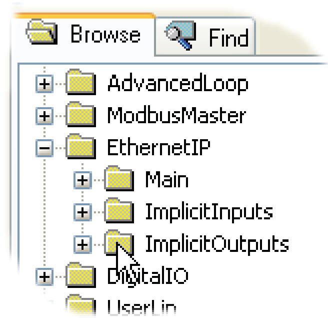
EXAMPLE

To add Loop 2 Setpoint 2 to Output 4 of the Client Output table.

In the example shown below, the instruments have both synchronised, and the 'Access' tool button clicked-on for both instruments to set them into configuration mode.

With the client selected, expand the EtherNet/IP folder in the Browse list, then double-click on the 'ImplicitOutputs' folder.

Locate and expand the Loop 2 SP folder in the Browse window, and click-drag SP2 to 'Output 4' and release.



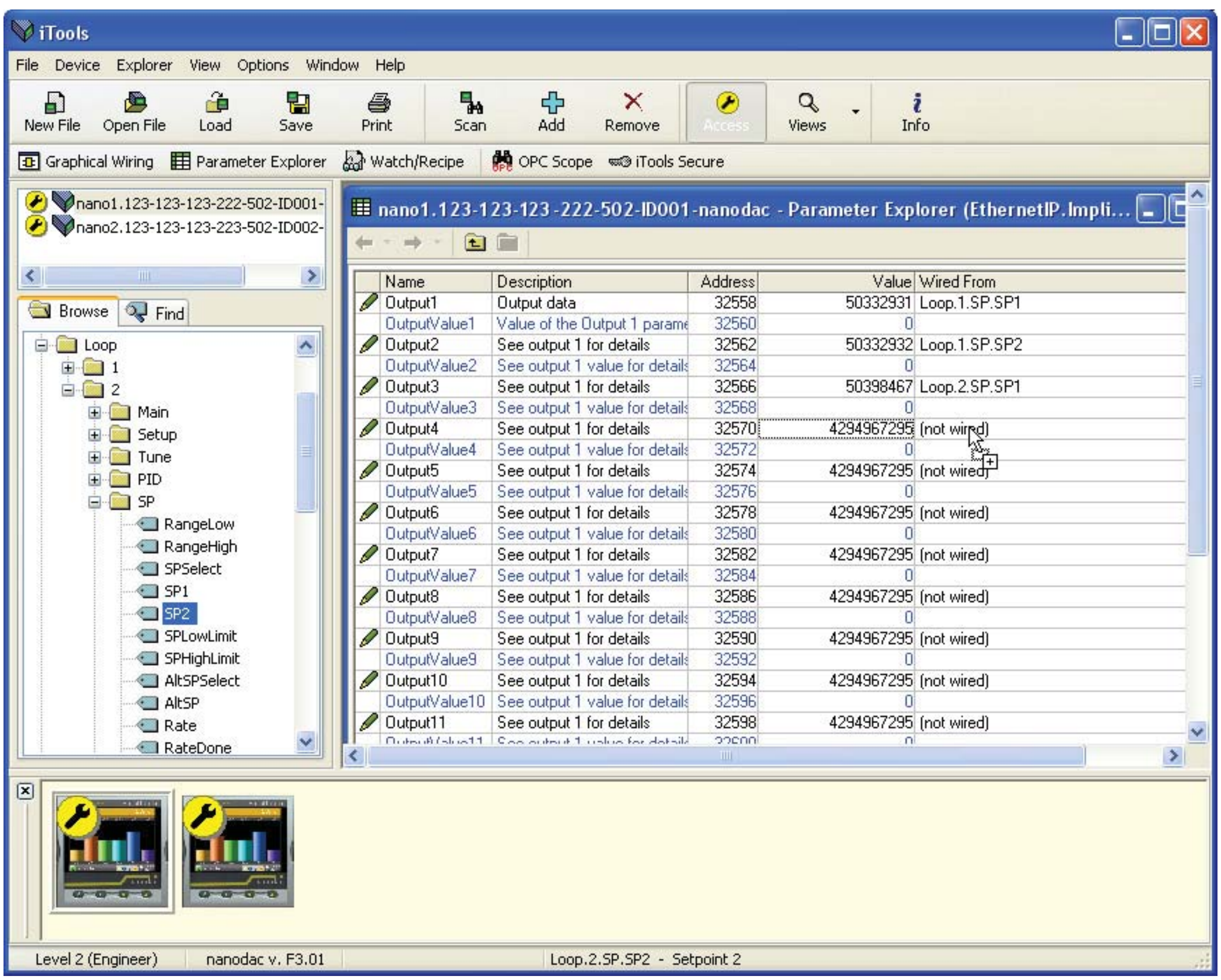


Figure 3.14.3c Dragging a parameter to the Output table

3.4.13 ETHERNET/IP DISPLAY MODE (Cont.)

An alternative to the click-drag technique is to right click on the required output (five in the example below), and select 'Edit Wire...' from the context menu that appears. A browse window pops up, allowing the user to navigate to the required parameter. This technique can be used both on previously empty inputs or outputs and on those previously filled.

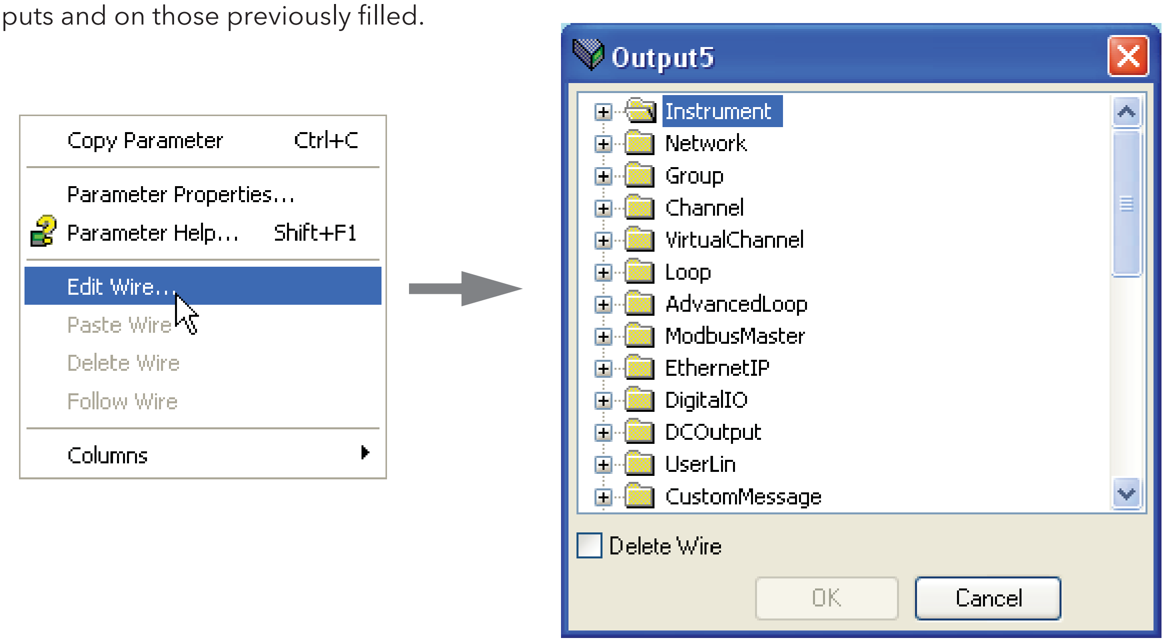


Figure 3.4.13d Context menu details

EXPLICIT DATA

As shown in table 3.4.13, when configured as a server, there is only one explicit application object, and that has the class ID= A2 (162 decimal). The instance ID is the Modbus address of the parameter and the Attribute is always = 1. Explicit service codes hex10 (decimal 16) and 0E (14) are both supported, for writing and reading single attributes respectively.

Service code		Class ID		Instance ID	Attribute
Hex	Dec	Hex	Dec	Decimal	
0010	16	A2	162	1-65535	1
000E	14	A2	162	1-65535	1

Table 3.4.13 Explicit data specification

When configured as a client, two separate connections are available allowing the user to produce two independent explicit read or write messages to different server devices.

Figure 3.4.13e below, shows an example of how to configure an explicit message request. The instance ID and the data type are taken from the server manufacturer's data. In this example a read request is configured to determine the Group recording status of a nanodac server, and it can be seen from table 5.3 that the decimal modbus address for this parameter is 4150 and the data type is int16. It is this address which is used as the instance ID.

Once all the information has been entered, the read is requested by setting 'Send' to 'Yes'. The Data field changes to '3' for this example and from table 5.3 it can be seen that the recording status is 'Recording enabled'.

Note: The nanodac supports only 16 bit data types for reading and writing of explicit messages.

3.4.13 ETHERNET/IP DISPLAY MODE (Cont.)

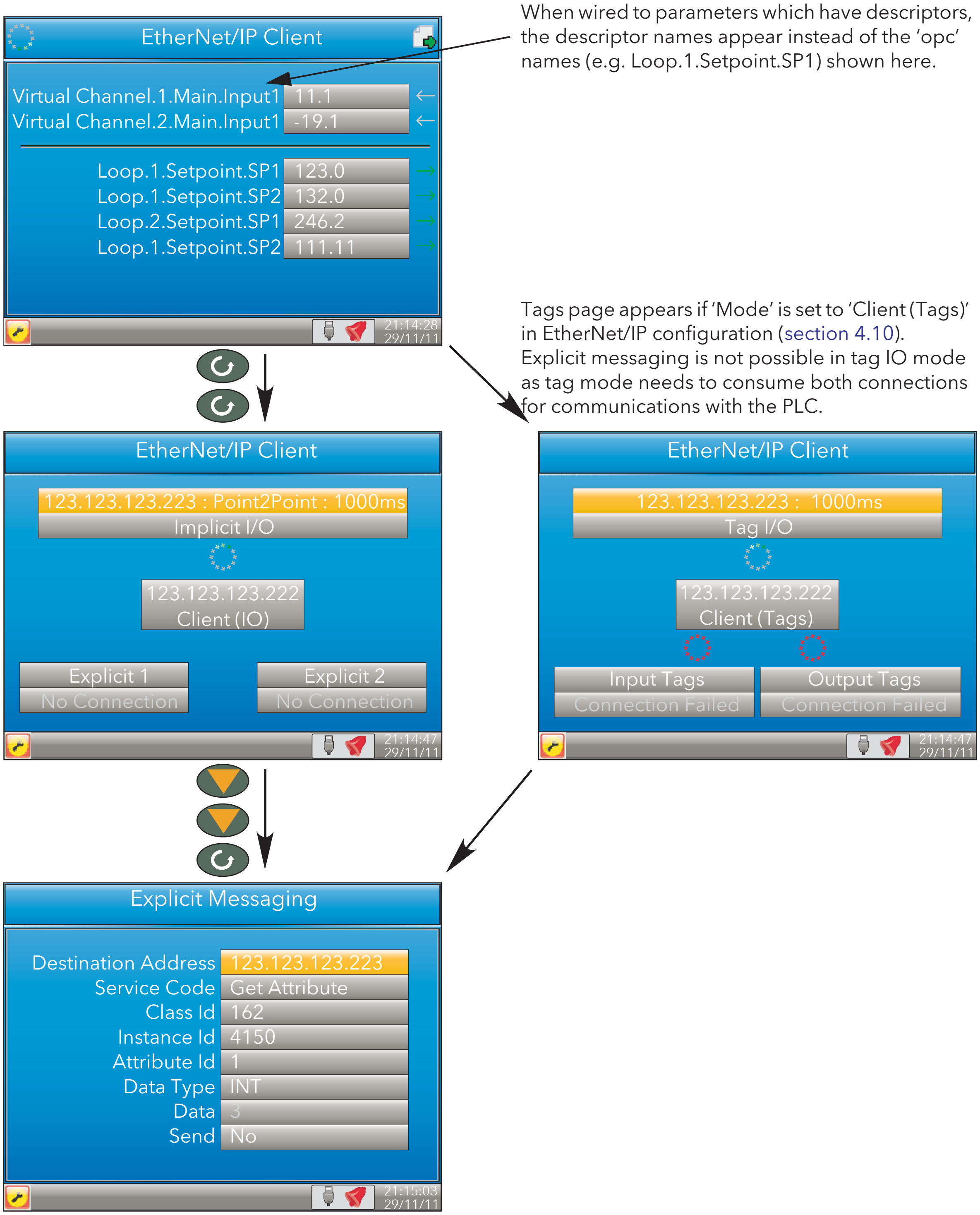


Figure 3.4.13e explicit messaging example

3.4.13 ETHERNET/IP DISPLAY MODE (Cont.)

USING TAGS

When acting as servers, many PLCs present their data in a tag format instead of implicit data format. For this reason, when the client is configured as 'Client (Tags)', (section 4.10) 30 input and 30 output tags become available to the user via iTools (figure 3.4.13f).

This allows tag names to be typed in, input tags 1 to 30 being associated with implicit inputs 1to 30 respectively and output tags 1 to 30 being associated with implicit outputs 1to 30 respectively.

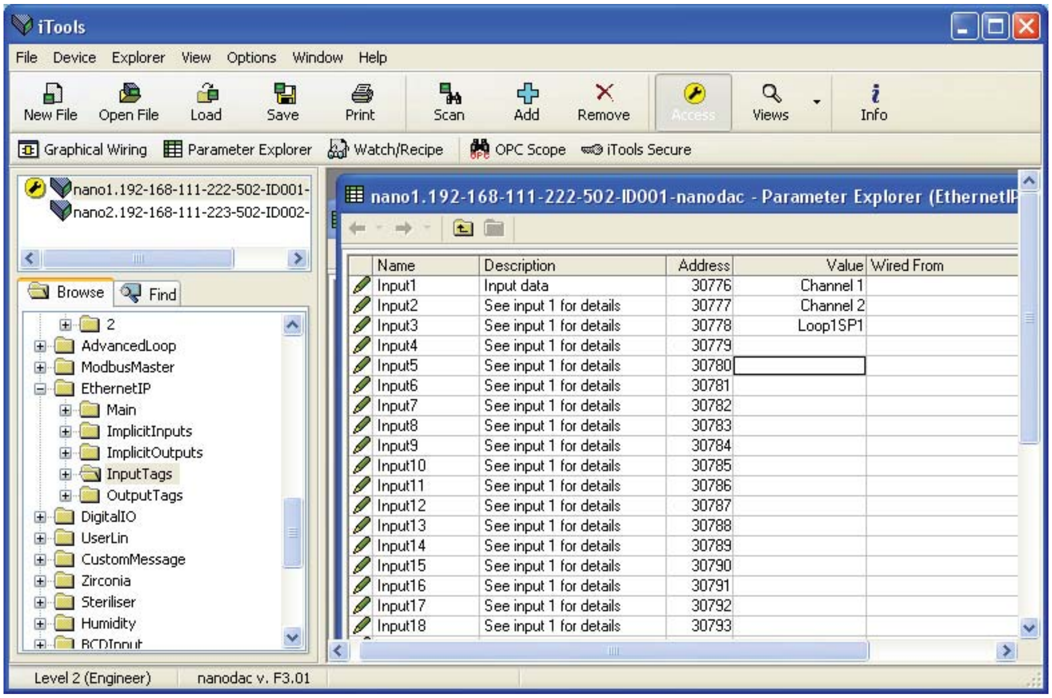


Figure 3.4.13f iTools display showing input tags.

In the example above, the value of the parameter with the tag 'Channel 1' will be written to implicit input 1.

Notes:

1. Most PLCs have a data buffer limit of 500 Bytes. The total number of bytes being used is given by the equation: Total number of data bytes = (tag length + 10) × the number of requested tags.
2. Input data direction is always to the nanodac:
   in server mode input data is written to the nanodac from the client
   in client mode, input data is read by the nanodac from the server device.
3. Output data direction is always from the nanodac:
   in server mode output data is written to the client from the nanodac
   in client mode, output data is read by the server from the nanodac.

3.5 TREND HISTORY

Entered from the top level menu (section 3.1), this allows vertical and horizontal traces to be reviewed for Trend group channels. The amount of data displayed in one screen depends on the 'Zoom In/Out' setting in the History menu (section 3.5.2) and on the recording interval selected in Group Recording configuration (section 4.3.2). It is also possible to enter a time and date to which the history then jumps.

The history display is identical in appearance with the trend display except:

1. History displays can include messages if so configured in the History menu.
2. For horizontal trends, the scale is displayed permanently at the left edge of the display.

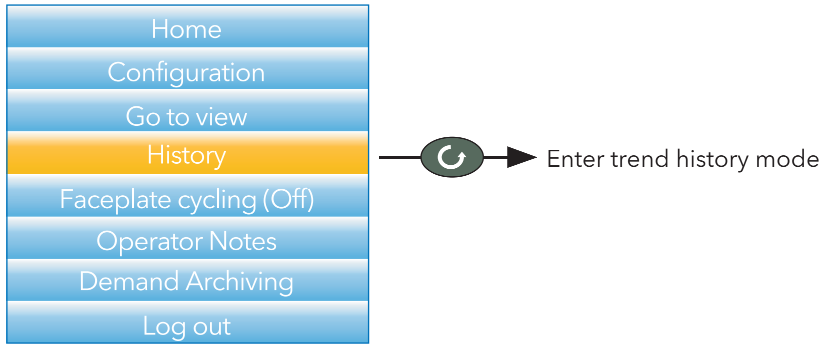


Figure 3.5a Top level menu

3.5.1 Navigation

 The down arrow button moves the display backwards in time by $^1/_3$ screen-full per operation (assuming that the current display is not the earliest). See also 'SEARCH FOR', below.

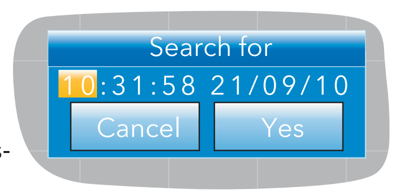
 The up arrow button moves the display forwards in time by $^1/_3$ screen-full per operation (assuming that the current display is not the latest). See also 'SEARCH FOR', below

 The scroll key scrolls through the trend group channels, emphasizing each channel (and displaying its faceplate) as it is selected.

 The page key calls the History Menu, described in section 3.5.2, below.

SEARCH FOR

In the history display, holding the up or down arrow key operated for approximately two seconds produces a 'Search for' display which allows the user to enter a time and date. Once a time and date have been entered, 'Yes' then causes the history display to jump to that time and date (if such history exists).



To enter a time and date:

1. Use the up/down arrows to highlight the item to be edited.
2. When highlighted (orange background), operate the scroll button. The highlighted text turns black.
3. Use the up and down arrow keys to scroll to the required value for the field, then operate the scroll button again. The text goes white.
4. Repeat the above editing process for all the remaining items which are to be edited.
5. Use the up/down keys to select 'Yes'. The 'Search for' window closes, and the history display jumps to the selected time and date.

Notes:

1. If no history exists for the selected time and/or date 'No History Available' is displayed.
2. The time and date format and Daylight Savings Time (DST) effects are as set in the 'Locale' area of Instrument configuration. See section 4.1.2 for further details.

3.5.2 History Options Menu

Operating the page key from within a history display, causes the History Options menu to appear.

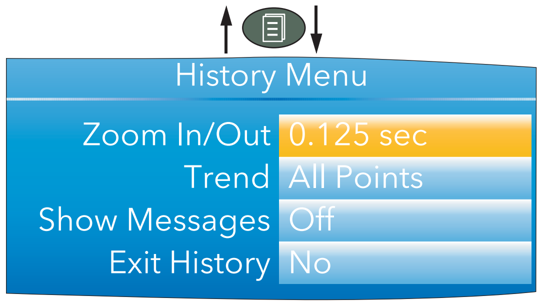


Figure 3.5.2 History Options menu

PARAMETERS

Zoom In/out	Allows the user to select the amount of history displayed on the screen.
Trend	Select either 'All Points' or 'Each Point'.
	'All points' displays all channels in the trend group, with the first channel emphasized on the screen and its faceplate displayed. The Scroll button is used to select the next channel in the group.
	'Each Point' initially displays only the first point in the trace group. The scroll key is used to cycle through individual group channels in turn.
Show Messages	'Off' disable the inclusion of messages in history display. 'On' causes messages to appear, superimposed upon the point traces (vertical trend mode only).
Exit History	Selecting 'Yes' for this item causes a return to the top level menu or to the message summary page.

Note: Operating the page key from the History menu causes a return to the history display.

3.6 TEXT ENTRY

The user is often required to enter text characters or numbers (when editing operator notes, for example). This is done using the pop-up keyboards which are displayed when required. When only numerals are required a special keyboard is presented which contains only numerals.

Figure 3.6 shows the three standard keyboards, along with a 'scan' direction for operations of both up arrow and down arrow keys. To change keyboards, use the arrow pushbuttons to highlight the keyboard name ('Numeric', 'Symbols' or 'Alpha'), and then operate the scroll button.

Generally, to enter text, the required character is highlighted using the up and down arrows and the scroll button is used as an 'Enter' key. Once text entry is complete, the Page button is used to confirm the edit (use the down arrow to select 'Yes' then operate the scroll button).

Pressing and holding the scroll button and then immediately operating the up or down arrow, causes the character insertion point to move to the left (down arrow) or to the right (up arrow).

The user can press and hold the scroll key to display variations on certain characters (the letter 'e' in the figure). Once displayed, the up and down arrows can again be used to scroll through auxiliary list, allowing capital letters, and characters with diacriticals (e.g. accents, umlauts, tildes, cedillas) to be selected and entered using the scroll button.

The backarrow key is used as a back space key - i.e. it deletes the character to the left of the cursor position. The 'Del' key deletes the character to the right of the cursor.

Note: Leading and trailing space characters are automatically removed from text strings.

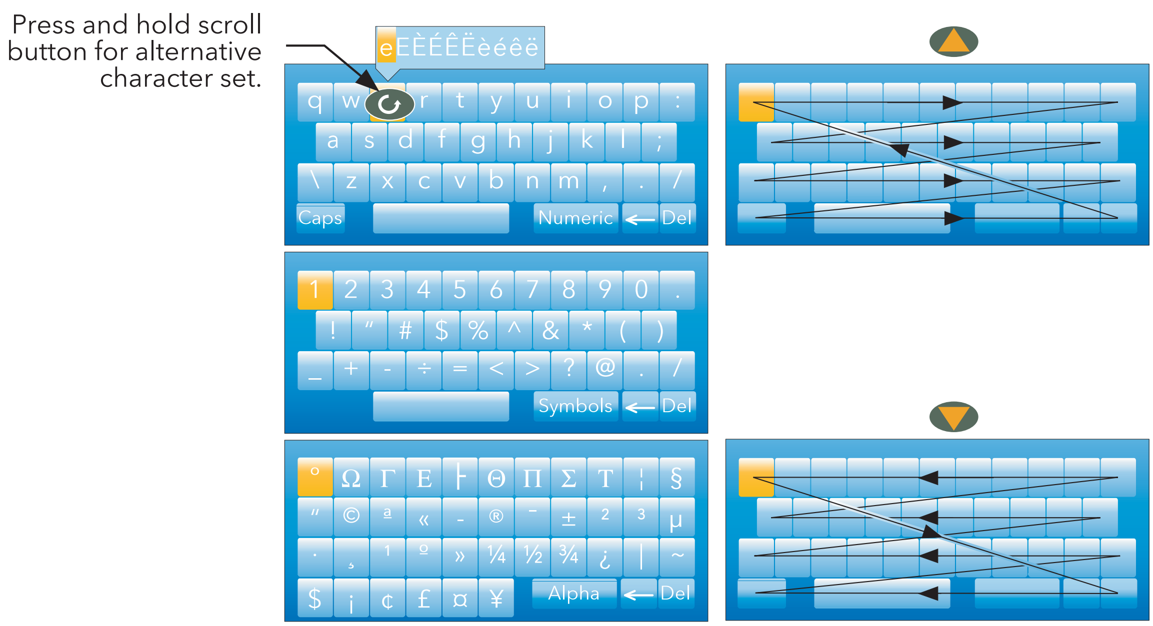


Figure 3.6 Standard Keyboards

3.6.1 Numeric keyboard

As mentioned previously, for functions which can take only numerals, a special numeric keyboard appears, as depicted in figure 3.6.1.

Figure 3.6.1 Numeric keyboard

3.6.2 USB keyboard

Text and numeric entry can also be carried out using a USB keyboard as described in section 8.3.

4 CONFIGURATION

Entered from the top level menu (section 3.1) this allows the recorder configuration to be accessed and edited ('Engineer' access level required for full editing).

CAUTION

Recording is stopped for as long as the recorder login is at Engineer level. This means that Input/output circuits are switched off during configuration.

As shown in figure 4, below, the recorder configuration is arranged in a number of 'areas', each of which is allocated its own sub-section within section 4.

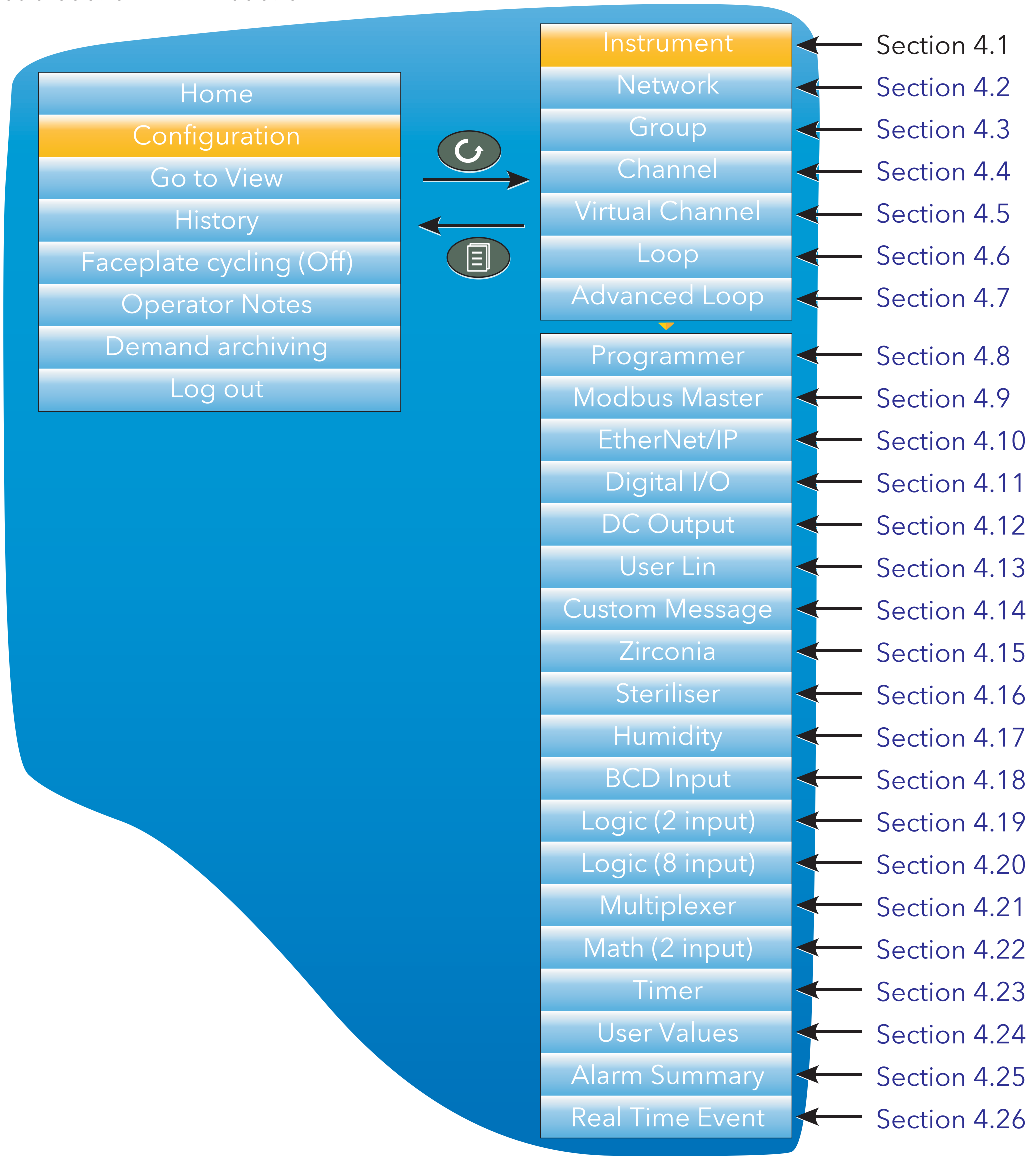


Figure 4 Top level configuration menu

The factory default configuration can be returned-to, if required, by entering a special Engineer password, as described in section 4.1.6.

4.1 INSTRUMENT MENU

Instrument

- Clock (section 4.1.1)
  - Date
  - Time
- Locale (section 4.1.2)
  - Language
  - Date format
  - Time zone
  - DST enable
- Display (section 4.1.3)
  - Brightness
  - Save after
  - Saver Brightness
  - Home page
  - HPage timeout
  - Vertical trend
  - Horizontal trend
  - Future trend
  - Vertical bar
  - Horizontal bar
  - Numeric
  - Alarm panel
  - Loop control
  - Dual loop
  - Cascade
  - Programmer
  - Steriliser
  - Promote list
  - Modbus Master
  - EtherNet/IP
  - Trend back-ground
  - History back-ground
  - H.Trend scal-ing
  - Faceplate cy-cling
  - Setpoint colour
  - Number format
  - USB auto scan
- Info (section 4.1.4)
  - Name
  - Type
  - Version
  - Bootrom
  - Company ID
  - Config Rev
  - Security Rev
  - Nvol writes
  - Line Voltage
  - Wires Free
- Upgrade (section 4.1.5)
  - Type
  - IP Address
  - Username
  - Password
  - Source Path
  - Initiate
- Security (section 4.1.6)
  - Engineer Password
  - Supervisor Password
  - Operator Password
  - Feature Pass-words
  - Comms Pass-word
  - OEM Pass
  - OEM Entry
  - OEM Status
- I/O Fitted (Section 4.1.7)
- Save/Restore (Section 4.1.8)
  - Select Save or Restore
- Input Adjust (section 4.1.9)
  - Select channs
  - Start IP adjust
  - Abort
- Output Adjust (section 4.1.10)
  - Output
  - Measured o/p
  - Confirm

4.1.1 Clock

The up and down arrows are used to highlight 'Date' (default) or 'Time'.

To set the date, the scroll button is used to display the numeric keyboard described in section 3.6.1. The up and down arrows are used to highlight the relevant numeral or separator ('/' or ':') and the scroll key used to enter it into the display window.

To set the time, the scroll button is operated to enter edit mode, then the up and down buttons are used to scroll to display a time, say 15 seconds later than the current time. Once the current time matches the display, the scroll button is pressed to confirm the time and to start the clock.

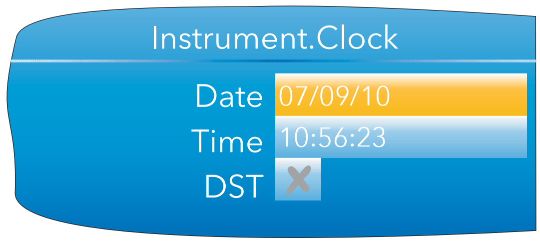


Figure 4.1.1 Clock menu

The 'DST' field appears only If 'DST Enable' is selected 'Yes', in 'Locale' (section 4.1.2). If the 'box' contains a cross (as shown) then Daylight Saving Time (DST) is not currently active. A 'tick' means that the time shown has been advanced by an hour because DST is active.

4.1.2 Locale

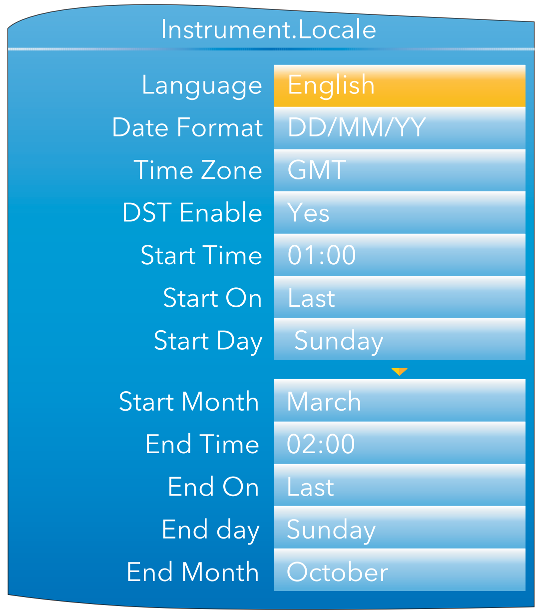


Figure 4.1.2 Typical Instrument configuration menu (expanded to show all fields)

Language	Select the language to be used for displays etc.
Date format	Select MM/DD/YY, YY/MM/DD as the required format.
Time Zone	Select the required offset from GMT (UTC). This setting affects only the displayed time. Archiving, recording etc. times remain in GMT.
DST Enable	Daylight Saving Time enable. Once the selection is enabled, the following (previously hidden) fields appear, allowing the start and end dates for Daylight Saving Time (DST) to be configured. DST affects only the displayed time. Archiving, recording etc. times remain in GMT.
Start Time	Appears only when 'DST Enable' (above) is set to 'Yes'. Use the up/down keys to scroll to the required start time.
Start On	Select 'Last', 'First', 'Second', 'Third' or 'Fourth' as the required week. Used in conjunction with the 'Start Day' and 'Start Month' entries following.
Start Day	Select the day of the week on which DST is to commence.
Start Month	Select the month in which DST is to commence.
End Time, End On, End Day, End Month	As for 'Start Time' etc. above, but specifies the end time and date for daylight savings.

4.1.3 Display configuration

This allows the user to set display brightnesses and screen saver details, to select a display mode as the 'Home' page, and to enable/ disable the various display modes. The normal 'Select, Scroll, Enter' editing technique is used as has been previously described.

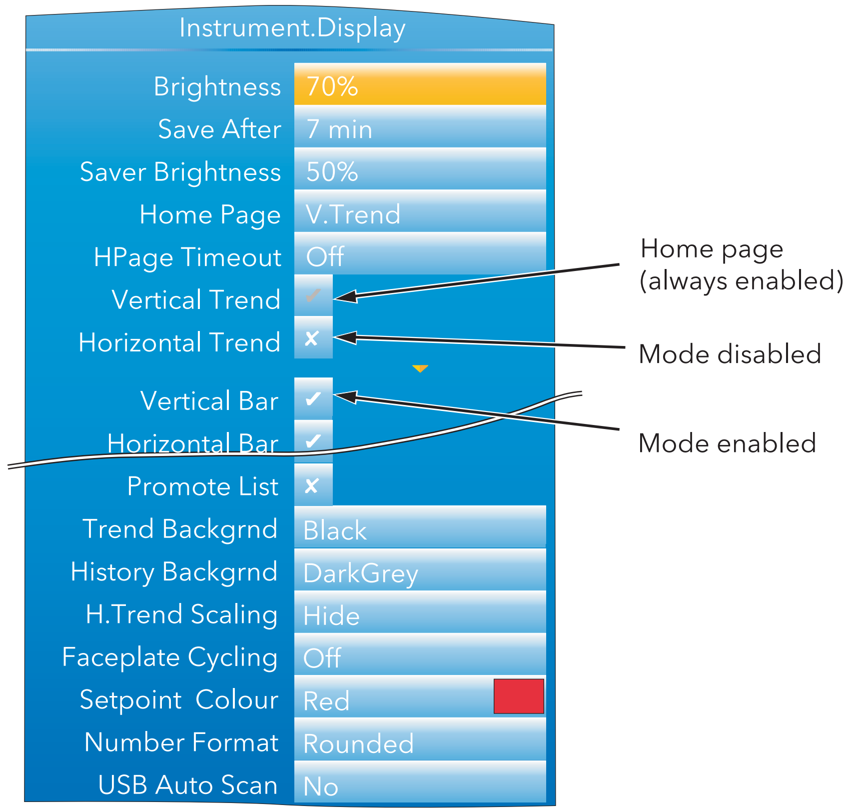


Figure 4.1.3 Display menu (expanded to show all fields)

Brightness	Allows the user to select a normal operating brightness for the screen from 10% to 100%, in 10% steps.
Save After	The elapsed time (since last button press) before the screen switches from 'Brightness' to 'Saver Brightness'. (Off = saver function disabled)
Saver Brightness	The screen saver brightness. Valid entries are 10% to 100% inclusive, in 10% steps. Using a lower power when not 'in use' not only saves power, but also increases display life. Typical screen power consumption is 0.5W at 100%, falling in a linear fashion to 0.05W at 10%.
Home page	Allows any display mode to be chosen as the 'Home' page. This is the page that the recorder displays at power up, and also the page displayed when the 'Home' key is selected from the top level menu (section 3.3). The selected display mode (vertical trend in figure 4.1.3) is always enabled in the following display mode enable fields (its 'tick' is greyed out and cannot be edited). See section 3.4 for a description of the available modes.
HPage Timeout	The elapsed time (since last button press) before the display returns to the home screen. (Off = disabled)
Vertical Trend	This is the default home page, and its tick is greyed. If this is not the home page, the tick can be changed to a cross, by highlighting it and operating the scroll button.

4.1.3 DISPLAY CONFIGURATION (Cont.)

Horizontal Trend, Vertical Bar, Horizontal bar, Numeric, Alarm Panel, Loop control, Dual Loop, Cascade, Programmer, Steriliser, Promote List, Modbus Master, EtherNet/IP. As for Vertical Trend, above. By default some display modes are disabled (grey cross). In order to enable such display modes the relevant cross is highlighted using the up/down arrow buttons, and the scroll button then used to change the grey cross to a white tick.
The tick associated with the selected home page is always grey.

Note: Some display modes are available only if the relevant option is fitted.

Future Trend	This and the associated colour selections appear only if the Programmer option is fitted. See section 3.4.9 for more details.
Trend Background	Allows the user to select black (default), white dark grey or light gray as the 'chart' colour.
History Background	As above for 'Trend background', but for history displays.
H.Trend Scaling	As described in section 3.4.2, by default, the scale for horizontal trends appears at the left edge of the chart for a few seconds before the chart expands leftwards to occupy the scale area. Setting 'H.Trend Scaling' to 'Permanent', ensures that the scale remains permanently on display.
Faceplate cycling	Allows the default faceplate cycling state to be defined as 'On' or 'Off' (section 3.3.5)
Setpoint colour	The colour for the setpoint in Control Loop display pages (section 3.4.7).
Number Format	Rounded: Truncated:
USB Auto Scan	If set to 'Yes', bar code data messages are automatically generated and appear on the display and in the Message list without operator intervention. If set to 'No', the Message appears on the screen for editing and/or confirmation, before being displayed etc. Section 8.2 provides further details.

There is a new paramter been added to the Instrument.Display list - Number format.

The options are to "Round" or "Truncate" values. On the previous phases of the nano, numbers were truncated (in the same was as the 6000).

With phase 3 there is an option to allow numbers to be rounded. The reason for this is driven primarily from a control point-of-view. With truncation, it is quite likely that the PV will look as though it never settles onto setpoint. The rounding/truncation affects the UI display and MODBUS scaled integers, the underlying numbers are not affected, nor the values saved in the history files. Over MODBUS comms, all floating point parameters that are read via scaled integer comms will take note of the configured setting for rounding or truncating and reflect this. On the UI, ALL floating point values rendered will adhere to the configured setting of rounding or truncating.

4.1.4 Info menu

Gives information about the recorder hardware and software, and allows the user to enter a descriptor for the instrument. The normal 'Select, Scroll, Enter' editing technique, previously described) is used to edit those fields that are not read only.

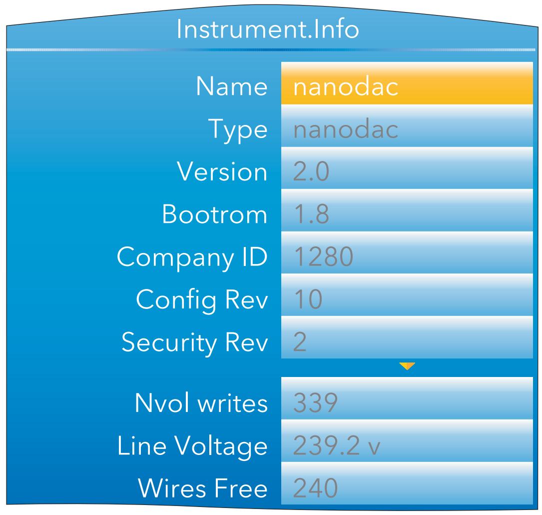


Figure 4.1.4 Info menu (expanded to show all fields)

Name	Allows the user to enter a descriptor of up to 20 characters, using the text entry techniques described in section 3.6. The number of characters visible in the display mode pages varies according to the number of alarm symbols on display.
Type	Nano. Read only display of the instrument model (used by 'iTools').
Version	Read only. The software version of the instrument.
Bootrom	Read only. Instrument software Boot ROM version
Company ID	Read only. For CNOMO* purposes over Modbus (1280 decimal; 0500 hex).
Config Rev	Read only. This value is updated, and a message including this value generated, every time configuration is quit, if any one or more configuration parameter has been changed.
Security Rev	Read only. This number is incremented every time configuration is quit, if any one or more passwords has been changed, or if the FTP Server username has been changed, or if the Comms Enable field has been edited.
Nvol writes	Number of non volatile write operations for diagnostic purposes.
Line voltage	The instantaneous value of the supply voltage applied to the instrument. Used in some control loop operations.
Wires Free	This shows the number of wires free to be used. The value takes into account all user wiring whether carried out at the instrument or downloaded from the iTools graphical wiring editor.

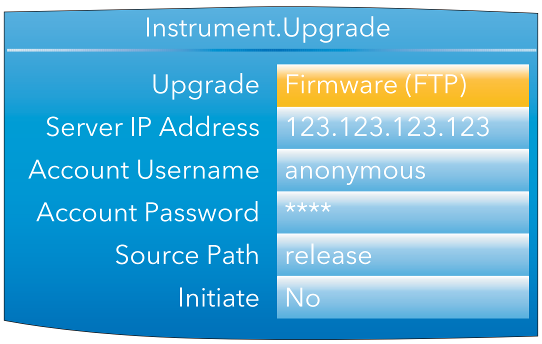
* CNOMO = Comité de normalisation des moyens de production.

4.1.5 Upgrade

CAUTION

1. Power must not be removed from the unit whilst upgrade is in progress, as to do so will cause permanent damage to the unit.
2. For USB upgrades, the memory stick must not be removed whilst upgrade is in progress or the instrument will be permanently damaged.

This item allows the user to update the instrument firmware, either from a memory stick in the USB socket at the rear of the unit, or via FTP transfer from a host computer. Firmware upgrade files are downloaded from the recorder manufacturer and transferred to the instrument by memory stick or by FTP transfer. Splash screens are prepared by the user and transferred using a memory stick. The unit restarts automatically after an upgrade or splash screen replacement.



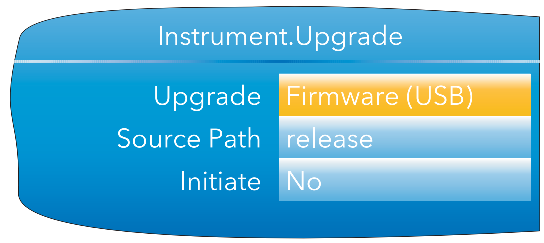


Figure 4.1.5 Typical Upgrade menus

Upgrade	Select 'Firmware (USB)', 'Firmware (FTP)', 'Bootrom (USB)' or 'Splash (USB)' as the source of the upgrade.
Server IP Address	For 'Upgrade' = 'Firmware (FTP)' only, this field must contain the IP address of the pc which is to supply the upgrade file.
Account Username	For 'Type' = 'Firmware (FTP)' only, the username set up in the host ftp server
Account Password	For 'Type' = 'Firmware (FTP)' only, the password set up in the host ftp server
Source Path	The name of the directory from which the upgrade file is to be read. This is only the name of the directory without any path elements (e.g. '/') included unless the path is 'release/upgrade/files'.
Initiate	Select 'Yes' to initiate the upgrade.

CUSTOMISING THE SPLASH SCREEN

'Splash (USB)' allows the user to select a new image for the splash screen (i.e. the screen that appears at power up or restart). When 'Initiate' is set to 'Yes', the instrument searches the USB device for a file called 'splash.bmp' located in the 'release' folder. If such a file is found, it is loaded, and the instrument re-starts with the new image as the 'splash' screen. If no file is found, the request is ignored. If the image is not of the correct type or size, the instrument re-starts with the default splash screen.

The original splash screen is included on the 'tools' DVD, so that it can be restored if required.

Rules:

1. This feature is available only with Bootrom versions 2.0 and above.
2. The file must be located in a folder called 'release' and the file name must be 'splash.bmp'.
3. The image must be 320 x 240; 24-bit resolution.
4. The image must be in bitmap (suffix.bmp) format.
5. The image may not exceed 256kB.

4.1.6 Security menu

This allows the user to enter passwords for all security levels (except logged out), and to enable/disable serial communications security.

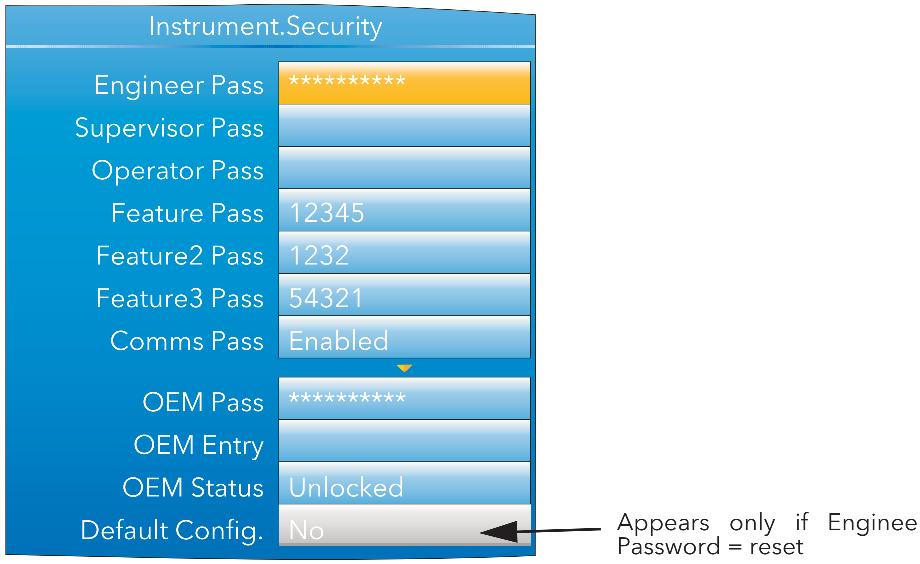


Figure 4.1.6 Security menu

Engineer Pass	Gives access to configuration menus. Set to 100 when despatched, but can be edited here, if required, by entering an alternative of up to 20 characters (note 1). If 'reset' (case sensitive) is entered as the Engineer Password, the 'Default Config.' field appears allowing the instrument default configuration to be restored (note 2).
Supervisor Pass	A password (none by default) of up to 20 characters can be entered here to protect Supervisor level access.
Operator Pass	A password (none by default) of up to 20 characters can be entered here to protect Operator level access.
Feature Pass	This is a password supplied by the manufacturer to enable the software options (e.g. Loop, Zirconia block, Toolkit blocks etc.). When applying for this code, the manufacturer will require the instrument's MAC address (Network.Interface menu section 4.2.1) and the instrument's firmware Version (Instrument.info menu - section 4.1.4). The password is MAC address dependent so that it cannot be used on any other instrument.
Feature2/3 Pass	Similar to 'Feature Pass' above, but for additional features.
Comms Pass	Enables/disables password security for external communications (including via iTools). If set to 'Enabled', the Engineer level password will be required if an attempt is made to enter the configuration menus from a remote pc. If set to 'Disabled', then access to configuration can be gained over a communications link, without a password. If enabled, then entry to configuration mode via the Instrument Mode (IM) parameter must be completed within 5 seconds of entering the password, or the attempt will fail.

Notes:

1. It is recommended that only such characters as appear on the user's pc keyboard be used in the Engineer password. The use of other characters makes it necessary to use 'Escape' codes (e.g. Alt 0247 for the '÷' sign) when trying to enter configuration mode from iTools, for example.
2. Restoring factory default configuration can also be carried out in iTools, using the Engineer password 'reset' and selecting Default Config to 'Yes'.

4.1.6 SECURITY MENU (Cont.)

OEM Pass	The configured pass phrase used to enable / disable the OEM security option. This field is editable whilst the OEM Status is 'Unlocked' and the user has 'Engineer' access.
OEM entry	To lock or unlock the OEM security feature, the user must enter the pass phrase entered in 'OEM Pass' above.
OEM Status	Read only 'Locked' or 'Unlocked' status display.
Default Config	This field appears only if 'reset' has been entered as the Engineer Password. Selecting 'Yes' Causes the instrument to restart with default configuration (i.e. the instrument 'cold starts'). See note 2 above.

OEM SECURITY

In products that incorporate user wiring, the value of an application may lie more in the user wiring (connecting the function blocks together) than in the configuration of the instrument's parameters.

OEM Security allows the user to prevent the application from being copied either via comms (by iTools or a third party comms package) or via the instrument's user interface.

When OEM security is enabled, users are prevented from accessing wiring (for reading or writing) from any source (comms or user interface), and it is not possible to Load or Save the configuration of the instrument via iTools or by using the Save/Restore facility (section 4.1.8).

4.1.7 I/O fitted

This provides a read only display showing what type of input or output circuit is associated with each set of rear terminals.

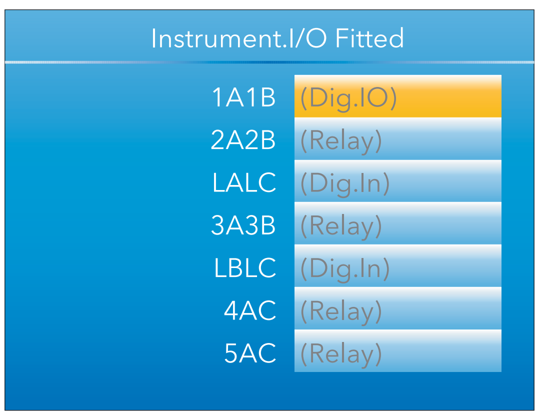


Figure 4.1.7 I/O fitted display

I/O TYPES

Dig.IO	Digital input/output
Relay	Relay output
Dig.In	Digital input
Dig.Out	Digital output
DC.Op	DC output

Note: The I/O types fitted in locations LALC, LBLC, 4AC and 5AC are always as shown above. The types of I/O fitted in locations 1A1B, 2A2B and 3A3B depends on the options specified at time of order.

4.1.8 Save/Restore

This allows the user to save and/or restore instrument clone configurations to a memory stick inserted into the USB connector at the rear of the unit. The format of the saved/restored files is iTools clone files (*.uic)

Selecting 'Restore' presents a list of clone files in the configured directory on the USB device. (In the example below, the file is located in the basic usb0 directory - it has not been saved to a particular configuration directory.)
When 'Save' is selected, the virtual keyboard must be used to enter the filename. If the file already exists on the USB device, a warning appears offering 'Cancel' or 'Overwrite' alternatives.

Notes:
1. The ability to save and restore is disabled if OEM security is enabled.
2. Configuration save/restore is available only when the unit is logged into at 'Engineer' access level.
3. During USB cloning (USB save/restore), the priority of modbus slave comms is lowered. This allows the save/restore process to complete in a minimal time (around 60 seconds). During this period, modbus slave comms response times will be extended and may result in the master device timing-out.

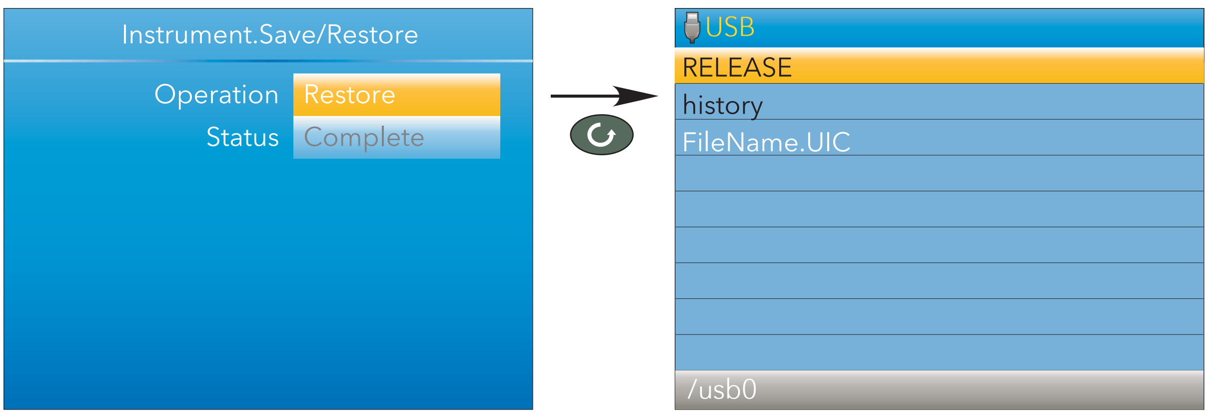
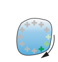


Figure 4.1.8 Save/Restore display

Operation	Select 'Save' or 'Restore'. Use the up/down arrow keys to highlight the required .UIC file, then use the scroll key to initiate the operation.
Status	Shows the status of the operation, as follows: Inactive: Neither saving or restoring a clone file has occurred since the last time the instrument was power cycled. Complete: Indicates that the cloning process has completed. Restoring: Restore operation is currently in progress. Saving: A clone file is currently being saved. Cold started: A power-cycle of the product occurred whilst a Restore operation was in progress. The product configuration is unreliable and has been reset to factory default.



The 'Restoring' and 'Saving' status text is accompanied by an animated display (circling green 'flash') to indicate that the operation is in progress.

4.1.9 Input adjust

Notes
1. Input adjust cannot be applied to input channels with input type of 'Digital', 'Test' or 'Off'.
2. Input adjustments can be carried out only by users logged in as 'Engineer' (see section 3.3.7).
3. The instrument must be powered for a sufficient time (e.g. 30 minutes) for it to reach thermal equilibrium before an input adjust is performed.

This facility allows the user to compensate for tolerance errors etc. The technique used is to select those channels to which adjust is to be applied, then for each channel to:

a apply a known low level signal (at or close to the low input range value) to the relevant input. When the recorder reading is steady, press 'Apply'.

b. apply a known high level signal (at, or close to, the high input range value) to the relevant input. When the recorder reading is steady, press 'Apply'.

Figure 4.1.9a shows a typical display when 'Input adjust' is selected from the Instrument menu, and Apply adjust has been selected. As can be seen, channel 3 has previously been adjusted.

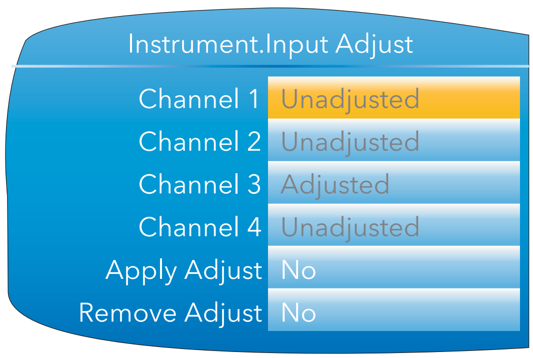


Figure 4.1.9a Input adjust top level display

Channel 1 to 4	Shows the adjust status of each channel
Apply Adjust	Selecting 'Yes' initiates the adjustment procedure described below.
Remove Adjust	Selecting 'Yes' initiates the adjustment removal procedure described below.
Abort	Allows the user to abandon input adjustment at any point in the procedure.

ADJUSTMENT PROCEDURE

1. As shown in figure 4.1.9b, highlight the 'Apply Adjust' field, and operate the scroll key to enter edit mode. Use the up or down arrow key to select 'Yes'. Use the scroll button to change Channel 1 'cross' to a 'tick' (check mark). Similarly select any other channels which require adjustment.

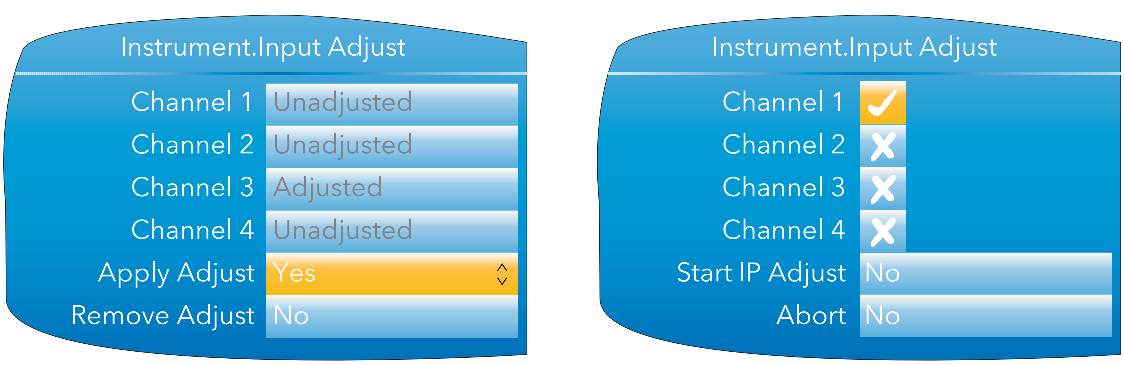


Figure 4.1.9b Channel adjustment procedure (1)

4.1.9 INPUT ADJUST (Cont.)

ADJUSTMENT PROCEDURE (Cont.)

2. Highlight the 'Start IP 'Adjust' field and use the scroll and up/down arrow to select 'Yes'. Use the scroll key again to enter the low value adjust page.
3. Apply the known low value and wait for the value to stabilise. Enter the 'Low Target Value' (the value that the recorder is to read for the applied input). When all is steady, use the scroll and up/down arrow to set the 'Confirm Low' field to 'Yes', then operate the scroll button again.

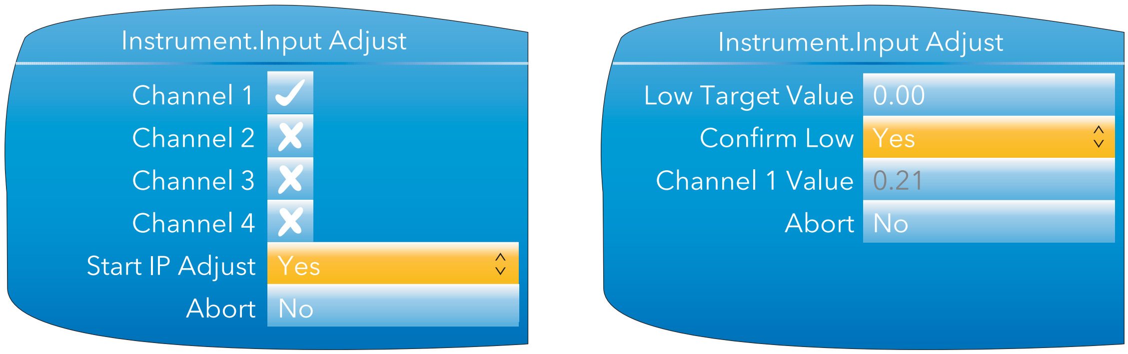


Figure 4.1.9c Channel adjustment procedure (2)

4. The display changes to the high value adjust page.
5. Apply the known high value and wait for the value to stabilise. Enter the High Target Value (the value that the recorder is to read for the applied input). When all is steady, set 'Confirm High' to 'Yes'.

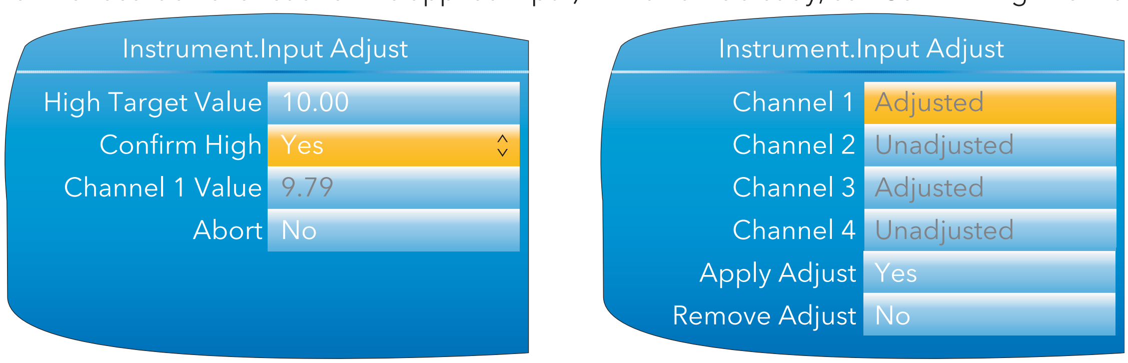


Figure 4.1.9d Channel adjustment procedure (3)

REMOVAL PROCEDURE

1. Set 'Remove Adjust' to 'Yes' and operate the scroll button.
2. Use the scroll and up/down arrow buttons to change the required channel icons from crosses to ticks.
3. Select Remove IP Adjust to 'Yes' and operate the scroll key. The adjustment is removed from all selected channels without further confirmation.

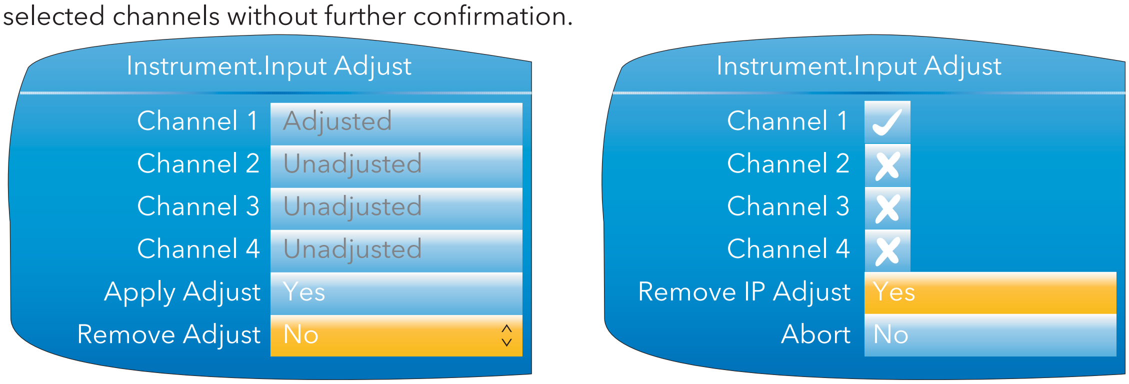
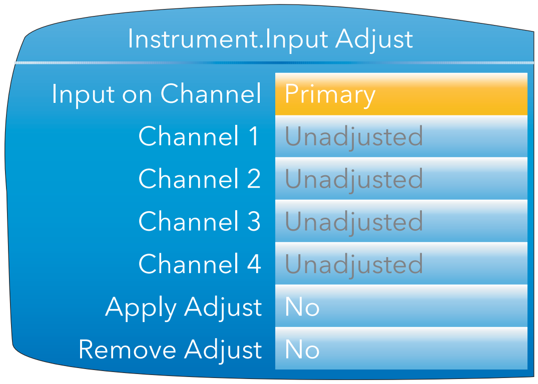


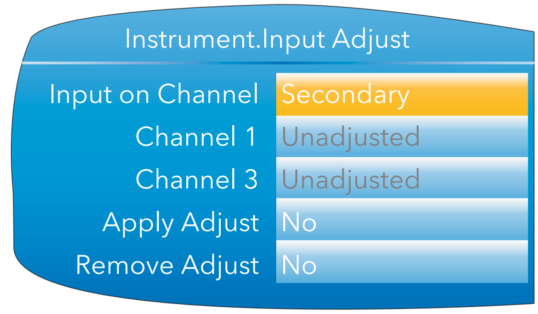
Figure 4.1.9e Channel adjustment removal

4.1.9 INPUT ADJUST (Cont.)

DUAL INPUT CHANNELS

For the dual input channel option, input adjust is carried out as described above, except that for any channel where dual inputs are configured, the user must initiate adjustment to primary and secondary inputs separately. As shown in figure 4.1.9f, a new field 'Input on Channel' is introduced for this purpose.





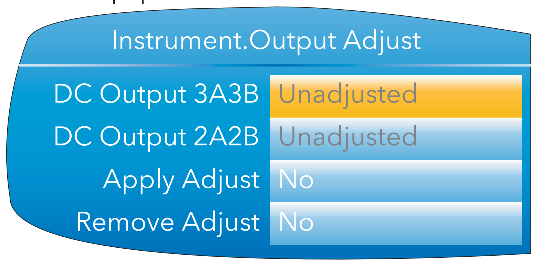
Only those channels with 'Type' set to 'Dual mA', 'Dual mV' or 'Dual T/C' appear in the list of secondary channels. In this example, only channels 1 and 3 are configured as dual input. (See section 4.4.1 for channel Type configuration.)

Figure 4.1.9f Input adjust top level display (dual input channels)

For primary inputs, all four channels are included in the list and can therefore be selected for adjustment. For secondary inputs, only those channels which have been configured as dual input are included.

4.1.10 Output adjust

This item appears only if one or more of I/O type DC Output is fitted and allows the user to compensate for tolerance errors etc. in connected equipment.



1A1B and 2A2B can be configured only as mA outputs.

3A3B can be configured as mA or Volts.

See section 4.12 for configuration details.

Figure 4.1.10a Output adjust initial display

ADJUST PROCEDURE

1. Highlight the 'Apply Adjust' field, and operate the scroll key to enter edit mode. Use the up or down arrow key to select the required output and confirm with the scroll key. The output adjust page appears for the low point.
2. Measure the output at the required point, and enter this value in the 'Measured Output' field using the text entry techniques described in section 3.6. To skip this stage go to step 3.
3. Set 'Confirm Low' to 'Yes'. The output adjust page appears for the high point.
4. Measure the output at the required point, and enter this value in the 'Measured Output' field as described for the low point. To skip this stage go to step 5.
5. Set 'Confirm High' to 'Yes'. The output adjust initial display reappears, with the word 'Adjusted' in the relevant DC Output field.

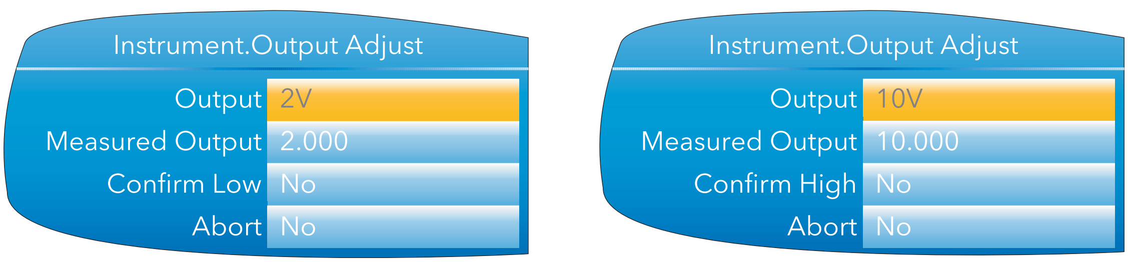


Figure 4.1.10b Low and High adjust point displays

Notes:

1 The figures above show the displays when the DC output is set to 'Volts' (section 4.12) (3A3B only). The mA displays are similar, but the fixed low and high values are 4mA and 20mA respectively.

2. 'Abort' cancels operations so far and returns to the output adjust initial display (figure 4.1.10a).

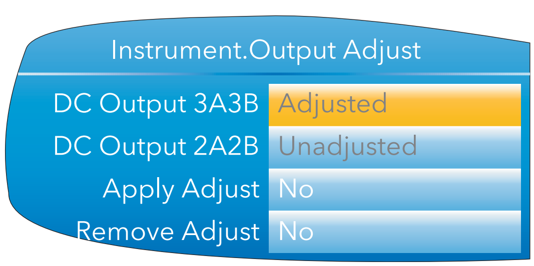


Figure 4.1.10c Adjusted display

ADJUST REMOVAL

In the output adjust initial display (figure 4.1.10c) highlight the 'Remove Adjust' field, and operate the scroll key to enter edit mode. Use the up or down arrow key to select the required output and confirm with the scroll key. The output adjustment is removed, without confirmation. The initial display returns to 'Unadjusted' as in figure 4.1.10a.

4.2 NETWORK MENU

Network

- Interface (Section 4.2.1)
  - MAC address
  - Client Identifier
  - IP type
  - IP address
  - Subnet mask
  - Gateway
- Archiving (Section 4.2.2)
  - Media size
  - Media free
  - Media duration
  - Rate
  - Destination
  - File format
  - On media full
  - Remote path
  - Primary server
  - Primary user
  - Primary password
  - Secondary server
  - Secondary user
  - Secondary password
  - Trigger
  - Period
- FTP Server (Section 4.2.3)
  - User name
  - Password
- Modbus (Section 4.2.4)
  - Prefmaster IP Address
  - Input timeout
  - Unit ID Enable
  - Serial Mode
  - Time Format
  - Pref Master Conn
  - Response time
  - Master Conn 2
  - Response time
  - Master Conn 3
  - Response time
  - Master Conn 4
  - Response time

4.2.1 Interface

This area of configuration allows the user to set up an IP address for the instrument, either by typing one in (Fixed), or automatically (DHCP), assuming a DHCP server is running.

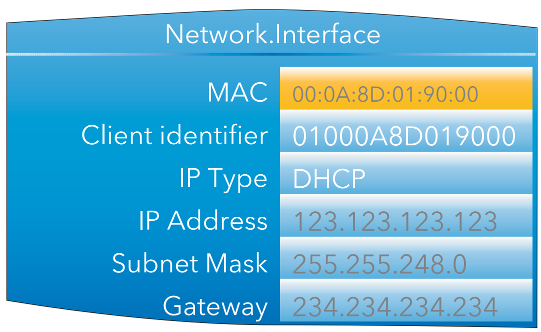


Figure 4.2.1 Network Interface menu

MAC	Read only. Media Access Control. A unique address for each instrument, entered at the factory.
Client Identifier	The client identifier is a unique id used by DHCP servers that implement option 61. Each nano product will have a unique ID built up from its MAC address. If the DHCP server is configured to use option 61, then it will use this id instead of the MAC address to assign a dynamic IP address.
IP Type	If 'Fixed', the user needs to enter an IP address and Subnet Mask in the following fields, and a Gateway address if required. If 'DHCP' the subsequent fields become read only, with the entries automatically generated by the DHCP server. When set to DHCP, it takes several seconds before the IP address is obtained from the DHCP server.
IP Address	Read only if 'IP Type' = 'DHCP'. If 'IP Type' = 'Fixed', the user may enter an IP address (IPV4 dot notation). This would normally be supplied by the user's IT department, or from the Network supervisor.
Subnet Mask	Read only if 'IP Type' = 'DHCP'. If 'IP Type' = 'Fixed', this sets a range of IP addresses that can be accessed. Normally supplied by the user's IT department, or from the Network supervisor.

4.2.1 INTERFACE (Cont.)

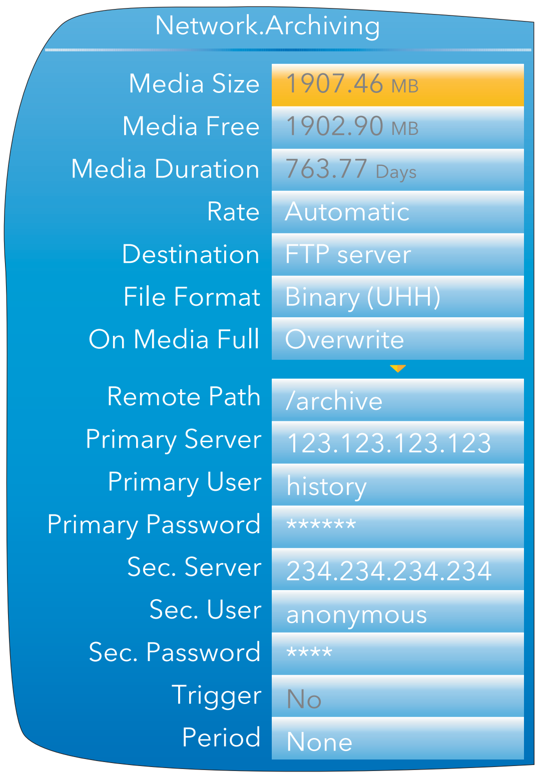
Gateway — Read only if 'IP Type' = 'DHCP'.
If 'IP Type' = 'Fixed' this allows the user to enter a gateway address for use when the unit is to communicate outside the local network. Normally supplied by the user's IT department, or from the Network supervisor.

4.2.2 Archiving

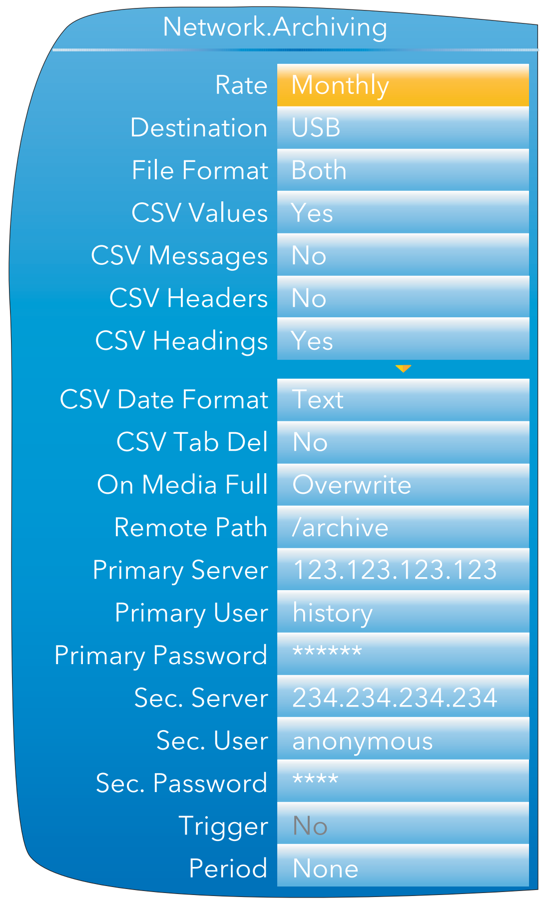
This area of configuration is used to set up the parameters for use during unattended archiving. Some of the fields appear only if other fields are set to a particular value. For example, the CSV fields appear only if 'File Format' is set to 'CSV' or to 'Both'.

The archived data is not removed from the flash memory of the instrument. When the flash memory is full, new data causes the oldest file(s) to be discarded.

Note: For remote archiving, the host computer must be set up to respond to 'pings'. This is because the nano pings the host whilst establishing connection, and if it does not receive a response the archive attempt fails.



Remote with Binary file format



Local with CSV files included

Figure 4.2.2a Unattended Archive configuration (typical settings)

Media Size — Appears only for File Format = 'Binary (UHH)'. A read only value showing the capacity of the memory stick inserted in the USB port at the rear of the unit. Shows zero if no memory stick is present.

Media Free — Appears only for File Format = 'Binary (UHH)'. A read only value showing the space remaining in the memory stick inserted in the USB port at the rear of the unit. Shows zero if no memory stick is present.

Media Duration — Appears only for File Format = 'Binary (UHH)'. A read only value showing the time it will take to fill the Memory stick if the recorder configuration remains unchanged.

4.2.2 ARCHIVING (Cont.)

Rate — Allows the user to specify the frequency at which the contents of the Flash memory are archived to the USB port or, via FTP, to a pc. Scrollable settings are:

- None — Automatic archiving is disabled. Any archiving must be initiated by the user using Demand Archiving, as described in section 3.3.7.
- Hourly — Archive occurs on the hour, every hour.
- Daily — Archive initiated at 00:00* each day
- Weekly — Archive is initiated at midnight* every Sunday
- Monthly — Archive is initiated at 00:00* on the 1st of every month.
- Automatic — The recorder selects the least frequent of the above archive periods which is guaranteed not to lose data as a result of the internal flash memory's running out of space.

*Note: Archive times are not adjusted for daylight saving time (DST). Thus, if the archive is set to 'Daily', 'Weekly' or 'Monthly', then during summer time, the archive will be triggered an hour late (i.e at 01:00 hours instead of midnight).

Destination — Select 'FTP Server' for archive to a remote pc, or 'USB' to archive to the USB port device.

File format — Select 'Binary (UHH)' 'CSV' or 'Both'.

- Binary (UHH) — A proprietary format used by the instrument that needs other software (e.g. Review', to interpret the data before it can be presented in spreadsheets etc. Binary files have the extension '.uhh'.
- CSV — This format is a standard open-file format for numeric data. A simple ASCII-based format, it is readable by a wide range of pc applications as well as being suitable for direct import into many commercial databases. CSV files have the extension '.csv'.
- Both — Archiving includes both .uhh and .csv files.

Note: CSV is ASCII based and cannot interpret Unicode characters. For this reason, some characters available to the user will not be displayed correctly in .csv files.

CSV Values — Appears only if 'File Format' is set to 'CSV' or 'Both'. If 'Yes' is selected, then process values are included in the file (see figure 4.2.2b for details).

CSV Messages — Appears only if 'File Format' is set to 'CSV' or 'Both'. If 'Yes' is selected, then messages are included in the file (see figure 4.2.2b for details).

CSV Headers — Appears only if 'File Format' is set to 'CSV' or 'Both'. If 'Yes' is selected, then Header details are included in the file (see figure 4.2.2b for details).

CSV Headings — Appears only if 'File Format' is set to 'CSV' or 'Both'. If 'Yes' is selected, then column headers are included in the file (see figure 4.2.2b for details).

CSV Date Format — Appears only if 'File Format' is set to 'CSV' or 'Both'. Allows 'Text' or 'Spreadsheet' to be selected. Text causes a time/date to appear in the spreadsheet. 'Spreadsheet Nu' displays the number of days since December 30th 1899. The decimal part of the number represents the latest six hours. For example: DDD--- --DD.25 represents 06:00 hours and DDD--- --DD.5 represents 12:00 hours. Spreadsheet Numeric format is more easily interpreted than 'Text' by some spreadsheet applications.

CSV Tab Del — Appears only if 'File Format' is set to 'CSV' or 'Both'.
CSV (Comma Separated Variables) does not always use commas as separators. For example, in some countries the decimal point is represented by a full stop (period), whilst in others a comma is used. In order to avoid confusion between a comma as a decimal point and a comma as a separator, a different separator can be used. This field allows the 'tab' character (^t) to be used instead of a comma.

4.2.2 ARCHIVING (Cont.)

On Media Full — For 'Destination' = 'USB' only, this allows the user to select 'Overwrite' or 'Stop' as the action to be taken when the memory stick is full. 'Overwrite' causes the oldest data to be discarded from the memory stick to make room for newer data. 'Stop' inhibits archiving activity.

Remote Path — Left blank if the archive destination is the home folder. If the destination is to a subfolder within the home folder, then the name of the subfolder is entered here, preceded by a '/' character (e.g. '/history').

Primary Server — Allows the user to enter the IP address for the pc to be used as the primary FTP server.

Primary User/Password

These are the Login name and password of the remote host account, assigned either by the Network administrator, or set up in the 'Guest' account of the remote host's 'FTP server' or 'User Manager' configuration.

Sec. Server/user/password

As Primary server details above, but for the secondary FTP server used when the primary is not available for any reason.

Trigger — This parameter can be 'wired' to, say, an alarm going active, or a digital input, to allow an archive to be triggered remotely. Can also be set to 'yes' manually.

Period — Appears only if 'Trigger' is wired (section 7). Allows a period of history to be selected for archiving when 'Trigger' goes 'true. Selections are: None, Last Hour, Last Day, Last Week, Last Month, All, Bring to Date. ('Last Month' archives the last 31 days of history.)

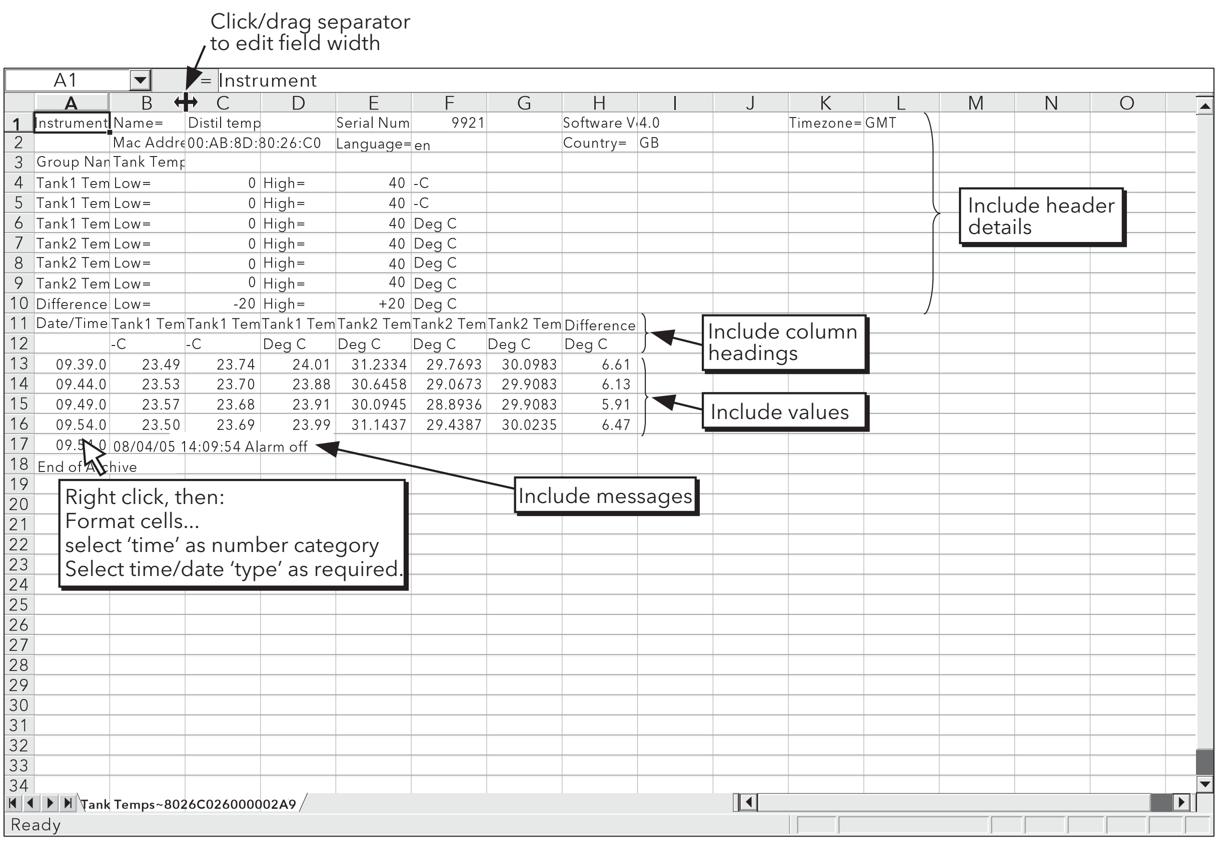


Figure 4.2.2b CSV data example

4.2.3 FTP Server

This area of configuration allows the user to enter the Username and Password used to access the instrument from a remote FTP client.

4.2.4 Modbus TCP

This allows the user to configure the recorder so as to allow it to communicate using Modbus Transmission Control Protocol.

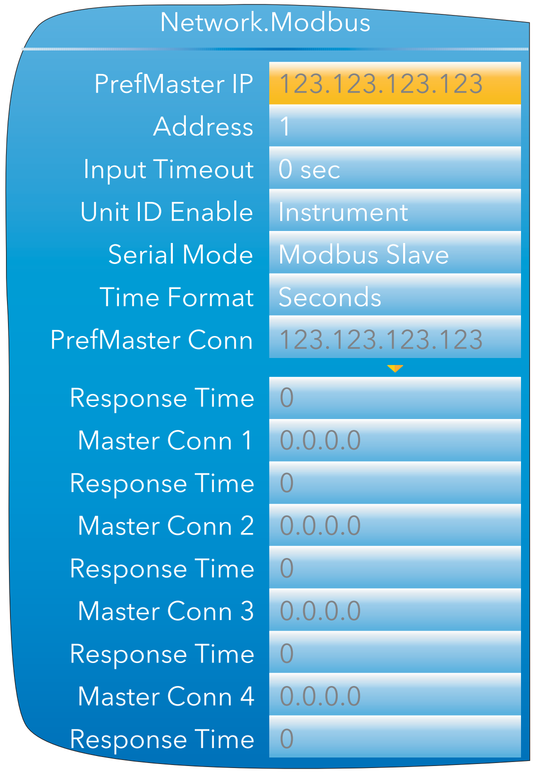


Figure 4.2.4 Modbus TCP configuration menu

PrefMaster IP — The IP address of the relevant Modbus master. The Preferred master is guaranteed to be able to connect, even if all slave connections (max. = 4 for TCP) are in use.

Address — The Modbus address for this slave. This address must be unique for the network to which it is attached. The recorder will respond to this address and to Address 255.

Input Timeout — Allows a value of between 0 and 3600 seconds to be entered to set the timeout period for modbus input channels. If a modbus input is not written to within this period the value of the channel is set to -9999.0 with a 'No Data' status. A value of 0 disables the comms inactivity timeout feature.

Unit ID Enable — Enables/Disables the checking of the Modbus TCP unit identity field.

- Strict — The Modbus TCP Unit Identity Field (UIF) does not have to match the instrument address. The instrument responds only to Hex value FF in the UIF. iTools finds this instrument only at location 255, and then stops scanning.
- Loose — The Modbus TCP Unit Identity Field (UIF) does not have to match the instrument address. The instrument responds to any value in the UIF
- Instrument — The Modbus TCP Unit Identity Field (UIF) must match the instrument address or no response will be made to messages.

Serial Mode — Slave communications via the side mounted configuration port interface (CPI) clip (for iTools use.) Parameters: Baud rate 19,200; Parity = none; Number of data bits = 8; Number of stop bits = 1; no flow control. Can be set to 'Modbus Slave' or 'Off'. The unit must be restarted before any change takes effect.

Time Format — Allows the user to choose milliseconds, seconds, minutes or hours as the time format. Sets the resolution for the reading and writing of time format parameters.

PrefMaster Conn — Read only. Shows the IP address of the preferred master, when connected.

Response Time — Read only. Shows the response time for a single communications request to the relevant master.

Master Conn 1 to 4 — Read only. Shows the IP addresses of any other masters connected to this recorder.

4.3 GROUP CONFIGURATION

Group configuration is separated into two areas, one which defines trending characteristics (for display channels) the other defining the recording characteristics for saving data to the Flash memory ready for archiving.

4.3.1 Group Trend configuration

This allows the user to define which points are to be traced on the display and at what interval, and also allows the number of chart divisions to be set up. Figure 4.3.1 shows a typical configuration page.

Note: The background chart colour is set up as a part of Instrument Display configuration (section 4.1.3)

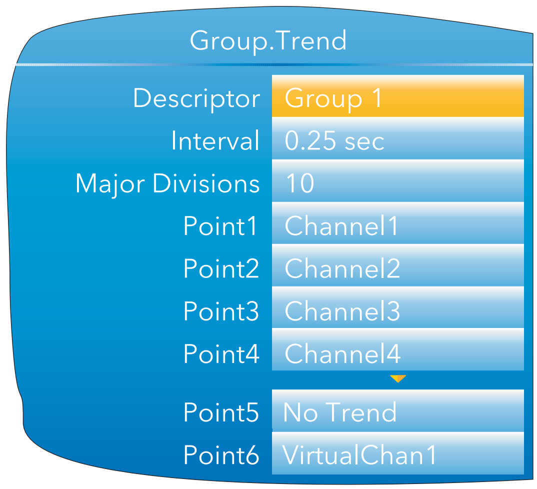


Figure 4.3.1 Group Trend Configuration

Descriptor	Allows the user to enter a descriptor (20 characters max.) for the group.
Interval	The trending interval which defines how much data appears on one screen height or width. A number of discrete intervals can be chosen between 0.125 seconds to 1 hour. The selection should be made according to how much detail is required, and how much data is to be visible on the screen.
Major Divisions	Allows the user to select the number of divisions into which the scale is divided and how many gridlines are displayed. Setting the value to 1 results in just the zero and full scale values appearing. Setting the value to 10 (the maximum) results in a scale with zero, full scale and nine intermediate values appearing, with associated grid lines.
Point1 to Point6	Allows the user to select which channels and virtual channels are to be traced. The maximum number of traces is six.

4.3.2 Group Recording configuration

Similar to Trend configuration, above, but for saving the data to Flash memory history files. Each point can individually be enabled or disabled for recording, or recording can be disabled for the whole group.

Figure 4.3.2 shows a typical page.

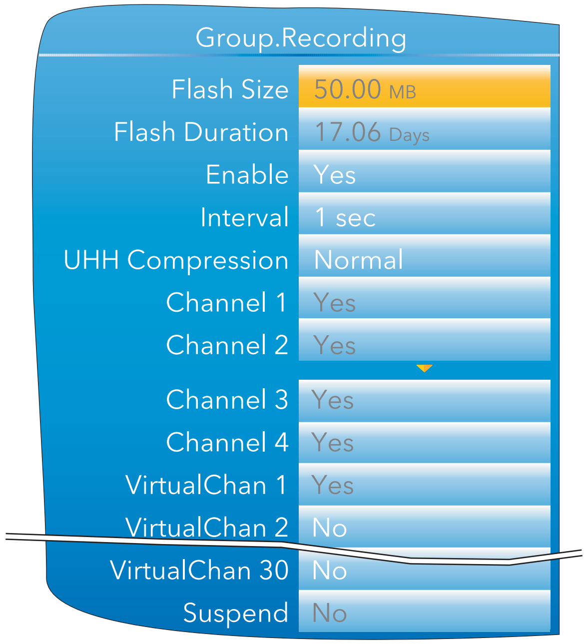


Figure 4.3.2 Group trend recording configuration

Flash Size	Read only. Shows the size of the Flash memory fitted in MB.
Flash Duration	Read only. Shows the time it will take to fill the Flash memory if the recorder configuration remains unchanged.
Enable	'Yes' enables group recording so that all points set to 'Yes' are stored in the recorder's flash memory. 'No' disables group recording.
Interval	Defines the rate at which data is saved to the recorder's Flash memory. The value affects how much trace history appears on the screen in trend history mode.
UHH Compression	Select 'Normal' or 'High'. 'Normal' compresses the data, but still provides an exact copy. 'High' compresses more, but values are saved only to 1 part in 10^8 resolution. See also note 1, below.
Channel 1 to VirtualChan 30 (see note 2, below)	Read only (greyed 'yes') for points being trended, (these are automatically recorded). For non-trending points the user may enable or disable each point individually.
Suspend	Ignored unless the user has wired to this field. If wired then when set to 'No' recording is active, when set to 'Yes' recording is paused.

Notes:

1. Where very high values are involved, such as in some totaliser values, 'High' compression may cause the value displayed at the recorder, and held in the history file, to be incorrect. The problem may be resolved by changing to 'Normal' compression, or, in the case of a totaliser, by re-scaling it (for example from MegaWatt hours to TeraWatt hours).
2. Virtual channels 1 to 15 are included in the standard build. Channels 16 to 30 are included only if the Modbus Master and / or EtherNet/IP option is fitted.

4.4 INPUT CHANNEL CONFIGURATION

Channel

N Select channel number

Main (Section 4.4.1)	Trend (Section 4.4.2)	Alarm 1/2 (Section 4.4.3)
Descriptor	Colour	Type
Type	Span low	Status
PV	Span high	Threshold
Status		Hysteresis
IP adjust state		Latch
Resolution		Block
Units		Dwell
Test signal		Acknowledge
Input low/high		Active
Shunt value		Inactive
Linearisation type		Not acknowledged
Range low/high		Acknowledgement
Scale low/high		
Offset		
CJ type		
Filter		
Sensor break type		
Fault Response		
Sensor break value		
Measured value		
Internal CJ Temp		

Figure 4.4 Channel configuration menu

4.4.1 Channel Main

This section describes all possible menu items, but it should be noted that some items are context dependent (e.g. Cold Junction settings appear only for Type = 'Thermocouple').

Channels one to four in the configuration relate to An In 1 (terminals 1I, 1+ and 1-) to An In 4 (terminals 4I, 4+ and 4-) respectively - see figure 2.2.

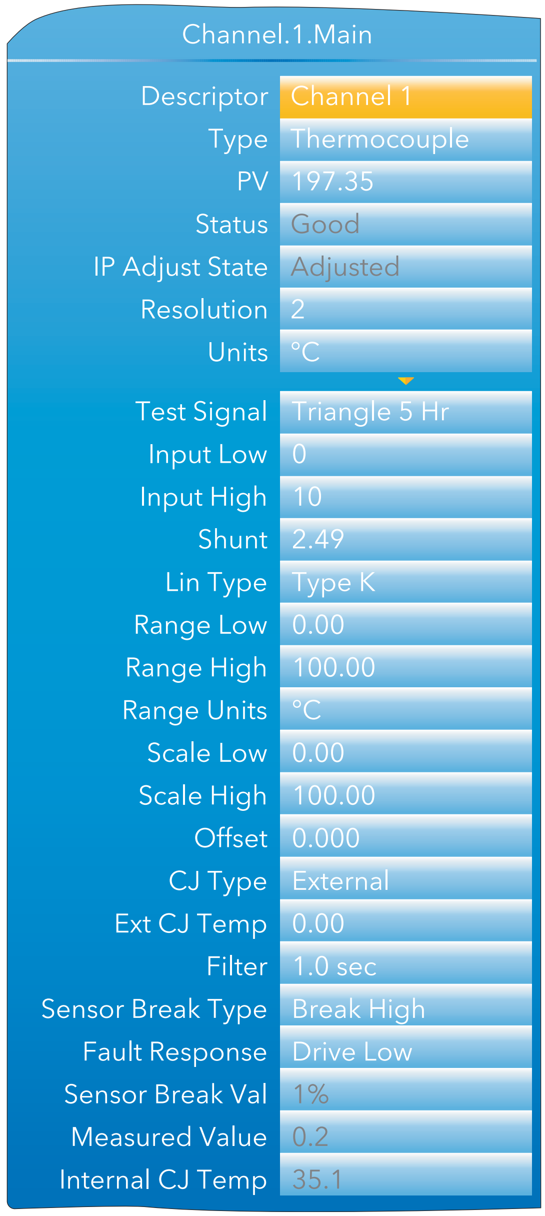


Figure 4.4.1a Channel main menu (expanded)

Note: For the sake of completeness, the figure above shows all possible fields, even though many are mutually exclusive. For example, 'Test signal' appears only when 'Test' is selected as Type. It would never appear when Type = thermocouple (as shown). Similarly, 'Shunt' would appear only for Type = mA.

4.4.1 CHANNEL MAIN (Cont.)

Descriptor	Allows a (20 character max.) descriptor to be entered for the channel. Some thought should be given to ensure that the descriptor is meaningful because in some display screens it is truncated. For example, 'Furnace 1 area 1' and 'Furnace 1 area 2' might both appear as 'Furnace 1 a' and thus be indistinguishable from one another, except in background colour.
PV	Read only. Displays the current value of the channel.
Status	Read only. Shows the channel status as one of: 'Good', 'Channel Off', 'Over range', 'Under range', 'HW error', 'Ranging', 'HW (capability) exceeded'.
PV2	Read only. For dual inputs only, displays the current value of the secondary input.
Status2	Read only. For dual inputs only, shows the secondary input status (as 'Status' above).
IP Adjust State	Appears only for channels which have been included in the 'Adjust Input' procedure described in section 4.1.9.
IP Adjust State2	As 'IP Adjust State', above but for secondary channels.
Resolution	Allows the number of decimal places to be defined for the channel. Valid entries are zero to nine.
Units	Allows a units string of up to five characters to be entered.
Type	Allows the user to select an input type for the channel. Available selections are: 'Off', 'Thermocouple', 'mV', 'V', 'mA', 'RTD', 'Digital', 'Test' or 'Ohms'. If the Dual Input option is fitted, Dual mV, Dual mA, Dual T/C (if enabled) are also available.

Note : If Dual T/C is selected then it is essential that the secondary T/C input is field calibrated using the Input Adjust procedure (section 4.1.9)

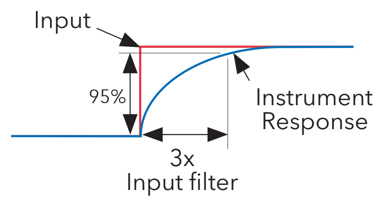
Test signal	Appears only if 'Test' is selected as 'Type'. Allows either a sinusoidal or a triangular waveform to be selected at one of a number of cycle times between 40 seconds and five hours.
Input Low*	For Type = mV, Dual mV, V, mA, Dual mA or Ohms, the lowest value of the applied signal in electrical units.
Input High*	As 'Input Low', but the highest value of the applied signal in electrical units.
Shunt value	For mA and Dual mA input types only, this allows the value of the shunt resistor (in Ohms) to be entered. The recorder does not validate this value - it is up to the user to ensure that the value entered here matches that of the shunt resistor(s) fitted. For Dual mA input type, both primary and secondary inputs must have independent shunts each of the same value.
Lin type	Linear, Square root, x3/2, x5/2, User Lin. Thermocouple types (alphabetical order): B, C, D, E, G2, J, K, L, N, R, S, T, U, NiMo/NiCo, Platinel, Ni/MiMo, Pt20%Rh/Pt40%Rh. User 1 to User 4 Resistance thermometer types: Cu10, Pt100, Pt100A, JPT100, Ni100, Ni120, Cu53. See Appendix A for input ranges, accuracies etc. associated with the above thermocouple and RTD types. See section 4.13 for details of user linearisations.
Range Low*	For thermocouples, RTDs, User linearisations and retransmitted signals only, the lowest value of the required linearisation range.
Range High*	For thermocouples, RTDs, User linearisations and retransmitted signals only, the highest value of the required linearisation range.
Range Units	For thermocouples only and RTDs, Select °C, °F or K.
Scale Low/High	Maps the process value to (Scale High - Scale Low). For example, an input of 4 to 20mA may be scaled as 0 to 100% by setting Scale low to 0 and Scale High to 100.
Scale Low2/High2	As 'Scale Low/High but for the secondary input (PV2).
Offset	Allows a fixed value to be added to or subtracted from the process variable.

*Note: See section 4.13 for details of the configuration of Range High/Low and Input High/Low when 'Type' = User 1 to User 4.

4.4.1 CHANNEL MAIN (Cont.)

Offset2 — The nature of the secondary input results in an offset being introduced into the process variable value.
For mA inputs this offset is removed automatically, without user intervention.
For mV inputs the offset depends on the value of the voltage source impedance and is equal to 199.9µV/Ω. This offset can be compensated for either by using this Offset2 parameter, or by carrying out the 'Input Adjust' procedure (Section 4.1.9).
For Dual T/C inputs, it is recommended that the 'Input Adjust' procedure be used instead of Offset2 as the use of Offset2 results in an offset which is non-linear over the thermocouple range.

Input filter — Damping can be used to filter out noise from slowly changing signals so that the underlying trend can be seen more clearly. Valid input values are between 0 and 60 seconds.



Note: Applying a filter to an input channel can affect the operation of any Rate-of-change alarms configured to act on that channel.

CJC Type — For thermocouple input types only, this allows the user to select 'None', 'Internal', 'External' or 'Remote 1' to 'Remote 4'. For Dual T/C inputs, both primary and secondary inputs use the same cold junction.
None: No Cold junction compensation applied.
'Internal' uses the recorder's internal cold junction temperature measurement.
'External' means that the cold junction is to be maintained by the user, at a fixed, known temperature. This temperature is entered in the 'External CJ Temp' field which appears when 'External' is selected.
Remote 1 (2) (3) (4) means that the cold junction temperature is being measured by input channel 1 (2) (3) (4) respectively. (This must be a different channel from that currently being configured).

Ext. CJ Temp — Appears only if CJC type is set to 'External', and allows the user to enter the temperature at which the external cold junction is being maintained.

Sensor Break Type — Defines whether the sensor break becomes active for circuit impedances greater than expected.
'Off' disables Sensor Break detection.
Break Low: Sensor break active if measured impedance is greater than the 'Break Low impedance' value given in table 4.4.1.
Break High: Sensor break active if measured impedance is greater than the 'Break High Impedance' value given in table 4.4.1.
For mA inputs, limits are applied, such that if the process value lies outside these limits, a sensor break is assumed to have occurred. These limits are (Input lo - 4% Span) and (Input high + 6% Span). For example, for a 4 to 20mA signal, an input below 3.36mA or above 20.96mA will trigger a sensor break event

Range	Break Low impedance	Break High Impedance
40mV	~5kΩ	~20kΩ
80mV	~5kΩ	~20kΩ
2V	~12.5kΩ	~70kΩ
10V	~12.5kΩ	~120kΩ

Table 4.4.1 Minimum impedances for sensor break detection

Note: Break High impedance values would be used typically for sensors which have a high nominal impedance when working normally

4.4.1 CHANNEL MAIN (Cont.)

Sensor Break type (Cont.)

Input sensor break detection is not supported for secondary inputs. The internal circuit acts as a 'pull up' on the secondary input which therefore saturates high in the event of a sensor break.

Fault Response — Specifies the behaviour of the recorder if a sensor break is detected or if the input is over driven (saturated high or low).
'None' means that the input drifts, with the wiring acting as an aerial.
'Drive High' means that the trace moves to (Scale High +10%). 'Drive Low' means that the trace moves to (Scale Low -10%), where the 10% values represent 10% of (Scale High - Scale Low).

Sensor Break Val — A diagnostic representation of how close the sensor break detection circuitry is to tripping.
Measured ValueThe (read only) input channel measured value before any scaling or linearisation is applied.

Measured Value2 — As 'Measured Value', above but for the secondary input.

Internal CJ temp — The (read only) temperature of the internal cold junction associated with this channel.

4.4.2 Channel Trend configuration

This area allows the configuration of channel colour and span.

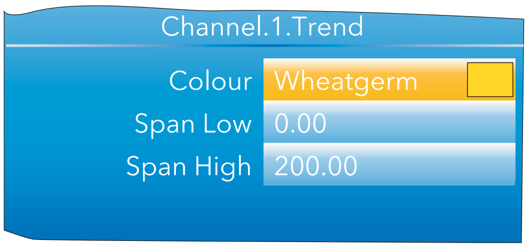


Figure 4.4.2a Channel Trend menu

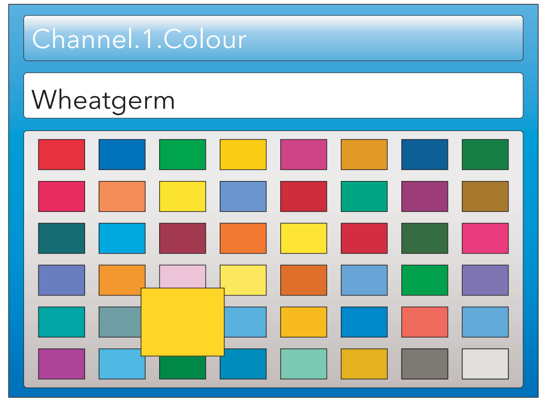


Figure 4.4.2b Colour selection

Colour	Allows a colour to be specified for the channel. The Scroll key is used to enter the colour swatch page. The up and down arrows are used to scroll through the available colours, with each colour being enlarged for as long as it is 'selected'. Once the required colour, is reached, the scroll key is used again to return to the Trend Configuration.
Span Low/High	Span low and high values.

Note: Trend colours and alarm settings for secondary inputs are configured in the maths channels to which they are wired.

SPAN EXAMPLE

In an input range of 0 to 600 degrees C, the temperature range between 500 and 600 degrees is of most interest. In such a case, Span Low is set to 500 and Span High to 600 so that the recorder trends only the required part of the temperature range, effectively magnifying the area of interest.

Note: Trending is restricted to the PV range (Span High - Span Low), but the instrument can display values outside this range.

CHANNEL CONFIGURATION EXAMPLE

A type J thermocouple is used to measure a temperature range of 100 to 200 degrees Celsius. This thermocouple output is transmitted to the recorder by a 4 to 20mA transmitter, for display as a value between 0 and 100%.

In Channel.Main, set the following for the relevant channel:

Type	= mA
Units	= %
Input Low	= 4.00
Input high	= 20.00
Shunt	= 250 Ohms
Lin Type	= Type J
Range Low	= 100.00
Range High	= 200.00
Range Units	= °C
Scale Low	= 0
Scale High	= 100

Other items may be left at their defaults.

4.4.3 Alarm 1 menu

Allows the alarm characteristics for Alarm 1 to be configured. The figure below shows a typical configuration page (expanded for clarity). Actual configuration parameters are context sensitive.

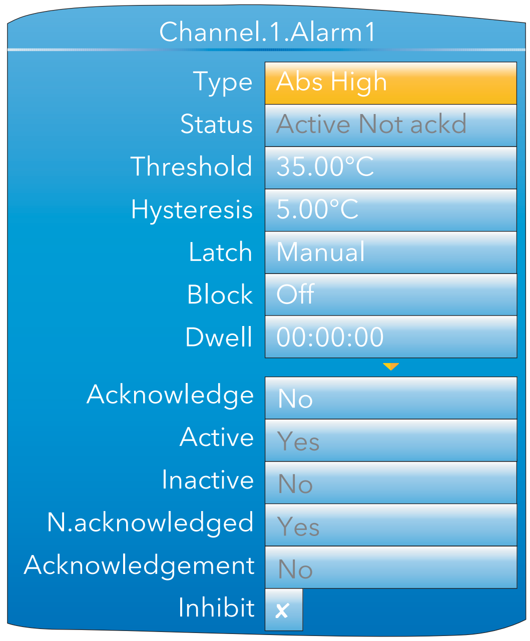


Figure 4.4.3 Typical alarm 1 configuration menu

Type — Select an alarm type from: 'Off', 'Abs. High' (absolute high). 'Abs. Low' (absolute low), 'Dev. High' (deviation high), 'Dev. Low' (deviation low), 'Dev. Band' (deviation band), 'Rise ROC' (rate-of-change: rising), 'Fall ROC' (rate-of-change: falling), 'Digital High', 'Digital Low'. See 'Alarm types', below, for definitions.

Status — Read only. This shows that the alarm is Off, Active, SafeNotAcked or ActiveNotAcked. For 'Auto' and 'Manual' alarms only, 'SafeNotAcked' means that the alarm trigger source has returned to a non-alarm state, but the alarm is still active because it has not been acknowledged. Similarly, 'ActiveNotAcked' means that the source is still active and the alarm has not been acknowledged. Always shows 'Off' when the alarm is inhibited (see below).

Threshold — For absolute alarms only, this is the trip point for the alarm. For absolute high alarms, if the threshold value is exceeded by the process value (PV) of this channel, then the alarm becomes active, and remains active until the PV falls below the value (threshold - hysteresis). For absolute low alarms, if the PV of this channel falls below the threshold value, then the alarm becomes active and remains active until the PV rises above (Threshold + Hysteresis).

Reference — For deviation alarms only, this provides a 'centre point' for the deviation band.
For 'deviation high' alarms, the alarm becomes active if the process value (PV) rises above the value (Reference + Deviation) and remains active until the PV falls below (Reference + Deviation - Hysteresis).
For 'deviation low' alarms, the alarm becomes active if the process value (PV) falls below the value (Reference - Deviation) and remains active until the PV rises above (Reference - Deviation + Hysteresis).
For 'deviation band' alarms, the alarm is active whenever the process value (PV) lies outside the value (Reference ± Deviation) and remains active until the PV returns to within the band, minus or plus Hysteresis as appropriate.

Deviation — For deviation alarms only, 'Deviation' defines the width of the deviation band, each side of the Reference value, as described immediately above.

4.4.3 ALARM 1 MENU (Cont.)

Hysteresis	For absolute and deviation alarms, this provides a means of preventing multiple alarm triggering, if the process value is drifting close to the trigger value.
Amount	For rate-of-change alarms only. The alarm becomes active if the process value rises (Rise ROC) or falls (Fall ROC) by more than the specified 'Amount' within the time period defined in 'Change Time', below. The alarm remains active until the rate of change falls below the value (Amount/Change Time) in the relevant sense.
Change Time	Settable to 1 second, 1 minute or 1 hour. See 'Amount' (above).
Average Time	For rate-of-change alarms only. This allows an averaging period (for the process value) to be entered to reduce nuisance trips due to signal noise, or if the rate of change is hovering around the trip value.
Latch	None: the alarm remains active until the monitored value has returned to a non alarm state, when it becomes inactive. Auto: The alarm remains active until the monitored value has returned to a non alarm state and the alarm has been acknowledged. Acknowledgement can take place either before or after the value has returned a non alarm state. Manual: The alarm remains active until the monitored value has returned to a non alarm state and the alarm has been acknowledged. Acknowledgement is permitted only after the value has returned a non alarm state. Trigger: Not enunciated, this mode is used only to initiate an action defined by user wiring either using iTools or using the user interface.
Block	Alarms with 'Block' set to 'On' are inhibited until the monitored value has entered the 'safe' condition after a start-up. This prevents such alarms from becoming active whilst the process is brought into control. If a latching alarm is not acknowledged then the alarm is re-asserted (not blocked), unless the alarm's threshold or reference value is changed, in which case the alarm is blocked again.
Dwell	Initiates a delay between the trigger source becoming active, and the alarm becoming active. If the trigger source returns to a non alarm state before the dwell time has elapsed, then the alarm is not triggered and the dwell timer is reset.
Acknowledge	Select 'yes' to acknowledge the alarm. Display returns to 'No'.
Active	Read only. Shows the status of the alarm as 'Yes' if it is active, or No, if inactive. The active/inactive state depends on the Latch type (above) and acknowledgment status of the alarm. Always shows 'No' if the alarm is inbited (below).
Inactive	As for 'Active' above, but shows 'Yes' if the alarm in inactive and 'No' if the alarm is active. Always shows 'Yes' if the alarm is inbited (below).
N.acknowledged	As for 'Active' above but shows 'Yes' for as long as the alarm is unacknowledged, and 'No' as soon as it is acknowledged. Always shows 'No' if the alarm is inbited (below).
Acknowledgement	Fleetingly goes 'Yes' on alarm acknowledgement, and then returns to 'No'.
Inhibit	When 'Inhibit' is enabled, (tick symbol), the alarm is inhibited. Status is set to 'Off'; 'Active' and 'N.acknowledged' are set to 'No', and 'Inactive' is set to 'Yes'. If the alarm is active when inhibit is enabled, then it becomes inactive until inhibit is disabled, when its status depends on its configuration. Similarly if the alarm trigger becomes active when the alarm is inhibited, the alarm remains 'off' until inhibit is disabled, when its status depends on its configuration.

4.4.4 Alarm 2 menu

As above for Alarm 1 menu.

Note: The parameters 'Acknowledge', 'Active', 'Inactive', 'N(ot) Acknowledged' and, 'Acknowledgement' can all be 'wired' to other parameters, so, for example, a relay can be made to operate whilst the alarm is inactive or whilst it is active or on acknowledgement etc. by wiring the relevant parameter to the relay's 'PV' input. See section 7 for details of user wiring.

4.4.5 Alarm types

The following figures attempt to show graphically the meanings of the alarm parameters which can be set for the various alarm types available.

ABSOLUTE ALARMS

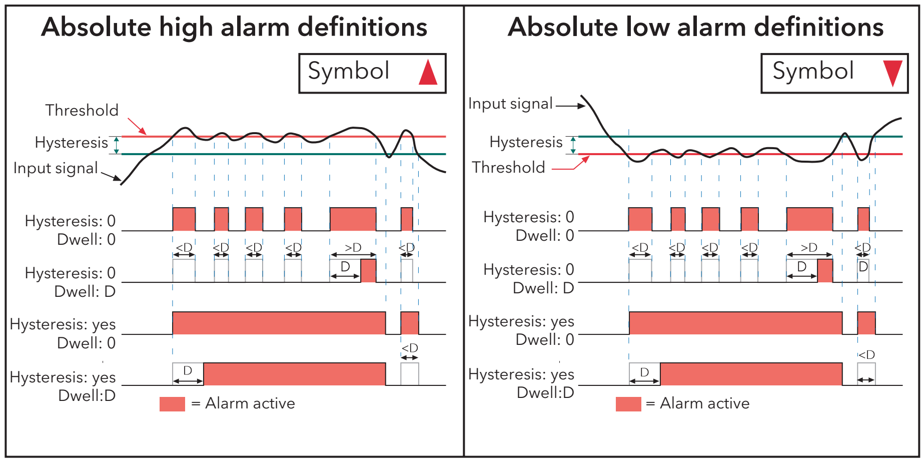


Figure 4.4.5a absolute alarm parameters

DEVIATION ALARMS

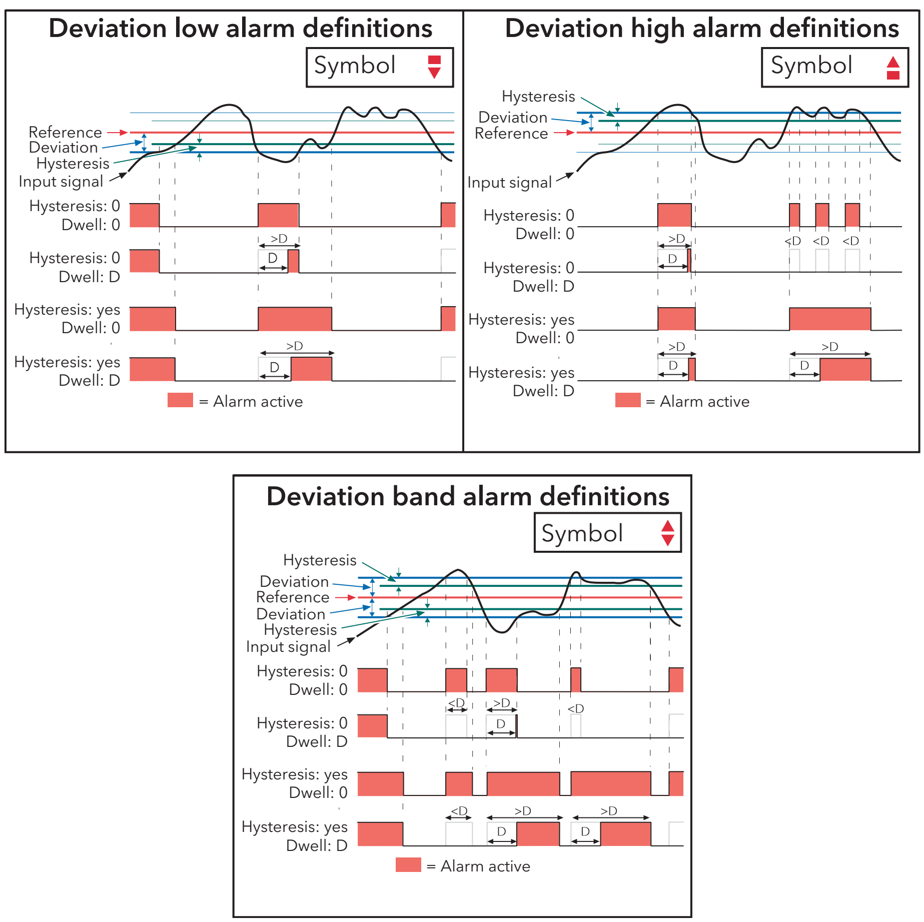


Figure 4.4.5b Deviation alarm parameters

4.4.5 ALARM TYPES (Cont.)

RATE-OF-CHANGE ALARMS

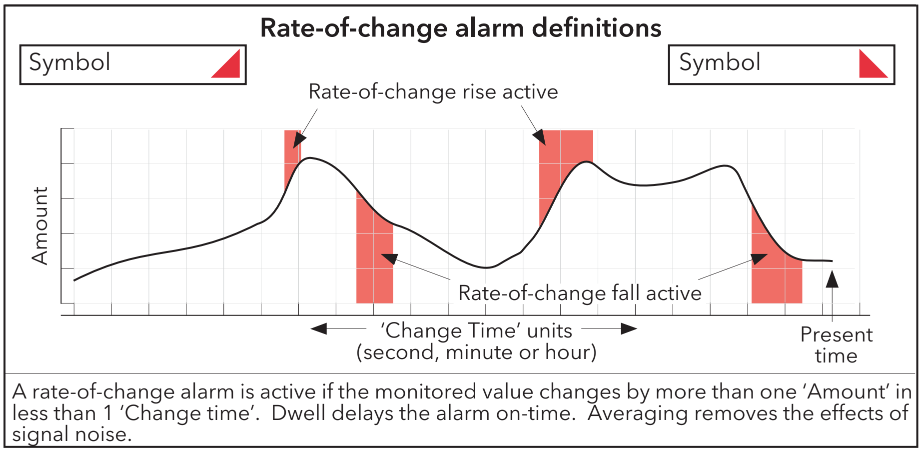


Figure 4.4.5c Rate-of-change alarm parameters

Note: Operation of rate-of-change alarms may be affected if an input filter (section 4.4.1) is applied to the input signal.

4.5 VIRTUAL CHANNEL CONFIGURATION

This allows the configuration of maths channels, totalisers and counters. The configuration is divided into the following areas: 'Main', 'Trend', 'Alarm 1*' and 'Alarm 2*'. Items appearing in the 'Trend', Alarm 1' and 'Alarm 2' areas are identical with the equivalent items described in section 4.4 (Input channels), above.

*Note: Virtual channels 16 to 30 (supplied with Modbus Master and EtherNet/IP options only) come without alarms.

4.5.1 Maths channel configuration

The following maths functions are available (listed in up-arrow scroll order)

Off, Add, Subtract, Multiply, Divide, Group Average, Group minimum, Group maximum, Modbus input, Copy, Group minimum (latch), Group maximum (latch), Channel maximum, Channel minimum, Channel Average, Configuration revision, Off.

Figure 4.5.1 shows a typical maths channel configuration

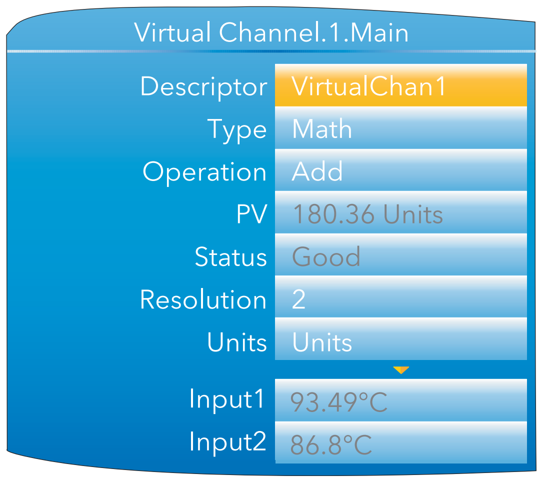


Figure 4.5.1 Maths channel configuration (typical)

Descriptor	Allows the user to enter a descriptor (20 characters max.) for the maths channel
Type	Math selected for this example. (See sections 4.5.2 and 4.5.3 for totalisers and counters respectively.)
Operation	Allows the user to select the required maths function. See 'Maths Functions', below.
PV	Read only. Shows the dynamic value of this channel in the units entered in 'Units' below.
Status	Read only. Shows the status of this channel, reflecting the status of the input sources.
Resolution	Enter the number of decimal places required
Units	Allows a five character string to be entered to be used as the channel units.
Input1	The value of input 1. May be entered manually, or it may be wired from another parameter (section 7). Uses the resolution of the source.
Input 2	As for 'Input 1', Appears only when the operation requires two inputs.
Reset	Allows the user to reset latching functions (e.g. Channel Max) or averaging functions (e.g. Channel Avg). Reset is carried out by setting the field to 'Yes', then operating the scroll key. The display returns to 'No'. Alternatively the function can be reset by another parameter wired to 'Reset'.
Time Remaining	The period of time remaining before the virtual channel performs its operation. For example, the time remaining for the maths channel average operation to sample the input before performing the calculation.
Period	For averaging functions, this allows a period to be entered, over which the value is to be averaged. Selectable periods are: 0.125, 0.25, 0.5, 1, 2, 5, 10, 20, 30 seconds, 1, 2, 5, 10, 20, 30 minutes, 1, 2, 6, 12, 24 hours

4.5.1 MATHS CHANNEL CONFIGURATION (Cont.)

MATHS FUNCTIONS

Off	Out = -9999; status = Off
Add	Out = Input1 + Input2
Subtract	Out = Input1 - Input2
Multiply	Out = Input1 x Input2
Divide	Out = Input1 ÷ Input2. If Input2 = 0, Out = -9999; Status = 'Bad'.
Group Avg*	Out = Instantaneous sum of all points in the recording group (except this one and any channel that has been configured with operation = group average, group minimum, group maximum, group minimum (latched), group maximum (latched), channel maximum or channel minimum), divided by the number of points in the group (excluding this one). Any point that has a status other than 'Good' is excluded from the calculation. If the group contains no channels, Out = -9999; Status = 'No data'.
Group Min*	Out = Instantaneous value of whichever point (except this one) in the recording group has the lowest value. Any point that has a status other than 'Good' is excluded from the calculation. If the group contains no channels, Out = -9999; Status = 'No data'.
Group Max*	Out = Instantaneous value of whichever point (except this one) in the recording group has the highest value. Any point that has a status other than 'Good' is excluded from the calculation. If the group contains no channels, Out = -9999; Status = 'No data'.
Modbus Input	Out = value written to this channel's modbus input. If the comms timeout expires, Out = -9999; status = 'No data'.
Copy	Allows an input or other derived channel to be copied.
Grp Min Latch*	Out = Lowest value reached by any point in the recording group (except this one) since last reset. Any point that has a status other than 'Good' is excluded from the calculation. If the group contains no channels, Out = -9999; Status = 'No data'.
Grp Max Latch*	Out = Highest value reached by any point in the recording group (except this one) since last reset. Any point that has a status other than 'Good' is excluded from the calculation. If the group contains no channels, Out = -9999; Status = 'No data'.
Channel Max	Out = Highest value reached by Input1 since last reset. If Input1 has a status other than 'Good', then Out = -9999 and 'Status' depends on the status of Input1.
Channel Min	Out = Lowest value reached by Input1 since last reset. If Input1 has a status other than 'Good', then Out = -9999 and 'Status' depends on the status of Input1.
Channel Avg	Out = the average value of Input1 over the time specified in 'Period'. If Input1 has a status other than 'Good', then Out = -9999 and 'Status' depends on the status of Input1.
Config Revision	Out = current Configuration Revision value.

*Note: All 'Group' functions operate on the 'Recording' group, not on the 'Trend' group.

4.5.2 Totaliser configuration

Totalisers allow the user to maintain a running total of any input channel, or of any maths channel. Using maths channels, it is possible to totalise combinations of input channels so that, for example, the sum of two channels or the difference between them could be totalised if required.

The maximum capacity for each totaliser is 1,000,000. This range can be expanded by wiring from the 'Roll-over' output of the totaliser to the 'trigger' input of a counter. Wiring is carried out either at the operator interface (section 7) or in iTools (section 6).

The totaliser equation is:

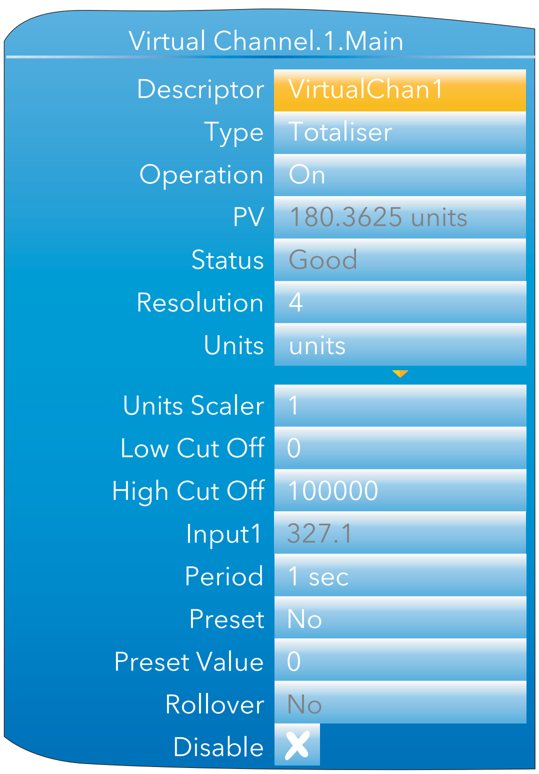
$$tot_t = tot_{t-1} + \frac{ma_t}{PSF \times USF}$$

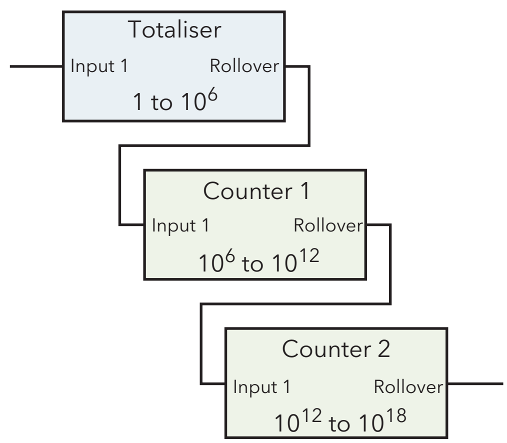
where,

tot_t = totaliser value this sample
tot_{t-1} = totaliser value last sample
ma_t = process value this sample
PSF = Period Scaling Factor (Period)
USF = Units Scaling Factor (Units scaler)

Note: the time between samples is 125ms.

Figure 4.5.2 shows a typical configuration page.





Using cascaded counters to expand the totalisation range.

Figure 4.5.2 Typical totaliser configuration menu

Descriptor	Allows the user to enter a descriptor (20 characters max.) for the totaliser.
Type	Select: Math, Counter or Totaliser.
Operation	Allows the user to enable ('On') or disable ('Off') the totaliser.
PV	Read only. Shows the dynamic value of the totaliser.

4.5.2 TOTALISER CONFIGURATION (Cont.)

Status	Read only. Shows the status of the totaliser.

Notes:

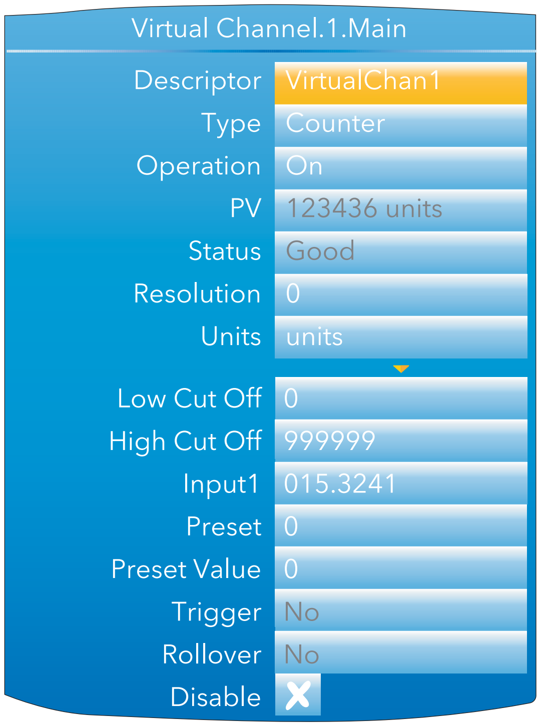
1. Because of the way in which the totaliser value is stored (IEEE 32-bit floating point), it is possible that if the current totaliser value is very large, then very small input values can be smaller than the minimum that can be resolved. In such a case the small value is not totalised, and the status 'Overflow' is set. This should not be confused with 'Rollover', described below.
2. The incremental value (ma/(PSF*USF)) at the rollover point (1,000,000) should be ≥ 1.

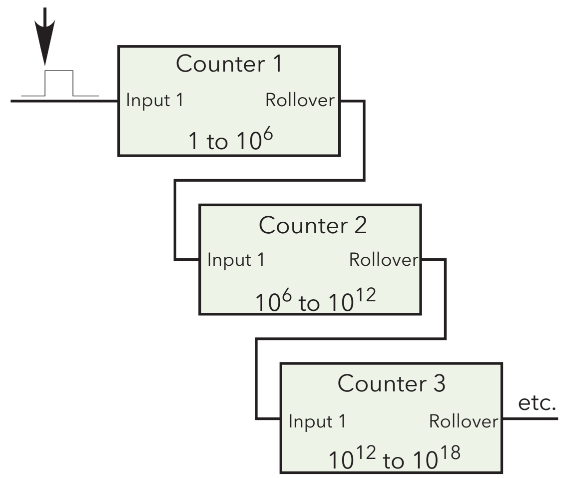
Resolution	Allows the number of decimal places (up to 6) to be selected for the totaliser.
Units	Allows a units string of up to five characters to be entered for the totalised value.
Units Scaler	Allows a units scaler to be selected. If, for example, the input channel has units of litres per hour, then, if the Units Scaler is set to one, the totalised value will be in litres. If the Units Scaler is set to 1000, then the totalised value will be in thousands of litres. Setting the Units Scaler to a negative value, causes the totaliser to decrement rather than increment.
Low Cut Off	Used to restrict the input operating range of the totaliser. Minimum value = -100 000
High Cut Off	Used to restrict the input operating range of the totaliser. Maximum value = 100 000
Input1	The value of the source. May be entered manually, or this parameter can be wired from an external channel PV.
Period	The totaliser equation works in seconds. If the totalised channel units are other than 'per second', a period scaler different from the default (1 sec) must be used. The 'Period' field presents a number of fixed periods from 0.125 seconds to 24 hours for selection.
Preset	Setting this to 'Yes' causes the totaliser to adopt the Preset Value. The field returns immediately to 'No'. The totaliser can also be preset by an external source 'wired' to this parameter.
Preset Value	Allows the entry of a value, from which the totaliser is to start incrementing or decrementing. The direction of the count is set by the sign of the units scaler: positive = increment; negative = decrement.
Rollover	The maximum capacity of the totaliser is 1 000 000. If, for example, the current totaliser value is 999 999 and 'Input 1' = 10, then the next sample will set the totaliser value to (999,999 +10 - 1,000,000 = 9) and 'Rollover' is set to 'Yes' for one iteration period. This can be used to increment a counter by wiring the totaliser 'Rollover' parameter to the 'Trigger' parameter of the counter. The maximum capacity of each counter is also 1 million and if necessary, counters can be cascaded in a similar way, the first counter counting in millions, the second in units of 10^{12}, the third in units of 10^{18}, and so on.
Disable	Allows the user temporarily to suspend totalising action. The output retains the pre-disabled value until the totaliser is re-enabled, when it resumes from that value. The totaliser is toggled between being enabled (cross symbol) and disabled (tick symbol) by means of the scroll key.

4.5.3 Counter configuration

This allows the user to set up a counter to count trigger inputs (or it may be incremented from the Configuration page. Maximum count is 1 000 000. Counters can be cascaded by wiring from 'Rollover' of one counter to 'trigger' of the next. Wiring is carried out from the operator interface (section 7) or in iTools (section 6).

For 'Trend', 'Alarm 1' and 'Alarm 2' configurations please see the relevant parts of section 4.4.





Cascading counters

Figure 4.5.3 Typical Counter configuration

Descriptor	Allows the user to enter a descriptor (20 characters max.) for the counter.
Type	Select: Math, Counter or Totaliser.
Operation	Allows the user to enable ('On') or disable ('Off') the counter.
PV	Read only. Shows the dynamic value of the counter.
Status	Read only. Reflects the status of the input channel.
Resolution	Allows the number of decimal places (up to six) to be defined for the channel.
Units	Allows a units string of up to five characters to be entered for the counter value
Low Cut Off	Specifies a value below which the counter will not decrement.
High Cut Off	Specifies a value above which the counter will not increment.
Input1	The amount by which the counter is incremented each time 'Trigger' goes high. The value may be entered manually, or wired from another parameter. Negative values cause the counter to decrement.
Preset	Setting this to 'Yes' causes the counter to adopt its Preset Value. The field returns immediately to 'No'. The counter can also be preset by wiring from another parameter.
Preset Val	Allows the entry of a value, from which the counter is to start incrementing or decrementing.
Trigger	Setting this to 1, causes the current value of the input source to be added to the Counter value. This function can be carried out manually, or the input can be wired from another parameter (section 7.2).
Rollover	The maximum capacity of the counter is 1 000 000. If, for example, the current value is 999 999 and Input 1 = 15, then the next sample will set the totaliser value to 14 (999,999 +15 - 1,000,000) and 'Rollover' is set to 'Yes' for one iteration period. This can be used to increment a further counter by wiring 'Rollover' to 'Trigger'.
Disable	Allows the user temporarily to suspend counting. The output retains the pre-disabled value until the counter is re-enabled, when it resumes counting from that value. The counter is toggled between being enabled (cross symbol) and disabled (tick symbol) by means of the scroll key.

4.6 LOOP OPTION CONFIGURATION

This configuration area allows the user to set up two control loops. This description refers to temperature control loops, but the configuration parameters apply equally to other types of control. For each loop, channel 1 is assumed to be a heating channel; channel 2 a cooling channel.

The configuration is divided into a number of areas, as shown in the overview below.

Loop

N   N = 1 or 2

Main	Setup	Tune	PID	Setpoint	Output	Diagnostics
(Section 4.6.1)	(Section 4.6.2)	(Section 4.6.3)	(Section 4.6.4)	(Section 4.6.5)	(Section 4.6.6)	(Section 4.6.7)
Auto/Manual	Loop name	Tune Enable	Sched Type	Range Low	Output Low	Error
PV	Ch1 Control	Low Output	No. of sets	Range High	Output High	Target Output
Inhibit	Ch2 Control	High Output	Remote i/p	SP Select	Ch1/2 Output	Working Out Low
Target Setpoint	Control action	State	Active set	SP1	Ch2 Deadband	Working Out High
Working Setpoint	PB Units	Stage Time	Boundary 1-2	SP2	Ch1/2 OnOff Hyst	Loop Break
Working Output	Deriv Type		Boundary 2-3	SP Low Limit	Ch1/2 Travel time	Prop Output
Integral Hold	Setpoint Access		PB	SP High Limit	Nudge raise	Integral Output
	Auto/Man Access		Ti	Alt SP Enable	Nudge lower	Deriv Output
			Td	Alt SP	Ch1/2 pot pos	Sensor Break
			CBH	Rate	Ch1/2 pot brk	Sched PB
			CBL	Rate Done	Pot Brk mode	Sched Ti
			MR	SP rate disable	Rate	Sched Td
			LBT	Servo to PV	SbrkMode	Sched CBH
			Output Low	SP Trim	Sbrk OP	Sched CBL
			Output High	SP Trim Low	Safe OP	Sched MR
				SP Trim High	Manual Mode	Sched Loop Break
				Manual Track	Manual Output	Sched Out Low
				Setpoint Track	Forced Output	Sched Out High
				Track PV	Manual Startup	
				Track Value	Pff En	
				SP Int Balance	Power In	
					Cool type	
					FF type/gain	
					FF offset/trim lin	
					FF OP	
					Track Output	
					Track Enable	
					Rem. Output Low	
					Rem. Output High	

Figure 4.6 Loop configuration overview

For a general discussion of control loops, please see Appendix B to this manual.

4.6.1 Main menu parameters

Auto/Manual	Selects Auto(matic) or Manual operation. 'Auto' automatically controls output power in a closed loop configuration. In manual mode, the operator controls the output power.
PV	The Process Variable input value. The value can be entered by the user, but is most often 'wired' from an analogue input.
Inhibit	Select 'No' or 'Yes'. 'Yes' stops the loop and sets the output to a 'safe' value, this value being entered as a part of the Output configuration (section 4.6.6). If an output rate limit is set, then the output ramps to the safe level at that rate, otherwise it performs a step change. If setpoint or manual tracking is enabled (in setpoint configuration section 4.6.5), Inhibit overrides tracking. If 'No' is selected, the loop operates normally. Inhibit can be enabled/disabled from an external source.
Target Setpoint	The value at which the control loop is aiming. SP may be derived from a number of sources, as described in Appendix B, section B2.5. The value range limited by the setpoint limits (SP High Limit and SP Low Limit) described in section 4.6.5.
Working Setpoint	A read-only value displaying the current value of setpoint being used by the loop. This might or might not be the Target setpoint. The value may come from a number of sources, but is limited by the setpoint limits (SP High Lim and SP Low Lim) described in section 4.6.5.
Working Output	The actual working output value before being split into channel 1 and 2 outputs.
Integral Hold	Select 'Yes' or 'No'. 'Yes' freezes the integral term at its current value. IntHold ensures that the power is reapplied smoothly after the loop has been broken for service reasons, for example.

4.6.2 Setup menu parameters

Loop Name	Allows entry of an 11 character name for the loop.
Ch1 Control	Selects the type of control for channel one from: Off: Channel is turned off OnOff: Channel uses on/off control PID: Proportional + integral + derivative (three-term) control. VPU: Valve positioning unbounded VPB: Valve positioning bounded. Appendix B, Section B2.2 provides more details.
Ch2 Control	As above, but for loop channel two.
Control Action	Select 'Reverse' or 'Direct'. 'Reverse' means that the output is 'on' when the process value (PV) is below the target setpoint (SP). This is normal for heating control. 'Direct' means that the output is on when PV is above SP. This is normal for cooling control.
PB Units *	Select 'Engineering' or 'Percent'. 'Engineering' displays values in (for example) temperature units (e.g. °C or °F). 'Percent' displays values as a percentage of loop span (Range Hi - Range Lo).
Deriv Type *	'Error' means that changes to PV or SP cause changes to the derivative output. Derivative on error should be used with a programmer since it tends to reduce ramp overshoot. 'Error' provides rapid response to small setpoint changes which makes it ideal for temperature control systems. 'PV' means that changes in PV alone cause changes to the derivative output. Typically used for process systems using valve control, as it reduces wear on the valve mechanics.
Setpoint Access	Allows setpoint editing permission in the loop display pages (section 3.4.7). 'Read/Write' allows free access to all users 'Read Only' allows editing only in Configuration or Supervisor modes. 'Operator R/W' allows editing in all modes except 'Logged out'.

4.6.2 SETUP MENU PARAMETERS (Cont.)

Auto/Man Access — As 'Setpoint Access' above, but for Auto/manual parameter.

*Note: 'PB Units' and 'Deriv Type' appear only if at least one of Ch1 Control and Ch2 Control is set to 'PID', 'VPU' or' VPB'.

4.6.3 Tune menu parameters

Tune Enable — 'On' initiates autotune. Legend changes to 'Off' when autotune is complete. Can be set to 'Off' manually, to stop the tuning process.

Low Output — Sets a low limit to be imposed whilst autotune is running. The value must be greater than or equal to the 'Output Low' value, specified in the Output menu (section 4.6.6).

High Output — Sets a high limit to be imposed whilst autotune is running. The value must be less than or equal to the 'Output High' value, specified in the Output menu (section 4.6.6).

State — Read only display of autotune progress:
Off. Autotune not running
Ready. Fleeting display. Changes immediately to 'Running'.
Running. Autotune is in progress.
Complete. Autotune completed successfully. This is a fleeting display which changes immediately to 'Off'.
Timeout, TI Limit and R2G Limit are error conditions described in Appendix B section B2.4.5. If any of these occurs, tuning is aborted and the PID settings remain unchanged.

Stage — A read only display showing the progress of the autotune:
Settling. Displayed during the first minute whilst loop stability is checked (Appendix B, section B2.4.5)
To SP. Heating or cooling switched on.
Wait min. Power output off.
Wait max. Power output on.
Timeout, TI Limit and R2G Limit are error conditions described in Appendix B section B2.4.5.

Stage Time — Time into the current stage of the autotune process. 0 to 99999 seconds.

AT.R2G — Autotune at R2G. 'Yes' means that the control loop uses the R2G value calculated by autotune. 'No' causes the loop to use the R2G value entered by the user (PID menu) calculated as described in Appendix B section B2.4.5.

4.6.4 PID menu parameters

Note: If control type is set to 'Off', or 'OnOff' in the Setup menu, the PID menu contains only the Loop Break time parameter 'LBT'.

Sched Type	Selects the type of gain scheduling (section B2.3.7) to be applied. Off. Gain scheduling not active Set. The user selects the PID parameter set to be used. Setpoint. Transfer from one set to the next depends on the setpoint value PV. The transfer from one set to another depends on the PV value Error. The transfer between sets depends on the value of the error signal OP. Transfer depends on the value of the output. Rem. Transfer is controlled by a remote input.
Number of Sets	Allows the number of sets of PID parameters for use in Gain scheduling to be selected.
Remote input	For 'Sched Type' = 'Rem' only, this shows the current value of the remote input channel being used to select which set is active. If the remote input value ≤ the Boundary 1-2 value (see below) then set 1 is selected. If it is > Boundary 1-2 value but ≤ Boundary 2-3 value then set 2 is used. If the remote value is > Boundary 2-3 value, then set three is used. If the Remote input is not 'wired', the value is user editable from the front panel.
Active Set	The set number currently in use.
Boundary 1-2	For all Sched Types except 'Set', this allows the user to enter a 'boundary' value, which means that if the relevant value (SP, PV, Error etc.) rises above this boundary, the loop switches from PID set 1 to PID set 2. If it falls below the boundary value, the loop switches from set 2 to set 1.
Boundary 2-3	As above but for switching between sets 2 and 3.
PB/PB2/PB3	Proportional band for set one/two/three. The proportional term in the units (Engineering units or %) set in 'PBUnits' in the Setup menu. See Appendix B section B2.2.2 for more details.
Ti/Ti2/Ti3	Integral time constant for set one/two/three. Valid entries are1 to 9999.9 seconds, or 'Off'. If set Off, then integral action is disabled. Removes steady state control offsets by moving the output up or down at a rate proportional to the error signal.
Td/Td2/Td3	Derivative time constant for set one/two/three. Valid entries are 1 to 9999.9 seconds, or 'Off'. If set Off, then derivative action is disabled. Determines how strongly the controller reacts to a change in the PV. Used to control overshoot and undershoot and to restore the PV rapidly if there is a sudden change in demand.
R2G/R2G2/R2G3	Relative cool gain for set one/two/three. Appears only if cooling has been configured (Ch2 Control not 'Off' or 'OnOff' in Setup menu). Valid entries are 0.1 to 10. Sets the cooling proportional band which compensates for differences between heating and cooling power gains.
CBH/CBH2/CBH3	Cutback high for set one/two/three. Valid entries 'Auto' (3×PB) or 0.1 to 9999.9. The number of display units above setpoint at which the controller output is forced to 0% or -100% (OP min), in order to modify undershoot on cool down. See section B2.3.2 for more details.
CBL/CBL2/CBL3	Cutback low for set one/two/three. Valid entries 'Auto' (3×PB) or 0.1 to 9999.9. The number of display units below setpoint at which the controller output is forced to 100% (OP max), in order to modify overshoot on heat up. See section B2.3.2 for more details.
MR/MR2/MR3	Manual reset for set one/two/three. Valid entries 0 to 100%. Introduces a fixed additional power level to the output in order to eliminate steady state error from proportional only control. Applied instead of the integral component when Ti is set to 'Off'.
LBT/LBT2/LBT3	Loop break time for set one/two/three. valid entries are 1 to 99999 seconds, or 'Off'. See section B2.3.6 for more details.
Output Low/2/3	Output low limit for set one/two/three. Valid entries are in the range Output High/2/3 to -100.
Output High/2/3	Output high limit for set one/two/three. Valid entries are in the range Output Low/2/3 to +100

4.6.5 Setpoint menu parameters

Range High/Low	Range limits. Valid entries from 99999 to -99999. Range limits set absolute maxima and minima for control loop setpoints. If the proportional band is configured as a % span, the span is derived from the range limits.
SP select	Select SP1 or SP2. SP1 is considered to be the primary setpoint for the controller, and SP2 a secondary (standby) setpoint.
SP1, SP2	Allows values for Setpoints 1 and 2 to be entered. Valid entries are any within the range 'SPHigh Limit' to 'SPLowLim'.
SP Low Limit	Minimum setpoint limit for SP1 and SP2. Valid entries are in the range 'Range Lo' and 'SP High Limit'
SP High Limit	Maximum setpoint limit for SP1 and SP2. Valid entries are in the range 'Range Hi' and 'SP Low Limit'
Alt SP Enable	'Yes' enables the alternative setpoint; 'No' disables it. May be wired to an external or internal source.
Alt SP	When wired this is a read only display of the alternative setpoint value. Otherwise, the user may insert a value. Valid values are limited by 'Range Hi' and 'Range Lo'.
Rate	Sets the maximum rate at which the working setpoint may change in Engineering units per minute. Often used to protect the load from thermal shock cause by large step changes in setpoint. 'Off' disables rate limiting.
Rate Done	Read only display. 'Yes' indicates that the working setpoint has completed its change. 'No' indicates that the setpoint is still ramping.
SP Rate Disable	Appears only if Rate is not 'Off'. 'Yes' disables rate limiting; 'No' enables rate limiting.
Servo To PV	If 'Rate' is set to any value other than 'Off', and if 'Servo to PV' is set to 'Yes' then any change in the current setpoint value causes the working setpoint to servo to the current PV before ramping to the new setpoint value.
SP Trim	A positive or negative value added to the setpoint, for local fine tuning. Valid entries are any value between 'SP Trim High' and 'SP Trim Low'.
SP Trim High/Low	Setpoint trim high and low limits
Manual Track	'On' enables manual tracking to allow the local SP to follow the value of the current PV. See section B2.5.5 for more details. 'Off' disables manual tracking.
Setpoint Track	'On' enables setpoint tracking to allow the local SP to follow the value of the alternative SP. See section B2.5.4 for more details. 'Off' disables setpoint tracking.
Track PV	The unit tracks the PV when it is servoing or tracking.
Track Value	The SP to track in manual tracking
SP Int Balance	Allows the user to enable (tick) or disable (cross) debump on PV change.

4.6.6 Output menu items

Appendix B section B2.6 contains details of the output functions.

Output Low	The minimum power, or the maximum 'negative' (i.e. cooling) power to be delivered by the system. The valid input range is -100% and Output High.
Output High	The maximum output power to be delivered by channels 1 and 2, where 100% is full power. The valid input range is Output Low to 100.0%. Reducing this value reduces the rate of change of the process, but it also reduces the controller's ability to react to perturbations.
Ch1 Output	Displays the positive power values used by the heat output. Values range from Output low to Output high
Ch2 Output	Displays the cooling power values for channel two. Appears as a value between Output high and -100%, where -100% represents full cooling power.
Ch2 Deadband	A gap (in %) between output 1 switching off, and output 2 switching on, and *vice-versa*. Valid inputs are 0 (off) to 100%.
Rate	Limit on the rate at which the output from the PID can change. Can be useful in preventing rapid changes in output that could damage the process, heater elements etc.
Ch1 OnOff Hyst	Appears only if 'Ch1 Control' has been set to 'OnOff' in the Setup menu. Allows the user to enter a hysteresis value for channel one. Valid entries are 0.0 to 200.0.
Ch2 OnOff Hyst	Appears only if 'Ch2 Control' has been set to 'OnOff' in the Setup menu. Allows the user to enter a hysteresis value for channel two. Valid entries are 0.0 to 200.0.
Ch1 Travel Time	Appears only if Setup menu parameter 'Ch1 Control' is set to 'VPB' or 'VPU'. This is the valve travel time from closed (0%) to open (100%). In a valve positioning application, channel 1 output is connected by a single software 'wire' to a Valve Raise/Valve Lower relay pair. For heat/cool applications, channel 1 is associated with the heating valve. Valid entries: 0.0 to 1000.0 seconds.
Ch2 Travel Time	Appears only if Setup menu parameter 'Ch2 Control' is set to 'VPB' or 'VPU'. This is the valve travel time from closed (0%) to open (100%). For heat/cool applications, channel 2 is associated with the cooling valve. Valid entries: 0.0 to 1000.0 seconds.
Nudge Raise	Appears only if Setup menu parameter 'Ch1 Control' or Ch2 Control is set to 'VPU'. If set to 'Yes', the valve can be moved towards the open position by, for example, a contact closure, an up arrow button operation or a serial communications command. The default minimum nudge time is 125 ms, but this can be edited in the relevant relay configuration - see section 4.11.2. See also Section B2.6.10 for more 'Nudge' details.
Nudge Lower	As for 'Nudge Raise', above but moves the valve towards the closed position.
Ch1 Pot Pos*	The position of the channel one actuator as measured by the feedback potentiometer.
Ch1 Pot Brk*	'On' indicates that the input to the relevant channel is open circuit.
Ch2 Pot Pos*	The position of the channel two actuator as measured by the feedback potentiometer.
Ch2 Pot Brk*	'On' indicates that the input to the relevant channel is open circuit.
Pot Brk Mode*	Defines the action to be taken if a potentiometer break is detected: Raise: opens the valve Lower: closes the valve Rest: the valve remains in its current state. Model: the controller tracks the position of the valve and sets up a model of the system so that it continues to function if the potentiometer becomes faulty.

* Note: These parameters appear only if the 'Setup' menu parameter 'Ch1 Control' or 'Ch2 control' (as appropriate) is set to 'VBP'. The Setup menu is described in section 4.6.2.

4.6.6 OUTPUT MENU PARAMETERS (Cont.)

SBrk Mode	Defines the action to be taken in the event of a sensor break. Safe: The output adopts the value configured in 'Sbrk OP', below. Hold: The output remains at its current level.
Sbrk OP	The value to be output if a sensor break occurs, and SBrk Mode (above) is set to 'Safe'.
Safe OP	The output level adopted when the loop is inhibited (Main menu section 4.6.1).
Manual Mode	Selects the type of transition to occur when changing to manual mode (section 4.6.1): Track: Whilst in Auto mode, the manual output tracks the control output so that there is no change of output when manual mode is switched to. Step: On transition to manual mode, the output is set to the value entered for 'Forced-OP' (below). Last Man. Out: On transition to manual mode, the output adopts the manual output value as last set by the operator.
Manual Output	The output when the loop is in manual mode. In manual mode the controller limits the maximum power, but it is not recommended that it be left unattended at high power settings. It is important that over range alarms are fitted to protect the process.

Note: It is recommended that all processes are fitted with an independent over range detection system.

Forced Output	Forced Manual output value. When 'Manual Mode' = 'Step', this is the output value adopted when changing from Auto to Manual mode.
Manual Startup	When set to off (cross symbol), the controller powers up in the same (auto or manual) mode that obtained when it was switched off. When set to on (tick symbol) the controller always powers up in manual mode.
Pff En	Power feed forward enable. 'Yes' enables power feed forward (adjusts the output signal to compensate for variations is supply voltage. 'No' disables Pff. See section B2.6.6 for further details.
Power In	Read only display of the current supply voltage.
Cool Type	Appears only if 'Ch2 Control' = 'PID' in the setup menu (section 4.6.2) and allows the user to enter the appropriate type of cooling (section B2.6.7): Linear: For use when controller output changes linearly with PID demand. Oil: For oil cooled applications Water: For water cooled applications Fan: For forced air cooling.
FF Type	Feed forward type (section B2.6.8): None: No signal fed forward. Remote: A remote signal fed forward. SP: Setpoint is fed forward. PV: PV is fed forward.
FF Gain	For FF types 'PV' and 'SP', this scales the feed forward signal.
FF Offset	For FF types 'PV' and 'SP', this defines the offset of the scaled feed forward signal.
FF Trim lim	For FF types 'PV' and 'SP', defines symmetrical limits about the PID output which are applied to the scaled feed forward signal.
FF OP	For FF types 'PV' and 'SP', this is the calculated (scaled, offset and trimmed) feed forward signal. FF OP = FF gain (input + FF Offset)
Track Output	If 'Track Enable' (below) is set to 'Yes', this is the value for the control output. PID remains in Auto mode and tracks the output. The Track OP value can be wired to an external source, or can be entered via the front panel. Similar to entering manual mode.
Track Enable	When set to 'Yes', the output follows the Track OP value (above). When subsequently set to 'Off' the loop makes a bump less return to control.
Rem. Output Low/High	Used to limit the output using a remote source. These limits cannot exceed the 'Output Low' and 'Output High' values described earlier in this section.

4.6.7 Loop diagnostics

These 'parameters' are read only unless otherwise stated.

Error	The difference in value between the setpoint and the PV.
Target Output	The requested control output. The target of the active output if rate limiting is active.
Working Out Low	The low limit for the working output. This is the value used to limit the output power of the loop and is derived from the gain scheduled limit, the remote limit and the safety limit.
Working Out High	The high limit for the working output. This is the value used to limit the output power of the loop and is derived from the gain scheduled limit, the remote limit and the safety limit.
Loop Break	Loop Break Alarm. Becomes active 'Yes' if the loop break time (LBT), set in the PID menu (section 4.6.4) is exceeded, otherwise 'No' is displayed.
Prop. Output	Shows the proportional term contribution to the control output
Integral Output	Shows the integral term contribution to the control output
Deriv. Output	Shows the derivative term contribution to the control output
Sensor Break	Indicates sensor break status. On (tick symbol) indicates a sensor break has occurred; Off (cross symbol) shows that no sensor breaks have been detected.
Sched PB	The scheduled proportional band for the current PID set.
Sched Ti	The scheduled integral time for the current PID set.
Sched Td	The scheduled derivative time for the current PID set.
Sched R2G	The scheduled relative cool gain value for the current PID set.
Sched CBH	The scheduled cutback high value for the current PID set.
Sched CBL	The scheduled cutback low value for the current PID set.
Sched MR	The scheduled manual reset value for the current PID set.
Sched Loop Break	The scheduled loop break time for the current PID set.
Sched Out Low	The scheduled output low limit for the current PID set.
Sched Out High	The scheduled output high limit for the current PID set.

4.7 ADVANCED LOOP CONFIGURATION

Similar to the Loop option described above, advanced loop includes the ability to run a cascade loop. Figure 4.7 is an overview of the configuration menu structure.

Advanced Loop

- **Main** (Section 4.7.1)
  - Master PV
  - Master WSP
  - Target setpoint
  - Slave PV
  - Slave WSP
  - Working Output
  - Cascade Mode
  - Inhibit
  - Master Int.Hold
  - Slave Int.Hold
- **Setup** (Section 4.7.2)
  - Master Name
  - Slave Name
  - Master Loop
  - Cascade Type
  - Slave Channel 1
  - Slave Channel 2
  - Setpoint access
  - Mode Access
- **Tune** (Section 4.7.3)
  - Tune Type
  - Tune Enable
  - Tune Slave R2G
  - Tune High
  - Tune Low
  - Output High
  - Output Low
  - State
  - Stage Time
  - Diagnostics
- **Master PID** (Section 4.7.4)
  - Control Action
  - PB Units
  - Derivative Type
  - PB
  - Ti
  - Td
  - CBH
  - CBL
  - MR
  - LBT
- **Slave PID** (Section 4.7.5)
  - Control Action
  - PB Units
  - Derivative Type
  - Sched Type
  - No of sets
  - Remote input
  - Set boundaries
  - PB
  - Ti
  - Td
  - R2G
  - CBH
  - CBL
  - MR
  - LBT
  - Output Low
  - Output High
- **Master SP** (Section 4.7.6)
  - Range High
  - Range Low
  - SP Select
  - SP1
  - SP2
  - SP High Limit
  - SP Low Limit
  - Alt SP Enable
  - Alt SP
  - Rate
  - Rate Done
  - SP Trim
  - SP Trim High
  - SP Trim Low
  - Manual Track
  - Setpoint Track
  - Track PV
  - Track SP
  - SP Int Balance
- **Slave SP** (Section 4.7.7)
  - Range High
  - Range Low
  - SP High Limit
  - SP Low Limit
  - Local SP
  - Alt SP
  - Remote FF
  - Remote FF Enable
  - Remote FF High
  - Remote FF Low
  - Manual Track
- **Output** (Section 4.7.8)
  - Output High
  - Output Low
  - Ch1 Output
  - Ch2 Output
  - Ch2 Deadband
  - Rate
  - Sbrk Mode
  - Sbrk OP
  - Safe OP
  - Manual Mode
  - Manual Output
  - Forced Output
  - Manual Startup
  - Pff En
  - Line Voltage
  - Cool Type
  - FF Type
  - Track Output
  - Track Enable
  - Rem. Output Low
  - Rem. Output High
- **Diagnostics** (Section 4.7.9)
  - Master Eror
  - Slave Error
  - (M)Prop. Output
  - (M)Integral Out
  - (M)Deriv. Output
  - (S)Prop. Output
  - (S)Integral Out
  - (S)Deriv. Output
  - Target Output
  - Loop Break (S)
  - Loop Break (M)
  - Sensor Break (S)
  - Sensor Break (M)
  - Sched PB
  - Sched Ti/Td
  - Sched CBH/CBL
  - Sched MR
  - Sched Loop Break
  - Sched R2G
  - Sched Out High
  - Sched Out Low
  - Working Out Low
  - Working Out High

4.7.1 Advanced Loop Main menu

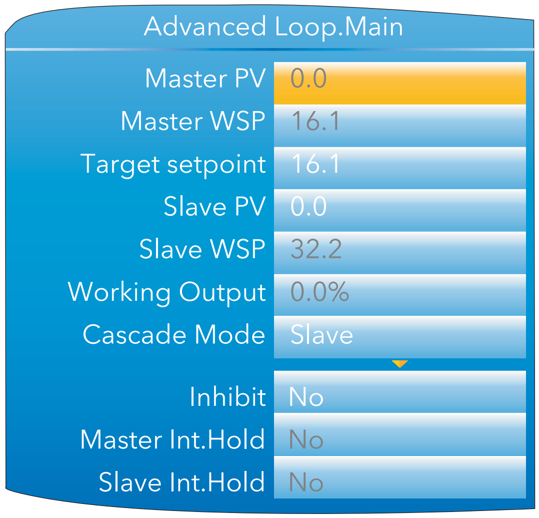


Figure 4.7.1 Main menu

Master PV	This is the process value for the outer (master) loop of cascade control, typically obtained from an analogue input.
Master WSP	This is the (read only) working setpoint for the outer (master) loop of cascade control. The Master WSP can obtain its value from one of a number of sources such as 'Internal SP' or 'Remote SP'.
Target setpoint	The target setpoint is the value which the outer (master) control loop is attempting to reach. The value may come from one of a number of sources, such as internal SP or remote SP
Slave PV	This is the process value for the inner (slave) loop of cascade control, typically wired from an analogue input.
Slave WSP	This is the (read only) working setpoint for the inner (slave) loop. The value may come from one of a number of sources, such as the output from the master loop or the local slave setpoint.
Working Output	The actual output of the inner (slave) loop before it is split into channel 1 and channel 2 outputs.
Cascade Mode	Slave: Also known as 'Slave Local Auto', this is a single loop controlling with a local setpoint. Manual: Also known as 'Slave Manual', this provides a single manual power setting for the slave. Cascade: (Full) cascade. In this mode, the master is in 'Auto' mode and provides the setpoint for the slave.
Inhibit	If set to 'Yes', both outer (master) loop and inner (slave) loops stop controlling and the output of the slave loop is set to the safe output value (SafeOp) set in the Output menu (section 4.7.8).
Master Int.Hold	If set to 'Yes', the integral component of the outer (master) loop PID calculation is held at its current value and does not integrate any further disturbances in the plant. Essentially this is equivalent to switching into PD control with a manual reset value pre-configured.
Slave Int.Hold	As for Master.IntHold, above, but for the inner (slave) loop.

4.7.2 Advanced Loop Setup menu

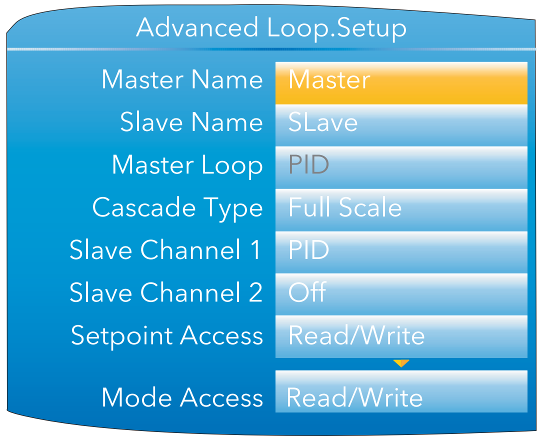


Figure 4.7.2 Advanced Loop Setup menu

Master Name	Allows the user to enter a 10-character string for the Master loop name in the Cascade display page (section 3.4.8)
Slave Name	As above, but for the slave loop.
Master Loop	The control algorithm for the master control loop (PID only for this software release).
Cascade Type	Full Scale: The master generates a setpoint (between SP High limit and SP Low limit) for the slave. Trim: The master working setpoint is used as the base setpoint of the slave. This is then modified by the addition of a setpoint trim, to become the target setpoint for the slave. The PID output from the master is mapped to range set by Trim Range High and Trim Range Low.
Slave Channel 1	Selects the channel 1 control algorithm. Different algorithms can be selected for channels 1 and 2. In temperature control applications, channel 1 is usually the heating channel, and channel 2 the cooling channel. PID: Control Output Configured as PID VPB: Control Output Configured as Bounded VP. Bounded VP is implemented as a PID algorithm driving a position loop and is used in systems with position feedback.
Slave Channel 2	Selects the channel 2 control algorithm. Different algorithms can be selected for channels 1 and 2. In temperature control applications, channel 1 is usually the heating channel, channel 2 the cooling channel. Off: Control output is not configured PID: Control Output Configured as PID
Setpoint Access	Allows the user to select 'Read Only', 'Read/Write', or 'Operator R/W' for setpoint access, where 'Operator R/W means that the setpoint is read write for access levels operator and above, but read only in Logged out mode.
Mode Access	As for 'Setpoint Access', above, but for Auto/Manual mode switching.

4.7.3 Advanced Loop Tune menu

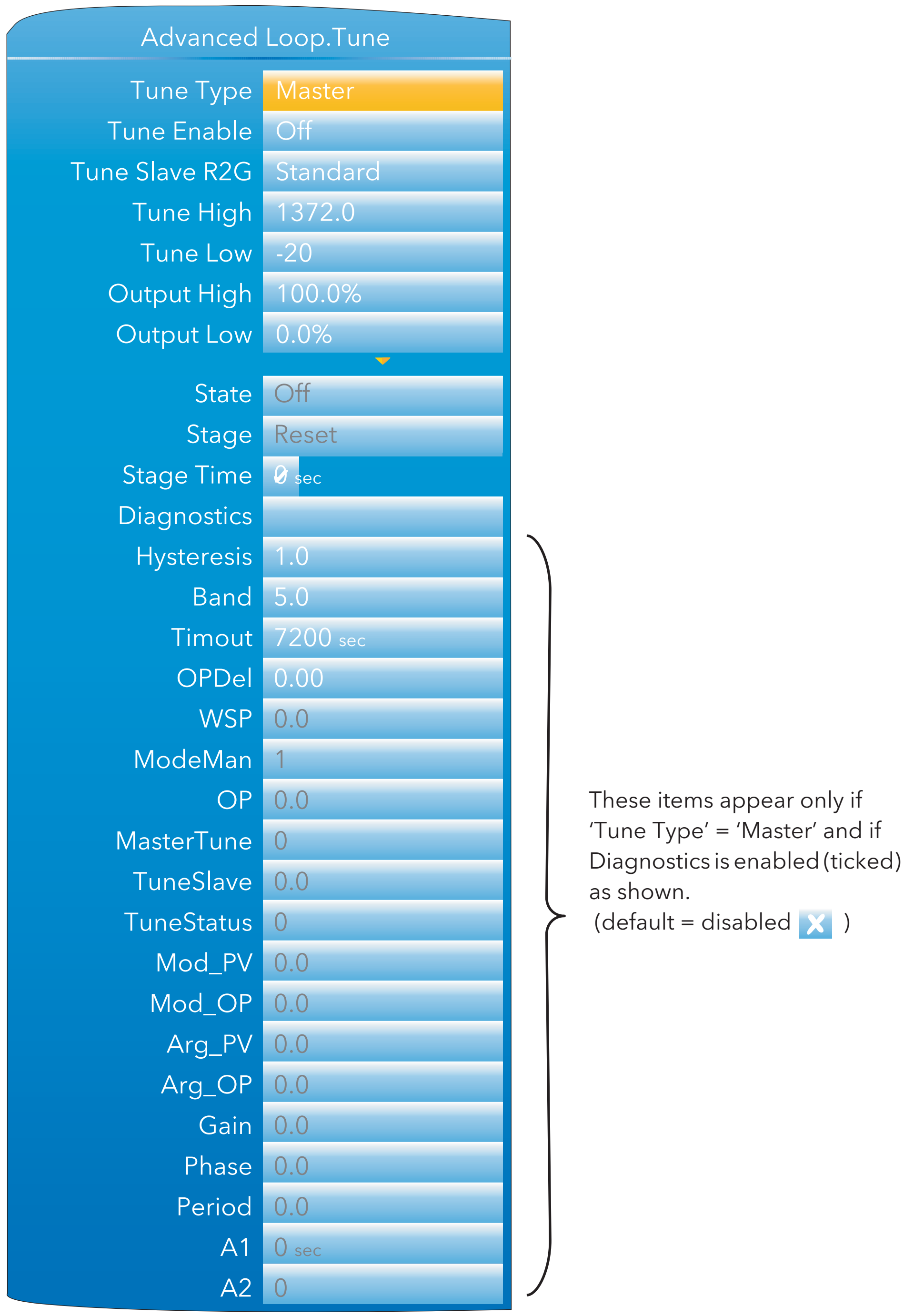


Figure 4.7.3 Advanced Loop Tune menu

Tune Type	Select 'Master' or 'Slave' for the Tuning process.
Tune Enable	Allows the user to initiate an autotune.
Tune Slave R2G	Appears only if the Slave channel 2 is set to 'PID' in the Setup menu (section 4.7.2). Standard: Normal compensation applied to account for differences in heating and cooling efficiencies between the heating and cooling channels. R2GPD: Typically used in heavily lagged systems.
Tune High	Sets the maximum value for the master loop setpoint during the tuning process.
Tune Low	Sets the maximum value for the master loop setpoint during the tuning process.

4.7.3 ADVANCED LOOP TUNE MENU (Cont.)

Output High	The maximum output power level which the controller may supply during the tuning process. If 'Output High' in the Output menu (section 4.7.8) is lower than 'High Output' then the maximum output is clipped to the 'Output High' value.
Output Low	The minimum output power level which the controller may supply during the tuning process. If 'Output Low' in the Output menu ((section 4.7.8) is higher than 'Low Output' then the minimum output is clipped to the 'Output Low' value.
State	The current autotune state. Off: Autotune not enabled Ready: Running: Autotune running Complete: The tune process completed successfully. Fleeting display before returning to 'Off'. Time-Out: A timeout error has occurred and the autotune has been aborted. Ti Limit R2G Limit
Stage	Reset None Settling Current SP New SP To SP Wait Max Wait Min Store CoolT PID Abort Complete NewR2G 1:Half Cycle 2:Full Cycle 3:Full Cycle 4:FinalCycle 5:Calc.
Stage Time	Elapsed time since entering this stage of the tuning.
Diagnostics	If this is enabled, a number of further parameters become visible.
Hysteresis	This defines the hysteresis of the switch used during master autotuning to generate the oscillation. It is set as a % of the master PV range (High Range - Low Range) in engineering units being +/- Hysteresis/2 about the tuning setpoint
Band	This defines the band between which the setpoint of the slave controller will be switched during the master autotune oscillation. It is set as a % of the master PV (High Range - Low Range) in engineering units being +/- Band/2 about the tuning setpoint. The actual values applied to the slave may actually be constrained inside this band by the wind-up control mechanism
Timeout	Defines the maximum time permitted for each stage of the master tuning.
OPDel	This is an internal setting of the order of 0.5 during tuning.
WSP	This is the actual setpoint around which the autotuning oscillation of the master takes place. It is used for the calculations associated with the Hysteresis and Band parameters.

4.7.3 ADVANCED LOOP TUNE MENU (Cont.)

ModeMan	This parameter is used by the master autotune algorithm to communicate with the master loop. Puts master controller into 'Not-Auto' mode
OP	This signal is generated within the master loop during the autotune oscillation. It is used only as an input to the calculations which generate the slave loop setpoint. It is not the overall loop output to the load which at all times is under the control of the slave PID calculations.
MasterTune	Master tune in progress
TuneSlave	The autotune process is requesting a slave tune.
Tune Status	This indicates the internal stage of tuning. 0 = Not tuning 1 = Tuning the slave 2 = Tuning the master 3 = Tuning completed -1 = Tuning has aborted or timed-out
Mod_PV	This is the amplitude of the fundamental component of the master PV during the last cycle of the tuning oscillation.
Mod_OP	This is the amplitude of the fundamental component of the master OP during the last cycle of the tuning oscillation.
Arg_PV	This is the argument (phase) of the fundamental component of the master PV during the last cycle of the tuning oscillation. Value in radians.
Arg_OP	This is the argument (phase) of the fundamental component of the master OP during the last cycle of the tuning oscillation. Value in radians.
Gain	This is the gain between the master OP and the master PV over the path via the slave loop and the load, measured at the fundamental frequency of the autotuning oscillation.
Phase	The phase shift in radians between the master OP and the master PV over the path via the slave loop and the load, measured at the fundamental frequency of the autotuning oscillation
Period	This is the period of the last cycle of the autotune oscillation, in seconds.
A1	This is the number of samples actually taken in order to determine the fundamental components of the master PV and OP. The target number is around 100 samples but the actual number taken may differ slightly from this depending on the load's behaviour.
A2	The A2 parameter is a used for diagnostic purposes. Its value indicates the design method chosen by the algorithm which depends on the characteristics of the master tuning oscillation and the measured values of frequency, gain, and phase shift around the master loop. This influences the choices of the P, I and D values set into the master loop.
Alpha_p	R2GPD tuning diagnostic parameter: Heat time / cool time.
OPss	R2GPD tuning diagnostic parameter: Steady state output at the end of the settling period.
Alpha	R2GPD tuning diagnostic parameter: 1/R2G.
Debug	R2GPD tuning diagnostic parameter: 0-PID, 1-PI, 2-PD, 3-P.
CycleNo	R2GPD tuning diagnostic parameter: Number of cycles in auto tune sequence.
PBs	R2GPD tuning diagnostic parameter: PBs scales the proportional band which will be used in the PD settling period.
TDs	R2GPD tuning diagnostic parameter: TDs scales the derivative value which will be used during the PD settling period.
Settle	R2GPD tuning diagnostic parameter: Used to scale the last cycle time. The result will be used for the PD settling time.

4.7.4 Advanced Loop Master PID menu

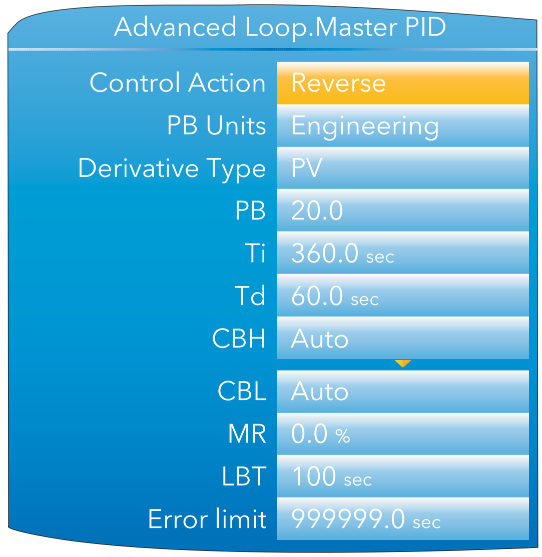


Figure 4.7.4 Advanced Loop master PID menu

Control Action	Select 'Reverse' or 'Direct'. 'Reverse' means that the output is 'on' when the process value (PV) is below the target setpoint (SP). This is normal for heating control. 'Direct' means that the output is on when PV is above SP. This is normal for cooling control.
PB Units	Select 'Engineering' or 'Percent'. 'Engineering' displays values in (for example) temperature units (e.g. °C or °F). 'Percent' displays values as a percentage of loop span (Range High - Range Low).
Deriv Type	'Error' means that changes to PV or SP cause changes to the derivative output. Derivative on error should be used with a programmer since it tends to reduce ramp overshoot. 'Error' provides rapid response to small setpoint changes which makes it ideal for temperature control systems. 'PV' means that changes in PV alone cause changes to the derivative output. Typically used for process systems using valve control, as it reduces wear on the valve mechanics.
PB	Proportional band. The proportional term in the units (Engineering units or %) set in 'PBUnits' above. See Appendix B section B2.2.2 for more details.
Ti	Integral time constant. Valid entries are1 to 9999.9 seconds, or 'Off'. If set Off, then integral action is disabled. Removes steady state control offsets by moving the output up or down at a rate proportional to the error signal.
Td	Derivative time constant. Valid entries are 1 to 9999.9 seconds, or 'Off'. If set Off, then derivative action is disabled. Determines how strongly the controller reacts to the rate-of-change in the PV. Used to control overshoot and undershoot and to restore the PV rapidly if there is a sudden change in demand.
CBH	Cutback high. Valid entries 'Auto' (3×PB) or 0.1 to 9999.9. The number of display units above setpoint at which the controller output is forced to 0% or -100% (OP min), in order to modify undershoot on cool down. See section B2.3.2 for more details.
CBL	Cutback low. Valid entries 'Auto' (3×PB) or 0.1 to 9999.9. The number of display units below setpoint at which the controller output is forced to 100% (OP max), in order to modify overshoot on heat up. See section B2.3.2 for more details.
MR	Manual reset. Valid entries -100% to +100%. Introduces a fixed additional power level to the output in order to eliminate steady state error from proportional only control. Applied instead of the integral component when Ti is set to 'Off'.
LBT	Loop break time. valid entries are 1 to 99999 seconds, or 'Off'. See section B2.3.6 for more details

4.7.5 Advanced Loop Slave PID menu

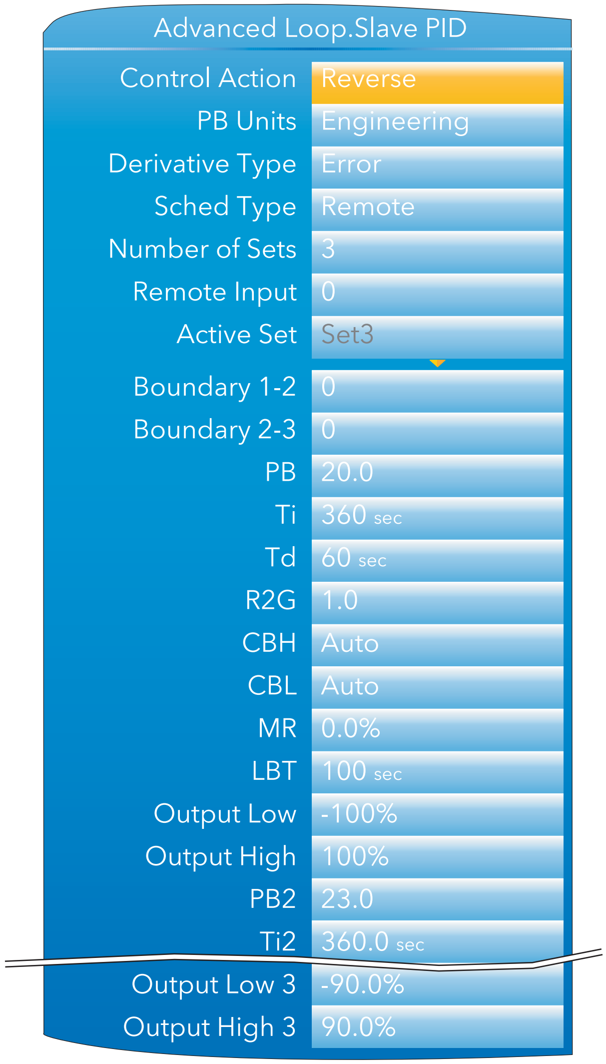


Figure 4.7.5 Advanced Loop Slave PID Menu (Typical)

Control Action	Select 'Reverse' or 'Direct'. 'Reverse' means that the output is 'on' when the process value (PV) is below the target setpoint (SP). This is normal for heating control. 'Direct' means that the output is on when PV is above SP. This is normal for cooling control.
PB Units	Select 'Engineering' or 'Percent'. 'Engineering' displays values in (for example) temperature units (e.g. °C or °F). 'Percent' displays values as a percentage of loop span (Range High - Range Low).
Deriv Type	'Error' means that changes to PV or SP cause changes to the derivative output. Derivative on error should be used with a programmer since it tends to reduce ramp overshoot. 'Error' provides rapid response to small setpoint changes which makes it ideal for temperature control systems. 'PV' means that changes in PV alone cause changes to the derivative output. Typically used for process systems using valve control, as it reduces wear on the valve mechanics.

4.7.5 ADVANCED LOOP SLAVE PID MENU (Cont.)

Sched Type	Selects the type of Gain Scheduling (section B2.3.7) to be applied. Off. Gain Scheduling not active Set. The user selects the PID parameter set to be used. Setpoint. Transfer from one set to the next depends on the setpoint value PV. The transfer from one set to another depends on the PV value Error. The transfer between sets depends on the value of the error signal OP. Transfer depends on the value of the output. Rem. Transfer is controlled by a remote input.
Number of Sets	Allows the number of sets of PID parameters for use in Gain scheduling to be selected.
Remote input	For 'Sched Type' = 'Rem' only, this shows the current value of the remote input channel being used to select which set is active. If the remote input value ≤ the Boundary 1-2 value (see below) then set 1 is selected. If it is > Boundary 1-2 value but ≤ Boundary 2-3 value then set 2 is used. If the remote value is > Boundary 2-3 value, then set three is used. If the Remote input is not 'wired', the value is user editable from the front panel.
Active Set	The set number currently in use.
Boundary 1-2	For all Sched Types except 'Set', this allows the user to enter a 'boundary' value, which means that if the relevant value (SP, PV, Error etc.) rises above this boundary, the loop switches from PID set 1 to PID set 2. If it falls below the boundary value, the loop switches from set 2 to set 1.
Boundary 2-3	As above but for switching between sets 2 and 3.
PB/PB2/PB3	Proportional band for set one/two/three. The proportional term in the units (Engineering units or %) set in 'PBUnits' in the Setup menu. See Appendix B section B2.2.2 for more details.
Ti/Ti2/Ti3	Integral time constant for set one/two/three. Valid entries are1 to 9999.9 seconds, or 'Off'. If set Off, then integral action is disabled. Removes steady state control offsets by moving the output up or down at a rate proportional to the error signal.
Td/Td2/Td3	Derivative time constant for set one/two/three. Valid entries are 1 to 9999.9 seconds, or 'Off'. If set Off, then derivative action is disabled. Determines how strongly the controller reacts to the rate-of-change in the PV. Used to control overshoot and undershoot and to restore the PV rapidly if there is a sudden change in demand.
R2G/R2G2/R2G3	Relative cool gain for set one/two/three. Appears only if cooling has been configured (Ch2 Control not 'Off' in the Setup menu). Valid entries are 0.1 to 10. Sets the cooling proportional band which compensates for differences between heating and cooling power gains.
CBH/CBH2/CBH3	Cutback high for set one/two/three. Valid entries 'Auto' (3×PB) or 0.1 to 9999.9. The number of display units above setpoint at which the controller output is forced to 0% or -100% (OP min), in order to modify undershoot on cool down. See section B2.3.2 for more details.
CBL/CBL2/CBL3	Cutback low for set one/two/three. Valid entries 'Auto' (3×PB) or 0.1 to 9999.9. The number of display units below setpoint at which the controller output is forced to 100% (OP max), in order to modify overshoot on heat up. See section B2.3.2 for more details.
MR/MR2/MR3	Manual reset for set one/two/three. Valid entries 0 to 100%. Introduces a fixed additional power level to the output in order to eliminate steady state error from proportional only control. Applied instead of the integral component when Ti is set to 'Off'.
LBT/LBT2/LBT3	Loop break time for set one/two/three. valid entries are 1 to 99999 seconds, or 'Off'. See section B2.3.6 for more details.
Output Low/2/3	Output low limit for set one/two/three. Valid entries are in the range Output High/2/3 to -100.
Output High/2/3	Output high limit for set one/two/three. Valid entries are in the range Output Low/2/3 to +100

4.7.6 Advanced Loop Master SP menu

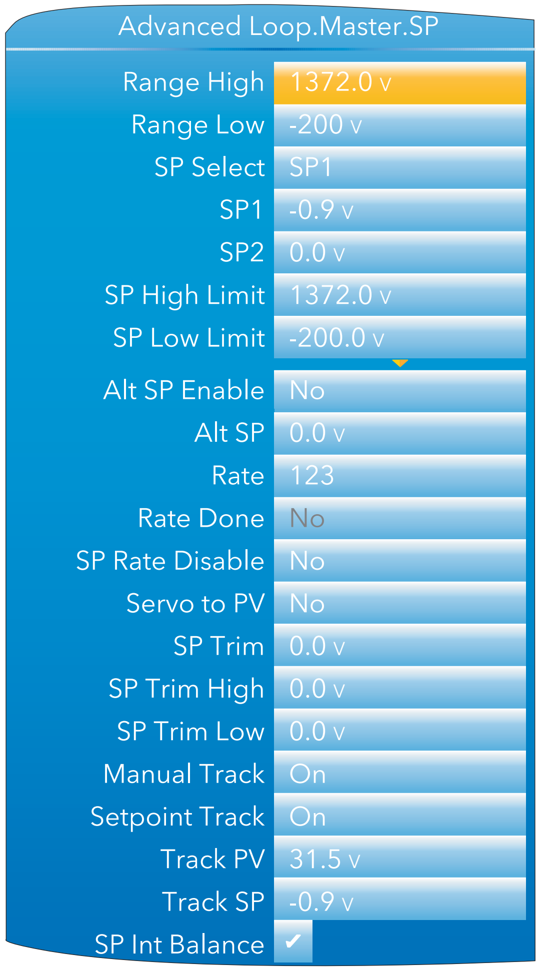


Figure 4.7.6 Advanced Loop Master SP menu

Range High/Low	Range limits. Range limits set absolute maxima and minima for control loop setpoints. If the proportional band is configured as a % span, the span is derived from the range limits.
SP select	Select SP1 or SP2. SP1 is often considered to be the primary setpoint for the controller, and SP2 a secondary setpoint.
SP1, SP2	Allows values for Setpoints 1 and 2 to be entered. Valid entries are any within the range 'SPHigh Limit' to 'SPLowLim'.
SP High Limit	Maximum setpoint limit for SP1 and SP2. Valid entries are in the range 'Range Hi' and 'SP Low Limit'
SP Low Limit	Minimum setpoint limit for SP1 and SP2. Valid entries are in the range 'Range Lo' and 'SP High Limit'
Alt SP Enable	'Yes' enables the alternative setpoint; 'No' disables it. May be wired to an external or internal source.
Alt SP	When wired this is a read only display of the alternative setpoint value. Otherwise, the user may insert a value. Valid values are limited by 'Range Hi' and 'Range Lo'.
Rate	Sets the maximum rate at which the working setpoint may change in Engineering units per minute. Often used to protect the load from thermal shock caused by large step changes in setpoint. 'Off' disables rate limiting.
Rate Done	Read only display. 'Yes' indicates that the working setpoint has completed its change. 'No' indicates that the setpoint is still ramping.

4.7.6 ADVANCED LOOP MASTER SP MENU (Cont.)

SP Rate Disable	Appears only if Rate is not 'Off'. 'Yes' disables rate limiting; 'No' enables rate limiting.
Servo To PV	If 'Rate' is set to any value other than 'Off', and if 'Servo to PV' is set to 'Yes' then any change in the current setpoint value causes the working setpoint to servo to the current PV before ramping to the new setpoint value.
SP Trim	A positive or negative value added to the setpoint, for local fine tuning. Valid entries are any value between 'SP Trim High' and 'SP Trim Low'.
SP Trim High/Low	Setpoint trim high and low limits
Manual Track	'On' enables manual tracking. Manual tracking removes steps in setpoint when switching between M'Man' and 'Auto' modes. When the loop is switched from manual to auto the target setpoint is set to the current PV. See section B2.5.5 for more details. 'Off' disables manual tracking.
Setpoint Track	'On' enables setpoint tracking. When setpoint tracking is enabled, it ensures 'bumpless' transfer in setpoint when seitching from Alternative setpoint to a local setpoint. See section B2.5.4 for more details. 'Off' disables setpoint tracking.
Track PV	The unit tracks the PV when it is servoing or tracking.
Track SP	The SP to track in manual tracking - see 'Setpoint Track', above.
SP Int Balance	Allows the user to enable (tick) or disable (cross) debump on PV change.

4.7.7 Advanced Loop Slave SP menu

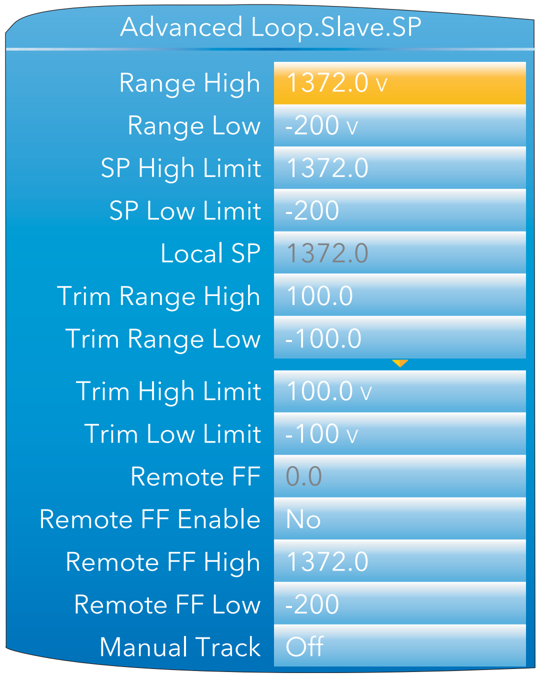


Figure 4.7.7a Advanced Loop Slave Setpint menu

Range High/Low	Range limits. Valid entries from 99999 to -99999. Range limits set absolute maxima and minima for control loop setpoints. If the proportional band is configured as a % span, the span is derived from the range limits.
SP High Limit	Maximum setpoint limit for the local setpoint. Valid entries are in the range 'Range Hi' and 'SP Low Limit'
SP Low Limit	Minimum setpoint limit for the local setpoint. Valid entries are in the range 'Range Lo' and 'SP High Limit'
Local SP	The Slave local setpoint
Trim Range High	Trim Range upper limit. Appears only if 'Cascade type' has been set to 'Trim' in the Set-up menu.
Trim Range Low	Trim Range upper limit. Appears only if 'Cascade type' has been set to 'Trim' in the Set-up menu.
Trim High Limit	Maximum value for Trim High value. Appears only if 'Cascade type' has been set to 'Trim' in the Setup menu.
Trim Low Limit	Minimum value for Trim Low value. Appears only if 'Cascade type' has been set to 'Trim' in the Setup menu.
Remote FF	The current remote feedforward value
Remote FF Enable	Enables or disables the use of a remote Feedforward signal. Appears only if 'Cascade type' has been set to 'Full Scale' in the Setup menu.
Remote FF High	High limit for the remote feedforward signal value. Appears only if 'Cascade type' has been set to 'Full Scale' in the Setup menu.
Remote FF Low	Low limit for the remote feedforward signal value. Appears only if 'Cascade type' has been set to 'Full Scale' in the Setup menu.
FF Select	Allows the user to select the source of the feedforward signal from 'master PV', Master working setpoint' or Remote FF'. Appears only if 'Cascade type' has been set to 'Trim' in the Setup menu.
Manual Track	'On' enables manual tracking to allow the local SP to follow the value of the current PV to allow bumpless transfer when switching to Auto. See section B2.5.5 for more details. 'Off' disables manual tracking.

4.7.7 ADVANCED LOOP SLAVE SP MENU (Cont.)

Sbrk Mode	This defines the behaviour when the master loop process variable is bad, i.e. the sensor has failed.
Sbrk SP	The setpoint for the slave loop when the master sensor has gone into sensor break and the sensor break mode for the master is set to SbrkSP

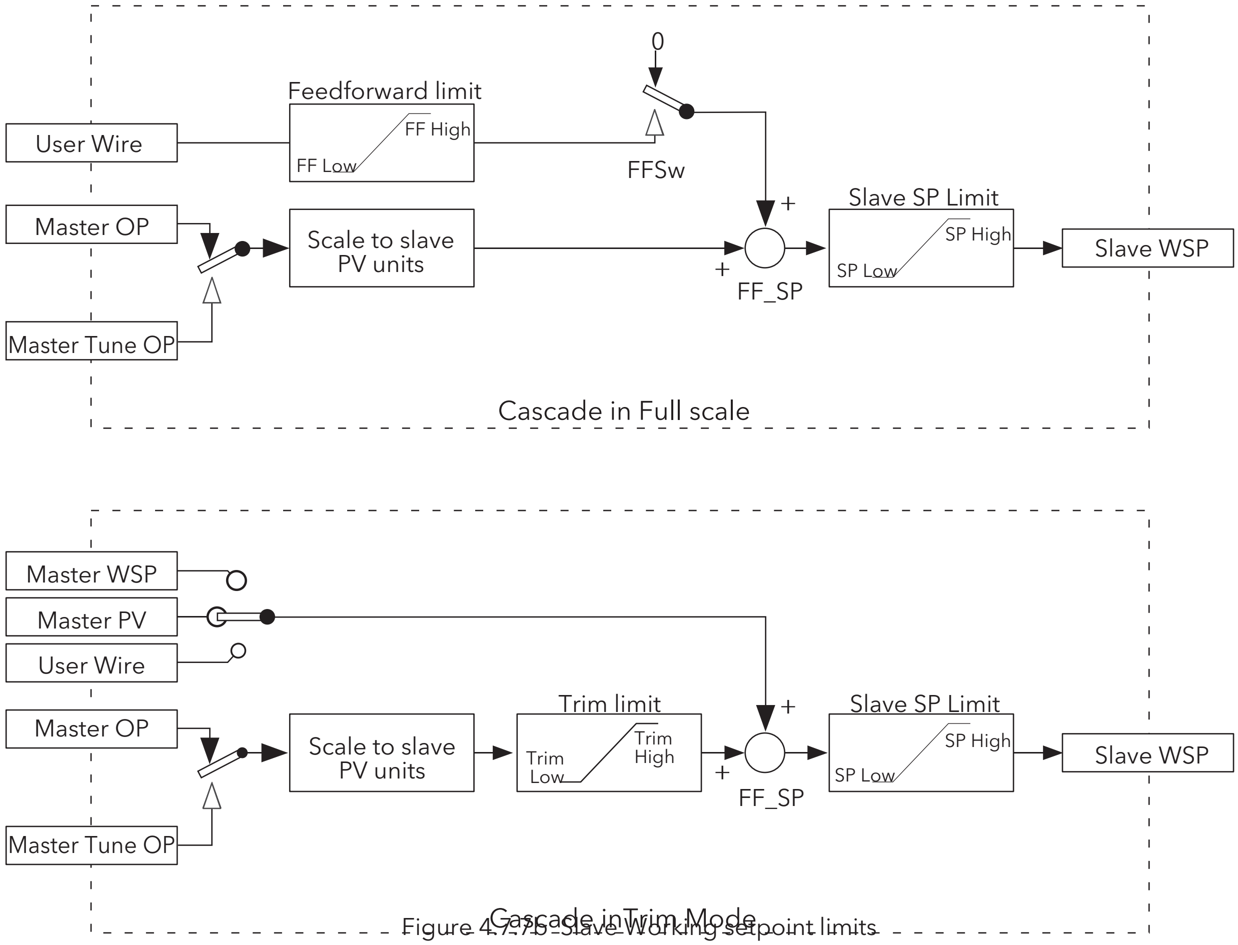


Figure 4.7.7b Slave Working setpoint limits

4.7.8 Advanced Loop Output menu

Appendix B section B2.6 contains details of the output functions.

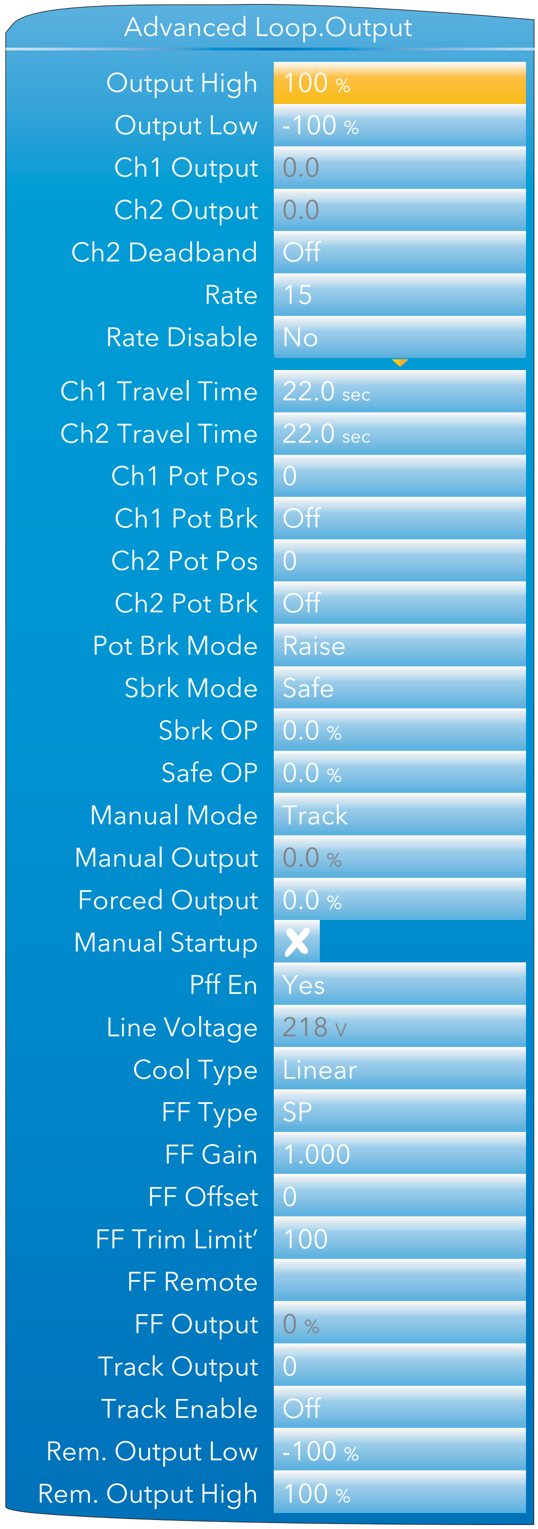


Figure 4.7.8 Advanced Loop Output menu

4.7.8 ADVANCED LOOP OUTPUT MENU (Cont.)

Output High	The maximum output power to be delivered by channels 1 and 2, where 100% is full power. The valid input range is Output Low to 100.0%. Reducing this value reduces the rate of change of the process, but it also reduces the controller's ability to react to perturbations and can even cause it to fail to achieve setpoint.
Output Low	The minimum power, or the maximum 'negative' (i.e. cooling) power to be delivered by the system.
Ch1 Output	Displays the positive power values used by the heat output.
Ch2 Output	Displays the cooling power values for channel two. Appears as a value between Output High and -100%, where -100% represents full cooling power.
Ch2 Deadband	A gap (in %) between output 1 switching off, and output 2 switching on, and *vice-versa*. Valid inputs are 0 (off) to 100%.
Rate	Limit on the rate at which the output from the PID can change. Can be useful in preventing rapid changes in output that could damage the process, heater elements etc.
Rate Disable	The Output Rate limit may be disabled by setting its value to 0.0. Alternatively, for some applications it is useful to be able to wire to the Output Rate Disable so that 'Rate' can be switched on/off during stages of the process. For example, Rate Disable can be used with the programmer event outputs to control the output rate of change during a particular segment.
Ch1 Travel Time	Appears only if Setup menu parameter 'Slave Channel 1' is set to 'VPB'. This is the valve travel time from closed (0%) to open (100%). In a valve positioning application, channel 1 output is connected by a single software 'wire' to a Valve Raise/Valve Lower relay pair. For heat/cool applications, channel 1 is associated with the heating valve. Valid entries: 0.0 to 1000.0 seconds.
Ch2 Travel Time	Appears only if Setup menu parameter 'Slave Channel 2' is set to 'VPB' . This is the valve travel time from closed (0%) to open (100%). For heat/cool applications, channel 2 is associated with the cooling valve. Valid entries: 0.0 to 1000.0 seconds.
Ch1 Pot Pos*	The position of the channel one actuator as measured by the feedback potentiometer.
Ch1 Pot Brk*	'On' indicates that the input to the relevant channel is open circuit.
Ch2 Pot Pos*	The position of the channel two actuator as measured by the feedback potentiometer.
Ch2 Pot Brk*	'On' indicates that the input to the relevant channel is open circuit.
Pot Brk Mode*	Defines the action to be taken if a potentiometer break is detected: Raise: opens the valve Lower: closes the valve Rest: the valve remains in its current state. Model: the controller tracks the position of the valve and sets up a model of the system so that it continues to function if the potentiometer becomes faulty. This does not mean that the potentiometer can be omitted with VPB, as the accuracy of valve position control is reduced without it.

* Note: These parameters appear only if the 'Setup' menu parameter 'Slave Channel 1' or 'Slave Channel 2' (as appropriate) is set to 'VPB'. The Setup menu is described in section 4.7.2.

SBrk Mode	Defines the action to be taken in the event of a sensor break. Safe: The output adopts the value configured in 'Sbrk OP', below. Hold: The output remains at its current level.
Sbrk OP	The value to be output if a Slave sensor break occurs, and SBrk Mode (above) is set to 'Safe'.
Safe OP	The output level adopted when the loop is inhibited (Main menu section 4.7.1).

4.7.8 ADVANCED LOOP OUTPUT MENU (Cont.)

Manual Mode	Selects the type of transition to occur when changing to manual cascade mode (section 4.7.1): Track: Whilst in Auto mode, the manual output tracks the control output so that there is no change of output when manual mode is switched to. Step: On transition to manual mode, the output is set to the value entered for 'Forced-OP' (below). Last Man. Out: On transition to manual mode, the output adopts the manual output value as last set by the operator.
Manual Output	The output when the loop is in manual mode. In manual mode the controller limits the maximum power, but it is not recommended that it be left unattended at high power settings. It is important that over range alarms are fitted to protect the process.

Note: It is recommended that all processes are fitted with an independent over range detection system.

Forced Output	Forced Manual output value. When 'Manual Mode' = 'Step', this is the output value adopted when changing from Auto to Manual mode.
Manual Startup	When set to off (cross symbol), the controller powers up in the same (auto or manual) mode that obtained when it was switched off. When set to on (tick symbol) the controller always powers up in manual mode.
Pff En	Power feed forward enable. 'Yes' enables power feed forward (adjusts the output signal to compensate for variations is supply voltage. 'No' disables Pff. See section B2.6.6 for further details.
Line Voltage	Read only display of the current supply voltage.
Cool Type	Appears only if 'Ch2 Control' = 'PID' in the setup menu (section 4.7.2) and allows the user to enter the appropriate type of cooling (section B2.6.7): Linear: For use when controller output changes linearly with PID demand. Oil: For oil cooled applications Water: For water cooled applications Fan: For forced air cooling.
FF Type	Feed forward type (section B2.6.8): None: No signal fed forward. Remote: A remote signal is fed forward. SP: Setpoint is fed forward. PV: PV is fed forward.
FF Gain	For FF types 'PV' and 'SP', this scales the feed forward signal.
FF Offset	For FF types 'PV' and 'SP', this defines the offset of the scaled feed forward signal.
FF Trim Limit	For FF types 'PV' and 'SP', defines symmetrical limits about the PID output which are applied to the scaled feed forward signal.
FF Remote	Allows another value from the strategy to be used as the primary control variable in the feed forward strategy. The gain and offset are not applied to the remote value.
FF Output	For FF types 'PV' and 'SP', this is the calculated (scaled, offset and trimmed) feed forward signal. FF OP = FF gain (input + FF Offset)
Track Output	If 'Track Enable' (below) is set to 'Yes', this is the value for the loop output to track when output track is enabled.
Track Enable	When set to 'Yes', the output follows the Track OP value (above). When subsequently set to 'Off' the loop makes a bumpless return to control.
Rem. Output Low/High	Used to limit the output when using a remote source. These limits cannot exceed the 'Output Low' and 'Output High' values described earlier in this section.

4.7.9 Advanced Loop Diagnostics menu

Master Error	The difference in value between the setpoint and the PV for the Master (Read only).
Slave Error	The difference in value between the setpoint and the PV for the Slave (Read only).
(M)Prop. Output	Shows the proportional term contribution to the control output of the Master (Read only).
(M)Integral Out	Shows the integral term contribution to the control output of the Master (Read only).
(M)Deriv. Output	Shows the derivative term contribution to the control output of the Master (Read only).
(S)Prop. Output	Shows the proportional term contribution to the control output of the Slave (Read only).
(S)Integral Out	Shows the integral term contribution to the control output of the Slave (Read only).
(S)Deriv. Output	Shows the derivative term contribution to the control output of the Slave (Read only).
Target Output	The requested control output. The target of the active output if rate limiting is active. (Read only.)
Loop Break (S)	Loop Break Alarm (Read only). Becomes active 'Yes' if the relevant loop break time (LBT1/2/3), set in the Slave PID menu (section 4.7.5) is exceeded, otherwise 'No' is displayed.
Loop Break (M)	Loop Break Alarm (Read only). Becomes active 'Yes' if the Master loop break time (LBT), set in the Master PID menu (section 4.7.4) is exceeded, otherwise 'No' is displayed.
Sensor Break (S)	Indicates Slave sensor break status (Read only). On (tick symbol) indicates a sensor break has occurred; Off (cross symbol) shows that no sensor breaks have been detected.
Sensor Break (M)	Indicates Master sensor break status (Read only). On (tick symbol) indicates a sensor break has occurred; Off (cross symbol) shows that no sensor breaks have been detected.
Sched PB	The scheduled proportional band for the current PID set.
Sched Ti	The scheduled integral time for the current PID set.
Sched Td	The scheduled derivative time for the current PID set.
Sched CBH	The scheduled cutback high value for the current PID set.
Sched CBL	The scheduled cutback low value for the current PID set.
Sched MR	The scheduled manual reset value for the current PID set.
Sched Loop Break	The scheduled loop break time for the current PID set.
Sched R2G	The scheduled relative cool gain value for the current PID set.
Sched Out High	The scheduled output high limit for the current PID set.
Sched Out Low	The scheduled output low limit for the current PID set.
Working Out Low	The low limit for the working output (Read only). This is the value used to limit the output power of the loop and is derived from the gain scheduled limit, the remote limit and the safety limit.
Working Out High	The high limit for the working output (Read only). This is the value used to limit the output power of the loop and is derived from the gain scheduled limit, the remote limit and the safety limit.
Master FB	Master FB is the value of the master control output after limiting and is used for Integral desaturation.
Calc OP	Master P+I+D
HiSatLim	HiSatLim is an internally generated limit
LoSatLim	LoSatLim is an internally generated limit
OPPID	Master control output It will be the same as Calc OP if the master is not in Cutback

4.8 PROGRAMMER CONFIGURATION

The programmer option allows the user to configure a setpoint program with one or two channels, as required. The program can be run from the Programmer operator display page (section 3.4.9) or can be controlled by inputs received from other parameters. In particular, the programmer is intended for use with the loop or advanced loop options.

The programmer configuration is separated into a number of areas as depicted in the overview below. The segment configuration (ramp type etc.) is carried out from the programmer edit page, also described in section 3.4.9.

Programmer

Features Section 4.8.1)	FTP (Section 4.8.2)	Set Up (Section 4.8.3)	Run (Section 4.8.4)
Holdback	IP Address	Channels	Mode
PV Event	Username	Prog Mode Access	Status
User Value	password	Prog Edit Access	Ch1(2) PSP
Messages		Prog Store Access	Segment Name
FTP Store		Rate Resolution	Segment type
		Ch1(2) Units	Segment Time Left
		Ch1(2) Resolution	Segment Time Run
		Ch1(2) Servo To	Prog Time Left
		Ch1(2) PV Input	Prog Time Spent
		Ch1(2) SP Input	Prog Time Run
		Power Fail Action	Duration
		Max Events	Ch1(2) TSP
		Reset Events 1 to 8	Ch1(2) rate
		Reset Ch1(2) UV	Ch1(2) Time
		Run	Cycles Left
		Hold	Ch1(2) User Val
		Reset	Ch1(2) PV Event
		Run reset	Event 1 to 8
		Run Hold	End Output
		Wait Digital	
		Wait analogue 1(2)	
		Advance	
		Operation	
		Status	

4.8.1 Programmer Features menu

This menu allows the user to enable/disable some of the items presented to the user in the Programmer edit page described in section 3.4.9. Features are enabled/disabled by using the up/down arrow keys to highlight the required item and then using the scroll button to toggle between enabled (tick) and disabled (cross). Typically, items would be left disabled in order to reduce the number of configuration fields presented to a user who may not need all such features.

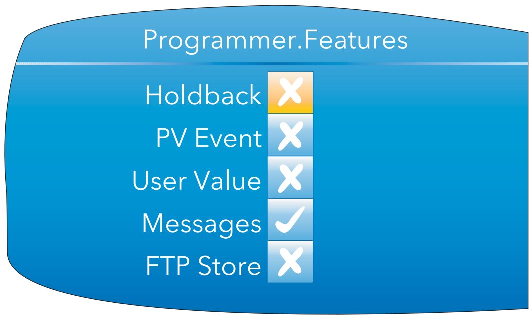


Figure 4.8.1 Programmer features menu

Holdback — Holdback pauses the program (freezes the Programmer setpoint (PSP) and the time remaining parameters) if the difference between the Process value (PV) and the PSP exceeds a user-specified amount (deviation). The program remains paused until the PV returns to within the specified deviation.
In ramp or step segments, holdback indicates that the PV is lagging the SP by more than the specified amount and that the program is waiting for the process to catch up. In a dwell segment, holdback is used to guarantee that a work piece stays at set-point within a specified tolerance for the specified dwell duration.
Holdback type and deviation value are configured, on a per program basis, to be applied to either the entire program or to individual segments. See Program edit (section 3.4.9) for details.

PV Event — A PV Event is available for each channel in every segment except for Wait and Go Back segment types. A PV Event is an absolute or deviation analogue alarm on the channel PV, and can be used to trigger a secondary process, or to trigger an analogue alarm.

User Value — A user value can be entered for every segment (except for Wait or Go Back types) and when the segment is entered, this value is transferred to the associated User Value Output parameter, which could be wired to another parameter to form part of an application strategy.

Messages — Table 4.8.1, below, lists the programmer specific events that generate messages that are displayed in the message summary and recorded into the history file.
It is also possible to trigger custom messages from any of the programmer outputs via user wiring. The program name and segment name can be embedded in custom messages by inserting the modbus address for the current program / segment name parameters in square brackets i.e.:

[<current_program_name_modbus_address>]

[<current_segment_name_modbus_address>]

4.8.1 PROGRAMMER FEATURES CONFIGURATION (Cont.)

Event	Message
Program Run	<program_name>: Run
Program End	<program_name>: Complete
Program Hold	<program_name>: <segment_name>: Hold
Program Resume	<program_name>: <segment_name>: Resume
Program Reset	<program_name>: <segment_name>: Reset
Segment Start	<program_name>: <segment_name>: Segment Start
Advance	<program_name>: <segment_name>: Advanced
Holdback	<program_name>: <segment_name>: Holdback:Channel No.
PV Event	<program_name>: <segment_name>: PV Event:Channel No.

Table 4.8.1 Programmer messages

FTP Store — If this feature is enabled, an FTP menu item appears in the top level Programmer configuration menu. 'FTP' allows the user to enter communications parameters for the host computer which is to act as the ftp server.
FTP Store allows the user to set-up a centralised program store from which several instruments can select their program.

Notes

1 A maximum of 100 entries is supported on all drives. Directory trees are supported for both USB and FTP, and if the root of the drive contains only files (no directories), then up to 100 files are listed. If the root of the drive contains directories then each directory can contain 100 entries (but one of these entries will be taken up by '..' to return to the directory above).
2 Program files are in compressed XML (.uipz) file format.
3 When a program is selected from an FTP server a local copy of the program file is made within the instrument before being processed. It should be noted that the number of program files in the internal 'user' drive does not affect this local copy, and therefore a program from an FTP server can be loaded, even when the internal user drive is full.
4 As the loaded program resides in the current program database it is automatically included in a clone file. In addition, program files stored in the internal program drive are included in a clone file (refer to 'Cloning', below).
5. On the internal program drive only a flat directory structure is supported. However, full tree directories are supported on both the USB memory stick and FTP server (accessed via the HMI File Explorer).
6. It is not possible to store program files on an external device. Programs selected from an external device can, however, be stored in the internal program store.
7. It is not possible to select a program from an external device over comms and iTools.

CLONING

Each program file stored locally on the instrument IS included in a clone file as a Binary Large Object (BLOB), similar to the Graphical Wiring Editor layout. Each program file BLOB contains the program filename.

When loading a clone file, existing programs in the instrument's internal drive are deleted, and program file BLOB(s) in the clone are reformatted into program files by the instrument.

4.8.2 Programmer FTP menu

Note: This menu item is accessible only if 'FTP' has been enabled in the Programmer features menu described above.

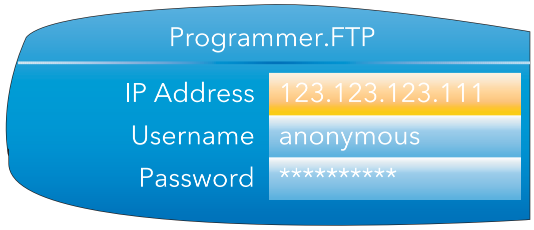


Figure 4.8.2 Programmer FTP menu

IP Address	The IP address of the FTP server.
Username	The User Name entered when setting up the FTP server
Password	The password associated with the above User Name.

Section C2 gives an example of how to set up an FTP server using 'Filezilla'

4.8.3 Programmer Setup menu

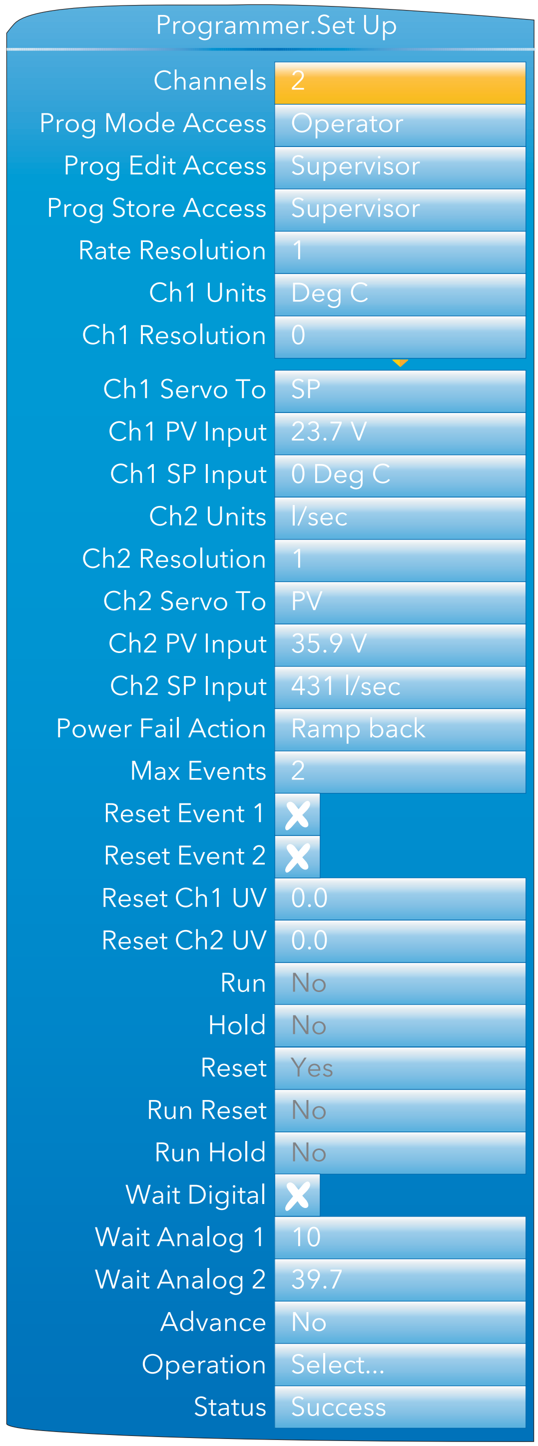


Figure 4.8.3 Programmer Set Up menu

Channels	The number of channels to be profiled. 1 = single channel mode, 2 = dual channel sync-all mode
Prog Mode Access	Sets the minimum access level (Logged off, Operator, Supervisor) for allowing changes to the current program mode (run, hold or reset)

4.8.3 PROGRAMMER SET UP MENU (Cont.)

Prog Edit Access	Sets the minimum access level (Logged off, Operator, Supervisor, Engineer) for loading programs, and for allowing edits to the current program including permission to advance a segment.
Prog Store Access	Sets the minimum access level (Logged off, Operator, Supervisor, Engineer) that allows users to copy, store and delete programs.
Rate Resolution	Sets the resolution (0 to 4 decimal places) of ramp rates when read from / written to via scaled integer comms.
Ch1 Units	Five-character (max.) descriptor for channel 1 units. If wired, the units will be those of the wire source.
Ch1 Resolution	Number of decimal places for channel 1 value. If wired, the value will be that of the wire source.
Ch1 Servo To	Determines whether the programmer starts running channel 1 from the control loop's configured set-point (servo to SP), or from the current process value (servo to PV).
Ch1 PV Input	Various programmer functions (for example Ch1 Servo to PV), require the PV value of the loop that the programmer is trying to control. The parameter is normally wired from the loop's Track PV parameter.
Ch1 SP Input	Various programmer functions (for example Ch1 Servo to SP), require the SP value of the loop that the programmer is trying to control - it is normally wired from the loop's Track SP parameter.
Ch2 Units	As 'Ch1 Units', above but for channel 2. Appears only if 'Channels' is set to '2'.
Ch2 Resolution	As 'Ch1 Resolution', above, but for channel 2. Appears only if 'Channels' is set to '2'.
Ch2 Servo To	As 'Ch1 Servo To', above, but for channel 2. Appears only if 'Channels' is set to '2'.
Ch2 PV Input	As 'Ch1 PV Input', above, but for channel 2. Appears only if 'Channels' is set to '2'.
Ch1 SP Input	As 'Ch1 SP Input', above, but for channel 2. Appears only if 'Channels' is set to '2'.
Power Fail Action	If the power supplied to the instrument is interrupted, the program status is retained and when power is restored, the instrument performs the selected power fail action. Continue: The programmer set-point returns immediately to its last value prior to the power down and the program continue to run from that point. Reset: The program resets. Ramp Back: The programmer servos the programmer set-point to the channel PV, and ramps to the target set-point at the rate prior to the power-fail. The time remaining for the segment is recalculated.

Notes:

1. If the interrupted segment was a 'time to target' ramp, then when power is returned the calculated ramp rate prior to the interruption is used.
2. If the interrupted segment was 'Dwell', then the ramp rate is determined by the previous ramp segment. On achieving the dwell set-point, the dwell period continues.
3. If a previous ramp segment does not exist (i.e. the first segment of a program is a dwell), the dwell continues at the 'servo to PV' programmer set-point.

Max Events	Configures the maximum number of event outputs (0 to 8).
Reset Event N	Sets the state of event output 'N' when the program is in reset. Appears only if 'Max Events' is > (N-1).
Reset Ch1 UV	Enter the value to be written to user value 1 when the program is in reset. Appears only if 'User Value' feature is enabled in Programmer.Features configuration (section 4.8.1).
Reset Ch2 UV	Enter the value to be written to user value 2 when the program is in reset. Appears only if 'User Value' feature is enabled in Programmer.Features configuration (section 4.8.1) and 'Channels' = '2'
Run	The input that causes the programmer to place the current program in Run mode.
Hold	The input that causes the programmer to place the current program in Hold mode.

4.8.3 PROGRAMMER SET UP MENU (Cont.)

Reset	The input that causes the programmer to place the current program in Reset mode.
Run Reset	Dual functionality input, that causes the programmer to place the current program in Run or Reset mode.
Run Hold	Dual functionality input, that causes the programmer to place the current program in Run or Hold mode.
Wait Digital	The Boolean input that is used in Wait segments.
Wait Analog 1	The analogue input associated with channel 1 that is used in wait segments.
Wait Analog 2	The analogue input associated with channel 2 that is used in wait segments. Appears only if 'Channels' = '2'
Advance	The input to advance the current segment
Operation	Program file operation selection parameter. See 'Program editing' (section 3.4.9) for further details
Status	Status indication of the selected file operation.See 'Program editing' (section 3.4.9) for further details
Amended	Indicates whether the current program has been amended since being loaded (Comms only)
File Error Status	File operation error status (Busy, OK, Load Open File Error, Store Open File Error, Delete File Fail, Copy File Fail, Invalid Format, Invalid Device, Invalid Version, Invalid Num Channels, Parameter Write Fail, Store Operation Did Not Complete, Load Operation Did Not Complete, Delete Operation Did Not Complete, Copy Operation Did Not Complete, Invalid Filename, Unspecified Error). Available only over Comms as the error is displayed on the display screen. 'Parameter Write Fail' indicates that one or more program/segment parameters failed to be written to during a 'Load' operation. This is generally caused by a program that contains features (i.e. Holdback, User Values, PV Events) which are disabled in the instrument's Programmer block, or the program contains more Event Outputs than configured in the instrument's Programmer block.

4.8.4 Programmer Run menu

Figure 4.8.4 Programmer Run menu

Mode	Current program mode (Run, Hold, Reset).
Status	Current program status (Running, Holding, Holdback, Waiting, Reset, Complete)
Ch1 PSP	The output setpoint for channel 1.
Ch2 PSP	The output setpoint for channel 2. Appears only if 'Channels' = '2' in the Set Up menu (section 4.8.3).
Segment	Name of the current segment as entered in the Program Edit page (section 3.4.9)
Segment Type	Current segment type as entered in the Program Edit page (section 3.4.9)
Seg Time Left	Indicates the minimum amount of time left in the current segment.
Seg Time Run	The length of time that the current segment has been running. This value does not include time spent in Hold, Holdback or Waiting
Prog Time Left	Shows the minimum amount of time left before the program completes. Each segment can be up to 500 hours in length. The maximum display is 500 hours, and if the length of the entire program is greater than this, the display remains at 500 until the remaining time falls below 500 hours.
Prog Time Spent	Indicates the length of time the current program has been running, including time spent in Hold, Holdback or Waiting

4.8.4 PROGRAMMER RUN MENU (Cont.)

Prog Time Run	The length of time the current program has been running. This value does not include time spent in Hold, Holdback or Waiting
Duration	For Dwell segments only, this is the dwell duration.
Ch1 TSP	For Ramp and Step segments, this is the current target setpoint for channel 1.
Ch1 Time	For Ramp segments, this is the configured time for channel 1 to reach it's Target Setpoint (TSP)
Ch2 TSP	For Ramp and Step segments, this is the current target setpoint for channel 2. Appears only if 'Channels' = '2' in the Programmer Set Up menu (section 4.8.3).
Ch2 Time	For Ramp segments, this is the configured time for channel 2 to reach it's Target Setpoint (TSP). Appears only if 'Channels' = '2' in the Programmer Set Up menu (section 4.8.3)
Cycles Left	The number of Go Back cycles remaining before the Go Back loop ends.
Ch1 User Val	The value of user value 1 in the current segment. Appears only if the 'User Value' feature is enabled in the Programmer Features menu (section 4.8.1).
Ch2 User Val	The value of user value 2 in the current segment. Appears only if the 'User Value' feature is enabled in the Programmer Features menu (section 4.8.1) and if 'Channels' = '2' in the Programmer Set Up menu (section 4.8.3)
Ch1 PV Event	The state of channel 1 PV event (Off = Cross symbol, On = Tick). Appears only if the 'PV Event' feature is enabled
Ch2 PV Event	The state of channel 2 PV event (Off = Cross symbol, On = Tick). Appears only if the 'PV Event' feature is enabled and if 'Channels' = '2' in the Programmer Set Up menu (section 4.8.3).
Event 1 to 8	The state of event output 1 to 8 for the current segment (Off = Cross symbol, On = Tick). The number of events appearing is defined in the Programmer Set Up menu (section 4.8.3) (Max Events)
End Output	The output that is set by the end segment (Off = Cross symbol, On = Tick).

4.8.5 Connecting the programmer to a loop

Below are some examples of how programmers and loops may be soft-wired together so that the programmer has access to the Loop PV and Loop setpoint. The examples are taken from iTools (section 6), but may be carried out through User Wiring (section 7) if more convenient.

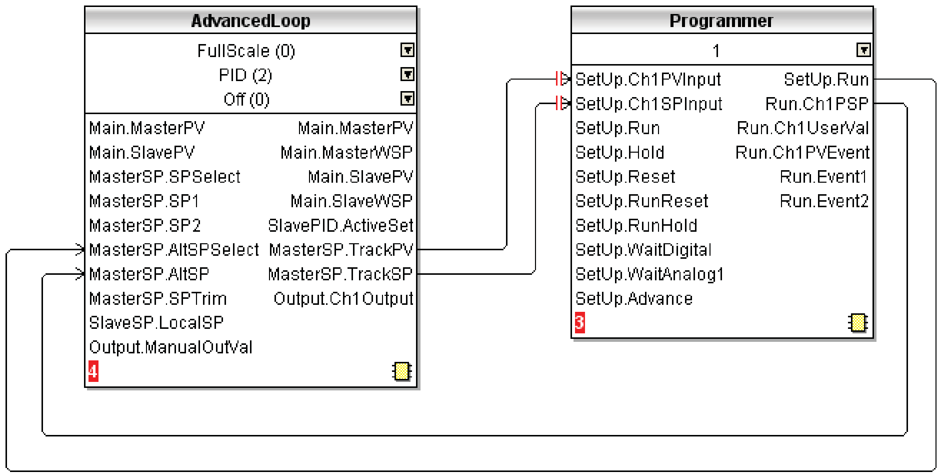


Figure 4.8.5a Advanced loop to Programmer basic wiring

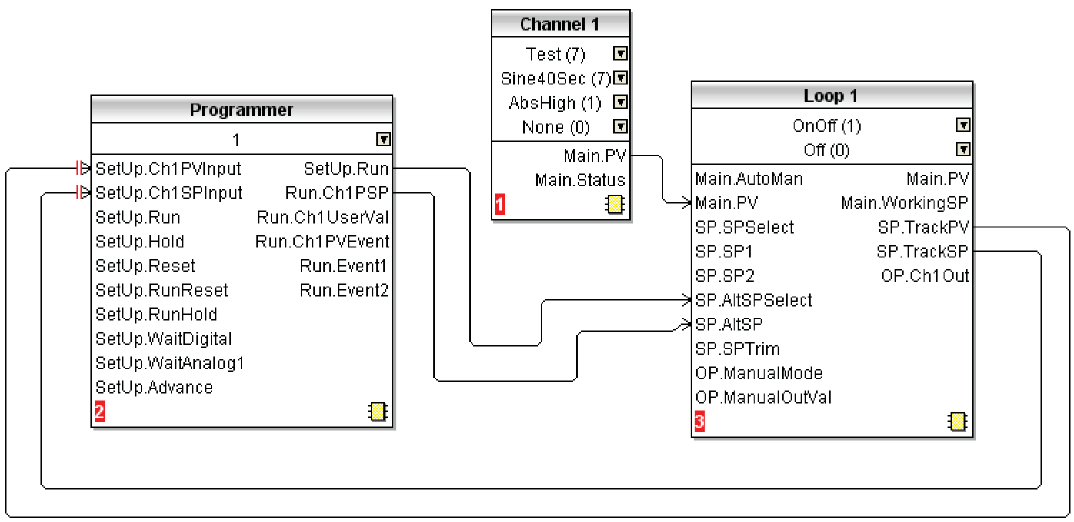


Figure 4.8.5b Programmer to Loop basic wiring

4.8.5 CONNECTING THE PROGRAMMER TO A LOOP (Cont.)

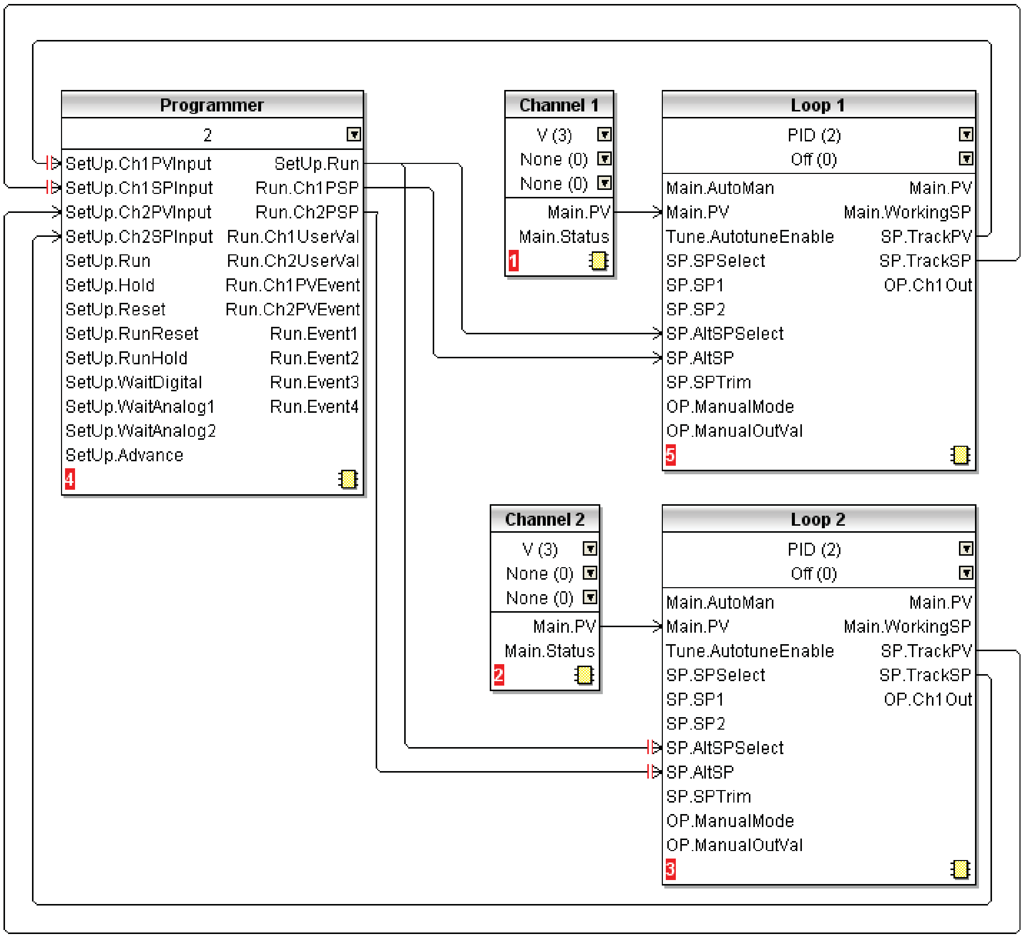


Figure 4.8.5c Dual programmer to two loops basic wiring

4.8.6 Configuration by Modbus Comms

It is possible to configure, store, delete, or load a program via Modbus comms by setting the Program and Segment parameters using either their scaled integer or native modbus addresses (section 5.3).

EXAMPLE 1: CONFIGURE A PROGRAM

To configure a simple Ramp-Dwell-Ramp program via modbus comms:

Set Segment.1.Type (address 15040) to Ramp (1)

Set Segment.1.Ch1TSP (address 15042) to 60.0 (600 - 1dp)

Set Segment.1.Ch1Time (address 15044) to 60s (60s)

Set Segment.2.Type (address 15088) to Dwell (2)

Set Segment.2.Duration (address 15089) to 120s (120)

Set Segment.3.Type (address 15136) to Ramp (1)

Set Segment.3.Ch1TSP (address 15138) to 0.0 (0 - 1dp)

Set Segment.3.Ch1Time (address 15140) to 180s (180)

EXAMPLE 2: STORE A PROGRAM

To store the current program:

Set Programmer.FileList.FilenameEntry (address 27281) to required filename (e.g. George)

Set Programmer.Setup.Operation (address 14912) to Store (4)

Read Programmer.Setup.Operation (address 14912) until it returns Select (1)

Read Programmer.Setup.Status (address 14913) to get the status of the store operation (Success = 1, Failed = 2)

EXAMPLE 3 LIST STORED PROGRAMS

To get a listing of stored program files:

Set Programmer.FileList.Operation (address 14976) to Get Listing (1)

Read Programmer.FileList.Operation (address 14976) until it returns Complete (0)

Read Programmer.FileList.Filename1 to 100 parameters (address 30976 - 31075)

Note: for each filename parameter perform a 21 register block read starting from the base address of the parameter, 1st null string indicates end of List.

EXAMPLE 4: LOADING PROGRAMS

To load a program:

Get a listing as described above

Set Programmer.FileList.FilenameEntry (address 27281) to the filename to be loaded (e.g. George)

Set Programmer.Setup.Operation (address 14912) to Load (2)

Read Programmer.Setup.Operation (address 14912) until it returns Select (1)

Read Programmer.Setup.Status (address 14913) to get the status of the store operation (Success = 1, Failed = 2)

4.9 MODBUS MASTER CONFIGURATION

Modbus master configuration is divided into two areas: a) setting up the slave(s), including diagnostics, and b) defining the locations of the parameters to be read. Figure 4.9 shows an overview.

Section 3.4.12 shows the Modbus Master display page, and describes the configuration options available there.

Note: Versions 2.40 to 2.50 of the Mini8 Controller, and versions 2.70 to 3.20 of the Model 3550 controller are supported. It is not guaranteed that later software versions of these instruments will be fully compatible.

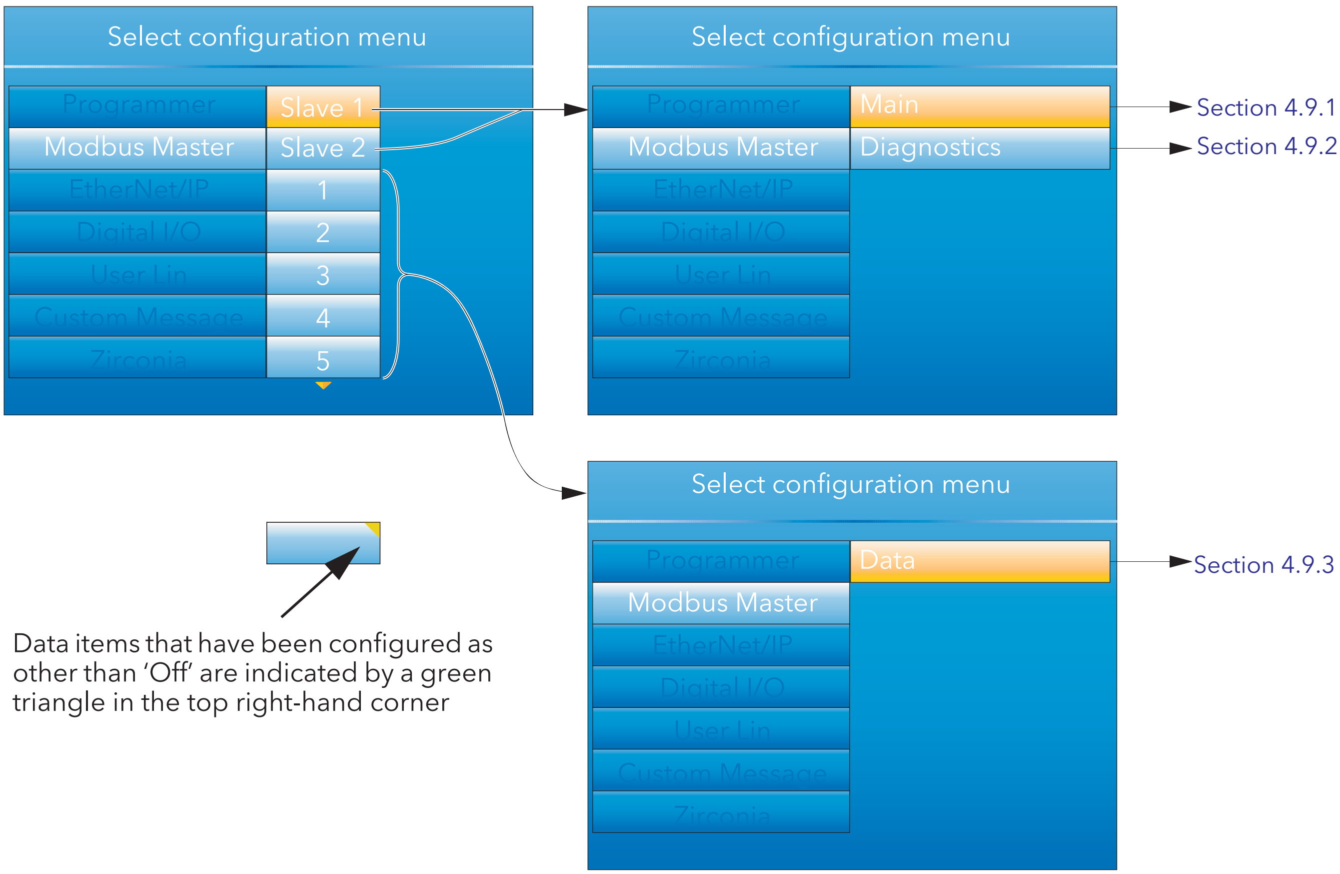
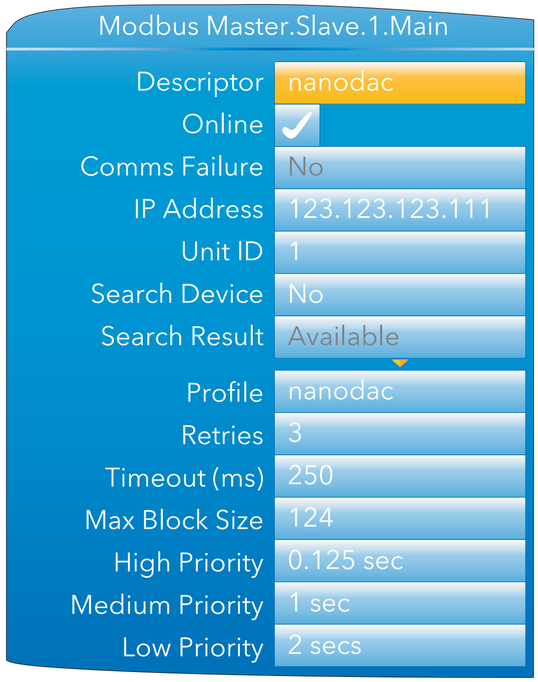


Figure 4.9 Modbus Master configuration top level menus

4.9.1 Slave Main menu

This allows the IP address, Unit ID and other communications parameters to be entered for Slaves 1 and 2.



Available Priority selections		
Seconds	Minutes	Hours
0.125	1	1
0.25	2	
0.5	5	
1	10	
2	20	
5	30	
10		
20		
30		

Figure 4.9.1 Modbus Master Slave 1 configuration (Slave 2 similar)

Descriptor	A descriptor for this instrument. For use in Modbus communications, this is not the same as the 'Name' which appears in the Instrument Info configuration (section 4.14).
Online	Disabled by default (Cross symbol). Must be enabled (highlighted using the down arrow, then edited by the scroll button) to allow the remaining configuration items to appear and to allow data transactions be processed. Setting the slave offline temporarily disables data transactions - it does not reconfigure them.
Comms Failure	Active (yes) if a data item has failed to respond after all retries.
IP Address	The IP address of the Slave device
Unit ID	The Unit Id or Modbus address to use in each data transaction with the slave device. Limits are 1 to 255
Search Device	Setting this to 'Yes' searches the network to see if the device with the specified IP address and Unit ID is available. If so, the descriptor will be overwritten to indicate what type of device has been found.
Search Result	The status of the selected 'Search Device' request (Searching, Available, Unreachable). Search activity is indicated by a rotating animated display in the 'Searching' field.
Profile	A number of profiles are held within the instrument that match a selection of known devices. If the device is 'known', its type, model number etc. is displayed. If the device is unknown, '3rd Party' appears instead.
Retries	The number of times (0 to 3) to re-send a data transaction to the device if no response is received within the configured timeout period (below).
Timeout	The timeout period for each Modbus transaction in ms
Max Block Size	The maximum number of registers (16bit words) that a single data transaction is permitted to contain
High Priority	The interval rate between each high priority data transaction. Default = 0.125 second.
Medium Priority	The interval rate between each medium priority data transaction. Default = 1 second.
Low Priority	The interval rate between each low priority data transaction. Default = 2 seconds.

4.9.1 SLAVE MAIN MENU (Cont.)

PRIORITY LEVELS

Three levels of update rate can be entered for use in data configuration (section 4.9.3), to define how often a value is read or written. In order to optimise performance, it is recommended that the slowest rate consistent with requirements be selected. The intervals are selected from a scroll list see figure 4.9.1 above.

4.9.2 Slave Diagnostics menu

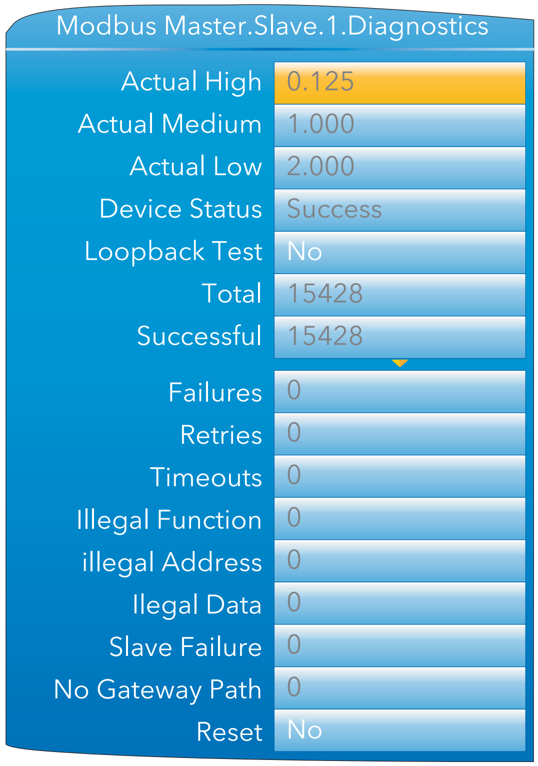


Figure 4.9.2 Diagnostics menu

Note: Diagnostic values are reset on power up

Actual High	The high priority rate that this slave is actually running at. This can never be faster than the high priority rate that was configured for this device (Slave Main menu, above), but if the master is heavily loaded the rate may be lower than that specified.
Actual Medium	The medium priority rate that this slave is running at. This can never be faster than the medium priority rate that was configured for this device (Slave Main menu, above), but if the master is heavily loaded the rate may be lower than that specified.
Actual Low	The actual low priority rate that this slave is running at. This can never be faster than the low priority rate that was configured for this device (Slave Main menu, above), but if the master is heavily loaded the rate may be lower than that specified.
Device Status	The status of the last transaction to this slave Success: The transaction was successfully actioned by the slave device Timeout: There was no response from the slave device to a given request within the configured time Illegal Address: The request to the slave device contained an invalid modbus address. The address may be for a read only parameter Illegal Value: The request to the slave device contained invalid data for the specified parameter Bad Sub: The sub function code in the request was invalid

4.9.2 SLAVE DIAGNOSTICS MENU (Cont.)

DEVICE STATUS (Cont.)

	Idle: This data item is currently idle and not communicating with the slave device
	Illegal Code: The slave does not support the function code transmitted by the master.
	Pending: The request is waiting to be sent, the most likely cause being that the slave device has not been set to online
Loopback Test	If set to 'Yes', Sends a function code 8 transaction to the slave, and waits for a response.
Total	A count of all the transactions sent to the slave including reads, writes both good and failed transactions.
Successful	A count of all the successful transactions sent to the slave.
Failures	A count of all the unsuccessful (failed) transactions sent to the slave. May be caused by Illegal Function, Illegal Address etc. failures, as detailed below
Retries	The number of transactions that were re-sent because of timed out responses from the slave devices.
Timeouts	A count of all the transactions sent to the slave for which no response was received within the configured timeout period.
Illegal Function	A count of all the transactions sent to the slave that the slave claimed contained an invalid function code. Exception code (1).
Illegal Address	A count of all the transactions sent to the slave that the slave claimed contained an invalid Modbus register address. Exception code (2).
Illegal Data	A count of all the transactions sent to the slave that the slave claimed contained an invalid value. Exception code (3)
Slave Failure	A count of all the times this slave device has failed to communicate. Exception code (4)
No Gateway Path	A count of all the times it has not been possible to access the slave device as it is on another network that requires a gateway for access
Master Rejects	A count of all the transactions that the Modbus Master has refused to send to the slave due to invalid configuration data
Reset	A one shot action that immediately resets all diagnostics counts.

4.9.3 Modbus master data configuration

This is the area of configuration in which the individual data items are selected for transmission across the Modbus master communications link. The configuration fields that appear depends on the parameter selected, so the examples given here will probably not match those that appear to the user. The parameters that appear in the 'parameter List' scroll menu depends on the slave model.

EXAMPLE 1: TARGET SP1 WITH NANODAC SLAVE

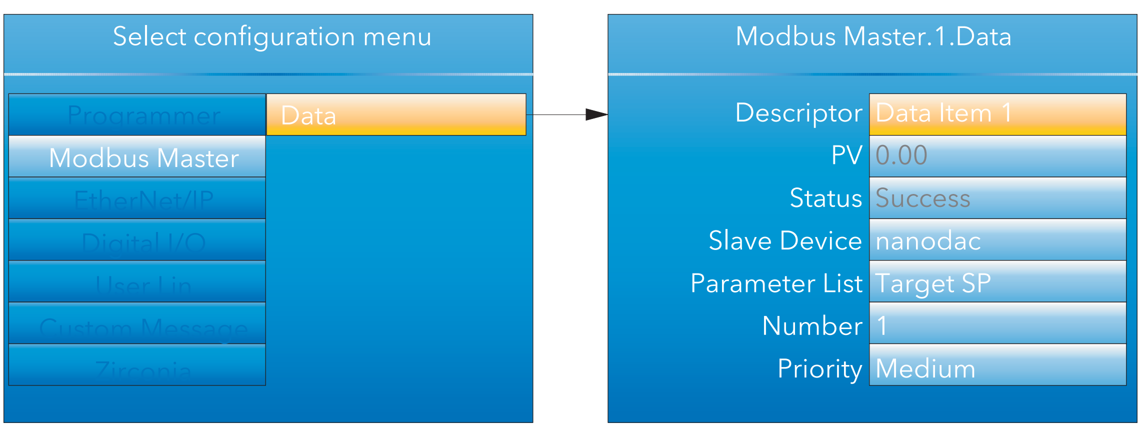


Figure 4.9.3a Target Setpoint

4.9.3 MODBUS MASTER DATA CONFIGURATION (Cont.)

EXAMPLE 2 USER DEFINED PARAMETER

This allows the user to enter a Modbus address (decimal) and a data type in order to read the value of a parameter from or write a parameter value to the slave. Modbus address and data types must be obtained from the documentation supplied with the slave device. For convenience, this example uses a nanodac as the slave; table 5.3 of this document providing the required data.

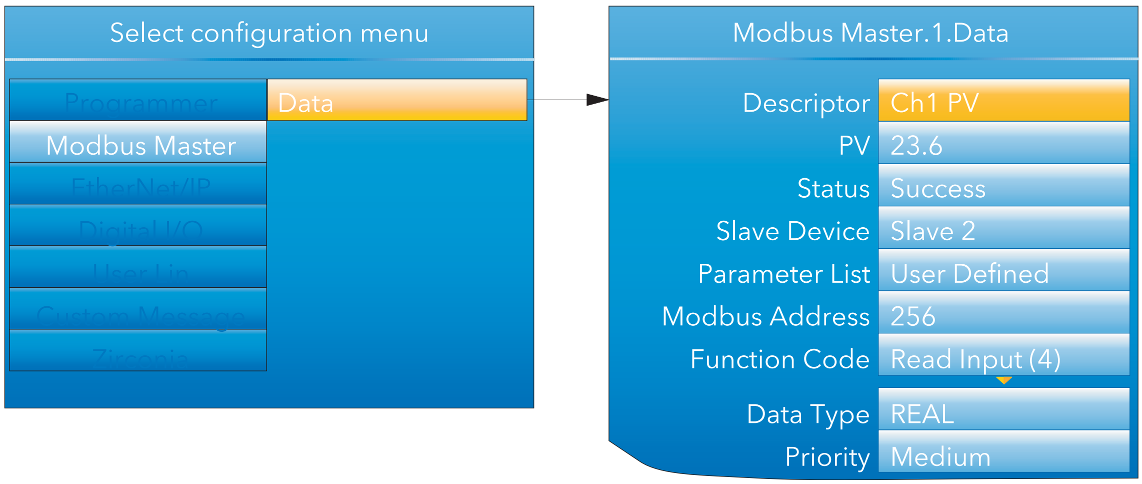


Figure 4.9.3b User defined parameters

DATA PARAMETERS

This lists all possible configuration fields that might appear, not just those shown in the examples above.

Descriptor	Up to 20 characters used to describe the current data item (used in the Modbus Master user page (section 3.4.12)).
PV	The process value currently being read from the selected slave. Visible only if data item is not an alarm type. The value must be wired to a virtual channel with ‘Operation’ = ‘Copy’ if it is to be trended and/or recorded.
Sys Alm status	The status (e.g. None, Active) of the data item. Visible only for specific read profiles. The value must be wired to a virtual channel with ‘Operation’ = ‘Copy’ if it is to be trended and/or recorded.
Chan. Alm Status	The status of the data item. Visible only for specific read profiles. The value must be wired to a virtual channel with ‘Operation’ = ‘Copy’ if it is to be trended and/or recorded.
Set	Allows the user to set an on/off value. Visible only for specific write profiles.
Mode	Allows the user to set an auto/manual value. Visible only for specific write profiles.
Value	Configured or wired value to be sent to the selected slave. This parameter is available only with function codes 6 & 16
Fall Back Value	The value to be sent to the selected slave if the 'Value' parameter is wired and has a status other than GOOD_PV. This parameter is available only with function codes 6 & 16 It is not possible to wire Fall Back Value from another parameter and it can be configured only manually
Send	A one shot action that sends the data in the 'Value' parameter or the 'Fall Back Value' parameter (depending upon the status of 'Value') to the selected slave. This is classed as an acyclic write and so is available only for function codes 6 & 16. The 'Priority' parameter must be set to 'Acyclic'

4.9.3 MODBUS MASTER DATA CONFIGURATION (Cont.)

Status — The status of the last transaction sent to the selected slave

Success: The transaction was successfully actioned by the slave device

Timeout: There was no response from the slave device to a given request within the configured time

Illegal Address: The request to the slave device contained an invalid modbus address. The address may be for a read only parameter

Illegal Value: The request to the slave device contained invalid data for the specified parameter

Bad Sub: The sub function code in the request was invalid

Idle: This data item is currently idle and not communicating with the slave device
Illegal Code: The slave does not support the function code transmitted by the master.
Pending: The request is waiting to be sent, the most likely cause being that the slave device has not been set to online.

Slave Device — A list of available slaves that this data is to communicate with.

Parameter List — List of parameters available for the selected slave devices profile. These parameters require no user configuration.

Number — The channel, loop or group etc. instance.

Modbus Address — The Modbus register address that this data is to be read or written to. Limits are 0 - 65535

Function Code — The function code to use, this determines if the data is going to be read or written to the selected slave. Supported function codes are:

Code	Description	Code	Description
1	Read contiguous status coils	5	Write a single coil on or off
2	Read contiguous discrete inputs	6	Write to a single register
3	Read contiguous holding registers	8	Loopback test
4	Read contiguous input registers	16	Write to contiguous registers

Data Type — The data type that defines how this data is going to be represented. The data types listed below are supported.

8-bit signed byte (BYTE)

8-bit unsigned byte (UBYTE)

16-bit signed integer (INT)

16-bit unsigned integer (UINT)

32-bit signed long (DINT)

32-bit unsigned long (UDINT)

32-bit floating point IEEE (REAL)

32-bit signed long (little Endian, word swapped) (DINT (Swap))

32-bit unsigned long (little Endian, word swapped) (UDINT (Swap))

32-bit floating point IEEE (little Endian, word swapped) (REAL (swap))

Bit from register (BIT)

By default all 16 & 32 bit data types (unless specified) will be transmitted in Big Endian format, where the most significant byte in the value is sent first. Byte Ordering: (for big Endian) (0x12 sent first)

16-bit	0x1234	0x12, 0x34
32-bit	0x12345678	0x12, 0x34, 0x56, 0x78

Bit Position — The bit in the register to be extracted, this is only available if the 'Data Type' selected is 'BIT In Register'

Scaling — The decimal placing for scaled 16 bit data types. Visible depending on the 'Data Type' selected.

Priority — The frequency with which this data will be managed. See 'Priority Levels', in section 4.9.1, above.

4.10 ETHERNET/IP CONFIGURATION

This area of configuration allows the ‘Client’ user to set up an EtherNet/IP communications link with up to two Server units. The ‘Server’ user has a more limited range of configurable items.

Note: Implicit I/O is used for continuous real-time transfer of multiple data items from instrument to instrument. Explicit I/O is used as a ‘one-shot’ transfer of a single data item. See section 3.4.13 for further details.

Figure 4.10 shows that the configuration is split into three areas: Main, Implicit Inputs and Implicit Outputs, but it should be noted that the implicit inputs and implicit outputs are read only, as these can be configured only by using iTools, as described in the EtherNet/IP display mode description (section 3.4.13).

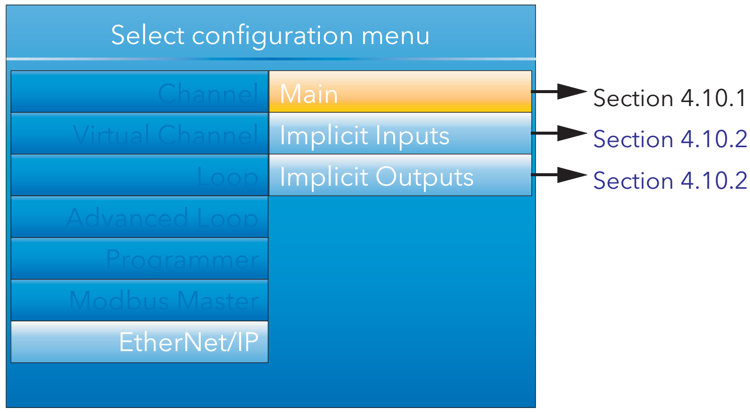


Figure 4.10 Client configuration

4.10.1 Ethernet/IP Configuration Main menu

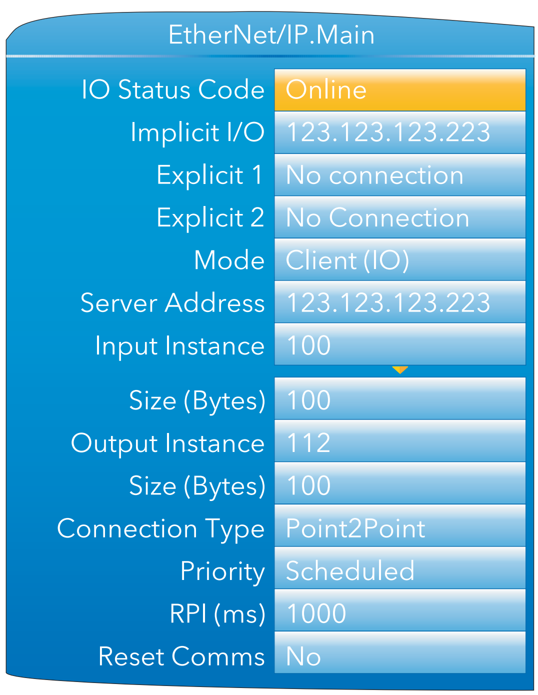


Figure 4.10.1 Ethernet/IP Main menu

4.10.1 ETHERNET/IP CONFIGURATION MAIN MENU (Cont.)

Net Status Code	Network status (Server only) Offline: nanodac online but there are currently no CIP connections Online: nanodac online with at least 1 CIP connection Connection Timeout: The connection has timed out Duplicate IP: A duplicate IP address has been detected on the network Initialisation: nanodac is initialising comms
IO Status Code	IO status (Client (IO) only). As above.
Tag Status code	Tag status (Client (Tags) only. See table 4.10.1, below.
Implicit I/O	Connected IO server IP address
Multicast	Connected IO server IP address (only if multicast selected)
Explicit 1	Connected client/server IP address
Explicit 2	Connected client/server IP address
Mode	Modes of operation: Server, Client (IO) or Client (Tags)
Server Address	IO Server IP address (Client mode only)
Input Instance	Input class instance number (client mode only)
Size (bytes)	The size in bytes of data that the client is expecting to read from the implicit input.
Output Instance	Output class instance number (client mode only)
Size (bytes)	The size of data that the client is expecting to write to the server.
Connection Type	Connection type (client mode only)
Priority	Connection priority (client mode only)
Rpi	IO connection speed (client mode only)
Reset Comms	Applies all changes to the EtherNet/IP stack at the same time. Or can be used to reset communications using the current configuration
Slot Number	PLC slot number (zero indexed) when communicating using tags

4.10.2 Implicit inputs/outputs

This display provides a read-only display of the values in the input and output data tables. Parameters are placed in the input and output tables using the proprietary software tool called 'iTools', as described in section 3.4.13.

4.10.3 Explicit inputs/outputs

See section 3.4.13 for details.

4.10 ETHERNET/IP CONFIGURATION (Cont.)

0	Success. Service was successful
1	Connection Failed. A connection in the path failed
2	Invalid Parameter. A parameter associated with the request was invalid
3	Memory Unavailable. No available resources in the server to service the request
4	Path Segment Error. The syntax of all or some of the path was not understood
5	Path Dest. Error. The path references an unknown object, class or instance
6	Partial Transfer. Only part of the expected data was transferred
7	Connection Lost. The messaging connection was lost
8	Service Unsupported. Undefined service for requested object
9	Invalid Attribute. Invalid attribute data detected
10	Attribute Error. An attribute in the response has a non zero status
11	Already Requested. The object is already in the mode/state being requested
12	Object Conflict. The object cannot perform the requested service
13	Already Exists. The requested instance or object already exists
14	Attribute Error. Request to modify a non modifiable attribute received
15	No Privileges. Permission/Privilege check failed
16	State Conflict. The current state or mode prohibits the execution of the requested service
17	Reply To Large. Response buffer too small for response data
18	Fragmented Value. For example this service request will return only half a REAL data type
19	Not Enough Data. The service does not provide enough data to complete the request
20	Invalid Attribute. Requested attribute is not supported
21	Too Much Data. The service supplied more than was expected
22	Object Non-Exist. The object specified does not exist in the device
23	Seq. Fragmentation. The fragmentation sequence for this service is not active
24	No Attribute Data. The attribute data for this object was not saved at the server prior to this request service
25	Data Store Failure. The attribute data for this object was not saved due to a failure during the attempt
26	Routing Failed. The service request packet was too large for transmission on a network in the path to the destination. The routing device was forced to abort the service
27	Routing Failed. The service request packet was too large for transmission on a network in the path to the destination. The routing device was forced to abort the service
28	Missing Attribute. The service did not supply an attribute in a list of attributes that was needed by the service to perform the requested behaviour
29	Invalid Attribute. The service is returning the list of attributes supplied with status information for those attributes that were invalid
30	Embedded Tag Error. An embedded service resulted in an error. This is most commonly an incorrectly formatted tag name
31	Vendor Error. A vendor specific error has encountered
32	Invalid Parameter. A parameter associated with the request was invalid
33	Write Once Error. An attempt to write to a write once only parameter occured
34	Invalid Reply. An invalid reply was received
35	Buffer Overflow. The message received is larger than the receiving buffer
36	Format Error. The format of the received message is not supported
37	Key Path Failure. The key segement in the path does not match destination key
38	Path Size Error. The size of the path in the request is too large
39	Unexpected Attribute. Unable to set the attribute at this time
40	Invalid Member Id. The requested member id does not match class object
41	Member Is R/O. A request to modify a R/O member was received
42	Group 2 Server. Group 2 DeviceNet server response
43	Translation Error. A CIP modbus translator request failed
44	Attribute Is R/O. A request to read a non readable attribute was received
64	No Tags Found. There were no tags configured in the input or output tables
65	Invalid Config. The total length in characters of all the tags in this table will cause the PLC to exceed its internal buffer of 500 bytes. To eliminate this problem, reduce the length of some or all tag names

Table 4.10.1 Tag Status code definition

4.11 DIGITAL I/O

This area of configuration allows the digital I/O types to be selected.

Notes:
1. If 2A2B is set to 'Valve Raise', then 3A3B is set to 'Valve Lower'. Similarly, if relay 4AC is set to 'Valve Raise', then relay 5AC is set to 'Valve Lower'.
   When the loop channel output is wired to the PV input of a Valve Raise function, then the PV input of the associated Valve Lower function becomes unavailable for wiring, and both outputs are controlled by the loop as a pair, using only the single wire.
2. See section B2.6.11 for a description of time proportioning.

Note: These fields do not appear if they contain I/O type 'DC output'.

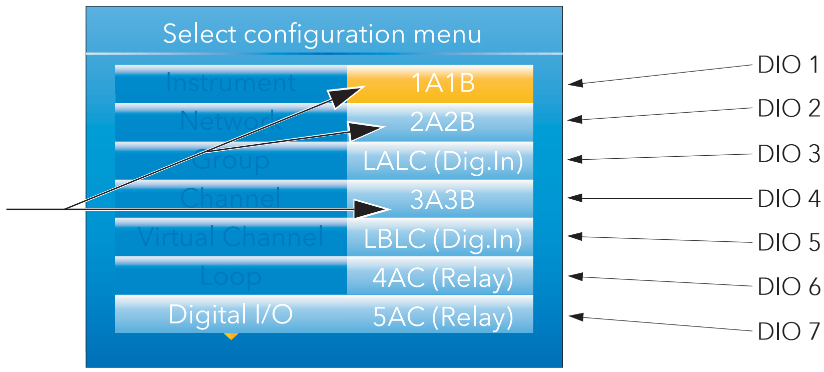


Figure 4.11 Digital I/O top level menu

4.11.1 Digital input/output

This applies to signals at terminals 1A/1B (figure 2.2). Highlight '1A1B', then operate the scroll key to reveal the configuration menu.

Module Ident	Dig IO
Type	On Off O/P, Time Prop O/P or Contact I/P (default)
PV	For inputs, 0 = contact is open; 1 = contact is closed. For On Off O/P, a value ≥ 0.5 drives the output high, otherwise, the output is driven low. For Time Prop O/P, the value is the demanded output %.
Min On Time	For Type = Time Prop O/P only, this allows a minimum on time to be specified. Configurable range = 0.1 to 150 seconds
Invert	Inverts the output sense for digital outputs; or the input signal for digital inputs.
Output	Off = output being driven low; On = output being driven high. Does not appear for Type = Contact I/P

4.11.2 Relay outputs

This may apply to terminal pairs 1A1B, 2A2B, 3A3B, 4AC, 5AC (figure 2.2). Highlight the relevant terminal pair, then operate the scroll key to reveal the configuration menu.

Module Ident	Relay
Type (2A2B, 4AC)	On Off O/P (default), Time Prop O/P, Valve Raise (not if DC output I/O fitted).
Type (3A3B, 5AC)	'On Off O/P' (default), 'Time Prop O/P'. The 3A3B relay is not fitted if 'DC Output' I/O is fitted.
PV	For On Off O/P, a value ≥ 0.5 closes the relay contacts, otherwise, the contacts are open. For Time Prop O/P, the value is the demanded output %.
Min On Time	For Type = Time Prop O/P only, this allows a minimum on time to be specified to reduce relay wear. Configurable range = 0.1 to 150 seconds
Invert	Inverts the output sense for the relays (not applicable if Type = Valve Raise).

(Continued)

4.11.2 RELAY OUTPUTS (Cont.)

Inertia	For Type = Valve Raise only, this allows a value to be entered (in seconds) to take into account valve run-on.
Backlash	For Type = Valve Raise only, this allows a value to be entered (in seconds) in order to compensate for backlash in the valve linkage.
Standby action	For Type = Valve Raise only, this specifies the valve action when the instrument is in standby mode. Continue: Output continues at the demanded level Freeze: The valve stops being driven.
Output	Off = relay contacts open; On = relay contacts closed.

4.11.3 Digital inputs

This applies to terminals pairs LALC, LBLC (figure 2.2). Highlight the relevant terminal pair, then operate the scroll key to reveal the configuration menu.

Module Ident	Dig.In
Type	Contact I/P
PV	0 = contact is open; 1 = contact is closed.
Invert	Inverts the sense of the input.

4.11.4 Digital outputs

This applies to terminal pair 2A2B (figure 2.2). Highlight 2A2B, then operate the scroll key to reveal the configuration menu.

Module Ident	Dig.Out
Type	On Off O/P, Time Prop O/P or Valve Raise
PV	For On Off O/P, a value ≥ 0.5 drives the output high, otherwise, the output is driven low. For Time Prop O/P, the value is the demanded output %.
Min On Time	For Type = Time Prop O/P only, this allows a minimum on time to be specified. Configurable range = 0.1 to 150 seconds
Invert	Inverts the output sense for digital outputs; or the input signal for digital inputs.
Inertia	For Type = Valve Raise only, this allows a value to be entered (in seconds) to take into account valve run-on.
Backlash	For Type = Valve Raise only, this allows a value to be entered (in seconds) in order to compensate for backlash in the valve linkage.
Standby action	For Type = Valve Raise only, this specifies the valve action when the instrument is in standby mode. Continue: Output continues at the demanded level Freeze: The valve stops being driven.
Output	Off = output being driven low; On = output being driven high.

4.12 DC OUTPUT

This option provides a voltage (terminals 3A3B only) or mA output. Terminal location is shown in figure 2.2.

CAUTION

There are no mechanical interlocks to prevent a chassis with the dc output option being fitted into a 'sleeve' or 'case' which has previously been wired for the standard relay output. Before fitting the chassis into the case, it should be ensured that the terminal wiring is not attached to live voltage supplies, as such voltages may cause permanent damage to the instrument.

4.12.1 Configuration display

As shown in the figure below, highlight the required DC output, then operate the scroll button to reveal the configuration page.

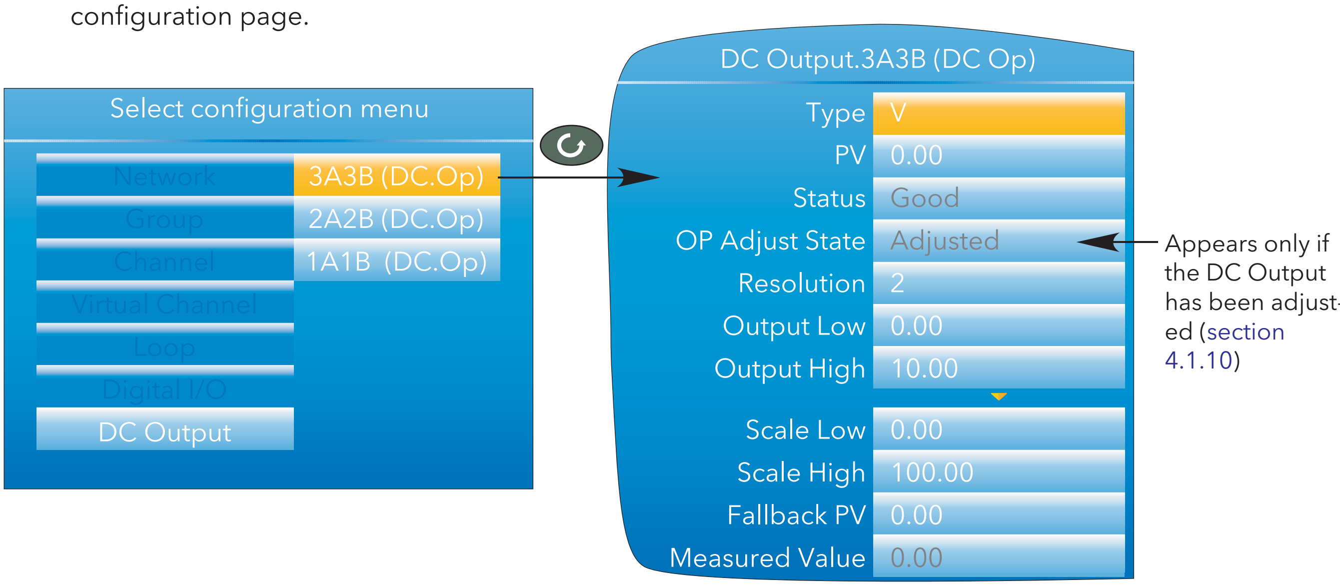


Figure 4.12.1 DC Output option configuration page (typical)

PARAMETERS

Type	Select V(olts) (3A3B only) or mA as the output type.
PV	Input value to the function. Normally 'wired' to a suitable parameter.
Status	The status of the input parameter.
OP Adjust State	Adjusted. Appears only if the Output Adjust facility (section 4.1.10) has been used.
Resolution	The number of decimal places to be used for this configuration item.
Output Low	The minimum output value in Volts or mA as appropriate
Output High	The maximum output value to be output in Volts or mA as appropriate.
Scale Low	See 'SCALING INFORMATION' below.
Scale High	See 'SCALING INFORMATION' below.
Fallback PV	The output value when the status of the input parameter is not 'good'.
Measured Value	The Voltage or mA value appearing at the output terminals

Note: The output voltage or current can be calibrated by using the output adjust procedure described in section 4.1.10.

SCALING INFORMATION

When PV = Scale Low, Output = output low value. When PV = Scale high, Output = output high value. The PV is mapped via the scale range onto the output range according to the equation:

$$\text{Output} = \left(\frac{\text{PV - Scale Low}}{\text{Scale High - Scale Low}}\right)(\text{Output High} - \text{Output Low}) + \text{Output Low}$$

4.13 USER LIN

Allows the entry of up to four user linearisation tables, any one of which can be selected as 'Lin Type' in Channel configuration (section 4.4.1). Configuration consists of defining the number of points to be included (2 to 32) and then entering an X and a Y value for each point, where X values are the inputs and the Y values are the resulting outputs.

4.13.1 User linearisation table rules

1. Tables must be monotonic - i.e. there may not be more than one X value with the same Y value assigned to it.
2 Each X value must be greater than the preceding one.
3. Each Y value must be greater than the preceding one.
4. If units other than temperature units are to be displayed, the channel scale high and scale low values should be set to the same as the range high and low values, and the required scale units entered.

Figure 4.13.1 shows the first part of the configuration table for an imaginary cylinder example.

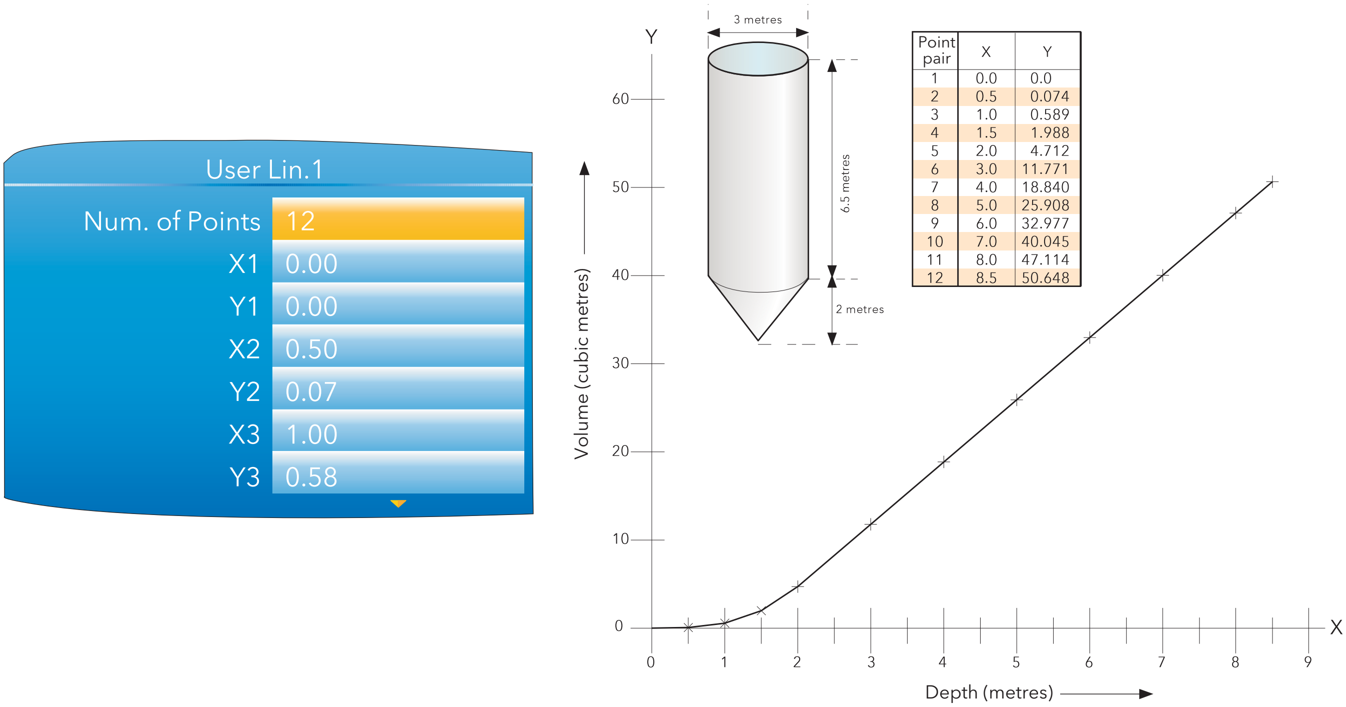


Figure 4.13.1 User Linearisation table example

When configuring a channel (section 4.4.1) to use a User linearisation table:

If Type = Thermocouple or RTD, then Range High/Low must be set to the highest and lowest 'Y' values to be used, respectively. The instrument automatically looks up the associated 'X' mV or Ohms values.

If Type = mV, V or mA, then Range High/Low must be set to the highest and lowest 'Y' values to be used, respectively. Input High/Low should be set to the highest and lowest 'X' values in the table, respectively.

4.14 CUSTOM MESSAGES

This feature allows the entry of up to 10 messages for sending to the history file, when triggered by a wired source (e.g. an alarm going active).

The messages of up to 100 characters each are entered using either the virtual keyboard, described in section 3.6, or by means of iTools configuration software.

Up to three parameter values may be embedded in messages in the format [Address], where 'Address' is the decimal Modbus address of the parameter (section5.3). E.G. [256] embeds Channel 1 PV.

4.15 ZIRCONIA BLOCK OPTION

This option allows the calculation of Carbon Potential, Dew point or Oxygen concentration. A zirconia (oxygen) probe consists of two platinum electrodes bonded to a pellet or cylinder of zirconia. At elevated temperatures, such a probe develops an emf across it which is proportional to the probe absolute temperature and to the log of the difference in oxygen partial pressure between its two ends.

The temperature of the probe is normally measured using a type K or type R thermocouple. The temperature effect on the thermocouple is such, that for successful operation, the probe temperature must be greater than 973K (700˚C).

4.15.1 Definitions

TEMPERATURE CONTROL

The sensor input of the temperature loop may come from the zirconia probe but it is common for a separate thermocouple to be used. The controller provides a heating output which may be used to control gas burners. In some applications a cooling output may also be connected to a circulation fan or exhaust damper.

CARBON POTENTIAL CONTROL

The zirconia probe generates a millivolt signal based on the ratio of oxygen concentrations on the reference side of the probe (outside the furnace) to the amount of oxygen in the furnace.

The controller uses the temperature and carbon potential signals to calculate the actual percentage of carbon in the furnace. This second loop generally has two outputs. One output is connected to a valve which controls the amount of an enrichment gas supplied to the furnace. The second output controls the level of dilution air.

SOOTING ALARM

In addition to other alarms which may be detected by the controller, the instrument can trigger an alarm when the atmospheric conditions are such that carbon will be deposited as soot on all surfaces inside the furnace. The alarm may be wired to an output (e.g. relay) to initiate an external alarm.

AUTOMATIC PROBE CLEANING

The instrument has a probe clean and recovery strategy that can be programmed to occur between batches or be manually requested. At the start of the cleaning process a ‘snapshot’ of the probe mV is taken, and a short blast of compressed air is used to remove any soot and other particles that may have accumulated on the probe. A minimum and maximum cleaning time can be set by the user. If the probe mV has not recovered to within 5% of the snapshot value within the maximum recovery time set then an alarm is given. This indicates that the probe is ageing and replacement or refurbishment is due. During the cleaning and recovery cycle the PV is frozen, thereby ensuring continuous furnace operation. The ‘Pv Frozen’ parameter can be used in an individual strategy, for example to hold the integral action during cleaning.

ENDOTHERMIC GAS CORRECTION

A gas analyser may be used to determine the carbon monoxide (CO) concentration of the endothermic gas. If a 4 to 20mA output is available from the analyser, this can be applied to the instrument to adjust the calculated % carbon reading automatically. Alternatively, this value can be entered manually.

CLEAN PROBE

As these sensors are used in furnace environments they require regular cleaning. Cleaning (Burn Off) is performed by forcing compressed air through the probe. Cleaning can be initiated either manually or automatically using a timed period. During cleaning ‘PV Frozen’ is set to ‘Yes’.

OXYGEN CONCENTRATION

In order to measure oxygen concentrations, one end of the probe is inserted into the atmosphere to be measured, whilst the other is subjected to a reference atmosphere. For most applications, air provides a suitable reference (reference input = 20.95 for air).

4.15.2 Configuration

The configuration parameters appear in one of three lists as shown in Figure 4.15.2a.

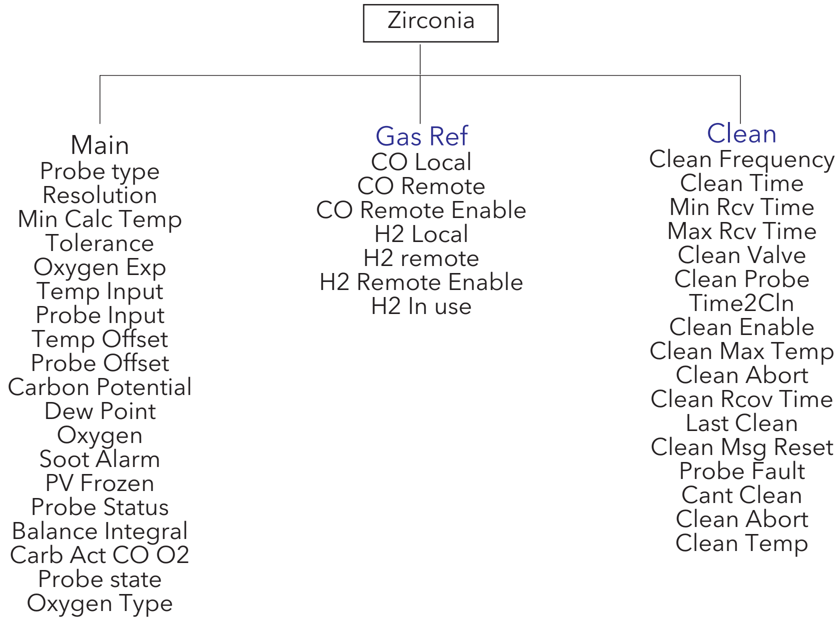


Figure 4.15.2a Zirconia probe configuration layout.

ZIRCONIA MAIN

The parameters that appear depend on the 'Probe Type' setting. For this reason, not all the parameters listed appear for all probe types. Figure 4.15.2b shows a typical configuration page.

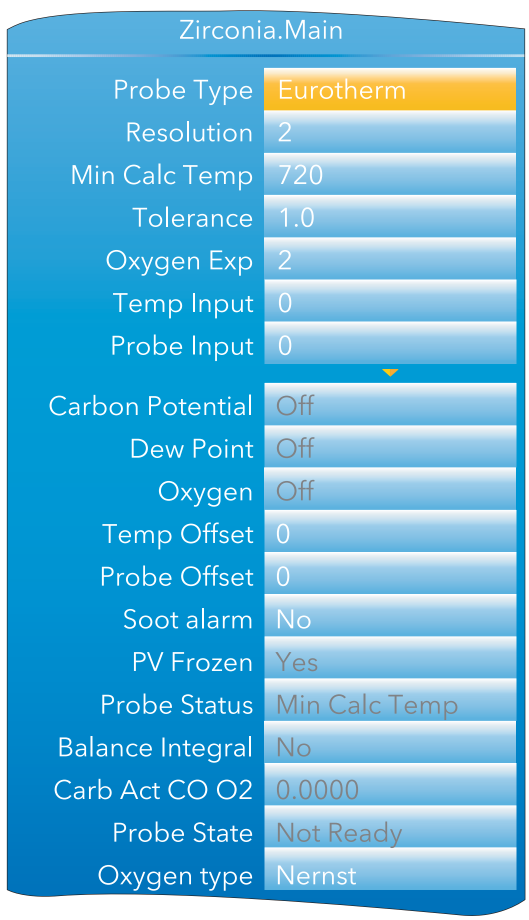


Figure 4.15.2b Zirconia Probe configuration (typical)

4.15.2 CONFIGURATION (Cont.)

MAIN PARAMETERS

Probe Type	Select from a variety of probe manufacturers. The subsequent parameter list depends on which manufacturer is selected.
Resolution	Enter the number of decimal places to be used for the value display
Gas Reference	Reference value for the hydrogen concentration in the atmosphere.
Rem Gas Ref	Remote reference value for hydrogen concentration in the atmosphere. Allows hydrogen concentration to be read from an external source.
Rem Gas Enable	'Yes' allows remote gas measurement. 'No' uses the internal Gas Reference value.
Working Gas	Read only. Working Reference Gas value
Min Calc Temp*	The minimum temperature in at which the calculation is valid.
Oxygen Exp	The exponent units of the log oxygen type calculation. valid entries -24 to +24.
Tolerance	Sooting tolerance multiplier. Allows the user to adjust the sensitivity of the Sooting alarm, in order to reduce the incidence of nuisance alarms.
Process Factor	Process factor defined by the probe manufacturer.
Clean Frequency	Allows the interval between probe cleaning cycles to be entered in hours and minutes.
Clean Time	Allows Probe clean time to be entered in hours and minutes.
Min Rcov Time	The minimum recovery time after purging in hours and minutes.
Max Rcov Time	The maximum recovery time after purging in hours and minutes.
Temp Input*	Zirconia probe temperature input value
Temp Offset*	Allows a temperature offset to be entered for the probe.
Probe Input	Zirconia probe mV input
Probe mV Offset	Allows an offset to be entered for the probe mV input
Oxygen	Read only. calculated oxygen value
Carbon Potential	Read only. The calculated carbon potential.
Dew Point	Read only. The dew point value derived from temperature and remote gas reference inputs.
Soot Alarm	Read only. Sooting alarm. Active if sooting is likely to take place. The sensitivity of the alarm can be adjusted by using the 'Tolerance' parameter, above.
Probe Fault	'Yes' indicates a sensor break.
PV Frozen	Read only. Parameter set to 'Yes' during Probe cleaning.
Clean Valve	Read only. Enable the Clean valve.
Clean State	Read only. The burn off state of the zirconia probe: 'Waiting', 'Cleaning' or 'Recovering'.Clean Probe'Yes' = Initiate probe cleaning. 'No' = Do not clean probe.
Time to Clean	Read only. The time remaining, in hours and minutes until the next cleaning cycle is due.
Probe Status	Read only. Current probe status OK — Normal working mV Sensor Brk — Probe input sensor break Temp Sensor Brk — Temperature input sensor break Min Calc Temp — Probe deteriorating
Balance Integral	This output goes 'true' when a step change in the output occurs, which requires an integral re-balance if the readings are used for PID control.
Carb Act CO O2	The carbon activity for the surface gas reaction between Carbon monoxide (CO) and Oxygen (O2)
Probe State	Read only. The current state of the probe. If 'Measuring', then the outputs are updated. For any other state (Clean, Clean Recovery, Test impedance, Impedance Recovery, Waiting), the outputs are not updated.
Oxygen Type	Oxygen equation being used.

* Temperature units are those configured for the channel to which the temperature measuring transducer is connected.

4.15.2 CONFIGURATION (Cont.)

GAS REFERENCES PARAMETERS

CO Local	Reference value for the carbon monoxide (CO) concentration in the atmosphere.
CO Remote	Remote reference value for the carbon monoxide concentration in the atmosphere. allows the value to be read remotely.
CO Remote En	'Yes' allows remote CO measurement. 'No' uses the internal value.
CO in Use	The CO gas measurement value currently being used.
H2 Local	Reference value for the hydrogen (H) concentration in the atmosphere.
H2 Remote	Remote reference value for the hydrogen concentration in the atmosphere. allows the value to be read remotely.
H2 Remote En	'Yes' allows remote H measurement. 'No' uses the internal value.
H2 In Use	The H gas measurement value currently being used.

CLEAN PARAMETERS

Clean Frequency	Allows the interval between probe cleaning cycles to be entered in hours and minutes.
Clean Time	Allows Probe clean time to be entered in hours and minutes.
Min Rcov Time	The minimum recovery time after purging in hours and minutes.
Max Rcov time	The maximum recovery time after purging in hours and minutes.
Clean Valve	Read only. Enable the Clean valve.
Clean Probe	Initiate probe cleaning
Time to Clean	Read only. The time remaining, in hours and minutes until the next cleaning cycle is due.
Clean Enable	Enable probe cleaning
Clean Max Temp	Maximum temperature for cleaning. If the temperature exceeds this value, cleaning is aborted.
Clean Abort	Abort probe cleaning
Clean Rcov Time	The time taken for the probe to recover to 95% of its original value after the last clean. If the last clean did not recover within the Max Rcov time, this value is set to 0.
Last Clean	The mV output from the probe after the last clean.
Clean Msg Reset	'Yes' clears cleaning related alarms
Probe Fault	'Yes' means that the probe failed to recover to 95% of its original output, following a clean,
Cant Clean	Conditions exist which prevent a clean cycle starting. Can be cleared using 'Clean Msg Reset'.
Clean Abort	A clean cycle was aborted. Can be cleared using 'Clean Msg Reset'.
Clean Temp	A clean cycle was aborted because the temperature was too high. Can be cleared using 'Clean Msg Reset'.

4.15.3 Wiring

Figure 4.15.3 shows a typical wiring arrangement for a Zirconia probe.

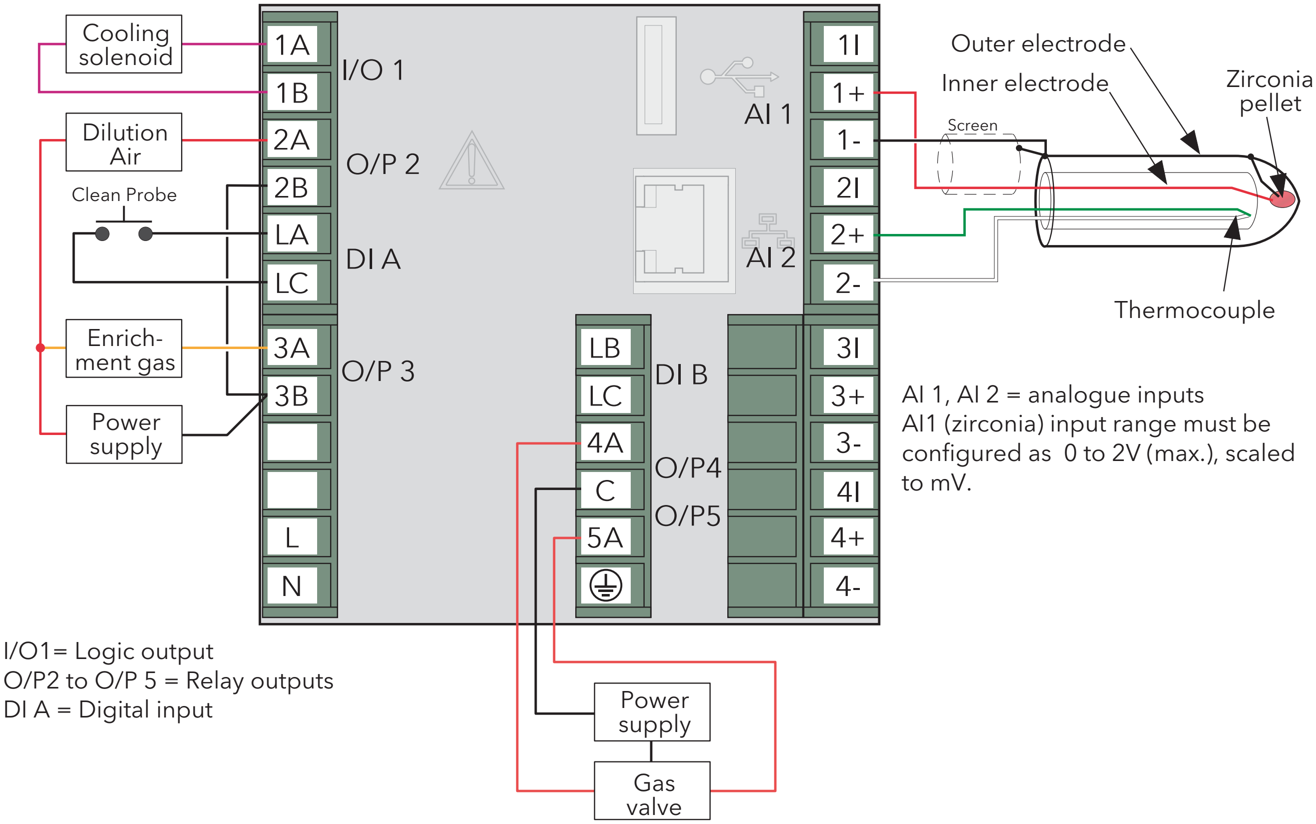


Figure 4.15.3 Typical zirconia probe wiring

4.16 STERILISER OPTION

This block provides a means of recording complete sterilisation cycles, including for example, venting and pumping as well as the actual sterilising period. See section 3.4.10 for display mode details.

Data is stored in .uhh history files for viewing in Review software.

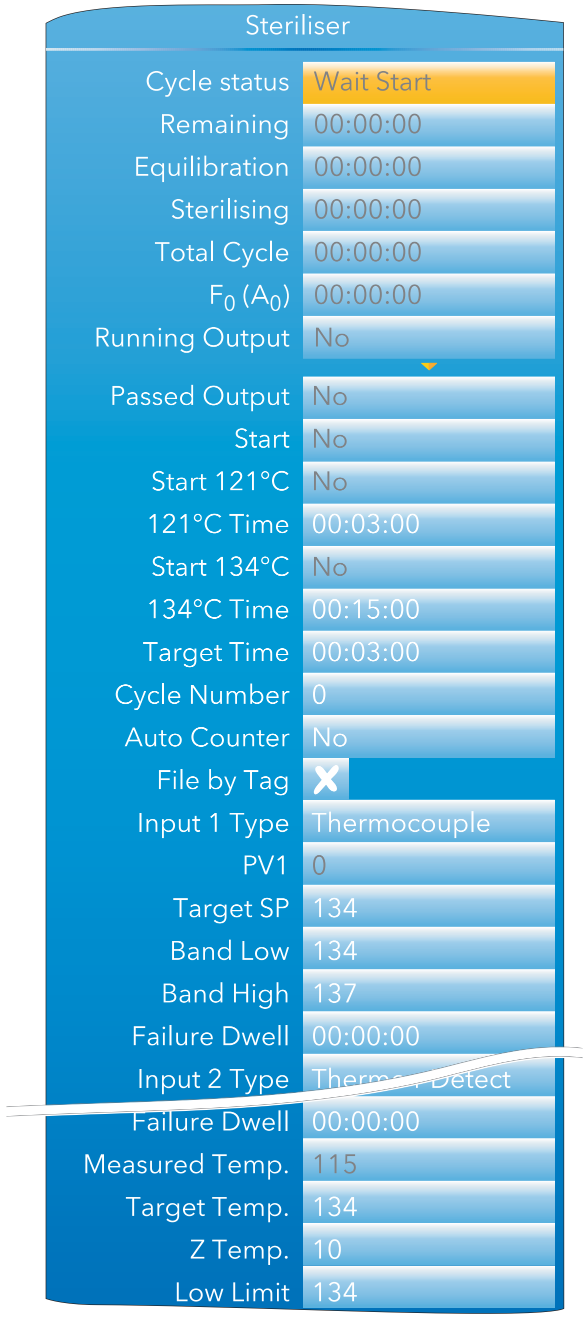


Figure 4.16 Steriliser block configuration menu

4.16.1 Configuration parameters

Cycle Status

Wait start: The cycle is waiting to be started
Waiting: Waiting for input 1 to reach its target setpoint.
Equilibration: Currently in the equilibration period
Sterilising: Currently in the sterilising phase
Passed: The cycle has completed successfully
Failed: The cycle has failed
Test cycle: A test cycle is in progress

4.16.1 CONFIGURATION PARAMETERS (Cont.)

Remaining	The sterilising time remaining for the current cycle
Equilibration	The equilibration time period for the current cycle
Sterilising	The time for which the load has currently been at sterilisation conditions
Total Cycle	The total cycle time
F_0 (A_0)	The current F_0, F_H or A_0 value
Running Output	'Yes' = Cycle running; 'No' = Cycle not running
Passed Output	'Yes' = Output passed; 'No' = Output did not pass
Start	Trigger to start a custom cycle (i.e. one for which High and Low band and / or Target setpoint have been changed from their default values.)
Start 121°C	Trigger to start a pre-defined 121°C cycle (Setpoint, Band Low/Band High etc. values are set to their 121° defaults when the cycle is initiated).
121°C Time	Target time for a121°C cycle. Automatically copied to the 'Target Time' field when Start 121°C requested. Scrollable value in hh:mm:ss format.
Start 134°C	Trigger to start a pre-defined 134°C cycle (Setpoint, Band Low/Band High etc. values are set to their 134° defaults when the cycle is initiated)
134°C Time	Target time for a134°C cycle. Automatically copied to the 'Target Time' field when Start 134°C requested. Scrollable value in hh:mm:ss format.
Target Time	The time for which the input values must remain at their sterilisation values in order that the cycle shall pass. The cycle fails if any input moves outside its specified band limits during the Target Time. Scrollable value in hh:mm:ss format.
Cycle Number	Each execution of the Steriliser block uses a unique cycle number. This may be entered manually, or can be set to increment automatically by setting 'Auto Counter' (below) to 'Yes'.
Auto Counter	'Yes' causes the Cycle Number (above) to increment automatically each time a new cycle is initiated. If Auto counter = 'Yes', the Cycle Number forms part of the historical data and can be used to help identify data during later review.
File By Tag	'Tick' ensures that each cycle is recorded in its own unique history file identified by cycle number and 'File tag' (below).
File tag	This field appears only if 'File By Tag' is enabled (tick symbol). File tag allows a four-character identifier to be entered to be used with the Cycle Number (above) to identify the history file
Input n Type	Select 'Off', 'Thermocouple', 'Rising Pressure', 'Falling pressure', 'Rise Air Detect', or 'Fall Air Detect'.

Off	This input will not be included in steriliser monitoring calculations
Thermocouple	Degrees Celsius input
Rising pressure	A mBar pressure input with a rising pressure expected during the cycle. This pressure input would normally be synchronised with a temperature input, in the same chamber, when performing a 121°C or 134°C cycle.
Falling pressure	As 'Rising Pressure' above, but with a falling pressure expected during the cycle
Rise Air Detect	A mBar pressure input with a rising pressure expected during the cycle. This pressure input is not synchronised with a temperature input when performing a 121°C or 134°C cycle, as it is (typically) an outside chamber pressure.
Fall Air Detect	As 'Rise Air Detect' above, but with a falling pressure expected during the cycle

PV n	Input value (wireable only). See note 1 below.
Target SP	Target setpoint for this input. (Does not appear if relevant Input Type = 'Off'.) See note 2 below.
Band Low/High	The low and high steriliser temperature or pressure band for this input. (Does not appear if relevant Input Type = 'Off'.) See note 2 below. Values are effective only during Sterilisation mode.

4.16.1 CONFIGURATION PARAMETERS (Cont.)

Failure Dwell — A failure alarm is set if this input is out of band range for more than the Failure Dwell time. Scrollable value in hh:mm:ss format.

Notes
1. n = 1 to 4, where typically, inputs 1 to 3 are temperature inputs and input 4 is a pressure input.
2. Target SP and Band High/Low values are set to their relevant default values when a 121°C or 134°C cycle is initiated.

Measured Temp. — For F_0 or A_0 calculations, this value must be in °C. Typically wired to an input channel PV .

Target Temp. — For F_0 or A_0 calculations, the target temperature (see section 3.4.10 for details). This typically is the same value as the Target SP (above).

Z Temp. — For F_0 or A_0 calculations this is a temperature interval representing a factor-of-10 increase in killing efficiency. Z = 10°C for F_0 and A_0, and 20°C for F_H

Low Limit — The temperature below which F_0 or A_0 calculations are suspended.

4.17 HUMIDITY BLOCK OPTION

This block uses wet and dry bulb temperatures, and atmospheric pressure inputs to derive values for relative humidity and dew point.

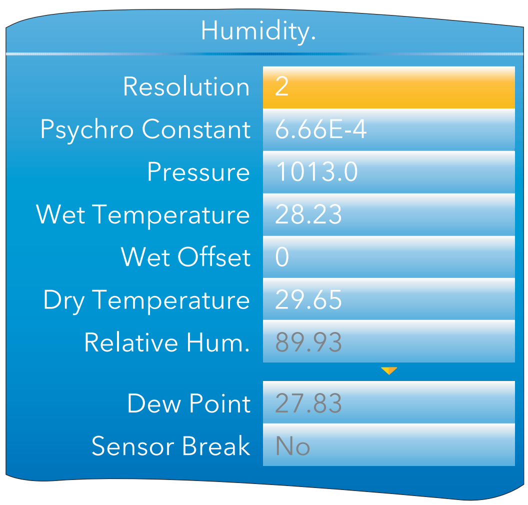


Figure 4.17 Humidity calculation configuration

4.17.1 Configuration parameters

Resolution — The number of decimal places for the Relative humidity and Dew point displays.

Psychro constant — The psychrometric constant (default = 6.66×10^{-4}) (See note below).

Pressure — The current atmospheric pressure in mBar.

Wet Temperature — The wet bulb thermometer temperature.

Wet Offset — Offset for the wet bulb temperature.

Dry Temperature — The dry bulb thermometer temperature.

Relative Hum. — The relative humidity value calculated from the Wet temperature, the Dry temperature and the Pressure inputs. The number of decimal places depends on the Resolution setting.

Dew Point — The dew point value calculated from the Wet temperature, the Dry temperature and the Pressure inputs. The number of decimal places depends on the Resolution setting.

Sensor Break — ‘Yes’ implies that a break has occurred between one (or more) of the temperature or pressure transducer and its input.

Note: The default value 6.66 may be edited, but the multiplier is always 10^{-4} (i.e. it cannot be edited).

4.18 BCD INPUT

Part of the 'Toolkit Blocks' option, this block derives decimal and two-decade binary coded decimal (BCD) values from eight discrete inputs, where input 1 is the least significant input ($2^0 = 1$) and input 8 is the most significant ($2^7 = 128$). The example below shows that for inputs 2, 4, 6 and 8 high, the decimal input value is 170, but the BCD value is invalid. In any such case, the maximum BCD value for each decade is limited to 9.

Input number	8	7	6	5	4	3	2	1	
Input status	1	0	1	0	1	0	1	0	
Decimal input	128	0	32	0	8	0	2	0	(=170)
BCD output	1	0	1	0	1	0	1	0	(=10, 10)

Figure 4.18 BCD block example

4.18.1 Input rules

Valid BCD outputs are produced only with the following inputs set:

1. Any combination of inputs 1, 2, 3, 5, 6 and 7
2. Any combination of Inputs 1, 4, 5 and 8

4.18.2 Configuration

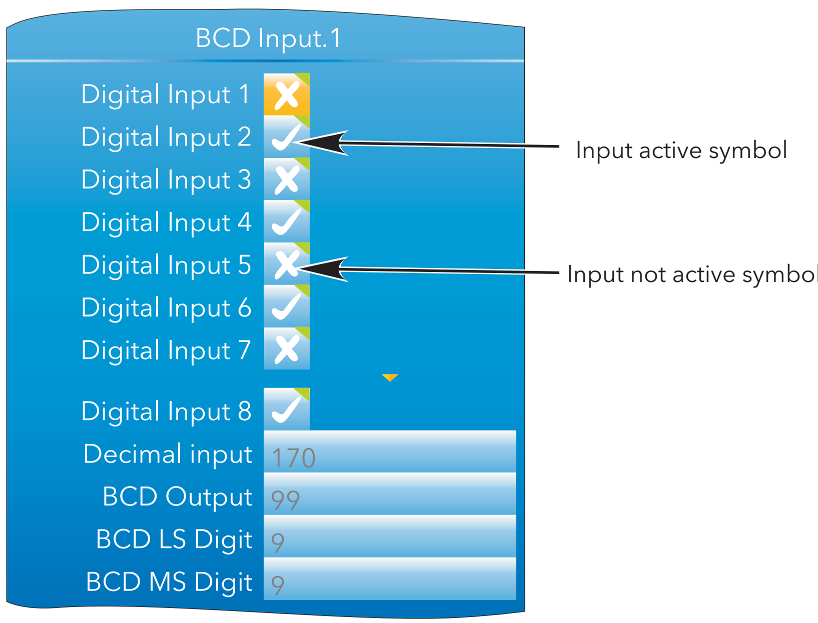


Figure 4.18.2 BCD block configuration

PARAMETERS

Digital Input N	Digital inputs, wired (for example) to contact inputs at the rear panel or to other suitable parameter outputs.
Decimal input	The value defined by the active inputs, where input 1 = 1, when active, input 2 = 2, input 3 = 4, input 4 = 8 and so on.
BCD Output	A two digit output being the binary coded decimal version of the input.
BCD LS Digit	This least significant (right-most) digit represents the value of inputs 1 to 4, where input 1 = 1, input 2 = 2, input 3 = 4, input 4 = 8. Maximum value = 9, even if input is greater than 9.
BCD MS Digit	This most significant (left-most) digit represents the value of inputs 5 to 8, where input 5 = 1, input 6 = 2, input 7 = 4, input 8 = 8. Maximum value = 9, even if input is greater than 9.

4.19 LOGIC (2 INPUT) BLOCK

Part of the 'Toolkit Blocks' option, this block allows a number of logic and comparison operations to be performed on a pair of inputs. For logic functions, the inputs can be inverted to allow, for example, a NOR function to be implemented by inverting the inputs to an AND function. 12 two-input logic blocks are available.

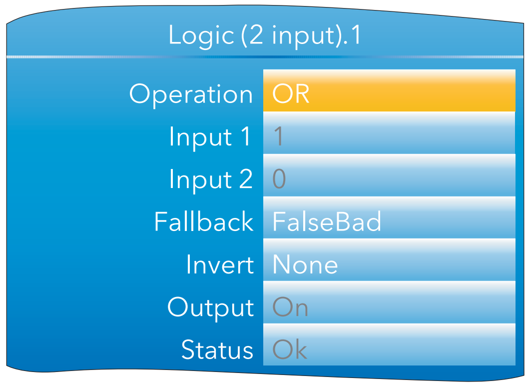


Figure 4.19 Two-input logic block configuration

4.19.1 Parameters

Operation	AND, OR, XOR, LATCH (boolean values only) == (Input 1 = Input 2) <> (Input 1 ≠ Input 2) < (Input 1 < Input 2} <= (Input 1 ≤ Input 2) > (Input 1 > Input 2) => (Input 1 ≥ Input 2)
Input 1(2)	The inputs to the specified operation. For inverted inputs (below), this shows the 'real' (non-inverted) state.
Fallback	Configures the output and status values to be used if either input has a status other than 'Good'. FalseBad: Output = False; Status = Bad TrueBad: Output = True; Status = Bad FalseGood: Output = False; Status = Good TrueGood: Output = True; Status = Good
Invert	For logic operators only allows neither, either or both inputs to be inverted. Input 1 and Input 2 show the non-inverted state.
Output	On or Off depending on input states etc.
Status	The status of the result ('Ok' or 'Error').

4.20 LOGIC (8 INPUT) BLOCK

Part of the 'Toolkit Blocks' option, this block allows AND, OR and cascading* XOR logic operations to be carried out on up to eight inputs.

*Cascading XOR example for inputs 1 to 4: (((Input1 ⊕ Input2) ⊕ Input3) ⊕ Input4).

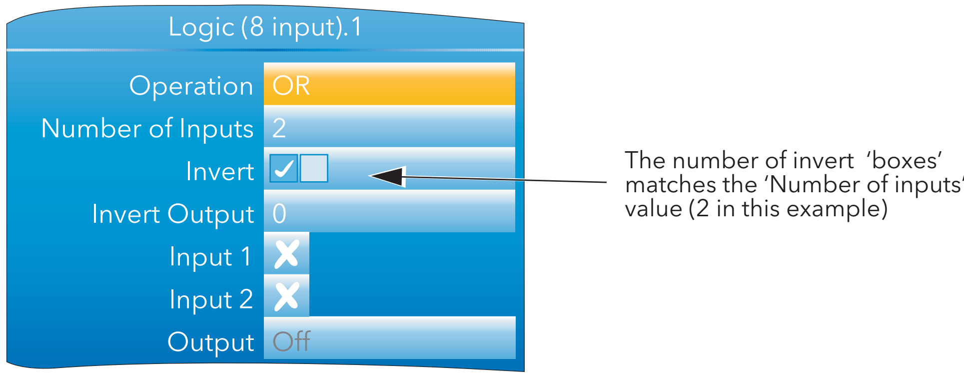


Figure 4.20 Eight input logic block configuration

4.20.1 Parameters

Operation	AND, OR or XOR
Number of inputs	The number of inputs to the logic operator
Invert	Allows the user to invert individual inputs, as described below.
Invert Output	'Yes' inverts the output status
Input 1	The status of input 1, ignoring the Invert status. Cross = off; Tick = on.
Inputs 2 to N	As for input 1, where N = the value of the 'Number of Inputs' parameter.
Output	On or Off. Includes the effect of 'Invert Output' status.

INPUT INVERSION

1. Use the down arrow key to highlight the 'Invert' field and operate the scroll key to enter edit mode
2. Use the up arrow key to highlight the first input to be inverted (the relevant input numbers appear in the display boxes for uninverted inputs when highlighted).
3. Once the required input box is highlighted, use the scroll key to change the numeric character to a tick symbol (to invert) or change the tick character to a numeric character (to remove a previous inversion).
4. Repeat for any further inputs, then operate the page key to confirm the changes and to quit edit mode.

4.20.2 Schematic

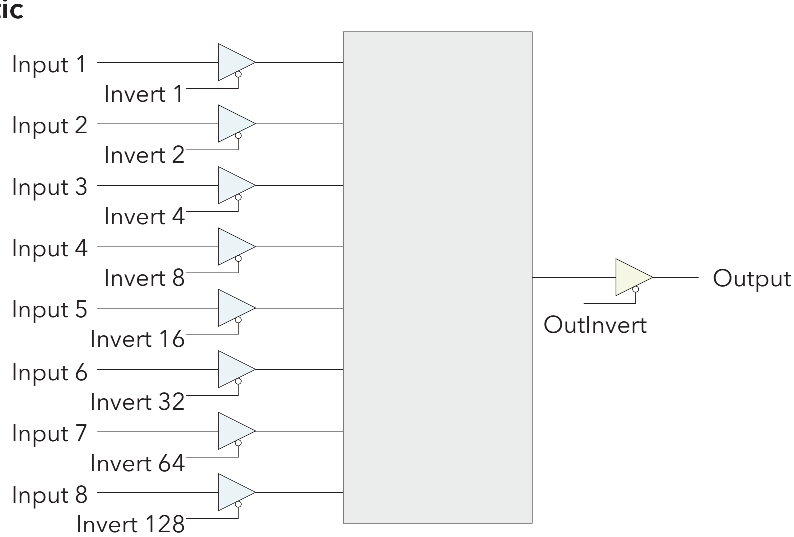


Figure 4.20.2 Logic (8 input) block schematic

4.20.3 Invert input decoding table

Over a communications link, the inversion status is transmitted as a decimal value, which can be encoded/ decoded using the following table

Input 8 7 6 5 4 3 2 1	Hex	Dec	Input 8 7 6 5 4 3 2 1	Hex	Dec	Input 8 7 6 5 4 3 2 1	Hex	Dec	Input 8 7 6 5 4 3 2 1	Hex	Dec
N N N N N N N N	00	0	N 7 N N N N N N	40	64	8 N N N N N N N	80	128	8 7 N N N N N N	C0	192
N N N N N N N 1	01	1	N 7 N N N N N 1	41	65	8 N N N N N N 1	81	129	8 7 N N N N N 1	C1	193
N N N N N N 2 N	02	2	N 7 N N N N 2 N	42	66	8 N N N N N 2 N	82	130	8 7 N N N N 2 N	C2	194
N N N N N N 2 1	03	3	N 7 N N N N 2 1	43	67	8 N N N N N 2 1	83	131	8 7 N N N N 2 1	C3	195
N N N N N 3 N N	04	4	N 7 N N N 3 N N	44	68	8 N N N N 3 N N	84	132	8 7 N N N 3 N N	C4	196
N N N N N 3 N 1	05	5	N 7 N N N 3 N 1	45	69	8 N N N N 3 N 1	85	133	8 7 N N N 3 N 1	C5	197
N N N N N 3 2 N	06	6	N 7 N N N 3 2 N	46	70	8 N N N N 3 2 N	86	134	8 7 N N N 3 2 N	C6	198
N N N N N 3 2 1	07	7	N 7 N N N 3 2 1	47	71	8 N N N N 3 2 1	87	135	8 7 N N N 3 2 1	C7	199
N N N N 4 N N N	08	8	N 7 N N 4 N N N	48	72	8 N N N 4 N N N	88	136	8 7 N N 4 N N N	C8	200
N N N N 4 N N 1	09	9	N 7 N N 4 N N 1	49	73	8 N N N 4 N N 1	89	137	8 7 N N 4 N N 1	C9	201
N N N N 4 N 2 N	0A	10	N 7 N N 4 N 2 N	4A	74	8 N N N 4 N 2 N	8A	138	8 7 N N 4 N 2 N	CA	202
N N N N 4 N 2 1	0B	11	N 7 N N 4 N 2 1	4B	75	8 N N N 4 N 2 1	8B	139	8 7 N N 4 N 2 1	CB	203
N N N N 4 3 N N	0C	12	N 7 N N 4 3 N N	4C	76	8 N N N 4 3 N N	8C	140	8 7 N N 4 3 N N	CC	204
N N N N 4 3 N 1	0D	13	N 7 N N 4 3 N 1	4D	77	8 N N N 4 3 N 1	8D	141	8 7 N N 4 3 N 1	CD	205
N N N N 4 3 2 N	0E	14	N 7 N N 4 3 2 N	4E	78	8 N N N 4 3 2 N	8E	142	8 7 N N 4 3 2 N	CE	206
N N N N 4 3 2 1	0F	15	N 7 N N 4 3 2 1	4F	79	8 N N N 4 3 2 1	8F	143	8 7 N N 4 3 2 1	CF	207
N N N 5 N N N N	10	16	N 7 N 5 N N N N	50	80	8 N N 5 N N N N	90	144	8 7 N 5 N N N N	D0	208
N N N 5 N N N 1	11	17	N 7 N 5 N N N 1	51	81	8 N N 5 N N N 1	91	145	8 7 N 5 N N N 1	D1	209
N N N 5 N N 2 N	12	18	N 7 N 5 N N 2 N	52	82	8 N N 5 N N 2 N	92	146	8 7 N 5 N N 2 N	D2	210
N N N 5 N N 2 1	13	19	N 7 N 5 N N 2 1	53	83	8 N N 5 N N 2 1	93	147	8 7 N 5 N N 2 1	D3	211
N N N 5 N 3 N N	14	20	N 7 N 5 N 3 N N	54	84	8 N N 5 N 3 N N	94	148	8 7 N 5 N 3 N N	D4	212
N N N 5 N 3 N 1	15	21	N 7 N 5 N 3 N 1	55	85	8 N N 5 N 3 N 1	95	149	8 7 N 5 N 3 N 1	D5	213
N N N 5 N 3 2 N	16	22	N 7 N 5 N 3 2 N	56	86	8 N N 5 N 3 2 N	96	150	8 7 N 5 N 3 2 N	D6	214
N N N 5 N 3 2 1	17	23	N 7 N 5 N 3 2 1	57	87	8 N N 5 N 3 2 1	97	151	8 7 N 5 N 3 2 1	D7	215
N N N 5 4 N N N	18	24	N 7 N 5 4 N N N	58	88	8 N N 5 4 N N N	98	152	8 7 N 5 4 N N N	D8	216
N N N 5 4 N N 1	19	25	N 7 N 5 4 N N 1	59	89	8 N N 5 4 N N 1	99	153	8 7 N 5 4 N N 1	D9	217
N N N 5 4 N 2 N	1A	26	N 7 N 5 4 N 2 N	5A	90	8 N N 5 4 N 2 N	9A	154	8 7 N 5 4 N 2 N	DA	218
N N N 5 4 N 2 1	1B	27	N 7 N 5 4 N 2 1	5B	91	8 N N 5 4 N 2 1	9B	155	8 7 N 5 4 N 2 1	DB	219
N N N 5 4 3 N N	1C	28	N 7 N 5 4 3 N N	5C	92	8 N N 5 4 3 N N	9C	156	8 7 N 5 4 3 N N	DC	220
N N N 5 4 3 N 1	1D	29	N 7 N 5 4 3 N 1	5D	93	8 N N 5 4 3 N 1	9D	157	8 7 N 5 4 3 N 1	DD	221
N N N 5 4 3 2 N	1E	30	N 7 N 5 4 3 2 N	5E	94	8 N N 5 4 3 2 N	9E	158	8 7 N 5 4 3 2 N	DE	222
N N N 5 4 3 2 1	1F	31	N 7 N 5 4 3 2 1	5F	95	8 N N 5 4 3 2 1	9F	159	8 7 N 5 4 3 2 1	DF	223
N N 6 N N N N N	20	32	N 7 6 N N N N N	60	96	8 N 6 N N N N N	A0	160	8 7 6 N N N N N	E0	224
N N 6 N N N N 1	21	33	N 7 6 N N N N 1	61	97	8 N 6 N N N N 1	A1	161	8 7 6 N N N N 1	E1	225
N N 6 N N N 2 N	22	34	N 7 6 N N N 2 N	62	98	8 N 6 N N N 2 N	A2	162	8 7 6 N N N 2 N	E2	226
N N 6 N N N 2 1	23	35	N 7 6 N N N 2 1	63	99	8 N 6 N N N 2 1	A3	163	8 7 6 N N N 2 1	E3	227
N N 6 N N 3 N N	24	36	N 7 6 N N 3 N N	64	100	8 N 6 N N 3 N N	A4	164	8 7 6 N N 3 N N	E4	228
N N 6 N N 3 N 1	25	37	N 7 6 N N 3 N 1	65	101	8 N 6 N N 3 N 1	A5	165	8 7 6 N N 3 N 1	E5	229
N N 6 N N 3 2 N	26	38	N 7 6 N N 3 2 N	66	102	8 N 6 N N 3 2 N	A6	166	8 7 6 N N 3 2 N	E6	230
N N 6 N N 3 2 1	27	39	N 7 6 N N 3 2 1	67	103	8 N 6 N N 3 2 1	A7	167	8 7 6 N N 3 2 1	E7	231
N N 6 N 4 N N N	28	40	N 7 6 N 4 N N N	68	104	8 N 6 N 4 N N N	A8	168	8 7 6 N 4 N N N	E8	232
N N 6 N 4 N N 1	29	41	N 7 6 N 4 N N 1	69	105	8 N 6 N 4 N N 1	A9	169	8 7 6 N 4 N N 1	E9	233
N N 6 N 4 N 2 N	2A	42	N 7 6 N 4 N 2 N	6A	106	8 N 6 N 4 N 2 N	AA	170	8 7 6 N 4 N 2 N	EA	234
N N 6 N 4 N 2 1	2B	43	N 7 6 N 4 N 2 1	6B	107	8 N 6 N 4 N 2 1	AB	171	8 7 6 N 4 N 2 1	EB	235
N N 6 N 4 3 N N	2C	44	N 7 6 N 4 3 N N	6C	108	8 N 6 N 4 3 N N	AC	172	8 7 6 N 4 3 N N	EC	236
N N 6 N 4 3 N 1	2D	45	N 7 6 N 4 3 N 1	6D	109	8 N 6 N 4 3 N 1	AD	173	8 7 6 N 4 3 N 1	ED	237
N N 6 N 4 3 2 N	2E	46	N 7 6 N 4 3 2 N	6E	110	8 N 6 N 4 3 2 N	AE	174	8 7 6 N 4 3 2 N	EE	238
N N 6 N 4 3 2 1	2F	47	N 7 6 N 4 3 2 1	6F	111	8 N 6 N 4 3 2 1	AF	175	8 7 6 N 4 3 2 1	EF	239
N N 6 5 N N N N	30	48	N 7 6 5 N N N N	70	112	8 N 6 5 N N N N	B0	176	8 7 6 5 N N N N	F0	240
N N 6 5 N N N 1	31	49	N 7 6 5 N N N 1	71	113	8 N 6 5 N N N 1	B1	177	8 7 6 5 N N N 1	F1	241
N N 6 5 N N 2 N	32	50	N 7 6 5 N N 2 N	72	114	8 N 6 5 N N 2 N	B2	178	8 7 6 5 N N 2 N	F2	242
N N 6 5 N N 2 1	33	51	N 7 6 5 N N 2 1	73	115	8 N 6 5 N N 2 1	B3	179	8 7 6 5 N N 2 1	F3	243
N N 6 5 N 3 N N	34	52	N 7 6 5 N 3 N N	74	116	8 N 6 5 N 3 N N	B4	180	8 7 6 5 N 3 N N	F4	244
N N 6 5 N 3 N 1	35	53	N 7 6 5 N 3 N 1	75	117	8 N 6 5 N 3 N 1	B5	181	8 7 6 5 N 3 N 1	F5	245
N N 6 5 N 3 2 N	36	54	N 7 6 5 N 3 2 N	76	118	8 N 6 5 N 3 2 N	B6	182	8 7 6 5 N 3 2 N	F6	246
N N 6 5 N 3 2 1	37	55	N 7 6 5 N 3 2 1	77	119	8 N 6 5 N 3 2 1	B7	183	8 7 6 5 N 3 2 1	F7	247
N N 6 5 4 N N N	38	56	N 7 6 5 4 N N N	78	120	8 N 6 5 4 N N N	B8	184	8 7 6 5 4 N N N	F8	248
N N 6 5 4 N N 1	39	57	N 7 6 5 4 N N 1	79	121	8 N 6 5 4 N N 1	B9	185	8 7 6 5 4 N N 1	F9	249
N N 6 5 4 N 2 N	3A	58	N 7 6 5 4 N 2 N	7A	122	8 N 6 5 4 N 2 N	BA	186	8 7 6 5 4 N 2 N	FA	250
N N 6 5 4 N 2 1	3B	59	N 7 6 5 4 N 2 1	7B	123	8 N 6 5 4 N 2 1	BB	187	8 7 6 5 4 N 2 1	FB	251
N N 6 5 4 3 N N	3C	60	N 7 6 5 4 3 N N	7C	124	8 N 6 5 4 3 N N	BC	188	8 7 6 5 4 3 N N	FC	252
N N 6 5 4 3 N 1	3D	61	N 7 6 5 4 3 N 1	7D	125	8 N 6 5 4 3 N 1	BD	189	8 7 6 5 4 3 N 1	FD	253
N N 6 5 4 3 2 N	3E	62	N 7 6 5 4 3 2 N	7E	126	8 N 6 5 4 3 2 N	BE	190	8 7 6 5 4 3 2 N	FE	254
N N 6 5 4 3 2 1	3F	63	N 7 6 5 4 3 2 1	7F	127	8 N 6 5 4 3 2 1	BF	191	8 7 6 5 4 3 2 1	FF	255

Example: Decimal 146 means that inputs 8, 5 and 2 are inverted.

4.21 Multiplexer block

This 'Toolkit' option block selects one of eight analogue inputs to appear at its output

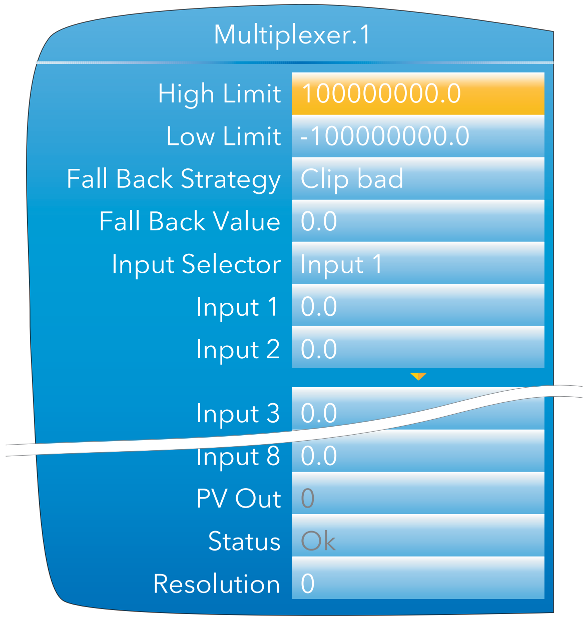


Figure 4.21 Multiplexer block configuration

4.21.1 Configuration parameters

High Limit	The high limit for input, output and fallback values. Minimum value is Low Limit.
Low Limit	The low limit for input and fallback values. Maximum value is High Limit.
Fallback Strategy	Clip Bad: If the input value is above 'High Limit' or below 'Low Limit', then the output value is set to the appropriate limit, and the status is set to 'Bad'. If the input signal is within the limits, but its status is bad, the output is set to the Fallback value. Clip Good: If the input value is above 'High Limit' or below 'Low Limit', then the output value is set to the appropriate limit, and the status is set to 'Good'. If the input signal is within the limits, but its status is bad, the output is set to the Fallback value. Fall Bad: If the input value is above 'High Limit' or below 'Low Limit', then the output value is set to the Fallback value, and the status is set to 'Bad' Fall Good: If the input value is above 'High Limit' or below 'Low Limit', then the output value is set to the Fallback value, and the status is set to 'Good' Upscale: If the input status is bad, or if the input signal is above 'High Limit' or below 'Low Limit', the output value is set to the High limit. Downscale: If the input status is bad, or if the input signal is above 'High Limit' or below 'Low Limit', the output value is set to the Low limit.
Fallback Value	The value to be adopted by the output, under error conditions, if 'Fallback Status' is set to 'Fall Good' or 'Fall Bad'.
Input Selector	Selects which of the eight inputs is presented at the output. When wired to a suitable parameter, Input Selector becomes read only. Input 1 is selected for an Input Selector value of 1, Input 2 for a value of 2 and so on. Input Selector values greater than 8 are ignored. If not wired, the user may select the required input using the scroll keys.
Input 1 to 8	Wired to the relevant analogue inputs.
PV Out	The output from the multiplexer block.
Status	Indicates the status of the operation as 'Ok' or 'Error'.
Resolution	The number of decimal places for the output value (maximum = 6)

4.22 MATH (2 INPUT)

This ‘Toolkit’ option block allows one of a number of operations to be carried out using two input values which may be analogue or digital in nature. Either or both of the inputs can be scaled, using a ‘Multiplier’.

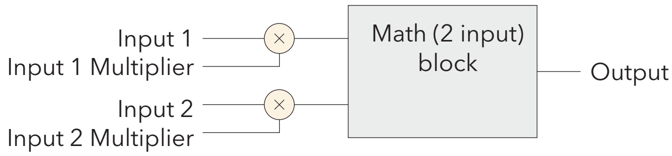


Figure 4.22a Block schematic

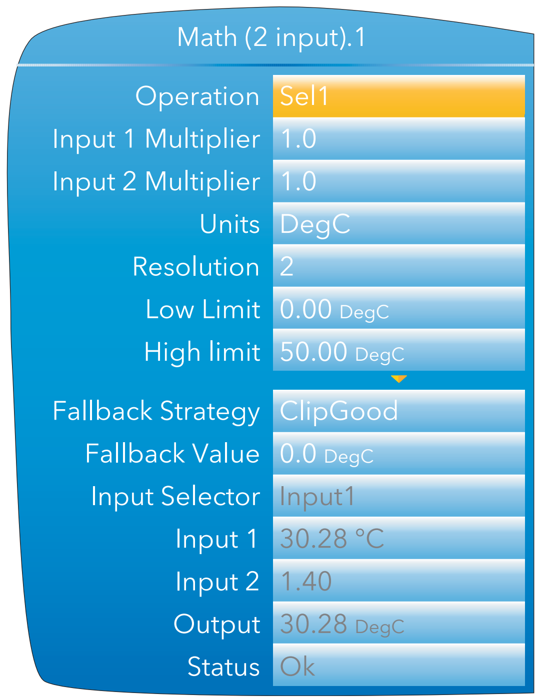


Figure 4.22b Block configuration (typical)

4.22.1 Parameters

Operation	Add	Output = Input 1 + Input 2
	Subtract	Output = Input 1 - Input 2
	Multiply	Output = Input 1 x Input 2
	Divide	Output = Input 1 ÷ Input 2
	Abs Diff	Output = the difference between Input 1 and Input 2, ignoring sign
	Select Max	Output = whichever is the larger of Input 1 or Input 2
	Select Min	Output = whichever is the smaller of Input 1 or Input 2
	Hot Swap	Output = Input 2 if Input 1 is ‘Bad’; otherwise Output = Input 1
	Sample/Hold	Output tracks Input 1 whilst Input 2 = 1. Output value is held whilst Input 2 = 0 (See section 4.22.2, below, for more details)
	Power*	Output = Input 1 to the power of Input 2. (Output = Input $1^{\text{Input 2}}$)
	Square Root	Output = √Input 1 (Input 2 ignored)
	Log Base 10	Output = Log_{10} Input 1 (Input 2 ignored)
	Log Base e	Output = Ln Input 1 (Input 2 ignored)
	Exponential	Output = e^{Input1} (Input 2 ignored)
	10 to the X	Output = $10^{\text{Input 1}}$ (Input 2 ignored)
	Sel1	Output = Input 1 if Input Selector = Input1 Output = Input 2 if Input Selector = Input2

* Note... For this implementation:
0 to the power 0 = 1.
Negative values raised to any power result in bad status.
0 raised to a negative power results in bad status.

4.22.1 PARAMETERS (Cont.)

Input 1(2) Multiplier	The scaling factor for input 1(2). This multiplying factor is applied to the input of the function, but does not affect the displayed values of Input1 and Input 2 (below).
Units	Allows a five-character string to be entered for the function
Resolution	Sets the number of decimal places for the Output value. Input resolution (if applicable) is that of the relevant input.
High Limit	The high limit for input, output and fallback values. Minimum value is Low Limit.
Low Limit	The low limit for input and fallback values. Maximum value is High Limit.
Fallback Strategy	Clip Bad: If the input value is above 'High Limit' or below 'Low Limit', then the output value is set to the appropriate limit, and the status is set to 'Bad'. If the input signal is within the limits, but its status is bad, the output is set to the Fall Back value. Clip Good: If the input value is above 'High Limit' or below 'Low Limit', then the output value is set to the appropriate limit, and the status is set to 'Good'. If the input signal is within the limits, but its status is bad, the output is set to the Fall Back value. Fall Bad: If the input value is above 'High Limit' or below 'Low Limit', then the output value is set to the Fall Back value, and the status is set to 'Bad' Fall Good: If the input value is above 'High Limit' or below 'Low Limit', then the output value is set to the Fall Back value, and the status is set to 'Good' Upscale: If the input status is bad, or if the input signal is above 'High Limit' or below 'Low Limit', the output value is set to the High limit. Downscale: If the input status is bad, or if the input signal is above 'High Limit' or below 'Low Limit', the output value is set to the Low limit.
Fallback Value	The value to be adopted by the output, under error conditions, if 'Fallback Status' is set to 'Fall Good' or 'Fall Bad'.
Input Selector	For 'Select' operation only. When wired to a suitable parameter, Input Select becomes read only. Input 1 is selected if 'Input Select' = 1; Input 2 is selected if 'Input Select' = 2. Input Select values greater than 2 are ignored. If not wired, the user may select the required input using the scroll keys.
Input 1(2)	Wired to suitable input parameters. Displayed values ignore any input multiplier effects.
Output	Gives the output value for the operation.
Status	Shows the status of the output value, as 'Ok' or 'Error'

4.22.2 Sample and Hold details

As described above, Output follows Input1 as long as Input 2 is 'High'. When Input 2 goes Low, the output adopts the instantaneous value of Input 1 until Input 2 goes High again. When Input 2 goes high the output jumps to the current value of Input 1 and tracks it until Input 2 goes low.

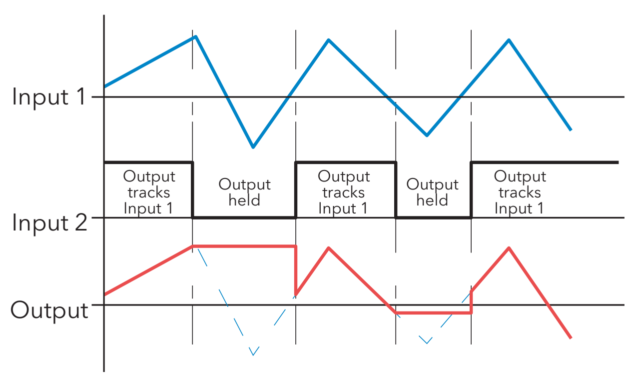


Figure 4.22.2 Sample and Hold example

4.23 TIMER

This 'Toolkit' option allows the user to configure up to four timers as: 'On Pulse', 'On Delay', 'One Shot' or 'Min On' types. The different types are described in section 4.23.2, below.

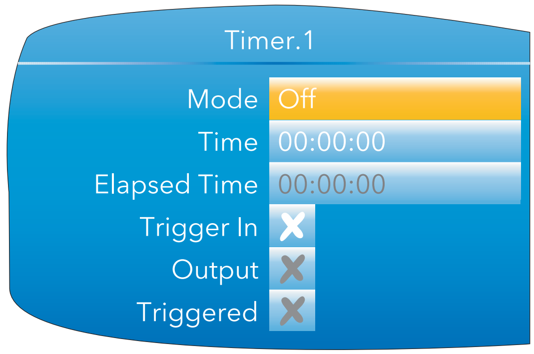


Figure 4.23 Timer configuration

4.23.1 Parameters

Mode	Select 'On pulse', 'On delay', 'One shot' or 'Min On'
Time	Allows the user to enter a period for the timer.
Elapsed time	This read-only parameter shows timing progress
Trigger in	Shows if the trigger source is active (tick) or inactive (cross)
Output	Shows if the output is on (tick) or off (cross)
Triggered	Shows if the timer is currently triggered (can remain triggered even after the trigger source has returned to off).

4.23.2 Timer modes

ON PULSE

Output goes 'on' as soon as the trigger input goes active, and remains on until the time period has elapsed. If the timer is re-triggered during the timing period, the timer restarts.

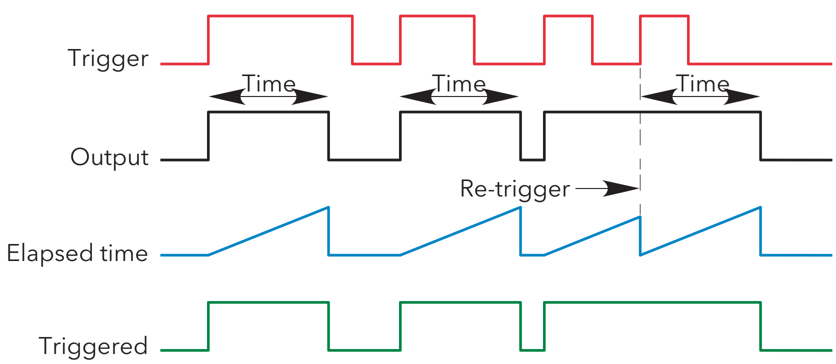


Figure 4.23.2a 'On Pulse' definitions

4.23.2 TIMER MODES (Cont.)

ON DELAY

Provides a delay between the trigger point and the timer output becoming active.

Rules

1. After the trigger goes active, the output switches on after the delay time has elapsed, and stays on until the trigger goes inactive.
2. If the trigger goes inactive before the delay time has elapsed, the output does not switch on.

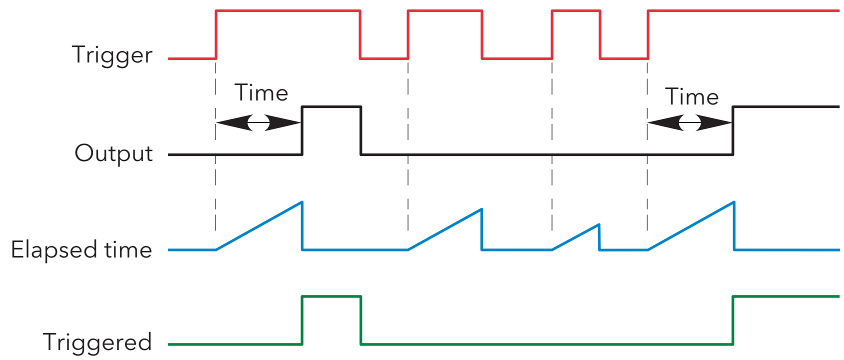


Figure 4.23.2b 'On Delay' definitions

ONE SHOT

If the trigger input is active, countdown timing is initiated as soon as the entered time value is confirmed (scroll key). The entered time decrements to zero, and must be re-entered by the user before any further timer function can be initiated.

Rules

1. The time value decrements only when the trigger input is active.
2. The output is On only when the trigger value is active (and the entered time value has not elapsed).
3. The entered time value can be edited at any time to increase or decrease the remaining time period.

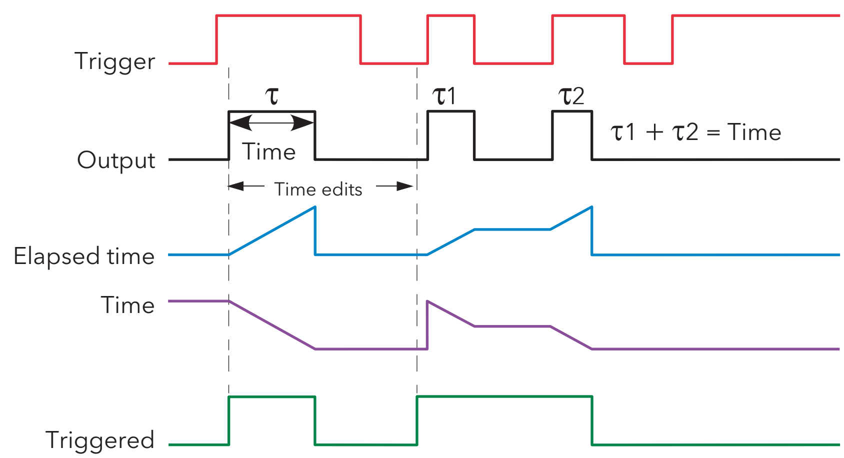


Figure 4.23.2c 'One Shot' timer definitions

Note: For ease of comparison the two time edits in the figure above were both to the same value. This is not a necessary condition.

4.23.2 TIMER MODES (Cont.)

MIN ON

This 'Off delay' function provides an output signal that goes 'on' when the trigger goes active and remains on for a specified period after the trigger goes inactive.

If the trigger goes inactive, then active again before the time period has elapsed, then the elapsed time is reset to zero and the output remains on.

The 'Triggered' parameter is on whenever the elapsed time is counting down.

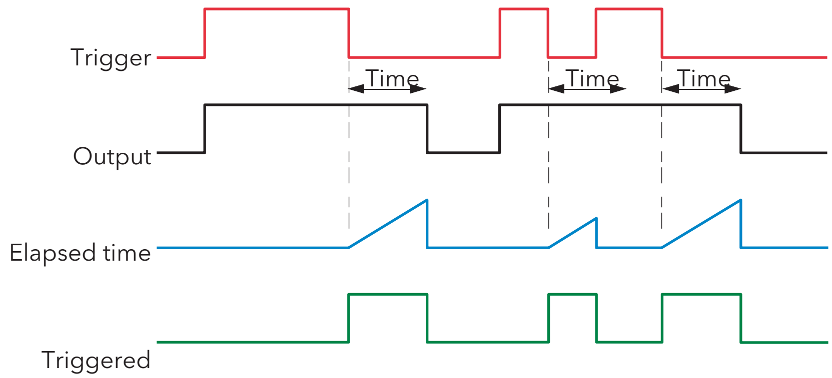


Figure 4.23.2d 'Min On' timer definitions

4.24 USER VALUES

This 'Toolkit' option block allows up to 12 values to be configured for use as inputs to other parameters.

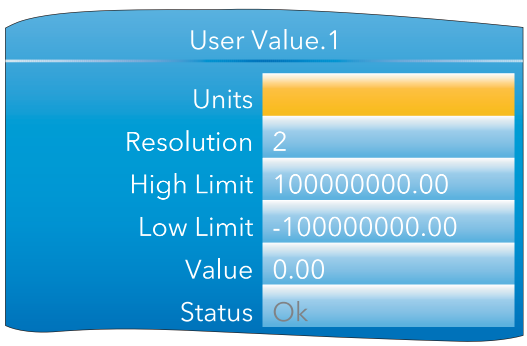


Figure 4.24 User value configuration

4.24.1 Parameters

Units	Allows a five-character string to be entered for the user value units
Resolution	The number of decimal places for the user value (max. = 6)
High/Low Limit	Sets maximum and minimum values that the User value can be set to
Value	The user value, either entered manually, or wired to another appropriate parameter
Status	The output status for the User Value.

4.25 ALARM SUMMARY

Allows the user to view the overall status of the unit's alarms, and to carry out a global acknowledgement of active alarms if required.

Global Ack	Allows the user to acknowledge all applicable alarms simultaneously. 'Manual' alarms must be non-active before they can be acknowledged.
Any Channel alarm	Indicates if there are any channel alarms active, acknowledged etc.
Any Sys Alarm	Indicates if there are any active system alarms.
Any Alarm	Indicates if there are any channel or system alarms active.

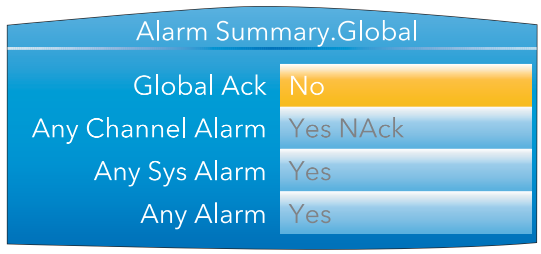


Figure 4.25 Alarm summary display

4.26 REAL TIME EVENT CONFIGURATION

This allows the user to configure up to two events to trigger at a specific time and date, or on a particular day, and to remain active for a configurable time, either measured as a duration, or as a specific 'Off' time.

Typical applications would be to start and/or stop a programmer at a particular time, or to act as an input to a 'Wait' segment.

Figure 4.26 shows the two types of timer: 'Time and Date', and 'Time and Day', for Event 1.

Figure 4.26 Real Time Events (typical)

Type	Selects the type of the real time event (Off, Time and Day, Time and Date
On Month	For 'Time and Date' only, this is the month that the event is to switch on.
On Date	For 'Time and Date' only, this is the date in the month that the event is to switch on.
On Day	For 'Time and Day' only, this is the day(s) of the week that the event output is to switch on (Mon, Tue, Wed, Thu, Fri, Sat, Sun, Mon-Fri, Sat-Sun, Everyday).
On Time	The time of day that the event output is to switch on (00:00:00 to 23:59:59)
Off Type	Selects the action that will switch the event off (Duration, Time)
Off Month	For 'Time and Date' only and with 'Off Type' set to 'Time', this is the month that the event is to switch off.
Off Date	For 'Time and Date' only and with 'Off Type' set to 'Time', this is the day number in the month that the event is to switch off.
Off Day	For 'Time and Day' only and with 'Off Type' set to 'Time', this is the day of the week that the event output is to switch off (Mon, Tue, Wed, Thu, Fri, Sat, Sun, Mon-Fri, Sat-Sun, Everyday).
Off Time	The time at which the event output is to switch off (00:00:00 - 23:59:59)
Duration	For 'Off type' set to 'Duration', this specifies the duration for which the event output is to remain on (00:00:01 to 23:59:59 for Time and Day, or 00:00:01 to 500:00:00 for Time and Date)
Output	The output for the real time event (Cross symbol = Off, Tick = On) (Read only)

5 MODBUS TCP SLAVE COMMS

5.1 INSTALLATION

The installation of the Modbus link consists of connecting a standard Ethernet cable between the RJ45 connector at the rear of the unit to a host computer either directly or via a network. A 'straight-through' cable can be used in either case (i.e. a cross-over cable is not required).

5.2 INTRODUCTION

MODBUS TCP allows the instrument to act as a 'slave' device to one or more host computers connected via the RJ45 connector at the rear of the recorder. Each recorder must have a unique Internet Protocol (IP) address, set up as described in Section 4.2.1 (Network.Interface).

MODBUS TCP (Transmission Control Protocol) is a variant of the MODBUS family of communications protocols intended for supervision and control of automated equipment specifically covering the use of MODBUS messaging in an intranet or internet environment, using TCP/IP protocols. Much of the MODBUS detail in this manual is derived from the document openmbus.doc, available at http://www.modbus.org/default.htm The above mentioned document also includes implementation guidelines for users.

Note: The Modbus protocol allows a maximum of 255 data bytes to be read from or written to in one transaction. For this reason, the maximum number of standard (16 bit) registers that can be accessed in one transaction is 255/2 = 127 and the maximum number of IEEE (32-bit) registers is 127/2 = 63.

5.2.1 Function Codes

MODBUS function codes 3, 4, 6, 8 and 16, defined in table 8.2.1a below, are supported and are fully described in section 5.5, below.

Code	Modbus definition	Description
03	Read holding registers	Reads the binary contents if holding registers. In this implementation codes 3 and 4 are identical in operation.
04	Read input registers	Reads the binary contents if holding registers. In this implementation codes 3 and 4 are identical in operation.
06	Preset single register	Writes a single value to a single register.
08	Diagnostics	Performs a simple loop back test.
16	Preset multiple registers	Writes values to multiple holding registers.

Table 5.2.1a MODBUS Function code definition

DIAGNOSTIC CODES

Function code 08, subfunction 00 (Return query data) echoes the query (Loop back).

5.2.1 FUNCTION CODES (Cont.)

EXCEPTION CODES

MODBUS TCP provides reserved codes used for exceptions. These codes provide error information relating to failed requests. Exceptions are signalled by hex 80 being added to the function code of the request, followed by one of the codes listed in table 8.2.1b, below.

Code Dec	Code Hex	Modbus definition	Description (see Modbus specification for full details)
01	01	Illegal function	An invalid function code was received
02	02	Illegal Data Address	An invalid data address was received
03	03	Illegal Data Value	An invalid data value was received
04	04	Slave Device Failure	An unrecoverable error occurred in the instrument
09	09	Illegal Sub Function	An invalid sub function was received
10	0A	Gateway path unavailable	Gateway misconfigured or overloaded
11	0B	Gateway target device failed to respond	Device not present on the network

Table 5.2.1b Exception codes

5.2.2 Data types

The following data types are supported:

1. 2's complement signed 16-bit analogue values with implied decimal point. The decimal point position must be configured in both the recorder and the host computer.
2. 16, 32 and 64 bit signed integers.
3. 16-bit unsigned integer values.
4. 32 bit IEEE Floating point values.
5. Strings of limited size, can be transferred across Modbus TCP in Unicode format using a single non-multiplexed set of consecutive registers.

DATA ENCODING

MODBUS uses what is called a 'Big endian' representation for addresses and data items. This means that when a numerical quantity larger than a single byte is transmitted, the most significant byte is sent first. For example a 32-bit hex value of 12345678 would be transmitted as 12, followed by 34, followed by 56 and finally 78.

5.2.3 Invalid multiple register writes

When a recorder receives a multi-register write request, it is possible that one or more requests will be rejected. Under such a circumstance, the recorder accepts all valid write requests and ignores any invalid writes. No error response is produced.

5.2.4 Master communications timeout

Whilst the instrument is archiving, it is possible that communications responses slow sufficiently to cause communications timouts. The Modbus master device should be configured with a timout value large enough to ensure against nuisance timeouts during archiving.

5.2.4 Non-volatile parameters in EEPROM

CAUTION

The parameters in the following list must not be written-to on a continuous basis as to do so will damage the EEPROM, greatly shortening its useful life.

Note: ‘nvol’ = ‘non-volatile’. Loop ‘N’ = Loop1 and Loop2; Channel ‘N’ = Channel 1, 2, 3 and 4 etc.

AdvancedLoop.MasterPID.ControlAction
AdvancedLoop.MasterPID.CutbackHigh
AdvancedLoop.MasterPID.CutbackLow
AdvancedLoop.MasterPID.DerivativeTime
AdvancedLoop.MasterPID.DerivativeType
AdvancedLoop.MasterPID.ErrorLimit
AdvancedLoop.MasterPID.IntegralTime
AdvancedLoop.MasterPID.LoopBreakTime
AdvancedLoop.MasterPID.ManualReset
AdvancedLoop.MasterPID.PBUnits
AdvancedLoop.MasterPID.ProportionalBand
AdvancedLoop.MasterSP.ManualTrack
AdvancedLoop.MasterSP.RangeHigh
AdvancedLoop.MasterSP.RangeLow
AdvancedLoop.MasterSP.ServoToPV
AdvancedLoop.MasterSP.SPHighLimit
AdvancedLoop.MasterSP.SPIntBal
AdvancedLoop.MasterSP.SPLowLimit
AdvancedLoop.MasterSP.SPTrack
AdvancedLoop.MasterSP.SPTrimHighLimit
AdvancedLoop.MasterSP.SPTrimLowLimit
AdvancedLoop.Output.Ch1OnOffHysteresis
AdvancedLoop.Output.Ch1TravelTime
AdvancedLoop.Output.Ch2Deadband
AdvancedLoop.Output.Ch2OnOffHysteresis
AdvancedLoop.Output.Ch2TravelTime
AdvancedLoop.Output.CoolType
AdvancedLoop.Output.EnablePowerFeedforward
AdvancedLoop.Output.FeedForwardGain
AdvancedLoop.Output.FeedForwardOffset
AdvancedLoop.Output.FeedForwardTrimLimit
AdvancedLoop.Output.FeedForwardType
AdvancedLoop.Output.ManualMode
AdvancedLoop.Output.ManualStartup
AdvancedLoop.Output.OutputHighLimit
AdvancedLoop.Output.OutputLowLimit
AdvancedLoop.Output.PotBreakMode
AdvancedLoop.Output.Rate
AdvancedLoop.Output.RateDisable
AdvancedLoop.Output.SafeOutVal
AdvancedLoop.Output.SbrkOP
AdvancedLoop.Output.SlaveSensorBreakMode
AdvancedLoop.Setup.CascadeType
AdvancedLoop.Setup.MasterName
AdvancedLoop.Setup.ModeAccess
AdvancedLoop.Setup.SetpointAccess
AdvancedLoop.Setup.SlaveChannel1
AdvancedLoop.Setup.SlaveChannel2
AdvancedLoop.Setup.SlaveName
AdvancedLoop.SlavePID.Boundary1-2
AdvancedLoop.SlavePID.Boundary2-3
AdvancedLoop.SlavePID.ControlAction
AdvancedLoop.SlavePID.CutbackHigh
AdvancedLoop.SlavePID.CutbackHigh2
AdvancedLoop.SlavePID.CutbackHigh3
AdvancedLoop.SlavePID.CutbackLow
AdvancedLoop.SlavePID.CutbackLow2
AdvancedLoop.SlavePID.CutbackLow3
AdvancedLoop.SlavePID.DerivativeTime
AdvancedLoop.SlavePID.DerivativeTime2
AdvancedLoop.SlavePID.DerivativeTime3
AdvancedLoop.SlavePID.DerivativeType
AdvancedLoop.SlavePID.IntegralTime
AdvancedLoop.SlavePID.IntegralTime2
AdvancedLoop.SlavePID.IntegralTime3
AdvancedLoop.SlavePID.LoopBreakTime
AdvancedLoop.SlavePID.LoopBreakTime2
AdvancedLoop.SlavePID.LoopBreakTime3
AdvancedLoop.SlavePID.ManualReset
AdvancedLoop.SlavePID.ManualReset2
AdvancedLoop.SlavePID.ManualReset3
AdvancedLoop.SlavePID.NumberOfSets
AdvancedLoop.SlavePID.PBUnits
AdvancedLoop.SlavePID.ProportionalBand
AdvancedLoop.SlavePID.ProportionalBand2
AdvancedLoop.SlavePID.ProportionalBand3
AdvancedLoop.SlavePID.RelCh2Gain
AdvancedLoop.SlavePID.RelCh2Gain2
AdvancedLoop.SlavePID.RelCh2Gain3
AdvancedLoop.SlavePID.RemoteInput
AdvancedLoop.SlavePID.SchedulerType
AdvancedLoop.SlaveSP.FFSelect
AdvancedLoop.SlaveSP.ManualTrack
AdvancedLoop.SlaveSP.MasterSensorBreakMode
AdvancedLoop.SlaveSP.RangeHigh
AdvancedLoop.SlaveSP.RangeLow
AdvancedLoop.SlaveSP.SbrkSP
AdvancedLoop.Tune.Band
AdvancedLoop.Tune.CycleNo
AdvancedLoop.Tune.Hysteresis
AdvancedLoop.Tune.OutputHighLimit
AdvancedLoop.Tune.OutputLowLimit
AdvancedLoop.Tune.PBs
AdvancedLoop.Tune.Settle
AdvancedLoop.Tune.TDs
AdvancedLoop.Tune.Timeout
AdvancedLoop.Tune.TuneHigh
AdvancedLoop.Tune.TuneLow
AdvancedLoop.Tune.TuneR2G
AdvancedLoop.Tune.TuneType
BCDInput.N.InN
Channel.N.AlarmN.Amount
Channel.N.AlarmN.AverageTime
Channel.N.AlarmN.Block
Channel.N.AlarmN.ChangeTime
Channel.N.AlarmN.Deviation
Channel.N.AlarmN.Dwell
Channel.N.AlarmN.Hysteresis
Channel.N.AlarmN.Latch
Channel.N.AlarmN.Threshold
Channel.N.AlarmN.Type
Channel.N.Main.CJType
Channel.N.Main.CloseString
Channel.N.Main.Descriptor
Channel.N.Main.ExtCJTemp
Channel.N.Main.FaultResponse
Channel.N.Main.Filter
Channel.N.Main.InputHigh
Channel.N.Main.InputLow
Channel.N.Main.LinType
Channel.N.Main.Offset
Channel.N.Main.Offset2
Channel.N.Main.OpenString
Channel.N.Main.RangeHigh
Channel.N.Main.RangeLow
Channel.N.Main.RangeUnits
Channel.N.Main.Resolution
Channel.N.Main.ScaleHigh
Channel.N.Main.ScaleHigh2
Channel.N.Main.ScaleLow
Channel.N.Main.ScaleLow2
Channel.N.Main.SensorBreakType
Channel.N.Main.Shunt
Channel.N.Main.TestSignal
Channel.N.Main.Type
Channel.N.Main.Units
Channel.N.Trend.Colour
Channel.N.Trend.SpanHigh
Channel.N.Trend.SpanLow
CustomMessage.MessageN
DCOutput.1A1B_DCOP.FallbackPV
DCOutput.1A1B_DCOP.OutputHigh
DCOutput.1A1B_DCOP.OutputLow
DCOutput.1A1B_DCOP.Resolution
DCOutput.1A1B_DCOP.ScaleHigh
DCOutput.1A1B_DCOP.ScaleLow
DCOutput.1A1B_DCOP.Type
DCOutput.2A2B_DCOP.FallbackPV
DCOutput.2A2B_DCOP.OutputHigh
DCOutput.2A2B_DCOP.OutputLow
DCOutput.2A2B_DCOP.Resolution
DCOutput.2A2B_DCOP.ScaleHigh
DCOutput.2A2B_DCOP.ScaleLow
DCOutput.2A2B_DCOP.Type
DCOutput.3A3B_DCOP.FallbackPV
DCOutput.3A3B_DCOP.OutputHigh
DCOutput.3A3B_DCOP.OutputLow
DCOutput.3A3B_DCOP.Resolution
DCOutput.3A3B_DCOP.ScaleHigh
DCOutput.3A3B_DCOP.ScaleLow
DCOutput.3A3B_DCOP.Type
DigitalIO.1A1B.Backlash
DigitalIO.1A1B.Inertia
DigitalIO.1A1B.Invert
DigitalIO.1A1B.MinOnTime
DigitalIO.1A1B.StandbyAction
DigitalIO.1A1B.Type
DigitalIO.2A2B.Backlash
DigitalIO.2A2B.Inertia
DigitalIO.2A2B.Invert
DigitalIO.2A2B.MinOnTime
DigitalIO.2A2B.StandbyAction
DigitalIO.2A2B.Type
DigitalIO.3A3B.Backlash
DigitalIO.3A3B.Inertia
DigitalIO.3A3B.Invert
DigitalIO.3A3B.MinOnTime
DigitalIO.3A3B.StandbyAction
DigitalIO.3A3B.Type
DigitalIO.DI_LALC.Backlash
DigitalIO.DI_LALC.Inertia
DigitalIO.DI_LALC.Invert
DigitalIO.DI_LALC.MinOnTime
DigitalIO.DI_LALC.StandbyAction
DigitalIO.DI_LALC.Type
DigitalIO.DI_LBLC.Backlash
DigitalIO.DI_LBLC.Inertia
DigitalIO.DI_LBLC.Invert
DigitalIO.DI_LBLC.MinOnTime
DigitalIO.DI_LBLC.StandbyAction
DigitalIO.DI_LBLC.Type
DigitalIO.RELAY_4AC.Backlash
DigitalIO.RELAY_4AC.Inertia
DigitalIO.RELAY_4AC.Invert
DigitalIO.RELAY_4AC.MinOnTime
DigitalIO.RELAY_4AC.StandbyAction
DigitalIO.RELAY_4AC.Type
DigitalIO.RELAY_5AC.Backlash
DigitalIO.RELAY_5AC.Inertia
DigitalIO.RELAY_5AC.Invert
DigitalIO.RELAY_5AC.MinOnTime
DigitalIO.RELAY_5AC.StandbyAction
DigitalIO.RELAY_5AC.Type
EthernetIP.ImplicitInputs.InputN
EthernetIP.ImplicitOutputs.OutputN
EthernetIP.InputTags.InputN
EthernetIP.Main.ConfigInstance
EthernetIP.Main.ConfigSize
EthernetIP.Main.ConnectionType
EthernetIP.Main.InputInstance
EthernetIP.Main.InputSize
EthernetIP.Main.Mode
EthernetIP.Main.OutputInstance
EthernetIP.Main.OutputSize
EthernetIP.Main.Priority
EthernetIP.Main.Rpi
EthernetIP.Main.ServerAddress
EthernetIP.Main.SlotNumber
EthernetIP.OutputTags.OutputN
EthernetIP.OutputTags.Output2
Group.Recording.ChannelNEn
Group.Recording.Compression
Group.Recording.Enable
Group.Recording.Interval
Group.Recording.VirtualChanNEn
Group.Recording.VirtualChan28En
Group.Trend.Descriptor
Group.Trend.Interval
Group.Trend.MajorDivisions
Group.Trend.PointN
Humidity.Pressure
Humidity.PsychroConst
Humidity.Resolution
Humidity.WetOffset
Instrument.Display.AlarmPanel
Instrument.Display.Brightness
Instrument.Display.Cascade
Instrument.Display.DualLoopControl
Instrument.Display.EIPServerPage
Instrument.Display.FutureTrend
Instrument.Display.FutureTrend1Colour
Instrument.Display.FutureTrend2Colour
Instrument.Display.HistoryBackground
Instrument.Display.HomePage
Instrument.Display.HorizontalBar
Instrument.Display.HorizontalTrend
Instrument.Display.HPageTimeout
Instrument.Display.HTrendScaling
Instrument.Display.LoopControl
Instrument.Display.LoopSetpointColour
Instrument.Display.ModbusMaster
Instrument.Display.NumberFormat

5.2.4 NON-VOLATILE PARAMETERS IN EEPROM (Cont.)

Instrument.Display.Numeric
Instrument.Display.Programmer
Instrument.Display.PromoteListView
Instrument.Display.ScreenSaverAfter
Instrument.Display.ScreenSaverBrightness
Instrument.Display.SteriliserPage
Instrument.Display.TrendBackground
Instrument.Display.USBAutoScan
Instrument.Display.VerticalBar
Instrument.Display.VerticalTrend
Instrument.Info.CloneState
Instrument.Info.Name
Instrument.Locale.DateFormat
Instrument.Locale.DSTenable
Instrument.Locale.EndDay
Instrument.Locale.EndMonth
Instrument.Locale.EndOn
Instrument.Locale.EndTime
Instrument.Locale.Language
Instrument.Locale.StartDay
Instrument.Locale.StartMonth
Instrument.Locale.StartOn
Instrument.Locale.StartTime
Instrument.Locale.TimeZone
Instrument.Notes.NoteN
Instrument.PromoteList.PromoteListName
Instrument.PromoteList.PromoteParamN
Instrument.PromoteList.PromoteParamNDesc
Instrument.Security.CommsPass
Instrument.Security.DefaultConfig
Instrument.Security.EngineerPassword
Instrument.Security.OEMPass
Instrument.Security.OperatorPassword
Instrument.Security.SupervisorPassword
Lgc2.N.FallbackType
Lgc2.N.In1
Lgc2.N.In2
Lgc2.N.Invert
Lgc2.N.Oper
Lgc8.N.InN
Lgc8.N.InInvert
Lgc8.N.NumIn
Lgc8.N.Oper
Lgc8.N.OutInvert
Loop.N.Diag.LoopMode
Loop.N.OP.Ch1OnOffHysteresis
Loop.N.OP.Ch1TravelTime
Loop.N.OP.Ch2Deadband
Loop.N.OP.Ch2OnOffHysteresis
Loop.N.OP.Ch2TravelTime
Loop.N.OP.CoolType
Loop.N.OP.EnablePowerFeedforward
Loop.N.OP.FeedForwardGain
Loop.N.OP.FeedForwardOffset
Loop.N.OP.FeedForwardTrimLimit
Loop.N.OP.FeedForwardType
Loop.N.OP.ManStartup
Loop.N.OP.ManualMode
Loop.N.OP.OutputHighLimit
Loop.N.OP.OutputLowLimit
Loop.N.OP.PotBreakMode
Loop.N.OP.Rate
Loop.N.OP.RateDisable
Loop.N.OP.SafeOutVal
Loop.N.OP.SbrkOP
Loop.N.OP.SensorBreakMode
Loop.N.PID.Boundary1-2
Loop.N.PID.Boundary2-3
Loop.N.PID.CutbackHigh
Loop.N.PID.CutbackHighN
Loop.N.PID.CutbackLow
Loop.N.PID.CutbackLowN
Loop.N.PID.DerivativeTime
Loop.N.PID.DerivativeTimeN
Loop.N.PID.IntegralTime
Loop.N.PID.IntegralTimeN
Loop.N.PID.LoopBreakTime
Loop.N.PID.LoopBreakTimeN
Loop.N.PID.ManualReset
Loop.N.PID.ManualResetN
Loop.N.PID.NumSets
Loop.N.PID.ProportionalBand
Loop.N.PID.ProportionalBandN
Loop.N.PID.RelCh2Gain
Loop.N.PID.RelCh2GainN
Loop.N.PID.SchedulerRemoteInput
Loop.N.PID.SchedulerType
Loop.N.Setup.AutoManAccess
Loop.N.Setup.CH1ControlType
Loop.N.Setup.CH2ControlType
Loop.N.Setup.ControlAction
Loop.N.Setup.DerivativeType
Loop.N.Setup.LoopName
Loop.N.Setup.PBUnits
Loop.N.Setup.SPAccess
Loop.N.SP.ManualTrack
Loop.N.SP.RangeHigh
Loop.N.SP.RangeLow
Loop.N.SP.ServoToPV
Loop.N.SP.SPHighLimit
Loop.N.SP.SPIntBal
Loop.N.SP.SPLowLimit
Loop.N.SP.SPTrack
Loop.N.SP.SPTrimHighLimit
Loop.N.SP.SPTrimLowLimit
Loop.N.Tune.CycleNo
Loop.N.Tune.Diagnostics
Loop.N.Tune.OutputHighLimit
Loop.N.Tune.OutputLowLimit
Loop.N.Tune.PBs
Loop.N.Tune.Settle
Loop.N.Tune.TDs
Loop.N.Tune.TuneR2G
Loop.N.Tune.Type
Math2.N.Fallback
Math2.N.FallbackVal
Math2.N.HighLimit
Math2.N.InN
Math2.N.InNMul
Math2.N.LowLimit
Math2.N.Oper
Math2.N.Resolution
Math2.N.Select
Math2.N.Units
ModbusMaster.N.Data.BitPosition
ModbusMaster.N.Data.DataType
ModbusMaster.N.Data.Descriptor
ModbusMaster.N.Data.FallBackValue
ModbusMaster.N.Data.FunctionCode
ModbusMaster.N.Data.ModbusAddress
ModbusMaster.N.Data.Mode
ModbusMaster.N.Data.Number
ModbusMaster.N.Data.ParameterList
ModbusMaster.N.Data.Priority
ModbusMaster.N.Data.Scaling
ModbusMaster.N.Data.Set
ModbusMaster.N.Data.SlaveDevice
ModbusMaster.N.Data.Value
ModbusMaster.SlaveN.Data.BitPosition
ModbusMaster.SlaveN.Data.DataType
ModbusMaster.SlaveN.Data.Descriptor
ModbusMaster.SlaveN.Data.FallBackValue
ModbusMaster.SlaveN.Data.FunctionCode
ModbusMaster.SlaveN.Data.ModbusAddress
ModbusMaster.SlaveN.Data.Mode
ModbusMaster.SlaveN.Data.Number
ModbusMaster.SlaveN.Data.ParameterList
ModbusMaster.SlaveN.Data.Priority
ModbusMaster.SlaveN.Data.Scaling
ModbusMaster.SlaveN.Data.Set
ModbusMaster.SlaveN.Data.SlaveDevice
ModbusMaster.SlaveN.Data.Value
ModbusMaster.SlaveN.Main.Descriptor
ModbusMaster.SlaveN.Main.HighPriority
ModbusMaster.SlaveN.Main.IPAddress
ModbusMaster.SlaveN.Main.LowPriority
ModbusMaster.SlaveN.Main.MaxBlockSize
ModbusMaster.SlaveN.Main.MediumPriority
ModbusMaster.SlaveN.Main.Online
ModbusMaster.SlaveN.Main.Profile
ModbusMaster.SlaveN.Main.Retries
ModbusMaster.SlaveN.Main.Timeout
ModbusMaster.SlaveN.Main.UnitId
Mux8.N.Fallback
Mux8.N.FallbackVal
Mux8.N.HighLimit
Mux8.N.InN
Mux8.N.LowLimit
Mux8.N.Select
Network.Archive.ArchiveRate
Network.Archive.CSVDateFormat
Network.Archive.CSVHeaders
Network.Archive.CSVHeadings
Network.Archive.CSVIncludeValues
Network.Archive.CSVMessages
Network.Archive.CSVTabDelimiter
Network.Archive.Destination
Network.Archive.FileFormat
Network.Archive.OnFull
Network.Archive.Period
Network.Archive.PrimaryPassword
Network.Archive.PrimaryUser
Network.Archive.PServerIPAddress
Network.Archive.RemotePath
Network.Archive.SecondaryPassword
Network.Archive.SecondaryUser
Network.Archive.SServerIPAddress
Network.FTPserver.Password
Network.FTPserver.Username
Network.Interface.DNSserver
Network.Interface.Gateway
Network.Interface.IPaddress
Network.Interface.IPType
Network.Interface.SubnetMask
Network.Modbus.Address
Network.Modbus.InputTimeout
Network.Modbus.PrefMasterIP
Network.Modbus.SerialMode
Network.Modbus.TimeFormat
Network.Modbus.UnitIdEnable
Program.ChNHoldback
Program.ChNHoldbackVal
Program.ChNRampUnits
Program.HoldbackStyle
Program.RampStyle
Programmer.Features.FTPStore
Programmer.Features.Holdback
Programmer.Features.Messages
Programmer.Features.PVEvent
Programmer.Features.UserValue
Programmer.FTP.IPAddress
Programmer.FTP.Password
Programmer.FTP.Username
Programmer.SetUp.ChNResolution
Programmer.SetUp.ChNServoTo
Programmer.SetUp.ChNUnits
Programmer.SetUp.Channels
Programmer.SetUp.MaxEvents
Programmer.SetUp.PowerFailAction
Programmer.SetUp.ProgEditAccess
Programmer.SetUp.ProgModeAccess
Programmer.SetUp.ProgStoreAccess
Programmer.SetUp.RateResolution
Programmer.SetUp.ResetCh1UserVal
Programmer.SetUp.ResetCh2UserVal
Programmer.SetUp.ResetEventN
RealTimeEvent.N.Duration
RealTimeEvent.N.OffDate
RealTimeEvent.N.OffDay
RealTimeEvent.N.OffMonth
RealTimeEvent.N.OffTime
RealTimeEvent.N.OffType
RealTimeEvent.N.OnDate
RealTimeEvent.N.OnDay
RealTimeEvent.N.OnMonth
RealTimeEvent.N.OnTime
RealTimeEvent.N.Type
Segment.N.ChNHoldback
Segment.N.ChNHoldbackVal
Segment.N.ChNPVEvent
Segment.N.ChNPVEventUse
Segment.N.ChNPVEventVal
Segment.N.ChNRate
Segment.N.ChNTime
Segment.N.ChNTSP
Segment.N.ChNUserVal
Segment.N.ChNWait
Segment.N.ChNWaitVal
Segment.N.Cycles
Segment.N.Duration
Segment.N.EndType
Segment.N.EventN
Segment.N.GoBackTo
Segment.N.SegmentName
Segment.N.Type
Segment.N.WaitFor
Steriliser.AutoCounter
Steriliser.FailureDwellN
Steriliser.FileByTag
Steriliser.FileTag
Steriliser.InputNPV
Steriliser.InputTypeN
Steriliser.IP1BandHigh
Steriliser.IP1BandLow
Steriliser.IP1TargetSP
Steriliser.IP2BandHigh
Steriliser.IP2BandLow
Steriliser.IP2TargetSP
Steriliser.IP3BandHigh
Steriliser.IP3BandLow
Steriliser.IP3TargetSP
Steriliser.IP4BandHigh
Steriliser.IP4BandLow
Steriliser.IP4TargetSP
Steriliser.LowLimit
Steriliser.MeasuredTemp
Steriliser.TargetTemperature
Steriliser.TargetTime
Steriliser.TargetTime121
Steriliser.TargetTime134
Steriliser.ZTemperatureInterval
Timer.N.In
Timer.N.Type
UserLin.N.NumberOfBreakpoints
UserLin.N.XN

5.2.4 NON-VOLATILE PARAMETERS IN EEPROM (Cont.)

UserLin.N.YN
UsrVal.N.HighLimit
UsrVal.N.LowLimit
UsrVal.N.Resolution
UsrVal.N.Units
VirtualChannel.N.AlarmN.Amount
VirtualChannel.N.AlarmN.AverageTime
VirtualChannel.N.AlarmN.Block
VirtualChannel.N.AlarmN.ChangeTime
VirtualChannel.N.AlarmN.Deviation
VirtualChannel.N.AlarmN.Dwell
VirtualChannel.N.AlarmN.Hysteresis
VirtualChannel.N.AlarmN.Latch
VirtualChannel.N.AlarmN.Threshold
VirtualChannel.N.AlarmN.Type
VirtualChannel.N.Main.Descriptor
VirtualChannel.N.Main.HighCutOff
VirtualChannel.N.Main.LowCutOff
VirtualChannel.N.Main.Operation
VirtualChannel.N.Main.Period
VirtualChannel.N.Main.PresetValue
VirtualChannel.N.Main.Resolution
VirtualChannel.N.Main.Type
VirtualChannel.N.Main.Units
VirtualChannel.N.Main.UnitsScaler
VirtualChannel.N.Trend.Colour
VirtualChannel.N.Trend.SpanHigh
VirtualChannel.N.Trend.SpanLow
Zirconia.Clean.CleanEnable
Zirconia.Clean.CleanFreq
Zirconia.Clean.CleanMaxTemp
Zirconia.Clean.CleanTime
Zirconia.Clean.MaxRcovTime
Zirconia.Clean.MinRcovTime
Zirconia.CleanFreq
Zirconia.CleanTime
Zirconia.GasRef

Zirconia.GasRefs.CO_Ideal
Zirconia.GasRefs.CO_Local
Zirconia.GasRefs.CO_RemoteEn
Zirconia.GasRefs.H2_Local
Zirconia.GasRefs.H2_RemoteEn
Zirconia.MaxRcovTime
Zirconia.MinCalTemp
Zirconia.MinRcovTime
Zirconia.NumResolution
Zirconia.OxygenExp
Zirconia.OxygenType
Zirconia.ProbeOffset
Zirconia.ProbeType
Zirconia.ProcFactor
Zirconia.RemGasEn
Zirconia.TempOffset
Zirconia.Tolerance

UserLin.N.YN
UsrVal.N.HighLimit
UsrVal.N.LowLimit
UsrVal.N.Resolution
UsrVal.N.Units
VirtualChannel.N.AlarmN.Amount
VirtualChannel.N.AlarmN.AverageTime
VirtualChannel.N.AlarmN.Block
VirtualChannel.N.AlarmN.ChangeTime
VirtualChannel.N.AlarmN.Deviation
VirtualChannel.N.AlarmN.Dwell
VirtualChannel.N.AlarmN.Hysteresis
VirtualChannel.N.AlarmN.Latch
VirtualChannel.N.AlarmN.Threshold
VirtualChannel.N.AlarmN.Type
VirtualChannel.N.Main.Descriptor
VirtualChannel.N.Main.HighCutOff
VirtualChannel.N.Main.LowCutOff
VirtualChannel.N.Main.Operation

VirtualChannel.N.Main.Period
VirtualChannel.N.Main.PresetValue
VirtualChannel.N.Main.Resolution
VirtualChannel.N.Main.Type
VirtualChannel.N.Main.Units
VirtualChannel.N.Main.UnitsScaler
VirtualChannel.N.Trend.Colour
VirtualChannel.N.Trend.SpanHigh
VirtualChannel.N.Trend.SpanLow
Zirconia.Clean.CleanEnable
Zirconia.Clean.CleanFreq
Zirconia.Clean.CleanMaxTemp
Zirconia.Clean.CleanTime
Zirconia.Clean.MaxRcovTime
Zirconia.Clean.MinRcovTime
Zirconia.CleanFreq
Zirconia.CleanTime
Zirconia.GasRef
Zirconia.GasRefs.CO_Ideal
Zirconia.GasRefs.CO_Local
Zirconia.GasRefs.CO_RemoteEn
Zirconia.GasRefs.H2_Local
Zirconia.GasRefs.H2_RemoteEn
Zirconia.MaxRcovTime
Zirconia.MinCalTemp
Zirconia.MinRcovTime
Zirconia.NumResolution
Zirconia.OxygenExp
Zirconia.OxygenType
Zirconia.ProbeOffset
Zirconia.ProbeType
Zirconia.ProcFactor
Zirconia.RemGasEn
Zirconia.TempOffset
Zirconia.Tolerance

5.3 PARAMETER LIST

This list is arranged in alphabetical block order and gives the memory address for each parameter in both hex and decimal.

The Modbus addresses, in the range 0x0001 - 0x3FFF, listed in the table below give access to the parameter values in a scaled integer format. It is possible to gain access to the parameter values in native format by using the following formula:

Native address = (scaled integer address x 2) + 0x8000

The blocks are ordered as follows:

Advanced Loop	Loop 2	Virtual chan 1	Virtual chan 18
Alarm summary	Math (2 input)	Virtual chan 2	Virtual chan 19
BCD Input	Modbus Master	Virtual chan 3	Virtual chan 20
Channel 1	Multiplexer	Virtual chan 4	Virtual chan 21
Channel 2	Network	Virtual chan 5	Virtual chan 22
Channel 3	OR block	Virtual chan 6	Virtual chan 23
Channel 4	Program	Virtual chan 7	Virtual chan 24
Custom messages	Programmer	Virtual chan 8	Virtual chan 25
DC Output	Real Time Events	Virtual chan 9	Virtual chan 26
Digital I/O	Segments	Virtual chan 10	Virtual chan 27
Ether|Net/!P	Steriliser	Virtual chan 11	Virtual chan 28
Group	Timer	Virtual chan 12	Virtual chan 29
Humidity	User Lin 1	Virtual chan 13	Virtual chan 30
Instrument	User Lin 2	Virtual chan 14	Zirconia
Logic (2 Input)	User Lin 3	Virtual chan 15	
Logic (8 input)	User Lin 4	Virtual chan 16	
Loop 1	User values	Virtual chan 17	

5.3 PARAMETER LIST (Cont.)

Parameter path	Description	Type	Hex	Dec	Resolution
AdvancedLoop.Diag.CalcOP	Calc OP	float32	031f	799	1dp
AdvancedLoop.Diag.HiSatLim	HiSatLim	float32	0320	800	1dp
AdvancedLoop.Diag.LoSatLim	LoSatLim	float32	0321	801	1dp
AdvancedLoop.Diag.MasterDerivativeOutContrib	Master derivative output contribution	float32	0312	786	0dp
AdvancedLoop.Diag.MasterError	Master error	float32	030d	781	Same as AdvancedLoop.Main.MasterPV
AdvancedLoop.Diag.MasterFB	Master feedback	float32	031e	798	1dp
AdvancedLoop.Diag.MasterIntegralOutContrib	Master integral output contribution	float32	0311	785	4dp
AdvancedLoop.Diag.MasterLoopBreakAlarm	Master loop break (0 = No; 1 = Yes)	bool	0323	803	Not applicable
AdvancedLoop.Diag.MasterPropOutContrib	Master loop proportional output contribution	float32	0310	784	0dp
AdvancedLoop.Diag.MasterSensorBreak	Master sensor break (0 = Off, 1 = On)	bool	0313	787	Not applicable
AdvancedLoop.Diag.OPPid	OPPID	float32	0322	802	1dp
AdvancedLoop.Diag.SchedCBH	Scheduled cutback high	float32	3195	12693	0dp
AdvancedLoop.Diag.SchedCBL	Scheduled cutback low	float32	3196	12694	0dp
AdvancedLoop.Diag.SchedLPBrk	Scheduled loop break time	float32	3198	12696	0dp
AdvancedLoop.Diag.SchedMR	Scheduled manual reset	float32	3197	12695	1dp
AdvancedLoop.Diag.SchedOutputHigh	Scheduled output high limit	float32	319a	12698	1dp
AdvancedLoop.Diag.SchedOutputLow	Scheduled output low limit	float32	319b	12699	1dp
AdvancedLoop.Diag.SchedPB	Scheduled proportional band	float32	3192	12690	1dp
AdvancedLoop.Diag.SchedR2G	Scheduled relative cool gain	float32	3199	12697	1dp
AdvancedLoop.Diag.SchedTd	Scheduled derivative time	float32	3194	12692	1dp
AdvancedLoop.Diag.SchedTi	Scheduled integral time	float32	3193	12691	1dp
AdvancedLoop.Diag.SlaveDerivativeOutContrib	Slave derivative output contribution	float32	031d	797	0dp
AdvancedLoop.Diag.SlaveError	Slave error	float32	031a	794	Same as AdvancedLoop.Main.SlavePV
AdvancedLoop.Diag.SlaveIntegralOutContrib	Slave integral output contribution	float32	031c	796	4dp
AdvancedLoop.Diag.SlaveLoopBreakAlarm	Slave loop break (0 = No; 1 = Yes)	bool	030f	783	Not applicable
AdvancedLoop.Diag.SlavePropOutContrib	Slave loop proportional output contribution	float32	031b	795	0dp
AdvancedLoop.Diag.SlaveSensorBreak	Slave sensor break (0 = Off; 1 = On)	bool	0325	805	Not applicable
AdvancedLoop.Diag.TargetOutput	Target output	float32	030e	782	Same as AdvancedLoop.Output.Out-putHighLimit
AdvancedLoop.Diag.WorkingOutputHigh	Slave output high limit	float32	0315	789	0dp
AdvancedLoop.Diag.WorkingOutputLow	Slave output low limit	float32	0314	788	0dp
AdvancedLoop.Main.ActiveOut	Working output	float32	0303	771	Same as AdvancedLoop.Output.Out-putHighLimit
AdvancedLoop.Main.CascadeMode	Cascade mode (0 = Cascade; 1 = Slave; 2 = Manual)	uint8	0316	790	Not applicable
AdvancedLoop.Main.Inhibit	Control inhibit (0 = No; 1 = Yes)	bool	0304	772	Not applicable
AdvancedLoop.Main.MasterIntHold	Master integral hold (0 = No; 1 = Yes)	uint8	0305	773	Not applicable
AdvancedLoop.Main.MasterPV	Master loop process variable	float32	0317	791	1dp
AdvancedLoop.Main.MasterWSP	Master loop working setpoint	float32	0318	792	Same as AdvancedLoop.Main.MasterPV
AdvancedLoop.Main.SlaveIntHold	Slave integral hold (0 = No; 1 = Yes)	uint8	0306	774	Not applicable
AdvancedLoop.Main.SlavePV	Slave loop process variable	float32	0300	768	1dp
AdvancedLoop.Main.SlaveWSP	Slave loop working setpoint	float32	0302	770	Same as AdvancedLoop.Main.SlavePV
AdvancedLoop.Main.TargetSetpoint	Target setpoint	float32	0301	769	Same as AdvancedLoop.Main.MasterPV
AdvancedLoop.MasterPID.ControlAction	Control action (0 = Reverse acting; 1 = Direct acting)	uint8	3103	12547	Not applicable
AdvancedLoop.MasterPID.CutbackHigh	Cutback high (0 = Auto)	float32	31af	12719	1dp
AdvancedLoop.MasterPID.CutbackLow	Cutback low (0 = Auto)	float32	31b0	12720	1dp
AdvancedLoop.MasterPID.DerivativeTime	Derivative time (0 = Off)	float32	31ae	12718	1dp
AdvancedLoop.MasterPID.DerivativeType	Derivative type (0 = PV; 1 = Eror)	uint8	3105	12549	Not applicable
AdvancedLoop.MasterPID.ErrorLimit	Error limit	float32	31cc	12748	1dp
AdvancedLoop.MasterPID.IntegralTime	Integral time (0 = Off)	float32	31ad	12717	1dp
AdvancedLoop.MasterPID.LoopBreakTime	Loop break time (0 = Off)	float32	31b2	12722	0dp
AdvancedLoop.MasterPID.ManualReset	Manual reset	float32	31b1	12721	1dp
AdvancedLoop.MasterPID.PBUnits	Proportional band units (0 = Engineering; 1 = Percentage)	uint8	3104	12548	Not applicable
AdvancedLoop.MasterPID.ProportionalBand	Proportional band	float32	31ac	12716	1dp
AdvancedLoop.MasterSP.AltSP	Alternative setpoint	float32	3160	12640	Same as AdvancedLoop.Main.MasterPV
AdvancedLoop.MasterSP.AltSPSelect	Alternative setpoint enable (0 = No; 1 = Yes)	uint8	3161	12641	Not applicable
AdvancedLoop.MasterSP.ManualTrack	Manual track enable (0 = Off; 1 = On)	uint8	3167	12647	Not applicable
AdvancedLoop.MasterSP.RangeHigh	Range high	float32	3159	12633	Same as AdvancedLoop.Main.MasterPV
AdvancedLoop.MasterSP.RangeLow	Range low	float32	315a	12634	Same as AdvancedLoop.Main.MasterPV
AdvancedLoop.MasterSP.Rate	Setpoint rate limit value (0 = Off)	float32	3162	12642	Same as AdvancedLoop.Main.MasterPV
AdvancedLoop.MasterSP.RateDisable	Setpoint rate limit disable (0 = No; 1 = Yes)	bool	3163	12643	Not applicable
AdvancedLoop.MasterSP.RateDone	Setpoint rate limit complete (0 = No; 1 = Yes)	bool	030a	778	Not applicable
AdvancedLoop.MasterSP.ServoToPV	Servo to PV enable (0 = No; 1 = Yes)	bool	316c	12652	Not applicable
AdvancedLoop.MasterSP.SP1	Setpoint 1	float32	315c	12636	Same as AdvancedLoop.Main.MasterPV
AdvancedLoop.MasterSP.SP2	Setpoint 2	float32	315d	12637	Same as AdvancedLoop.Main.MasterPV
AdvancedLoop.MasterSP.SPHighLimit	Setpoint high limit	float32	315e	12638	Same as AdvancedLoop.Main.MasterPV
AdvancedLoop.MasterSP.SPIntBal	SP integral balance (0 = Off; 1 = On)	bool	316b	12651	Not applicable
AdvancedLoop.MasterSP.SPLowLimit	Setpoint low limit	float32	315f	12639	Same as AdvancedLoop.Main.MasterPV
AdvancedLoop.MasterSP.SPSelect	Active setpoint select (0 - Setpoint 1; 1 = Setpoint 2)	uint8	315b	12635	Not applicable
AdvancedLoop.MasterSP.SPTrack	Setpoint tracking enable (0 = Off; 1 = On)	uint8	3168	12648	Not applicable
AdvancedLoop.MasterSP.SPTrim	Setpoint trim	float32	3164	12644	Same as AdvancedLoop.Main.MasterPV
AdvancedLoop.MasterSP.SPTrimHighLimit	Setpoint trim high limit	float32	3165	12645	Same as AdvancedLoop.Main.MasterPV
AdvancedLoop.MasterSP.SPTrimLowLimit	Setpoint trim low limit	float32	3166	12646	Same as AdvancedLoop.Main.MasterPV
AdvancedLoop.MasterSP.TrackPV	Track PV	float32	3169	12649	Same as AdvancedLoop.Main.MasterPV
AdvancedLoop.MasterSP.TrackSP	Track SP	float32	316a	12650	Same as AdvancedLoop.Main.MasterPV
AdvancedLoop.Output.Ch1OnOffHysteresis	Channel 1 on/off hysteresis	float32	3172	12658	Same as AdvancedLoop.Main.MasterPV
AdvancedLoop.Output.Ch1Output	Channel 1 output value	float32	030b	779	Same as AdvancedLoop.Output.Out-putHighLimit
AdvancedLoop.Output.Ch1PotBreak	Channel 1 potentiometer break (0 = Off; 1 = On)	uint8	3179	12665	Not applicable
AdvancedLoop.Output.Ch1PotPosition	Channel 1 valve position	float32	3178	12664	0dp
AdvancedLoop.Output.Ch1TravelTime	Channel 1 travel time	float32	3174	12660	1dp
AdvancedLoop.Output.Ch2Deadband	Channel 2 deadband (0 = Off)	float32	316f	12655	Same as AdvancedLoop.Output.Out-putHighLimit

5.3 PARAMETER LIST (Cont.)

Parameter path	Description	Type	Hex	Dec	Resolution
AdvancedLoop.Output.Ch2OnOffHysteresis	Channel 2 on/off hysteresis	float32	3173	12659	Same as AdvancedLoop.Main.MasterPV
AdvancedLoop.Output.Ch2Output	Channel 2 (cool) output value	float32	030c	780	Same as AdvancedLoop.Output.OutputHighLimit
AdvancedLoop.Output.Ch2PotBreak	Channel 2 potentiometer break (0 = Off; 1 = On)	uint8	317b	12667	Not applicable
AdvancedLoop.Output.Ch2PotPosition	Channel 2 valve position	float32	317a	12666	0dp
AdvancedLoop.Output.Ch2TravelTime	Channel 2 travel time	float32	3175	12661	1dp
AdvancedLoop.Output.CoolType	Cooling algorithm type 0 = Linear 1 = Oil 2 = Water 3 = Fan	uint8	3183	12675	Not applicable
AdvancedLoop.Output.EnablePowerFeedforward	Power feed forward enable (0 = No; 1 = Yes)	uint8	3181	12673	Not applicable
AdvancedLoop.Output.FeedForwardGain	Feedforward gain	float32	3185	12677	3dp
AdvancedLoop.Output.FeedForwardOffset	Feedforward offset	float32	3186	12678	0dp
AdvancedLoop.Output.FeedForwardOutput	Feedforward output	float32	3188	12680	0dp
AdvancedLoop.Output.FeedForwardRemote	Feedforward remote	float32	318d	12685	0dp
AdvancedLoop.Output.FeedForwardTrimLimit	Feedforward trim limit	float32	3187	12679	0dp
AdvancedLoop.Output.FeedForwardType	Feedforward type 0 = None 1 = Remote 2 = SP 3 = PV	uint8	3184	12676	Not applicable
AdvancedLoop.Output.ForcedOP	Forced manual output value	float32	318f	12687	1dp
AdvancedLoop.Output.ManualMode	Manual output mode (0 = Track; 1 = Step; 2 = LastMOP)	uint8	317f	12671	Not applicable
AdvancedLoop.Output.ManualOutVal	Manual output value	float32	3180	12672	Same as AdvancedLoop.Output.OutputHighLimit
AdvancedLoop.Output.ManualStartup	Manual startup mode (0 = Off; 1 = On)	bool	3190	12688	Not applicable
AdvancedLoop.Output.MeasuredPower	Measured mains voltage	float32	3182	12674	0dp
AdvancedLoop.Output.NudgeLower	Valve nudge lower (0 = No; 1 = Yes)	uint8	3177	12663	Not applicable
AdvancedLoop.Output.NudgeRaise	Valve nudge raise (0 = No; 1 = Yes)	uint8	3176	12662	Not applicable
AdvancedLoop.Output.OutputHighLimit	Output high limit	float32	316d	12653	1dp
AdvancedLoop.Output.OutputLowLimit	Output low limit	float32	316e	12654	Same as AdvancedLoop.Output.OutputHighLimit
AdvancedLoop.Output.PotBreakMode	Potentiometer break mode 0 = Raise 1 = Lower 2 = Reset 3 = Model	uint8	317c	12668	Not applicable
AdvancedLoop.Output.Rate	Output rate limit value (0 = Off)	float32	3170	12656	1dp
AdvancedLoop.Output.RateDisable	Rate disable (0 = No; 1 = Yes)	bool	3171	12657	Not applicable
AdvancedLoop.Output.RemoteOutputHigh	Remote output high limit	float32	318c	12684	Same as AdvancedLoop.Main.ActiveOut
AdvancedLoop.Output.RemoteOutputLow	Remote output low limit	float32	318b	12683	Same as AdvancedLoop.Main.ActiveOut
AdvancedLoop.Output.SafeOutVal	Safe output value	float32	317e	12670	Same as AdvancedLoop.Output.OutputHighLimit
AdvancedLoop.Output.SbrkOP	Sensor break output	float32	318e	12686	Same as AdvancedLoop.Output.OutputHighLimit
AdvancedLoop.Output.SlaveSensorBreakMode	Slave sensor break mode (0 = SbrkOP; 1 = Hold)	uint8	317d	12669	Not applicable
AdvancedLoop.Output.TrackEnable	Enable output tracking (0 = Off; 1 = On)	uint8	318a	12682	Not applicable
AdvancedLoop.Output.TrackOutput	Output track value	float32	3189	12681	0dp
AdvancedLoop.Setup.CascadeType	Cascade type (0 = Full scale; 1 = Trim)	uint8	1606	5638	Not applicable
AdvancedLoop.Setup.MasterLoop	Master loop type (0 = PID)	uint8	31b3	12723	Not applicable
AdvancedLoop.Setup.MasterName	Master loop name	string_t	7010	28688	Not applicable
AdvancedLoop.Setup.ModeAccess	Mode access 0 = R/W (Logged out) 1 = R/W (Operator) 2 = Read Only	uint8	31a8	12712	Not applicable
AdvancedLoop.Setup.SetpointAccess	Setpoint access (as Mode Access, above)	uint8	31a7	12711	Not applicable
AdvancedLoop.Setup.SlaveChannel1	Slave heat/channel 1 control type 0 = Off 1 = On/Off 2 = PID 3 = VPU 4 = VPB	uint8	3101	12545	Not applicable
AdvancedLoop.Setup.SlaveChannel2	Slave cool/channel 2 control type (as above)	uint8	3102	12546	Not applicable
AdvancedLoop.Setup.SlaveName	Slave loop name	string_t	7020	28704	Not applicable
AdvancedLoop.SlavePID.ActiveSet	Active set (1 = Set 1; 2 = Set 2; 3 = Set 3)	uint8	3138	12600	Not applicable
AdvancedLoop.SlavePID.Boundary1-2	Scheduler boundary 1-2	float32	3139	12601	0dp
AdvancedLoop.SlavePID.Boundary2-3	Scheduler boundary 2-3	float32	133a	4922	0dp
AdvancedLoop.SlavePID.ControlAction	Control action (0 = Reverse acting; 1 = Direct acting)	uint8	3106	12550	Not applicable
AdvancedLoop.SlavePID.CutbackHigh	Cutback high set 1 (0 = Auto)	float32	313f	12607	1dp
AdvancedLoop.SlavePID.CutbackHigh2	Cutback high set 2 (0 = Auto)	float32	3147	12615	1dp
AdvancedLoop.SlavePID.CutbackHigh3	Cutback high set 3 (0 = Auto)	float32	314f	12623	1dp
AdvancedLoop.SlavePID.CutbackLow	Cutback low set 1 (0 = Auto)	float32	3140	12608	1dp
AdvancedLoop.SlavePID.CutbackLow2	Cutback low set 2 (0 = Auto)	float32	3148	12616	1dp
AdvancedLoop.SlavePID.CutbackLow3	Cutback low set 3 (0 = Auto)	float32	3150	12624	1dp
AdvancedLoop.SlavePID.DerivativeTime	Derivative time set 1 (0 = Off)	float32	313d	12605	1dp
AdvancedLoop.SlavePID.DerivativeTime2	Derivative time set 2 (0 = Off)	float32	3145	12613	1dp
AdvancedLoop.SlavePID.DerivativeTime3	Derivative time set 3 (0 = Off)	float32	314d	12621	1dp
AdvancedLoop.SlavePID.DerivativeType	Derivative type (0 = PV; 1 = Error)	uint8	3305	13061	Not applicable
AdvancedLoop.SlavePID.IntegralTime	Integral time set 1 (0 = Off)	float32	313c	12604	1dp
AdvancedLoop.SlavePID.IntegralTime2	Integral time set 2 (0 = Off)	float32	3144	12612	1dp
AdvancedLoop.SlavePID.IntegralTime3	Integral time set 3 (0 = Off)	float32	314c	12620	1dp
AdvancedLoop.SlavePID.LoopBreakTime	Loop break time set 1 (0 = Off)	float32	3142	12610	0dp
AdvancedLoop.SlavePID.LoopBreakTime2	Loop break time set 2 (0 = Off)	float32	314a	12618	0dp
AdvancedLoop.SlavePID.LoopBreakTime3	Loop break time set 3 (0 = Off)	float32	3152	12626	0dp
AdvancedLoop.SlavePID.ManualReset	Manual reset	float32	3141	12609	1dp
AdvancedLoop.SlavePID.ManualReset2	Manual reset 2	float32	3149	12617	1dp
AdvancedLoop.SlavePID.ManualReset3	Manual reset 3	float32	3151	12625	1dp
AdvancedLoop.SlavePID.NumberOfSets	Number of PID sets	uint8	3136	12598	Not applicable
AdvancedLoop.SlavePID.OutputHi2	Output high limit	float32	3155	12629	1dp
AdvancedLoop.SlavePID.OutputHi3	Output high limit	float32	3157	12631	1dp
AdvancedLoop.SlavePID.OutputHigh	Output high limit	float32	3153	12627	1dp
AdvancedLoop.SlavePID.OutputLo2	Output low limit 2	float32	3156	12630	1dp
AdvancedLoop.SlavePID.OutputLo3	Output low limit	float32	3158	12632	1dp
AdvancedLoop.SlavePID.OutputLow	Output low limit	float32	3154	12628	1dp
AdvancedLoop.SlavePID.PBUnits	Proportional band units (0 = Engineering; 1 = Percentage)	uint8	3304	13060	Not applicable

5.3 PARAMETER LIST (Cont.)

Parameter path	Description	Type	Hex	Dec	Resolution
AdvancedLoop.SlavePID.ProportionalBand	Proportional band set 1	float32	313b	12603	1dp
AdvancedLoop.SlavePID.ProportionalBand2	Proportional band set 2	float32	3143	12611	1dp
AdvancedLoop.SlavePID.ProportionalBand3	Proportional band set 3	float32	314b	12619	1dp
AdvancedLoop.SlavePID.RelCh2Gain	Relative cool/channel 2 gain	float32	313e	12606	1dp
AdvancedLoop.SlavePID.RelCh2Gain2	Relative cool/channel 2 gain 2	float32	3146	12614	1dp
AdvancedLoop.SlavePID.RelCh2Gain3	Relative cool/channel 2 gain 3	float32	314e	12622	1dp
AdvancedLoop.SlavePID.RemoteInput	Scheduler remote input	float32	3137	12599	0dp
AdvancedLoop.SlavePID.SchedulerType	Scheduler type 0 = Off 1 = Manually set 2 = Setpoint 3 = PV 4 = Error 5 = Output 6 = Remote	uint8	3135	12597	Not applicable
AdvancedLoop.SlaveSP.FFSelect	Feedforward select 0 = Master PV 1 = Master WSP 2 = Remote FF	uint8	31bf	12735	Not applicable
AdvancedLoop.SlaveSP.LocalSP	Local setpoint	float32	31b4	12724	Same as AdvancedLoop.Main.SlavePV
AdvancedLoop.SlaveSP.ManualTrack	Manual track enable (0 = Off; 1 = On)	uint8	31ca	12746	Not applicable
AdvancedLoop.SlaveSP.MasterSensorBreakMode	Master sensor break mode 0 = SbrkSP 1 = Hold 2 = SlaveSB	uint8	31c2	12738	Not applicable
AdvancedLoop.SlaveSP.RangeHigh	Range high	float32	31c0	12736	Same as AdvancedLoop.Main.SlavePV
AdvancedLoop.SlaveSP.RangeLow	Range low	float32	31c1	12737	Same as AdvancedLoop.Main.SlavePV
AdvancedLoop.SlaveSP.RemoteFeedForward	Remote feedforward input	float32	31bb	12731	Same as AdvancedLoop.Main.SlavePV
AdvancedLoop.SlaveSP.RemoteFFEnable	Remote feedforward enable (0 = No; 1 = Yes)	bool	31be	12734	Not applicable
AdvancedLoop.SlaveSP.RemoteFFHigh	Remote feedforward high	float32	31bc	12732	Same as AdvancedLoop.Main.SlavePV
AdvancedLoop.SlaveSP.RemoteFFLow	Remote feddforward low	float32	31bd	12733	Same as AdvancedLoop.Main.SlavePV
AdvancedLoop.SlaveSP.SbrkSP	Sensor break setpoint	float32	31c3	12739	Same as AdvancedLoop.Main.SlavePV
AdvancedLoop.SlaveSP.SPHighLimit	Setpoint high limit	float32	31b5	12725	Same as AdvancedLoop.Main.SlavePV
AdvancedLoop.SlaveSP.SPLowLimit	Setpoint low limit	float32	31b6	12726	Same as AdvancedLoop.Main.SlavePV
AdvancedLoop.SlaveSP.TrimHighLimit	Trim high limit	float32	31b9	12729	Same as AdvancedLoop.Main.MasterPV
AdvancedLoop.SlaveSP.TrimLowLimit	Trim low limit	float32	31ba	12730	Same as AdvancedLoop.Main.MasterPV
AdvancedLoop.SlaveSP.TrimRangeHigh	Trim range high	float32	31b7	12727	Same as AdvancedLoop.Main.SlavePV
AdvancedLoop.SlaveSP.TrimRangeLow	Trim range low	float32	31b8	12728	Same as AdvancedLoop.Main.SlavePV
AdvancedLoop.Tune.A1	A1	float32	320d	12813	0dp
AdvancedLoop.Tune.A2	A2	float32	320e	12814	0dp
AdvancedLoop.Tune.Alpha	Alpha	float32	3211	12817	4dp
AdvancedLoop.Tune.Alpha_p	Alpha_p	float32	320f	12815	2dp
AdvancedLoop.Tune.ArgOP	Argument Output	float32	3209	12809	1dp
AdvancedLoop.Tune.ArgPV	Argument PV	float32	3208	12808	1dp
AdvancedLoop.Tune.Band	Band	float32	31c7	12743	1dp
AdvancedLoop.Tune.CycleNo	CycleNo	float32	3213	12819	0dp
AdvancedLoop.Tune.Debug	Debug	float32	3212	12818	2dp
AdvancedLoop.Tune.Diagnostics	Tuning diagnostics	bool	31cb	12747	Not applicable
AdvancedLoop.Tune.Gain	Gain	float32	320a	12810	1dp
AdvancedLoop.Tune.Hysteresis	Hysteresis	float32	31c6	12742	1dp
AdvancedLoop.Tune.MasterTune	Master tune	float32	3203	12803	0dp
AdvancedLoop.Tune.ModeMan	Mode Man	float32	3201	12801	0dp
AdvancedLoop.Tune.ModOP	Modulus OP	float32	3207	12807	1dp
AdvancedLoop.Tune.ModPV	Modulus PV	float32	3206	12806	1dp
AdvancedLoop.Tune.OP	Output	float32	3202	12802	1dp
AdvancedLoop.Tune.OPDel	OPDel	float32	0319	793	2dp
AdvancedLoop.Tune.OPss	OPss	float32	3210	12816	2dp
AdvancedLoop.Tune.OutputHighLimit	Output high	float32	3132	12594	Same as AdvancedLoop.Output.Out-putHighLimit
AdvancedLoop.Tune.OutputLowLimit	Output low	float32	3133	12595	Same as AdvancedLoop.Output.Out-putHighLimit
AdvancedLoop.Tune.PBs	PBs	float32	3214	12820	2dp
AdvancedLoop.Tune.Period	Period	float32	320c	12812	0dp
AdvancedLoop.Tune.Phase	Phase	float32	320b	12811	1dp
AdvancedLoop.Tune.Settle	Settle	float32	3216	12822	2dp
AdvancedLoop.Tune.Stage	Stage 0 = Reset 1 = None 2 = Settling 3 = Current SP 4 = New PP 5 = To SP 6 = Wait Max. 7 = Wait Min 8 = Store 9 = CoolT 10 = PID 11 = Abort 12 = Complete 13 = New R2g 14 = 1: Half Cycle 15 = 2: Full Cycle 16 = 3: Full Cycle 17 = 4: Final cycle 18 = 5: Calculating	uint8	0308	776	Not applicable
AdvancedLoop.Tune.StageTime	Stage time	float32	0309	777	0dp
AdvancedLoop.Tune.State	State 0 = Off 1 = Ready 2 - Running 3 = Complete 4 = Time-out 5 = Ti Limit 6 = R2G limit	uint8	0307	775	Not applicable
AdvancedLoop.Tune.TDs	TDs	float32	3215	12821	2dp
AdvancedLoop.Tune.Timeout	Timeout	float32	0326	806	0dp
AdvancedLoop.Tune.TuneEnable	Autotune enable (0 = Off; 1 = On)	bool	3131	12593	Not applicable
AdvancedLoop.Tune.TuneHigh	Tune high	float32	31c8	12744	Same as AdvancedLoop.Main.SlavePV
AdvancedLoop.Tune.TuneLow	Tune low	float32	31c9	12745	Same as AdvancedLoop.Main.SlavePV
AdvancedLoop.Tune.TuneR2G	Slave R2G tuning type 0 = Standard R2G tuning 1 = R2GPD tuning 2 = Off	uint8	3130	12592	Not applicable
AdvancedLoop.Tune.TuneSlave	Tune slave	float32	3204	12804	1dp
AdvancedLoop.Tune.TuneStatus	Tune Status 0 = Not tuning 1 = Tuning the slave 2 = Tuning the master 3 = Tuning complete -1 = Tuning aborted or timed-out	float32	3205	12805	0dp
AdvancedLoop.Tune.TuneType	Autotune algorithm type (0 = Slave; 1 = Master)	uint8	31c5	12741	Not applicable
AdvancedLoop.Tune.WSP	Working setpoint	float32	3200	12800	Same as AdvancedLoop.Main.MasterPV

5.3 PARAMETER LIST (Cont.)

Parameter path	Description	Type	Hex	Dec	Resolution
AlarmSummary.AnyAlarm	0 = No active alarms; 1 = one or more alarms active	bool	01a2	418	Not applicable
AlarmSummary.AnyChanAlarm	0 = No channel alarms 1 = Channel alarm(s) active but all ack'd. 2 = Channel alarm(s) active but not all ack'd	uint8	01a0	416	Not applicable
AlarmSummary.AnySystemAlarm	0 = No system alarms; 1 = 1 or more system alm(s)	bool	01a1	417	Not applicable
AlarmSummary.Channel.Alarm1Ack	Acknowledge the most recent channel alarm	bool	1192	4498	Not applicable
AlarmSummary.Channel.Alarm1Num	Channel and alarm number of most recent alarm 0 = No alarm 4 = Ch1;Al1 5 =Ch1;Al2 8 = Ch2;Al1 9 = Ch2Al2 12 = Ch3;Al1 13 = Ch3;Al2 16 = Ch4;Al1 17 = Ch4;Al2 132 = VC1;Al1 133 = VC1;Al2 136 = VC2;Al1 137 = VC2;Al2 140 = VC3;Al1 141 = VC3;Al2 144 = VC4;Al1 145 = VC4;Al2 148 = VC5;Al1 149 = VC5;Al2 152 = VC6;Al1 153 = VC6;Al2 156 = VC7;Al1 157 = VC7;Al2 160 = VC8;Al1 161 = VC8;Al2 164 = VC9;Al1 165 = VC9;Al2 168 = VC10;Al1 169 = VC10;Al2 172 = VC11;Al1 173 = VC11;Al2 176 = VC12;Al1 177 = VC12;Al2 180 = VC13;Al1 181 = VC13;Al2 184 = VC14;Al1 185 = VC14;Al2 188 = VC15;Al1 189 = VC15:Al2	uint8	1190	4496	Not applicable
AlarmSummary.Channel.Alarm1Status	Status of most recent alarm 0 = Off 1 = Active 2 = Safe unack 3 = Active unack	uint8	1191	4497	Not applicable
AlarmSummary.Channel.Alarm2Ack	Acknowledge the 2nd most recent channel alarm	bool	1195	4501	Not applicable
AlarmSummary.Channel.Alarm2Num	As Alarm1Num, but for 2nd most recent alarm	uint8	1193	4499	Not applicable
AlarmSummary.Channel.Alarm2Status	As Alarm1Status, but for 2nd most recent alarm	uint8	1194	4500	Not applicable
AlarmSummary.Channel.Alarm3Ack	Acknowledge the 3rd most recent channel alarm	bool	1198	4504	Not applicable
AlarmSummary.Channel.Alarm3Num	As Alarm1Num, but for 3rd most recent alarm	uint8	1196	4502	Not applicable
AlarmSummary.Channel.Alarm3Status	As Alarm1Status, but for 3rd most recent alarm	uint8	1197	4503	Not applicable
AlarmSummary.Channel.Alarm4Ack	Acknowledge the 4th most recent channel alarm	bool	119b	4507	Not applicable
AlarmSummary.Channel.Alarm4Num	As Alarm1Num, but for 4th most recent alarm	uint8	1199	4505	Not applicable
AlarmSummary.Channel.Alarm4Status	As Alarm1Status, but for 4th most recent alarm	uint8	119a	4506	Not applicable
AlarmSummary.Channel.Alarm5Ack	Acknowledge the 5th most recent channel alarm	bool	119e	4510	Not applicable
AlarmSummary.Channel.Alarm5Num	As Alarm1Num, but for 5th most recent alarm	uint8	119c	4508	Not applicable
AlarmSummary.Channel.Alarm5Status	As Alarm1Status, but for 5th most recent alarm	uint8	119d	4509	Not applicable
AlarmSummary.Channel.Alarm6Ack	Acknowledge the 6th most recent channel alarm	bool	11a1	4513	Not applicable
AlarmSummary.Channel.Alarm6Num	As Alarm1Num, but for 6th most recent alarm	uint8	119f	4511	Not applicable
AlarmSummary.Channel.Alarm6Status	As Alarm1Status, but for 6th most recent alarm	uint8	11a0	4512	Not applicable
AlarmSummary.Channel.Alarm7Ack	Acknowledge the 7th most recent channel alarm	bool	11a4	4516	Not applicable
AlarmSummary.Channel.Alarm7Num	As Alarm1Num, but for 7th most recent alarm	uint8	11a2	4514	Not applicable
AlarmSummary.Channel.Alarm7Status	As Alarm1Status, but for 7th most recent alarm	uint8	11a3	4515	Not applicable
AlarmSummary.Channel.Alarm8Ack	Acknowledge the 8th most recent channel alarm	bool	11a7	4519	Not applicable
AlarmSummary.Channel.Alarm8Num	As Alarm1Num, but for 8th most recent alarm	uint8	11a5	4517	Not applicable
AlarmSummary.Channel.Alarm8Status	As Alarm1Status, but for 8th most recent alarm	uint8	11a6	4518	Not applicable
AlarmSummary.Channel.Alarm9Ack	Acknowledge the 9th most recent channel alarm	bool	11aa	4522	Not applicable
AlarmSummary.Channel.Alarm9Num	As Alarm1Num, but for 9th most recent alarm	uint8	11a8	4520	Not applicable
AlarmSummary.Channel.Alarm9Status	As Alarm1Status, but for 9th most recent alarm	uint8	11a9	4521	Not applicable
AlarmSummary.Channel.Alarm10Ack	Acknowledge the 10th most recent channel alarm	bool	11ad	4525	Not applicable
AlarmSummary.Channel.Alarm10Num	As Alarm1Num, but for 10th most recent alarm	uint8	11ab	4523	Not applicable
AlarmSummary.Channel.Alarm10Status	As Alarm1Status, but for 10th most recent alarm	uint8	11ac	4524	Not applicable
AlarmSummary.Channel.Alarm11Ack	Acknowledge the 11th most recent channel alarm	bool	11b0	4528	Not applicable
AlarmSummary.Channel.Alarm11Num	As Alarm1Num, but for 11th most recent alarm	uint8	11ae	4526	Not applicable
AlarmSummary.Channel.Alarm11Status	As Alarm1Status, but for 11th most recent alarm	uint8	11af	4527	Not applicable
AlarmSummary.Channel.Alarm12Ack	Acknowledge the 12th most recent channel alarm	bool	11b3	4531	Not applicable
AlarmSummary.Channel.Alarm12Num	As Alarm1Num, but for 12th most recent alarm	uint8	11b1	4529	Not applicable
AlarmSummary.Channel.Alarm12Status	As Alarm1Status, but for 12th most recent alarm	uint8	11b2	4530	Not applicable
AlarmSummary.Channel.Alarm13Ack	Acknowledge the 13th most recent channel alarm	bool	11b6	4534	Not applicable
AlarmSummary.Channel.Alarm13Num	As Alarm1Num, but for 13th most recent alarmr	uint8	11b4	4532	Not applicable
AlarmSummary.Channel.Alarm13Status	As Alarm1Status, but for 13th most recent alarm	uint8	11b5	4533	Not applicable
AlarmSummary.Channel.Alarm14Ack	Acknowledge the 14th most recent channel alarm	bool	11b9	4537	Not applicable
AlarmSummary.Channel.Alarm14Num	As Alarm1Num, but for 14th most recent alarmr	uint8	11b7	4535	Not applicable
AlarmSummary.Channel.Alarm14Status	As Alarm1Status, but for 14th most recent alarm	uint8	11b8	4536	Not applicable
AlarmSummary.Channel.Alarm15Ack	Acknowledge the 15th most recent channel alarm	bool	11bc	4540	Not applicable
AlarmSummary.Channel.Alarm15Num	As Alarm1Num, but for 15th most recent alarm	uint8	11ba	4538	Not applicable
AlarmSummary.Channel.Alarm15Status	As Alarm1Status, but for 15th most recent alarm	uint8	11bb	4539	Not applicable
AlarmSummary.Channel.Alarm16Ack	Acknowledge the 16th most recent channel alarm	bool	11bf	4543	Not applicable
AlarmSummary.Channel.Alarm16Num	As Alarm1Num, but for 16th most recent alarm	uint8	11bd	4541	Not applicable
AlarmSummary.Channel.Alarm16Status	As Alarm1Status, but for 16th most recent alarm	uint8	11be	4542	Not applicable
AlarmSummary.Channel.Alarm17Ack	Acknowledge the 17th most recent channel alarm	bool	11c2	4546	Not applicable
AlarmSummary.Channel.Alarm17Num	As Alarm1Num, but for 17th most recent alarm	uint8	11c0	4544	Not applicable
AlarmSummary.Channel.Alarm17Status	As Alarm1Status, but for 17th most recent alarm	uint8	11c1	4545	Not applicable
AlarmSummary.Channel.Alarm18Ack	Acknowledge the 18th most recent channel alarm	bool	11c5	4549	Not applicable
AlarmSummary.Channel.Alarm18Num	As Alarm1Num, but for 18th most recent alarm	uint8	11c3	4547	Not applicable
AlarmSummary.Channel.Alarm18Status	As Alarm1Status, but for 18th most recent alarm	uint8	11c4	4548	Not applicable
AlarmSummary.Channel.Alarm19Ack	Acknowledge the 19th most recent channel alarm	bool	11c8	4552	Not applicable
AlarmSummary.Channel.Alarm19Num	As Alarm1Num, but for 19th most recent alarm	uint8	11c6	4550	Not applicable
AlarmSummary.Channel.Alarm19Status	As Alarm1Status, but for 19th most recent alarm	uint8	11c7	4551	Not applicable
AlarmSummary.Channel.Alarm20Ack	Acknowledge the 20th most recent channel alarm	bool	11cb	4555	Not applicable
AlarmSummary.Channel.Alarm20Num	As Alarm1Num, but for 20th most recent alarm	uint8	11c9	4553	Not applicable
AlarmSummary.Channel.Alarm20Status	As Alarm1Status, but for 20th most recent alarm	uint8	11ca	4554	Not applicable
AlarmSummary.Channel.Alarm21Ack	Acknowledge the 21st most recent channel alarm	bool	11ce	4558	Not applicable
AlarmSummary.Channel.Alarm21Num	As Alarm1Num, but for 21st most recent alarm	uint8	11cc	4556	Not applicable
AlarmSummary.Channel.Alarm21Status	As Alarm1Status, but for 21st most recent alarm	uint8	11cd	4557	Not applicable
AlarmSummary.Channel.Alarm22Ack	Acknowledge the 22nd most recent channel alarm	bool	11d1	4561	Not applicable

5.3 PARAMETER LIST (Cont.)

Parameter path	Description	Type	Hex	Dec	Resolution
AlarmSummary.Channel.Alarm22Num	As Alarm1Num, but for 22nd most recent alarm	uint8	11cf	4559	Not applicable
AlarmSummary.Channel.Alarm22Status	As Alarm1Status, but for 22nd most recent alarm	uint8	11d0	4560	Not applicable
AlarmSummary.Channel.Alarm23Ack	Acknowledge the 23rd most recent channel alarm	bool	11d4	4564	Not applicable
AlarmSummary.Channel.Alarm23Num	As Alarm1Num, but for 23th most recent alarm	uint8	11d2	4562	Not applicable
AlarmSummary.Channel.Alarm23Status	As Alarm1Status, but for 23rd most recent alarm	uint8	11d3	4563	Not applicable
AlarmSummary.Channel.Alarm24Ack	Acknowledge the 24th most recent channel alarm	bool	11d7	4567	Not applicable
AlarmSummary.Channel.Alarm24Num	As Alarm1Num, but for 24th most recent alarm	uint8	11d5	4565	Not applicable
AlarmSummary.Channel.Alarm24Status	As Alarm1Status, but for 24th most recent alarm	uint8	11d6	4566	Not applicable
AlarmSummary.Channel.Alarm25Ack	Acknowledge the 25th most recent channel alarm	bool	11da	4570	Not applicable
AlarmSummary.Channel.Alarm25Num	As Alarm1Num, but for 25th most recent alarm	uint8	11d8	4568	Not applicable
AlarmSummary.Channel.Alarm25Status	As Alarm1Status, but for 25th most recent alarm	uint8	11d9	4569	Not applicable
AlarmSummary.Channel.Alarm26Ack	Acknowledge the 26th most recent channel alarm	bool	11dd	4573	Not applicable
AlarmSummary.Channel.Alarm26Num	As Alarm1Num, but for 26th most recent alarm	uint8	11db	4571	Not applicable
AlarmSummary.Channel.Alarm26Status	As Alarm1Status, but for 26th most recent alarm	uint8	11dc	4572	Not applicable
AlarmSummary.Channel.Alarm27Ack	Acknowledge the 27th most recent channel alarm	bool	11e0	4576	Not applicable
AlarmSummary.Channel.Alarm27Num	As Alarm1Num, but for 27th most recent alarm	uint8	11de	4574	Not applicable
AlarmSummary.Channel.Alarm27Status	As Alarm1Status, but for 27th most recent alarm	uint8	11df	4575	Not applicable
AlarmSummary.Channel.Alarm28Ack	Acknowledge the 28th most recent channel alarm	bool	11e3	4579	Not applicable
AlarmSummary.Channel.Alarm28Num	As Alarm1Num, but for 28th most recent alarm	uint8	11e1	4577	Not applicable
AlarmSummary.Channel.Alarm28Status	As Alarm1Status, but for 28th most recent alarm	uint8	11e2	4578	Not applicable
AlarmSummary.Channel.Alarm29Ack	Acknowledge the 29th most recent channel alarm	bool	11e6	4582	Not applicable
AlarmSummary.Channel.Alarm29Num	As Alarm1Num, but for 29th most recent alarm	uint8	11e4	4580	Not applicable
AlarmSummary.Channel.Alarm29Status	As Alarm1Status, but for 29th most recent alarm	uint8	11e5	4581	Not applicable
AlarmSummary.Channel.Alarm30Ack	Acknowledge the 30th most recent channel alarm	bool	11e9	4585	Not applicable
AlarmSummary.Channel.Alarm30Num	As Alarm1Num, but for 30th most recent alarm	uint8	11e7	4583	Not applicable
AlarmSummary.Channel.Alarm30Status	As Alarm1Status, but for 30th most recent alarm	uint8	11e8	4584	Not applicable
AlarmSummary.Channel.Alarm31Ack	Acknowledge the 31st most recent channel alarm	bool	11ec	4588	Not applicable
AlarmSummary.Channel.Alarm31Num	As Alarm1Num, but for 31st most recent alarm	uint8	11ea	4586	Not applicable
AlarmSummary.Channel.Alarm31Status	As Alarm1Status, but for 31st most recent alarm	uint8	11eb	4587	Not applicable
AlarmSummary.Channel.Alarm32Ack	Acknowledge the 32nd most recent channel alarm	bool	11ef	4591	Not applicable
AlarmSummary.Channel.Alarm32Num	As Alarm1Num, but for 32nd most recent alarm	uint8	11ed	4589	Not applicable
AlarmSummary.Channel.Alarm32Status	As Alarm1Status, but for 32nd most recent alarm	uint8	11ee	4590	Not applicable
AlarmSummary.Channel.Alarm33Ack	Acknowledge the 33rd most recent channel alarm	bool	11f2	4594	Not applicable
AlarmSummary.Channel.Alarm33Num	As Alarm1Num, but for 33rd most recent alarm	uint8	11f0	4592	Not applicable
AlarmSummary.Channel.Alarm33Status	As Alarm1Status, but for 33rd most recent alarm	uint8	11f1	4593	Not applicable
AlarmSummary.Channel.Alarm34Ack	Acknowledge the 34th most recent channel alarm	bool	11f5	4597	Not applicable
AlarmSummary.Channel.Alarm34Num	As Alarm1Num, but for 34th most recent alarm	uint8	11f3	4595	Not applicable
AlarmSummary.Channel.Alarm34Status	As Alarm1Status, but for 34th most recent alarm	uint8	11f4	4596	Not applicable
AlarmSummary.Channel.Alarm35Ack	Acknowledge the 35th most recent channel alarm	bool	11f8	4600	Not applicable
AlarmSummary.Channel.Alarm35Num	As Alarm1Num, but for 35th most recent alarm	uint8	11f6	4598	Not applicable
AlarmSummary.Channel.Alarm35Status	As Alarm1Status, but for 35th most recent alarm	uint8	11f7	4599	Not applicable
AlarmSummary.Channel.Alarm36Ack	Acknowledge the 36th most recent channel alarm	bool	11fb	4603	Not applicable
AlarmSummary.Channel.Alarm36Num	As Alarm1Num, but for 36th most recent alarm	uint8	11f9	4601	Not applicable
AlarmSummary.Channel.Alarm36Status	As Alarm1Status, but for 36th most recent alarm	uint8	11fa	4602	Not applicable
AlarmSummary.Channel.Alarm37Ack	Acknowledge the 37th most recent channel alarm	bool	11fe	4606	Not applicable
AlarmSummary.Channel.Alarm37Num	As Alarm1Num, but for 37th most recent alarm	uint8	11fc	4604	Not applicable
AlarmSummary.Channel.Alarm37Status	As Alarm1Status, but for 38th most recent alarm	uint8	11fd	4605	Not applicable
AlarmSummary.Channel.Alarm38Ack	Acknowledge the 38th most recent channel alarm	bool	1201	4609	Not applicable
AlarmSummary.Channel.Alarm38Num	As Alarm1Num, but for 38th most recent alarm	uint8	11ff	4607	Not applicable
AlarmSummary.Channel.Alarm38Status	As Alarm1Status, but for 38th most recent alarm	uint8	1200	4608	Not applicable
AlarmSummary.GlobalAck	Acknowledge all alarms. 0=No;1 = yes	bool	01a3	419	Not applicable
AlarmSummary.StatusWord1	A summary of Channel 1-4 alarms	int16	01a4	420	Not applicable
	Bit 0: 1 = Channel 1 Alarm 1 active				
	Bit 1: 1 = Channel 1 Alarm 1 not acknowledged				
	Bit 2: 1 = Channel 1 Alarm 2 active				
	Bit 3: 1 = Channel 1 Alarm 2 not acknowledged				
	Bit 4: 1 = Channel 2 Alarm 1 active				
	Bit 5: 1 = Channel 2 Alarm 1 not acknowledged				
	Bit 6: 1 = Channel 2 Alarm 2 active				
	Bit 7: 1 = Channel 2 Alarm 2 not acknowledged				
	Bit 8: 1 = Channel 3 Alarm 1 active				
	Bit 9: 1 = Channel 3 Alarm 1 not acknowledged				
	Bit 10: 1 = Channel 3 Alarm 2 active				
	Bit 11: 1 = Channel 3 Alarm 2 not acknowledged				
	Bit 12: 1 = Channel 4 Alarm 1 active				
	Bit 13: 1 = Channel 4 Alarm 1 not acknowledged				
	Bit 14: 1 = Channel 4 Alarm 2 active				
	Bit 15: 1 = Channel 4 Alarm 2 not acknowledged				
AlarmSummary.StatusWord2	A summary of Virtual Channel 1 to 4 alarms	int16	01a5	421	Not applicable
	Bit 0: 1 = Virtual channel 1 Alarm 1 active				
	Bit 1: 1 = Virtual channel 1 Alarm 1 not ack'd				
	Bit 2: 1 = Virtual channel 1 Alarm 2 active				
	Bit 3: 1 = Virtual channel 1 Alarm 2 not ack'd				
	Bit 4: 1 = Virtual channel 2 Alarm 1 active				
	Bit 5: 1 = Virtual channel 2 Alarm 1 not ack'd				
	Bit 6: 1 = Virtual channel 2 Alarm 2 active				
	Bit 7: 1 = Virtual channel 2 Alarm 2 not ack'd				
	Bit 8: 1 = Virtual channel 3 Alarm 1 active				
	Bit 9: 1 = Virtual channel 3 Alarm 1 not ack'd				
	Bit 10: 1 = Virtual channel 3 Alarm 2 active				
	Bit 11: 1 = Virtual channel 3 Alarm 2 not ack'd				

5.3 PARAMETER LIST (Cont.)

Parameter path	Description	Type	Hex	Dec	Resolution
AlarmSummary.StatusWord2 (Cont.)	Bit 12: 1 = Virtual channel 4 Alarm 1 active Bit 13: 1 = Virtual channel 4 Alarm 1 not ack'd Bit 14: 1 = Virtual channel 4 Alarm 2 active Bit 15: 1 = Virtual channel 4 Alarm 2 not ack'd				
AlarmSummary.StatusWord3	A summary of Virtual Channel 5 to 8 alarms As for Status Word 2 but for virtual channs 5 to 8	int16	01a6	422	Not applicable
AlarmSummary.StatusWord4	A summary of Virtual Channel 9 to 12 alarms As for Status Word 2 but for virtual channs 9 to 12	int16	01a7	423	Not applicable
AlarmSummary.StatusWord5	A summary of Virtual Channel 13 to 14 alarms As for Status Word 2 but for virtual channs 13 to 15	int16	01a8	424	Not applicable
AlarmSummary.System.Alarm1ID	Most recent active system alarm 0 = No Alarm 1 = Low battery 2 = Battery failure 3 = System clock fail 4 = Channel error 5 = Channel fail 6 = DHCP server fail 7 = FTP Archive file lost 8 = FTP Archive slow 9 = FTP Primary server failure 10 = FTP Secondary server failure 11 = Insufficient non-volatile memory 12 = Maths channel failure 13 = Media archive file lost 14 = Media archive slow 15 = Network boot failure 16 = DC Output Cal. Error 17 = Recording failure 18 = Media failure 19: = Media full 20 =SNTP failure 21 = Time synchronisation failure 22 = Media missing 23: Archive disabled 24 = Archiving failed 25 = Archiving timed out 26 = USB Over Current 27 = USB unsuported 28 = Invalid parameter database 29 = Invalid non-volatile data 30 = Flash write failure 31 = Wiring failure 32 = Broadcast Storm 33 = Non-volatile memory write frequency warning	uint8	1210	4624	Not applicable
AlarmSummary.System.Alarm2ID	2nd most recent active system alarm (as Alarm1ID)	uint8	1211	4625	Not applicable
AlarmSummary.System.Alarm3ID	3rd most recent active system alarm (as Alarm1ID)	uint8	1212	4626	Not applicable
AlarmSummary.System.Alarm4ID	4th most recent active system alarm (as Alarm1ID)	uint8	1213	4627	Not applicable
AlarmSummary.System.Alarm5ID	5th most recent active system alarm (as Alarm1ID)	uint8	1214	4628	Not applicable
AlarmSummary.System.Alarm6ID	6th most recent active system alarm (as Alarm1ID)	uint8	1215	4629	Not applicable
AlarmSummary.System.Alarm7ID	7th most recent active system alarm (as Alarm1ID)	uint8	1216	4630	Not applicable
AlarmSummary.System.Alarm8ID	8th most recent active system alarm (as Alarm1ID)	uint8	1217	4631	Not applicable
AlarmSummary.System.Alarm9ID	9th most recent active system alarm (as Alarm1ID)	uint8	1218	4632	Not applicable
AlarmSummary.System.Alarm10ID	10th most recent active system alarm (as Alarm1ID)	uint8	1219	4633	Not applicable
AlarmSummary.System.Alarm11ID	11th most recent active system alarm (as Alarm1ID)	uint8	121a	4634	Not applicable
AlarmSummary.System.Alarm12ID	12th most recent active system alarm (as Alarm1ID)	uint8	121b	4635	Not applicable
AlarmSummary.System.Alarm13ID	13th most recent active system alarm (as Alarm1ID)	uint8	121c	4636	Not applicable
AlarmSummary.System.Alarm14ID	14th most recent active system alarm (as Alarm1ID)	uint8	121d	4637	Not applicable
AlarmSummary.System.Alarm15ID	15th most recent active system alarm (as Alarm1ID)	uint8	121e	4638	Not applicable
AlarmSummary.System.Alarm16ID	16th most recent active system alarm (as Alarm1ID)	uint8	121f	4639	Not applicable
AlarmSummary.System.Alarm17ID	17th most recent active system alarm (as Alarm1ID)	uint8	1220	4640	Not applicable
AlarmSummary.System.Alarm18ID	18th most recent active system alarm (as Alarm1ID)	uint8	1221	4641	Not applicable
AlarmSummary.System.Alarm19ID	19th most recent active system alarm (as Alarm1ID)	uint8	1222	4642	Not applicable
AlarmSummary.System.Alarm20ID	20th most recent active system alarm (as Alarm1ID)	uint8	1223	4643	Not applicable
AlarmSummary.System.Alarm21ID	21st most recent active system alarm (as Alarm1ID)	uint8	1224	4644	Not applicable
AlarmSummary.System.Alarm22ID	22nd most recent active system alarm (as Alarm1ID)	uint8	1225	4645	Not applicable
AlarmSummary.System.Alarm23ID	23rd most recent active system alarm (as Alarm1ID)	uint8	1226	4646	Not applicable
AlarmSummary.System.Alarm24ID	24th most recent active system alarm (as Alarm1ID)	uint8	1227	4647	Not applicable
AlarmSummary.System.Alarm25ID	25th most recent active system alarm (as Alarm1ID)	uint8	1228	4648	Not applicable
AlarmSummary.System.Alarm26ID	26th most recent active system alarm (as Alarm1ID)	uint8	1229	4649	Not applicable
AlarmSummary.System.Alarm27ID	27th most recent active system alarm (as Alarm1ID)	uint8	122a	4650	Not applicable
AlarmSummary.System.Alarm28ID	28th most recent active system alarm (as Alarm1ID)	uint8	122b	4651	Not applicable
AlarmSummary.System.Alarm29ID	29th most recent active system alarm (as Alarm1ID)	uint8	122c	4652	Not applicable
AlarmSummary.System.Alarm30ID	30th most recent active system alarm (as Alarm1ID)	uint8	122d	4653	Not applicable
AlarmSummary.System.Alarm31ID	31st most recent active system alarm (as Alarm1ID)	uint8	122e	4654	Not applicable
AlarmSummary.System.Alarm32ID	32nd most recent active system alarm (as Alarm1ID)	uint8	122f	4655	Not applicable
BCDInput.1.BCDVal	BCD1 BCD Value	uint8	2ed1	11985	Not applicable
BCDInput.1.DecByte	BCD1 Decimal Value	uint8	2ed0	11984	Not applicable
BCDInput.1.In1	BCD1 Input 1 (0 = Off; 1 = On)	bool	2ec8	11976	Not applicable
BCDInput.1.In2	BCD1 Input 2 (0 = Off; 1 = On)	bool	2ec9	11977	Not applicable
BCDInput.1.In3	BCD1 Input 3 (0 = Off; 1 = On)	bool	2eca	11978	Not applicable
BCDInput.1.In4	BCD1 Input 4 (0 = Off; 1 = On)	bool	2ecb	11979	Not applicable
BCDInput.1.In5	BCD1 Input 5 (0 = Off; 1 = On)	bool	2ecc	11980	Not applicable
BCDInput.1.In6	BCD1 Input 6 (0 = Off; 1 = On)	bool	2ecd	11981	Not applicable
BCDInput.1.In7	BCD1 Input 7 (0 = Off; 1 = On)	bool	2ece	11982	Not applicable
BCDInput.1.In8	BCD1 Input 8 (0 = Off; 1 = On)	bool	2ecf	11983	Not applicable
BCDInput.1.Tens	BCD1 Tens (MSD)	uint8	2ed3	11987	Not applicable
BCDInput.1.Units	BCD1 Units (LSD)	uint8	2ed2	11986	Not applicable
BCDInput.2.BCDVal	BCD2 BCD Value	uint8	2edd	11997	Not applicable
BCDInput.2.DecByte	BCD2 Decimal Value	uint8	2edc	11996	Not applicable
BCDInput.2.In1	BCD2 Input 1 (0 = Off; 1 = On)	bool	2ed4	11988	Not applicable
BCDInput.2.In2	BCD2 Input 2 (0 = Off; 1 = On)	bool	2ed5	11989	Not applicable
BCDInput.2.In3	BCD2 Input 3 (0 = Off; 1 = On)	bool	2ed6	11990	Not applicable

5.3 PARAMETER LIST (Cont.)

Parameter path	Description	Type	Hex	Dec	Resolution
BCDInput.2.In4	BCD2 Input 4 (0 = Off; 1 = On)	bool	2ed7	11991	Not applicable
BCDInput.2.In5	BCD2 Input 5 (0 = Off; 1 = On)	bool	2ed8	11992	Not applicable
BCDInput.2.In6	BCD2 Input 6 (0 = Off; 1 = On)	bool	2ed9	11993	Not applicable
BCDInput.2.In7	BCD2 Input 7 (0 = Off; 1 = On)	bool	2eda	11994	Not applicable
BCDInput.2.In8	BCD2 Input 8 (0 = Off; 1 = On)	bool	2edb	11995	Not applicable
BCDInput.2.Tens	BCD2 Tens (MSD)	uint8	2edf	11999	Not applicable
BCDInput.2.Units	BCD2 Units (LSD)	uint8	2ede	11998	Not applicable
Channel.1.Alarm1.Acknowledge	1 = Acknowledge alarm	bool	01b0	432	Not applicable
Channel.1.Alarm1.Acknowledgement	1 = Alarm acknowledged	bool	1850	6224	Not applicable
Channel.1.Alarm1.Active	1 = Alarm source active, or safe but not ack'd	bool	184b	6219	Not applicable
Channel.1.Alarm1.Amount	Alarm amount	float32	1848	6216	Same as Channel.1.Main.PV
Channel.1.Alarm1.AverageTime	Average time	time_t	184a	6218	Set by Network.Modbus.TimeFormat
Channel.1.Alarm1.Block	Blocking enable (0 = Off; 1 = On)	uint8	1842	6210	Not applicable
Channel.1.Alarm1.ChangeTime	Change time (0 = Per second; 1= Per minute; 2 =Per hour)	uint8	1849	6217	Not applicable
Channel.1.Alarm1.Deviation	Alarm deviation	float32	1847	6215	Same as Channel.1.Main.PV
Channel.1.Alarm1.Dwell	Alarm dwell	time_t	1845	6213	Set by Network.Modbus.TimeFormat
Channel.1.Alarm1.Hysteresis	Alarm hysteresis	float32	1844	6212	Same as Channel.1.Main.PV
Channel.1.Alarm1.Inactive	1 = the alarm is safe and acknowledged	bool	184e	6222	Not applicable
Channel.1.Alarm1.Inhibit	1 = the alarm is inhibited	bool	1851	6225	Not applicable
Channel.1.Alarm1.Latch	Alarm latch type	uint8	1841	6209	Not applicable
	0 = None 1 = Auto				
	2 = Manual 3 = Trigger				
Channel.1.Alarm1.NotAcknowledged	1 = the alarm has not been acknowledged	bool	184f	6223	Not applicable
Channel.1.Alarm1.Reference	Alarm reference	float32	1846	6214	Same as Channel.1.Main.PV
Channel.1.Alarm1.Status	Alarm status	uint8	0102	258	Not applicable
	0 = Off 1 = Active				
	2 = Safe not acknowledged 3 = Active not acknowledged				
Channel.1.Alarm1.Threshold	Alarm threshold	float32	1843	6211	Same as Channel.1.Main.PV
Channel.1.Alarm1.Type	Alarn type	uint8	1840	6208	Not applicable
	0 = None 1 = Abs High 2 = Abs Low				
	3 = Dev high 4 = Dev Low 5 = Dev band				
	6 = ROC rising 7 = ROC falling 10 = Dig Off				
	11 = Dig high 12 = Dig Low				
Channel.1.Alarm2.Acknowledge	1 = Acknowledge alarm	bool	01b1	433	Not applicable
Channel.1.Alarm2.Acknowledgement	1 = Alarm acknowledged	bool	1870	6256	Not applicable
Channel.1.Alarm2.Active	1 = Alarm source active, or safe but not ack'd	bool	186b	6251	Not applicable
Channel.1.Alarm2.Amount	Alarm amount	float32	1868	6248	Same as Channel.1.Main.PV
Channel.1.Alarm2.AverageTime	Average time	time_t	186a	6250	Set by Network.Modbus.TimeFormat
Channel.1.Alarm2.Block	Blocking enable (0 = Off; 1 = On)	uint8	1862	6242	Not applicable
Channel.1.Alarm2.ChangeTime	Change time (0 = Per second; 1= Per minute; 2 =Per hour)	uint8	1869	6249	Not applicable
Channel.1.Alarm2.Deviation	Alarm deviation	float32	1867	6247	Same as Channel.1.Main.PV
Channel.1.Alarm2.Dwell	Alarm dwell	time_t	1865	6245	Set by Network.Modbus.TimeFormat
Channel.1.Alarm2.Hysteresis	Alarm hysteresis	float32	1864	6244	Same as Channel.1.Main.PV
Channel.1.Alarm2.Inactive	1 = the alarm is safe and acknowledged	bool	186e	6254	Not applicable
Channel.1.Alarm2.Inhibit	1 = the alarm is inhibited	bool	1871	6257	Not applicable
Channel.1.Alarm2.Latch	Configures the latching type of the alarm (As Alarm1.Latch)	uint8	1861	6241	Not applicable
Channel.1.Alarm2.NotAcknowledged	1 = the alarm has not been acknowledged	bool	186f	6255	Not applicable
Channel.1.Alarm2.Reference	Alarm reference	float32	1866	6246	Same as Channel.1.Main.PV
Channel.1.Alarm2.Status	As Alarm1.Status	uint8	0103	259	Not applicable
Channel.1.Alarm2.Threshold	Alarm threshold	float32	1863	6243	Same as Channel.1.Main.PV
Channel.1.Alarm2.Type	Alarm type (as Alarm1.Type	uint8	1860	6240	Not applicable
Channel.1.Main.CJType	Cold junction compensation type	uint8	180c	6156	Not applicable
	0 = None 1 = Internal 2 = External				
	3 = Remote (Ch1) 4 = Remote (Ch2) 5 = Remote (Ch3)				
	6 = Remote (Ch4)				
Channel.1.Main.CloseString	Close String	string_t	4990	18832	Not applicable
Channel.1.Main.Descriptor	Text string to describe the channel	string_t	4900	18688	Not applicable
Channel.1.Main.ExtCJTemp	External CJ temperature	float32	180d	6157	1dp
Channel.1.Main.FaultResponse	Fault response. 0 = none; 1 = Drive high; 2 = Drive low	uint8	1810	6160	Not applicable
Channel.1.Main.Filter	Filter time constant	float32	180e	6158	1dp
Channel.1.Main.InputHigh	Input range high value	float32	1804	6148	1dp
Channel.1.Main.InputLow	Input range low value	float32	1803	6147	1dp
Channel.1.Main.InternalCJTemp	Channel internal cold junction temperature	float32	1815	6165	1dp
Channel.1.Main.IPAdjustState	Input Adjust state (0 = Unadjusted; 1 = Adjusted)	bool	1816	6166	Not applicable
Channel.1.Main.IPAdjustState2	Secondary Input Adjust state (0 = Unadjusted; 1 = Adjusted)	bool	181c	6172	Not applicable
Channel.1.Main.LinType	Linearisation type	uint8	1806	6150	Not applicable
	0 =Type B 1 = Type C 2 = Type D				
	3 = Type E 4 = Type G2 5 = Type J				
	6 =Type K 7 = Type L 8 = Type N				
	9 = Type R 10 = Type S 11 = Type T				
	12 = Type U 13 = NiMoNiCo 14 = Platinel				
	15 = NiNiMo 16 = Pt20RhPt40Rh 17 = User 1				
	18 = User 2 19 = User 3 20 = User 4				
	21 = Cu10 22 = Pt100 23 = Pt100A				
	24 = JPT100 25 = Ni100 26 = Ni120				
	27 = Cu53 28 = Linear 29 = Sqrt				
	30 = $x^{3/2}$ 32 = $x^{5/2}$				
Channel.1.Main.MeasuredValue	Input value before linearisation, scaling, adjust etc.	float32	1814	6164	Set by Channel.1.Main.Resolution
Channel.1.Main.MeasuredValue2	Measured value of the secondary input	float32	1819	6169	Set by Channel.1.Main.Resolution
Channel.1.Main.Offset	Fixed value to be added to/subtracted from PV	float32	1817	6167	3dp

5.3 PARAMETER LIST (Cont.)

Parameter path	Description	Type	Hex	Dec	Resolution
Channel.1.Main.Offset2	Secondary input offset (as above).	float32	1818	6168	3dp
Channel.1.Main.OpenString	Open String	string_t	496c	18796	Not applicable
Channel.1.Main.PV	The process variable (output) of the channel	float32	0100	256	Set by Channel.1.Main.Resolution
Channel.1.Main.PV2	The secondary input process variable (output) of the channel	float32	0110	272	Set by Channel.1.Main.Resolution
Channel.1.Main.RangeHigh	Range high value	float32	1808	6152	Set by Channel.1.Main.Resolution
Channel.1.Main.RangeLow	Range low value	float32	1807	6151	Set by Channel.1.Main.Resolution
Channel.1.Main.RangeUnits	Range units: 0 = °C; 1 = °F; 2 = Kelvins	uint8	1809	6153	Not applicable
Channel.1.Main.Resolution	Specifies the resolution/number of decimal places	uint8	1801	6145	Not applicable
Channel.1.Main.ScaleHigh	Scale high value	float32	180b	6155	Set by Channel.1.Main.Resolution
Channel.1.Main.ScaleHigh2	Scale high value for the secondary input	float32	181b	6171	Set by Channel.1.Main.Resolution
Channel.1.Main.ScaleLow	Scale low value	float32	180a	6154	Set by Channel.1.Main.Resolution
Channel.1.Main.ScaleLow2	Scale low value for the secondary input	float32	181a	6170	Set by Channel.1.Main.Resolution
Channel.1.Main.SensorBreakType	Sensor break type: 0 =Off; 1 = Low; 2 = High	uint8	180f	6159	Not applicable
Channel.1.Main.SensorBreakVal	Sensor break value	uint8	1811	6161	Not applicable
Channel.1.Main.Shunt	Shunt value (Ohms)	float32	1805	6149	2dp
Channel.1.Main.Status	The PV (output) status 0 =Good 1 = Off 2 = Over range 3 = Under range 4 = HW error 5 = Ranging 6 = Overflow 7 = bad 8 = HW exceeded 9 = No data 12 = Comm channel error	uint8	0101	257	Not applicable
Channel.1.Main.Status2	The secondary input PV (output) status (as above)	uint8	0111	273	Not applicable
Channel.1.Main.TestSignal	Channel test waveform 0 = Triangle 5hr 1 = Triangle 40 min 2 = Triangle 4 min 3 = Triangle 40 sec 4 = Sine 5 hr 5 = Sine 40 min 6 = Sine 4 min 7 = Sine 40 sec	uint8	1802	6146	Not applicable
Channel.1.Main.Type	Specifies the type of channel 0 = Off 1 = TC 2 = mV 3 = V 4 = mA 5 = RTD 6 = Digital 7 = Test 8 = Ohms 9 = Dual mV 10 = Dual mA 11 = Dual TC	uint8	1800	6144	Not applicable
Channel.1.Main.Units	Units descriptor	string_t	4915	18709	Not applicable
Channel.1.Trend.Colour	Configures the trend colour for this channeluint8 0 = Red 1 = Blue 2 = Green 3 = Honey 4 = Violet 5 = Russet 6 = Dark blue 7 = Jade 8 = Magenta 9 = Dusky rose 10 = Yellow 11 = Powder blue 12 = Dark red 13 = Avocado 14 = Indigo 15 = Dark brown 16 = Aegean 17 = Cyan 18 = Aubergine 19 = Dark orange 20 = Pale yellow 21 = Hyacinth 22 = Dark green 23 = Sugar pink 24 = Bluebell 25 = Orange 26 = Pink 27 = Buttersilk 28 = Terracotta 29 = Blue babe 30 = Lime 31 = Blue jive 32 = Cucumber 33 = Eurogreen 34 = Wheatgerm 35 = Sea Blue 36 = Ginger 37 = Aqua pool 38 = Pale red 39 = Pale blue 40 = Lilac 41 = Sky blue 42 = Wild moss 43 = Turquoise 44 = Pale green 45 = Coffee 49 = Dark Grey 53 = Light grey	1820		6176	Not applicable
Channel.1.Trend.SpanHigh	Specifies the highest PV (output value) to be displayed	float32	1822	6178	Same as Channel.1.Main.PV
Channel.1.Trend.SpanLow	Specifies the lowest PV (output value) to be displayed	float32	1821	6177	Same as Channel.1.Main.PV
Channel.2.Alarm1.Acknowledge	1 = acknowledge alarm	bool	01b2	434	Not applicable
Channel.2.Alarm1.Acknowledgement	1 = alarm acknowledged	bool	18d0	6352	Not applicable
Channel.2.Alarm1.Active	1 = alarm source active, or safe but not ack'd	bool	18cb	6347	Not applicable
Channel.2.Alarm1.Amount	Rate-of-change alarm 'Amount'	float32	18c8	6344	Same as Channel.2.Main.PV
Channel.2.Alarm1.AverageTime	Rate-of-change alarm 'Average time'	time_t	18ca	6346	Set by Network.Modbus.TimeFormat
Channel.2.Alarm1.Block	0 = Blocking alarms off; 1 = Blocking alarms on	uint8	18c2	6338	Not applicable
Channel.2.Alarm1.ChangeTime	Rate-of-change alarm 'Change Time'	uint8	18c9	6345	Not applicable
Channel.2.Alarm1.Deviation	Deviation alarm 'Deviation Value'	float32	18c7	6343	Same as Channel.2.Main.PV
Channel.2.Alarm1.Dwell	Alarm dwell time	time_t	18c5	6341	Set by Network.Modbus.TimeFormat
Channel.2.Alarm1.Hysteresis	Alarm hysteresis value	float32	18c4	6340	Same as Channel.2.Main.PV
Channel.2.Alarm1.Inactive	1 = alarm source safe and ack'd (if necessary)	bool	18ce	6350	Not applicable
Channel.2.Alarm1.Inhibit	1 = Alarm inhibited	bool	18d1	6353	Not applicable
Channel.2.Alarm1.Latch	Alarm latch type (as for Channel.1.Alarm1)	uint8	18c1	6337	Not applicable
Channel.2.Alarm1.NotAcknowledged	1 = alarm has not been acknowledged	bool	18cf	6351	Not applicable
Channel.2.Alarm1.Reference	Deviation alarm 'Reference' value	float32	18c6	6342	Same as Channel.2.Main.PV
Channel.2.Alarm1.Status	Alarm status (as for Channel.1.Alarm1)	uint8	0106	262	Not applicable
Channel.2.Alarm1.Threshold	Alarm trigger threshold	float32	18c3	6339	Same as Channel.2.Main.PV
Channel.2.Alarm1.Type	Alarn type (as for Channel.1.Alarm1)	uint8	18c0	6336	Not applicable
Channel.2.Alarm2.Acknowledge	1 = acknowledge alarm	bool	01b3	435	Not applicable
Channel.2.Alarm2.Acknowledgement	1 = alarm acknowledged	bool	18f0	6384	Not applicable
Channel.2.Alarm2.Active	1 = alarm source active, or safe but not ack'd	bool	18eb	6379	Not applicable
Channel.2.Alarm2.Amount	Rate-of-change alarm 'Amount'	float32	18e8	6376	Same as Channel.2.Main.PV
Channel.2.Alarm2.AverageTime	Rate-of-change alarm 'Average time'	time_t	18ea	6378	Set by Network.Modbus.TimeFormat
Channel.2.Alarm2.Block	0 = Blocking alarms off; 1 = Blocking alarms on	uint8	18e2	6370	Not applicable
Channel.2.Alarm2.ChangeTime	Rate-of-change alarm 'Change Time'	uint8	18e9	6377	Not applicable
Channel.2.Alarm2.Deviation	Deviation alarm 'Deviation Value'	float32	18e7	6375	Same as Channel.2.Main.PV
Channel.2.Alarm2.Dwell	Alarm dwell time	time_t	18e5	6373	Set by Network.Modbus.TimeFormat
Channel.2.Alarm2.Hysteresis	Alarm hysteresis value	float32	18e4	6372	Same as Channel.2.Main.PV
Channel.2.Alarm2.Inactive	1 = alarm source safe and ack'd (if necessary)	bool	18ee	6382	Not applicable
Channel.2.Alarm2.Inhibit	1 = Alarm inhibited	bool	18f1	6385	Not applicable
Channel.2.Alarm2.Latch	Alarm latch type (as for Channel.1.Alarm1)	uint8	18e1	6369	Not applicable

5.3 PARAMETER LIST (Cont.)

Parameter path	Description	Type	Hex	Dec	Resolution
Channel.2.Alarm2.NotAcknowledged	1 = alarm has not been acknowledged	bool	18ef	6383	Not applicable
Channel.2.Alarm2.Reference	Deviation alarm 'Reference' value	float32	18e6	6374	Same as Channel.2.Main.PV
Channel.2.Alarm2.Status	Alarm status (as for Channel.1.Alarm1)	uint8	0107	263	Not applicable
Channel.2.Alarm2.Threshold	Alarm trigger threshold	float32	18e3	6371	Same as Channel.2.Main.PV
Channel.2.Alarm2.Type	Alarn type (as for Channel.1.Alarm1)	uint8	18e0	6368	Not applicable
Channel.2.Main.CJType	Cold junction compensation type (as for Channel.1.Main)	uint8	188c	6284	Not applicable
Channel.2.Main.CloseString	Close String	string_t	4999	18841	Not applicable
Channel.2.Main.Descriptor	Text string to describe the channel	string_t	491b	18715	Not applicable
Channel.2.Main.ExtCJTemp	External CJ temperature	float32	188d	6285	1dp
Channel.2.Main.FaultResponse	Input fault response	uint8	1890	6288	Not applicable
Channel.2.Main.Filter	Filter time constant	float32	188e	6286	1dp
Channel.2.Main.InputHigh	Input range high value	float32	1884	6276	1dp
Channel.2.Main.InputLow	Input range low value	float32	1883	6275	1dp
Channel.2.Main.InternalCJTemp	Channel 2 internal cold junction temperature	float32	1895	6293	1dp
Channel.2.Main.IPAdjustState	Input Adjust state (0 = Unadjusted; 1 =Adjusted)	bool	1896	6294	Not applicable
Channel.2.Main.IPAdjustState2	Secondary Input Adjust state (0 = Unadjusted; 1 = Adjusted)	bool	189c	6300	Not applicable
Channel.2.Main.LinType	Linearisation type (as for Channel.1.Main)	uint8	1886	6278	Not applicable
Channel.2.Main.MeasuredValue	Input value before linearisation, scaling, adjust etc.	float32	1894	6292	Set by Channel.2.Main.Resolution
Channel.2.Main.MeasuredValue2	Measured value of the secondary input	float32	1899	6297	Set by Channel.2.Main.Resolution
Channel.2.Main.Offset	Fixed value to be added to/subtracted from PV	float32	1897	6295	3dp
Channel.2.Main.Offset2	Secondary input offset	float32	1898	6296	3dp
Channel.2.Main.OpenString	Open String	string_t	4975	18805	Not applicable
Channel.2.Main.PV	The output (displayed) value of the channel.	float32	0104	260	Set by Channel.2.Main.Resolution
Channel.2.Main.PV2	The secondary input process variable (output) of the channel	float32	0114	276	Set by Channel.2.Main.Resolution
Channel.2.Main.RangeHigh	Range high value	float32	1888	6280	Set by Channel.2.Main.Resolution
Channel.2.Main.RangeLow	Range low value	float32	1887	6279	Set by Channel.2.Main.Resolution
Channel.2.Main.RangeUnits	Range units (as channel.1.Main)	uint8	1889	6281	Not applicable
Channel.2.Main.Resolution	Specifies the resolution/number of decimal places	uint8	1881	6273	Not applicable
Channel.2.Main.ScaleHigh	Scale high value	float32	188b	6283	Set by Channel.2.Main.Resolution
Channel.2.Main.ScaleHigh2	Scale high value for the secondary input	float32	189b	6299	Set by Channel.2.Main.Resolution
Channel.2.Main.ScaleLow	Scale low value	float32	188a	6282	Set by Channel.2.Main.Resolution
Channel.2.Main.ScaleLow2	Scale low value for the secondary input	float32	189a	6298	Set by Channel.2.Main.Resolution
Channel.2.Main.SensorBreakType	Sensor break type (as for Channel.1.Main)	uint8	188f	6287	Not applicable
Channel.2.Main.SensorBreakVal	Sensor break value	uint8	1891	6289	Not applicable
Channel.2.Main.Shunt	Shunt value in Ohms	float32	1885	6277	2dp
Channel.2.Main.Status	Channel status (as for Channel.1.Main.Status)	uint8	0105	261	Not applicable
Channel.2.Main.Status2	The secondary input PV (output) status (as above)	uint8	0115	277	Not applicable
Channel.2.Main.TestSignal	Channel test waveform (as for Channel.1.Main)	uint8	1882	6274	Not applicable
Channel.2.Main.Type	Channel function (as for Channel.1.Main.Type)	uint8	1880	6272	Not applicable
Channel.2.Main.Units	Channel units string	string_t	4930	18736	Not applicable
Channel.2.Trend.Colour	Trend colour (as for Channel.1.Trend.Colour)	uint8	18a0	6304	Not applicable
Channel.2.Trend.SpanHigh	Specifies the highest PV (output value) to be displayed	float32	18a2	6306	Same as Channel.2.Main.PV
Channel.2.Trend.SpanLow	Specifies the lowest PV (output value) to be displayed	float32	18a1	6305	Same as Channel.2.Main.PV
Channel.3.Alarm1.Acknowledgement	1 = alarm acknowledged	bool	1950	6480	Not applicable
Channel.3.Alarm1.Active	1 = alarm source active, or safe but not ack'd	bool	194b	6475	Not applicable
Channel.3.Alarm1.Amount	Rate-of-change alarm 'Amount'	float32	1948	6472	Same as Channel.3.Main.PV
Channel.3.Alarm1.AverageTime	Rate-of-change alarm 'Average time'	time_t	194a	6474	Set by Network.Modbus.TimeFormat
Channel.3.Alarm1.Block	0 = Blocking alarms off; 1 = Blocking alarms on.	uint8	1942	6466	Not applicable
Channel.3.Alarm1.ChangeTime	Rate-of-change alarm 'Change Time'	uint8	1949	6473	Not applicable
Channel.3.Alarm1.Deviation	Deviation alarm 'Deviation Value'	float32	1947	6471	Same as Channel.3.Main.PV
Channel.3.Alarm1.Dwell	Alarm dwell time	time_t	1945	6469	Set by Network.Modbus.TimeFormat
Channel.3.Alarm1.Hysteresis	Alarm hysteresis value	float32	1944	6468	Same as Channel.3.Main.PV
Channel.3.Alarm1.Inactive	1 = alarm source safe and ack'd (if necessary)	bool	194e	6478	Not applicable
Channel.3.Alarm1.Inhibit	1 = alarm inhibited	bool	1951	6481	Not applicable
Channel.3.Alarm1.Latch	Alarm latch type (as for Channel.1.Alarm1)	uint8	1941	6465	Not applicable
Channel.3.Alarm1.NotAcknowledged	1 = alarm has not been acknowledged	bool	194f	6479	Not applicable
Channel.3.Alarm1.Reference	Deviation alarm 'Reference' value	float32	1946	6470	Same as Channel.3.Main.PV
Channel.3.Alarm1.Status	Alarm status (as for Channel.1.Alarm1)	uint8	010a	266	Not applicable
Channel.3.Alarm1.Threshold	Alarm trigger threshold	float32	1943	6467	Same as Channel.3.Main.PV
Channel.3.Alarm1.Type	Alarn type (as for Channel.1.Alarm1)	uint8	1940	6464	Not applicable
Channel.3.Alarm2.Acknowledge	1 = acknowledge alarm	bool	01b5	437	Not applicable
Channel.3.Alarm2.Acknowledgement	1 = alarm acknowledged	bool	1970	6512	Not applicable
Channel.3.Alarm2.Active	1 = alarm source active, or safe but not ack'd	bool	196b	6507	Not applicable
Channel.3.Alarm2.Amount	Rate-of-change alarm 'Amount'	float32	1968	6504	Same as Channel.3.Main.PV
Channel.3.Alarm2.AverageTime	Rate-of-change alarm 'Average time'	time_t	196a	6506	Set by Network.Modbus.TimeFormat
Channel.3.Alarm2.Block	0 = Blocking alarms off; 1 = Blocking alarms on.	uint8	1962	6498	Not applicable
Channel.3.Alarm2.ChangeTime	Rate-of-change alarm 'Change Time'	uint8	1969	6505	Not applicable
Channel.3.Alarm2.Deviation	Deviation alarm 'Deviation Value'	float32	1967	6503	Same as Channel.3.Main.PV
Channel.3.Alarm2.Dwell	Alarm dwell time	time_t	1965	6501	Set by Network.Modbus.TimeFormat
Channel.3.Alarm2.Hysteresis	Alarm hysteresis value	float32	1964	6500	Same as Channel.3.Main.PV
Channel.3.Alarm2.Inactive	1 = alarm source safe and ack'd (if necessary)	bool	196e	6510	Not applicable
Channel.3.Alarm2.Inhibit	1 = Alarm inhibited	bool	1971	6513	Not applicable
Channel.3.Alarm2.Latch	Alarm latch type (as for Channel.1.Alarm1)	uint8	1961	6497	Not applicable
Channel.3.Alarm2.NotAcknowledged	1 = alarm has not been acknowledged	bool	196f	6511	Not applicable
Channel.3.Alarm2.Reference	Deviation alarm 'Reference' value	float32	1966	6502	Same as Channel.3.Main.PV
Channel.3.Alarm2.Status	Alarm status (as for Channel.1.Alarm1)	uint8	010b	267	Not applicable
Channel.3.Alarm2.Threshold	Alarm trigger threshold	float32	1963	6499	Same as Channel.3.Main.PV
Channel.3.Alarm2.Type	Alarn type (as for Channel.1.Alarm1)	uint8	1960	6496	Not applicable
Channel.3.Main.CJType	Cold junction compensation type (as for Channel.1.Main)	uint8	190c	6412	Not applicable
Channel.3.Main.CloseString	Close String	string_t	49a2	18850	Not applicable

5.3 PARAMETER LIST (Cont.)

Parameter path	Description	Type	Hex	Dec	Resolution
Channel.3.Main.Descriptor	Text string to describe the channel	string_t	4936	18742	Not applicable
Channel.3.Main.ExtCJTemp	External CJ temperature	float32	190d	6413	1dp
Channel.3.Main.FaultResponse	Input fault response (As for Channel.1.Main)	uint8	1910	6416	Not applicable
Channel.3.Main.Filter	Filter time constant	float32	190e	6414	1dp
Channel.3.Main.InputHigh	Input range maximum value	float32	1904	6404	1dp
Channel.3.Main.InputLow	Input range minimum value	float32	1903	6403	1dp
Channel.3.Main.InternalCJTemp	Channel internal cold junction temperature	float32	1915	6421	1dp
Channel.3.Main.IPAdjustState	Input Adjust state (0 = Unadjusted; 1 = Adjusted)	bool	1916	6422	Not applicable
Channel.3.Main.IPAdjustState2	Secondary Input Adjust state (0 = Unadjusted; 1 = Adjusted)	bool	191c	6428	Not applicable
Channel.3.Main.LinType	Linearisation type (as for Channel.1.Main.LinType)	uint8	1906	6406	Not applicable
Channel.3.Main.MeasuredValue	Input value before linearisation, scaling, adjust etc.	float32	1914	6420	Set by Channel.3.Main.Resolution
Channel.3.Main.MeasuredValue2	Measured value of the secondary input	float32	1919	6425	Set by Channel.3.Main.Resolution
Channel.3.Main.Offset	Input offset	float32	1917	6423	3dp
Channel.3.Main.Offset2	Secondary input offset	float32	1918	6424	3dp
Channel.3.Main.OpenString	Open String	string_t	497e	18814	Not applicable
Channel.3.Main.PV	The output (displayed) value of the channel.	float32	0108	264	Set by Channel.3.Main.Resolution
Channel.3.Main.PV2	The secondary input process variable (output) of the channel	float32	0118	280	Set by Channel.3.Main.Resolution
Channel.3.Main.RangeHigh	Range high value	float32	1908	6408	Set by Channel.3.Main.Resolution
Channel.3.Main.RangeLow	Range low value	float32	1907	6407	Set by Channel.3.Main.Resolution
Channel.3.Main.RangeUnits	Range units	uint8	1909	6409	Not applicable
Channel.3.Main.Resolution	Specifies the resolution/number of decimal places	uint8	1901	6401	Not applicable
Channel.3.Main.ScaleHigh	Scale high value	float32	190b	6411	Set by Channel.3.Main.Resolution
Channel.3.Main.ScaleHigh2	Scale high value for the secondary input	float32	191b	6427	Set by Channel.3.Main.Resolution
Channel.3.Main.ScaleLow	Scale low value	float32	190a	6410	Set by Channel.3.Main.Resolution
Channel.3.Main.ScaleLow2	Scale low value for the secondary input	float32	191a	6426	Set by Channel.3.Main.Resolution
Channel.3.Main.SensorBreakType	Sensor break type (as for Channel.1.Main)	uint8	190f	6415	Not applicable
Channel.3.Main.SensorBreakVal	Sensor break value	uint8	1911	6417	Not applicable
Channel.3.Main.Shunt	Shunt value in Ohms	float32	1905	6405	2dp
Channel.3.Main.Status	Channel status (as for Channel.1.Main.Status)	uint8	0109	265	Not applicable
Channel.3.Main.Status2	The secondary input PV (output) status	uint8	0119	281	Not applicable
Channel.3.Main.TestSignal	Channel test waveform (as for Channel.1.Main)	uint8	1902	6402	Not applicable
Channel.3.Main.Type	Channel function (as for Channel.1.Main.Type)	uint8	1900	6400	Not applicable
Channel.3.Main.Units	Units descriptor	string_t	494b	18763	Not applicable
Channel.3.Trend.Colour	Trend colour (as for Channel.1.Trend.Colour)	uint8	1920	6432	Not applicable
Channel.3.Trend.SpanHigh	Specifies the highest PV (output value) to be displayed	float32	1922	6434	Same as Channel.3.Main.PV
Channel.3.Trend.SpanLow	Specifies the lowest PV (output value) to be displayed	float32	1921	6433	Same as Channel.3.Main.PV
Channel.4.Alarm1.Acknowledge	1 = acknowledge alarm	bool	01b6	438	Not applicable
Channel.4.Alarm1.Acknowledgement	1 = alarm acknowledged	bool	19d0	6608	Not applicable
Channel.4.Alarm1.Active	1 = alarm source active, or safe but not ack'd	bool	19cb	6603	Not applicable
Channel.4.Alarm1.Amount	Rate-of-change alarm 'Amount'	float32	19c8	6600	Same as Channel.4.Main.PV
Channel.4.Alarm1.AverageTime	Rate-of-change alarm 'Average time'	time_t	19ca	6602	Set by Network.Modbus.TimeFormat
Channel.4.Alarm1.Block	0 = Blocking alarms off; 1 = Blocking alarms on.	uint8	19c2	6594	Not applicable
Channel.4.Alarm1.ChangeTime	Rate-of-change alarm 'Change Time'	uint8	19c9	6601	Not applicable
Channel.4.Alarm1.Deviation	Deviation alarm 'Deviation Value'	float32	19c7	6599	Same as Channel.4.Main.PV
Channel.4.Alarm1.Dwell	Alarm dwell time	time_t	19c5	6597	Set by Network.Modbus.TimeFormat
Channel.4.Alarm1.Hysteresis	Alarm hysteresis value	float32	19c4	6596	Same as Channel.4.Main.PV
Channel.4.Alarm1.Inactive	1 = alarm source safe and ack'd (if necessary)	bool	19ce	6606	Not applicable
Channel.4.Alarm1.Inhibit	1 = alarm inhibited	bool	19d1	6609	Not applicable
Channel.4.Alarm1.Latch	Alarm latch type (as for Channel.1.Alarm1)	uint8	19c1	6593	Not applicable
Channel.4.Alarm1.NotAcknowledged	1 = alarm has not been acknowledged	bool	19cf	6607	Not applicable
Channel.4.Alarm1.Reference	Deviation alarm 'Reference' value	float32	19c6	6598	Same as Channel.4.Main.PV
Channel.4.Alarm1.Status	Alarm status (as for Channel.1.Alarm1)	uint8	010e	270	Not applicable
Channel.4.Alarm1.Threshold	Alarm trigger threshold	float32	19c3	6595	Same as Channel.4.Main.PV
Channel.4.Alarm1.Type	Alarn type (as for Channel.1.Alarm1)	uint8	19c0	6592	Not applicable
Channel.4.Alarm2.Acknowledge	1 = acknowledge alarm	bool	01b7	439	Not applicable
Channel.4.Alarm2.Acknowledgement	1 = alarm acknowledged	bool	19f0	6640	Not applicable
Channel.4.Alarm2.Active	1 = alarm source active, or safe but not ack'd	bool	19eb	6635	Not applicable
Channel.4.Alarm2.Amount	Rate-of-change alarm 'Amount'	float32	19e8	6632	Same as Channel.4.Main.PV
Channel.4.Alarm2.AverageTime	Rate-of-change alarm 'Average time'	time_t	19ea	6634	Set by Network.Modbus.TimeFormat
Channel.4.Alarm2.Block	0 = Blocking alarms off; 1 = Blocking alarms on	uint8	19e2	6626	Not applicable
Channel.4.Alarm2.ChangeTime	Rate-of-change alarm 'Change Time'	uint8	19e9	6633	Not applicable
Channel.4.Alarm2.Deviation	Deviation alarm 'Deviation Value'	float32	19e7	6631	Same as Channel.4.Main.PV
Channel.4.Alarm2.Dwell	Alarm dwell time	time_t	19e5	6629	Set by Network.Modbus.TimeFormat
Channel.4.Alarm2.Hysteresis	Alarm hysteresis value	float32	19e4	6628	Same as Channel.4.Main.PV
Channel.4.Alarm2.Inactive	1 = alarm source safe and ack'd (if necessary)	bool	19ee	6638	Not applicable
Channel.4.Alarm2.Latch	Alarm latch type (as for Channel.1.Alarm1)	uint8	19e1	6625	Not applicable
Channel.4.Alarm2.NotAcknowledged	1 = alarm has not been acknowledged	bool	19ef	6639	Not applicable
Channel.4.Alarm2.Reference	Deviation alarm 'Reference' value	float32	19e6	6630	Same as Channel.4.Main.PV
Channel.4.Alarm2.Status	Alarm status (as for Channel.1.Alarm1)	uint8	010f	271	Not applicable
Channel.4.Alarm2.Threshold	Alarm trigger threshold	float32	19e3	6627	Same as Channel.4.Main.PV
Channel.4.Alarm2.Type	Alarn type (as for Channel.1.Alarm1)	uint8	19e0	6624	Not applicable
Channel.4.Main.CJType	Cold junction compensation type(as for Channel.1.Main)	uint8	198c	6540	Not applicable
Channel.4.Main.CloseString	Close String	string_t	49ab	18859	Not applicable
Channel.4.Main.Descriptor	Text string to describe the channel	string_t	4951	18769	Not applicable
Channel.4.Main.ExtCJTemp	External CJ temperature	float32	198d	6541	1dp
Channel.4.Main.FaultResponse	Input fault response (as for Channel.1.Main)	uint8	1990	6544	Not applicable
Channel.4.Main.Filter	Filter time constant	float32	198e	6542	1dp
Channel.4.Main.InputHigh	Input range maximum value	float32	1984	6532	1dp
Channel.4.Main.InputLow	Input range minimum value	float32	1983	6531	1dp
Channel.4.Main.InternalCJTemp	Channel internal cold junction temperature	float32	1995	6549	1dp

5.3 PARAMETER LIST (Cont.)

Parameter path	Description	Type	Hex	Dec	Resolution
Channel.4.Main.IPAdjustState	Input Adjust state (0 = Unadjusted;1 =Adjusted)	bool	1996	6550	Not applicable
Channel.4.Main.IPAdjustState2	Secondary Input Adjust state (0 = Unadjusted; 1 = Adjusted	bool	199c	6556	Not applicable
Channel.4.Main.LinType	Linearisation type (as for Channel.1.Main.LinType)	uint8	1986	6534	Not applicable
Channel.4.Main.MeasuredValue	Input value before linearisation, scaling, adjust etc.	float32	1994	6548	Set by Channel.4.Main.Resolution
Channel.4.Main.MeasuredValue2	Measured value of the secondary input	float32	1999	6553	Set by Channel.4.Main.Resolution
Channel.4.Main.Offset	Fixed value to be added to/subtracted from PV	float32	1997	6551	3dp
Channel.4.Main.Offset2	Secondary input offset	float32	1998	6552	3dp
Channel.4.Main.OpenString	Open String	string_t	4987	18823	Not applicable
Channel.4.Main.PV	The output (displayed) value of the channel.	float32	010c	268	Set by Channel.4.Main.Resolution
Channel.4.Main.PV2	The secondary input process variable (output) of the channel	float32	011c	284	Set by Channel.4.Main.Resolution
Channel.4.Main.RangeHigh	Range high value	float32	1988	6536	Set by Channel.4.Main.Resolution
Channel.4.Main.RangeLow	Range low value	float32	1987	6535	Set by Channel.4.Main.Resolution
Channel.4.Main.RangeUnits	Range units (as channel.1.Main.RangeUnits)	uint8	1989	6537	Not applicable
Channel.4.Main.Resolution	Specifies the resolution/number of decimal places	uint8	1981	6529	Not applicable
Channel.4.Main.ScaleHigh	Scale high value	float32	198b	6539	Set by Channel.4.Main.Resolution
Channel.4.Main.ScaleHigh2	Scale high value for the secondary input	float32	199b	6555	Set by Channel.4.Main.Resolution
Channel.4.Main.ScaleLow	Scale low value	float32	198a	6538	Set by Channel.4.Main.Resolution
Channel.4.Main.ScaleLow2	Scale low value for the secondary input	float32	199a	6554	Set by Channel.4.Main.Resolution
Channel.4.Main.SensorBreakType	Sensor break type (as for Channel.1.Main)	uint8	198f	6543	Not applicable
Channel.4.Main.SensorBreakVal	Sensor break value	uint8	1991	6545	Not applicable
Channel.4.Main.Shunt	Shunt value in Ohms	float32	1985	6533	2dp
Channel.4.Main.Status	Channel status (as for Channel.1.Main.Status)	uint8	010d	269	Not applicable
Channel.4.Main.Status2	The secondary input PV (output) status	uint8	011d	285	Not applicable
Channel.4.Main.TestSignal	Channel test waveform (as for Channel.1.Main.TestSignal)	uint8	1982	6530	Not applicable
Channel.4.Main.Type	Channel function (as for Channel.1.Main.Type)	uint8	1980	6528	Not applicable
Channel.4.Main.Units	Units descriptor	string_t	4966	18790	Not applicable
Channel.4.Trend.Colour	Trend colour (as for Channel.1.Trend.Colour)	uint8	19a0	6560	Not applicable
Channel.4.Trend.SpanHigh	Specifies the highest PV (output value) to be displayed	float32	19a2	6562	Same as Channel.4.Main.PV
Channel.4.Trend.SpanLow	Specifies the lowest PV (output value) to be displayed	float32	19a1	6561	Same as Channel.4.Main.PV
CustomMessage.Message1	Custom message No 1	string_t	5e00	24064	Not applicable
CustomMessage.Message2	Custom message No 2	string_t	5e65	24165	Not applicable
CustomMessage.Message3	Custom message No 3	string_t	5eca	24266	Not applicable
CustomMessage.Message4	Custom message No 4	string_t	5f2f	24367	Not applicable
CustomMessage.Message5	Custom message No 5	string_t	5f94	24468	Not applicable
CustomMessage.Message6	Custom message No 6	string_t	5ff9	24569	Not applicable
CustomMessage.Message7	Custom message No 7	string_t	605e	24670	Not applicable
CustomMessage.Message8	Custom message No 8	string_t	60c3	24771	Not applicable
CustomMessage.Message9	Custom message No 9	string_t	6128	24872	Not applicable
CustomMessage.Message10	Custom message No 10	string_t	618d	24973	Not applicable
CustomMessage.Trigger1	Trigger for custom message No 1	bool	28f0	10480	Not applicable
CustomMessage.Trigger2	Trigger for custom message No 2	bool	28f1	10481	Not applicable
CustomMessage.Trigger3	Trigger for custom message No 3	bool	28f2	10482	Not applicable
CustomMessage.Trigger4	Trigger for custom message No 4	bool	28f3	10483	Not applicable
CustomMessage.Trigger5	Trigger for custom message No 5	bool	28f4	10484	Not applicable
CustomMessage.Trigger6	Trigger for custom message No 6	bool	28f5	10485	Not applicable
CustomMessage.Trigger7	Trigger for custom message No 7	bool	28f6	10486	Not applicable
CustomMessage.Trigger8	Trigger for custom message No 8	bool	28f7	10487	Not applicable
CustomMessage.Trigger9	Trigger for custom message No 9	bool	28f8	10488	Not applicable
CustomMessage.Trigger10	Trigger for custom message No 10	bool	28f9	10489	Not applicable
DCOutput.1A1B_DCOP.FallbackPV	Fallback PV value	float32	15c9	5577	Set by DCOutput.1A1B_DCOP.Resolution
DCOutput.1A1B_DCOP.MeasuredValue	Measured Value	float32	15ca	5578	2dp
DCOutput.1A1B_DCOP.OPAdjustState	0 = Unadjusted, 1 = Adjusted	bool	15c3	5571	Not applicable
DCOutput.1A1B_DCOP.OutputHigh	DC Output High value	float32	15c6	5574	2dp
DCOutput.1A1B_DCOP.OutputLow	DC Output Low value	float32	15c5	5573	2dp
DCOutput.1A1B_DCOP.PV	DC Output PV	float32	15c1	5569	Set by DCOutput.1A1B_DCOP.Resolution
DCOutput.1A1B_DCOP.Resolution	Specifies the resolution/number of decimal places	uint8	15c4	5572	Not applicable
DCOutput.1A1B_DCOP.ScaleHigh	Scale High value	float32	15c8	5576	Set by DCOutput.1A1B_DCOP.Resolution
DCOutput.1A1B_DCOP.ScaleLow	Scale Low value	float32	15c7	5575	Set by DCOutput.1A1B_DCOP.Resolution
DCOutput.1A1B_DCOP.Status	PV Status 0 = Good 1 = Off 2 = Over range 3 = Under range 4 = HW error 5 = Ranging 6 = Overflow 7 = Bad 8 = HW exceeded 9 = No data 10 = Comms channel error	uint8	15c2	5570	Not applicable
DCOutput.1A1B_DCOP.Type	DC Output Type (0 = Volts; 1 = mA)	uint8	15c0	5568	Not applicable
DCOutput.2A2B_DCOP.FallbackPV	Fallback PV value	float32	15b9	5561	Set by DCOutput.2A2B_DCOP.Resolution
DCOutput.2A2B_DCOP.MeasuredValue	Measured Value	float32	15ba	5562	2dp
DCOutput.2A2B_DCOP.OPAdjustState	0 = Unadjusted, 1 = Adjusted	bool	15b3	5555	Not applicable
DCOutput.2A2B_DCOP.OutputHigh	DC Output High value	float32	15b6	5558	2dp
DCOutput.2A2B_DCOP.OutputLow	DC Output Low value	float32	15b5	5557	2dp
DCOutput.2A2B_DCOP.PV	DC Output PV	float32	15b1	5553	Set by DCOutput.2A2B_DCOP.Resolution
DCOutput.2A2B_DCOP.Resolution	Specifies the resolution/number of decimal places	uint8	15b4	5556	Not applicable
DCOutput.2A2B_DCOP.ScaleHigh	Scale High value	float32	15b8	5560	Set by DCOutput.2A2B_DCOP.Resolution
DCOutput.2A2B_DCOP.ScaleLow	Scale Low value	float32	15b7	5559	Set by DCOutput.2A2B_DCOP.Resolution
DCOutput.2A2B_DCOP.Status	PV Status (as DCOutput.1A1B_DCOP.Status)	uint8	15b2	5554	Not applicable
DCOutput.2A2B_DCOP.Type	DC Output Type (0 = Volts; 1 = mA)	uint8	15b0	5552	Not applicable

5.3 PARAMETER LIST (Cont.)

Parameter path	Description	Type	Hex	Dec	Resolution
DCOutput.3A3B_DCOP.FallbackPV	Fallback PV value	float32	15a9	5545	Set by DCOutput.3A3B_DCOP.Resolution
DCOutput.3A3B_DCOP.MeasuredValue	Measured Value	float32	15aa	5546	2dp
DCOutput.3A3B_DCOP.OPAdjustState	0 = Unadjusted, 1 = Adjusted	bool	15a3	5539	Not applicable
DCOutput.3A3B_DCOP.OutputHigh	DC Output High value	float32	15a6	5542	2dp
DCOutput.3A3B_DCOP.OutputLow	DC Output Low value	float32	15a5	5541	2dp
DCOutput.3A3B_DCOP.PV	DC Output PV	float32	15a1	5537	Set by DCOutput.3A3B_DCOP.Resolution
DCOutput.3A3B_DCOP.Resolution	Specifies the resolution/number of decimal places	uint8	15a4	5540	Not applicable
DCOutput.3A3B_DCOP.ScaleHigh	Scale High value	float32	15a8	5544	Set by DCOutput.3A3B_DCOP.Resolution
DCOutput.3A3B_DCOP.ScaleLow	Scale Low value	float32	15a7	5543	Set by DCOutput.3A3B_DCOP.Resolution
DCOutput.3A3B_DCOP.Status	PV Status (as DCOutput.1A1B_DCOP.Status)	uint8	15a2	5538	Not applicable
DCOutput.3A3B_DCOP.Type	DC Output Type (0 = Volts; 1 = mA)	uint8	15a0	5536	Not applicable
DigitalIO.1A1B.Backlash	Valve positioning backlash compensation (seconds)	float32	1508	5384	1dp
DigitalIO.1A1B.Inertia	Inertia value for the valve	float32	1507	5383	1dp
DigitalIO.1A1B.Invert	1 = Invert; 0 = Do not invert	bool	1503	5379	Not applicable
DigitalIO.1A1B.MinOnTime	Time proportioned output minimum on time	float32	1502	5378	2dp
DigitalIO.1A1B.ModuleIdent	Module Identification 0 = Digital I/O 1 = Relay output 2 = Triac output 3 = Digital input 4 = Digital output	uint8	150a	5386	Not applicable
DigitalIO.1A1B.Output	0 = Output off, 1 = Output on	bool	1504	5380	Not applicable
DigitalIO.1A1B.PV	For contact inputs, 0 = Open, 1 = Closed. For On Off outputs, <0.5 = Drive low, else drive high For Time Proportional outputs, PV = demanded output %	float32	1501	5377	0dp
DigitalIO.1A1B.StandbyAction	Valve positioning standby action (0 = Continue; 1 = Freeze).	uint8	1509	5385	Not applicable
DigitalIO.1A1B.Type	Specifies the type of the digital input / output 0 = Contact closure input 1 = On Off output 2 = Time proportioniing output 3 = Valve raise 4 = Valve lower	uint8	1500	5376	Not applicable
DigitalIO.2A2B.Backlash	Valve positioning backlash compensation (seconds)	float32	1518	5400	1dp
DigitalIO.2A2B.Inertia	Inertia value for the valve	float32	1517	5399	1dp
DigitalIO.2A2B.Invert	1 = Invert; 0 = Do not invert	bool	1513	5395	Not applicable
DigitalIO.2A2B.MinOnTime	Time proportioned output minimum on time	float32	1512	5394	2dp
DigitalIO.2A2B.ModuleIdent	As DigitalIO.1A1B.ModuleIdent	uint8	151a	5402	Not applicable
DigitalIO.2A2B.Output	0 = Output off, 1 = Output on	bool	1514	5396	Not applicable
DigitalIO.2A2B.PV	Digital I/O process value (as DigitalIO.1A1B.PV)	float32	1511	5393	0dp
DigitalIO.2A2B.StandbyAction	Valve positioning standby action (0 = Continue; 1 = Freeze).	uint8	1519	5401	Not applicable
DigitalIO.2A2B.Type	Digital I/O type (as DigitalIO.1A1B.Type).	uint8	1510	5392	Not applicable
DigitalIO.3A3B.Backlash	Valve positioning backlash compensation (seconds)	float32	1538	5432	1dp
DigitalIO.3A3B.Inertia	Inertia value for the valve	float32	1537	5431	1dp
DigitalIO.3A3B.Invert	1 = Invert; 0 = Do not invert	bool	1533	5427	Not applicable
DigitalIO.3A3B.MinOnTime	Time proportioned output minimum on time	float32	1532	5426	2dp
DigitalIO.3A3B.ModuleIdent	As DigitalIO.1A1B.ModuleIdent	uint8	153a	5434	Not applicable
DigitalIO.3A3B.Output	0 = Output off, 1 = Output on	bool	1534	5428	Not applicable
DigitalIO.3A3B.PV	Digital I/O process value (as DigitalIO.1A1B.PV)	float32	1531	5425	0dp
DigitalIO.3A3B.StandbyAction	Valve positioning standby action (0 = Continue; 1 = Freeze).	uint8	1539	5433	Not applicable
DigitalIO.3A3B.Type	Digital I/O type (as DigitalIO.1A1B.Type).	uint8	1530	5424	Not applicable
DigitalIO.DI_LALC.Backlash	Valve positioning backlash compensation (seconds)	float32	1528	5416	1dp
DigitalIO.DI_LALC.Inertia	Inertia value for the valve	float32	1527	5415	1dp
DigitalIO.DI_LALC.Invert	1 = Invert; 0 = Do not invert	bool	1523	5411	Not applicable
DigitalIO.DI_LALC.MinOnTime	Time proportioned output minimum on time	float32	1522	5410	2dp
DigitalIO.DI_LALC.ModuleIdent	As DigitalIO.1A1B.ModuleIdent	uint8	152a	5418	Not applicable
DigitalIO.DI_LALC.Output	0 = Output off, 1 = Output on	bool	1524	5412	Not applicable
DigitalIO.DI_LALC.PV	Digital I/O process value (as DigitalIO.1A1B.PV)	float32	1521	5409	0dp
DigitalIO.DI_LALC.StandbyAction	Valve positioning standby action (0 = Continue; 1 = Freeze).	uint8	1529	5417	Not applicable
DigitalIO.DI_LALC.Type	Digital I/O type (as DigitalIO.1A1B.Type).	uint8	1520	5408	Not applicable
DigitalIO.DI_LBLC.Backlash	Valve positioning backlash compensation (seconds)	float32	1548	5448	1dp
DigitalIO.DI_LBLC.Inertia	Inertia value for the valve	float32	1547	5447	1dp
DigitalIO.DI_LBLC.Invert	1 = Invert; 0 = Do not invert	bool	1543	5443	Not applicable
DigitalIO.DI_LBLC.MinOnTime	Time proportioned output minimum on time	float32	1542	5442	2dp
DigitalIO.DI_LBLC.ModuleIdent	As DigitalIO.1A1B.ModuleIdent	uint8	154a	5450	Not applicable
DigitalIO.DI_LBLC.Output	0 = Output off, 1 = Output on	bool	1544	5444	Not applicable
DigitalIO.DI_LBLC.PV	Digital I/O process value (as DigitalIO.1A1B.PV)	float32	1541	5441	0dp
DigitalIO.DI_LBLC.StandbyAction	Valve positioning standby action (0 = Continue; 1 = Freeze).	uint8	1549	5449	Not applicable
DigitalIO.DI_LBLC.Type	Digital I/O type (as DigitalIO.1A1B.Type).	uint8	1540	5440	Not applicable
DigitalIO.RELAY_4AC.Backlash	Valve positioning backlash compensation (seconds)	float32	1558	5464	1dp
DigitalIO.RELAY_4AC.Inertia	Inertia value for the valve	float32	1557	5463	1dp
DigitalIO.RELAY_4AC.Invert	1 = Invert; 0 = Do not invert	bool	1553	5459	Not applicable
DigitalIO.RELAY_4AC.MinOnTime	Time proportioned output minimum on time	float32	1552	5458	2dp

5.3 PARAMETER LIST (Cont.)

Parameter path	Description	Type	Hex	Dec	Resolution
DigitalIO.RELAY_4AC.ModuleIdent	As DigitalIO.1A1B.ModuleIdent	uint8	155a	5466	Not applicable
DigitalIO.RELAY_4AC.Output	0 = Output off, 1 = Output on	bool	1554	5460	Not applicable
DigitalIO.RELAY_4AC.PV	Digital I/O process value (as DigitalIO.1A1B.PV)	float32	1551	5457	0dp
DigitalIO.RELAY_4AC.StandbyAction	Valve positioning standby action (0 = Continue; 1 = Freeze).	uint8	1559	5465	Not applicable
DigitalIO.RELAY_4AC.Type	Digital I/O type (as DigitalIO.1A1B.Type).	uint8	1550	5456	Not applicable
DigitalIO.RELAY_5AC.Backlash	Valve positioning backlash compensation (seconds)	float32	1568	5480	1dp
DigitalIO.RELAY_5AC.Inertia	Inertia value for the valve	float32	1567	5479	1dp
DigitalIO.RELAY_5AC.Invert	1 = Invert; 0 = Do not invert	bool	1563	5475	Not applicable
DigitalIO.RELAY_5AC.MinOnTime	Time proportioned output minimum on time	float32	1562	5474	2dp
DigitalIO.RELAY_5AC.ModuleIdent	As DigitalIO.1A1B.ModuleIdent	uint8	156a	5482	Not applicable
DigitalIO.RELAY_5AC.Output	0 = Output off, 1 = Output on	bool	1564	5476	Not applicable
DigitalIO.RELAY_5AC.PV	Digital I/O process value (as DigitalIO.1A1B.PV)	float32	1561	5473	0dp
DigitalIO.RELAY_5AC.StandbyAction	Valve positioning standby action (0 = Continue; 1 = Freeze).	uint8	1569	5481	Not applicable
DigitalIO.RELAY_5AC.Type	Digital I/O type (as DigitalIO.1A1B.Type).	uint8	1560	5472	Not applicable
EthernetIP.ImplicitInputs.Input1	Read only input from an EtherNet/IP client	eint32	7e66	32358	Not applicable
EthernetIP.ImplicitInputs.Input2	See input 1 for details	eint32	7e6a	32362	Not applicable
EthernetIP.ImplicitInputs.Input3	See input 1 for details	eint32	7e6e	32366	Not applicable
EthernetIP.ImplicitInputs.Input4	See input 1 for details	eint32	7e72	32370	Not applicable
EthernetIP.ImplicitInputs.Input5	See input 1 for details	eint32	7e76	32374	Not applicable
EthernetIP.ImplicitInputs.Input6	See input 1 for details	eint32	7e7a	32378	Not applicable
EthernetIP.ImplicitInputs.Input7	See input 1 for details	eint32	7e7e	32382	Not applicable
EthernetIP.ImplicitInputs.Input8	See input 1 for details	eint32	7e82	32386	Not applicable
EthernetIP.ImplicitInputs.Input9	See input 1 for details	eint32	7e86	32390	Not applicable
EthernetIP.ImplicitInputs.Input10	See input 1 for details	eint32	7e8a	32394	Not applicable
EthernetIP.ImplicitInputs.Input11	See input 1 for details	eint32	7e8e	32398	Not applicable
EthernetIP.ImplicitInputs.Input12	See input 1 for details	eint32	7e92	32402	Not applicable
EthernetIP.ImplicitInputs.Input13	See input 1 for details	eint32	7e96	32406	Not applicable
EthernetIP.ImplicitInputs.Input14	See input 1 for details	eint32	7e9a	32410	Not applicable
EthernetIP.ImplicitInputs.Input15	See input 1 for details	eint32	7e9e	32414	Not applicable
EthernetIP.ImplicitInputs.Input16	See input 1 for details	eint32	7ea2	32418	Not applicable
EthernetIP.ImplicitInputs.Input17	See input 1 for details	eint32	7ea6	32422	Not applicable
EthernetIP.ImplicitInputs.Input18	See input 1 for details	eint32	7eaa	32426	Not applicable
EthernetIP.ImplicitInputs.Input19	See input 1 for details	eint32	7eae	32430	Not applicable
EthernetIP.ImplicitInputs.Input20	See input 1 for details	eint32	7eb2	32434	Not applicable
EthernetIP.ImplicitInputs.Input21	See input 1 for details	eint32	7eb6	32438	Not applicable
EthernetIP.ImplicitInputs.Input22	See input 1 for details	eint32	7eba	32442	Not applicable
EthernetIP.ImplicitInputs.Input23	See input 1 for details	eint32	7ebe	32446	Not applicable
EthernetIP.ImplicitInputs.Input24	See input 1 for details	eint32	7ec2	32450	Not applicable
EthernetIP.ImplicitInputs.Input25	See input 1 for details	eint32	7ec6	32454	Not applicable
EthernetIP.ImplicitInputs.Input26	See input 1 for details	eint32	7eca	32458	Not applicable
EthernetIP.ImplicitInputs.Input27	See input 1 for details	eint32	7ece	32462	Not applicable
EthernetIP.ImplicitInputs.Input28	See input 1 for details	eint32	7ed2	32466	Not applicable
EthernetIP.ImplicitInputs.Input29	See input 1 for details	eint32	7ed6	32470	Not applicable
EthernetIP.ImplicitInputs.Input30	See input 1 for details	eint32	7eda	32474	Not applicable
EthernetIP.ImplicitInputs.Input31	See input 1 for details	eint32	7ede	32478	Not applicable
EthernetIP.ImplicitInputs.Input32	See input 1 for details	eint32	7ee2	32482	Not applicable
EthernetIP.ImplicitInputs.Input33	See input 1 for details	eint32	7ee6	32486	Not applicable
EthernetIP.ImplicitInputs.Input34	See input 1 for details	eint32	7eea	32490	Not applicable
EthernetIP.ImplicitInputs.Input35	See input 1 for details	eint32	7eee	32494	Not applicable
EthernetIP.ImplicitInputs.Input36	See input 1 for details	eint32	7ef2	32498	Not applicable
EthernetIP.ImplicitInputs.Input37	See input 1 for details	eint32	7ef6	32502	Not applicable
EthernetIP.ImplicitInputs.Input38	See input 1 for details	eint32	7efa	32506	Not applicable
EthernetIP.ImplicitInputs.Input39	See input 1 for details	eint32	7efe	32510	Not applicable
EthernetIP.ImplicitInputs.Input40	See input 1 for details	eint32	7f02	32514	Not applicable
EthernetIP.ImplicitInputs.Input41	See input 1 for details	eint32	7f06	32518	Not applicable
EthernetIP.ImplicitInputs.Input42	See input 1 for details	eint32	7f0a	32522	Not applicable
EthernetIP.ImplicitInputs.Input43	See input 1 for details	eint32	7f0e	32526	Not applicable
EthernetIP.ImplicitInputs.Input44	See input 1 for details	eint32	7f12	32530	Not applicable
EthernetIP.ImplicitInputs.Input45	See input 1 for details	eint32	7f16	32534	Not applicable
EthernetIP.ImplicitInputs.Input46	See input 1 for details	eint32	7f1a	32538	Not applicable
EthernetIP.ImplicitInputs.Input47	See input 1 for details	eint32	7f1e	32542	Not applicable
EthernetIP.ImplicitInputs.Input48	See input 1 for details	eint32	7f22	32546	Not applicable
EthernetIP.ImplicitInputs.Input49	See input 1 for details	eint32	7f26	32550	Not applicable
EthernetIP.ImplicitInputs.Input50	See input 1 for details	eint32	7f2a	32554	Not applicable
EthernetIP.ImplicitInputs.InputValue1	Value of the Input 1 parameter	int16	7e68	32360	Not applicable
EthernetIP.ImplicitInputs.InputValue2	See input 1 value for details	int16	7e6c	32364	Not applicable
EthernetIP.ImplicitInputs.InputValue3	See input 1 value for details	int16	7e70	32368	Not applicable
EthernetIP.ImplicitInputs.InputValue4	See input 1 value for details	int16	7e74	32372	Not applicable
EthernetIP.ImplicitInputs.InputValue5	See input 1 value for details	int16	7e78	32376	Not applicable
EthernetIP.ImplicitInputs.InputValue6	See input 1 value for details	int16	7e7c	32380	Not applicable
EthernetIP.ImplicitInputs.InputValue7	See input 1 value for details	int16	7e80	32384	Not applicable
EthernetIP.ImplicitInputs.InputValue8	See input 1 value for details	int16	7e84	32388	Not applicable
EthernetIP.ImplicitInputs.InputValue9	See input 1 value for details	int16	7e88	32392	Not applicable
EthernetIP.ImplicitInputs.InputValue10	See input 1 value for details	int16	7e8c	32396	Not applicable
EthernetIP.ImplicitInputs.InputValue11	See input 1 value for details	int16	7e90	32400	Not applicable
EthernetIP.ImplicitInputs.InputValue12	See input 1 value for details	int16	7e94	32404	Not applicable

5.3 PARAMETER LIST (Cont.)

Parameter path	Description	Type	Hex	Dec	Resolution
EthernetIP.ImplicitInputs.InputValue13	See input 1 value for details	int16	7e98	32408	Not applicable
EthernetIP.ImplicitInputs.InputValue14	See input 1 value for details	int16	7e9c	32412	Not applicable
EthernetIP.ImplicitInputs.InputValue15	See input 1 value for details	int16	7ea0	32416	Not applicable
EthernetIP.ImplicitInputs.InputValue16	See input 1 value for details	int16	7ea4	32420	Not applicable
EthernetIP.ImplicitInputs.InputValue17	See input 1 value for details	int16	7ea8	32424	Not applicable
EthernetIP.ImplicitInputs.InputValue18	See input 1 value for details	int16	7eac	32428	Not applicable
EthernetIP.ImplicitInputs.InputValue19	See input 1 value for details	int16	7eb0	32432	Not applicable
EthernetIP.ImplicitInputs.InputValue20	See input 1 value for details	int16	7eb4	32436	Not applicable
EthernetIP.ImplicitInputs.InputValue21	See input 1 value for details	int16	7eb8	32440	Not applicable
EthernetIP.ImplicitInputs.InputValue22	See input 1 value for details	int16	7ebc	32444	Not applicable
EthernetIP.ImplicitInputs.InputValue23	See input 1 value for details	int16	7ec0	32448	Not applicable
EthernetIP.ImplicitInputs.InputValue24	See input 1 value for details	int16	7ec4	32452	Not applicable
EthernetIP.ImplicitInputs.InputValue25	See input 1 value for details	int16	7ec8	32456	Not applicable
EthernetIP.ImplicitInputs.InputValue26	See input 1 value for details	int16	7ecc	32460	Not applicable
EthernetIP.ImplicitInputs.InputValue27	See input 1 value for details	int16	7ed0	32464	Not applicable
EthernetIP.ImplicitInputs.InputValue28	See input 1 value for details	int16	7ed4	32468	Not applicable
EthernetIP.ImplicitInputs.InputValue29	See input 1 value for details	int16	7ed8	32472	Not applicable
EthernetIP.ImplicitInputs.InputValue30	See input 1 value for details	int16	7edc	32476	Not applicable
EthernetIP.ImplicitInputs.InputValue31	See input 1 value for details	int16	7ee0	32480	Not applicable
EthernetIP.ImplicitInputs.InputValue32	See input 1 value for details	int16	7ee4	32484	Not applicable
EthernetIP.ImplicitInputs.InputValue33	See input 1 value for details	int16	7ee8	32488	Not applicable
EthernetIP.ImplicitInputs.InputValue34	See input 1 value for details	int16	7eec	32492	Not applicable
EthernetIP.ImplicitInputs.InputValue35	See input 1 value for details	int16	7ef0	32496	Not applicable
EthernetIP.ImplicitInputs.InputValue36	See input 1 value for details	int16	7ef4	32500	Not applicable
EthernetIP.ImplicitInputs.InputValue37	See input 1 value for details	int16	7ef8	32504	Not applicable
EthernetIP.ImplicitInputs.InputValue38	See input 1 value for details	int16	7efc	32508	Not applicable
EthernetIP.ImplicitInputs.InputValue39	See input 1 value for details	int16	7f00	32512	Not applicable
EthernetIP.ImplicitInputs.InputValue40	See input 1 value for details	int16	7f04	32516	Not applicable
EthernetIP.ImplicitInputs.InputValue41	See input 1 value for details	int16	7f08	32520	Not applicable
EthernetIP.ImplicitInputs.InputValue42	See input 1 value for details	int16	7f0c	32524	Not applicable
EthernetIP.ImplicitInputs.InputValue43	See input 1 value for details	int16	7f10	32528	Not applicable
EthernetIP.ImplicitInputs.InputValue44	See input 1 value for details	int16	7f14	32532	Not applicable
EthernetIP.ImplicitInputs.InputValue45	See input 1 value for details	int16	7f18	32536	Not applicable
EthernetIP.ImplicitInputs.InputValue46	See input 1 value for details	int16	7f1c	32540	Not applicable
EthernetIP.ImplicitInputs.InputValue47	See input 1 value for details	int16	7f20	32544	Not applicable
EthernetIP.ImplicitInputs.InputValue48	See input 1 value for details	int16	7f24	32548	Not applicable
EthernetIP.ImplicitInputs.InputValue49	See input 1 value for details	int16	7f28	32552	Not applicable
EthernetIP.ImplicitInputs.InputValue50	See input 1 value for details	int16	7f2c	32556	Not applicable
EthernetIP.ImplicitOutputs.Output1	Writable output to the EtherNet/IP client	eint32	7f2e	32558	Not applicable
EthernetIP.ImplicitOutputs.Output2	See output 1 for details	eint32	7f32	32562	Not applicable
EthernetIP.ImplicitOutputs.Output3	See output 1 for details	eint32	7f36	32566	Not applicable
EthernetIP.ImplicitOutputs.Output4	See output 1 for details	eint32	7f3a	32570	Not applicable
EthernetIP.ImplicitOutputs.Output5	See output 1 for details	eint32	7f3e	32574	Not applicable
EthernetIP.ImplicitOutputs.Output6	See output 1 for details	eint32	7f42	32578	Not applicable
EthernetIP.ImplicitOutputs.Output7	See output 1 for details	eint32	7f46	32582	Not applicable
EthernetIP.ImplicitOutputs.Output8	See output 1 for details	eint32	7f4a	32586	Not applicable
EthernetIP.ImplicitOutputs.Output9	See output 1 for details	eint32	7f4e	32590	Not applicable
EthernetIP.ImplicitOutputs.Output10	See output 1 for details	eint32	7f52	32594	Not applicable
EthernetIP.ImplicitOutputs.Output11	See output 1 for details	eint32	7f56	32598	Not applicable
EthernetIP.ImplicitOutputs.Output12	See output 1 for details	eint32	7f5a	32602	Not applicable
EthernetIP.ImplicitOutputs.Output13	See output 1 for details	eint32	7f5e	32606	Not applicable
EthernetIP.ImplicitOutputs.Output14	See output 1 for details	eint32	7f62	32610	Not applicable
EthernetIP.ImplicitOutputs.Output15	See output 1 for details	eint32	7f66	32614	Not applicable
EthernetIP.ImplicitOutputs.Output16	See output 1 for details	eint32	7f6a	32618	Not applicable
EthernetIP.ImplicitOutputs.Output17	See output 1 for details	eint32	7f6e	32622	Not applicable
EthernetIP.ImplicitOutputs.Output18	See output 1 for details	eint32	7f72	32626	Not applicable
EthernetIP.ImplicitOutputs.Output19	See output 1 for details	eint32	7f76	32630	Not applicable
EthernetIP.ImplicitOutputs.Output20	See output 1 for details	eint32	7f7a	32634	Not applicable
EthernetIP.ImplicitOutputs.Output21	See output 1 for details	eint32	7f7e	32638	Not applicable
EthernetIP.ImplicitOutputs.Output22	See output 1 for details	eint32	7f82	32642	Not applicable
EthernetIP.ImplicitOutputs.Output23	See output 1 for details	eint32	7f86	32646	Not applicable
EthernetIP.ImplicitOutputs.Output24	See output 1 for details	eint32	7f8a	32650	Not applicable
EthernetIP.ImplicitOutputs.Output25	See output 1 for details	eint32	7f8e	32654	Not applicable
EthernetIP.ImplicitOutputs.Output26	See output 1 for details	eint32	7f92	32658	Not applicable
EthernetIP.ImplicitOutputs.Output27	See output 1 for details	eint32	7f96	32662	Not applicable
EthernetIP.ImplicitOutputs.Output28	See output 1 for details	eint32	7f9a	32666	Not applicable
EthernetIP.ImplicitOutputs.Output29	See output 1 for details	eint32	7f9e	32670	Not applicable
EthernetIP.ImplicitOutputs.Output30	See output 1 for details	eint32	7fa2	32674	Not applicable
EthernetIP.ImplicitOutputs.Output31	See output 1 for details	eint32	7fa6	32678	Not applicable
EthernetIP.ImplicitOutputs.Output32	See output 1 for details	eint32	7faa	32682	Not applicable
EthernetIP.ImplicitOutputs.Output33	See output 1 for details	eint32	7fae	32686	Not applicable
EthernetIP.ImplicitOutputs.Output34	See output 1 for details	eint32	7fb2	32690	Not applicable
EthernetIP.ImplicitOutputs.Output35	See output 1 for details	eint32	7fb6	32694	Not applicable
EthernetIP.ImplicitOutputs.Output36	See output 1 for details	eint32	7fba	32698	Not applicable
EthernetIP.ImplicitOutputs.Output37	See output 1 for details	eint32	7fbe	32702	Not applicable
EthernetIP.ImplicitOutputs.Output38	See output 1 for details	eint32	7fc2	32706	Not applicable
EthernetIP.ImplicitOutputs.Output39	See output 1 for details	eint32	7fc6	32710	Not applicable
EthernetIP.ImplicitOutputs.Output40	See output 1 for details	eint32	7fca	32714	Not applicable
EthernetIP.ImplicitOutputs.Output41	See output 1 for details	eint32	7fce	32718	Not applicable
EthernetIP.ImplicitOutputs.Output42	See output 1 for details	eint32	7fd2	32722	Not applicable

5.3 PARAMETER LIST (Cont.)

Parameter path	Description	Type	Hex	Dec	Resolution
EthernetIP.ImplicitOutputs.Output43	See output 1 for details	eint32	7fd6	32726	Not applicable
EthernetIP.ImplicitOutputs.Output44	See output 1 for details	eint32	7fda	32730	Not applicable
EthernetIP.ImplicitOutputs.Output45	See output 1 for details	eint32	7fde	32734	Not applicable
EthernetIP.ImplicitOutputs.Output46	See output 1 for details	eint32	7fe2	32738	Not applicable
EthernetIP.ImplicitOutputs.Output47	See output 1 for details	eint32	7fe6	32742	Not applicable
EthernetIP.ImplicitOutputs.Output48	See output 1 for details	eint32	7fea	32746	Not applicable
EthernetIP.ImplicitOutputs.Output49	See output 1 for details	eint32	7fee	32750	Not applicable
EthernetIP.ImplicitOutputs.Output50	See output 1 for details	eint32	7ff2	32754	Not applicable
EthernetIP.ImplicitOutputs.OutputValue1	Value of the Output 1 parameter	int16	7f30	32560	Not applicable
EthernetIP.ImplicitOutputs.OutputValue2	See output 1 value for details	int16	7f34	32564	Not applicable
EthernetIP.ImplicitOutputs.OutputValue3	See output 1 value for details	int16	7f38	32568	Not applicable
EthernetIP.ImplicitOutputs.OutputValue4	See output 1 value for details	int16	7f3c	32572	Not applicable
EthernetIP.ImplicitOutputs.OutputValue5	See output 1 value for details	int16	7f40	32576	Not applicable
EthernetIP.ImplicitOutputs.OutputValue6	See output 1 value for details	int16	7f44	32580	Not applicable
EthernetIP.ImplicitOutputs.OutputValue7	See output 1 value for details	int16	7f48	32584	Not applicable
EthernetIP.ImplicitOutputs.OutputValue8	See output 1 value for details	int16	7f4c	32588	Not applicable
EthernetIP.ImplicitOutputs.OutputValue9	See output 1 value for details	int16	7f50	32592	Not applicable
EthernetIP.ImplicitOutputs.OutputValue10	See output 1 value for details	int16	7f54	32596	Not applicable
EthernetIP.ImplicitOutputs.OutputValue11	See output 1 value for details	int16	7f58	32600	Not applicable
EthernetIP.ImplicitOutputs.OutputValue12	See output 1 value for details	int16	7f5c	32604	Not applicable
EthernetIP.ImplicitOutputs.OutputValue13	See output 1 value for details	int16	7f60	32608	Not applicable
EthernetIP.ImplicitOutputs.OutputValue14	See output 1 value for details	int16	7f64	32612	Not applicable
EthernetIP.ImplicitOutputs.OutputValue15	See output 1 value for details	int16	7f68	32616	Not applicable
EthernetIP.ImplicitOutputs.OutputValue16	See output 1 value for details	int16	7f6c	32620	Not applicable
EthernetIP.ImplicitOutputs.OutputValue17	See output 1 value for details	int16	7f70	32624	Not applicable
EthernetIP.ImplicitOutputs.OutputValue18	See output 1 value for details	int16	7f74	32628	Not applicable
EthernetIP.ImplicitOutputs.OutputValue19	See output 1 value for details	int16	7f78	32632	Not applicable
EthernetIP.ImplicitOutputs.OutputValue20	See output 1 value for details	int16	7f7c	32636	Not applicable
EthernetIP.ImplicitOutputs.OutputValue21	See output 1 value for details	int16	7f80	32640	Not applicable
EthernetIP.ImplicitOutputs.OutputValue22	See output 1 value for details	int16	7f84	32644	Not applicable
EthernetIP.ImplicitOutputs.OutputValue23	See output 1 value for details	int16	7f88	32648	Not applicable
EthernetIP.ImplicitOutputs.OutputValue24	See output 1 value for details	int16	7f8c	32652	Not applicable
EthernetIP.ImplicitOutputs.OutputValue25	See output 1 value for details	int16	7f90	32656	Not applicable
EthernetIP.ImplicitOutputs.OutputValue26	See output 1 value for details	int16	7f94	32660	Not applicable
EthernetIP.ImplicitOutputs.OutputValue27	See output 1 value for details	int16	7f98	32664	Not applicable
EthernetIP.ImplicitOutputs.OutputValue28	See output 1 value for details	int16	7f9c	32668	Not applicable
EthernetIP.ImplicitOutputs.OutputValue29	See output 1 value for details	int16	7fa0	32672	Not applicable
EthernetIP.ImplicitOutputs.OutputValue30	See output 1 value for details	int16	7fa4	32676	Not applicable
EthernetIP.ImplicitOutputs.OutputValue31	See output 1 value for details	int16	7fa8	32680	Not applicable
EthernetIP.ImplicitOutputs.OutputValue32	See output 1 value for details	int16	7fac	32684	Not applicable
EthernetIP.ImplicitOutputs.OutputValue33	See output 1 value for details	int16	7fb0	32688	Not applicable
EthernetIP.ImplicitOutputs.OutputValue34	See output 1 value for details	int16	7fb4	32692	Not applicable
EthernetIP.ImplicitOutputs.OutputValue35	See output 1 value for details	int16	7fb8	32696	Not applicable
EthernetIP.ImplicitOutputs.OutputValue36	See output 1 value for details	int16	7fbc	32700	Not applicable
EthernetIP.ImplicitOutputs.OutputValue37	See output 1 value for details	int16	7fc0	32704	Not applicable
EthernetIP.ImplicitOutputs.OutputValue38	See output 1 value for details	int16	7fc4	32708	Not applicable
EthernetIP.ImplicitOutputs.OutputValue39	See output 1 value for details	int16	7fc8	32712	Not applicable
EthernetIP.ImplicitOutputs.OutputValue40	See output 1 value for details	int16	7fcc	32716	Not applicable
EthernetIP.ImplicitOutputs.OutputValue41	See output 1 value for details	int16	7fd0	32720	Not applicable
EthernetIP.ImplicitOutputs.OutputValue42	See output 1 value for details	int16	7fd4	32724	Not applicable
EthernetIP.ImplicitOutputs.OutputValue43	See output 1 value for details	int16	7fd8	32728	Not applicable
EthernetIP.ImplicitOutputs.OutputValue44	See output 1 value for details	int16	7fdc	32732	Not applicable
EthernetIP.ImplicitOutputs.OutputValue45	See output 1 value for details	int16	7fe0	32736	Not applicable
EthernetIP.ImplicitOutputs.OutputValue46	See output 1 value for details	int16	7fe4	32740	Not applicable
EthernetIP.ImplicitOutputs.OutputValue47	See output 1 value for details	int16	7fe8	32744	Not applicable
EthernetIP.ImplicitOutputs.OutputValue48	See output 1 value for details	int16	7fec	32748	Not applicable
EthernetIP.ImplicitOutputs.OutputValue49	See output 1 value for details	int16	7ff0	32752	Not applicable
EthernetIP.ImplicitOutputs.OutputValue50	See output 1 value for details	int16	7ff4	32756	Not applicable
EthernetIP.InputTags.Input1	A read only input from a PLC device	string_t	7838	30776	Not applicable
EthernetIP.InputTags.Input2	See input 1 for details	string_t	7839	30777	Not applicable
EthernetIP.InputTags.Input3	See input 1 for details	string_t	783a	30778	Not applicable
EthernetIP.InputTags.Input4	See input 1 for details	string_t	783b	30779	Not applicable
EthernetIP.InputTags.Input5	See input 1 for details	string_t	783c	30780	Not applicable
EthernetIP.InputTags.Input6	See input 1 for details	string_t	783d	30781	Not applicable
EthernetIP.InputTags.Input7	See input 1 for details	string_t	783e	30782	Not applicable
EthernetIP.InputTags.Input8	See input 1 for details	string_t	783f	30783	Not applicable
EthernetIP.InputTags.Input9	See input 1 for details	string_t	7840	30784	Not applicable
EthernetIP.InputTags.Input10	See input 1 for details	string_t	7841	30785	Not applicable
EthernetIP.InputTags.Input11	See input 1 for details	string_t	7842	30786	Not applicable
EthernetIP.InputTags.Input12	See input 1 for details	string_t	7843	30787	Not applicable
EthernetIP.InputTags.Input13	See input 1 for details	string_t	7844	30788	Not applicable
EthernetIP.InputTags.Input14	See input 1 for details	string_t	7845	30789	Not applicable
EthernetIP.InputTags.Input15	See input 1 for details	string_t	7846	30790	Not applicable
EthernetIP.InputTags.Input16	See input 1 for details	string_t	7847	30791	Not applicable
EthernetIP.InputTags.Input17	See input 1 for details	string_t	7848	30792	Not applicable
EthernetIP.InputTags.Input18	See input 1 for details	string_t	7849	30793	Not applicable
EthernetIP.InputTags.Input19	See input 1 for details	string_t	784a	30794	Not applicable
EthernetIP.InputTags.Input20	See input 1 for details	string_t	784b	30795	Not applicable
EthernetIP.InputTags.Input21	See input 1 for details	string_t	784c	30796	Not applicable

5.3 PARAMETER LIST (Cont.)

Parameter path	Description	Type	Hex	Dec	Resolution
EthernetIP.InputTags.Input22	See input 1 for details	string_t	784d	30797	Not applicable
EthernetIP.InputTags.Input23	See input 1 for details	string_t	784e	30798	Not applicable
EthernetIP.InputTags.Input24	See input 1 for details	string_t	784f	30799	Not applicable
EthernetIP.InputTags.Input25	See input 1 for details	string_t	7850	30800	Not applicable
EthernetIP.InputTags.Input26	See input 1 for details	string_t	7851	30801	Not applicable
EthernetIP.InputTags.Input27	See input 1 for details	string_t	7852	30802	Not applicable
EthernetIP.InputTags.Input28	See input 1 for details	string_t	7853	30803	Not applicable
EthernetIP.InputTags.Input29	See input 1 for details	string_t	7854	30804	Not applicable
EthernetIP.InputTags.Input30	See input 1 for details	string_t	7855	30805	Not applicable
EthernetIP.Main.ConfigInstance	Configuration assembly instance number	int16	7ffa	32762	Not applicable
EthernetIP.Main.ConfigSize	Configuration assembly data size in bytes	int16	7ffb	32763	Not applicable
EthernetIP.Main.ConnectionType	Implicit I/O connection type (0 = Point to point; 1 = Multicast)	uint8	7ffe	32766	Not applicable
EthernetIP.Main.Explicit1	Explicit TCP connection 1	string_t	65f1	26097	Not applicable
EthernetIP.Main.Explicit2	Explicit TCP connection 2	string_t	6601	26113	Not applicable
EthernetIP.Main.ImplicitIO	Implicit I/O data channel	string_t	65e1	26081	Not applicable
EthernetIP.Main.InputInstance	Implicit input assembly instance number	int16	7ff6	32758	Not applicable
EthernetIP.Main.InputSize	Implicit input assembly data size in bytes	int16	7ff7	32759	Not applicable
EthernetIP.Main.Mode	EtherNet/IP operation mode 0 = Server 1 = Client (IO) 2 = Client (Tags)	uint8	7fff	32767	Not applicable
EthernetIP.Main.Multicast	Implicit I/O data channel multicast address	string_t	6611	26129	Not applicable
EthernetIP.Main.NetworkStatusCode	EtherNet/IP communications network status 0 = Offline 2 = On line 3 = Connection timout 4 = Duplicate IP address 5 = Initialisation	uint8	7e64	32356	Not applicable
EthernetIP.Main.OutputInstance	Implicit output assembly instance number	int16	7ff8	32760	Not applicable
EthernetIP.Main.OutputSize	Implicit output assembly data size in bytes	int16	7ff9	32761	Not applicable
EthernetIP.Main.Priority	Level of message priority 0 = Low 1 = High 2 = Scheduled 3 = Urgent	uint8	7ffc	32764	Not applicable
EthernetIP.Main.ResetComms	Resets the client or server communications (0 = No; 1 = Yes)	uint8	7e63	32355	Not applicable
EthernetIP.Main.Rpi	Requested Packet Interval (milliseconds)	int16	7ffd	32765	Not applicable
EthernetIP.Main.ServerAddress	IP address of a server device	string_t	7129	28969	Not applicable
EthernetIP.Main.SlotNumber	PLC slot number	int16	7e60	32352	Not applicable
EthernetIP.Main.TagStatusCode	EtherNet/IP Tag server status code (see table 4.10.1)	uint8	7e62	32354	Not applicable
EthernetIP.Main.UCMM	Unconnected Message Manager (UCMM)	string_t	65d1	26065	Not applicable
EthernetIP.OutputTags.Output1	Writable output to the PLC device	string_t	7880	30848	Not applicable
EthernetIP.OutputTags.Output2	See output 1 for details	string_t	7881	30849	Not applicable
EthernetIP.OutputTags.Output3	See output 1 for details	string_t	7882	30850	Not applicable
EthernetIP.OutputTags.Output4	See output 1 for details	string_t	7883	30851	Not applicable
EthernetIP.OutputTags.Output5	See output 1 for details	string_t	7884	30852	Not applicable
EthernetIP.OutputTags.Output6	See output 1 for details	string_t	7885	30853	Not applicable
EthernetIP.OutputTags.Output7	See output 1 for details	string_t	7886	30854	Not applicable
EthernetIP.OutputTags.Output8	See output 1 for details	string_t	7887	30855	Not applicable
EthernetIP.OutputTags.Output9	See output 1 for details	string_t	7888	30856	Not applicable
EthernetIP.OutputTags.Output10	See output 1 for details	string_t	7889	30857	Not applicable
EthernetIP.OutputTags.Output11	See output 1 for details	string_t	788a	30858	Not applicable
EthernetIP.OutputTags.Output12	See output 1 for details	string_t	788b	30859	Not applicable
EthernetIP.OutputTags.Output13	See output 1 for details	string_t	788c	30860	Not applicable
EthernetIP.OutputTags.Output14	See output 1 for details	string_t	788d	30861	Not applicable
EthernetIP.OutputTags.Output15	See output 1 for details	string_t	788e	30862	Not applicable
EthernetIP.OutputTags.Output16	See output 1 for details	string_t	788f	30863	Not applicable
EthernetIP.OutputTags.Output17	See output 1 for details	string_t	7890	30864	Not applicable
EthernetIP.OutputTags.Output18	See output 1 for details	string_t	7891	30865	Not applicable
EthernetIP.OutputTags.Output19	See output 1 for details	string_t	7892	30866	Not applicable
EthernetIP.OutputTags.Output20	See output 1 for details	string_t	7893	30867	Not applicable
EthernetIP.OutputTags.Output21	See output 1 for details	string_t	7894	30868	Not applicable
EthernetIP.OutputTags.Output22	See output 1 for details	string_t	7895	30869	Not applicable
EthernetIP.OutputTags.Output23	See output 1 for details	string_t	7896	30870	Not applicable
EthernetIP.OutputTags.Output24	See output 1 for details	string_t	7897	30871	Not applicable
EthernetIP.OutputTags.Output25	See output 1 for details	string_t	7898	30872	Not applicable
EthernetIP.OutputTags.Output26	See output 1 for details	string_t	7899	30873	Not applicable
EthernetIP.OutputTags.Output27	See output 1 for details	string_t	789a	30874	Not applicable
EthernetIP.OutputTags.Output28	See output 1 for details	string_t	789b	30875	Not applicable
EthernetIP.OutputTags.Output29	See output 1 for details	string_t	789c	30876	Not applicable
EthernetIP.OutputTags.Output30	See output 1 for details	string_t	789d	30877	Not applicable
Group.Recording.Channel1En	Channel 1 enable (0 = Disabled; 1 = Enabled)	bool	1023	4131	Not applicable
Group.Recording.Channel2En	Channel 2 enable (0 = Disabled; 1 = Enabled)	bool	1024	4132	Not applicable
Group.Recording.Channel3En	Channel 3 enable (0 = Disabled; 1 = Enabled)	bool	1025	4133	Not applicable
Group.Recording.Channel4En	Channel 4 enable (0 = Disabled; 1 = Enabled)	bool	1026	4134	Not applicable
Group.Recording.Compression	The UHH file compression rate (0 = Normal; 1 = High)	uint8	1040	4160	Not applicable
Group.Recording.Enable	0 = Recording disabled; 1 = Recording enabled	uint8	1020	4128	Not applicable
Group.Recording.FlashDuration	Time in days until flash history files begin to be overwitten	float32	1039	4153	2dp
Group.Recording.FlashFree	Size of the internal flash in MBytes	float32	1038	4152	2dp
Group.Recording.FlashSize	Size of the internal flash in MBytes	float32	1037	4151	2dp

5.3 PARAMETER LIST (Cont.)

Parameter path	Description	Type	Hex	Dec	Resolution
Group.Recording.Interval	Recording interval 0 = 125 secs 1 = .25 secs 2 = 0.5 secs 3 = 1Hz 4 = 2 sec 5 = 5 sec 6 = 10 sec 7 = 20 sec 8 = 30 sec 9 = 1 min 10 = 2 min 11 = 5 min 12 = 10 min 13 = 20 min 14 = 30 min 15 = 1 hr	int32	1022	4130	Not applicable
Group.Recording.Status	Recording status 0 = Not recording 1 = Disabled 2 = Messages only 3 = Recording enabled 4 = Recording paused	int16	1036	4150	Not applicable
Group.Recording.Suspend	1 = Suspend recording	bool	1035	4149	Not applicable
Group.Recording.VirtualChan1En	Virtual Channel 1 enable (0 = Disabled; 1 = Enabled)	bool	1027	4135	Not applicable
Group.Recording.VirtualChan2En	Virtual Channel 2 enable (0 = Disabled; 1 = Enabled)	bool	1028	4136	Not applicable
Group.Recording.VirtualChan3En	Virtual Channel 3 enable (0 = Disabled; 1 = Enabled)	bool	1029	4137	Not applicable
Group.Recording.VirtualChan4En	Virtual Channel 4 enable (0 = Disabled; 1 = Enabled)	bool	102a	4138	Not applicable
Group.Recording.VirtualChan5En	Virtual Channel 5 enable (0 = Disabled; 1 = Enabled)	bool	102b	4139	Not applicable
Group.Recording.VirtualChan6En	Virtual Channel 6 enable (0 = Disabled; 1 = Enabled)	bool	102c	4140	Not applicable
Group.Recording.VirtualChan7En	Virtual Channel 7 enable (0 = Disabled; 1 = Enabled)	bool	102d	4141	Not applicable
Group.Recording.VirtualChan8En	Virtual Channel 8 enable (0 = Disabled; 1 = Enabled)	bool	102e	4142	Not applicable
Group.Recording.VirtualChan9En	Virtual Channel 9 enable (0 = Disabled; 1 = Enabled)	bool	102f	4143	Not applicable
Group.Recording.VirtualChan10En	Virtual Channel 10 enable (0 = Disabled; 1 = Enabled)	bool	1030	4144	Not applicable
Group.Recording.VirtualChan11En	Virtual Channel 11 enable (0 = Disabled; 1 = Enabled)	bool	1031	4145	Not applicable
Group.Recording.VirtualChan12En	Virtual Channel 12 enable (0 = Disabled; 1 = Enabled)	bool	1032	4146	Not applicable
Group.Recording.VirtualChan13En	Virtual Channel 13 enable (0 = Disabled; 1 = Enabled)	bool	1033	4147	Not applicable
Group.Recording.VirtualChan14En	Virtual Channel 14 enable (0 = Disabled; 1 = Enabled)	bool	1034	4148	Not applicable
Group.Recording.VirtualChan15En	Virtual Channel 15 enable (0 = Disabled; 1 = Enabled)	bool	103a	4154	Not applicable
Group.Recording.VirtualChan16En	Virtual Channel 16 enable (0 = Disabled; 1 = Enabled)	bool	103b	4155	Not applicable
Group.Recording.VirtualChan17En	Virtual Channel 17 enable (0 = Disabled; 1 = Enabled)	bool	103c	4156	Not applicable
Group.Recording.VirtualChan18En	Virtual Channel 18 enable (0 = Disabled; 1 = Enabled)	bool	103d	4157	Not applicable
Group.Recording.VirtualChan19En	Virtual Channel 19 enable (0 = Disabled; 1 = Enabled)	bool	103e	4158	Not applicable
Group.Recording.VirtualChan20En	Virtual Channel 20 enable (0 = Disabled; 1 = Enabled)	bool	103f	4159	Not applicable
Group.Recording.VirtualChan21En	Virtual Channel 21 enable (0 = Disabled; 1 = Enabled)	bool	1041	4161	Not applicable
Group.Recording.VirtualChan22En	Virtual Channel 22 enable (0 = Disabled; 1 = Enabled)	bool	1042	4162	Not applicable
Group.Recording.VirtualChan23En	Virtual Channel 23 enable (0 = Disabled; 1 = Enabled)	bool	1043	4163	Not applicable
Group.Recording.VirtualChan24En	Virtual Channel 24 enable (0 = Disabled; 1 = Enabled)	bool	1044	4164	Not applicable
Group.Recording.VirtualChan25En	Virtual Channel 25 enable (0 = Disabled; 1 = Enabled)	bool	1045	4165	Not applicable
Group.Recording.VirtualChan26En	Virtual Channel 26 enable (0 = Disabled; 1 = Enabled)	bool	1046	4166	Not applicable
Group.Recording.VirtualChan27En	Virtual Channel 27 enable (0 = Disabled; 1 = Enabled)	bool	1047	4167	Not applicable
Group.Recording.VirtualChan28En	Virtual Channel 28 enable (0 = Disabled; 1 = Enabled)	bool	1048	4168	Not applicable
Group.Recording.VirtualChan29En	Virtual Channel 29 enable (0 = Disabled; 1 = Enabled)	bool	1049	4169	Not applicable
Group.Recording.VirtualChan30En	Virtual Channel 30 enable (0 = Disabled; 1 = Enabled)	bool	104a	4170	Not applicable
Group.Trend.Descriptor	Group descriptor	string_t	5b00	23296	Not applicable
Group.Trend.Interval	Trend interval. As Group.Recording.Interval, above	int32	1002	4098	Not applicable
Group.Trend.MajorDivisions	Number of major divisions	uint8	1004	4100	Not applicable
Group.Trend.Point1	1st point in the group (VCh = Virtual channel)uint8 0 =No trend 1 = Channel 1 2 = Channel 2 3 = Channel 3 4 = Channel 4 5 = VCh1 6 = VCh2 7 = VCh3 8 = VCh4 9 = VCh5 10 = VCh6 11 = VCh7 12 = VCh8 13 = VCh9 14 = VCh10 15 = VCh11 16 = VCh12 17 = VCH13 18 = VCh14 19 = VCh15 20 = VCh 16 21 = VCh17 22 = VCh18 23 = VCh 19 24 = VCh20 25 = VCh21 26 = VCh 22 27 = VCh23 28 = VCh24 29 = VCh 25 30 = VCh26 31 = VCh27 32 = VCh 28 33 = VCh29 34 = VCh30	1006		4102	Not applicable
Group.Trend.Point2	As Group.Trend.Point1 but for 2nd point in group	uint8	1007	4103	Not applicable
Group.Trend.Point3	As Group.Trend.Point1 but for 3rd point in group	uint8	1008	4104	Not applicable
Group.Trend.Point4	As Group.Trend.Point1 but for 4th point in group	uint8	1009	4105	Not applicable
Group.Trend.Point5	As Group.Trend.Point1 but for 5th point in group	uint8	100a	4106	Not applicable
Group.Trend.Point6	As Group.Trend.Point1 but for 6th point in group	uint8	100b	4107	Not applicable
IHumidity.DewPoint	Dewpoint	float32	2e79	11897	Set by Humidity.Resolution
Humidity.DryTemp	Dry Bulb Temperature Measurement	float32	2e7d	11901	0dp
Humidity.Pressure	Current Atmospheric Pressure	float32	2e80	11904	1dp
Humidity.PsychroConst	Psychrometric Constant	float32	2e7f	11903	2dp
Humidity.RelHumid	Calculated Relative Humidity	float32	2e78	11896	Set by Humidity.Resolution
Humidity.Resolution	Result Resolution	uint8	2e81	11905	Not applicable
Humidity.SBrk	Sensor Broken (0 = No; 1 = Yes)	bool	2e7e	11902	Not applicable
Humidity.WetOffset	Offset of the Wet Bulb Temperature	float32	2e7b	11899	Same as Humidity.WetTemp
Humidity.WetTemp	Wet Bulb Temperature Measurement	float32	2e7c	11900	0dp
Instrument.Clock.Date	Local Date	string_t	4400	17408	Not applicable
Instrument.Clock.DST	1 = DST active; 0 = DST not active	bool	1082	4226	Not applicable
Instrument.Clock.Time	Local time (including Zone and DST effects)	time_t	1081	4225	Set by Network.Modbus.TimeFormat
Instrument.Display.AlarmPanel	1 = Alarm Panel display mode enabled	bool	10eb	4331	Not applicable
Instrument.Display.Brightness	Display brightness 10 = 10%; 20 = 20% etc. (whole decades)	uint8	1090	4240	Not applicable

5.3 PARAMETER LIST (Cont.)

Parameter path	Description	Type	Hex	Dec	Resolution
Instrument.Display.Cascade	1 = Cascade control display mode enabled	bool	10f2	4338	Not applicable
Instrument.Display.DualLoopControl	1 = Dual loop control display mode enabled	bool	109b	4251	Not applicable
Instrument.Display.EIPServerPage	1 = EtherNet/IPdisplay mode enabled	bool	10ef	4335	Not applicable
Instrument.Display.FaceplateCycling	1 = Faceplate cycling On	bool	109e	4254	Not applicable
Instrument.Display.FutureTrend	1 = Future trend display mode enabled	bool	10fb	4347	Not applicable
Instrument.Display.FutureTrend1Colour	Future trend colour(1) (As Channel.1.Trend.Colour)	uint8	10fc	4348	Not applicable
Instrument.Display.FutureTrend2Colour	Future trend colour(2) (As Channel.1.Trend.Colour)	uint8	10fd	4349	Not applicable
Instrument.Display.HistoryBackground	History background colour 0 = Black; 1 = Dark grey; 2 = Light grey; 3 = White	uint8	10a8	4264	Not applicable
Instrument.Display.HomePage	Home page	uint8	1093	4243	Not applicable
Instrument.Display.HorizontalBar	1 = Horizontal bar mode enabled	bool	1098	4248	Not applicable
Instrument.Display.HorizontalTrend	1 = Horizontal trend mode enabled	bool	1096	4246	Not applicable
Instrument.Display.HPageTimeout	Home time out value in minutes (0 = no timeout)	int16	1094	4244	Not applicable
Instrument.Display.HTrendScaling	0 = hide horizontal trend scale; 1 = scale permanent	uint8	109d	4253	Not applicable
Instrument.Display.LoopControl	1 = Loop control display mode enabled	bool	109a	4250	Not applicable
Instrument.Display.LoopSetpointColour	Loop setpoint colour (As Channel.1.Trend.Colour)	uint8	109f	4255	Not applicable
Instrument.Display.ModbusMaster	1 = Modbus Master display mode enabled	bool	10ee	4334	Not applicable
Instrument.Display.NumberFormat	Number format (0 = Rounded; 1 - Truncated)	uint8	10fe	4350	Not applicable
Instrument.Display.Numeric	1 = Numeric display mode enabled	bool	1099	4249	Not applicable
Instrument.Display.Programmer	1 = Programmer interface display mode enabled	bool	10f3	4339	Not applicable
Instrument.Display.PromoteListView	1 = Promote list display mode enabled	bool	10ea	4330	Not applicable
Instrument.Display.ScreenSaverAfter	Screen save after (in minutes)	int16	1091	4241	Not applicable
Instrument.Display.ScreenSaverBrightness	Screen saver brightness 10 = 10%; 20 = 20% etc. (whole decades only)	uint8	1092	4242	Not applicable
Instrument.Display.SteriliserPage	1 = Steriliser display mode enabled	bool	10ec	4332	Not applicable
Instrument.Display.TrendBackground	Trend chart colour: 0 = Black; 1 = Dark Grey; 2 = Light grey; 3 = White.	uint8	109c	4252	Not applicable
Instrument.Display.VerticalBar	1 = Vertical bar display mode enabled	bool	1097	4247	Not applicable
Instrument.Display.VerticalTrend	1 = Vertical trend display mode enabled	bool	1095	4245	Not applicable
Instrument.Info.Bootrom	Instrument bootrom version	string_t	447a	17530	Not applicable
Instrument.Info.CompanyID	Company identification. Always returns 1280	int16	0079	121	Not applicable
Instrument.Info.ConfigRev	The instrument configuration revision number	int32	10a0	4256	Not applicable
Instrument.Info.IM	Instrument mode Operating: All algorithms and I/O active. Standby: Control o/p off. Absolute alarms active Engineer: All outputs inactive.	uint8	00c7	199	Not applicable
Instrument.Info.LineVoltage	Displays the current line voltage	float32	10a6	4262	1dp
Instrument.Info.MicroBoardIssue	Micro Board Issue	uint8	10aa	4266	Not applicable
Instrument.Info.Name	The instrument descriptor	string_t	445f	17503	Not applicable
Instrument.Info.NvolWrites	Displays the number of non-volatile writes performed	int32	10a5	4261	Not applicable
Instrument.Info.PSUType	PSU type. 0 = 240Vac; 1 = 24v ac/dc	uint8	10a9	4265	Not applicable
Instrument.Info.SecurityRev	The instrument security revision number	int32	10a4	4260	Not applicable
Instrument.Info.Type	Instrument type	uint8	10a2	4258	Not applicable
Instrument.Info.Version	Instrument version	string_t	4474	17524	Not applicable
Instrument.Info.WiresFree	Number of wires free	int16	10ab	4267	Not applicable
Instrument.IOFitted.1A1B	I/O fitted at terminals 1A1Buint8 0 = Digital IO 1= Non-isolated dc op (mA only) 2 = Relay op 3 = TRIAC 1a1b 4 = Relay OP 5 = Isolated dc op (V/mA) 6 = Digital ip 7 = Isolated dc output (mA only) 8 = Digital op 9 = Relay op 10 = Triac 2A2B	10f4		4340	Not applicable
Instrument.IOFitted.2A2B	I/O fitted at terminals 2A2B (as for 1A1B above)	uint8	10f5	4341	Not applicable
Instrument.IOFitted.3A3B	I/O type fitted at terminals 3A3B (as for 1A1B above)	uint8	10f7	4343	Not applicable
Instrument.IOFitted.4AC	I/O type fitted at terminals 4AC (as for 1A1B above)	uint8	10f9	4345	Not applicable
Instrument.IOFitted.5AC	I/O type fitted at terminals 5AC (as for 1A1B above)	uint8	10fa	4346	Not applicable
Instrument.IOFitted.LALC	I/O type fitted at terminals LALC (as for 1A1B above)	uint8	10f6	4342	Not applicable
Instrument.IOFitted.LBLC	I/O type fitted at terminals LBLC (as for 1A1B above)	uint8	10f8	4344	Not applicable
Instrument.Locale.DateFormat	Date format (0 = DDMMYY. 1 = MMDDYY; 2 = YYMMDD)	uint8	10b1	4273	Not applicable
Instrument.Locale.DSTenable	1 = Daylight Saving Time enabled	bool	10b3	4275	Not applicable
Instrument.Locale.EndDay	Daylight savings: End day 0 = Sunday 1= Monday 2 = Tuesday 3 = Wednesday 4 = Thursday 5 = Friday 6 = Saturday	uint8	10ba	4282	Not applicable
Instrument.Locale.EndMonth	Daylight savings: End month 0 = Febuary 1= February 2 = March 3 = April 4 = May 5 = June 6 = July 7 = August 8 = September 9 = October 10 = November 11 = December	uint8	10bb	4283	Not applicable
Instrument.Locale.EndOn	Week for changing to/from DST 0 = First 1= Second 2 = Third 3 = Fourth 4 = Last 5 = Second to last	uint8	10b9	4281	Not applicable
Instrument.Locale.EndTime	DST end time in hours, minutes, seconds and milliseconds	time_t	10b8	4280	Set by Network.Modbus.TimeFormat
Instrument.Locale.Language	Language (0 = English)	uint8	10b0	4272	Not applicable
Instrument.Locale.StartDay	DST start day. As Instrument.Locale.EndDay, above	uint8	10b6	4278	Not applicable
Instrument.Locale.StartMonth	DST start month As Instrument.Locale.EndMonth, above	uint8	10b7	4279	Not applicable
Instrument.Locale.StartOn	Start DST on. As Instrument.Locale.EndOn, above	uint8	10b5	4277	Not applicable
Instrument.Locale.StartTime	DST start time. As Instrument.Locale.EndTime above	time_t	10b4	4276	Set by Network.Modbus.TimeFormat

5.3 PARAMETER LIST (Cont.)

Parameter path	Description	Type	Hex	Dec	Resolution
Instrument.Locale.TimeZone	Time zone 0 = GMT - 12 hours 1 = GMT - 11 hours 2 = GMT - 10 hours 3 = GMT - 9 hours 4 = GMT - 8 hours 5 = GMT - 7 hours 6 = GMT - 6 hours 7 = GMT - 5 hours 8 = GMT - 4 hours 9 = GMT - 3.5 hours 10 = GMT - 3 hours 11 = GMT - 2 hours 12 = GMT - 1 hour 13 = GMT 14 = GMT + 1 hour 15 = GMT + 2 hours 16 = GMT + 3 hours 17 = GMT + 3.5 hours 18 = GMT + 4 hours 19 = GMT + 4.5 hours 20 = GMT + 5 hours 21 = GMT + 5.5 hours 22 = GMT + 5.75 hours 23 = GMT + 6 hours 24 = GMT + 6.5 hours 25 = GMT + 7 hours 26 = GMT + 8 hours 27 = GMT + 9 hours 28 = GMT + 9.5 hours 29 = GMT + 10 hours 30 = GMT + 11 hours 31 = GMT + 12 hours 32 = GMT + 13 hours	uint8	10b2	4274	Not applicable
Instrument.Notes.Note	Operator Note	string_t	5500	21760	Not applicable
Instrument.Notes.Note1	Operator note 1	string_t	5580	21888	Not applicable
Instrument.Notes.Note2	Operator note 2	string_t	5600	22016	Not applicable
Instrument.Notes.Note3	Operator note 3	string_t	5680	22144	Not applicable
Instrument.Notes.Note4	Operator note 4	string_t	5700	22272	Not applicable
Instrument.Notes.Note5	Operator note 5	string_t	5780	22400	Not applicable
Instrument.Notes.Note6	Operator note 6	string_t	5800	22528	Not applicable
Instrument.Notes.Note7	Operator note 7	string_t	5880	22656	Not applicable
Instrument.Notes.Note8	Operator note 8	string_t	5900	22784	Not applicable
Instrument.Notes.Note9	Operator note 9	string_t	5980	22912	Not applicable
Instrument.Notes.Note10	Operator note 10	string_t	5a00	23040	Not applicable
Instrument.PromoteList.PromoteListName	Promote list (operator view) title	string_t	6d07	27911	Not applicable
Instrument.PromoteList.PromoteParam1	Promote parameter (1)	eint32	10e0	4320	Not applicable
strument.PromoteList.PromoteParam1Desc	Descriptor for promote parameter (1)	string_t	6300	25344	Not applicable
Instrument.PromoteList.PromoteParam2	Promote parameter (2)	eint32	10e1	4321	Not applicable
Instrument.PromoteList.PromoteParam2Desc	Descriptor for promote parameter (2)	string_t	6315	25365	Not applicable
Instrument.PromoteList.PromoteParam3	Promote parameter (3)	eint32	10e2	4322	Not applicable
Instrument.PromoteList.PromoteParam3Desc	Descriptor for promote parameter (3)	string_t	632a	25386	Not applicable
Instrument.PromoteList.PromoteParam4	Promote parameter (4)	eint32	10e3	4323	Not applicable
Instrument.PromoteList.PromoteParam4Desc	Descriptor for promote parameter (4)	string_t	633f	25407	Not applicable
Instrument.PromoteList.PromoteParam5	Promote parameter (5)	eint32	10e4	4324	Not applicable
Instrument.PromoteList.PromoteParam5Desc	Descriptor for promote parameter (5)	string_t	6354	25428	Not applicable
Instrument.PromoteList.PromoteParam6	Promote parameter (6)	eint32	10e5	4325	Not applicable
Instrument.PromoteList.PromoteParam6Desc	Descriptor for promote parameter (6)	string_t	6369	25449	Not applicable
Instrument.PromoteList.PromoteParam7	Promote parameter (7)	eint32	10e6	4326	Not applicable
Instrument.PromoteList.PromoteParam7Desc	Descriptor for promote parameter (7)	string_t	637e	25470	Not applicable
Instrument.PromoteList.PromoteParam8	Promote parameter (8)	eint32	10e7	4327	Not applicable
Instrument.PromoteList.PromoteParam8Desc	Descriptor for promote parameter (8)	string_t	6393	25491	Not applicable
Instrument.PromoteList.PromoteParam9	Promote parameter (9)	eint32	10e8	4328	Not applicable
Instrument.PromoteList.PromoteParam9Desc	Descriptor for promote parameter (9)	string_t	63a8	25512	Not applicable
Instrument.PromoteList.PromoteParam10	Promote parameter (10)	eint32	10e9	4329	Not applicable
Instrument.PromoteList.PromoteParam10Desc	Descriptor for promote parameter (10)	string_t	63bd	25533	Not applicable
InInstrument.Security.CommsPass	1 = Password required for comms access	bool	10c1	4289	Not applicable
Instrument.Security.DefaultConfig	1 = set all parameters to factory settings	bool	10c2	4290	Not applicable
Instrument.Security.EngineerAccess	1 = Engineer access required	bool	10c0	4288	Not applicable
Instrument.Security.EngineerPassword	Engineer pass phrase (default 100)	string_t	63d3	25555	Not applicable
Instrument.Security.Feature2Pass	Features2 pass code	int32	10c4	4292	Not applicable
Instrument.Security.Feature3Pass	Features3 pass code	int32	10c5	4293	Not applicable
Instrument.Security.FeaturePass	Features pass code	int32	10c3	4291	Not applicable
Instrument.Security.OEMEntry	OEM pass phrase entry	string_t	6d61	28001	Not applicable
Instrument.Security.OEMPass	OEM pass phrase	string_t	6d30	27952	Not applicable
Instrument.Security.OEMStatus	OEM status (0 = Unlocked; 1 = Locked)	bool	10c6	4294	Not applicable
Instrument.Security.OperatorPassword	Operator pass phrase (default = blank	string_t	6437	25655	Not applicable
Instrument.Security.PassPhrase	The parameter to be written to if comms security is enabled	string_t	4416	17430	Not applicable
Instrument.Security.SupervisorPassword	Supervisor pass phrase (default = blank	string_t	6405	25605	Not applicable
Lgc2.1.FallbackType	Fallback Condition 0 = Output False; Status Bad. 1 = Output True; Status Bad 2 = Output False; Status Good. 3 = Output True; Status good	uint8	2efb	12027	Not applicable
Lgc2.1.In1	Input Value 1	float32	2ef9	12025	0dp
Lgc2.1.In2	Input Value 2	float32	2efa	12026	0dp
Lgc2.1.Invert	Sense of Input Values 0 = Neither input inverted 1 = Input 1 inverted 2 = Input 2 inverted 3 = Both inputs inverted	uint8	2efc	12028	Not applicable
Lgc2.1.Oper	Logic Operation 0 = Off; 1 = AND; 2 = OR; 3 = XOR; 4 = 1 set/2 reset 5 = Input 1 = Input 2? 6 = Input 1 ≠ Input 2 7 = Input 1 > Input 2? 8 = Input 1< Input 2? 9 = Input 1 ≥ Input 2?; 10 = Input 1 ≤ Input 2?	uint8	2ef8	12024	Not applicable
Lgc2.1.Out	Output Value (0 = Off (false); 1 = On (true))	bool	2efd	12029	Not applicable

5.3 PARAMETER LIST (Cont.)

Parameter path	Description	Type	Hex	Dec	Resolution
Lgc2.1.OutputStatus	Output Status (0 = Good; 1 = Bad)	uint8	2efe	12030	Not applicable
Lgc2.2.FallbackType	Fallback Condition (as Lgc2.1.FallbackType)	uint8	2f02	12034	Not applicable
Lgc2.2.In1	Input Value 1	float32	2f00	12032	0dp
Lgc2.2.In2	Input Value 2	float32	2f01	12033	0dp
Lgc2.2.Invert	Sense of Input Value (as Lgc2.1.Invert)	uint8	2f03	12035	Not applicable
Lgc2.2.Oper	Logic Operation (as Lgc2.1.Oper)	uint8	2eff	12031	Not applicable
Lgc2.2.Out	The result of the logic operation (as Lgc2.1.Out)	bool	2f04	12036	Not applicable
Lgc2.2.OutputStatus	Output Status (0 = Good; 1 = Bad)	uint8	2f05	12037	Not applicable
Lgc2.3.FallbackType	Fallback Condition (as Lgc2.1.FallbackType)	uint8	2f09	12041	Not applicable
Lgc2.3.In1	Input Value 1	float32	2f07	12039	0dp
Lgc2.3.In2	Input Value 2	float32	2f08	12040	0dp
Lgc2.3.Invert	Sense of Input Value (as Lgc2.1.Invert)	uint8	2f0a	12042	Not applicable
Lgc2.3.Oper	Logic Operation (as Lgc2.1.Oper)	uint8	2f06	12038	Not applicable
Lgc2.3.Out	The result of the logic operation (as Lgc2.1.Out)	bool	2f0b	12043	Not applicable
Lgc2.3.OutputStatus	Output Status (0 = Good; 1 = Bad)	uint8	2f0c	12044	Not applicable
Lgc2.4.FallbackType	Fallback Condition (as Lgc2.1.FallbackType)	uint8	2f10	12048	Not applicable
Lgc2.4.In1	Input Value 1	float32	2f0e	12046	0dp
Lgc2.4.In2	Input Value 2	float32	2f0f	12047	0dp
Lgc2.4.Invert	Sense of Input Value (as Lgc2.1.Invert)	uint8	2f11	12049	Not applicable
Lgc2.4.Oper	Logic Operation (as Lgc2.1.Oper)	uint8	2f0d	12045	Not applicable
Lgc2.4.Out	The result of the logic operation (as Lgc2.1.Out)	bool	2f12	12050	Not applicable
Lgc2.4.OutputStatus	Output Status (0 = Good; 1 = Bad)	uint8	2f13	12051	Not applicable
Lgc2.5.FallbackType	Fallback Condition (as Lgc2.1.FallbackType)	uint8	2f17	12055	Not applicable
Lgc2.5.In1	Input Value 1	float32	2f15	12053	0dp
Lgc2.5.In2	Input Value 2	float32	2f16	12054	0dp
Lgc2.5.Invert	Sense of Input Value (as Lgc2.1.Invert)	uint8	2f18	12056	Not applicable
Lgc2.5.Oper	Logic Operation (as Lgc2.1.Oper)	uint8	2f14	12052	Not applicable
Lgc2.5.Out	The result of the logic operation (as Lgc2.1.Out)	bool	2f19	12057	Not applicable
Lgc2.5.OutputStatus	Output Status (0 = Good; 1 = Bad)	uint8	2f1a	12058	Not applicable
Lgc2.6.FallbackType	Fallback Condition (as Lgc2.1.FallbackType)	uint8	2f1e	12062	Not applicable
Lgc2.6.In1	Input Value 1	float32	2f1c	12060	0dp
Lgc2.6.In2	Input Value 2	float32	2f1d	12061	0dp
Lgc2.6.Invert	Sense of Input Value (as Lgc2.1.Invert)	uint8	2f1f	12063	Not applicable
Lgc2.6.Oper	Logic Operation (as Lgc2.1.Oper)	uint8	2f1b	12059	Not applicable
Lgc2.6.Out	The result of the logic operation (as Lgc2.1.Out)	bool	2f20	12064	Not applicable
Lgc2.6.OutputStatus	Output Status (0 = Good; 1 = Bad)	uint8	2f21	12065	Not applicable
Lgc2.7.FallbackType	Fallback Condition (as Lgc2.1.FallbackType)	uint8	2f25	12069	Not applicable
Lgc2.7.In1	Input Value 1	float32	2f23	12067	0dp
Lgc2.7.In2	Input Value 2	float32	2f24	12068	0dp
Lgc2.7.Invert	Sense of Input Value (as Lgc2.1.Invert)	uint8	2f26	12070	Not applicable
Lgc2.7.Oper	Logic Operation (as Lgc2.1.Oper)	uint8	2f22	12066	Not applicable
Lgc2.7.Out	The result of the logic operation (as Lgc2.1.Out)	bool	2f27	12071	Not applicable
Lgc2.7.OutputStatus	Output Status (0 = Good; 1 = Bad)	uint8	2f28	12072	Not applicable
Lgc2.8.FallbackType	Fallback Condition (as Lgc2.1.FallbackType)	uint8	2f2c	12076	Not applicable
Lgc2.8.In1	Input Value 1	float32	2f2a	12074	0dp
Lgc2.8.In2	Input Value 2	float32	2f2b	12075	0dp
Lgc2.8.Invert	Sense of Input Value (as Lgc2.1.Invert)	uint8	2f2d	12077	Not applicable
Lgc2.8.Oper	Logic Operation (as Lgc2.1.Oper)	uint8	2f29	12073	Not applicable
Lgc2.8.Out	The result of the logic operation (as Lgc2.1.Out)	bool	2f2e	12078	Not applicable
Lgc2.8.OutputStatus	Output Status (0 = Good; 1 = Bad)	uint8	2f2f	12079	Not applicable
Lgc2.9.FallbackType	Fallback Condition (as Lgc2.1.FallbackType)	uint8	2f33	12083	Not applicable
Lgc2.9.In1	Input Value 1	float32	2f31	12081	0dp
Lgc2.9.In2	Input Value 2	float32	2f32	12082	0dp
Lgc2.9.Invert	Sense of Input Value (as Lgc2.1.Invert)	uint8	2f34	12084	Not applicable
Lgc2.9.Oper	Logic Operation (as Lgc2.1.Oper)	uint8	2f30	12080	Not applicable
Lgc2.9.Out	The result of the logic operation (as Lgc2.1.Out)	bool	2f35	12085	Not applicable
Lgc2.9.OutputStatus	Output Status (0 = Good; 1 = Bad)	uint8	2f36	12086	Not applicable
Lgc2.10.FallbackType	Fallback Condition (as Lgc2.1.FallbackType)	uint8	2f3a	12090	Not applicable
Lgc2.10.In1	Input Value 1	float32	2f38	12088	0dp
Lgc2.10.In2	Input Value 2	float32	2f39	12089	0dp
Lgc2.10.Invert	Sense of Input Value (as Lgc2.1.Invert)	uint8	2f3b	12091	Not applicable
Lgc2.10.Oper	Logic Operation (as Lgc2.1.Oper)	uint8	2f37	12087	Not applicable

5.3 PARAMETER LIST (Cont.)

Parameter path	Description	Type	Hex	Dec	Resolution
Lgc2.10.Out	The result of the logic operation (as Lgc2.1.Out)	bool	2f3c	12092	Not applicable
Lgc2.10.OutputStatus	Output Status (0 = Good; 1 = Bad)	uint8	2f3d	12093	Not applicable
Lgc2.11.FallbackType	Fallback Condition (as Lgc2.1.FallbackType)	uint8	2f41	12097	Not applicable
Lgc2.11.In1	Input Value 1	float32	2f3f	12095	0dp
Lgc2.11.In2	Input Value 2	float32	2f40	12096	0dp
Lgc2.11.Invert	Sense of Input Value (as Lgc2.1.Invert)	uint8	2f42	12098	Not applicable
Lgc2.11.Oper	Logic Operation (as Lgc2.1.Oper)	uint8	2f3e	12094	Not applicable
Lgc2.11.Out	The result of the logic operation (as Lgc2.1.Out)	bool	2f43	12099	Not applicable
Lgc2.11.OutputStatus	Output Status (0 = Good; 1 = Bad)	uint8	2f44	12100	Not applicable
Lgc2.12.FallbackType	Fallback Condition (as Lgc2.1.FallbackType)	uint8	2f48	12104	Not applicable
Lgc2.12.In1	Input Value 1	float32	2f46	12102	0dp
Lgc2.12.In2	Input Value 2	float32	2f47	12103	0dp
Lgc2.12.Invert	Sense of Input Value (as Lgc2.1.Invert)	uint8	2f49	12105	Not applicable
Lgc2.12.Oper	Logic Operation (as Lgc2.1.Oper)	uint8	2f45	12101	Not applicable
Lgc2.12.Out	The result of the logic operation (as Lgc2.1.Out)	bool	2f4a	12106	Not applicable
Lgc2.12.OutputStatus	Output Status (0 = Good; 1 = Bad)	uint8	2f4b	12107	Not applicable
Lgc8.1.In1	Input 1 Value (0 = Off; 1 = On)	bool	2f4f	12111	Not applicable
Lgc8.1.In2	Input 2 Value (0 = Off; 1 = On)	bool	2f50	12112	Not applicable
Lgc8.1.In3	Input 3 Value (0 = Off; 1 = On)	bool	2f51	12113	Not applicable
Lgc8.1.In4	Input 4 Value (0 = Off; 1 = On)	bool	2f52	12114	Not applicable
Lgc8.1.In5	Input 5 Value (0 = Off; 1 = On)	bool	2f53	12115	Not applicable
Lgc8.1.In6	Input 6 Value (0 = Off; 1 = On)	bool	2f54	12116	Not applicable
Lgc8.1.In7	Input 7 Value (0 = Off; 1 = On)	bool	2f55	12117	Not applicable
Lgc8.1.In8	Input 8 Value (0 = Off; 1 = On)	bool	2f56	12118	Not applicable
Lgc8.1.InInvert	Invert Selected Inputs (See also section 4.20.3) Hex0001 = Invert input 1 Hex0010 = invert input 5 Hex0002 = Invert input 2 Hex0020 = invert input 6 Hex0003 = Invert input 3 Hex0030 = invert input 7 Hex0004 = invert input 4 Hex0040 = invert input 8	uint8	2f4d	12109	Not applicable
Lgc8.1.NumIn	Number of Inputs	uint8	2f4e	12110	Not applicable
Lgc8.1.Oper	Logic Operation (0 = Off; 1 = AND; 2 = OR; 3 = XOR)	uint8	2f4c	12108	Not applicable
Lgc8.1.Out	Output Value (0 = Off (false); 1 = On (true))	bool	2f57	12119	Not applicable
Lgc8.1.OutInvert	Invert the Output (0 = No; 1 = Yes)	bool	2f58	12120	Not applicable
Lgc8.2.In1	Input 1 Value (0 = Off; 1 = On)	bool	2f5c	12124	Not applicable
Lgc8.2.In2	Input 2 Value (0 = Off; 1 = On)	bool	2f5d	12125	Not applicable
Lgc8.2.In3	Input 3 Value (0 = Off; 1 = On)	bool	2f5e	12126	Not applicable
Lgc8.2.In4	Input 4 Value (0 = Off; 1 = On)	bool	2f5f	12127	Not applicable
Lgc8.2.In5	Input 5 Value (0 = Off; 1 = On)	bool	2f60	12128	Not applicable
Lgc8.2.In6	Input 6 Value (0 = Off; 1 = On)	bool	2f61	12129	Not applicable
Lgc8.2.In7	Input 7 Value (0 = Off; 1 = On)	bool	2f62	12130	Not applicable
Lgc8.2.In8	Input 8 Value (0 = Off; 1 = On)	bool	2f63	12131	Not applicable
Lgc8.2.InInvert	Invert Selected Inputs (as Lgc8.1.InInvert)	uint8	2f5a	12122	Not applicable
Lgc8.2.NumIn	Number of Inputs	uint8	2f5b	12123	Not applicable
Lgc8.2.Oper	Logic Operation (0 = Off; 1 = AND; 2 = OR; 3 = XOR)	uint8	2f59	12121	Not applicable
Lgc8.2.Out	Output Value (as Lgc8.1.Out)	bool	2f64	12132	Not applicable
Lgc8.2.OutInvert	Invert the Output (0 = No; 1 = Yes)	bool	2f65	12133	Not applicable
Loop.1.Diag.DerivativeOutContrib	Derivative Output Contribution	float32	0212	530	0dp
Loop.1.Diag.Error	Calculated error	float32	020d	525	Same as Loop.1.Main.PV
Loop.1.Diag.IntegralOutContrib	Integral Output Contribution	float32	0211	529	0dp
Loop.1.Diag.LoopBreakAlarm	Loop Break (0 = No break; 1 = Break)	bool	020f	527	Not applicable
Loop.1.Diag.LoopMode	Mode of the Loop (0 = Auto; 1 = Man; 2 = Off)	uint8	1691	5777	Not applicable
Loop.1.Diag.PropOutContrib	Proportional Output Contribution	float32	0210	528	0dp
Loop.1.Diag.SBrk	Sensor Break Status (0 = No break; 1 = Break)	bool	0213	531	Not applicable
Loop.1.Diag.SchedCBH	The Scheduled Cutback High (0 = Auto)	float32	1695	5781	0dp
Loop.1.Diag.SchedCBL	The Scheduled Cutback Low (0 = Auto)	float32	1696	5782	0dp
Loop.1.Diag.SchedLPBrk	The Scheduled Loop Break Time (0 = Off)	float32	1698	5784	0dp
Loop.1.Diag.SchedMR	The Scheduled Manual Reset	float32	1697	5783	1dp
Loop.1.Diag.SchedOPHi	The Scheduled Output High Limit	float32	169a	5786	1dp
Loop.1.Diag.SchedOPLo	The Scheduled Output Low Limit	float32	169b	5787	1dp
Loop.1.Diag.SchedPB	The Scheduled Proportional Band	float32	1692	5778	1dp
Loop.1.Diag.SchedR2G	The Scheduled Relative Cool Gain	float32	1699	5785	1dp
Loop.1.Diag.SchedTd	The Scheduled Derivative Time (0 = Off)	float32	1694	5780	0dp
Loop.1.Diag.SchedTi	The Scheduled Integral Time (0 = Off)	float32	1693	5779	0dp
Loop.1.Diag.TargetOutVal	Target Output value	float32	020e	526	Same as Loop.1.OP.OutputHighLimit
Loop.1.Diag.WrkOPHi	Working Output High Limit	float32	0215	533	0dp
Loop.1.Diag.WrkOPLo	Working Output Low Limit	float32	0214	532	0dp
Loop.1.Main.ActiveOut	Working Output	float32	0204	516	Same as Loop.1.OP.OutputHighLimit
Loop.1.Main.AutoMan	Auto/Manual Mode (0 = Auto; 1 = Man)	bool	0201	513	Not applicable
Loop.1.Main.Inhibit	Control Inhibit (0 = No; 1 = Yes)	bool	0205	517	Not applicable
Loop.1.Main.IntHold	Integral action inhibit. 0 = No; 1 = Yes	uint8	0206	518	Not applicable

5.3 PARAMETER LIST (Cont.)

Parameter path	Description	Type	Hex	Dec	Resolution
Loop1.Maim.PV	Process varaible	float32	0200	512	1dp
Loop.1.Main.TargetSP	Target Setpoint	float32	0202	514	Same as Loop.1.Main.PV
Loop.1.Main.WorkingSP	Working Setpoint	float32	0203	515	Same as Loop.1.Main.PV
Loop.1.OP.Ch1OnOffHysteresis	Ch1 On/Off Hysteresis in Engineering Units	float32	1672	5746	Same as Loop.1.Main.PV
Loop.1.OP.Ch1Out	Channel 1 Output Value	float32	020b	523	Same as Loop.1.OP.OutputHighLimit
Loop.1.OP.Ch1PotBreak	Ch1 Potentiometer Break (0 = Off; 1 = On)	uint8	1679	5753	Not applicable
Loop.1.OP.Ch1PotPosition	Ch1 Valve Position	float32	1678	5752	0dp
Loop.1.OP.Ch1TravelTime	Channel 1 Travel Time	float32	1674	5748	1dp
Loop.1.OP.Ch2Deadband	Channel 2 Deadband	float32	166f	5743	Same as Loop.1.OP.OutputHighLimit
Loop.1.OP.Ch2OnOffHysteresis	Ch2 On/Off Hysteresis in Eng Units	float32	1673	5747	Same as Loop.1.Main.PV
Loop.1.OP.Ch2Out	Channel 2 (Cool) Output Value	float32	020c	524	Same as Loop.1.OP.OutputHighLimit
Loop.1.OP.Ch2PotBreak	Ch2 Potentiometer Break (0 = Off; 1 = On)	uint8	167b	5755	Not applicable
Loop.1.OP.Ch2PotPosition	Ch2 Valve Position	float32	167a	5754	0dp
Loop.1.OP.Ch2TravelTime	Channel 2 Travel Time	float32	1675	5749	1dp
Loop.1.OP.CoolType	Cooling Algorithm Type 0 = Linear 1 = Oil 2 = Water 3 = Fan	uint8	1683	5763	Not applicable
Loop.1.OP.EnablePowerFeedforward	0 = Power Feedforward disabled; 1 = PFF enabled	uint8	1681	5761	Not applicable
Loop.1.OP.FeedForwardGain	Feedforward Gain	float32	1685	5765	3dp
Loop.1.OP.FeedForwardOffset	Feedforward Offset	float32	1686	5766	0dp
Loop.1.OP.FeedForwardTrimLimit	Feedforward Trim Limit	float32	1687	5767	0dp
Loop.1.OP.FeedForwardType	Feedforward Type (0 = None; 1 = Remote; 2 = SP; 3 = PV)	uint8	1684	5764	Not applicable
Loop.1.OP.FeedForwardVal	Feedforward Value	float32	1688	5768	0dp
Loop.1.OP.FF_Rem	Remote Feed Forward Input	float32	168d	5773	0dp
Loop.1.OP.ForcedOP	Forced manual output value	float32	168f	5775	1dp
Loop.1.OP.ManStartup	Manual Startup Mode (0 = Off; 1 = On)	bool	1690	5776	Not applicable
Loop.1.OP.ManualMode	Manual Output Mode (0 = Track; 1 = Step; 2 = Last MOP)	uint8	167f	5759	Not applicable
Loop.1.OP.ManualOutVal	Manual Output Value	float32	1680	5760	Same as Loop.1.OP.OutputHighLimit
Loop.1.OP.MeasuredPower	Measured Mains Voltage	float32	1682	5762	0dp
Loop.1.OP.NudgeLower	Valve Nudge Lower (1 = Lower)	uint8	1677	5751	Not applicable
Loop.1.OP.NudgeRaise	Valve Nudge Raise (1 = Raise)	uint8	1676	5750	Not applicable
Loop.1.OP.OutputHighLimit	Output High Limit	float32	166d	5741	1dp
Loop.1.OP.OutputLowLimit	Output Low Limit	float32	166e	5742	Same as Loop.1.OP.OutputHighLimit
Loop.1.OP.PotBreakMode	Potentiometer Break Mode (0 = Raise; 1 = Lower; 2 = Rest: 3 = Model)	uint8	167c	5756	Not applicable
Loop.1.OP.Rate	Output Rate Limit Value (0 = Off)	float32	1670	5744	1dp
Loop.1.OP.RateDisable	Output Rate Limit Disable (1 = Disabled)	bool	1671	5745	Not applicable
Loop.1.OP.RemOPH	Remote Output High Limit	float32	168c	5772	Same as Loop.1.Main.ActiveOut
Loop.1.OP.RemOPL	Remote Output Low Limit	float32	168b	5771	Same as Loop.1.Main.ActiveOut
Loop.1.OP.SafeOutVal	Safe Output Value	float32	167e	5758	Same as Loop.1.OP.OutputHighLimit
Loop.1.OP.SbrkOP	The output power in sensor break	float32	168e	5774	Same as Loop.1.OP.OutputHighLimit
Loop.1.OP.SensorBreakMode	Sensor Break Mode (0 = SbrkOP; 1 = Hold)	uint8	167d	5757	Not applicable
Loop.1.OP.TrackEnable	Enable Output Tracking (0 = Disabled; 1 = Enabled)	uint8	168a	5770	Not applicable
Loop.1.OP.TrackOutVal	Output Track Value	float32	1689	5769	0dp
Loop.1.PID.ActiveSet	Current PID Set	uint8	1638	5688	Not applicable
Loop.1.PID.Boundary1-2	Threshold for swapping between set 1 and set 2	float32	1639	5689	0dp
Loop.1.PID.Boundary2-3	Threshold for swapping between set 2 and set 3	float32	163a	5690	0dp
Loop.1.PID.CutbackHigh	Cutback high value for PID set 1 (0 = Auto)	float32	163f	5695	1dp
Loop.1.PID.CutbackHigh2	Cutback high value for PID set 2 (0 = Auto)	float32	1647	5703	1dp
Loop.1.PID.CutbackHigh3	Cutback high value for PID set 3 (0 = Auto)	float32	164f	5711	1dp
Loop.1.PID.CutbackLow	Cutback low value for PID set 1 (0 = Auto)	float32	1640	5696	1dp
Loop.1.PID.CutbackLow2	Cutback low value for PID set 2 (0 = Auto)	float32	1648	5704	1dp
Loop.1.PID.CutbackLow3	Cutback low value for PID set 3 (0 = Auto)	float32	1650	5712	1dp
Loop.1.PID.DerivativeTime	Derivative time for PID set 1	float32	163d	5693	0dp
Loop.1.PID.DerivativeTime2	Derivative time for PID set 2	float32	1645	5701	0dp
Loop.1.PID.DerivativeTime3	Derivative time for PID set 3	float32	164d	5709	0dp
Loop.1.PID.IntegralTime	Integral time for PID set 1	float32	163c	5692	0dp
Loop.1.PID.IntegralTime2	Integral time for PID set 2	float32	1644	5700	0dp
Loop.1.PID.IntegralTime3	Integral time for PID set 3	float32	164c	5708	0dp
Loop.1.PID.LoopBreakTime	Loop break time for PID set 1	float32	1642	5698	0dp
Loop.1.PID.LoopBreakTime2	Loop break time for PID set 2	float32	164a	5706	0dp
Loop.1.PID.LoopBreakTime3	Loop break time for PID set 3	float32	1652	5714	0dp
Loop.1.PID.ManualReset	Manual reset value for PID set 1	float32	1641	5697	1dp
Loop.1.PID.ManualReset2	Manual reset value for PID set 2	float32	1649	5705	1dp
Loop.1.PID.ManualReset3	Manual reset value for PID set 3	float32	1651	5713	1dp
Loop.1.PID.NumSets	Number of PID Sets to be used (max = 3)	uint8	1636	5686	Not applicable
Loop.1.PID.OutputHi	Gain scheduled output high limit for PID set 1	float32	1653	5715	1dp
Loop.1.PID.OutputHi2	Gain scheduled output high limit for PID set 2	float32	1655	5717	1dp
Loop.1.PID.OutputHi3	Gain scheduled output high limit for PID set 3	float32	1657	5719	1dp
Loop.1.PID.OutputLo	Gain scheduled output low limit for PID set 1	float32	1654	5716	1dp
Loop.1.PID.OutputLo2	Gain scheduled output low limit for PID set 2	float32	1656	5718	1dp
Loop.1.PID.OutputLo3	Gain scheduled output low limit for PID set 3	float32	1658	5720	1dp
Loop.1.PID.ProportionalBand	Proportional band value for PID set 1	float32	163b	5691	1dp
Loop.1.PID.ProportionalBand2	Proportional band value for PID set 2	float32	1643	5699	1dp
Loop.1.PID.ProportionalBand3	Proportional band value for PID set 3	float32	164b	5707	1dp
Loop.1.PID.RelCh2Gain	Channel 2 relative cool gain value for PID set 1	float32	163e	5694	1dp
Loop.1.PID.RelCh2Gain2	Channel 2 relative cool gain value for PID set 2	float32	1646	5702	1dp
Loop.1.PID.RelCh2Gain3	Channel 2 relative cool gain value for PID set 3	float32	164e	5710	1dp
Loop.1.PID.SchedulerRemoteInput	Scheduler Remote Input	float32	1637	5687	0dp
Loop.1.PID.SchedulerType	Scheduler Type 0 = Off 1 = Set 2 = SP 3 = PV 4 = Error 5 = OP 6 = Rem	uint8	1635	5685	Not applicable

5.3 PARAMETER LIST (Cont.)

Parameter path	Description	Type	Hex	Dec	Resolution
Loop.1.Setup.AutoManAccess	Edit access to 'Auto Man' in Loop display page 0 = Read/Write (R/W) all modes 1 = Editable in all modes except 'Logged out' 2 = Editable only at Engineer and Supervisor levels	uint8	16a8	5800	Not applicable
Loop.1.Setup.CH1ControlType	Heat/Ch1 Control Type 0 =Off; 1 = On Off; 2 = PID; 3 = VPU; 4 = VPB	uint8	1601	5633	Not applicable
Loop.1.Setup.CH2ControlType	Channel 2 control type (As channel 1, above)	uint8	1602	5634	Not applicable
Loop.1.Setup.ControlAction	Control Action (0 = Reverse; 1 = Direct)	uint8	1603	5635	Not applicable
Loop.1.Setup.DerivativeType	Derivative Type (0 = PV; 1 = Error)	uint8	1605	5637	Not applicable
Loop.1.Setup.LoopName	Loop Name	string_t	5d00	23808	Not applicable
Loop.1.Setup.LoopType	Loop Type (0 = Single; 1 = Cascade; 2 = Override; 3 = Ratio)	uint8	1600	5632	Not applicable
Loop.1.Setup.PBUnits	Proportional Band Units	uint8	1604	5636	Not applicable
Loop.1.Setup.SPAccess	Edit access to 'SP' in Loop display page 0 = Read/Write (R/W) all modes 1 = Editable in all modes except 'Logged out' 2 = Editable only at Engineer and Supervisor levels	uint8	16a7	5799	Not applicable
Loop.1.SP.AltSP	Alternative Setpoint	float32	1660	5728	Same as Loop.1.Main.PV
Loop.1.SP.AltSPSelect	Alternative Setpoint Enable (0 = disable; 1 = enable)	uint8	1661	5729	Not applicable
Loop.1.SP.ManualTrack	Manual Track Enable (0 = disable; 1 = enable)	uint8	1667	5735	Not applicable
Loop.1.SP.RangeHigh	Setpoint Range High Limit	float32	1659	5721	Same as Loop.1.Main.PV
Loop.1.SP.RangeLow	Setpoimt Range Low Limit	float32	165a	5722	Same as Loop.1.Main.PV
Loop.1.SP.Rate	Setpoint Rate Limit Value (0 = Rate limit off)	float32	1662	5730	Same as Loop.1.Main.PV
Loop.1.SP.RateDisable	Setpoint Rate Limit Disable (0 = No; 1 = Yes)	bool	1663	5731	Not applicable
Loop.1.SP.RateDone	Setpoint Rate Limit Complete (0 = No; 1 = Yes)	bool	020a	522	Not applicable
Loop.1.SP.ServoToPV	Servo to PV Enable (0 = No; 1 = Yes)	bool	166c	5740	Not applicable
Loop.1.SP.SP1	Setpoint 1	float32	165c	5724	Same as Loop.1.Main.PV
Loop.1.SP.SP2	Setpoint 2	float32	165d	5725	Same as Loop.1.Main.PV
Loop.1.SP.SPHighLimit	Setpoint High Limit	float32	165e	5726	Same as Loop.1.Main.PV
Loop.1.SP.SPIntBal	SP Integral Balance (0 = Off; 1 = On)	bool	166b	5739	Not applicable
Loop.1.SP.SPLowLimit	Setpoint Low Limit	float32	165f	5727	Same as Loop.1.Main.PV
Loop.1.SP.SPSelect	Active Setpoint Select (0 = SP1; 1 = SP2)	uint8	165b	5723	Not applicable
Loop.1.SP.SPTrack	Enables setpoint tracking (0 = Off; 1 = On)	uint8	1668	5736	Not applicable
Loop.1.SP.SPTrim	Setpoint Trim value	float32	1664	5732	Same as Loop.1.Main.PV
Loop.1.SP.SPTrimHighLimit	Setpoint Trim High Limit	float32	1665	5733	Same as Loop.1.Main.PV
Loop.1.SP.SPTrimLowLimit	Setpoint Trim Low Limit	float32	1666	5734	Same as Loop.1.Main.PV
Loop.1.SP.TrackPV	Track PV	float32	1669	5737	Same as Loop.1.Main.PV
Loop.1.SP.TrackSP	Manual Tracking Value	float32	166a	5738	Same as Loop.1.Main.PV
Loop.1.Tune.Alpha	Alpha	float32	16ad	5805	4dp
Loop.1.Tune.Alpha_p	Alpha_p	float32	16ab	5803	2dp
Loop.1.Tune.AutotuneEnable	Autotune Enable (0 = Autotune Off; 1 = on)	bool	1631	5681	Not applicable
Loop.1.Tune.CycleNo	CycleNo	float32	16af	5807	0dp
Loop.1.Tune.Debug	Debug	float32	16ae	5806	2dp
Loop.1.Tune.Diagnostics	Tuning diagnostics	bool	31cd	12749	Not applicable
Loop.1.Tune.OPss	OPss	float32	16ac	5804	2dp
Loop.1.Tune.OutputHighLimit	Autotune High Output Power Limit	float32	1632	5682	Same as Loop.1.OP.OutputHighLimit
Loop.1.Tune.OutputLowLimit	Autotune Low Output Power Limit	float32	1633	5683	Same as Loop.1.OP.OutputHighLimit
Loop.1.Tune.PBs	PBs	float32	16b0	5808	2dp
Loop.1.Tune.Settle	Settle	float32	16b2	5810	2dp
Loop.1.Tune.Stage	Autotune stage uint8 0 = Reset 1 = None 2 = Monitor 3 = Current SP 4 = NewSP 5 = ToSp 6 = Max 7 = Min	0208		520	Not applicable
Loop.1.Tune.StageTime	Time in this Stage of Tune	float32	0209	521	0dp
Loop.1.Tune.State	Tune status 0 = Off 1 = Ready 2 = Running 3 = Complete 4 = Timeout 5 = Ti Lmit 6 = R2g limit	uint8	0207	519	Not applicable
Loop.1.Tune.TDs	TDs	float32	16b1	5809	2dp
Loop.1.Tune.TuneR2G	R2G Tuning Type	uint8	1607	5639	Not applicable
Loop.1.Tune.Tuning	Tuning	float32	16aa	5802	0dp
Loop.1.Tune.Type	Autotune Algorithm Type (0 = Cycle; 1 = Single; 2 = Adaptive; 3 = R2GPD)	uint8	1630	5680	Not applicable
Loop.2.Diag.DerivativeOutContrib	Derivative Output Contribution	float32	0292	658	0dp
Loop.2.Diag.Error	Calculated Error	float32	028d	653	Same as Loop.2.Main.PV
Loop.2.Diag.IntegralOutContrib	Integral Output Contribution	float32	0291	657	0dp
Loop.2.Diag.LoopBreakAlarm	Loop Break (0 = No break; 1 = Break)	bool	028f	655	Not applicable
Loop.2.Diag.LoopMode	Loop mode (0 = Auto; 1 = Man; 2 = Off)	uint8	1791	6033	Not applicable
Loop.2.Diag.PropOutContrib	Proportional Output Contribution	float32	0290	656	0dp
Loop.2.Diag.SBrk	Sensor break status (0 = No break; 1 = Break)	bool	0293	659	Not applicable
Loop.2.Diag.SchedCBH	The Scheduled Cutback Hi (0 = Auto)	float32	1795	6037	0dp
Loop.2.Diag.SchedCBL	The Scheduled Cutback Lo (0 = Auto)	float32	1796	6038	0dp
Loop.2.Diag.SchedLPBrk	The Scheduled Loop Break Time	float32	1798	6040	0dp
Loop.2.Diag.SchedMR	The Scheduled Manual Reset	float32	1797	6039	1dp
Loop.2.Diag.SchedOPHi	The Scheduled Output High Limit	float32	179a	6042	1dp
Loop.2.Diag.SchedOPLo	The Scheduled Output Low Limit	float32	179b	6043	1dp
Loop.2.Diag.SchedPB	The Scheduled Proportional Band	float32	1792	6034	1dp
Loop.2.Diag.SchedR2G	The Scheduled Relative Cool Gain	float32	1799	6041	1dp
Loop.2.Diag.SchedTd	The Scheduled Derivative Time (0 = Off)	float32	1794	6036	0dp
Loop.2.Diag.SchedTi	The Scheduled Integral Time (0 = Off)	float32	1793	6035	0dp
Loop.2.Diag.TargetOutVal	Target Output	float32	028e	654	Same as Loop.2.OP.OutputHighLimit

5.3 PARAMETER LIST (Cont.)

Parameter path	Description	Type	Hex	Dec	Resolution
Loop.2.Diag.WrkOPHi	Working Output Hi Limit	float32	0295	661	0dp
Loop.2.Diag.WrkOPLo	Working Output Lo Limit	float32	0294	660	0dp
Loop.2.Main.ActiveOut	Working Output	float32	0284	644	Same as Loop.2.OP.OutputHighLimit
Loop.2.Main.AutoMan	Auto/Manual Mode (Mode. 0 = Auto; 1 = Man)	bool	0281	641	Not applicable
Loop.2.Main.Inhibit	Control Inhibit (0 = No; 1 = Yes)	bool	0285	645	Not applicable
Loop.2.Main.IntHold	Integral action inhibit. 0 = No; 1 = Yes	uint8	0286	646	Not applicable
Loop.2.Main.PV	Process Variable value	float32	0280	640	1dp
Loop.2.Main.TargetSP	Target Setpoint	float32	0282	642	Same as Loop.2.Main.PV
Loop.2.Main.WorkingSP	Working Setpoint	float32	0283	643	Same as Loop.2.Main.PV
Loop.2.OP.Ch1OnOffHysteresis	Channel 1 hysteresis in engineering units	float32	1772	6002	Same as Loop.2.Main.PV
Loop.2.OP.Ch1Out	Channel 1 Output Value	float32	028b	651	Same as Loop.2.OP.OutputHighLimit
Loop.2.OP.Ch1PotBreak	Ch1 Potentiometer Break (0 = Off; 1 = On)	uint8	1779	6009	Not applicable
Loop.2.OP.Ch1PotPosition	Ch1 Valve Position	float32	1778	6008	0dp
Loop.2.OP.Ch1TravelTime	Channel 1 Travel Time	float32	1774	6004	1dp
Loop.2.OP.Ch2Deadband	Channel 2 Deadband	float32	176f	5999	Same as Loop.2.OP.OutputHighLimit
Loop.2.OP.Ch2OnOffHysteresis	Channel 2 hysteresis in engineering units	float32	1773	6003	Same as Loop.2.Main.PV
Loop.2.OP.Ch2Out	Channel 2 output value	float32	028c	652	Same as Loop.2.OP.OutputHighLimit
Loop.2.OP.Ch2PotBreak	Channel 2 Potentiometer Break (0 = Off; 1 = On)	uint8	177b	6011	Not applicable
Loop.2.OP.Ch2PotPosition	Channel 2 Valve Position	float32	177a	6010	0dp
Loop.2.OP.Ch2TravelTime	Channel 2 Travel Time	float32	1775	6005	1dp
Loop.2.OP.CoolType	Cooling Algorithm Type 0 = Linear; 1 = Oil; 2 = Water; 3 = Fan	uint8	1783	6019	Not applicable
Loop.2.OP.EnablePowerFeedforward	0 = Power Feedforward disabled; 1 = PFF enabled	uint8	1781	6017	Not applicable
Loop.2.OP.FeedForwardGain	Feedforward Gain	float32	1785	6021	3dp
Loop.2.OP.FeedForwardOffset	Feedforward Offset	float32	1786	6022	0dp
Loop.2.OP.FeedForwardTrimLimit	Feedforward Trim Limit	float32	1787	6023	0dp
Loop.2.OP.FeedForwardType	Feedforward Type (0 = None; 1 = Remote; 2 = SP; 3 = PV)	uint8	1784	6020	Not applicable
Loop.2.OP.FeedForwardVal	Feedforward Value	float32	1788	6024	0dp
Loop.2.OP.FF_Rem	Remote Feed Forward Input	float32	178d	6029	0dp
Loop.2.OP.ForcedOP	Forced manual output value	float32	178f	6031	1dp
Loop.2.OP.ManStartup	Manual Startup Mode (0 = Off; 1 = On)	bool	1790	6032	Not applicable
Loop.2.OP.ManualMode	Manual Output Mode (0 = Track; 1 = Step; 2 = Last MOP)	uint8	177f	6015	Not applicable
Loop.2.OP.ManualOutVal	Manual Output Value	float32	1780	6016	Same as Loop.2.OP.OutputHighLimit
Loop.2.OP.MeasuredPower	Measured Mains Voltage	float32	1782	6018	0dp
Loop.2.OP.NudgeLower	Valve Nudge Lower (1 = Lower)	uint8	1777	6007	Not applicable
Loop.2.OP.NudgeRaise	Valve Nudge Raise (1 = Raise)	uint8	1776	6006	Not applicable
Loop.2.OP.OutputHighLimit	Output High Limit	float32	176d	5997	1dp
Loop.2.OP.OutputLowLimit	Output Low Limit	float32	176e	5998	Same as Loop.2.OP.OutputHighLimit
Loop.2.OP.PotBreakMode	Potentiometer Break Mode (0 = Raise; 1 = Lower; 2 = Rest; 3 = Model)	uint8	177c	6012	Not applicable
Loop.2.OP.Rate	Output Rate Limit Value (0 = off)	float32	1770	6000	1dp
Loop.2.OP.RateDisable	Output Rate Limit Disable (0 = No, 1 = Yes)	bool	1771	6001	Not applicable
Loop.2.OP.RemOPH	Remote Output High Limit	float32	178c	6028	Same as Loop.2.Main.ActiveOut
Loop.2.OP.RemOPL	Remote Output Low Limit	float32	178b	6027	Same as Loop.2.Main.ActiveOut
Loop.2.OP.SafeOutVal	Safe Output Value	float32	177e	6014	Same as Loop.2.OP.OutputHighLimit
Loop.2.OP.SbrkOP	The output power under sensor break conditions	float32	178e	6030	Same as Loop.2.OP.OutputHighLimit
Loop.2.OP.SensorBreakMode	Sensor Break Mode (0 = SbrkOP; 1 = Hold)	uint8	177d	6013	Not applicable
Loop.2.OP.TrackEnable	Enable Output Tracking (0 = Off; 1 = On)	uint8	178a	6026	Not applicable
Loop.2.OP.TrackOutVal	Output Track Value	float32	1789	6025	0dp
Loop.2.PID.ActiveSet	Current PID set	uint8	1738	5944	Not applicable
Loop.2.PID.Boundary1-2	Threshold for swapping between set 1 and set 2	float32	1739	5945	0dp
Loop.2.PID.Boundary2-3	Threshold for swapping between set 2 and set 3	float32	173a	5946	0dp
Loop.2.PID.CutbackHigh	Cutback high value for PID set 1 (0 = Auto)	float32	173f	5951	1dp
Loop.2.PID.CutbackHigh2	Cutback high value for PID set 2 (0 = Auto)	float32	1747	5959	1dp
Loop.2.PID.CutbackHigh3	Cutback high value for PID set 3 (0 = Auto)	float32	174f	5967	1dp
Loop.2.PID.CutbackLow	Cutback low value for PID set 1 (0 = Auto)	float32	1740	5952	1dp
Loop.2.PID.CutbackLow2	Cutback low value for PID set 2 (0 = Auto)	float32	1748	5960	1dp
Loop.2.PID.CutbackLow3	Cutback low value for PID set 3 (0 = Auto)	float32	1750	5968	1dp
Loop.2.PID.DerivativeTime	Derivative time for PID set 1	float32	173d	5949	0dp
Loop.2.PID.DerivativeTime2	Derivative time for PID set 2	float32	1745	5957	0dp
Loop.2.PID.DerivativeTime3	Derivative time for PID set 3	float32	174d	5965	0dp
Loop.2.PID.IntegralTime	Integral time for PID set 1	float32	173c	5948	0dp
Loop.2.PID.IntegralTime2	Integral time for PID set 2	float32	1744	5956	0dp
Loop.2.PID.IntegralTime3	Integral time for PID set 3	float32	174c	5964	0dp
Loop.2.PID.LoopBreakTime	Loop break time for PID set 1	float32	1742	5954	0dp
Loop.2.PID.LoopBreakTime2	Loop break time for PID set 2	float32	174a	5962	0dp
Loop.2.PID.LoopBreakTime3	Loop break time for PID set 3	float32	1752	5970	0dp
Loop.2.PID.ManualReset	Manual reset value for PID set 1	float32	1741	5953	1dp
Loop.2.PID.ManualReset2	Manual reset value for PID set 2	float32	1749	5961	1dp
Loop.2.PID.ManualReset3	Manual reset value for PID set 3	float32	1751	5969	1dp
Loop.2.PID.NumSets	Number of PID sets to be used (max. 3)	uint8	1736	5942	Not applicable
Loop.2.PID.OutputHi	Gain scheduled output high limit for PID set 1	float32	1753	5971	1dp
Loop.2.PID.OutputHi2	Gain scheduled output high limit for PID set 2	float32	1755	5973	1dp
Loop.2.PID.OutputHi3	Gain scheduled output high limit for PID set 3	float32	1757	5975	1dp
Loop.2.PID.OutputLo	Gain scheduled output low limit for PID set 1	float32	1754	5972	1dp
Loop.2.PID.OutputLo2	Gain scheduled output low limit for PID set 2	float32	1756	5974	1dp
Loop.2.PID.OutputLo3	Gain scheduled output low limit for PID set 3	float32	1758	5976	1dp
Loop.2.PID.ProportionalBand	Proportional band value for PID set 1	float32	173b	5947	1dp
Loop.2.PID.ProportionalBand2	Proportional band value for PID set 2	float32	1743	5955	1dp
Loop.2.PID.ProportionalBand3	Proportional band value for PID set 3	float32	174b	5963	1dp
Loop.2.PID.RelCh2Gain	Channel 2 relative cool gain value for PID set 1	float32	173e	5950	1dp

5.3 PARAMETER LIST (Cont.)

Parameter path	Description	Type	Hex	Dec	Resolution
Loop.2.PID.RelCh2Gain2	Channel 2 relative cool gain value for PID set 2	float32	1746	5958	1dp
Loop.2.PID.RelCh2Gain3	Channel 2 relative cool gain value for PID set 3	float32	174e	5966	1dp
Loop.2.PID.SchedulerRemoteInput	Scheduler Remote Input	float32	1737	5943	0dp
Loop.2.PID.SchedulerType	Scheduler Type 0 = Off 1 = Set 2 = SP 3 = PV 4 = Error 5 = OP 6 = Rem	uint8	1735	5941	Not applicable
Loop.2.Setup.AutoManAccess	Edit access to 'Auto Man' in Loop display page 0 = Read/Write (R/W) all modes 1 = Editable in all modes except 'Logged out' 2 = Editable only at Engineer and Supervisor levels	uint8	17a8	6056	Not applicable
Loop.2.Setup.CH1ControlType	Channel 1 Control Type 0 =Off; 1 = On Off; 2 = PID; 3 = VPU; 4 = VPB	uint8	1701	5889	Not applicable
Loop.2.Setup.CH2ControlType	Channel 2 Control Type (As channel 1, above)	uint8	1702	5890	Not applicable
Loop.2.Setup.ControlAction	Control Action (0 = Reverse; 1 = Direct)	uint8	1703	5891	Not applicable
Loop.2.Setup.DerivativeType	Derivative Type (0 = PV; 1 = Error)	uint8	1705	5893	Not applicable
Loop.2.Setup.LoopName	Loop Name	string_t	5d10	23824	Not applicable
Loop.2.Setup.LoopType	Loop Type (0 = single; 1 = cascade; 2 = override; 3 = ratio)	uint8	1700	5888	Not applicable
Loop.2.Setup.PBUnits	Proportional Band Units (0 = Engineering units; 1 = percent)	uint8	1704	5892	Not applicable
Loop.2.Setup.SPAccess	Edit access to 'SP' in Loop display page 0 = Read/Write (R/W) all modes 1 = Editable in all modes except 'Logged out' 2 = Editable only at Engineer and Supervisor levels	uint8	17a7	6055	Not applicable
Loop.2.SP.AltSP	Alternative Setpoint	float32	1760	5984	Same as Loop.2.Main.PV
Loop.2.SP.AltSPSelect	Select alternative setpoint (0 = No; 1 = Yes)	uint8	1761	5985	Not applicable
Loop.2.SP.ManualTrack	Manual Track Enable (0 = disable; 1 = enable)	uint8	1767	5991	Not applicable
Loop.2.SP.RangeHigh	Setpoint Range High Limit	float32	1759	5977	Same as Loop.2.Main.PV
Loop.2.SP.RangeLow	Setpoint Range Low Limit	float32	175a	5978	Same as Loop.2.Main.PV
Loop.2.SP.Rate	Setpoint Rate Limit Value (0 = Rate limit off)	float32	1762	5986	Same as Loop.2.Main.PV
Loop.2.SP.RateDisable	Setpoint Rate Limit Disable (0 = No; 1 = Yes)	bool	1763	5987	Not applicable
Loop.2.SP.RateDone	Setpoint Rate Limit Complete (0 = No; 1 = Yes)	bool	028a	650	Not applicable
Loop.2.SP.ServoToPV	Servo to PV Enable (0 = No; 1 = Yes)	bool	176c	5996	Not applicable
Loop.2.SP.SP1	Setpoint 1	float32	175c	5980	Same as Loop.2.Main.PV
Loop.2.SP.SP2	Setpoint 2	float32	175d	5981	Same as Loop.2.Main.PV
Loop.2.SP.SPHighLimit	Setpoint High Limit	float32	175e	5982	Same as Loop.2.Main.PV
Loop.2.SP.SPIntBal	SP Integral Balance (0 = Off; 1 = On)	bool	176b	5995	Not applicable
Loop.2.SP.SPLowLimit	Setpoint Low Limit	float32	175f	5983	Same as Loop.2.Main.PV
Loop.2.SP.SPSelect	Active Setpoint Select (0 = SP1; 1 = SP2)	uint8	175b	5979	Not applicable
Loop.2.SP.SPTrack	Enables setpoint tracking (0 = Off; 1 = On)	uint8	1768	5992	Not applicable
Loop.2.SP.SPTrim	Setpoint Trim	float32	1764	5988	Same as Loop.2.Main.PV
Loop.2.SP.SPTrimHighLimit	Setpoint Trim High Limit	float32	1765	5989	Same as Loop.2.Main.PV
Loop.2.SP.SPTrimLowLimit	Setpoint Trim Low Limit	float32	1766	5990	Same as Loop.2.Main.PV
Loop.2.SP.TrackPV	PV for Programmer to Track	float32	1769	5993	Same as Loop.2.Main.PV
Loop.2.SP.TrackSP	Manual Tracking Value	float32	176a	5994	Same as Loop.2.Main.PV
Loop.2.Tune.Alpha	Alpha	float32	17ad	6061	4dp
Loop.2.Tune.Alpha_p	Alpha_p	float32	17ab	6059	2dp
Loop.2.Tune.AutotuneEnable	Initiate autotune (0 = Autotune Off; 1 = on)	bool	1731	5937	Not applicable
Loop.2.Tune.CycleNo	CycleNo	float32	17af	6063	0dp
Loop.2.Tune.Debug	Debug	float32	17ae	6062	2dp
Loop.2.Tune.Diagnostics	Tuning diagnostics	bool	31ce	12750	Not applicable
Loop.2.Tune.OPss	OPss	float32	17ac	6060	2dp
Loop.2.Tune.OutputHighLimit	Autotune High Output Power Limit	float32	1732	5938	Same as Loop.2.OP.OutputHighLimit
Loop.2.Tune.OutputLowLimit	Autotune Low Output Power Limit	float32	1733	5939	Same as Loop.2.OP.OutputHighLimit
Loop.2.Tune.PBs	PBs	float32	17b0	6064	2dp
Loop.2.Tune.Settle	Settle	float32	17b2	6066	2dp
Loop.2.Tune.Stage	Stage of Tune 0 = Reset 1 = None 2 = Monitor 3 = Current SP 4 = NewSP 5 = ToSp 6 = Max 7 = Min	uint8	0288	648	Not applicable
Loop.2.Tune.StageTime	Time in this Stage of Tune	float32	0289	649	0dp
Loop.2.Tune.State	Autotune state 0 = Off 1 = Ready 2 = Complete 3 = Timeout 4 = Ti Lmit 5 = R2g limit	uint8	0287	647	Not applicable
Loop.2.Tune.TDs	TDs	float32	17b1	6065	2dp
Loop.2.Tune.TuneR2G	R2G Tuning Type	uint8	1608	5640	Not applicable
Loop.2.Tune.Tuning	Tuning	float32	17aa	6058	0dp
Loop.2.Tune.Type	Autotune Algorithm Type (0 = Cycle; 1 = Single; 2 = Adaptive; 3 = R2GPD)	uint8	1730	5936	Not applicable
Math2.1.Fallback	Fallback strategy 0 = Clip Bad; 1 = Clip Good; 2 = Fallback Bad 3 = Fallback Good; 4 = Up scale; 5 = Down scale.	uint8	2faf	12207	Not applicable
Math2.1.FallbackVal	Fallback Value	float32	2fab	12203	Same as Math2.1.Out
Math2.1.HighLimit	Output High Limit	float32	2fac	12204	Same as Math2.1.Out
Math2.1.In1	Input 1 Value	float32	2fa7	12199	0dp
Math2.1.In1Mul	Input 1 Multiplier	float32	2fa6	12198	1dp
Math2.1.In2	Input 2 Value	float32	2fa9	12201	0dp
Math2.1.In2Mul	Input 2 Multiplier	float32	2fa8	12200	1dp
Math2.1.LowLimit	Output Low Limit	float32	2fad	12205	Same as Math2.1.Out

5.3 PARAMETER LIST (Cont.)

Parameter path	Description	Type	Hex	Dec	Resolution
Math2.1.Oper	Operation 0 = Off 1 = Add 2 = Subtract 3 = Multiply 4 =Divide 5 = Abs diff 6 = Select Max 7 = Select Min 8 = Hot Swap 9 = Sample & Hold 10 = Power 11 = Square root 12 = Log 13 = Ln 14 = Exponential 15 = 10 to the X 51 = Select	uint8	2faa	12202	Not applicable
Math2.1.Out	Output Value	float32	2fae	12206	Set by Math2.1.Resolution
Math2.1.Resolution	Output Resolution	uint8	2fb2	12210	Not applicable
Math2.1.Select	Select Input 1 or Input 2	bool	2fb0	12208	Not applicable
Math2.1.Status	Status. 0 = Good (OK); 7 = Bad (Error)	uint8	2fb1	12209	Not applicable
Math2.1.Units	Output Units	string_t	6944	26948	Not applicable
Math2.2.Fallback	Fallback strategy (as Math2.1.Fallback)	uint8	2fbc	12220	Not applicable
Math2.2.FallbackVal	Fallback Value	float32	2fb8	12216	Same as Math2.2.Out
Math2.2.HighLimit	Output High Limit	float32	2fb9	12217	Same as Math2.2.Out
Math2.2.In1	Input 1 Value	float32	2fb4	12212	0dp
Math2.2.In1Mul	Input 1 Scale	float32	2fb3	12211	1dp
Math2.2.In2	Input 2 Value	float32	2fb6	12214	0dp
Math2.2.In2Mul	Input 2 Scale	float32	2fb5	12213	1dp
Math2.2.LowLimit	Output Low Limit	float32	2fba	12218	Same as Math2.2.Out
Math2.2.Oper	Operation (as Math2.1.Oper)	uint8	2fb7	12215	Not applicable
Math2.2.Out	Output Value	float32	2fbb	12219	Set by Math2.2.Resolution
Math2.2.Resolution	Output Resolution	uint8	2fbf	12223	Not applicable
Math2.2.Select	Select Input 1 or Input 2	bool	2fbd	12221	Not applicable
Math2.2.Status	Status. 0 = Good (OK); 7 = Bad (Error)	uint8	2fbe	12222	Not applicable
Math2.2.Units	Output Units	string_t	694a	26954	Not applicable
Math2.3.Fallback	Fallback strategy (as Math2.1.Fallback)	uint8	2fc9	12233	Not applicable
Math2.3.FallbackVal	Fallback Value	float32	2fc5	12229	Same as Math2.3.Out
Math2.3.HighLimit	Output High Limit	float32	2fc6	12230	Same as Math2.3.Out
Math2.3.In1	Input 1 Value	float32	2fc1	12225	0dp
Math2.3.In1Mul	Input 1 Scale	float32	2fc0	12224	1dp
Math2.3.In2	Input 2 Value	float32	2fc3	12227	0dp
Math2.3.In2Mul	Input 2 Scale	float32	2fc2	12226	1dp
Math2.3.LowLimit	Output Low Limit	float32	2fc7	12231	Same as Math2.3.Out
Math2.3.Oper	Operation (as Math2.1.Oper)	uint8	2fc4	12228	Not applicable
Math2.3.Out	Output Value	float32	2fc8	12232	Set by Math2.3.Resolution
Math2.3.Resolution	Output Resolution	uint8	2fcc	12236	Not applicable
Math2.3.Select	Select Between Input 1 and Input 2	bool	2fca	12234	Not applicable
Math2.3.Status	Status. 0 = Good (OK); 7 = Bad (Error)	uint8	2fcb	12235	Not applicable
Math2.3.Units	Output Units	string_t	6950	26960	Not applicable
Math2.4.Fallback	Fallback strategy (as Math2.1.Fallback)	uint8	2fd6	12246	Not applicable
Math2.4.FallbackVal	Fallback Value	float32	2fd2	12242	Same as Math2.4.Out
Math2.4.HighLimit	Output High Limit	float32	2fd3	12243	Same as Math2.4.Out
Math2.4.In1	Input 1 Value	float32	2fce	12238	0dp
Math2.4.In1Mul	Input 1 Scale	float32	2fcd	12237	1dp
Math2.4.In2	Input 2 Value	float32	2fd0	12240	0dp
Math2.4.In2Mul	Input 2 Scale	float32	2fcf	12239	1dp
Math2.4.LowLimit	Output Low Limit	float32	2fd4	12244	Same as Math2.4.Out
Math2.4.Oper	Operation (as Math2.1.Oper)	uint8	2fd1	12241	Not applicable
Math2.4.Out	Output Value	float32	2fd5	12245	Set by Math2.4.Resolution
Math2.4.Resolution	Output Resolution	uint8	2fd9	12249	Not applicable
Math2.4.Select	Select Between Input 1 and Input 2	bool	2fd7	12247	Not applicable
Math2.4.Status	Status. 0 = Good (OK); 7 = Bad (Error)	uint8	2fd8	12248	Not applicable
Math2.4.Units	Output Units	string_t	6956	26966	Not applicable
Math2.5.Fallback	Fallback strategy (as Math2.1.Fallback)	uint8	2fe3	12259	Not applicable
Math2.5.FallbackVal	Fallback Value	float32	2fdf	12255	Same as Math2.5.Out
Math2.5.HighLimit	Output High Limit	float32	2fe0	12256	Same as Math2.5.Out
Math2.5.In1	Input 1 Value	float32	2fdb	12251	0dp
Math2.5.In1Mul	Input 1 Scale	float32	2fda	12250	1dp
Math2.5.In2	Input 2 Value	float32	2fdd	12253	0dp
Math2.5.In2Mul	Input 2 Scale	float32	2fdc	12252	1dp
Math2.5.LowLimit	Output Low Limit	float32	2fe1	12257	Same as Math2.5.Out
Math2.5.Oper	Operation (as Math2.1.Oper)	uint8	2fde	12254	Not applicable
Math2.5.Out	Output Value	float32	2fe2	12258	Set by Math2.5.Resolution
Math2.5.Resolution	Output Resolution	uint8	2fe6	12262	Not applicable
Math2.5.Select	Select Between Input 1 and Input 2	bool	2fe4	12260	Not applicable
Math2.5.Status	Status. 0 = Good (OK); 7 = Bad (Error)	uint8	2fe5	12261	Not applicable
Math2.5.Units	Output Units	string_t	695c	26972	Not applicable

5.3 PARAMETER LIST (Cont.)

Parameter path	Description	Type	Hex	Dec	Resolution
Math2.6.Fallback	Fallback strategy (as Math2.1.Fallback)	uint8	2ff0	12272	Not applicable
Math2.6.FallbackVal	Fallback Value	float32	2fec	12268	Same as Math2.6.Out
Math2.6.HighLimit	Output High Limit	float32	2fed	12269	Same as Math2.6.Out
Math2.6.In1	Input 1 Value	float32	2fe8	12264	0dp
Math2.6.In1Mul	Input 1 Scale	float32	2fe7	12263	1dp
Math2.6.In2	Input 2 Value	float32	2fea	12266	0dp
Math2.6.In2Mul	Input 2 Scale	float32	2fe9	12265	1dp
Math2.6.LowLimit	Output Low Limit	float32	2fee	12270	Same as Math2.6.Out
Math2.6.Oper	Operation (as Math2.1.Oper)	uint8	2feb	12267	Not applicable
Math2.6.Out	Output Value	float32	2fef	12271	Set by Math2.6.Resolution
Math2.6.Resolution	Output Resolution	uint8	2ff3	12275	Not applicable
Math2.6.Select	Select Between Input 1 and Input 2	bool	2ff1	12273	Not applicable
Math2.6.Status	Status. 0 = Good (OK); 7 = Bad (Error)	uint8	2ff2	12274	Not applicable
Math2.6.Units	Output Units	string_t	6962	26978	Not applicable
Math2.7.Fallback	Fallback strategy (as Math2.1.Fallback)	uint8	2ffd	12285	Not applicable
Math2.7.FallbackVal	Fallback Value	float32	2ff9	12281	Same as Math2.7.Out
Math2.7.HighLimit	Output High Limit	float32	2ffa	12282	Same as Math2.7.Out
Math2.7.In1	Input 1 Value	float32	2ff5	12277	0dp
Math2.7.In1Mul	Input 1 Scale	float32	2ff4	12276	1dp
Math2.7.In2	Input 2 Value	float32	2ff7	12279	0dp
Math2.7.In2Mul	Input 2 Scale	float32	2ff6	12278	1dp
Math2.7.LowLimit	Output Low Limit	float32	2ffb	12283	Same as Math2.7.Out
Math2.7.Oper	Operation (as Math2.1.Oper)	uint8	2ff8	12280	Not applicable
Math2.7.Out	Output Value	float32	2ffc	12284	Set by Math2.7.Resolution
Math2.7.Resolution	Output Resolution	uint8	3000	12288	Not applicable
Math2.7.Select	Select Between Input 1 and Input 2	bool	2ffe	12286	Not applicable
Math2.7.Status	Status. 0 = Good (OK); 7 = Bad (Error)	uint8	2fff	12287	Not applicable
Math2.7.Units	Output Units	string_t	6968	26984	Not applicable
Math2.8.Fallback	Fallback strategy (as Math2.1.Fallback)	uint8	300a	12298	Not applicable
Math2.8.FallbackVal	Fallback Value	float32	3006	12294	Same as Math2.8.Out
Math2.8.HighLimit	Output High Limit	float32	3007	12295	Same as Math2.8.Out
Math2.8.In1	Input 1 Value	float32	3002	12290	0dp
Math2.8.In1Mul	Input 1 Scale	float32	3001	12289	1dp
Math2.8.In2	Input 2 Value	float32	3004	12292	0dp
Math2.8.In2Mul	Input 2 Scale	float32	3003	12291	1dp
Math2.8.LowLimit	Output Low Limit	float32	3008	12296	Same as Math2.8.Out
Math2.8.Oper	Operation (as Math2.1.Oper)	uint8	3005	12293	Not applicable
Math2.8.Out	Output Value	float32	3009	12297	Set by Math2.8.Resolution
Math2.8.Resolution	Output Resolution	uint8	300d	12301	Not applicable
Math2.8.Select	Select Between Input 1 and Input 2	bool	300b	12299	Not applicable
Math2.8.Status	Status. 0 = Good (OK); 7 = Bad (Error)	uint8	300c	12300	Not applicable
Math2.8.Units	Output Units	string_t	696e	26990	Not applicable
Math2.9.Fallback	Fallback strategy (as Math2.1.Fallback)	uint8	3017	12311	Not applicable
Math2.9.FallbackVal	Fallback Value	float32	3013	12307	Same as Math2.9.Out
Math2.9.HighLimit	Output High Limit	float32	3014	12308	Same as Math2.9.Out
Math2.9.In1	Input 1 Value	float32	300f	12303	0dp
Math2.9.In1Mul	Input 1 Scale	float32	300e	12302	1dp
Math2.9.In2	Input 2 Value	float32	3011	12305	0dp
Math2.9.In2Mul	Input 2 Scale	float32	3010	12304	1dp
Math2.9.LowLimit	Output Low Limit	float32	3015	12309	Same as Math2.9.Out
Math2.9.Oper	Operation (as Math2.1.Oper)	uint8	3012	12306	Not applicable
Math2.9.Out	Output Value	float32	3016	12310	Set by Math2.9.Resolution
Math2.9.Resolution	Output Resolution	uint8	301a	12314	Not applicable
Math2.9.Select	Select Between Input 1 and Input 2	bool	3018	12312	Not applicable
Math2.9.Status	Status. 0 = Good (OK); 7 = Bad (Error)	uint8	3019	12313	Not applicable
Math2.9.Units	Output Units	string_t	6974	26996	Not applicable
Math2.10.Fallback	Fallback strategy (as Math2.1.Fallback)	uint8	3024	12324	Not applicable
Math2.10.FallbackVal	Fallback Value	float32	3020	12320	Same as Math2.10.Out
Math2.10.HighLimit	Output High Limit	float32	3021	12321	Same as Math2.10.Out
Math2.10.In1	Input 1 Value	float32	301c	12316	0dp
Math2.10.In1Mul	Input 1 Scale	float32	301b	12315	1dp
Math2.10.In2	Input 2 Value	float32	301e	12318	0dp
Math2.10.In2Mul	Input 2 Scale	float32	301d	12317	1dp
Math2.10.LowLimit	Output Low Limit	float32	3022	12322	Same as Math2.10.Out
Math2.10.Oper	Operation (as Math2.1.Oper)	uint8	301f	12319	Not applicable
Math2.10.Out	Output Value	float32	3023	12323	Set by Math2.10.Resolution
Math2.10.Resolution	Output Resolution	uint8	3027	12327	Not applicable

5.3 PARAMETER LIST (Cont.)

Parameter path	Description	Type	Hex	Dec	Resolution
Math2.10.Select	Select Between Input 1 and Input 2	bool	3025	12325	Not applicable
Math2.10.Status	Status. 0 = Good (OK); 7 = Bad (Error)	uint8	3026	12326	Not applicable
Math2.10.Units	Output Units	string_t	697a	27002	Not applicable
Math2.11.Fallback	Fallback strategy (as Math2.1.Fallback)	uint8	3031	12337	Not applicable
Math2.11.FallbackVal	Fallback Value	float32	302d	12333	Same as Math2.11.Out
Math2.11.HighLimit	Output High Limit	float32	302e	12334	Same as Math2.11.Out
Math2.11.In1	Input 1 Value	float32	3029	12329	0dp
Math2.11.In1Mul	Input 1 Scale	float32	3028	12328	1dp
Math2.11.In2	Input 2 Value	float32	302b	12331	0dp
Math2.11.In2Mul	Input 2 Scale	float32	302a	12330	1dp
Math2.11.LowLimit	Output Low Limit	float32	302f	12335	Same as Math2.11.Out
Math2.11.Oper	Operation (as Math2.1.Oper)	uint8	302c	12332	Not applicable
Math2.11.Out	Output Value	float32	3030	12336	Set by Math2.11.Resolution
Math2.11.Resolution	Output Resolution	uint8	3034	12340	Not applicable
Math2.11.Select	Select Between Input 1 and Input 2	bool	3032	12338	Not applicable
Math2.11.Status	Status. 0 = Good (OK); 7 = Bad (Error)	uint8	3033	12339	Not applicable
Math2.11.Units	Output Units	string_t	6980	27008	Not applicable
Math2.12.Fallback	Fallback strategy (as Math2.1.Fallback)	uint8	303e	12350	Not applicable
Math2.12.FallbackVal	Fallback Value	float32	303a	12346	Same as Math2.12.Out
Math2.12.HighLimit	Output High Limit	float32	303b	12347	Same as Math2.12.Out
Math2.12.In1	Input 1 Value	float32	3036	12342	0dp
Math2.12.In1Mul	Input 1 Scale	float32	3035	12341	1dp
Math2.12.In2	Input 2 Value	float32	3038	12344	0dp
Math2.12.In2Mul	Input 2 Scale	float32	3037	12343	1dp
Math2.12.LowLimit	Output Low Limit	float32	303c	12348	Same as Math2.12.Out
Math2.12.Oper	Operation (as Math2.1.Oper)	uint8	3039	12345	Not applicable
Math2.12.Out	Output Value	float32	303d	12349	Set by Math2.12.Resolution
Math2.12.Resolution	Output Resolution	uint8	3041	12353	Not applicable
Math2.12.Select	Select Between Input 1 and Input 2	bool	303f	12351	Not applicable
Math2.12.Status	Status. 0 = Good (OK); 7 = Bad (Error)	uint8	3040	12352	Not applicable
Math2.12.Units	Output Units	string_t	6986	27014	Not applicable
ModbusMaster.1.Data.AlarmStatus	Alarm status (0 = No alarms; 1 = one or more alarms active)	uint8	7dbb	32187	Not applicable
ModbusMaster.1.Data.BitPosition	Bit position of the bit of interest in a 16 bit data type	uint8	7d4f	32079	Not applicable
ModbusMaster.1.Data.ChanAlarmStatus	Channel alarm status 0 = Off 1 = Active 2 = Safe Nackd 3 = Active Nackd	uint8	7ddb	32219	Not applicable
ModbusMaster.1.Data.DataType	Data type of the data being read/written 0 = Real 1 = DINT 2 = INT 3 = Byte 4 = UDINT 5 = UINT 6 = UBYTE 8 = Real (Swap) 9 = DINT (Swap) 10 = UDINT (Swap) 11 = BIT	uint8	7c06	31750	Not applicable
ModbusMaster.1.Data.Descriptor	Description for this data item	string_t	6687	26247	Not applicable
ModbusMaster.1.Data.Digital	Digital status (0 = Off, 1 = On)	bool	7e1b	32283	Not applicable
ModbusMaster.1.Data.FallBackValue	Fall back value to be writen to the slave device	float32	7c7e	31870	2dp
ModbusMaster.1.Data.FunctionCode	The modbus function codeuint8 1 = Read coil 2 = Read discrete 3 = Read holding 4 = Read input 5 = Write coil 6 = Write single 16 = Write multiple	7be8		31720	Not applicable
ModbusMaster.1.Data.ModbusAddress	Modbus register address of the data to be read/written	float32	7b8c	31628	0dp
ModbusMaster.1.Data.Mode	Auto Manual mode selection (0 = Auto; 1 = Manual)	uint8	7d9b	32155	Not applicable
ModbusMaster.1.Data.Number	Used for multiple instance parameters	uint8	7d13	32019	Not applicable
ModbusMaster.1.Data.ParameterList	Parameter list for a specific slave device	uint8	7cf5	31989	Not applicable
ModbusMaster.1.Data.Priority	Frequency at which the data is read/written 0 = High 1 = Medium 2 = Low 3 = Acyclic	uint8	7c24	31780	Not applicable
ModbusMaster.1.Data.PV	Process value recieved from slave device	float32	7b32	31538	2dp
ModbusMaster.1.Data.Scaling	Scaling in decimal places for non floating point data types	uint8	7d31	32049	Not applicable
ModbusMaster.1.Data.Send	1 = send the write value to the slave	bool	7cb9	31929	Not applicable
ModbusMaster.1.Data.Set	Sets a digital value (1 = on; 0 = off)	bool	7dfb	32251	Not applicable
ModbusMaster.1.Data.SlaveDevice	Slave device to communicate with.	uint8	7b14	31508	Not applicable
ModbusMaster.1.Data.Status	Transaction status 0 = Success 1 = Illegal function 2 = Ilegal address 6 = Slave busy 8 = Parity error 9 = Bad sub 10 = Bad gateway 11 = No response 12 = Idle 13 = Pending 14 = Timeout 15 = Unknown host 16 = Connect fail 17 = No sockets 18 = Loopback fail 19 = Login fail 20 = Unknown error 22 = Write fail 23 = Master reject	uint8	7cd7	31959	Not applicable
ModbusMaster.1.Data.Value	The value to be written to the slave device	float32	7c42	31810	2dp
ModbusMaster.2.Data.AlarmStatus	Alarm status (as for Modbus Master.1)	uint8	7dbc	32188	Not applicable
ModbusMaster.2.Data.BitPosition	Bit position of the bit of interest in a 16 bit data type	uint8	7d50	32080	Not applicable
ModbusMaster.2.Data.ChanAlarmStatus	Channel alarm status (as for Modbus Master.1)	uint8	7ddc	32220	Not applicable
ModbusMaster.2.Data.DataType	Type of data being read/written (as for Modbus Master.1)	uint8	7c07	31751	Not applicable
ModbusMaster.2.Data.Descriptor	Description for this data item	string_t	669c	26268	Not applicable
ModbusMaster.2.Data.Digital	Digital status (0 = Off, 1 = On)	bool	7e1c	32284	Not applicable
ModbusMaster.2.Data.FallBackValue	Fall back value to be writen to the slave device	float32	7c80	31872	2dp

5.3 PARAMETER LIST (Cont.)

Parameter path	Description	Type	Hex	Dec	Resolution
ModbusMaster.2.Data.FunctionCode	The modbus function code (as for Modbus Master.1)	uint8	7be9	31721	Not applicable
ModbusMaster.2.Data.ModbusAddress	Modbus register address of the data to be read/written	float32	7b8e	31630	0dp
ModbusMaster.2.Data.Mode	Auto Manual mode selection (0 = Auto; 1 = Manual)	uint8	7d9c	32156	Not applicable
ModbusMaster.2.Data.Number	Used for multiple instance parameters	uint8	7d14	32020	Not applicable
ModbusMaster.2.Data.ParameterList	Parameter list for a specific slave device	uint8	7cf6	31990	Not applicable
ModbusMaster.2.Data.Priority	Read/Write frequency (as for Modbus Master.1)	uint8	7c25	31781	Not applicable
ModbusMaster.2.Data.PV	Process value recieved from slave device	float32	7b34	31540	2dp
ModbusMaster.2.Data.Scaling	Scaling in decimal places for non floating point data types	uint8	7d32	32050	Not applicable
ModbusMaster.2.Data.Send	1 = send the write value to the slave	bool	7cba	31930	Not applicable
ModbusMaster.2.Data.Set	Sets a digital value (1 = on; 0 = off)	bool	7dfc	32252	Not applicable
ModbusMaster.2.Data.SlaveDevice	Slave device to communicate with.	uint8	7b15	31509	Not applicable
ModbusMaster.2.Data.Status	Transaction status (as for Modbus Master.1)	uint8	7cd8	31960	Not applicable
ModbusMaster.2.Data.Value	The value to be written to the slave device	float32	7c44	31812	2dp
ModbusMaster.3.Data.AlarmStatus	Alarm status (as for Modbus Master.1)	uint8	7dbd	32189	Not applicable
ModbusMaster.3.Data.BitPosition	Bit position of the bit of interest in a 16 bit data type	uint8	7d51	32081	Not applicable
ModbusMaster.3.Data.ChanAlarmStatus	Channel alarm status (as for Modbus Master.1)	uint8	7ddd	32221	Not applicable
ModbusMaster.3.Data.DataType	Type of data being read/written (as for Modbus Master.1)	uint8	7c08	31752	Not applicable
ModbusMaster.3.Data.Descriptor	Description for this data item	string_t	66b1	26289	Not applicable
ModbusMaster.3.Data.Digital	Digital status (0 = Off, 1 = On)	bool	7e1d	32285	Not applicable
ModbusMaster.3.Data.FallBackValue	Fall back value to be writen to the slave device	float32	7c82	31874	2dp
ModbusMaster.3.Data.FunctionCode	The modbus function code (as for Modbus Master.1)	uint8	7bea	31722	Not applicable
ModbusMaster.3.Data.ModbusAddress	Modbus register address of the data to be read/written	float32	7b90	31632	0dp
ModbusMaster.3.Data.Mode	Auto Manual mode selection (0 = Auto; 1 = Manual)	uint8	7d9d	32157	Not applicable
ModbusMaster.3.Data.Number	Used for multiple instance parameters	uint8	7d15	32021	Not applicable
ModbusMaster.3.Data.ParameterList	Parameter list for a specific slave device	uint8	7cf7	31991	Not applicable
ModbusMaster.3.Data.Priority	Read/Write frequency (as for Modbus Master.1)	uint8	7c26	31782	Not applicable
ModbusMaster.3.Data.PV	Process value recieved from slave device	float32	7b36	31542	2dp
ModbusMaster.3.Data.Scaling	Scaling in decimal places for non floating point data types	uint8	7d33	32051	Not applicable
ModbusMaster.3.Data.Send	1 = send the write value to the slave	bool	7cbb	31931	Not applicable
ModbusMaster.3.Data.Set	Sets a digital value (1 = on; 0 = off)	bool	7dfd	32253	Not applicable
ModbusMaster.3.Data.SlaveDevice	Slave device to communicate with.	uint8	7b16	31510	Not applicable
ModbusMaster.3.Data.Status	Transaction status (as for Modbus Master.1	uint8	7cd9	31961	Not applicable
ModbusMaster.3.Data.Value	The value to be written to the slave device	float32	7c46	31814	2dp
ModbusMaster.4.Data.AlarmStatus	Alarm status (as for Modbus Master.1)	uint8	7dbe	32190	Not applicable
ModbusMaster.4.Data.BitPosition	Bit position of the bit of interest in a 16 bit data type	uint8	7d52	32082	Not applicable
ModbusMaster.4.Data.ChanAlarmStatus	Channel alarm status (as for Modbus Master.1)	uint8	7dde	32222	Not applicable
ModbusMaster.4.Data.DataType	Type of data being read/written (as for Modbus Master.1)	uint8	7c09	31753	Not applicable
ModbusMaster.4.Data.Descriptor	Description for this data item	string_t	66c6	26310	Not applicable
ModbusMaster.4.Data.Digital	Digital status (0 = Off, 1 = On)	bool	7e1e	32286	Not applicable
ModbusMaster.4.Data.FallBackValue	Fall back value to be writen to the slave device	float32	7c84	31876	2dp
ModbusMaster.4.Data.FunctionCode	The modbus function code (as for Modbus Master.1)	uint8	7beb	31723	Not applicable
ModbusMaster.4.Data.ModbusAddress	Modbus register address of the data to be read/written	float32	7b92	31634	0dp
ModbusMaster.4.Data.Mode	Auto Manual mode selection (0 = Auto; 1 = Manual)	uint8	7d9e	32158	Not applicable
ModbusMaster.4.Data.Number	Used for multiple instance parameters	uint8	7d16	32022	Not applicable
ModbusMaster.4.Data.ParameterList	Parameter list for a specific slave device	uint8	7cf8	31992	Not applicable
ModbusMaster.4.Data.Priority	Read/Write frequency (as for Modbus Master.1)	uint8	7c27	31783	Not applicable
ModbusMaster.4.Data.PV	Process value recieved from slave device	float32	7b38	31544	2dp
ModbusMaster.4.Data.Scaling	Scaling in decimal places for non floating point data types	uint8	7d34	32052	Not applicable
ModbusMaster.4.Data.Send	1 = send the write value to the slave	bool	7cbc	31932	Not applicable
ModbusMaster.4.Data.Set	Sets a digital value (1 = on; 0 = off)	bool	7dfe	32254	Not applicable
ModbusMaster.4.Data.SlaveDevice	Slave device to communicate with.	uint8	7b17	31511	Not applicable
ModbusMaster.4.Data.Status	Transaction status (as for Modbus Master.1	uint8	7cda	31962	Not applicable
ModbusMaster.4.Data.Value	The value to be written to the slave device	float32	7c48	31816	2dp
ModbusMaster.5.Data.AlarmStatus	Alarm status (as for Modbus Master.1)	uint8	7dbf	32191	Not applicable
ModbusMaster.5.Data.BitPosition	Bit position of the bit of interest in a 16 bit data type	uint8	7d53	32083	Not applicable
ModbusMaster.5.Data.ChanAlarmStatus	Channel alarm status (as for Modbus Master.1)	uint8	7ddf	32223	Not applicable
ModbusMaster.5.Data.DataType	Type of data being read/written (as for Modbus Master.1)	uint8	7c0a	31754	Not applicable
ModbusMaster.5.Data.Descriptor	Description for this data item	string_t	66db	26331	Not applicable
ModbusMaster.5.Data.Digital	Digital status (0 = Off, 1 = On)	bool	7e1f	32287	Not applicable
ModbusMaster.5.Data.FallBackValue	Fall back value to be writen to the slave device	float32	7c86	31878	2dp
ModbusMaster.5.Data.FunctionCode	The modbus function code (as for Modbus Master.1)	uint8	7bec	31724	Not applicable
ModbusMaster.5.Data.ModbusAddress	Modbus register address of the data to be read/written	float32	7b94	31636	0dp
ModbusMaster.5.Data.Mode	Auto Manual mode selection (0 = Auto; 1 = Manual)	uint8	7d9f	32159	Not applicable
ModbusMaster.5.Data.Number	Used for multiple instance parameters	uint8	7d17	32023	Not applicable
ModbusMaster.5.Data.ParameterList	Parameter list for a specific slave device	uint8	7cf9	31993	Not applicable
ModbusMaster.5.Data.Priority	Read/Write frequency (as for Modbus Master.1)	uint8	7c28	31784	Not applicable
ModbusMaster.5.Data.PV	Process value recieved from slave device	float32	7b3a	31546	2dp
ModbusMaster.5.Data.Scaling	Scaling in decimal places for non floating point data types	uint8	7d35	32053	Not applicable
ModbusMaster.5.Data.Send	1 = send the write value to the slave	bool	7cbd	31933	Not applicable
ModbusMaster.5.Data.Set	Sets a digital value (1 = on; 0 = off)	bool	7dff	32255	Not applicable
ModbusMaster.5.Data.SlaveDevice	Slave device to communicate with.	uint8	7b18	31512	Not applicable
ModbusMaster.5.Data.Status	Transaction status (as for Modbus Master.1	uint8	7cdb	31963	Not applicable
ModbusMaster.5.Data.Value	The value to be written to the slave device	float32	7c4a	31818	2dp
ModbusMaster.6.Data.AlarmStatus	Alarm status (as for Modbus Master.1)	uint8	7dc0	32192	Not applicable
ModbusMaster.6.Data.BitPosition	Bit position of the bit of interest in a 16 bit data type	uint8	7d54	32084	Not applicable
ModbusMaster.6.Data.ChanAlarmStatus	Channel alarm status (as for Modbus Master.1)	uint8	7de0	32224	Not applicable
ModbusMaster.6.Data.DataType	Type of data being read/written (as for Modbus Master.1)	uint8	7c0b	31755	Not applicable

5.3 PARAMETER LIST (Cont.)

Parameter path	Description	Type	Hex	Dec	Resolution
ModbusMaster.6.Data.Descriptor	Description for this data item	string_t	66f0	26352	Not applicable
ModbusMaster.6.Data.Digital	Digital status (0 = Off, 1 = On)	bool	7e20	32288	Not applicable
ModbusMaster.6.Data.FallBackValue	Fall back value to be writen to the slave device	float32	7c88	31880	2dp
ModbusMaster.6.Data.FunctionCode	The modbus function code (as for Modbus Master.1)	uint8	7bed	31725	Not applicable
ModbusMaster.6.Data.ModbusAddress	Modbus register address of the data to be read/written	float32	7b96	31638	0dp
ModbusMaster.6.Data.Mode	Auto Manual mode selection (0 = Auto; 1 = Manual)	uint8	7da0	32160	Not applicable
ModbusMaster.6.Data.Number	Used for multiple instance parameters	uint8	7d18	32024	Not applicable
ModbusMaster.6.Data.ParameterList	Parameter list for a specific slave device	uint8	7cfa	31994	Not applicable
ModbusMaster.6.Data.Priority	Read/Write frequency (as for Modbus Master.1)	uint8	7c29	31785	Not applicable
ModbusMaster.6.Data.PV	Process value recieved from slave device	float32	7b3c	31548	2dp
ModbusMaster.6.Data.Scaling	Scaling in decimal places for non floating point data types	uint8	7d36	32054	Not applicable
ModbusMaster.6.Data.Send	1 = send the write value to the slave	bool	7cbe	31934	Not applicable
ModbusMaster.6.Data.Set	Sets a digital value (1 = on; 0 = off)	bool	7e00	32256	Not applicable
ModbusMaster.6.Data.SlaveDevice	Slave device to communicate with.	uint8	7b19	31513	Not applicable
ModbusMaster.6.Data.Status	Transaction status (as for Modbus Master.1	uint8	7cdc	31964	Not applicable
ModbusMaster.6.Data.Value	The value to be written to the slave device	float32	7c4c	31820	2dp
ModbusMaster.7.Data.AlarmStatus	Alarm status (as for Modbus Master.1)	uint8	7dc1	32193	Not applicable
ModbusMaster.7.Data.BitPosition	Bit position of the bit of interest in a 16 bit data type	uint8	7d55	32085	Not applicable
ModbusMaster.7.Data.ChanAlarmStatus	Channel alarm status (as for Modbus Master.1)	uint8	7de1	32225	Not applicable
ModbusMaster.7.Data.DataType	Type of data being read/written (as for Modbus Master.1)	uint8	7c0c	31756	Not applicable
ModbusMaster.7.Data.Descriptor	Description for this data item	string_t	6705	26373	Not applicable
ModbusMaster.7.Data.Digital	Digital status (0 = Off, 1 = On)	bool	7e21	32289	Not applicable
ModbusMaster.7.Data.FallBackValue	Fall back value to be writen to the slave device	float32	7c8a	31882	2dp
ModbusMaster.7.Data.FunctionCode	The modbus function code (as for Modbus Master.1)	uint8	7bee	31726	Not applicable
ModbusMaster.7.Data.ModbusAddress	Modbus register address of the data to be read/written	float32	7b98	31640	0dp
ModbusMaster.7.Data.Mode	Auto Manual mode selection (0 = Auto; 1 = Manual)	uint8	7da1	32161	Not applicable
ModbusMaster.7.Data.Number	Used for multiple instance parameters	uint8	7d19	32025	Not applicable
ModbusMaster.7.Data.ParameterList	Parameter list for a specific slave device	uint8	7cfb	31995	Not applicable
ModbusMaster.7.Data.Priority	Read/Write frequency (as for Modbus Master.1)	uint8	7c2a	31786	Not applicable
ModbusMaster.7.Data.PV	Process value recieved from slave device	float32	7b3e	31550	2dp
ModbusMaster.7.Data.Scaling	Scaling in decimal places for non floating point data types	uint8	7d37	32055	Not applicable
ModbusMaster.7.Data.Send	1 = send the write value to the slave	bool	7cbf	31935	Not applicable
ModbusMaster.7.Data.Set	Sets a digital value (1 = on; 0 = off)	bool	7e01	32257	Not applicable
ModbusMaster.7.Data.SlaveDevice	Slave device to communicate with.	uint8	7b1a	31514	Not applicable
ModbusMaster.7.Data.Status	Transaction status (as for Modbus Master.1	uint8	7cdd	31965	Not applicable
ModbusMaster.7.Data.Value	The value to be written to the slave device	float32	7c4e	31822	2dp
ModbusMaster.8.Data.AlarmStatus	Alarm status (as for Modbus Master.1)	uint8	7dc2	32194	Not applicable
ModbusMaster.8.Data.BitPosition	Bit position of the bit of interest in a 16 bit data type	uint8	7d56	32086	Not applicable
ModbusMaster.8.Data.ChanAlarmStatus	Channel alarm status (as for Modbus Master.1)	uint8	7de2	32226	Not applicable
ModbusMaster.8.Data.DataType	Type of data being read/written (as for Modbus Master.1)	uint8	7c0d	31757	Not applicable
ModbusMaster.8.Data.Descriptor	Description for this data item	string_t	671a	26394	Not applicable
ModbusMaster.8.Data.Digital	Digital status (0 = Off, 1 = On)	bool	7e22	32290	Not applicable
ModbusMaster.8.Data.FallBackValue	Fall back value to be writen to the slave device	float32	7c8c	31884	2dp
ModbusMaster.8.Data.FunctionCode	The modbus function code (as for Modbus Master.1)	uint8	7bef	31727	Not applicable
ModbusMaster.8.Data.ModbusAddress	Modbus register address of the data to be read/written	float32	7b9a	31642	0dp
ModbusMaster.8.Data.Mode	Auto Manual mode selection (0 = Auto; 1 = Manual)	uint8	7da2	32162	Not applicable
ModbusMaster.8.Data.Number	Used for multiple instance parameters	uint8	7d1a	32026	Not applicable
ModbusMaster.8.Data.ParameterList	Parameter list for a specific slave device	uint8	7cfc	31996	Not applicable
ModbusMaster.8.Data.Priority	Read/Write frequency (as for Modbus Master.1)	uint8	7c2b	31787	Not applicable
ModbusMaster.8.Data.PV	Process value recieved from slave device	float32	7b40	31552	2dp
ModbusMaster.8.Data.Scaling	Scaling in decimal places for non floating point data types	uint8	7d38	32056	Not applicable
ModbusMaster.8.Data.Send	1 = send the write value to the slave	bool	7cc0	31936	Not applicable
ModbusMaster.8.Data.Set	Sets a digital value (1 = on; 0 = off)	bool	7e02	32258	Not applicable
ModbusMaster.8.Data.SlaveDevice	Slave device to communicate with.	uint8	7b1b	31515	Not applicable
ModbusMaster.8.Data.Status	Transaction status (as for Modbus Master.1	uint8	7cde	31966	Not applicable
ModbusMaster.8.Data.Value	The value to be written to the slave device	float32	7c50	31824	2dp
ModbusMaster.9.Data.AlarmStatus	Alarm status (as for Modbus Master.1)	uint8	7dc3	32195	Not applicable
ModbusMaster.9.Data.BitPosition	Bit position of the bit of interest in a 16 bit data type	uint8	7d57	32087	Not applicable
ModbusMaster.9.Data.ChanAlarmStatus	Channel alarm status (as for Modbus Master.1)	uint8	7de3	32227	Not applicable
ModbusMaster.9.Data.DataType	Type of data being read/written (as for Modbus Master.1)	uint8	7c0e	31758	Not applicable
ModbusMaster.9.Data.Descriptor	Description for this data item	string_t	672f	26415	Not applicable
ModbusMaster.9.Data.Digital	Digital status (0 = Off, 1 = On)	bool	7e23	32291	Not applicable
ModbusMaster.9.Data.FallBackValue	Fall back value to be writen to the slave device	float32	7c8e	31886	2dp
ModbusMaster.9.Data.FunctionCode	The modbus function code (as for Modbus Master.1)	uint8	7bf0	31728	Not applicable
ModbusMaster.9.Data.ModbusAddress	Modbus register address of the data to be read/written	float32	7b9c	31644	0dp
ModbusMaster.9.Data.Mode	Auto Manual mode selection (0 = Auto; 1 = Manual)	uint8	7da3	32163	Not applicable
ModbusMaster.9.Data.Number	Used for multiple instance parameters	uint8	7d1b	32027	Not applicable
ModbusMaster.9.Data.ParameterList	Parameter list for a specific slave device	uint8	7cfd	31997	Not applicable
ModbusMaster.9.Data.Priority	FRead/Write frequency (as for Modbus Master.1)	uint8	7c2c	31788	Not applicable
ModbusMaster.9.Data.PV	Process value recieved from slave device	float32	7b42	31554	2dp
ModbusMaster.9.Data.Scaling	Scaling in decimal places for non floating point data types	uint8	7d39	32057	Not applicable
ModbusMaster.9.Data.Send	1 = send the write value to the slave	bool	7cc1	31937	Not applicable
ModbusMaster.9.Data.Set	Sets a digital value (1 = on; 0 = off)	bool	7e03	32259	Not applicable
ModbusMaster.9.Data.SlaveDevice	Slave device to communicate with.	uint8	7b1c	31516	Not applicable
ModbusMaster.9.Data.Status	Transaction status (as for Modbus Master.1	uint8	7cdf	31967	Not applicable
ModbusMaster.9.Data.Value	The value to be written to the slave device	float32	7c52	31826	2dp
ModbusMaster.10.Data.AlarmStatus	Alarm status (as for Modbus Master.1)	uint8	7dc4	32196	Not applicable

5.3 PARAMETER LIST (Cont.)

Parameter path	Description	Type	Hex	Dec	Resolution
ModbusMaster.10.Data.BitPosition	Bit position of the bit of interest in a 16 bit data type	uint8	7d58	32088	Not applicable
ModbusMaster.10.Data.ChanAlarmStatus	Channel alarm status (as for Modbus Master.1)	uint8	7de4	32228	Not applicable
ModbusMaster.10.Data.DataType	Type of data being read/written (as for Modbus Master.1)	uint8	7c0f	31759	Not applicable
ModbusMaster.10.Data.Descriptor	Description for this data item	string_t	6744	26436	Not applicable
ModbusMaster.10.Data.Digital	Digital status (0 = Off, 1 = On)	bool	7e24	32292	Not applicable
ModbusMaster.10.Data.FallBackValue	Fall back value to be writen to the slave device	float32	7c90	31888	2dp
ModbusMaster.10.Data.FunctionCode	The modbus function code (as for Modbus Master.1)	uint8	7bf1	31729	Not applicable
ModbusMaster.10.Data.ModbusAddress	Modbus register address of the data to be read/written	float32	7b9e	31646	0dp
ModbusMaster.10.Data.Mode	Auto Manual mode selection (0 = Auto; 1 = Manual)	uint8	7da4	32164	Not applicable
ModbusMaster.10.Data.Number	Used for multiple instance parameters	uint8	7d1c	32028	Not applicable
ModbusMaster.10.Data.ParameterList	Parameter list for a specific slave device	uint8	7cfe	31998	Not applicable
ModbusMaster.10.Data.Priority	Read/Write frequency (as for Modbus Master.1)	uint8	7c2d	31789	Not applicable
ModbusMaster.10.Data.PV	Process value recieved from slave device	float32	7b44	31556	2dp
ModbusMaster.10.Data.Scaling	Scaling in decimal places for non floating point data types	uint8	7d3a	32058	Not applicable
ModbusMaster.10.Data.Send	1 = send the write value to the slave	bool	7cc2	31938	Not applicable
ModbusMaster.10.Data.Set	Sets a digital value (1 = on; 0 = off)	bool	7e04	32260	Not applicable
ModbusMaster.10.Data.SlaveDevice	Slave device to communicate with.	uint8	7b1d	31517	Not applicable
ModbusMaster.10.Data.Status	Transaction status (as for Modbus Master.1	uint8	7ce0	31968	Not applicable
ModbusMaster.10.Data.Value	The value to be written to the slave device	float32	7c54	31828	2dp
ModbusMaster.11.Data.AlarmStatus	Alarm status (as for Modbus Master.1)	uint8	7dc5	32197	Not applicable
ModbusMaster.11.Data.BitPosition	Bit position of the bit of interest in a 16 bit data type	uint8	7d59	32089	Not applicable
ModbusMaster.11.Data.ChanAlarmStatus	Channel alarm status (as for Modbus Master.1)	uint8	7de5	32229	Not applicable
ModbusMaster.11.Data.DataType	Type of data being read/written (as for Modbus Master.1)	uint8	7c10	31760	Not applicable
ModbusMaster.11.Data.Descriptor	Description for this data item	string_t	6759	26457	Not applicable
ModbusMaster.11.Data.Digital	Digital status (0 = Off, 1 = On)	bool	7e25	32293	Not applicable
ModbusMaster.11.Data.FallBackValue	Fall back value to be writen to the slave device	float32	7c92	31890	2dp
ModbusMaster.11.Data.FunctionCode	The modbus function code (as for Modbus Master.1)	uint8	7bf2	31730	Not applicable
ModbusMaster.11.Data.ModbusAddress	Modbus register address of the data to be read/written	float32	7bc0	31680	0dp
ModbusMaster.11.Data.Mode	Auto Manual mode selection (0 = Auto; 1 = Manual)	uint8	7da5	32165	Not applicable
ModbusMaster.11.Data.Number	Used for multiple instance parameters	uint8	7d1d	32029	Not applicable
ModbusMaster.11.Data.ParameterList	Parameter list for a specific slave device	uint8	7cff	31999	Not applicable
ModbusMaster.11.Data.Priority	Read/Write frequency (as for Modbus Master.1)	uint8	7c2e	31790	Not applicable
ModbusMaster.11.Data.PV	Process value recieved from slave device	float32	7b46	31558	2dp
ModbusMaster.11.Data.Scaling	Scaling in decimal places for non floating point data types	uint8	7d3b	32059	Not applicable
ModbusMaster.11.Data.Send	1 = send the write value to the slave	bool	7cc3	31939	Not applicable
ModbusMaster.11.Data.Set	Sets a digital value (1 = on; 0 = off)	bool	7e05	32261	Not applicable
ModbusMaster.11.Data.SlaveDevice	Slave device to communicate with.	uint8	7b1e	31518	Not applicable
ModbusMaster.11.Data.Status	Transaction status (as for Modbus Master.1	uint8	7ce1	31969	Not applicable
ModbusMaster.11.Data.Value	The value to be written to the slave device	float32	7c56	31830	2dp
ModbusMaster.12.Data.AlarmStatus	Alarm status (as for Modbus Master.1)	uint8	7dc6	32198	Not applicable
ModbusMaster.12.Data.BitPosition	Bit position of the bit of interest in a 16 bit data type	uint8	7d5a	32090	Not applicable
ModbusMaster.12.Data.ChanAlarmStatus	Channel alarm status (as for Modbus Master.1)	uint8	7de6	32230	Not applicable
ModbusMaster.12.Data.DataType	Type of data being read/written (as for Modbus Master.1)	uint8	7c11	31761	Not applicable
ModbusMaster.12.Data.Descriptor	Description for this data item	string_t	676e	26478	Not applicable
ModbusMaster.12.Data.Digital	Digital status (0 = Off, 1 = On)	bool	7e26	32294	Not applicable
ModbusMaster.12.Data.FallBackValue	Fall back value to be writen to the slave device	float32	7c94	31892	2dp
ModbusMaster.12.Data.FunctionCode	The modbus function code (as for Modbus Master.1)	uint8	7bf3	31731	Not applicable
ModbusMaster.12.Data.ModbusAddress	Modbus register address of the data to be read/written	float32	7bc2	31682	0dp
ModbusMaster.12.Data.Mode	Auto Manual mode selection (0 = Auto; 1 = Manual)	uint8	7da6	32166	Not applicable
ModbusMaster.12.Data.Number	Used for multiple instance parameters	uint8	7d1e	32030	Not applicable
ModbusMaster.12.Data.ParameterList	Parameter list for a specific slave device	uint8	7d00	32000	Not applicable
ModbusMaster.12.Data.Priority	Read/Write frequency (as for Modbus Master.1)	uint8	7c2f	31791	Not applicable
ModbusMaster.12.Data.PV	Process value recieved from slave device	float32	7b48	31560	2dp
ModbusMaster.12.Data.Scaling	Scaling in decimal places for non floating point data types	uint8	7d3c	32060	Not applicable
ModbusMaster.12.Data.Send	1 = send the write value to the slave	bool	7cc4	31940	Not applicable
ModbusMaster.12.Data.Set	Sets a digital value (1 = on; 0 = off)	bool	7e06	32262	Not applicable
ModbusMaster.12.Data.SlaveDevice	Slave device to communicate with.	uint8	7b1f	31519	Not applicable
ModbusMaster.12.Data.Status	Transaction status (as for Modbus Master.1	uint8	7ce2	31970	Not applicable
ModbusMaster.12.Data.Value	The value to be written to the slave device	float32	7c58	31832	2dp
ModbusMaster.13.Data.AlarmStatus	Alarm status (as for Modbus Master.1)	uint8	7dc7	32199	Not applicable
ModbusMaster.13.Data.BitPosition	Bit position of the bit of interest in a 16 bit data type	uint8	7d5b	32091	Not applicable
ModbusMaster.13.Data.ChanAlarmStatus	Channel alarm status (as for Modbus Master.1)	uint8	7de7	32231	Not applicable
ModbusMaster.13.Data.DataType	Type of data being read/written (as for Modbus Master.1)	uint8	7c12	31762	Not applicable
ModbusMaster.13.Data.Descriptor	Description for this data item	string_t	6783	26499	Not applicable
ModbusMaster.13.Data.Digital	Digital status (0 = Off, 1 = On)	bool	7e27	32295	Not applicable
ModbusMaster.13.Data.FallBackValue	Fall back value to be writen to the slave device	float32	7c96	31894	2dp
ModbusMaster.13.Data.FunctionCode	The modbus function code (as for Modbus Master.1)	uint8	7bf4	31732	Not applicable
ModbusMaster.13.Data.ModbusAddress	Modbus register address of the data to be read/written	float32	7bc4	31684	0dp
ModbusMaster.13.Data.Mode	Auto Manual mode selection (0 = Auto; 1 = Manual)	uint8	7da7	32167	Not applicable
ModbusMaster.13.Data.Number	Used for multiple instance parameters	uint8	7d1f	32031	Not applicable
ModbusMaster.13.Data.ParameterList	Parameter list for a specific slave device	uint8	7d01	32001	Not applicable
ModbusMaster.13.Data.Priority	Read/Write frequency (as for Modbus Master.1)	uint8	7c30	31792	Not applicable
ModbusMaster.13.Data.PV	Process value recieved from slave device	float32	7b4a	31562	2dp
ModbusMaster.13.Data.Scaling	Scaling in decimal places for non floating point data types	uint8	7d3d	32061	Not applicable
ModbusMaster.13.Data.Send	1 = send the write value to the slave	bool	7cc5	31941	Not applicable
ModbusMaster.13.Data.Set	SSets a digital value (1 = on; 0 = off)	bool	7e07	32263	Not applicable
ModbusMaster.13.Data.SlaveDevice	Slave device to communicate with.	uint8	7b20	31520	Not applicable
ModbusMaster.13.Data.Status	Transaction status (as for Modbus Master.1	uint8	7ce3	31971	Not applicable

5.3 PARAMETER LIST (Cont.)

Parameter path	Description	Type	Hex	Dec	Resolution
ModbusMaster.13.Data.Value	The value to be written to the slave device	float32	7c5a	31834	2dp
ModbusMaster.14.Data.AlarmStatus	Alarm status (as for Modbus Master.1)	uint8	7dc8	32200	Not applicable
ModbusMaster.14.Data.BitPosition	Bit position of the bit of interest in a 16 bit data type	uint8	7d5c	32092	Not applicable
ModbusMaster.14.Data.ChanAlarmStatus	Channel alarm status (as for Modbus Master.1)	uint8	7de8	32232	Not applicable
ModbusMaster.14.Data.DataType	Type of data being read/written (as for Modbus Master.1)	uint8	7c13	31763	Not applicable
ModbusMaster.14.Data.Descriptor	Description for this data item	string_t	6798	26520	Not applicable
ModbusMaster.14.Data.Digital	Digital status (0 = Off, 1 = On)	bool	7e28	32296	Not applicable
ModbusMaster.14.Data.FallBackValue	Fall back value to be writen to the slave device	float32	7c98	31896	2dp
ModbusMaster.14.Data.FunctionCode	The modbus function code (as for Modbus Master.1)	uint8	7bf5	31733	Not applicable
ModbusMaster.14.Data.ModbusAddress	Modbus register address of the data to be read/written	float32	7bc6	31686	0dp
ModbusMaster.14.Data.Mode	Auto Manual mode selection (0 = Auto; 1 = Manual)	uint8	7da8	32168	Not applicable
ModbusMaster.14.Data.Number	Used for multiple instance parameters	uint8	7d20	32032	Not applicable
ModbusMaster.14.Data.ParameterList	Parameter list for a specific slave device	uint8	7d02	32002	Not applicable
ModbusMaster.14.Data.Priority	Read/Write frequency (as for Modbus Master.1)	uint8	7c31	31793	Not applicable
ModbusMaster.14.Data.PV	Process value recieved from slave device	float32	7b4c	31564	2dp
ModbusMaster.14.Data.Scaling	Scaling in decimal places for non floating point data types	uint8	7d3e	32062	Not applicable
ModbusMaster.14.Data.Send	1 = send the write value to the slave	bool	7cc6	31942	Not applicable
ModbusMaster.14.Data.Set	Sets a digital value (1 = on; 0 = off)	bool	7e08	32264	Not applicable
ModbusMaster.14.Data.SlaveDevice	Slave device to communicate with.	uint8	7b21	31521	Not applicable
ModbusMaster.14.Data.Status	Transaction status (as for Modbus Master.1	uint8	7ce4	31972	Not applicable
ModbusMaster.14.Data.Value	The value to be written to the slave device	float32	7c5c	31836	2dp
ModbusMaster.15.Data.AlarmStatus	Alarm status (as for Modbus Master.1)	uint8	7dc9	32201	Not applicable
ModbusMaster.15.Data.BitPosition	Bit position of the bit of interest in a 16 bit data type	uint8	7d5d	32093	Not applicable
ModbusMaster.15.Data.ChanAlarmStatus	Channel alarm status (as for Modbus Master.1)	uint8	7de9	32233	Not applicable
ModbusMaster.15.Data.DataType	Type of data being read/written (as for Modbus Master.1)	uint8	7c14	31764	Not applicable
ModbusMaster.15.Data.Descriptor	Description for this data item	string_t	67ad	26541	Not applicable
ModbusMaster.15.Data.Digital	Digital status (0 = Off, 1 = On)	bool	7e29	32297	Not applicable
ModbusMaster.15.Data.FallBackValue	Fall back value to be writen to the slave device	float32	7c9a	31898	2dp
ModbusMaster.15.Data.FunctionCode	The modbus function code (as for Modbus Master.1)	uint8	7bf6	31734	Not applicable
ModbusMaster.15.Data.ModbusAddress	Modbus register address of the data to be read/written	float32	7bc8	31688	0dp
ModbusMaster.15.Data.Mode	Auto Manual mode selection (0 = Auto; 1 = Manual)	uint8	7da9	32169	Not applicable
ModbusMaster.15.Data.Number	Used for multiple instance parameters	uint8	7d21	32033	Not applicable
ModbusMaster.15.Data.ParameterList	Parameter list for a specific slave device	uint8	7d03	32003	Not applicable
ModbusMaster.15.Data.Priority	Read/Write frequency (as for Modbus Master.1)	uint8	7c32	31794	Not applicable
ModbusMaster.15.Data.PV	Process value recieved from slave device	float32	7b4e	31566	2dp
ModbusMaster.15.Data.Scaling	Scaling in decimal places for non floating point data types	uint8	7d3f	32063	Not applicable
ModbusMaster.15.Data.Send	1 = send the write value to the slave	bool	7cc7	31943	Not applicable
ModbusMaster.15.Data.Set	Sets a digital value (1 = on; 0 = off)	bool	7e09	32265	Not applicable
ModbusMaster.15.Data.SlaveDevice	Slave device to communicate with.	uint8	7b22	31522	Not applicable
ModbusMaster.15.Data.Status	Transaction status (as for Modbus Master.1	uint8	7ce5	31973	Not applicable
ModbusMaster.15.Data.Value	The value to be written to the slave device	float32	7c5e	31838	2dp
ModbusMaster.16.Data.AlarmStatus	Alarm status (as for Modbus Master.1)	uint8	7dca	32202	Not applicable
ModbusMaster.16.Data.BitPosition	Bit position of the bit of interest in a 16 bit data type	uint8	7d5e	32094	Not applicable
ModbusMaster.16.Data.ChanAlarmStatus	Channel alarm status (as for Modbus Master.1)	uint8	7dea	32234	Not applicable
ModbusMaster.16.Data.DataType	Type of data being read/written (as for Modbus Master.1)	uint8	7c15	31765	Not applicable
ModbusMaster.16.Data.Descriptor	Description for this data item	string_t	67c2	26562	Not applicable
ModbusMaster.16.Data.Digital	Digital status (0 = Off, 1 = On)	bool	7e2a	32298	Not applicable
ModbusMaster.16.Data.FallBackValue	Fall back value to be writen to the slave device	float32	7c9c	31900	2dp
ModbusMaster.16.Data.FunctionCode	The modbus function code (as for Modbus Master.1)	uint8	7bf7	31735	Not applicable
ModbusMaster.16.Data.ModbusAddress	Modbus register address of the data to be read/written	float32	7bca	31690	0dp
ModbusMaster.16.Data.Mode	Auto Manual mode selection (0 = Auto; 1 = Manual)	uint8	7daa	32170	Not applicable
ModbusMaster.16.Data.Number	Used for multiple instance parameters	uint8	7d22	32034	Not applicable
ModbusMaster.16.Data.ParameterList	Parameter list for a specific slave device	uint8	7d04	32004	Not applicable
ModbusMaster.16.Data.Priority	Read/Write frequency (as for Modbus Master.1)	uint8	7c33	31795	Not applicable
ModbusMaster.16.Data.PV	Process value recieved from slave device	float32	7b50	31568	2dp
ModbusMaster.16.Data.Scaling	Scaling in decimal places for non floating point data types	uint8	7d40	32064	Not applicable
ModbusMaster.16.Data.Send	1 = send the write value to the slave	bool	7cc8	31944	Not applicable
ModbusMaster.16.Data.Set	Sets a digital value (1 = on; 0 = off)	bool	7e0a	32266	Not applicable
ModbusMaster.16.Data.SlaveDevice	Slave device to communicate with.	uint8	7b23	31523	Not applicable
ModbusMaster.16.Data.Status	Transaction status (as for Modbus Master.1	uint8	7ce6	31974	Not applicable
ModbusMaster.16.Data.Value	The value to be written to the slave device	float32	7c60	31840	2dp
ModbusMaster.17.Data.AlarmStatus	Alarm status (as for Modbus Master.1)	uint8	7dcb	32203	Not applicable
ModbusMaster.17.Data.BitPosition	Bit position of the bit of interest in a 16 bit data type	uint8	7d5f	32095	Not applicable
ModbusMaster.17.Data.ChanAlarmStatus	Channel alarm status (as for Modbus Master.1)	uint8	7deb	32235	Not applicable
ModbusMaster.17.Data.DataType	Type of data being read/written (as for Modbus Master.1)	uint8	7c16	31766	Not applicable
ModbusMaster.17.Data.Descriptor	Description for this data item	string_t	67d7	26583	Not applicable
ModbusMaster.17.Data.Digital	Digital status (0 = Off, 1 = On)	bool	7e2b	32299	Not applicable
ModbusMaster.17.Data.FallBackValue	Fall back value to be writen to the slave device	float32	7c9e	31902	2dp
ModbusMaster.17.Data.FunctionCode	The modbus function code (as for Modbus Master.1)	uint8	7bf8	31736	Not applicable
ModbusMaster.17.Data.ModbusAddress	Modbus register address of the data to be read/written	float32	7bcc	31692	0dp
ModbusMaster.17.Data.Mode	Auto Manual mode selection (0 = Auto; 1 = Manual)	uint8	7dab	32171	Not applicable
ModbusMaster.17.Data.Number	Used for multiple instance parameters	uint8	7d23	32035	Not applicable
ModbusMaster.17.Data.ParameterList	Parameter list for a specific slave device	uint8	7d05	32005	Not applicable
ModbusMaster.17.Data.Priority	Read/Write frequency (as for Modbus Master.1)	uint8	7c34	31796	Not applicable
ModbusMaster.17.Data.PV	Process value recieved from slave device	float32	7b52	31570	2dp
ModbusMaster.17.Data.Scaling	Scaling in decimal places for non floating point data types	uint8	7d41	32065	Not applicable
ModbusMaster.17.Data.Send	1 = send the write value to the slave	bool	7cc9	31945	Not applicable

5.3 PARAMETER LIST (Cont.)

Parameter path	Description	Type	Hex	Dec	Resolution
ModbusMaster.17.Data.Set	Sets a digital value (1 = on; 0 = off)	bool	7e0b	32267	Not applicable
ModbusMaster.17.Data.SlaveDevice	Slave device to communicate with.	uint8	7b24	31524	Not applicable
ModbusMaster.17.Data.Status	Transaction status (as for Modbus Master.1	uint8	7ce7	31975	Not applicable
ModbusMaster.17.Data.Value	The value to be written to the slave device	float32	7c62	31842	2dp
ModbusMaster.18.Data.AlarmStatus	Alarm status (as for Modbus Master.1)	uint8	7dcc	32204	Not applicable
ModbusMaster.18.Data.BitPosition	Bit position of the bit of interest in a 16 bit data type	uint8	7d60	32096	Not applicable
ModbusMaster.18.Data.ChanAlarmStatus	Channel alarm status (as for Modbus Master.1)	uint8	7dec	32236	Not applicable
ModbusMaster.18.Data.DataType	Type of data being read/written (as for Modbus Master.1)	uint8	7c17	31767	Not applicable
ModbusMaster.18.Data.Descriptor	Description for this data item	string_t	67ec	26604	Not applicable
ModbusMaster.18.Data.Digital	Digital status (0 = Off, 1 = On)	bool	7e2c	32300	Not applicable
ModbusMaster.18.Data.FallBackValue	Fall back value to be writen to the slave device	float32	7ca0	31904	2dp
ModbusMaster.18.Data.FunctionCode	The modbus function code (as for Modbus Master.1)	uint8	7bf9	31737	Not applicable
ModbusMaster.18.Data.ModbusAddress	Modbus register address of the data to be read/written	float32	7bce	31694	0dp
ModbusMaster.18.Data.Mode	Auto Manual mode selection (0 = Auto; 1 = Manual)	uint8	7dac	32172	Not applicable
ModbusMaster.18.Data.Number	Used for multiple instance parameters	uint8	7d24	32036	Not applicable
ModbusMaster.18.Data.ParameterList	Parameter list for a specific slave device	uint8	7d06	32006	Not applicable
ModbusMaster.18.Data.Priority	FRead/Write frequency (as for Modbus Master.1)	uint8	7c35	31797	Not applicable
ModbusMaster.18.Data.PV	Process value recieved from slave device	float32	7b54	31572	2dp
ModbusMaster.18.Data.Scaling	Scaling in decimal places for non floating point data types	uint8	7d42	32066	Not applicable
ModbusMaster.18.Data.Send	1 = send the write value to the slave device	bool	7cca	31946	Not applicable
ModbusMaster.18.Data.Set	Sets a digital value (1 = on; 0 = off)	bool	7e0c	32268	Not applicable
ModbusMaster.18.Data.SlaveDevice	Slave device to communicate with.	uint8	7b25	31525	Not applicable
ModbusMaster.18.Data.Status	Transaction status (as for Modbus Master.1	uint8	7ce8	31976	Not applicable
ModbusMaster.18.Data.Value	The value to be written to the slave device	float32	7c64	31844	2dp
ModbusMaster.19.Data.AlarmStatus	Alarm status (as for Modbus Master.1)	uint8	7dcd	32205	Not applicable
ModbusMaster.19.Data.BitPosition	Bit position of the bit of interest in a 16 bit data type	uint8	7d61	32097	Not applicable
ModbusMaster.19.Data.ChanAlarmStatus	Channel alarm status (as for Modbus Master.1)	uint8	7ded	32237	Not applicable
ModbusMaster.19.Data.DataType	Type of data being read/written (as for Modbus Master.1)	uint8	7c18	31768	Not applicable
ModbusMaster.19.Data.Descriptor	Description for this data item	string_t	6801	26625	Not applicable
ModbusMaster.19.Data.Digital	Digital status (0 = Off, 1 = On)	bool	7e2d	32301	Not applicable
ModbusMaster.19.Data.FallBackValue	Fall back value to be writen to the slave device	float32	7ca2	31906	2dp
ModbusMaster.19.Data.FunctionCode	The modbus function code (as for Modbus Master.1)	uint8	7bfa	31738	Not applicable
ModbusMaster.19.Data.ModbusAddress	Modbus register address of the data to be read/written	float32	7bd0	31696	0dp
ModbusMaster.19.Data.Mode	Auto Manual mode selection (0 = Auto; 1 = Manual)	uint8	7dad	32173	Not applicable
ModbusMaster.19.Data.Number	Used for multiple instance parameters	uint8	7d25	32037	Not applicable
ModbusMaster.19.Data.ParameterList	Parameter list for a specific slave device	uint8	7d07	32007	Not applicable
ModbusMaster.19.Data.Priority	Read/Write frequency (as for Modbus Master.1)	uint8	7c36	31798	Not applicable
ModbusMaster.19.Data.PV	Process value recieved from slave device	float32	7b56	31574	2dp
ModbusMaster.19.Data.Scaling	Scaling in decimal places for non floating point data types	uint8	7d43	32067	Not applicable
ModbusMaster.19.Data.Send	1 = send the write value to the slave	bool	7ccb	31947	Not applicable
ModbusMaster.19.Data.Set	Sets a digital value (1 = on; 0 = off)	bool	7e0d	32269	Not applicable
ModbusMaster.19.Data.SlaveDevice	Slave device to communicate with.	uint8	7b26	31526	Not applicable
ModbusMaster.19.Data.Status	Transaction status (as for Modbus Master.1	uint8	7ce9	31977	Not applicable
ModbusMaster.19.Data.Value	The value to be written to the slave device	float32	7c66	31846	2dp
ModbusMaster.20.Data.AlarmStatus	Alarm status (as for Modbus Master.1)	uint8	7dce	32206	Not applicable
ModbusMaster.20.Data.BitPosition	Bit position of the bit of interest in a 16 bit data type	uint8	7d62	32098	Not applicable
ModbusMaster.20.Data.ChanAlarmStatus	Channel alarm status (as for Modbus Master.1)	uint8	7dee	32238	Not applicable
ModbusMaster.20.Data.DataType	Type of data being read/written (as for Modbus Master.1)	uint8	7c19	31769	Not applicable
ModbusMaster.20.Data.Descriptor	Description for this data item	string_t	6816	26646	Not applicable
ModbusMaster.20.Data.Digital	Digital status (0 = Off, 1 = On)	bool	7e2e	32302	Not applicable
ModbusMaster.20.Data.FallBackValue	Fall back value to be writen to the slave device	float32	7ca4	31908	2dp
ModbusMaster.20.Data.FunctionCode	The modbus function code (as for Modbus Master.1)	uint8	7bfb	31739	Not applicable
ModbusMaster.20.Data.ModbusAddress	Modbus register address of the data to be read/written	float32	7bd2	31698	0dp
ModbusMaster.20.Data.Mode	Auto Manual mode selection (0 = Auto; 1 = Manual)	uint8	7dae	32174	Not applicable
ModbusMaster.20.Data.Number	Used for multiple instance parameters	uint8	7d26	32038	Not applicable
ModbusMaster.20.Data.ParameterList	Parameter list for a specific slave device	uint8	7d08	32008	Not applicable
ModbusMaster.20.Data.Priority	Read/Write frequency (as for Modbus Master.1)	uint8	7c37	31799	Not applicable
ModbusMaster.20.Data.PV	Process value recieved from slave device	float32	7b58	31576	2dp
ModbusMaster.20.Data.Scaling	Scaling in decimal places for non floating point data types	uint8	7d44	32068	Not applicable
ModbusMaster.20.Data.Send	1 = send the write value to the slave	bool	7ccc	31948	Not applicable
ModbusMaster.20.Data.Set	SSets a digital value (1 = on; 0 = off)	bool	7e0e	32270	Not applicable
ModbusMaster.20.Data.SlaveDevice	Slave device to communicate with.	uint8	7b27	31527	Not applicable
ModbusMaster.20.Data.Status	Transaction status (as for Modbus Master.1	uint8	7cea	31978	Not applicable
ModbusMaster.20.Data.Value	The value to be written to the slave device	float32	7c68	31848	2dp
ModbusMaster.21.Data.AlarmStatus	Alarm status (as for Modbus Master.1)	uint8	7dcf	32207	Not applicable
ModbusMaster.21.Data.BitPosition	Bit position of the bit of interest in a 16 bit data type	uint8	7d63	32099	Not applicable
ModbusMaster.21.Data.ChanAlarmStatus	Channel alarm status (as for Modbus Master.1)	uint8	7def	32239	Not applicable
ModbusMaster.21.Data.DataType	Type of data being read/written (as for Modbus Master.1)	uint8	7c1a	31770	Not applicable
ModbusMaster.21.Data.Descriptor	Description for this data item	string_t	682b	26667	Not applicable
ModbusMaster.21.Data.Digital	Digital status (0 = Off, 1 = On)	bool	7e2f	32303	Not applicable
ModbusMaster.21.Data.FallBackValue	Fall back value to be writen to the slave device	float32	7ca6	31910	2dp
ModbusMaster.21.Data.FunctionCode	The modbus function code (as for Modbus Master.1)	uint8	7bfc	31740	Not applicable
ModbusMaster.21.Data.ModbusAddress	Modbus register address of the data to be read/written	float32	7bd4	31700	0dp
ModbusMaster.21.Data.Mode	Auto Manual mode selection (0 = Auto; 1 = Manual)	uint8	7daf	32175	Not applicable
ModbusMaster.21.Data.Number	Used for multiple instance parameters	uint8	7d27	32039	Not applicable
ModbusMaster.21.Data.ParameterList	Parameter list for a specific slave device	uint8	7d09	32009	Not applicable
ModbusMaster.21.Data.Priority	Read/Write frequency (as for Modbus Master.1)	uint8	7c38	31800	Not applicable

5.3 PARAMETER LIST (Cont.)

Parameter path	Description	Type	Hex	Dec	Resolution
ModbusMaster.21.Data.PV	Process value recieved from slave device	float32	7b5a	31578	2dp
ModbusMaster.21.Data.Scaling	Scaling in decimal places for non floating point data types	uint8	7d45	32069	Not applicable
ModbusMaster.21.Data.Send	1 = send the write value to the slave	bool	7ccd	31949	Not applicable
ModbusMaster.21.Data.Set	Sets a digital value (1 = on; 0 = off)	bool	7e0f	32271	Not applicable
ModbusMaster.21.Data.SlaveDevice	Slave device to communicate with.	uint8	7b28	31528	Not applicable
ModbusMaster.21.Data.Status	Transaction status (as for Modbus Master.1	uint8	7ceb	31979	Not applicable
ModbusMaster.21.Data.Value	The value to be written to the slave device	float32	7c6a	31850	2dp
ModbusMaster.22.Data.AlarmStatus	Alarm status (as for Modbus Master.1)	uint8	7dd0	32208	Not applicable
ModbusMaster.22.Data.BitPosition	Bit position of the bit of interest in a 16 bit data type	uint8	7d64	32100	Not applicable
ModbusMaster.22.Data.ChanAlarmStatus	Channel alarm status (as for Modbus Master.1)	uint8	7df0	32240	Not applicable
ModbusMaster.22.Data.DataType	Type of data being read/written (as for Modbus Master.1)	uint8	7c1b	31771	Not applicable
ModbusMaster.22.Data.Descriptor	Description for this data item	string_t	6840	26688	Not applicable
ModbusMaster.22.Data.Digital	Digital status (0 = Off, 1 = On)	bool	7e30	32304	Not applicable
ModbusMaster.22.Data.FallBackValue	Fall back value to be writen to the slave device	float32	7ca8	31912	2dp
ModbusMaster.22.Data.FunctionCode	The modbus function code (as for Modbus Master.1)	uint8	7bfd	31741	Not applicable
ModbusMaster.22.Data.ModbusAddress	Modbus register address of the data to be read/written	float32	7bd6	31702	0dp
ModbusMaster.22.Data.Mode	Auto Manual mode selection (0 = Auto; 1 = Manual)	uint8	7db0	32176	Not applicable
ModbusMaster.22.Data.Number	Used for multiple instance parameters	uint8	7d28	32040	Not applicable
ModbusMaster.22.Data.ParameterList	Parameter list for a specific slave device	uint8	7d0a	32010	Not applicable
ModbusMaster.22.Data.Priority	Read/Write frequency (as for Modbus Master.1)	uint8	7c39	31801	Not applicable
ModbusMaster.22.Data.PV	Process value recieved from slave device	float32	7b5c	31580	2dp
ModbusMaster.22.Data.Scaling	Scaling in decimal places for non floating point data types	uint8	7d46	32070	Not applicable
ModbusMaster.22.Data.Send	1 = send the write value to the slave	bool	7cce	31950	Not applicable
ModbusMaster.22.Data.Set	Sets a digital value (1 = on; 0 = off)	bool	7e10	32272	Not applicable
ModbusMaster.22.Data.SlaveDevice	Slave device to communicate with.	uint8	7b29	31529	Not applicable
ModbusMaster.22.Data.Status	Transaction status (as for Modbus Master.1	uint8	7cec	31980	Not applicable
ModbusMaster.22.Data.Value	The value to be written to the slave device	float32	7c6c	31852	2dp
ModbusMaster.23.Data.AlarmStatus	Alarm status (as for Modbus Master.1)	uint8	7dd1	32209	Not applicable
ModbusMaster.23.Data.BitPosition	Bit position of the bit of interest in a 16 bit data type	uint8	7d65	32101	Not applicable
ModbusMaster.23.Data.ChanAlarmStatus	Channel alarm status (as for Modbus Master.1)	uint8	7df1	32241	Not applicable
ModbusMaster.23.Data.DataType	Type of data being read/written (as for Modbus Master.1)	uint8	7c1c	31772	Not applicable
ModbusMaster.23.Data.Descriptor	Description for this data item	string_t	6855	26709	Not applicable
ModbusMaster.23.Data.Digital	Digital status (0 = Off, 1 = On)	bool	7e31	32305	Not applicable
ModbusMaster.23.Data.FallBackValue	Fall back value to be writen to the slave device	float32	7caa	31914	2dp
ModbusMaster.23.Data.FunctionCode	The modbus function code (as for Modbus Master.1)	uint8	7bfe	31742	Not applicable
ModbusMaster.23.Data.ModbusAddress	Modbus register address of the data to be read/written	float32	7bd8	31704	0dp
ModbusMaster.23.Data.Mode	Auto Manual mode selection (0 = Auto; 1 = Manual)	uint8	7db1	32177	Not applicable
ModbusMaster.23.Data.Number	Used for multiple instance parameters	uint8	7d29	32041	Not applicable
ModbusMaster.23.Data.ParameterList	Parameter list for a specific slave device	uint8	7d0b	32011	Not applicable
ModbusMaster.23.Data.Priority	Read/Write frequency (as for Modbus Master.1)	uint8	7c3a	31802	Not applicable
ModbusMaster.23.Data.PV	Process value recieved from slave device	float32	7b5e	31582	2dp
ModbusMaster.23.Data.Scaling	Scaling in decimal places for non floating point data types	uint8	7d47	32071	Not applicable
ModbusMaster.23.Data.Send	1 = send the write value to the slave	bool	7ccf	31951	Not applicable
ModbusMaster.23.Data.Set	Sets a digital value (1 = on; 0 = off)	bool	7e11	32273	Not applicable
ModbusMaster.23.Data.SlaveDevice	Slave device to communicate with.	uint8	7b2a	31530	Not applicable
ModbusMaster.23.Data.Status	Transaction status (as for Modbus Master.1	uint8	7ced	31981	Not applicable
ModbusMaster.23.Data.Value	The value to be written to the slave device	float32	7c6e	31854	2dp
ModbusMaster.24.Data.AlarmStatus	Alarm status (as for Modbus Master.1)	uint8	7dd2	32210	Not applicable
ModbusMaster.24.Data.BitPosition	Bit position of the bit of interest in a 16 bit data type	uint8	7d66	32102	Not applicable
ModbusMaster.24.Data.ChanAlarmStatus	Channel alarm status (as for Modbus Master.1)	uint8	7df2	32242	Not applicable
ModbusMaster.24.Data.DataType	Type of data being read/written (as for Modbus Master.1)	uint8	7c1d	31773	Not applicable
ModbusMaster.24.Data.Descriptor	Description for this data item	string_t	686a	26730	Not applicable
ModbusMaster.24.Data.Digital	Digital status (0 = Off, 1 = On)	bool	7e32	32306	Not applicable
ModbusMaster.24.Data.FallBackValue	Fall back value to be writen to the slave device	float32	7cac	31916	2dp
ModbusMaster.24.Data.FunctionCode	The modbus function code (as for Modbus Master.1)	uint8	7bff	31743	Not applicable
ModbusMaster.24.Data.ModbusAddress	Modbus register address of the data to be read/written	float32	7bda	31706	0dp
ModbusMaster.24.Data.Mode	Auto Manual mode selection (0 = Auto; 1 = Manual)	uint8	7db2	32178	Not applicable
ModbusMaster.24.Data.Number	Used for multiple instance parameters	uint8	7d2a	32042	Not applicable
ModbusMaster.24.Data.ParameterList	Parameter list for a specific slave device	uint8	7d0c	32012	Not applicable
ModbusMaster.24.Data.Priority	Read/Write frequency (as for Modbus Master.1)	uint8	7c3b	31803	Not applicable
ModbusMaster.24.Data.PV	Process value recieved from slave device	float32	7b60	31584	2dp
ModbusMaster.24.Data.Scaling	Scaling in decimal places for non floating point data types	uint8	7d48	32072	Not applicable
ModbusMaster.24.Data.Send	1 = send the write value to the slave	bool	7cd0	31952	Not applicable
ModbusMaster.24.Data.Set	Sets a digital value (1 = on; 0 = off)	bool	7e12	32274	Not applicable
ModbusMaster.24.Data.SlaveDevice	Slave device to communicate with.	uint8	7b2b	31531	Not applicable
ModbusMaster.24.Data.Status	Transaction status (as for Modbus Master.1	uint8	7cee	31982	Not applicable
ModbusMaster.24.Data.Value	The value to be written to the slave device	float32	7c70	31856	2dp
ModbusMaster.25.Data.AlarmStatus	Alarm status (as for Modbus Master.1)	uint8	7dd3	32211	Not applicable
ModbusMaster.25.Data.BitPosition	Bit position of the bit of interest in a 16 bit data type	uint8	7d67	32103	Not applicable
ModbusMaster.25.Data.ChanAlarmStatus	Channel alarm status (as for Modbus Master.1)	uint8	7df3	32243	Not applicable
ModbusMaster.25.Data.DataType	Type of data being read/written (as for Modbus Master.1)	uint8	7c1e	31774	Not applicable
ModbusMaster.25.Data.Descriptor	Description for this data item	string_t	687f	26751	Not applicable
ModbusMaster.25.Data.Digital	Digital status (0 = Off, 1 = On)	bool	7e33	32307	Not applicable
ModbusMaster.25.Data.FallBackValue	Fall back value to be writen to the slave device	float32	7cae	31918	2dp
ModbusMaster.25.Data.FunctionCode	The modbus function code (as for Modbus Master.1)	uint8	7c00	31744	Not applicable
ModbusMaster.25.Data.ModbusAddress	Modbus register address of the data to be read/written	float32	7bdc	31708	0dp
ModbusMaster.25.Data.Mode	Auto Manual mode selection (0 = Auto; 1 = Manual)	uint8	7db3	32179	Not applicable
ModbusMaster.25.Data.Number	Used for multiple instance parameters	uint8	7d2b	32043	Not applicable

5.3 PARAMETER LIST (Cont.)

Parameter path	Description	Type	Hex	Dec	Resolution
ModbusMaster.25.Data.ParameterList	Parameter list for a specific slave device	uint8	7d0d	32013	Not applicable
ModbusMaster.25.Data.Priority	Read/Write frequency (as for Modbus Master.1)	uint8	7c3c	31804	Not applicable
ModbusMaster.25.Data.PV	Process value recieved from slave device	float32	7b62	31586	2dp
ModbusMaster.25.Data.Scaling	Scaling in decimal places for non floating point data types	uint8	7d49	32073	Not applicable
ModbusMaster.25.Data.Send	1 = send the write value to the slave	bool	7cd1	31953	Not applicable
ModbusMaster.25.Data.Set	Sets a digital value (1 = on; 0 = off)	bool	7e13	32275	Not applicable
ModbusMaster.25.Data.SlaveDevice	Slave device to communicate with.	uint8	7b2c	31532	Not applicable
ModbusMaster.25.Data.Status	Transaction status (as for Modbus Master.1	uint8	7cef	31983	Not applicable
ModbusMaster.25.Data.Value	The value to be written to the slave device	float32	7c72	31858	2dp
ModbusMaster.26.Data.AlarmStatus	Alarm status (as for Modbus Master.1)	uint8	7dd4	32212	Not applicable
ModbusMaster.26.Data.BitPosition	Bit position of the bit of interest in a 16 bit data type	uint8	7d68	32104	Not applicable
ModbusMaster.26.Data.ChanAlarmStatus	Channel alarm status (as for Modbus Master.1)	uint8	7df4	32244	Not applicable
ModbusMaster.26.Data.DataType	Type of data being read/written (as for Modbus Master.1)	uint8	7c1f	31775	Not applicable
ModbusMaster.26.Data.Descriptor	Description for this data item	string_t	6894	26772	Not applicable
ModbusMaster.26.Data.Digital	Digital status (0 = Off, 1 = On)	bool	7e34	32308	Not applicable
ModbusMaster.26.Data.FallBackValue	Fall back value to be writen to the slave device	float32	7cb0	31920	2dp
ModbusMaster.26.Data.FunctionCode	The modbus function code (as for Modbus Master.1)	uint8	7c01	31745	Not applicable
ModbusMaster.26.Data.ModbusAddress	Modbus register address of the data to be read/written	float32	7bde	31710	0dp
ModbusMaster.26.Data.Mode	Auto Manual mode selection (0 = Auto; 1 = Manual)	uint8	7db4	32180	Not applicable
ModbusMaster.26.Data.Number	Used for multiple instance parameters	uint8	7d2c	32044	Not applicable
ModbusMaster.26.Data.ParameterList	Parameter list for a specific slave device	uint8	7d0e	32014	Not applicable
ModbusMaster.26.Data.Priority	Read/Write frequency (as for Modbus Master.1)	uint8	7c3d	31805	Not applicable
ModbusMaster.26.Data.PV	Process value recieved from slave device	float32	7b64	31588	2dp
ModbusMaster.26.Data.Scaling	Scaling in decimal places for non floating point data types	uint8	7d4a	32074	Not applicable
ModbusMaster.26.Data.Send	1 = send the write value to the slave	bool	7cd2	31954	Not applicable
ModbusMaster.26.Data.Set	Sets a digital value (1 = on; 0 = off)	bool	7e14	32276	Not applicable
ModbusMaster.26.Data.SlaveDevice	Slave device to communicate with.	uint8	7b2d	31533	Not applicable
ModbusMaster.26.Data.Status	Transaction status (as for Modbus Master.1	uint8	7cf0	31984	Not applicable
ModbusMaster.26.Data.Value	The value to be written to the slave device	float32	7c74	31860	2dp
ModbusMaster.27.Data.AlarmStatus	Alarm status (as for Modbus Master.1)	uint8	7dd5	32213	Not applicable
ModbusMaster.27.Data.BitPosition	Bit position of the bit of interest in a 16 bit data type	uint8	7d69	32105	Not applicable
ModbusMaster.27.Data.ChanAlarmStatus	Channel alarm status (as for Modbus Master.1)	uint8	7df5	32245	Not applicable
ModbusMaster.27.Data.DataType	Type of data being read/written (as for Modbus Master.1)	uint8	7c20	31776	Not applicable
ModbusMaster.27.Data.Descriptor	Description for this data item	string_t	68a9	26793	Not applicable
ModbusMaster.27.Data.Digital	Digital status (0 = Off, 1 = On)	bool	7e35	32309	Not applicable
ModbusMaster.27.Data.FallBackValue	Fall back value to be writen to the slave device	float32	7cb2	31922	2dp
ModbusMaster.27.Data.FunctionCode	The modbus function code (as for Modbus Master.1)	uint8	7c02	31746	Not applicable
ModbusMaster.27.Data.ModbusAddress	Modbus register address of the data to be read/written	float32	7be0	31712	0dp
ModbusMaster.27.Data.Mode	Auto Manual mode selection (0 = Auto; 1 = Manual)	uint8	7db5	32181	Not applicable
ModbusMaster.27.Data.Number	Used for multiple instance parameters	uint8	7d2d	32045	Not applicable
ModbusMaster.27.Data.ParameterList	Parameter list for a specific slave device	uint8	7d0f	32015	Not applicable
ModbusMaster.27.Data.Priority	Read/Write frequency (as for Modbus Master.1)	uint8	7c3e	31806	Not applicable
ModbusMaster.27.Data.PV	Process value recieved from slave device	float32	7b66	31590	2dp
ModbusMaster.27.Data.Scaling	Scaling in decimal places for non floating point data types	uint8	7d4b	32075	Not applicable
ModbusMaster.27.Data.Send	1 = send the write value to the slave	bool	7cd3	31955	Not applicable
ModbusMaster.27.Data.Set	Sets a digital value (1 = on; 0 = off)	bool	7e15	32277	Not applicable
ModbusMaster.27.Data.SlaveDevice	Slave device to communicate with.	uint8	7b2e	31534	Not applicable
ModbusMaster.27.Data.Status	Transaction status (as for Modbus Master.1	uint8	7cf1	31985	Not applicable
ModbusMaster.27.Data.Value	The value to be written to the slave device	float32	7c76	31862	2dp
ModbusMaster.28.Data.AlarmStatus	Alarm status (as for Modbus Master.1)	uint8	7dd6	32214	Not applicable
ModbusMaster.28.Data.BitPosition	Bit position of the bit of interest in a 16 bit data type	uint8	7d6a	32106	Not applicable
ModbusMaster.28.Data.ChanAlarmStatus	Channel alarm status (as for Modbus Master.1)	uint8	7df6	32246	Not applicable
ModbusMaster.28.Data.DataType	Type of data being read/written (as for Modbus Master.1)	uint8	7c21	31777	Not applicable
ModbusMaster.28.Data.Descriptor	Description for this data item	string_t	68be	26814	Not applicable
ModbusMaster.28.Data.Digital	Digital status (0 = Off, 1 = On)	bool	7e36	32310	Not applicable
ModbusMaster.28.Data.FallBackValue	Fall back value to be writen to the slave device	float32	7cb4	31924	2dp
ModbusMaster.28.Data.FunctionCode	The modbus function code (as for Modbus Master.1)	uint8	7c03	31747	Not applicable
ModbusMaster.28.Data.ModbusAddress	Modbus register address of the data to be read/written	float32	7be2	31714	0dp
ModbusMaster.28.Data.Mode	Auto Manual mode selection (0 = Auto; 1 = Manual)	uint8	7db6	32182	Not applicable
ModbusMaster.28.Data.Number	Used for multiple instance parameters	uint8	7d2e	32046	Not applicable
ModbusMaster.28.Data.ParameterList	Parameter list for a specific slave device	uint8	7d10	32016	Not applicable
ModbusMaster.28.Data.Priority	Read/Write frequency (as for Modbus Master.1)	uint8	7c3f	31807	Not applicable
ModbusMaster.28.Data.PV	Process value recieved from slave device	float32	7b68	31592	2dp
ModbusMaster.28.Data.Scaling	Scaling in decimal places for non floating point data types	uint8	7d4c	32076	Not applicable
ModbusMaster.28.Data.Send	1 = send the write value to the slave	bool	7cd4	31956	Not applicable
ModbusMaster.28.Data.Set	Sets a digital value (1 = on; 0 = off)	bool	7e16	32278	Not applicable
ModbusMaster.28.Data.SlaveDevice	Slave device to communicate with.	uint8	7b2f	31535	Not applicable
ModbusMaster.28.Data.Status	Transaction status (as for Modbus Master.1	uint8	7cf2	31986	Not applicable
ModbusMaster.28.Data.Value	The value to be written to the slave device	float32	7c78	31864	2dp
ModbusMaster.29.Data.AlarmStatus	Alarm status (as for Modbus Master.1)	uint8	7dd7	32215	Not applicable
ModbusMaster.29.Data.BitPosition	Bit position of the bit of interest in a 16 bit data type	uint8	7d6b	32107	Not applicable
ModbusMaster.29.Data.ChanAlarmStatus	Channel alarm status (as for Modbus Master.1)	uint8	7df7	32247	Not applicable
ModbusMaster.29.Data.DataType	Type of data being read/written (as for Modbus Master.1)	uint8	7c22	31778	Not applicable
ModbusMaster.29.Data.Descriptor	Description for this data item	string_t	70ff	28927	Not applicable
ModbusMaster.29.Data.Digital	Digital status (0 = Off, 1 = On)	bool	7e37	32311	Not applicable
ModbusMaster.29.Data.FallBackValue	Fall back value to be writen to the slave device	float32	7cb6	31926	2dp
ModbusMaster.29.Data.FunctionCode	The modbus function code (as for Modbus Master.1)	uint8	7c04	31748	Not applicable

5.3 PARAMETER LIST (Cont.)

Parameter path	Description	Type	Hex	Dec	Resolution
ModbusMaster.29.Data.ModbusAddress	Modbus register address of the data to be read/written	float32	7be4	31716	0dp
ModbusMaster.29.Data.Mode	Auto Manual mode selection (0 = Auto; 1 = Manual)	uint8	7db7	32183	Not applicable
ModbusMaster.29.Data.Number	Used for multiple instance parameters	uint8	7d2f	32047	Not applicable
ModbusMaster.29.Data.ParameterList	Parameter list for a specific slave device	uint8	7d11	32017	Not applicable
ModbusMaster.29.Data.Priority	Read/Write frequency (as for Modbus Master.1)	uint8	7c40	31808	Not applicable
ModbusMaster.29.Data.PV	Process value recieved from slave device	float32	7b6a	31594	2dp
ModbusMaster.29.Data.Scaling	Scaling in decimal places for non floating point data types	uint8	7d4d	32077	Not applicable
ModbusMaster.29.Data.Send	1 = send the write value to the slave	bool	7cd5	31957	Not applicable
ModbusMaster.29.Data.Set	Sets a digital value (1 = on; 0 = off)	bool	7e17	32279	Not applicable
ModbusMaster.29.Data.SlaveDevice	Slave device to communicate with.	uint8	7b30	31536	Not applicable
ModbusMaster.29.Data.Status	Transaction status (as for Modbus Master.1	uint8	7cf3	31987	Not applicable
ModbusMaster.29.Data.Value	The value to be written to the slave device	float32	7c7a	31866	2dp
ModbusMaster.30.Data.AlarmStatus	Alarm status (as for Modbus Master.1)	uint8	7dd8	32216	Not applicable
ModbusMaster.30.Data.BitPosition	Bit position of the bit of interest in a 16 bit data type	uint8	7d6c	32108	Not applicable
ModbusMaster.30.Data.ChanAlarmStatus	Channel alarm status (as for Modbus Master.1)	uint8	7df8	32248	Not applicable
ModbusMaster.30.Data.DataType	Type of data being read/written (as for Modbus Master.1)	uint8	7c23	31779	Not applicable
ModbusMaster.30.Data.Descriptor	Description for this data item	string_t	7114	28948	Not applicable
ModbusMaster.30.Data.Digital	Digital status (0 = Off, 1 = On)	bool	7e38	32312	Not applicable
ModbusMaster.30.Data.FallBackValue	Fall back value to be writen to the slave device	float32	7cb8	31928	2dp
ModbusMaster.30.Data.FunctionCode	The modbus function code (as for Modbus Master.1)	uint8	7c05	31749	Not applicable
ModbusMaster.30.Data.ModbusAddress	Modbus register address of the data to be read/written	float32	7be6	31718	0dp
ModbusMaster.30.Data.Mode	Auto Manual mode selection (0 = Auto; 1 = Manual)	uint8	7db8	32184	Not applicable
ModbusMaster.30.Data.Number	Used for multiple instance parameters	uint8	7d30	32048	Not applicable
ModbusMaster.30.Data.ParameterList	Parameter list for a specific slave device	uint8	7d12	32018	Not applicable
ModbusMaster.30.Data.Priority	Read/Write frequency (as for Modbus Master.1)	uint8	7c41	31809	Not applicable
ModbusMaster.30.Data.PV	Process value recieved from slave device	float32	7b6c	31596	2dp
ModbusMaster.30.Data.Scaling	Scaling in decimal places for non floating point data types	uint8	7d4e	32078	Not applicable
ModbusMaster.30.Data.Send	1 = send the write value to the slave	bool	7cd6	31958	Not applicable
ModbusMaster.30.Data.Set	Sets a digital value (1 = on; 0 = off)	bool	7e18	32280	Not applicable
ModbusMaster.30.Data.SlaveDevice	Slave device to communicate with.	uint8	7b31	31537	Not applicable
ModbusMaster.30.Data.Status	Transaction status (as for Modbus Master.1	uint8	7cf4	31988	Not applicable
ModbusMaster.30.Data.Value	The value to be written to the slave device	float32	7c7c	31868	2dp
ModbusMaster.Slave1.Data.AlarmStatus	Alarm status (0 = none; 1 = one or more alarms active)	uint8	7db9	32185	Not applicable
ModbusMaster.Slave1.Data.BitPosition	Bit position of the bit of interest in a 16 bit data type	uint8	7d95	32149	Not applicable
ModbusMaster.Slave1.Data.ChanAlarmStatus	Channel alarm status 0 = Off 1 = Active 2 = Safe Nak'd 3 = Active Nack'd	uint8	7dd9	32217	Not applicable
ModbusMaster.Slave1.Data.DataType	Data type of the data being read/written 0 = Real 1 = DINT 2 = INT 3 = Byte 4 = UDINT 5 = UINT 6 = UBYTE 8 = Real (Swap) 9 = DINT (Swap) 10 = UDINT (Swap) 11 = BIT	uint8	7d7f	32127	Not applicable
ModbusMaster.Slave1.Data.Descriptor	Description for this data item	string_t	665d	26205	Not applicable
ModbusMaster.Slave1.Data.Digital	Digital status (0 = Off; 1 = On)	bool	7e19	32281	Not applicable
ModbusMaster.Slave1.Data.FallBackValue	Fall back value to be writen to the slave device	float32	7d87	32135	2dp
ModbusMaster.Slave1.Data.FunctionCode	The modbus function code 1 = Read coil 2 = Read discrete 3 = Read holding 4 = Read input 5 = Write coil 6 = Write single 16 = Write multiple	uint8	7d7d	32125	Not applicable
ModbusMaster.Slave1.Data.ModbusAddress	Modbus register address of the data to be read/written	float32	7d79	32121	0dp
ModbusMaster.Slave1.Data.Mode	Auto Manual mode selection (0 = Auto; 1 = Manual)	uint8	7d99	32153	Not applicable
ModbusMaster.Slave1.Data.Number	Used for multiple instance parameters	uint8	7d91	32145	Not applicable
ModbusMaster.Slave1.Data.ParameterList	Parameter list for a specific slave device	uint8	7d8f	32143	Not applicable
ModbusMaster.Slave1.Data.Priority	Frequency at which the data is read/written 0 = High 1 = Medium 2 = Low 3 = Acyclic	uint8	7d81	32129	Not applicable
ModbusMaster.Slave1.Data.PV	Process value recieved from slave device	float32	7d73	32115	2dp
ModbusMaster.Slave1.Data.Scaling	Scaling in decimal places for non floating point data types	uint8	7d93	32147	Not applicable
ModbusMaster.Slave1.Data.Send	1 = send the write value to the slave	bool	7d8b	32139	Not applicable
ModbusMaster.Slave1.Data.Set	Sets a digital value to on (1) or off (0)	bool	7df9	32249	Not applicable
ModbusMaster.Slave1.Data.SlaveDevice	Slave device to communicate with.	uint8	7d71	32113	Not applicable
ModbusMaster.Slave1.Data.Status	Transaction status 0 = Success 1 = Illegal function 2 = Ilegal address 3 = Illegal value 6 = Slave busy 8 = Parity error 9 = Bad sub 10 = Bad gateway 11 = No response 12 = Idle 13 = Pending 14 = Timeout 15 = Unknown host 16 = Connect fail 17 = No sockets 18 = Loopback fail 19 = Login fail 20 = Unknown error 22 = Write fail 23 = Master reject	uint8	7d8d	32141	Not applicable
ModbusMaster.Slave1.Data.Value	The value to be written to the slave device	float32	7d83	32131	2dp
ModbusMaster.Slave1.Main.CommsFailure	1 = a device communications failure	bool	7d97	32151	Not applicable
ModbusMaster.Slave1.Main.Descriptor	Device descriptor	string_t	6633	26163	Not applicable
ModbusMaster.Slave1.Main.HighPriority	High priority rate 0 = 125ms 1 = 250ms 2 = 500 ms 3 = 1 sec 4 = 2 secs 5 = 5 secs 6 = 10 secs 7 = 20 secs 8 = 30 secs 9 = 1 min 10 = 2 mins 11 = 5 mins 12 = 10 mins 13 = 20 mins 14 = 30 mins 15 = 1 hr	uint8	7b0c	31500	Not applicable
ModbusMaster.Slave1.Main.IPAddress	Internet Protocol (IP) address for a slave device	string_t	68d3	26835	Not applicable
ModbusMaster.Slave1.Main.LowPriority	Low priority rate (as 'high priority' above)	uint8	7b10	31504	Not applicable
ModbusMaster.Slave1.Main.MaxBlockSize	Maximum amount of data in a single transaction	uint8	7b0a	31498	Not applicable
ModbusMaster.Slave1.Main.MediumPriority	Medium priority rate (as 'high priority' above)	uint8	7b0e	31502	Not applicable
ModbusMaster.Slave1.Main.Online	Enables communications (0 = offline; 1 = online)	bool	7b00	31488	Not applicable

5.3 PARAMETER LIST (Cont.)

Parameter path	Description	Type	Hex	Dec	Resolution
ModbusMaster.Slave1.Main.Profile	A profile that defines the device type 0 = 3rd party 1 = Mini8 2 = 3xxx 3 = 35xx 4 = 2xxx 5 = 2500 6 = 5000 7 = 6000 8 = nanodac 9 = EPower	uint8	7b12	31506	Not applicable
ModbusMaster.Slave1.Main.Retries	Transaction retries	uint8	7b04	31492	Not applicable
ModbusMaster.Slave1.Main.SearchDevice	Initiates a slave search (0 = No; 1 = Yes)	bool	7d6d	32109	Not applicable
ModbusMaster.Slave1.Main.SearchResult	Current search status 0 = Searching 1 = Available 2 = Unavailable 3 = Unreachable 4 = Aborted	uint8	7d6f	32111	Not applicable
ModbusMaster.Slave1.Main.Timeout	Time in milliseconds the master will wait for a response	float32	7b06	31494	0dp
ModbusMaster.Slave1.Main.UnitId	Unit id for a slave device	uint8	7b02	31490	Not applicable
ModbusMaster.Slave2.Data.AlarmStatus	Alarm status (0 = none; 1 = one or more alarms active)	uint8	7dba	32186	Not applicable
ModbusMaster.Slave2.Data.BitPosition	Bit position of the bit of interest in a 16 bit data type	uint8	7d96	32150	Not applicable
ModbusMaster.Slave2.Data.ChanAlarmStatus	Channel alarm status (as Slave1.Data)	uint8	7dda	32218	Not applicable
ModbusMaster.Slave2.Data.DataType	Data type of the data being read/written (as Slave1.Data)	uint8	7d80	32128	Not applicable
ModbusMaster.Slave2.Data.Descriptor	Description for this data item	string_t	6672	26226	Not applicable
ModbusMaster.Slave2.Data.Digital	Digital status (0 = Off; 1 = On)	bool	7e1a	32282	Not applicable
ModbusMaster.Slave2.Data.FallBackValue	Fall back value to be writen to the slave device	float32	7d89	32137	2dp
ModbusMaster.Slave2.Data.FunctionCode	The modbus function code (as Slave1.Data)	uint8	7d7e	32126	Not applicable
ModbusMaster.Slave2.Data.ModbusAddress	Modbus register address of the data to be read/written	float32	7d7b	32123	0dp
ModbusMaster.Slave2.Data.Mode	Auto Manual mode selectionn (0 = Auto; 1 = Manual)	uint8	7d9a	32154	Not applicable
ModbusMaster.Slave2.Data.Number	Used for multiple instance parameters	uint8	7d92	32146	Not applicable
ModbusMaster.Slave2.Data.ParameterList	Parameter list for a specific slave device	uint8	7d90	32144	Not applicable
ModbusMaster.Slave2.Data.Priority	Frequency at which the data is read/written (as Slave1.Data)	uint8	7d82	32130	Not applicable
ModbusMaster.Slave2.Data.PV	Process value recieved from slave device	float32	7d75	32117	2dp
ModbusMaster.Slave2.Data.Scaling	Scaling in decimal places for non floating point data types	uint8	7d94	32148	Not applicable
ModbusMaster.Slave2.Data.Send	1 = send the write value to the slave	bool	7d8c	32140	Not applicable
ModbusMaster.Slave2.Data.Set	SSets a digital value to on (1) or off (0)	bool	7dfa	32250	Not applicable
ModbusMaster.Slave2.Data.SlaveDevice	Slave device to communicate with.	uint8	7d72	32114	Not applicable
ModbusMaster.Slave2.Data.Status	Transaction status (as for Slave 1)	uint8	7d8e	32142	Not applicable
ModbusMaster.Slave2.Data.Value	The value to be written to the slave device	float32	7d85	32133	2dp
ModbusMaster.Slave2.Main.CommsFailure	1 = a device communications failure	bool	7d98	32152	Not applicable
ModbusMaster.Slave2.Main.Descriptor	Device descriptor	string_t	6648	26184	Not applicable
ModbusMaster.Slave2.Main.HighPriority	High priority rate (as for Slave 1)	uint8	7b0d	31501	Not applicable
ModbusMaster.Slave2.Main.IPAddress	Internet Protocol (IP) address for a slave device	string_t	68e5	26853	Not applicable
ModbusMaster.Slave2.Main.LowPriority	Low priority rate (as for Slave 1)	uint8	7b11	31505	Not applicable
ModbusMaster.Slave2.Main.MaxBlockSize	Maximum amount of data in a single transaction	uint8	7b0b	31499	Not applicable
ModbusMaster.Slave2.Main.MediumPriority	Medium priority rate (as for Slave 1)	uint8	7b0f	31503	Not applicable
ModbusMaster.Slave2.Main.Online	Enables communications (0 = offline; 1 = online)	bool	7b01	31489	Not applicable
ModbusMaster.Slave2.Main.Profile	A profile that defines the device type (as Slave1.Data)	uint8	7b13	31507	Not applicable
ModbusMaster.Slave2.Main.Retries	Transaction retries	uint8	7b05	31493	Not applicable
ModbusMaster.Slave2.Main.SearchDevice	Initiates a slave search (0 = No; 1 = Yes)	bool	7d6e	32110	Not applicable
ModbusMaster.Slave2.Main.SearchResult	Current search status (as Slave1.Data)	uint8	7d70	32112	Not applicable
ModbusMaster.Slave2.Main.Timeout	Time in milliseconds the master will wait for a response	float32	7b08	31496	0dp
ModbusMaster.Slave2.Main.UnitId	Unit id for a slave device	uint8	7b03	31491	Not applicable
Mux8.1.Fallback	Fallback Strategy 0 = Clip Bad; 1 = Clip Good; 2 = Fallback Good 3 = Fallback Good; 4 = Up scale; 5 = Down scale.	uint8	2f66	12134	Not applicable
Mux8.1.FallbackVal	Fallback Value	float32	2f67	12135	1dp
Mux8.1.HighLimit	High Limit	float32	2f69	12137	1dp
Mux8.1.In1	Input 1	float32	2f6b	12139	1dp
Mux8.1.In2	Input 2	float32	2f6c	12140	1dp
Mux8.1.In3	Input 3	float32	2f6d	12141	1dp
Mux8.1.In4	Input 4	float32	2f6e	12142	1dp
Mux8.1.In5	Input 5	float32	2f6f	12143	1dp
Mux8.1.In6	Input 6	float32	2f70	12144	1dp
Mux8.1.In7	Input 7	float32	2f71	12145	1dp
Mux8.1.In8	Input 8	float32	2f72	12146	1dp
Mux8.1.LowLimit	Low Limit	float32	2f6a	12138	1dp
Mux8.1.Out	Output	float32	2f73	12147	Set by Mux8.1.Resolution
Mux8.1.Resolution	Resolution	uint8	2f75	12149	Not applicable
Mux8.1.Select	Input Selection Switch 1 to 8 = input 1 to 8 (respectively) selected for output	uint8	2f68	12136	Not applicable
Mux8.1.Status	Status. 0 = Good (OK); 7 = Bad (Error)	bool	2f74	12148	Not applicable
Mux8.2.Fallback	Fallback Strategy (as Mux8.1.Fallback)	uint8	2f76	12150	Not applicable
Mux8.2.FallbackVal	Fallback Value	float32	2f77	12151	1dp
Mux8.2.HighLimit	High Limit	float32	2f79	12153	1dp
Mux8.2.In1	Input 1	float32	2f7b	12155	1dp
Mux8.2.In2	Input 2	float32	2f7c	12156	1dp
Mux8.2.In3	Input 3	float32	2f7d	12157	1dp
Mux8.2.In4	Input 4	float32	2f7e	12158	1dp
Mux8.2.In5	Input 5	float32	2f7f	12159	1dp
Mux8.2.In6	Input 6	float32	2f80	12160	1dp
Mux8.2.In7	Input 7	float32	2f81	12161	1dp

5.3 PARAMETER LIST (Cont.)

Parameter path	Description	Type	Hex	Dec	Resolution
Mux8.2.In8	Input 8	float32	2f82	12162	1dp
Mux8.2.LowLimit	Low Limit	float32	2f7a	12154	1dp
Mux8.2.Out	Output	float32	2f83	12163	Set by Mux8.2.Resolution
Mux8.2.Resolution	Resolution	uint8	2f85	12165	Not applicable
Mux8.2.Select	Input Selection (as Mux8.1.Select)	uint8	2f78	12152	Not applicable
Mux8.2.Status	Status. 0 = Good (OK); 7 = Bad (Error)	bool	2f84	12164	Not applicable
Mux8.3.Fallback	Fallback Strategy (as Mux8.1.Fallback)	uint8	2f86	12166	Not applicable
Mux8.3.FallbackVal	Fallback Value	float32	2f87	12167	1dp
Mux8.3.HighLimit	High Limit	float32	2f89	12169	1dp
Mux8.3.In1	Input 1	float32	2f8b	12171	1dp
Mux8.3.In2	Input 2	float32	2f8c	12172	1dp
Mux8.3.In3	Input 3	float32	2f8d	12173	1dp
Mux8.3.In4	Input 4	float32	2f8e	12174	1dp
Mux8.3.In5	Input 5	float32	2f8f	12175	1dp
Mux8.3.In6	Input 6	float32	2f90	12176	1dp
Mux8.3.In7	Input 7	float32	2f91	12177	1dp
Mux8.3.In8	Input 8	float32	2f92	12178	1dp
Mux8.3.LowLimit	Low Limit	float32	2f8a	12170	1dp
Mux8.3.Out	Output	float32	2f93	12179	Set by Mux8.3.Resolution
Mux8.3.Resolution	Resolution	uint8	2f95	12181	Not applicable
Mux8.3.Select	Input Selection (as Mux8.1.Select)	uint8	2f88	12168	Not applicable
Mux8.3.Status	Status. 0 = Good (OK); 7 = Bad (Error)	bool	2f94	12180	Not applicable
Mux8.4.Fallback	Fallback Strategy (as Mux8.1.Fallback)	uint8	2f96	12182	Not applicable
Mux8.4.FallbackVal	Fallback Value	float32	2f97	12183	1dp
Mux8.4.HighLimit	High Limit	float32	2f99	12185	1dp
Mux8.4.In1	Input 1	float32	2f9b	12187	1dp
Mux8.4.In2	Input 2	float32	2f9c	12188	1dp
Mux8.4.In3	Input 3	float32	2f9d	12189	1dp
Mux8.4.In4	Input 4	float32	2f9e	12190	1dp
Mux8.4.In5	Input 5	float32	2f9f	12191	1dp
Mux8.4.In6	Input 6	float32	2fa0	12192	1dp
Mux8.4.In7	Input 7	float32	2fa1	12193	1dp
Mux8.4.In8	Input 8	float32	2fa2	12194	1dp
Mux8.4.LowLimit	Low Limit	float32	2f9a	12186	1dp
Mux8.4.Out	Output	float32	2fa3	12195	Set by Mux8.4.Resolution
Mux8.4.Resolution	Resolution	uint8	2fa5	12197	Not applicable
Mux8.4.Select	Input Selection (as Mux8.1.Select)	uint8	2f98	12184	Not applicable
Mux8.4.Status	Status. 0 = Good (OK); 7 = Bad (Error)	bool	2fa4	12196	Not applicable
nano_ui.Access	Access level 0 = Logged out; 1 = Operator; 2 = Supervisor; 3 = Engineer	uint8	2c00	11264	Not applicable
nano_ui.Password	Password	string_t	5400	21504	Not applicable
Network.Archive.ArchiveRate	Rate at which to archive history files 0 = None 1 = Every minute 2 = Hourly 3 = Daily 4 = Weekly 5 = Monthly 6 = Automatic	uint8	1114	4372	Not applicable
Network.Archive.CSVDateFormat	Date/Time format (0 = Text; 1 = spreadsheet numeric)	uint8	111d	4381	Not applicable
Network.Archive.CSVHeaders	Include header details (0 = No; 1 = Yes)	bool	111b	4379	Not applicable
Network.Archive.CSVHeadings	Include headings (0 = No; 1 = Yes)	bool	111c	4380	Not applicable
Network.Archive.CSVIncludeValues	Include process values (0 = No; 1 = Yes)	bool	1119	4377	Not applicable
Network.Archive.CSVMessages	Include messages (0 = No; 1 = Yes)	bool	111a	4378	Not applicable
Network.Archive.CSVTabDelimiter	Use Tab delimeter instead of comma (0 = No; 1 = Yes)	bool	111e	4382	Not applicable
Network.Archive.Destination	Archive destination. 0 = USB; 1 = FTP Server	uint8	1111	4369	Not applicable
Network.Archive.FileFormat	Archive file format (0 = Binary; 1 = CSV; 2 = both)	uint8	1115	4373	Not applicable
Network.Archive.MediaDuration	Time in days until the USB is full	float32	1118	4376	2dp
Network.Interface.Gateway	Default gateway internet protocol address	string_t	4524	17700	Not applicable
Network.Interface.IPaddress	Internet Protocol (IP) address of this instrument	string_t	4500	17664	Not applicable
Network.Interface.IPType	IP Lookup. 0 = DHCP, 1 = Fixed	uint8	1102	4354	Not applicable
Network.Interface.MAC	Media Access Control (MAC) address of this instrument	string_t	4548	17736	Not applicable
Network.Interface.SubnetMask	Sub network identification mask	string_t	4512	17682	Not applicable
Network.Modbus.Address	Modbus address for this instrument	uint8	1140	4416	Not applicable
Network.Modbus.InputTimeout	Modbus Input inactivity timeout (in seconds)	int16	1141	4417	Not applicable
Network.Modbus.PrefMasterIP	Preferred master IP	string_t	469c	18076	Not applicable
Network.Modbus.SerialMode	Modbus serial port mode	uint8	1143	4419	Not applicable
Network.Modbus.TimeFormat	Time parameter comms resolution	uint8	1144	4420	Not applicable
Network.Modbus.UnitIdEnable	Unit ident enable	uint8	1142	4418	Not applicable
OR.1.Input1	OR Block 1, input 1. 0 = off; 1 = on	bool	2d00	11520	Not applicable
OR.1.Input2	OR Block 1, input 2. 0 = off; 1 = on	bool	2d01	11521	Not applicable
OR.1.Input3	OR Block 1, input 3. 0 = off; 1 = on	bool	2d02	11522	Not applicable
OR.1.Input4	OR Block 1, input 4. 0 = off; 1 = on	bool	2d03	11523	Not applicable
OR.1.Input5	OR Block 1, input 5. 0 = off; 1 = on	bool	2d04	11524	Not applicable
OR.1.Input6	OR Block 1, input 6. 0 = off; 1 = on	bool	2d05	11525	Not applicable
OR.1.Input7	OR Block 1, input 7. 0 = off; 1 = on	bool	2d06	11526	Not applicable

5.3 PARAMETER LIST (Cont.)

Parameter path	Description	Type	Hex	Dec	Resolution
OR.1.Input8	OR Block 1, input 8. 0 = off; 1 = on	bool	2d07	11527	Not applicable
OR.1.Output	OR Block 1, output. 0 = off; 1 = on	bool	2d08	11528	Not applicable
OR.2.Input1	OR Block 2, input 1. 0 = off; 1 = on	bool	2d10	11536	Not applicable
OR.2.Input2	OR Block 2, input 2. 0 = off; 1 = on	bool	2d11	11537	Not applicable
OR.2.Input3	OR Block 2, input 3. 0 = off; 1 = on	bool	2d12	11538	Not applicable
OR.2.Input4	OR Block 2, input 4. 0 = off; 1 = on	bool	2d13	11539	Not applicable
OR.2.Input5	OR Block 2, input 5. 0 = off; 1 = on	bool	2d14	11540	Not applicable
OR.2.Input6	OR Block 2, input 6. 0 = off; 1 = on	bool	2d15	11541	Not applicable
OR.2.Input7	OR Block 2, input 7. 0 = off; 1 = on	bool	2d16	11542	Not applicable
OR.2.Input8	OR Block 2, input 8. 0 = off; 1 = on	bool	2d17	11543	Not applicable
OR.2.Output	OR Block 1, output. 0 = off; 1 = on	bool	2d18	11544	Not applicable
OR.3.Input1	OR Block 3, input 1. 0 = off; 1 = on	bool	2d20	11552	Not applicable
OR.3.Input2	OR Block 3, input 2. 0 = off; 1 = on	bool	2d21	11553	Not applicable
OR.3.Input3	OR Block 3, input 3. 0 = off; 1 = on	bool	2d22	11554	Not applicable
OR.3.Input4	OR Block 3, input 4. 0 = off; 1 = on	bool	2d23	11555	Not applicable
OR.3.Input5	OR Block 3, input 5. 0 = off; 1 = on	bool	2d24	11556	Not applicable
OR.3.Input6	OR Block 3, input 6. 0 = off; 1 = on	bool	2d25	11557	Not applicable
OR.3.Input7	OR Block 3, input 7. 0 = off; 1 = on	bool	2d26	11558	Not applicable
OR.3.Input8	OR Block 3, input 8. 0 = off; 1 = on	bool	2d27	11559	Not applicable
OR.3.Output	OR Block 3, output. 0 = off; 1 = on	bool	2d28	11560	Not applicable
OR.4.Input1	OR Block 4, input 1. 0 = off; 1 = on	bool	2d30	11568	Not applicable
OR.4.Input2	OR Block 4, input 2. 0 = off; 1 = on	bool	2d31	11569	Not applicable
OR.4.Input3	OR Block 4, input 3. 0 = off; 1 = on	bool	2d32	11570	Not applicable
OR.4.Input4	OR Block 4, input 4. 0 = off; 1 = on	bool	2d33	11571	Not applicable
OR.4.Input5	OR Block 4, input 5. 0 = off; 1 = on	bool	2d34	11572	Not applicable
OR.4.Input6	OR Block 4, input 6. 0 = off; 1 = on	bool	2d35	11573	Not applicable
OR.4.Input7	OR Block 4, input 7. 0 = off; 1 = on	bool	2d36	11574	Not applicable
OR.4.Input8	OR Block 4, input 8. 0 = off; 1 = on	bool	2d37	11575	Not applicable
OR.4.Output	OR Block 4, output. 0 = off; 1 = on	bool	2d38	11576	Not applicable
OR.5.Input1	OR Block 5, input 1. 0 = off; 1 = on	bool	2d40	11584	Not applicable
OR.5.Input2	OR Block 5, input 2. 0 = off; 1 = on	bool	2d41	11585	Not applicable
OR.5.Input3	OR Block 5, input 3. 0 = off; 1 = on	bool	2d42	11586	Not applicable
OR.5.Input4	OR Block 5, input 4. 0 = off; 1 = on	bool	2d43	11587	Not applicable
OR.5.Input5	OR Block 5, input 5. 0 = off; 1 = on	bool	2d44	11588	Not applicable
OR.5.Input6	OR Block 5, input 6. 0 = off; 1 = on	bool	2d45	11589	Not applicable
OR.5.Input7	OR Block 5, input 7. 0 = off; 1 = on	bool	2d46	11590	Not applicable
OR.5.Input8	OR Block 5, input 8. 0 = off; 1 = on	bool	2d47	11591	Not applicable
OR.5.Output	OR Block 5, output. 0 = off; 1 = on	bool	2d48	11592	Not applicable
OR.6.Input1	OR Block 6, input 1. 0 = off; 1 = on	bool	2d50	11600	Not applicable
OR.6.Input2	OR Block 6, input 2. 0 = off; 1 = on	bool	2d51	11601	Not applicable
OR.6.Input3	OR Block 6, input 3. 0 = off; 1 = on	bool	2d52	11602	Not applicable
OR.6.Input4	OR Block 6, input 4. 0 = off; 1 = on	bool	2d53	11603	Not applicable
OR.6.Input5	OR Block 6, input 5. 0 = off; 1 = on	bool	2d54	11604	Not applicable
OR.6.Input6	OR Block 6, input 6. 0 = off; 1 = on	bool	2d55	11605	Not applicable
OR.6.Input7	OR Block 6, input 7. 0 = off; 1 = on	bool	2d56	11606	Not applicable
OR.6.Input8	OR Block 6, input 8. 0 = off; 1 = on	bool	2d57	11607	Not applicable
OR.6.Output	OR Block 6, output. 0 = off; 1 = on	bool	2d58	11608	Not applicable
OR.7.Input1	OR Block 7, input 1. 0 = off; 1 = on	bool	2d60	11616	Not applicable
OR.7.Input2	OR Block 7, input 2. 0 = off; 1 = on	bool	2d61	11617	Not applicable
OR.7.Input3	OR Block 7, input 3. 0 = off; 1 = on	bool	2d62	11618	Not applicable
OR.7.Input4	OR Block 7, input 4. 0 = off; 1 = on	bool	2d63	11619	Not applicable
OR.7.Input5	OR Block 7, input 5. 0 = off; 1 = on	bool	2d64	11620	Not applicable
OR.7.Input6	OR Block 7, input 6. 0 = off; 1 = on	bool	2d65	11621	Not applicable
OR.7.Input7	OR Block 7, input 7. 0 = off; 1 = on	bool	2d66	11622	Not applicable
OR.7.Input8	OR Block 7, input 8. 0 = off; 1 = on	bool	2d67	11623	Not applicable
OR.7.Output	OR Block 7, output. 0 = off; 1 = on	bool	2d68	11624	Not applicable
OR.8.Input1	OR Block 8, input 1. 0 = off; 1 = on	bool	2d70	11632	Not applicable
OR.8.Input2	OR Block 8, input 2. 0 = off; 1 = on	bool	2d71	11633	Not applicable
OR.8.Input3	OR Block 8, input 3. 0 = off; 1 = on	bool	2d72	11634	Not applicable
OR.8.Input4	OR Block 8, input 4. 0 = off; 1 = on	bool	2d73	11635	Not applicable
OR.8.Input5	OR Block 8, input 5. 0 = off; 1 = on	bool	2d74	11636	Not applicable
OR.8.Input6	OR Block 8, input 6. 0 = off; 1 = on	bool	2d75	11637	Not applicable
OR.8.Input7	OR Block 8, input 7. 0 = off; 1 = on	bool	2d76	11638	Not applicable
OR.8.Input8	OR Block 8, input 8. 0 = off; 1 = on	bool	2d77	11639	Not applicable
OR.8.Output	OR Block 8, output. 0 = off; 1 = on	bool	2d78	11640	Not applicable
OR.9.Input1	OR Block 9, input 1. 0 = off; 1 = on	bool	2d80	11648	Not applicable
OR.9.Input2	OR Block 9, input 2. 0 = off; 1 = on	bool	2d81	11649	Not applicable
OR.9.Input3	OR Block 9, input 3. 0 = off; 1 = on	bool	2d82	11650	Not applicable
OR.9.Input4	OR Block 9, input 4. 0 = off; 1 = on	bool	2d83	11651	Not applicable
OR.9.Input5	OR Block 9, input 5. 0 = off; 1 = on	bool	2d84	11652	Not applicable
OR.9.Input6	OR Block 9, input 6. 0 = off; 1 = on	bool	2d85	11653	Not applicable
OR.9.Input7	OR Block 9, input 7. 0 = off; 1 = on	bool	2d86	11654	Not applicable
OR.9.Input8	OR Block 9, input 8. 0 = off; 1 = on	bool	2d87	11655	Not applicable
OR.9.Output	OR Block 9, output. 0 = off; 1 = on	bool	2d88	11656	Not applicable
OR.10.Input1	OR Block 10, input 1. 0 = off; 1 = on	bool	2d90	11664	Not applicable
OR.10.Input2	OR Block 10, input 2. 0 = off; 1 = on	bool	2d91	11665	Not applicable
OR.10.Input3	OR Block 10, input 3. 0 = off; 1 = on	bool	2d92	11666	Not applicable
OR.10.Input4	OR Block 10, input 4. 0 = off; 1 = on	bool	2d93	11667	Not applicable
OR.10.Input5	OR Block 10, input 5. 0 = off; 1 = on	bool	2d94	11668	Not applicable
OR.10.Input6	OR Block 10, input 6. 0 = off; 1 = on	bool	2d95	11669	Not applicable
OR.10.Input7	OR Block 10, input 7. 0 = off; 1 = on	bool	2d96	11670	Not applicable

5.3 PARAMETER LIST (Cont.)

Parameter path	Description	Type	Hex	Dec	Resolution
OR.10.Input8	OR Block 10, input 8. 0 = off; 1 = on	bool	2d97	11671	Not applicable
OR.10.Output	OR Block 10, output. 0 = off; 1 = on	bool	2d98	11672	Not applicable
OR.11.Input1	OR Block 11, input 1. 0 = off; 1 = on	bool	2da0	11680	Not applicable
OR.11.Input2	OR Block 11, input 2. 0 = off; 1 = on	bool	2da1	11681	Not applicable
OR.11.Input3	OR Block 11, input 3. 0 = off; 1 = on	bool	2da2	11682	Not applicable
OR.11.Input4	OR Block 11, input 4. 0 = off; 1 = on	bool	2da3	11683	Not applicable
OR.11.Input5	OR Block 11, input 5. 0 = off; 1 = on	bool	2da4	11684	Not applicable
OR.11.Input6	OR Block 11, input 6. 0 = off; 1 = on	bool	2da5	11685	Not applicable
OR.11.Input7	OR Block 11, input 7. 0 = off; 1 = on	bool	2da6	11686	Not applicable
OR.11.Input8	OR Block 11, input 8. 0 = off; 1 = on	bool	2da7	11687	Not applicable
OR.11.Output	OR Block 11, output. 0 = off; 1 = on	bool	2da8	11688	Not applicable
OR.12.Input1	OR Block 12, input 1. 0 = off; 1 = on	bool	2db0	11696	Not applicable
OR.12.Input2	OR Block 12, input 2. 0 = off; 1 = on	bool	2db1	11697	Not applicable
OR.12.Input3	OR Block 12, input 3. 0 = off; 1 = on	bool	2db2	11698	Not applicable
OR.12.Input4	OR Block 12, input 4. 0 = off; 1 = on	bool	2db3	11699	Not applicable
OR.12.Input5	OR Block 12, input 5. 0 = off; 1 = on	bool	2db4	11700	Not applicable
OR.12.Input6	OR Block 12, input 6. 0 = off; 1 = on	bool	2db5	11701	Not applicable
OR.12.Input7	OR Block 12, input 7. 0 = off; 1 = on	bool	2db6	11702	Not applicable
OR.12.Input8	OR Block 12, input 8. 0 = off; 1 = on	bool	2db7	11703	Not applicable
OR.12.Output	OR Block 12, output. 0 = off; 1 = on	bool	2db8	11704	Not applicable
Program.Ch1Holdback	Channel 1 holdback type 0 = Off 1 = Low 2 = High 3 = Band	uint8	3aa1	15009	Not applicable
Program.Ch1HoldbackVal	Channel 1 holdback value	float32	3aa3	15011	Same as Programmer.SetUp.Ch1PVInput
Program.Ch1RampUnits	Channel 1 ramp units	uint8	3aa6	15014	Not applicable
Program.Ch2Holdback	Channel 2 holdback type (as for Program.Ch1, above)	uint8	3aa2	15010	Not applicable
Program.Ch2HoldbackVal	Channel 2 holdback value	float32	3aa4	15012	Same as Programmer.SetUp.Ch2PVInput
Program.Ch2RampUnits	Channel 2 ramp units	uint8	3aa7	15015	Not applicable
Program.HoldbackStyle	Holdback style (0 = per segment; 1 = per program)	uint8	3aa0	15008	Not applicable
Program.Program	Program	string_t	6abb	27323	Not applicable
Program.RampStyle	Ramp style (0 = Time; 1 = Rate)	uint8	3aa5	15013	Not applicable
Programmer.Features.FTPStore	FTP store feature enable	bool	3a04	14852	Not applicable
Programmer.Features.Holdback	Holdback feature enable	bool	3a00	14848	Not applicable
Programmer.Features.Messages	Messages feature enable	bool	3a03	14851	Not applicable
Programmer.Features.PVEvent	PV Event feature enable	bool	3a01	14849	Not applicable
Programmer.Features.UserValue	User value feature enable	bool	3a02	14850	Not applicable
Programmer.FileList.Filename1	Filename	string_t	7900	30976	Not applicable
Programmer.FileList.Filename2	Filename	string_t	7901	30977	Not applicable
Programmer.FileList.Filename3	Filename	string_t	7902	30978	Not applicable
Programmer.FileList.Filename4	Filename	string_t	7903	30979	Not applicable
Programmer.FileList.Filename5	Filename	string_t	7904	30980	Not applicable
Programmer.FileList.Filename6	Filename	string_t	7905	30981	Not applicable
Programmer.FileList.Filename7	Filename	string_t	7906	30982	Not applicable
Programmer.FileList.Filename8	Filename	string_t	7907	30983	Not applicable
Programmer.FileList.Filename9	Filename	string_t	7908	30984	Not applicable
Programmer.FileList.Filename10	Filename	string_t	7909	30985	Not applicable
Programmer.FileList.Filename11	Filename	string_t	790a	30986	Not applicable
Programmer.FileList.Filename12	Filename	string_t	790b	30987	Not applicable
Programmer.FileList.Filename13	Filename	string_t	790c	30988	Not applicable
Programmer.FileList.Filename14	Filename	string_t	790d	30989	Not applicable
Programmer.FileList.Filename15	Filename	string_t	790e	30990	Not applicable
Programmer.FileList.Filename16	Filename	string_t	790f	30991	Not applicable
Programmer.FileList.Filename17	Filename	string_t	7910	30992	Not applicable
Programmer.FileList.Filename18	Filename	string_t	7911	30993	Not applicable
Programmer.FileList.Filename19	Filename	string_t	7912	30994	Not applicable
Programmer.FileList.Filename20	Filename	string_t	7913	30995	Not applicable
Programmer.FileList.Filename21	Filename	string_t	7914	30996	Not applicable
Programmer.FileList.Filename22	Filename	string_t	7915	30997	Not applicable
Programmer.FileList.Filename23	Filename	string_t	7916	30998	Not applicable
Programmer.FileList.Filename24	Filename	string_t	7917	30999	Not applicable
Programmer.FileList.Filename25	Filename	string_t	7918	31000	Not applicable
Programmer.FileList.Filename26	Filename	string_t	7919	31001	Not applicable
Programmer.FileList.Filename27	Filename	string_t	791a	31002	Not applicable
Programmer.FileList.Filename28	Filename	string_t	791b	31003	Not applicable
Programmer.FileList.Filename29	Filename	string_t	791c	31004	Not applicable
Programmer.FileList.Filename30	Filename	string_t	791d	31005	Not applicable
Programmer.FileList.Filename31	Filename	string_t	791e	31006	Not applicable
Programmer.FileList.Filename32	Filename	string_t	791f	31007	Not applicable
Programmer.FileList.Filename33	Filename	string_t	7920	31008	Not applicable
Programmer.FileList.Filename34	Filename	string_t	7921	31009	Not applicable
Programmer.FileList.Filename35	Filename	string_t	7922	31010	Not applicable
Programmer.FileList.Filename36	Filename	string_t	7923	31011	Not applicable
Programmer.FileList.Filename37	Filename	string_t	7924	31012	Not applicable
Programmer.FileList.Filename38	Filename	string_t	7925	31013	Not applicable
Programmer.FileList.Filename39	Filename	string_t	7926	31014	Not applicable
Programmer.FileList.Filename40	Filename	string_t	7927	31015	Not applicable
Programmer.FileList.Filename41	Filename	string_t	7928	31016	Not applicable
Programmer.FileList.Filename42	Filename	string_t	7929	31017	Not applicable
Programmer.FileList.Filename43	Filename	string_t	792a	31018	Not applicable
Programmer.FileList.Filename44	Filename	string_t	792b	31019	Not applicable

5.3 PARAMETER LIST (Cont.)

Parameter path	Description	Type	Hex	Dec	Resolution
Programmer.FileList.Filename45	Filename	string_t	792c	31020	Not applicable
Programmer.FileList.Filename46	Filename	string_t	792d	31021	Not applicable
Programmer.FileList.Filename47	Filename	string_t	792e	31022	Not applicable
Programmer.FileList.Filename48	Filename	string_t	792f	31023	Not applicable
Programmer.FileList.Filename49	Filename	string_t	7930	31024	Not applicable
Programmer.FileList.Filename50	Filename	string_t	7931	31025	Not applicable
Programmer.FileList.Filename51	Filename	string_t	7932	31026	Not applicable
Programmer.FileList.Filename52	Filename	string_t	7933	31027	Not applicable
Programmer.FileList.Filename53	Filename	string_t	7934	31028	Not applicable
Programmer.FileList.Filename54	Filename	string_t	7935	31029	Not applicable
Programmer.FileList.Filename55	Filename	string_t	7936	31030	Not applicable
Programmer.FileList.Filename56	Filename	string_t	7937	31031	Not applicable
Programmer.FileList.Filename57	Filename	string_t	7938	31032	Not applicable
Programmer.FileList.Filename58	Filename	string_t	7939	31033	Not applicable
Programmer.FileList.Filename59	Filename	string_t	793a	31034	Not applicable
Programmer.FileList.Filename60	Filename	string_t	793b	31035	Not applicable
Programmer.FileList.Filename61	Filename	string_t	793c	31036	Not applicable
Programmer.FileList.Filename62	Filename	string_t	793d	31037	Not applicable
Programmer.FileList.Filename63	Filename	string_t	793e	31038	Not applicable
Programmer.FileList.Filename64	Filename	string_t	793f	31039	Not applicable
Programmer.FileList.Filename65	Filename	string_t	7940	31040	Not applicable
Programmer.FileList.Filename66	Filename	string_t	7941	31041	Not applicable
Programmer.FileList.Filename67	Filename	string_t	7942	31042	Not applicable
Programmer.FileList.Filename68	Filename	string_t	7943	31043	Not applicable
Programmer.FileList.Filename69	Filename	string_t	7944	31044	Not applicable
Programmer.FileList.Filename70	Filename	string_t	7945	31045	Not applicable
Programmer.FileList.Filename71	Filename	string_t	7946	31046	Not applicable
Programmer.FileList.Filename72	Filename	string_t	7947	31047	Not applicable
Programmer.FileList.Filename73	Filename	string_t	7948	31048	Not applicable
Programmer.FileList.Filename74	Filename	string_t	7949	31049	Not applicable
Programmer.FileList.Filename75	Filename	string_t	794a	31050	Not applicable
Programmer.FileList.Filename76	Filename	string_t	794b	31051	Not applicable
Programmer.FileList.Filename77	Filename	string_t	794c	31052	Not applicable
Programmer.FileList.Filename78	Filename	string_t	794d	31053	Not applicable
Programmer.FileList.Filename79	Filename	string_t	794e	31054	Not applicable
Programmer.FileList.Filename80	Filename	string_t	794f	31055	Not applicable
Programmer.FileList.Filename81	Filename	string_t	7950	31056	Not applicable
Programmer.FileList.Filename82	Filename	string_t	7951	31057	Not applicable
Programmer.FileList.Filename83	Filename	string_t	7952	31058	Not applicable
Programmer.FileList.Filename84	Filename	string_t	7953	31059	Not applicable
Programmer.FileList.Filename85	Filename	string_t	7954	31060	Not applicable
Programmer.FileList.Filename86	Filename	string_t	7955	31061	Not applicable
Programmer.FileList.Filename87	Filename	string_t	7956	31062	Not applicable
Programmer.FileList.Filename88	Filename	string_t	7957	31063	Not applicable
Programmer.FileList.Filename89	Filename	string_t	7958	31064	Not applicable
Programmer.FileList.Filename90	Filename	string_t	7959	31065	Not applicable
Programmer.FileList.Filename91	Filename	string_t	795a	31066	Not applicable
Programmer.FileList.Filename92	Filename	string_t	795b	31067	Not applicable
Programmer.FileList.Filename93	Filename	string_t	795c	31068	Not applicable
Programmer.FileList.Filename94	Filename	string_t	795d	31069	Not applicable
Programmer.FileList.Filename95	Filename	string_t	795e	31070	Not applicable
Programmer.FileList.Filename96	Filename	string_t	795f	31071	Not applicable
Programmer.FileList.Filename97	Filename	string_t	7960	31072	Not applicable
Programmer.FileList.Filename98	Filename	string_t	7961	31073	Not applicable
Programmer.FileList.Filename99	Filename	string_t	7962	31074	Not applicable
Programmer.FileList.Filename100	Filename	string_t	7963	31075	Not applicable
Programmer.FileList.FilenameEntry	Filename of the program to loaded or stored	string_t	6a91	27281	Not applicable
Programmer.FileList.Operation	Operation (0 = Complete; 1 = Get listing; 2 = iTools only)	uint8	3a80	14976	Not applicable
Programmer.FileList.RefreshList	Refresh list (0 = No; 1 = Yes)	bool	3a81	14977	Not applicable
Programmer.FTP.IPAddress	Internet Protocol address	string_t	698c	27020	Not applicable
Programmer.FTP.Password	Password	string_t	6a2c	27180	Not applicable
Programmer.FTP.Username	Username	string_t	6a03	27139	Not applicable
Programmer.Run.Ch1PSP	Channel 1 programmer set-point	float32	3a53	14931	Same as Programmer.SetUp.Ch1PVInput
Programmer.Run.Ch1PVEvent	Channel 1 PV event (0 = Off; 1 = On)	bool	3a6c	14956	Not applicable
Programmer.Run.Ch1Rate	Channel 1 rate	float32	3a5e	14942	Set by Programmer.SetUp.RateResolution
Programmer.Run.Ch1Time	Channel 1 time	time_t	3a5c	14940	Set by Network.Modbus.TimeFormat
Programmer.Run.Ch1TSP	Channel 1 target set-point	float32	3a5a	14938	Same as Programmer.SetUp.Ch1PVInput
Programmer.Run.Ch1UserVal	Channel 1 user value	float32	3a6a	14954	0dp
Programmer.Run.Ch2PSP	Channel 2 programmer set-point	float32	3a54	14932	Same as Programmer.SetUp.Ch2PVInput
Programmer.Run.Ch2PVEvent	Channel 2 PV event (0 = Off; 1 = On)	bool	3a6d	14957	Not applicable
Programmer.Run.Ch2Rate	Channel 2 rate	float32	3a5f	14943	Set by Programmer.SetUp.RateResolution
Programmer.Run.Ch2Time	Channel 2 time	time_t	3a5d	14941	Set by Network.Modbus.TimeFormat
Programmer.Run.Ch2TSP	Channel 2 target set-point	float32	3a5b	14939	Same as Programmer.SetUp.Ch2PVInput
Programmer.Run.Ch2UserVal	Channel 2 user value	float32	3a6b	14955	0dp
Programmer.Run.CyclesLeft	Cycles left (-1 = continuous)	int16	3a60	14944	Not applicable
Programmer.Run.Duration	Duration	time_t	3a59	14937	Set by Network.Modbus.TimeFormat
Programmer.Run.EndOutput	End output (0 = Off; 1 = On)	bool	3a61	14945	Not applicable
Programmer.Run.Event1	Event 1 (0 = Off; 1 = On)	bool	3a62	14946	Not applicable
Programmer.Run.Event2	Event 2 (0 = Off; 1 = On)	bool	3a63	14947	Not applicable
Programmer.Run.Event3	Event 3 (0 = Off; 1 = On)	bool	3a64	14948	Not applicable
Programmer.Run.Event4	Event 4 (0 = Off; 1 = On)	bool	3a65	14949	Not applicable

5.3 PARAMETER LIST (Cont.)

Parameter path	Description	Type	Hex	Dec	Resolution
Programmer.Run.Event5	Event 5 (0 = Off; 1 = On)	bool	3a66	14950	Not applicable
Programmer.Run.Event6	Event 6 (0 = Off; 1 = On)	bool	3a67	14951	Not applicable
Programmer.Run.Event7	Event 7 (0 = Off; 1 = On)	bool	3a68	14952	Not applicable
Programmer.Run.Event8	Event 8 (0 = Off; 1 = On)	bool	3a69	14953	Not applicable
Programmer.Run.Intervention	Intervention 0 = No Program 1 = None 2 = User intervention 4 = PV Event	uint8	3a6f	14959	Not applicable
Programmer.Run.Mode	Mode (1 = Reset; 2 = Run; 4 = Hold)	uint8	3a50	14928	Not applicable
Programmer.Run.ProgTimeLeft	Program time left	time_t	3a57	14935	Set by Network.Modbus.TimeFormat
Programmer.Run.ProgTimeRunning	Program time running	time_t	3a70	14960	Set by Network.Modbus.TimeFormat
Programmer.Run.ProgTimeSpent	Program time spent	time_t	3a58	14936	Set by Network.Modbus.TimeFormat
Programmer.Run.Segment	Segment	string_t	6aa6	27302	Not applicable
Programmer.Run.SegmentType	Segment type 0 = End 1 = Ramp 2 = Dwell 3 = Step 4 = Wait 5 = Go back	uint8	3a52	14930	Not applicable
Programmer.Run.SegTimeLeft	Segment time left	time_t	3a55	14933	Set by Network.Modbus.TimeFormat
Programmer.Run.SegTimeRun	Segment time run	time_t	3a56	14934	Set by Network.Modbus.TimeFormat
Programmer.Run.Status	Status 1 = Reset 2 = Running 4 = Holding 8 = Holdback 16 = Waiting 32 = Complete	uint8	3a51	14929	Not applicable
Programmer.SetUp.Advance	Advance (0 = No 1 = Yes)	bool	3a42	14914	Not applicable
Programmer.SetUp.Amended	Amended (0 = No 1 = Yes)	bool	3a44	14916	Not applicable
Programmer.SetUp.Ch1PVInput	Channel 1 PV input	float32	3a26	14886	Set by Programmer.SetUp.Ch1Resolution
Programmer.SetUp.Ch1Resolution	Channel 1 Resolution	uint8	3a46	14918	Not applicable
Programmer.SetUp.Ch1ServoTo	Channel 1 servo to (0 = PV; 1 = SP)	uint8	3a2a	14890	Not applicable
Programmer.SetUp.Ch1SPInput	Channel 1 SP input	float32	3a28	14888	0dp
Programmer.SetUp.Ch1Units	Channel 1 units	string_t	6a85	27269	Not applicable
Programmer.SetUp.Ch2PVInput	Channel 2 PV input	float32	3a27	14887	Set by Programmer.SetUp.Ch2Resolution
Programmer.SetUp.Ch2Resolution	Channel 2 Resolution	uint8	3a47	14919	Not applicable
Programmer.SetUp.Ch2ServoTo	Channel 2 servo to (0 = PV; 1 = SP)	uint8	3a2b	14891	Not applicable
Programmer.SetUp.Ch2SPInput	Channel 2 SP input	float32	3a29	14889	0dp
Programmer.SetUp.Ch2Units	Channel 2 units	string_t	6a8b	27275	Not applicable
Programmer.SetUp.Channels	Number of channels	uint8	3a20	14880	Not applicable
Programmer.SetUp.FileErrorStatus	File error status 0 = Busy 1 = OK 2 = Load open file 3 = Store open file 4 =Delete fail 5 = Copy fail 6 = Invalid format 7 = Invalid device 8 = Invalid version 9 = Invalid number of channels 10 = Parameter write failed 11 = Store operation failed to complete 12 = Load operation failed to complete 13 = Delete operation failed to complete 14 = Copy operation failed to complete 15 = Invalid filename entered or selected 16 = General file operation error 17 = Would result in more than the ma.x no. of program files	uint8	3a45	14917	Not applicable
Programmer.SetUp.Hold	Hold (0 = No 1 = Yes)	bool	3a39	14905	Not applicable
Programmer.SetUp.MaxEvents	Maximum events	uint8	3a2d	14893	Not applicable
Programmer.SetUp.Operation	Operation 1 = Select 2 =Load 4 = Store 8 = Delete 16 = Delete All 32=Copy 64 = Copy All	uint8	3a40	14912	Not applicable
Programmer.SetUp.PowerFailAction	Power fail action (0 = ramp back; 1 = Reset; 2 = Continue)	uint8	3a2c	14892	Not applicable
Programmer.SetUp.ProgEditAccess	Program edit access level 0 = Logged out 1 = Operator 2 = Supervisor 3 = Engineer	uint8	3a22	14882	Not applicable
Programmer.SetUp.ProgModeAccess	Program mode access level (as Program Edit Access, above)	uint8	3a21	14881	Not applicable
Programmer.SetUp.ProgStoreAccess	Program store access level (as Program Edit Access, above)	uint8	3a23	14883	Not applicable
Programmer.SetUp.RateResolution	Rate resolution	uint8	3a24	14884	Not applicable
Programmer.SetUp.Reset	Reset (0 = No 1 = Yes)	bool	3a3a	14906	Not applicable
Programmer.SetUp.ResetCh1UserVal	Reset channel 1 user value	float32	3a36	14902	1dp
Programmer.SetUp.ResetCh2UserVal	Reset channel 2 user value	float32	3a37	14903	1dp
Programmer.SetUp.ResetEvent1	Reset event 1 (0 = Off, 1 = On)	bool	3a2e	14894	Not applicable
Programmer.SetUp.ResetEvent2	Reset event 2 (0 = Off, 1 = On)	bool	3a2f	14895	Not applicable
Programmer.SetUp.ResetEvent3	Reset event 3 (0 = Off, 1 = On)	bool	3a30	14896	Not applicable
Programmer.SetUp.ResetEvent4	Reset event 4 (0 = Off, 1 = On)	bool	3a31	14897	Not applicable
Programmer.SetUp.ResetEvent5	Reset event 5 (0 = Off, 1 = On)	bool	3a32	14898	Not applicable
Programmer.SetUp.ResetEvent6	Reset event 6 (0 = Off, 1 = On)	bool	3a33	14899	Not applicable
Programmer.SetUp.ResetEvent7	Reset event 7 (0 = Off, 1 = On)	bool	3a34	14900	Not applicable
Programmer.SetUp.ResetEvent8	Reset event 8 (0 = Off, 1 = On)	bool	3a35	14901	Not applicable
Programmer.SetUp.Run	Run (0 = No 1 = Yes)	bool	3a38	14904	Not applicable
Programmer.SetUp.RunHold	Run Hold (0 = No 1 = Yes)	bool	3a3c	14908	Not applicable
Programmer.SetUp.RunReset	Run Rese (0 = No 1 = Yes)t	bool	3a3b	14907	Not applicable
Programmer.SetUp.Status	Status 0 = Inactive 1 = Success 2 = Failed 3 = Loading 4 = Storing 5 = Deleting 6 = Copying	uint8	3a41	14913	Not applicable
Programmer.SetUp.WaitAnalog1	Wait analog input 1	float32	3a3e	14910	0dp
Programmer.SetUp.WaitAnalog2	Wait analog input 2	float32	3a3f	14911	0dp
Programmer.SetUp.WaitDigital	Wait Digital (0 = Off 1 = On)	bool	3a3d	14909	Not applicable
RealTimeEvent.1.Duration	Sets the duration for the event to remain On	time_t	30e6	12518	Set by Network.Modbus.TimeFormat

5.3 PARAMETER LIST (Cont.)

Parameter path	Description	Type	Hex	Dec	Resolution
RealTimeEvent.1.OffDate	Sets the date in the month that the event is to switch off	uint8	30e8	12520	Not applicable
RealTimeEvent.1.OffDay	Sets the day the the event is to switch Off 0 = Sunday 1 = Monday 2 = Tuesday 3 = Wednesday 4 = Thursday 5 = Friday 6 = Saturday 7 = Monday to Friday 8 = Saturday to Sunday 9 = Every day	uint8	30e9	12521	Not applicable
RealTimeEvent.1.OffMonth	The month number when the event is to switch off	uint8	30e7	12519	Not applicable
RealTimeEvent.1.OffTime	Sets the time that the event is to switch Off	time_t	30ea	12522	Set by Network.Modbus.TimeFormat
RealTimeEvent.1.OffType	0 = Duration; 1 = Time	uint8	30e5	12517	Not applicable
RealTimeEvent.1.OnDate	Sets the date in the month that the event is to switch on	uint8	30e2	12514	Not applicable
RealTimeEvent.1.OnDay	Sets the day on which event is to switch on (as 'OffDay', above)	uint8	30e3	12515	Not applicable
RealTimeEvent.1.OnMonth	The month number when the event is to switch on	uint8	30e1	12513	Not applicable
RealTimeEvent.1.OnTime	Sets the time that the event is to switch On	time_t	30e4	12516	Set by Network.Modbus.TimeFormat
RealTimeEvent.1.Output	The output from the real time event (0 = Off; 1 = On)	bool	30eb	12523	Not applicable
RealTimeEvent.1.Type	Selects the type of Real Time Event 0 = Off 1 = Time and Day 2 = Time and Date	uint8	30e0	12512	Not applicable
RealTimeEvent.2.Duration	Sets the duration for the event to remain On	time_t	30f6	12534	Set by Network.Modbus.TimeFormat
RealTimeEvent.2.OffDate	Sets the date in the month that the event is to switch off	uint8	30f8	12536	Not applicable
RealTimeEvent.2.OffDay	Sets the day the the event is to switch Off (as for Event 1)	uint8	30f9	12537	Not applicable
RealTimeEvent.2.OffMonth	Sets the month that the event is to switch off	uint8	30f7	12535	Not applicable
RealTimeEvent.2.OffTime	Sets the time that the event is to switch Off	time_t	30fa	12538	Set by Network.Modbus.TimeFormat
RealTimeEvent.2.OffType	Selects the type that will switch off the event (as for Event 1)	uint8	30f5	12533	Not applicable
RealTimeEvent.2.OnDate	Sets the date in the month that the event is to switch on	uint8	30f2	12530	Not applicable
RealTimeEvent.2.OnDay	Sets the day the event is to switch on (as for Event 1)	uint8	30f3	12531	Not applicable
RealTimeEvent.2.OnMonth	Sets the month that the event is to switch on	uint8	30f1	12529	Not applicable
RealTimeEvent.2.OnTime	Sets the time that the event is to switch On	time_t	30f4	12532	Set by Network.Modbus.TimeFormat
RealTimeEvent.2.Output	The output from the real time event (0 = Off; 1 = On)	bool	30fb	12539	Not applicable
RealTimeEvent.2.Type	Selects the type of Real Time Event 0 = Off 1 = Time and Day 2 = Time and Date	uint8	30f0	12528	Not applicable
Segment.1.Ch1Holdback	Channel 1 holdback type 0 = Off 1 = Low 2= High 3 = Band	uint8	3ac9	15049	Not applicable
Segment.1.Ch1HoldbackVal	Channel 1 holdback value	float32	3acb	15051	Same as Programmer.SetUp.Ch1PVInput
Segment.1.Ch1PVEvent	Channel 1 PV event 0 = Off 1 = Absolute High 2 = Absolute Low 3 = Deviation High 4 = Deviation Low 5 = Deviation Band	uint8	3ad4	15060	Not applicable
Segment.1.Ch1PVEventUse	Channel 1 PV event use (0 = Trigger; 1 = Alarm)	bool	3ae2	15074	Not applicable
Segment.1.Ch1PVEventVal	Channel 1 PV event value	float32	3ad6	15062	Same as Programmer.SetUp.Ch1PVInput
Segment.1.Ch1Rate	Channel 1 rate	float32	3ac6	15046	Set by Programmer.SetUp.RateResolution
Segment.1.Ch1Time	Channel 1 time	time_t	3ac4	15044	Set by Network.Modbus.TimeFormat
Segment.1.Ch1TSP	Channel 1 target set-point	float32	3ac2	15042	Same as Programmer.SetUp.Ch1PVInput
Segment.1.Ch1UserVal	Channel 1 user value	float32	3ad8	15064	Same as Programmer.SetUp.ResetCh1UserVal
Segment.1.Ch1Wait	Channel 1 Wait (Analogue 1 criterion) 1= Abs high 2 = Abs low 3 = Dev high 4 = Dev Low	uint8	3ace	15054	Not applicable
Segment.1.Ch1WaitVal	Channel 1 wait value	float32	3ad0	15056	Same as Programmer.SetUp.PVWait1
Segment.1.Ch2Holdback	Channel 2 holdback type (as for Ch1Holdback, above)	uint8	3aca	15050	Not applicable
Segment.1.Ch2HoldbackVal	Channel 2 holdback value	float32	3acc	15052	Same as Programmer.SetUp.Ch2PVInput
Segment.1.Ch2PVEvent	Channel 2 PV event (as for Ch1PVEvent, above)	uint8	3ad5	15061	Not applicable
Segment.1.Ch2PVEventUse	Channel 2 PV event use (as for Ch1PVEventUse, above)	bool	3ae3	15075	Not applicable
Segment.1.Ch2PVEventVal	Channel 2 PV event value	float32	3ad7	15063	Same as Programmer.SetUp.Ch2PVInput
Segment.1.Ch2Rate	Channel 2 rate	float32	3ac7	15047	Set by Programmer.SetUp.RateResolution
Segment.1.Ch2Time	Channel 2 time	time_t	3ac5	15045	Set by Network.Modbus.TimeFormat
Segment.1.Ch2TSP	Channel 2 target set-point	float32	3ac3	15043	Same as Programmer.SetUp.Ch2PVInput
Segment.1.Ch2UserVal	Channel 2 user value	float32	3ad9	15065	Same as Programmer.SetUp.ResetCh2UserVal
Segment.1.Ch2Wait	Channel 2 Wait (analogue 2 criterion; as for Ch1Wait, above)	uint8	3acf	15055	Not applicable
Segment.1.Ch2WaitVal	Channel 2 wait value	float32	3ad1	15057	Same as Programmer.SetUp.PVWait2
Segment.1.Cycles	Cycles (0 = Continuous)	int16	3ad3	15059	Not applicable
Segment.1.Duration	Duration	time_t	3ac1	15041	Set by Network.Modbus.TimeFormat
Segment.1.EndType	End type (0 = Dwell; 1 = Reset)	uint8	3ac8	15048	Not applicable
Segment.1.Event1	Event 1 (0 = Off; 1 = On)	bool	3ada	15066	Not applicable
Segment.1.Event2	Event 2 (0 = Off; 1 = On)	bool	3adb	15067	Not applicable
Segment.1.Event3	Event 3 (0 = Off; 1 = On)	bool	3adc	15068	Not applicable
Segment.1.Event4	Event 4 (0 = Off; 1 = On)	bool	3add	15069	Not applicable
Segment.1.Event5	Event 5 (0 = Off; 1 = On)	bool	3ade	15070	Not applicable
Segment.1.Event6	Event 6 (0 = Off; 1 = On)	bool	3adf	15071	Not applicable
Segment.1.Event7	Event 7 (0 = Off; 1 = On)	bool	3ae0	15072	Not applicable
Segment.1.Event8	Event 8 (0 = Off; 1 = On)	bool	3ae1	15073	Not applicable
Segment.1.GoBackTo	Go back to	uint8	3ad2	15058	Not applicable
Segment.1.SegmentName	Segment name	string_t	6ad0	27344	Not applicable
Segment.1.Type	Type 0 = End 1 = Ramp 2 = Dwell 3 = Step 4 = Wait 5 = GoBack	uint8	3ac0	15040	Not applicable
Segment.1.WaitFor	Wait for 0 = Digital High 1 = Wait analogue 1 2 = Wait analogue 2 3 = Wait analogue 1 and analogue 2	uint8	3acd	15053	Not applicable
Segment.2.Ch1Holdback	Channel 1 holdback type	uint8	3af9	15097	Not applicable

5.3 PARAMETER LIST (Cont.)

Parameter path	Description	Type	Hex	Dec	Resolution
Segment.2.Ch1HoldbackVal	Channel 1 holdback value	float32	3afb	15099	Same as Programmer.SetUp.Ch1PVInput
Segment.2.Ch1PVEvent	Channel 1 PV event	uint8	3b04	15108	Not applicable
Segment.2.Ch1PVEventUse	Channel 1 PV event use	bool	3b12	15122	Not applicable
Segment.2.Ch1PVEventVal	Channel 1 PV event value	float32	3b06	15110	Same as Programmer.SetUp.Ch1PVInput
Segment.2.Ch1Rate	Channel 1 rate	float32	3af6	15094	Set by Programmer.SetUp.RateResolution
Segment.2.Ch1Time	Channel 1 time	time_t	3af4	15092	Set by Network.Modbus.TimeFormat
Segment.2.Ch1TSP	Channel 1 target set-point	float32	3af2	15090	Same as Programmer.SetUp.Ch1PVInput
Segment.2.Ch1UserVal	Channel 1 user value	float32	3b08	15112	Same as Programmer.SetUp.ResetCh1UserVal
Segment.2.Ch1Wait	Channel 1 Wait	uint8	3afe	15102	Not applicable
Segment.2.Ch1WaitVal	Channel 1 wait value	float32	3b00	15104	Same as Programmer.SetUp.PVWait1
Segment.2.Ch2Holdback	Channel 2 holdback type	uint8	3afa	15098	Not applicable
Segment.2.Ch2HoldbackVal	Channel 2 holdback value	float32	3afc	15100	Same as Programmer.SetUp.Ch2PVInput
Segment.2.Ch2PVEvent	Channel 2 PV event	uint8	3b05	15109	Not applicable
Segment.2.Ch2PVEventUse	Channel 2 PV event use	bool	3b13	15123	Not applicable
Segment.2.Ch2PVEventVal	Channel 2 PV event value	float32	3b07	15111	Same as Programmer.SetUp.Ch2PVInput
Segment.2.Ch2Rate	Channel 2 rate	float32	3af7	15095	Set by Programmer.SetUp.RateResolution
Segment.2.Ch2Time	Channel 2 time	time_t	3af5	15093	Set by Network.Modbus.TimeFormat
Segment.2.Ch2TSP	Channel 2 target set-point	float32	3af3	15091	Same as Programmer.SetUp.Ch2PVInput
Segment.2.Ch2UserVal	Channel 2 user value	float32	3b09	15113	Same as Programmer.SetUp.ResetCh2UserVal
Segment.2.Ch2Wait	Channel 2 Wait	uint8	3aff	15103	Not applicable
Segment.2.Ch2WaitVal	Channel 2 wait value	float32	3b01	15105	Same as Programmer.SetUp.PVWait2
Segment.2.Cycles	Cycles	int16	3b03	15107	Not applicable
Segment.2.Duration	Duration	time_t	3af1	15089	Set by Network.Modbus.TimeFormat
Segment.2.EndType	End type	uint8	3af8	15096	Not applicable
Segment.2.Event1	Event 1	bool	3b0a	15114	Not applicable
Segment.2.Event2	Event 2	bool	3b0b	15115	Not applicable
Segment.2.Event3	Event 3	bool	3b0c	15116	Not applicable
Segment.2.Event4	Event 4	bool	3b0d	15117	Not applicable
Segment.2.Event5	Event 5	bool	3b0e	15118	Not applicable
Segment.2.Event6	Event 6	bool	3b0f	15119	Not applicable
Segment.2.Event7	Event 7	bool	3b10	15120	Not applicable
Segment.2.Event8	Event 8	bool	3b11	15121	Not applicable
Segment.2.GoBackTo	Go back to	uint8	3b02	15106	Not applicable
Segment.2.SegmentName	Segment name	string_t	6ae5	27365	Not applicable
Segment.2.Type	Type	uint8	3af0	15088	Not applicable
Segment.2.WaitFor	Wait for	uint8	3afd	15101	Not applicable
Segment.3.Ch1Holdback	Channel 1 holdback type	uint8	3b29	15145	Not applicable
Segment.3.Ch1HoldbackVal	Channel 1 holdback value	float32	3b2b	15147	Same as Programmer.SetUp.Ch1PVInput
Segment.3.Ch1PVEvent	Channel 1 PV event	uint8	3b34	15156	Not applicable
Segment.3.Ch1PVEventUse	Channel 1 PV event use	bool	3b42	15170	Not applicable
Segment.3.Ch1PVEventVal	Channel 1 PV event value	float32	3b36	15158	Same as Programmer.SetUp.Ch1PVInput
Segment.3.Ch1Rate	Channel 1 rate	float32	3b26	15142	Set by Programmer.SetUp.RateResolution
Segment.3.Ch1Time	Channel 1 time	time_t	3b24	15140	Set by Network.Modbus.TimeFormat
Segment.3.Ch1TSP	Channel 1 target set-point	float32	3b22	15138	Same as Programmer.SetUp.Ch1PVInput
Segment.3.Ch1UserVal	Channel 1 user value	float32	3b38	15160	Same as Programmer.SetUp.ResetCh1UserVal
Segment.3.Ch1Wait	Channel 1 Wait	uint8	3b2e	15150	Not applicable
Segment.3.Ch1WaitVal	Channel 1 wait value	float32	3b30	15152	Same as Programmer.SetUp.PVWait1
Segment.3.Ch2Holdback	Channel 2 holdback type	uint8	3b2a	15146	Not applicable
Segment.3.Ch2HoldbackVal	Channel 2 holdback value	float32	3b2c	15148	Same as Programmer.SetUp.Ch2PVInput
Segment.3.Ch2PVEvent	Channel 2 PV event	uint8	3b35	15157	Not applicable
Segment.3.Ch2PVEventUse	Channel 2 PV event use	bool	3b43	15171	Not applicable
Segment.3.Ch2PVEventVal	Channel 2 PV event value	float32	3b37	15159	Same as Programmer.SetUp.Ch2PVInput
Segment.3.Ch2Rate	Channel 2 rate	float32	3b27	15143	Set by Programmer.SetUp.RateResolution
Segment.3.Ch2Time	Channel 2 time	time_t	3b25	15141	Set by Network.Modbus.TimeFormat
Segment.3.Ch2TSP	Channel 2 target set-point	float32	3b23	15139	Same as Programmer.SetUp.Ch2PVInput
Segment.3.Ch2UserVal	Channel 2 user value	float32	3b39	15161	Same as Programmer.SetUp.ResetCh2UserVal
Segment.3.Ch2Wait	Channel 2 Wait	uint8	3b2f	15151	Not applicable
Segment.3.Ch2WaitVal	Channel 2 wait value	float32	3b31	15153	Same as Programmer.SetUp.PVWait2
Segment.3.Cycles	Cycles	int16	3b33	15155	Not applicable
Segment.3.Duration	Duration	time_t	3b21	15137	Set by Network.Modbus.TimeFormat
Segment.3.EndType	End type	uint8	3b28	15144	Not applicable
Segment.3.Event1	Event 1	bool	3b3a	15162	Not applicable
Segment.3.Event2	Event 2	bool	3b3b	15163	Not applicable
Segment.3.Event3	Event 3	bool	3b3c	15164	Not applicable
Segment.3.Event4	Event 4	bool	3b3d	15165	Not applicable
Segment.3.Event5	Event 5	bool	3b3e	15166	Not applicable
Segment.3.Event6	Event 6	bool	3b3f	15167	Not applicable
Segment.3.Event7	Event 7	bool	3b40	15168	Not applicable
Segment.3.Event8	Event 8	bool	3b41	15169	Not applicable
Segment.3.GoBackTo	Go back to	uint8	3b32	15154	Not applicable
Segment.3.SegmentName	Segment name	string_t	6afa	27386	Not applicable
Segment.3.Type	Type	uint8	3b20	15136	Not applicable
Segment.3.WaitFor	Wait for	uint8	3b2d	15149	Not applicable
Segment.4.Ch1Holdback	Channel 1 holdback type	uint8	3b59	15193	Not applicable
Segment.4.Ch1HoldbackVal	Channel 1 holdback value	float32	3b5b	15195	Same as Programmer.SetUp.Ch1PVInput
Segment.4.Ch1PVEvent	Channel 1 PV event	uint8	3b64	15204	Not applicable
Segment.4.Ch1PVEventUse	Channel 1 PV event use	bool	3b72	15218	Not applicable
Segment.4.Ch1PVEventVal	Channel 1 PV event value	float32	3b66	15206	Same as Programmer.SetUp.Ch1PVInput
Segment.4.Ch1Rate	Channel 1 rate	float32	3b56	15190	Set by Programmer.SetUp.RateResolution

For parameter values and settings (enumerations), see Segment 1

5.3 PARAMETER LIST (Cont.)

Parameter path	Description	Type	Hex	Dec	Resolution
Segment.4.Ch1Time	Channel 1 time	time_t	3b54	15188	Set by Network.Modbus.TimeFormat
Segment.4.Ch1TSP	Channel 1 target set-point	float32	3b52	15186	Same as Programmer.SetUp.Ch1PVInput
Segment.4.Ch1UserVal	Channel 1 user value	float32	3b68	15208	Same as Programmer.SetUp.ResetCh1UserVal
Segment.4.Ch1Wait	Channel 1 Wait	uint8	3b5e	15198	Not applicable
Segment.4.Ch1WaitVal	Channel 1 wait value	float32	3b60	15200	Same as Programmer.SetUp.PVWait1
Segment.4.Ch2Holdback	Channel 2 holdback type	uint8	3b5a	15194	Not applicable
Segment.4.Ch2HoldbackVal	Channel 2 holdback value	float32	3b5c	15196	Same as Programmer.SetUp.Ch2PVInput
Segment.4.Ch2PVEvent	Channel 2 PV event	uint8	3b65	15205	Not applicable
Segment.4.Ch2PVEventUse	Channel 2 PV event use	bool	3b73	15219	Not applicable
Segment.4.Ch2PVEventVal	Channel 2 PV event value	float32	3b67	15207	Same as Programmer.SetUp.Ch2PVInput
Segment.4.Ch2Rate	Channel 2 rate	float32	3b57	15191	Set by Programmer.SetUp.RateResolution
Segment.4.Ch2Time	Channel 2 time	time_t	3b55	15189	Set by Network.Modbus.TimeFormat
Segment.4.Ch2TSP	Channel 2 target set-point	float32	3b53	15187	Same as Programmer.SetUp.Ch2PVInput
Segment.4.Ch2UserVal	Channel 2 user value	float32	3b69	15209	Same as Programmer.SetUp.ResetCh2UserVal
Segment.4.Ch2Wait	Channel 2 Wait	uint8	3b5f	15199	Not applicable
Segment.4.Ch2WaitVal	Channel 2 wait value	float32	3b61	15201	Same as Programmer.SetUp.PVWait2
Segment.4.Cycles	Cycles	int16	3b63	15203	Not applicable
Segment.4.Duration	Duration	time_t	3b51	15185	Set by Network.Modbus.TimeFormat
Segment.4.EndType	End type	uint8	3b58	15192	Not applicable
Segment.4.Event1	Event 1	bool	3b6a	15210	Not applicable
Segment.4.Event2	Event 2	bool	3b6b	15211	Not applicable
Segment.4.Event3	Event 3	bool	3b6c	15212	Not applicable
Segment.4.Event4	Event 4	bool	3b6d	15213	Not applicable
Segment.4.Event5	Event 5	bool	3b6e	15214	Not applicable
Segment.4.Event6	Event 6	bool	3b6f	15215	Not applicable
Segment.4.Event7	Event 7	bool	3b70	15216	Not applicable
Segment.4.Event8	Event 8	bool	3b71	15217	Not applicable
Segment.4.GoBackTo	Go back to	uint8	3b62	15202	Not applicable
Segment.4.SegmentName	Segment name	string_t	6b0f	27407	Not applicable
Segment.4.Type	Type	uint8	3b50	15184	Not applicable
Segment.4.WaitFor	Wait for	uint8	3b5d	15197	Not applicable
Segment.5.Ch1Holdback	Channel 1 holdback type	uint8	3b89	15241	Not applicable
Segment.5.Ch1HoldbackVal	Channel 1 holdback value	float32	3b8b	15243	Same as Programmer.SetUp.Ch1PVInput
Segment.5.Ch1PVEvent	Channel 1 PV event	uint8	3b94	15252	Not applicable
Segment.5.Ch1PVEventUse	Channel 1 PV event use	bool	3ba2	15266	Not applicable
Segment.5.Ch1PVEventVal	Channel 1 PV event value	float32	3b96	15254	Same as Programmer.SetUp.Ch1PVInput
Segment.5.Ch1Rate	Channel 1 rate	float32	3b86	15238	Set by Programmer.SetUp.RateResolution
Segment.5.Ch1Time	Channel 1 time	time_t	3b84	15236	Set by Network.Modbus.TimeFormat
Segment.5.Ch1TSP	Channel 1 target set-point	float32	3b82	15234	Same as Programmer.SetUp.Ch1PVInput
Segment.5.Ch1UserVal	Channel 1 user value	float32	3b98	15256	Same as Programmer.SetUp.ResetCh1UserVal
Segment.5.Ch1Wait	Channel 1 Wait	uint8	3b8e	15246	Not applicable
Segment.5.Ch1WaitVal	Channel 1 wait value	float32	3b90	15248	Same as Programmer.SetUp.PVWait1
Segment.5.Ch2Holdback	Channel 2 holdback type	uint8	3b8a	15242	Not applicable
Segment.5.Ch2HoldbackVal	Channel 2 holdback value	float32	3b8c	15244	Same as Programmer.SetUp.Ch2PVInput
Segment.5.Ch2PVEvent	Channel 2 PV event	uint8	3b95	15253	Not applicable
Segment.5.Ch2PVEventUse	Channel 2 PV event use	bool	3ba3	15267	Not applicable
Segment.5.Ch2PVEventVal	Channel 2 PV event value	float32	3b97	15255	Same as Programmer.SetUp.Ch2PVInput
Segment.5.Ch2Rate	Channel 2 rate	float32	3b87	15239	Set by Programmer.SetUp.RateResolution
Segment.5.Ch2Time	Channel 2 time	time_t	3b85	15237	Set by Network.Modbus.TimeFormat
Segment.5.Ch2TSP	Channel 2 target set-point	float32	3b83	15235	Same as Programmer.SetUp.Ch2PVInput
Segment.5.Ch2UserVal	Channel 2 user value	float32	3b99	15257	Same as Programmer.SetUp.ResetCh2UserVal
Segment.5.Ch2Wait	Channel 2 Wait	uint8	3b8f	15247	Not applicable
Segment.5.Ch2WaitVal	Channel 2 wait value	float32	3b91	15249	Same as Programmer.SetUp.PVWait2
Segment.5.Cycles	Cycles	int16	3b93	15251	Not applicable
Segment.5.Duration	Duration	time_t	3b81	15233	Set by Network.Modbus.TimeFormat
Segment.5.EndType	End type	uint8	3b88	15240	Not applicable
Segment.5.Event1	Event 1	bool	3b9a	15258	Not applicable
Segment.5.Event2	Event 2	bool	3b9b	15259	Not applicable
Segment.5.Event3	Event 3	bool	3b9c	15260	Not applicable
Segment.5.Event4	Event 4	bool	3b9d	15261	Not applicable
Segment.5.Event5	Event 5	bool	3b9e	15262	Not applicable
Segment.5.Event6	Event 6	bool	3b9f	15263	Not applicable
Segment.5.Event7	Event 7	bool	3ba0	15264	Not applicable
Segment.5.Event8	Event 8	bool	3ba1	15265	Not applicable
Segment.5.GoBackTo	Go back to	uint8	3b92	15250	Not applicable
Segment.5.SegmentName	Segment name	string_t	6b24	27428	Not applicable
Segment.5.Type	Type	uint8	3b80	15232	Not applicable
Segment.5.WaitFor	Wait for	uint8	3b8d	15245	Not applicable
Segment.6.Ch1Holdback	Channel 1 holdback type	uint8	3bb9	15289	Not applicable
Segment.6.Ch1HoldbackVal	Channel 1 holdback value	float32	3bbb	15291	Same as Programmer.SetUp.Ch1PVInput
Segment.6.Ch1PVEvent	Channel 1 PV event	uint8	3bc4	15300	Not applicable
Segment.6.Ch1PVEventUse	Channel 1 PV event use	bool	3bd2	15314	Not applicable
Segment.6.Ch1PVEventVal	Channel 1 PV event value	float32	3bc6	15302	Same as Programmer.SetUp.Ch1PVInput
Segment.6.Ch1Rate	Channel 1 rate	float32	3bb6	15286	Set by Programmer.SetUp.RateResolution
Segment.6.Ch1Time	Channel 1 time	time_t	3bb4	15284	Set by Network.Modbus.TimeFormat
Segment.6.Ch1TSP	Channel 1 target set-point	float32	3bb2	15282	Same as Programmer.SetUp.Ch1PVInput
Segment.6.Ch1UserVal	Channel 1 user value	float32	3bc8	15304	Same as Programmer.SetUp.ResetCh1UserVal
Segment.6.Ch1Wait	Channel 1 Wait	uint8	3bbe	15294	Not applicable
Segment.6.Ch1WaitVal	Channel 1 wait value	float32	3bc0	15296	Same as Programmer.SetUp.PVWait1

For parameter values and settings (enumerations), see Segment 1

5.3 PARAMETER LIST (Cont.)

Parameter path	Description	Type	Hex	Dec	Resolution
Segment.6.Ch2Holdback	Channel 2 holdback type	uint8	3bba	15290	Not applicable
Segment.6.Ch2HoldbackVal	Channel 2 holdback value	float32	3bbc	15292	Same as Programmer.SetUp.Ch2PVInput
Segment.6.Ch2PVEvent	Channel 2 PV event	uint8	3bc5	15301	Not applicable
Segment.6.Ch2PVEventUse	Channel 2 PV event use	bool	3bd3	15315	Not applicable
Segment.6.Ch2PVEventVal	Channel 2 PV event value	float32	3bc7	15303	Same as Programmer.SetUp.Ch2PVInput
Segment.6.Ch2Rate	Channel 2 rate	float32	3bb7	15287	Set by Programmer.SetUp.RateResolution
Segment.6.Ch2Time	Channel 2 time	time_t	3bb5	15285	Set by Network.Modbus.TimeFormat
Segment.6.Ch2TSP	Channel 2 target set-point	float32	3bb3	15283	Same as Programmer.SetUp.Ch2PVInput
Segment.6.Ch2UserVal	Channel 2 user value	float32	3bc9	15305	Same as Programmer.SetUp.ResetCh2UserVal
Segment.6.Ch2Wait	Channel 2 Wait	uint8	3bbf	15295	Not applicable
Segment.6.Ch2WaitVal	Channel 2 wait value	float32	3bc1	15297	Same as Programmer.SetUp.PVWait2
Segment.6.Cycles	Cycles	int16	3bc3	15299	Not applicable
Segment.6.Duration	Duration	time_t	3bb1	15281	Set by Network.Modbus.TimeFormat
Segment.6.EndType	End type	uint8	3bb8	15288	Not applicable
Segment.6.Event1	Event 1	bool	3bca	15306	Not applicable
Segment.6.Event2	Event 2	bool	3bcb	15307	Not applicable
Segment.6.Event3	Event 3	bool	3bcc	15308	Not applicable
Segment.6.Event4	Event 4	bool	3bcd	15309	Not applicable
Segment.6.Event5	Event 5	bool	3bce	15310	Not applicable
Segment.6.Event6	Event 6	bool	3bcf	15311	Not applicable
Segment.6.Event7	Event 7	bool	3bd0	15312	Not applicable
Segment.6.Event8	Event 8	bool	3bd1	15313	Not applicable
Segment.6.GoBackTo	Go back to	uint8	3bc2	15298	Not applicable
Segment.6.SegmentName	Segment name	string_t	6b39	27449	Not applicable
Segment.6.Type	Type	uint8	3bb0	15280	Not applicable
Segment.6.WaitFor	Wait for	uint8	3bbd	15293	Not applicable
Segment.7.Ch1Holdback	Channel 1 holdback type	uint8	3be9	15337	Not applicable
Segment.7.Ch1HoldbackVal	Channel 1 holdback value	float32	3beb	15339	Same as Programmer.SetUp.Ch1PVInput
Segment.7.Ch1PVEvent	Channel 1 PV event	uint8	3bf4	15348	Not applicable
Segment.7.Ch1PVEventUse	Channel 1 PV event use	bool	3c02	15362	Not applicable
Segment.7.Ch1PVEventVal	Channel 1 PV event value	float32	3bf6	15350	Same as Programmer.SetUp.Ch1PVInput
Segment.7.Ch1Rate	Channel 1 rate	float32	3be6	15334	Set by Programmer.SetUp.RateResolution
Segment.7.Ch1Time	Channel 1 time	time_t	3be4	15332	Set by Network.Modbus.TimeFormat
Segment.7.Ch1TSP	Channel 1 target set-point	float32	3be2	15330	Same as Programmer.SetUp.Ch1PVInput
Segment.7.Ch1UserVal	Channel 1 user value	float32	3bf8	15352	Same as Programmer.SetUp.ResetCh1UserVal
Segment.7.Ch1Wait	Channel 1 Wait	uint8	3bee	15342	Not applicable
Segment.7.Ch1WaitVal	Channel 1 wait value	float32	3bf0	15344	Same as Programmer.SetUp.PVWait1
Segment.7.Ch2Holdback	Channel 2 holdback type	uint8	3bea	15338	Not applicable
Segment.7.Ch2HoldbackVal	Channel 2 holdback value	float32	3bec	15340	Same as Programmer.SetUp.Ch2PVInput
Segment.7.Ch2PVEvent	Channel 2 PV event	uint8	3bf5	15349	Not applicable
Segment.7.Ch2PVEventUse	Channel 2 PV event use	bool	3c03	15363	Not applicable
Segment.7.Ch2PVEventVal	Channel 2 PV event value	float32	3bf7	15351	Same as Programmer.SetUp.Ch2PVInput
Segment.7.Ch2Rate	Channel 2 rate	float32	3be7	15335	Set by Programmer.SetUp.RateResolution
Segment.7.Ch2Time	Channel 2 time	time_t	3be5	15333	Set by Network.Modbus.TimeFormat
Segment.7.Ch2TSP	Channel 2 target set-point	float32	3be3	15331	Same as Programmer.SetUp.Ch2PVInput
Segment.7.Ch2UserVal	Channel 2 user value	float32	3bf9	15353	Same as Programmer.SetUp.ResetCh2UserVal
Segment.7.Ch2Wait	Channel 2 Wait	uint8	3bef	15343	Not applicable
Segment.7.Ch2WaitVal	Channel 2 wait value	float32	3bf1	15345	Same as Programmer.SetUp.PVWait2
Segment.7.Cycles	Cycles	int16	3bf3	15347	Not applicable
Segment.7.Duration	Duration	time_t	3be1	15329	Set by Network.Modbus.TimeFormat
Segment.7.EndType	End type	uint8	3be8	15336	Not applicable
Segment.7.Event1	Event 1	bool	3bfa	15354	Not applicable
Segment.7.Event2	Event 2	bool	3bfb	15355	Not applicable
Segment.7.Event3	Event 3	bool	3bfc	15356	Not applicable
Segment.7.Event4	Event 4	bool	3bfd	15357	Not applicable
Segment.7.Event5	Event 5	bool	3bfe	15358	Not applicable
Segment.7.Event6	Event 6	bool	3bff	15359	Not applicable
Segment.7.Event7	Event 7	bool	3c00	15360	Not applicable
Segment.7.Event8	Event 8	bool	3c01	15361	Not applicable
Segment.7.GoBackTo	Go back to	uint8	3bf2	15346	Not applicable
Segment.7.SegmentName	Segment name	string_t	6b4e	27470	Not applicable
Segment.7.Type	Type	uint8	3be0	15328	Not applicable
Segment.7.WaitFor	Wait for	uint8	3bed	15341	Not applicable
Segment.8.Ch1Holdback	Channel 1 holdback type	uint8	3c19	15385	Not applicable
Segment.8.Ch1HoldbackVal	Channel 1 holdback value	float32	3c1b	15387	Same as Programmer.SetUp.Ch1PVInput
Segment.8.Ch1PVEvent	Channel 1 PV event	uint8	3c24	15396	Not applicable
Segment.8.Ch1PVEventUse	Channel 1 PV event use	bool	3c32	15410	Not applicable
Segment.8.Ch1PVEventVal	Channel 1 PV event value	float32	3c26	15398	Same as Programmer.SetUp.Ch1PVInput
Segment.8.Ch1Rate	Channel 1 rate	float32	3c16	15382	Set by Programmer.SetUp.RateResolution
Segment.8.Ch1Time	Channel 1 time	time_t	3c14	15380	Set by Network.Modbus.TimeFormat
Segment.8.Ch1TSP	Channel 1 target set-point	float32	3c12	15378	Same as Programmer.SetUp.Ch1PVInput
Segment.8.Ch1UserVal	Channel 1 user value	float32	3c28	15400	Same as Programmer.SetUp.ResetCh1UserVal
Segment.8.Ch1Wait	Channel 1 Wait	uint8	3c1e	15390	Not applicable
Segment.8.Ch1WaitVal	Channel 1 wait value	float32	3c20	15392	Same as Programmer.SetUp.PVWait1
Segment.8.Ch2Holdback	Channel 2 holdback type	uint8	3c1a	15386	Not applicable
Segment.8.Ch2HoldbackVal	Channel 2 holdback value	float32	3c1c	15388	Same as Programmer.SetUp.Ch2PVInput
Segment.8.Ch2PVEvent	Channel 2 PV event	uint8	3c25	15397	Not applicable
Segment.8.Ch2PVEventUse	Channel 2 PV event use	bool	3c33	15411	Not applicable
Segment.8.Ch2PVEventVal	Channel 2 PV event value	float32	3c27	15399	Same as Programmer.SetUp.Ch2PVInput

For parameter values and settings (enumerations), see Segment 1

5.3 PARAMETER LIST (Cont.)

Parameter path	Description	Type	Hex	Dec	Resolution
Segment.8.Ch2Rate	Channel 2 rate	float32	3c17	15383	Set by Programmer.SetUp.RateResolution
Segment.8.Ch2Time	Channel 2 time	time_t	3c15	15381	Set by Network.Modbus.TimeFormat
Segment.8.Ch2TSP	Channel 2 target set-point	float32	3c13	15379	Same as Programmer.SetUp.Ch2PVInput
Segment.8.Ch2UserVal	Channel 2 user value	float32	3c29	15401	Same as Programmer.SetUp.ResetCh2UserVal
Segment.8.Ch2Wait	Channel 2 Wait	uint8	3c1f	15391	Not applicable
Segment.8.Ch2WaitVal	Channel 2 wait value	float32	3c21	15393	Same as Programmer.SetUp.PVWait2
Segment.8.Cycles	Cycles	int16	3c23	15395	Not applicable
Segment.8.Duration	Duration	time_t	3c11	15377	Set by Network.Modbus.TimeFormat
Segment.8.EndType	End type	uint8	3c18	15384	Not applicable
Segment.8.Event1	Event 1	bool	3c2a	15402	Not applicable
Segment.8.Event2	Event 2	bool	3c2b	15403	Not applicable
Segment.8.Event3	Event 3	bool	3c2c	15404	Not applicable
Segment.8.Event4	Event 4	bool	3c2d	15405	Not applicable
Segment.8.Event5	Event 5	bool	3c2e	15406	Not applicable
Segment.8.Event6	Event 6	bool	3c2f	15407	Not applicable
Segment.8.Event7	Event 7	bool	3c30	15408	Not applicable
Segment.8.Event8	Event 8	bool	3c31	15409	Not applicable
Segment.8.GoBackTo	Go back to	uint8	3c22	15394	Not applicable
Segment.8.SegmentName	Segment name	string_t	6b63	27491	Not applicable
Segment.8.Type	Type	uint8	3c10	15376	Not applicable
Segment.8.WaitFor	Wait for	uint8	3c1d	15389	Not applicable
Segment.9.Ch1Holdback	Channel 1 holdback type	uint8	3c49	15433	Not applicable
Segment.9.Ch1HoldbackVal	Channel 1 holdback value	float32	3c4b	15435	Same as Programmer.SetUp.Ch1PVInput
Segment.9.Ch1PVEvent	Channel 1 PV event	uint8	3c54	15444	Not applicable
Segment.9.Ch1PVEventUse	Channel 1 PV event use	bool	3c62	15458	Not applicable
Segment.9.Ch1PVEventVal	Channel 1 PV event value	float32	3c56	15446	Same as Programmer.SetUp.Ch1PVInput
Segment.9.Ch1Rate	Channel 1 rate	float32	3c46	15430	Set by Programmer.SetUp.RateResolution
Segment.9.Ch1Time	Channel 1 time	time_t	3c44	15428	Set by Network.Modbus.TimeFormat
Segment.9.Ch1TSP	Channel 1 target set-point	float32	3c42	15426	Same as Programmer.SetUp.Ch1PVInput
Segment.9.Ch1UserVal	Channel 1 user value	float32	3c58	15448	Same as Programmer.SetUp.ResetCh1UserVal
Segment.9.Ch1Wait	Channel 1 Wait	uint8	3c4e	15438	Not applicable
Segment.9.Ch1WaitVal	Channel 1 wait value	float32	3c50	15440	Same as Programmer.SetUp.PVWait1
Segment.9.Ch2Holdback	Channel 2 holdback type	uint8	3c4a	15434	Not applicable
Segment.9.Ch2HoldbackVal	Channel 2 holdback value	float32	3c4c	15436	Same as Programmer.SetUp.Ch2PVInput
Segment.9.Ch2PVEvent	Channel 2 PV event	uint8	3c55	15445	Not applicable
Segment.9.Ch2PVEventUse	Channel 2 PV event use	bool	3c63	15459	Not applicable
Segment.9.Ch2PVEventVal	Channel 2 PV event value	float32	3c57	15447	Same as Programmer.SetUp.Ch2PVInput
Segment.9.Ch2Rate	Channel 2 rate	float32	3c47	15431	Set by Programmer.SetUp.RateResolution
Segment.9.Ch2Time	Channel 2 time	time_t	3c45	15429	Set by Network.Modbus.TimeFormat
Segment.9.Ch2TSP	Channel 2 target set-point	float32	3c43	15427	Same as Programmer.SetUp.Ch2PVInput
Segment.9.Ch2UserVal	Channel 2 user value	float32	3c59	15449	Same as Programmer.SetUp.ResetCh2UserVal
Segment.9.Ch2Wait	Channel 2 Wait	uint8	3c4f	15439	Not applicable
Segment.9.Ch2WaitVal	Channel 2 wait value	float32	3c51	15441	Same as Programmer.SetUp.PVWait2
Segment.9.Cycles	Cycles	int16	3c53	15443	Not applicable
Segment.9.Duration	Duration	time_t	3c41	15425	Set by Network.Modbus.TimeFormat
Segment.9.EndType	End type	uint8	3c48	15432	Not applicable
Segment.9.Event1	Event 1	bool	3c5a	15450	Not applicable
Segment.9.Event2	Event 2	bool	3c5b	15451	Not applicable
Segment.9.Event3	Event 3	bool	3c5c	15452	Not applicable
Segment.9.Event4	Event 4	bool	3c5d	15453	Not applicable
Segment.9.Event5	Event 5	bool	3c5e	15454	Not applicable
Segment.9.Event6	Event 6	bool	3c5f	15455	Not applicable
Segment.9.Event7	Event 7	bool	3c60	15456	Not applicable
Segment.9.Event8	Event 8	bool	3c61	15457	Not applicable
Segment.9.GoBackTo	Go back to	uint8	3c52	15442	Not applicable
Segment.9.SegmentName	Segment name	string_t	6b78	27512	Not applicable
Segment.9.Type	Type	uint8	3c40	15424	Not applicable
Segment.9.WaitFor	Wait for	uint8	3c4d	15437	Not applicable
Segment.10.Ch1Holdback	Channel 1 holdback type	uint8	3c79	15481	Not applicable
Segment.10.Ch1HoldbackVal	Channel 1 holdback value	float32	3c7b	15483	Same as Programmer.SetUp.Ch1PVInput
Segment.10.Ch1PVEvent	Channel 1 PV event	uint8	3c84	15492	Not applicable
Segment.10.Ch1PVEventUse	Channel 1 PV event use	bool	3c92	15506	Not applicable
Segment.10.Ch1PVEventVal	Channel 1 PV event value	float32	3c86	15494	Same as Programmer.SetUp.Ch1PVInput
Segment.10.Ch1Rate	Channel 1 rate	float32	3c76	15478	Set by Programmer.SetUp.RateResolution
Segment.10.Ch1Time	Channel 1 time	time_t	3c74	15476	Set by Network.Modbus.TimeFormat
Segment.10.Ch1TSP	Channel 1 target set-point	float32	3c72	15474	Same as Programmer.SetUp.Ch1PVInput
Segment.10.Ch1UserVal	Channel 1 user value	float32	3c88	15496	Same as Programmer.SetUp.ResetCh1UserVal
Segment.10.Ch1Wait	Channel 1 Wait	uint8	3c7e	15486	Not applicable
Segment.10.Ch1WaitVal	Channel 1 wait value	float32	3c80	15488	Same as Programmer.SetUp.PVWait1
Segment.10.Ch2Holdback	Channel 2 holdback type	uint8	3c7a	15482	Not applicable
Segment.10.Ch2HoldbackVal	Channel 2 holdback value	float32	3c7c	15484	Same as Programmer.SetUp.Ch2PVInput
Segment.10.Ch2PVEvent	Channel 2 PV event	uint8	3c85	15493	Not applicable
Segment.10.Ch2PVEventUse	Channel 2 PV event use	bool	3c93	15507	Not applicable
Segment.10.Ch2PVEventVal	Channel 2 PV event value	float32	3c87	15495	Same as Programmer.SetUp.Ch2PVInput
Segment.10.Ch2Rate	Channel 2 rate	float32	3c77	15479	Set by Programmer.SetUp.RateResolution
Segment.10.Ch2Time	Channel 2 time	time_t	3c75	15477	Set by Network.Modbus.TimeFormat
Segment.10.Ch2TSP	Channel 2 target set-point	float32	3c73	15475	Same as Programmer.SetUp.Ch2PVInput
Segment.10.Ch2UserVal	Channel 2 user value	float32	3c89	15497	Same as Programmer.SetUp.ResetCh2UserVal
Segment.10.Ch2Wait	Channel 2 Wait	uint8	3c7f	15487	Not applicable

For parameter values and settings (enumerations), see Segment 1

5.3 PARAMETER LIST (Cont.)

Parameter path	Description	Type	Hex	Dec	Resolution
Segment.10.Ch2WaitVal	Channel 2 wait value	float32	3c81	15489	Same as Programmer.SetUp.PVWait2
Segment.10.Cycles	Cycles	int16	3c83	15491	Not applicable
Segment.10.Duration	Duration	time_t	3c71	15473	Set by Network.Modbus.TimeFormat
Segment.10.EndType	End type	uint8	3c78	15480	Not applicable
Segment.10.Event1	Event 1	bool	3c8a	15498	Not applicable
Segment.10.Event2	Event 2	bool	3c8b	15499	Not applicable
Segment.10.Event3	Event 3	bool	3c8c	15500	Not applicable
Segment.10.Event4	Event 4	bool	3c8d	15501	Not applicable
Segment.10.Event5	Event 5	bool	3c8e	15502	Not applicable
Segment.10.Event6	Event 6	bool	3c8f	15503	Not applicable
Segment.10.Event7	Event 7	bool	3c90	15504	Not applicable
Segment.10.Event8	Event 8	bool	3c91	15505	Not applicable
Segment.10.GoBackTo	Go back to	uint8	3c82	15490	Not applicable
Segment.10.SegmentName	Segment name	string_t	6b8d	27533	Not applicable
Segment.10.Type	Type	uint8	3c70	15472	Not applicable
Segment.10.WaitFor	Wait for	uint8	3c7d	15485	Not applicable
Segment.11.Ch1Holdback	Channel 1 holdback type	uint8	3ca9	15529	Not applicable
Segment.11.Ch1HoldbackVal	Channel 1 holdback value	float32	3cab	15531	Same as Programmer.SetUp.Ch1PVInput
Segment.11.Ch1PVEvent	Channel 1 PV event	uint8	3cb4	15540	Not applicable
Segment.11.Ch1PVEventUse	Channel 1 PV event use	bool	3cc2	15554	Not applicable
Segment.11.Ch1PVEventVal	Channel 1 PV event value	float32	3cb6	15542	Same as Programmer.SetUp.Ch1PVInput
Segment.11.Ch1Rate	Channel 1 rate	float32	3ca6	15526	Set by Programmer.SetUp.RateResolution
Segment.11.Ch1Time	Channel 1 time	time_t	3ca4	15524	Set by Network.Modbus.TimeFormat
Segment.11.Ch1TSP	Channel 1 target set-point	float32	3ca2	15522	Same as Programmer.SetUp.Ch1PVInput
Segment.11.Ch1UserVal	Channel 1 user value	float32	3cb8	15544	Same as Programmer.SetUp.ResetCh1UserVal
Segment.11.Ch1Wait	Channel 1 Wait	uint8	3cae	15534	Not applicable
Segment.11.Ch1WaitVal	Channel 1 wait value	float32	3cb0	15536	Same as Programmer.SetUp.PVWait1
Segment.11.Ch2Holdback	Channel 2 holdback type	uint8	3caa	15530	Not applicable
Segment.11.Ch2HoldbackVal	Channel 2 holdback value	float32	3cac	15532	Same as Programmer.SetUp.Ch2PVInput
Segment.11.Ch2PVEvent	Channel 2 PV event	uint8	3cb5	15541	Not applicable
Segment.11.Ch2PVEventUse	Channel 2 PV event use	bool	3cc3	15555	Not applicable
Segment.11.Ch2PVEventVal	Channel 2 PV event value	float32	3cb7	15543	Same as Programmer.SetUp.Ch2PVInput
Segment.11.Ch2Rate	Channel 2 rate	float32	3ca7	15527	Set by Programmer.SetUp.RateResolution
Segment.11.Ch2Time	Channel 2 time	time_t	3ca5	15525	Set by Network.Modbus.TimeFormat
Segment.11.Ch2TSP	Channel 2 target set-point	float32	3ca3	15523	Same as Programmer.SetUp.Ch2PVInput
Segment.11.Ch2UserVal	Channel 2 user value	float32	3cb9	15545	Same as Programmer.SetUp.ResetCh2UserVal
Segment.11.Ch2Wait	Channel 2 Wait	uint8	3caf	15535	Not applicable
Segment.11.Ch2WaitVal	Channel 2 wait value	float32	3cb1	15537	Same as Programmer.SetUp.PVWait2
Segment.11.Cycles	Cycles	int16	3cb3	15539	Not applicable
Segment.11.Duration	Duration	time_t	3ca1	15521	Set by Network.Modbus.TimeFormat
Segment.11.EndType	End type	uint8	3ca8	15528	Not applicable
Segment.11.Event1	Event 1	bool	3cba	15546	Not applicable
Segment.11.Event2	Event 2	bool	3cbb	15547	Not applicable
Segment.11.Event3	Event 3	bool	3cbc	15548	Not applicable
Segment.11.Event4	Event 4	bool	3cbd	15549	Not applicable
Segment.11.Event5	Event 5	bool	3cbe	15550	Not applicable
Segment.11.Event6	Event 6	bool	3cbf	15551	Not applicable
Segment.11.Event7	Event 7	bool	3cc0	15552	Not applicable
Segment.11.Event8	Event 8	bool	3cc1	15553	Not applicable
Segment.11.GoBackTo	Go back to	uint8	3cb2	15538	Not applicable
Segment.11.SegmentName	Segment name	string_t	6ba2	27554	Not applicable
Segment.11.Type	Type	uint8	3ca0	15520	Not applicable
Segment.11.WaitFor	Wait for	uint8	3cad	15533	Not applicable
Segment.12.Ch1Holdback	Channel 1 holdback type	uint8	3cd9	15577	Not applicable
Segment.12.Ch1HoldbackVal	Channel 1 holdback value	float32	3cdb	15579	Same as Programmer.SetUp.Ch1PVInput
Segment.12.Ch1PVEvent	Channel 1 PV event	uint8	3ce4	15588	Not applicable
Segment.12.Ch1PVEventUse	Channel 1 PV event use	bool	3cf2	15602	Not applicable
Segment.12.Ch1PVEventVal	Channel 1 PV event value	float32	3ce6	15590	Same as Programmer.SetUp.Ch1PVInput
Segment.12.Ch1Rate	Channel 1 rate	float32	3cd6	15574	Set by Programmer.SetUp.RateResolution
Segment.12.Ch1Time	Channel 1 time	time_t	3cd4	15572	Set by Network.Modbus.TimeFormat
Segment.12.Ch1TSP	Channel 1 target set-point	float32	3cd2	15570	Same as Programmer.SetUp.Ch1PVInput
Segment.12.Ch1UserVal	Channel 1 user value	float32	3ce8	15592	Same as Programmer.SetUp.ResetCh1UserVal
Segment.12.Ch1Wait	Channel 1 Wait	uint8	3cde	15582	Not applicable
Segment.12.Ch1WaitVal	Channel 1 wait value	float32	3ce0	15584	Same as Programmer.SetUp.PVWait1
Segment.12.Ch2Holdback	Channel 2 holdback type	uint8	3cda	15578	Not applicable
Segment.12.Ch2HoldbackVal	Channel 2 holdback value	float32	3cdc	15580	Same as Programmer.SetUp.Ch2PVInput
Segment.12.Ch2PVEvent	Channel 2 PV event	uint8	3ce5	15589	Not applicable
Segment.12.Ch2PVEventUse	Channel 2 PV event use	bool	3cf3	15603	Not applicable
Segment.12.Ch2PVEventVal	Channel 2 PV event value	float32	3ce7	15591	Same as Programmer.SetUp.Ch2PVInput
Segment.12.Ch2Rate	Channel 2 rate	float32	3cd7	15575	Set by Programmer.SetUp.RateResolution
Segment.12.Ch2Time	Channel 2 time	time_t	3cd5	15573	Set by Network.Modbus.TimeFormat
Segment.12.Ch2TSP	Channel 2 target set-point	float32	3cd3	15571	Same as Programmer.SetUp.Ch2PVInput
Segment.12.Ch2UserVal	Channel 2 user value	float32	3ce9	15593	Same as Programmer.SetUp.ResetCh2UserVal
Segment.12.Ch2Wait	Channel 2 Wait	uint8	3cdf	15583	Not applicable
Segment.12.Ch2WaitVal	Channel 2 wait value	float32	3ce1	15585	Same as Programmer.SetUp.PVWait2
Segment.12.Cycles	Cycles	int16	3ce3	15587	Not applicable
Segment.12.Duration	Duration	time_t	3cd1	15569	Set by Network.Modbus.TimeFormat
Segment.12.EndType	End type	uint8	3cd8	15576	Not applicable
Segment.12.Event1	Event 1	bool	3cea	15594	Not applicable

For parameter values and settings (enumerations), see Segment 1

5.3 PARAMETER LIST (Cont.)

Parameter path	Description	Type	Hex	Dec	Resolution
Segment.12.Event2	Event 2	bool	3ceb	15595	Not applicable
Segment.12.Event3	Event 3	bool	3cec	15596	Not applicable
Segment.12.Event4	Event 4	bool	3ced	15597	Not applicable
Segment.12.Event5	Event 5	bool	3cee	15598	Not applicable
Segment.12.Event6	Event 6	bool	3cef	15599	Not applicable
Segment.12.Event7	Event 7	bool	3cf0	15600	Not applicable
Segment.12.Event8	Event 8	bool	3cf1	15601	Not applicable
Segment.12.GoBackTo	Go back to	uint8	3ce2	15586	Not applicable
Segment.12.SegmentName	Segment name	string_t	6bb7	27575	Not applicable
Segment.12.Type	Type	uint8	3cd0	15568	Not applicable
Segment.12.WaitFor	Wait for	uint8	3cdd	15581	Not applicable
Segment.13.Ch1Holdback	Channel 1 holdback type	uint8	3d09	15625	Not applicable
Segment.13.Ch1HoldbackVal	Channel 1 holdback value	float32	3d0b	15627	Same as Programmer.SetUp.Ch1PVInput
Segment.13.Ch1PVEvent	Channel 1 PV event	uint8	3d14	15636	Not applicable
Segment.13.Ch1PVEventUse	Channel 1 PV event use	bool	3d22	15650	Not applicable
Segment.13.Ch1PVEventVal	Channel 1 PV event value	float32	3d16	15638	Same as Programmer.SetUp.Ch1PVInput
Segment.13.Ch1Rate	Channel 1 rate	float32	3d06	15622	Set by Programmer.SetUp.RateResolution
Segment.13.Ch1Time	Channel 1 time	time_t	3d04	15620	Set by Network.Modbus.TimeFormat
Segment.13.Ch1TSP	Channel 1 target set-point	float32	3d02	15618	Same as Programmer.SetUp.Ch1PVInput
Segment.13.Ch1UserVal	Channel 1 user value	float32	3d18	15640	Same as Programmer.SetUp.ResetCh1UserVal
Segment.13.Ch1Wait	Channel 1 Wait	uint8	3d0e	15630	Not applicable
Segment.13.Ch1WaitVal	Channel 1 wait value	float32	3d10	15632	Same as Programmer.SetUp.PVWait1
Segment.13.Ch2Holdback	Channel 2 holdback type	uint8	3d0a	15626	Not applicable
Segment.13.Ch2HoldbackVal	Channel 2 holdback value	float32	3d0c	15628	Same as Programmer.SetUp.Ch2PVInput
Segment.13.Ch2PVEvent	Channel 2 PV event	uint8	3d15	15637	Not applicable
Segment.13.Ch2PVEventUse	Channel 2 PV event use	bool	3d23	15651	Not applicable
Segment.13.Ch2PVEventVal	Channel 2 PV event value	float32	3d17	15639	Same as Programmer.SetUp.Ch2PVInput
Segment.13.Ch2Rate	Channel 2 rate	float32	3d07	15623	Set by Programmer.SetUp.RateResolution
Segment.13.Ch2Time	Channel 2 time	time_t	3d05	15621	Set by Network.Modbus.TimeFormat
Segment.13.Ch2TSP	Channel 2 target set-point	float32	3d03	15619	Same as Programmer.SetUp.Ch2PVInput
Segment.13.Ch2UserVal	Channel 2 user value	float32	3d19	15641	Same as Programmer.SetUp.ResetCh2UserVal
Segment.13.Ch2Wait	Channel 2 Wait	uint8	3d0f	15631	Not applicable
Segment.13.Ch2WaitVal	Channel 2 wait value	float32	3d11	15633	Same as Programmer.SetUp.PVWait2
Segment.13.Cycles	Cycles	int16	3d13	15635	Not applicable
Segment.13.Duration	Duration	time_t	3d01	15617	Set by Network.Modbus.TimeFormat
Segment.13.EndType	End type	uint8	3d08	15624	Not applicable
Segment.13.Event1	Event 1	bool	3d1a	15642	Not applicable
Segment.13.Event2	Event 2	bool	3d1b	15643	Not applicable
Segment.13.Event3	Event 3	bool	3d1c	15644	Not applicable
Segment.13.Event4	Event 4	bool	3d1d	15645	Not applicable
Segment.13.Event5	Event 5	bool	3d1e	15646	Not applicable
Segment.13.Event6	Event 6	bool	3d1f	15647	Not applicable
Segment.13.Event7	Event 7	bool	3d20	15648	Not applicable
Segment.13.Event8	Event 8	bool	3d21	15649	Not applicable
Segment.13.GoBackTo	Go back to	uint8	3d12	15634	Not applicable
Segment.13.SegmentName	Segment name	string_t	6bcc	27596	Not applicable
Segment.13.Type	Type	uint8	3d00	15616	Not applicable
Segment.13.WaitFor	Wait for	uint8	3d0d	15629	Not applicable
Segment.14.Ch1Holdback	Channel 1 holdback type	uint8	3d39	15673	Not applicable
Segment.14.Ch1HoldbackVal	Channel 1 holdback value	float32	3d3b	15675	Same as Programmer.SetUp.Ch1PVInput
Segment.14.Ch1PVEvent	Channel 1 PV event	uint8	3d44	15684	Not applicable
Segment.14.Ch1PVEventUse	Channel 1 PV event use	bool	3d52	15698	Not applicable
Segment.14.Ch1PVEventVal	Channel 1 PV event value	float32	3d46	15686	Same as Programmer.SetUp.Ch1PVInput
Segment.14.Ch1Rate	Channel 1 rate	float32	3d36	15670	Set by Programmer.SetUp.RateResolution
Segment.14.Ch1Time	Channel 1 time	time_t	3d34	15668	Set by Network.Modbus.TimeFormat
Segment.14.Ch1TSP	Channel 1 target set-point	float32	3d32	15666	Same as Programmer.SetUp.Ch1PVInput
Segment.14.Ch1UserVal	Channel 1 user value	float32	3d48	15688	Same as Programmer.SetUp.ResetCh1UserVal
Segment.14.Ch1Wait	Channel 1 Wait	uint8	3d3e	15678	Not applicable
Segment.14.Ch1WaitVal	Channel 1 wait value	float32	3d40	15680	Same as Programmer.SetUp.PVWait1
Segment.14.Ch2Holdback	Channel 2 holdback type	uint8	3d3a	15674	Not applicable
Segment.14.Ch2HoldbackVal	Channel 2 holdback value	float32	3d3c	15676	Same as Programmer.SetUp.Ch2PVInput
Segment.14.Ch2PVEvent	Channel 2 PV event	uint8	3d45	15685	Not applicable
Segment.14.Ch2PVEventUse	Channel 2 PV event use	bool	3d53	15699	Not applicable
Segment.14.Ch2PVEventVal	Channel 2 PV event value	float32	3d47	15687	Same as Programmer.SetUp.Ch2PVInput
Segment.14.Ch2Rate	Channel 2 rate	float32	3d37	15671	Set by Programmer.SetUp.RateResolution
Segment.14.Ch2Time	Channel 2 time	time_t	3d35	15669	Set by Network.Modbus.TimeFormat
Segment.14.Ch2TSP	Channel 2 target set-point	float32	3d33	15667	Same as Programmer.SetUp.Ch2PVInput
Segment.14.Ch2UserVal	Channel 2 user value	float32	3d49	15689	Same as Programmer.SetUp.ResetCh2UserVal
Segment.14.Ch2Wait	Channel 2 Wait	uint8	3d3f	15679	Not applicable
Segment.14.Ch2WaitVal	Channel 2 wait value	float32	3d41	15681	Same as Programmer.SetUp.PVWait2
Segment.14.Cycles	Cycles	int16	3d43	15683	Not applicable
Segment.14.Duration	Duration	time_t	3d31	15665	Set by Network.Modbus.TimeFormat
Segment.14.EndType	End type	uint8	3d38	15672	Not applicable
Segment.14.Event1	Event 1	bool	3d4a	15690	Not applicable
Segment.14.Event2	Event 2	bool	3d4b	15691	Not applicable
Segment.14.Event3	Event 3	bool	3d4c	15692	Not applicable
Segment.14.Event4	Event 4	bool	3d4d	15693	Not applicable
Segment.14.Event5	Event 5	bool	3d4e	15694	Not applicable
Segment.14.Event6	Event 6	bool	3d4f	15695	Not applicable

For parameter values and settings (enumerations), see Segment 1

5.3 PARAMETER LIST (Cont.)

Parameter path	Description	Type	Hex	Dec	Resolution
Segment.14.Event7	Event 7	bool	3d50	15696	Not applicable
Segment.14.Event8	Event 8	bool	3d51	15697	Not applicable
Segment.14.GoBackTo	Go back to	uint8	3d42	15682	Not applicable
Segment.14.SegmentName	Segment name	string_t	6be1	27617	Not applicable
Segment.14.Type	Type	uint8	3d30	15664	Not applicable
Segment.14.WaitFor	Wait for	uint8	3d3d	15677	Not applicable
Segment.15.Ch1Holdback	Channel 1 holdback type	uint8	3d69	15721	Not applicable
Segment.15.Ch1HoldbackVal	Channel 1 holdback value	float32	3d6b	15723	Same as Programmer.SetUp.Ch1PVInput
Segment.15.Ch1PVEvent	Channel 1 PV event	uint8	3d74	15732	Not applicable
Segment.15.Ch1PVEventUse	Channel 1 PV event use	bool	3d82	15746	Not applicable
Segment.15.Ch1PVEventVal	Channel 1 PV event value	float32	3d76	15734	Same as Programmer.SetUp.Ch1PVInput
Segment.15.Ch1Rate	Channel 1 rate	float32	3d66	15718	Set by Programmer.SetUp.RateResolution
Segment.15.Ch1Time	Channel 1 time	time_t	3d64	15716	Set by Network.Modbus.TimeFormat
Segment.15.Ch1TSP	Channel 1 target set-point	float32	3d62	15714	Same as Programmer.SetUp.Ch1PVInput
Segment.15.Ch1UserVal	Channel 1 user value	float32	3d78	15736	Same as Programmer.SetUp.ResetCh1UserVal
Segment.15.Ch1Wait	Channel 1 Wait	uint8	3d6e	15726	Not applicable
Segment.15.Ch1WaitVal	Channel 1 wait value	float32	3d70	15728	Same as Programmer.SetUp.PVWait1
Segment.15.Ch2Holdback	Channel 2 holdback type	uint8	3d6a	15722	Not applicable
Segment.15.Ch2HoldbackVal	Channel 2 holdback value	float32	3d6c	15724	Same as Programmer.SetUp.Ch2PVInput
Segment.15.Ch2PVEvent	Channel 2 PV event	uint8	3d75	15733	Not applicable
Segment.15.Ch2PVEventUse	Channel 2 PV event use	bool	3d83	15747	Not applicable
Segment.15.Ch2PVEventVal	Channel 2 PV event value	float32	3d77	15735	Same as Programmer.SetUp.Ch2PVInput
Segment.15.Ch2Rate	Channel 2 rate	float32	3d67	15719	Set by Programmer.SetUp.RateResolution
Segment.15.Ch2Time	Channel 2 time	time_t	3d65	15717	Set by Network.Modbus.TimeFormat
Segment.15.Ch2TSP	Channel 2 target set-point	float32	3d63	15715	Same as Programmer.SetUp.Ch2PVInput
Segment.15.Ch2UserVal	Channel 2 user value	float32	3d79	15737	Same as Programmer.SetUp.ResetCh2UserVal
Segment.15.Ch2Wait	Channel 2 Wait	uint8	3d6f	15727	Not applicable
Segment.15.Ch2WaitVal	Channel 2 wait value	float32	3d71	15729	Same as Programmer.SetUp.PVWait2
Segment.15.Cycles	Cycles	int16	3d73	15731	Not applicable
Segment.15.Duration	Duration	time_t	3d61	15713	Set by Network.Modbus.TimeFormat
Segment.15.EndType	End type	uint8	3d68	15720	Not applicable
Segment.15.Event1	Event 1	bool	3d7a	15738	Not applicable
Segment.15.Event2	Event 2	bool	3d7b	15739	Not applicable
Segment.15.Event3	Event 3	bool	3d7c	15740	Not applicable
Segment.15.Event4	Event 4	bool	3d7d	15741	Not applicable
Segment.15.Event5	Event 5	bool	3d7e	15742	Not applicable
Segment.15.Event6	Event 6	bool	3d7f	15743	Not applicable
Segment.15.Event7	Event 7	bool	3d80	15744	Not applicable
Segment.15.Event8	Event 8	bool	3d81	15745	Not applicable
Segment.15.GoBackTo	Go back to	uint8	3d72	15730	Not applicable
Segment.15.SegmentName	Segment name	string_t	6bf6	27638	Not applicable
Segment.15.Type	Type	uint8	3d60	15712	Not applicable
Segment.15.WaitFor	Wait for	uint8	3d6d	15725	Not applicable
Segment.16.Ch1Holdback	Channel 1 holdback type	uint8	3d99	15769	Not applicable
Segment.16.Ch1HoldbackVal	Channel 1 holdback value	float32	3d9b	15771	Same as Programmer.SetUp.Ch1PVInput
Segment.16.Ch1PVEvent	Channel 1 PV event	uint8	3da4	15780	Not applicable
Segment.16.Ch1PVEventUse	Channel 1 PV event use	bool	3db2	15794	Not applicable
Segment.16.Ch1PVEventVal	Channel 1 PV event value	float32	3da6	15782	Same as Programmer.SetUp.Ch1PVInput
Segment.16.Ch1Rate	Channel 1 rate	float32	3d96	15766	Set by Programmer.SetUp.RateResolution
Segment.16.Ch1Time	Channel 1 time	time_t	3d94	15764	Set by Network.Modbus.TimeFormat
Segment.16.Ch1TSP	Channel 1 target set-point	float32	3d92	15762	Same as Programmer.SetUp.Ch1PVInput
Segment.16.Ch1UserVal	Channel 1 user value	float32	3da8	15784	Same as Programmer.SetUp.ResetCh1UserVal
Segment.16.Ch1Wait	Channel 1 Wait	uint8	3d9e	15774	Not applicable
Segment.16.Ch1WaitVal	Channel 1 wait value	float32	3da0	15776	Same as Programmer.SetUp.PVWait1
Segment.16.Ch2Holdback	Channel 2 holdback type	uint8	3d9a	15770	Not applicable
Segment.16.Ch2HoldbackVal	Channel 2 holdback value	float32	3d9c	15772	Same as Programmer.SetUp.Ch2PVInput
Segment.16.Ch2PVEvent	Channel 2 PV event	uint8	3da5	15781	Not applicable
Segment.16.Ch2PVEventUse	Channel 2 PV event use	bool	3db3	15795	Not applicable
Segment.16.Ch2PVEventVal	Channel 2 PV event value	float32	3da7	15783	Same as Programmer.SetUp.Ch2PVInput
Segment.16.Ch2Rate	Channel 2 rate	float32	3d97	15767	Set by Programmer.SetUp.RateResolution
Segment.16.Ch2Time	Channel 2 time	time_t	3d95	15765	Set by Network.Modbus.TimeFormat
Segment.16.Ch2TSP	Channel 2 target set-point	float32	3d93	15763	Same as Programmer.SetUp.Ch2PVInput
Segment.16.Ch2UserVal	Channel 2 user value	float32	3da9	15785	Same as Programmer.SetUp.ResetCh2UserVal
Segment.16.Ch2Wait	Channel 2 Wait	uint8	3d9f	15775	Not applicable
Segment.16.Ch2WaitVal	Channel 2 wait value	float32	3da1	15777	Same as Programmer.SetUp.PVWait2
Segment.16.Cycles	Cycles	int16	3da3	15779	Not applicable
Segment.16.Duration	Duration	time_t	3d91	15761	Set by Network.Modbus.TimeFormat
Segment.16.EndType	End type	uint8	3d98	15768	Not applicable
Segment.16.Event1	Event 1	bool	3daa	15786	Not applicable
Segment.16.Event2	Event 2	bool	3dab	15787	Not applicable
Segment.16.Event3	Event 3	bool	3dac	15788	Not applicable
Segment.16.Event4	Event 4	bool	3dad	15789	Not applicable
Segment.16.Event5	Event 5	bool	3dae	15790	Not applicable
Segment.16.Event6	Event 6	bool	3daf	15791	Not applicable
Segment.16.Event7	Event 7	bool	3db0	15792	Not applicable
Segment.16.Event8	Event 8	bool	3db1	15793	Not applicable
Segment.16.GoBackTo	Go back to	uint8	3da2	15778	Not applicable
Segment.16.SegmentName	Segment name	string_t	6c0b	27659	Not applicable
Segment.16.Type	Type	uint8	3d90	15760	Not applicable

For parameter values and settings (enumerations), see Segment 1

5.3 PARAMETER LIST (Cont.)

Parameter path	Description	Type	Hex	Dec	Resolution
Segment.16.WaitFor	Wait for	uint8	3d9d	15773	Not applicable
Segment.17.Ch1Holdback	Channel 1 holdback type	uint8	3dc9	15817	Not applicable
Segment.17.Ch1HoldbackVal	Channel 1 holdback value	float32	3dcb	15819	Same as Programmer.SetUp.Ch1PVInput
Segment.17.Ch1PVEvent	Channel 1 PV event	uint8	3dd4	15828	Not applicable
Segment.17.Ch1PVEventUse	Channel 1 PV event use	bool	3de2	15842	Not applicable
Segment.17.Ch1PVEventVal	Channel 1 PV event value	float32	3dd6	15830	Same as Programmer.SetUp.Ch1PVInput
Segment.17.Ch1Rate	Channel 1 rate	float32	3dc6	15814	Set by Programmer.SetUp.RateResolution
Segment.17.Ch1Time	Channel 1 time	time_t	3dc4	15812	Set by Network.Modbus.TimeFormat
Segment.17.Ch1TSP	Channel 1 target set-point	float32	3dc2	15810	Same as Programmer.SetUp.Ch1PVInput
Segment.17.Ch1UserVal	Channel 1 user value	float32	3dd8	15832	Same as Programmer.SetUp.ResetCh1UserVal
Segment.17.Ch1Wait	Channel 1 Wait	uint8	3dce	15822	Not applicable
Segment.17.Ch1WaitVal	Channel 1 wait value	float32	3dd0	15824	Same as Programmer.SetUp.PVWait1
Segment.17.Ch2Holdback	Channel 2 holdback type	uint8	3dca	15818	Not applicable
Segment.17.Ch2HoldbackVal	Channel 2 holdback value	float32	3dcc	15820	Same as Programmer.SetUp.Ch2PVInput
Segment.17.Ch2PVEvent	Channel 2 PV event	uint8	3dd5	15829	Not applicable
Segment.17.Ch2PVEventUse	Channel 2 PV event use	bool	3de3	15843	Not applicable
Segment.17.Ch2PVEventVal	Channel 2 PV event value	float32	3dd7	15831	Same as Programmer.SetUp.Ch2PVInput
Segment.17.Ch2Rate	Channel 2 rate	float32	3dc7	15815	Set by Programmer.SetUp.RateResolution
Segment.17.Ch2Time	Channel 2 time	time_t	3dc5	15813	Set by Network.Modbus.TimeFormat
Segment.17.Ch2TSP	Channel 2 target set-point	float32	3dc3	15811	Same as Programmer.SetUp.Ch2PVInput
Segment.17.Ch2UserVal	Channel 2 user value	float32	3dd9	15833	Same as Programmer.SetUp.ResetCh2UserVal
Segment.17.Ch2Wait	Channel 2 Wait	uint8	3dcf	15823	Not applicable
Segment.17.Ch2WaitVal	Channel 2 wait value	float32	3dd1	15825	Same as Programmer.SetUp.PVWait2
Segment.17.Cycles	Cycles	int16	3dd3	15827	Not applicable
Segment.17.Duration	Duration	time_t	3dc1	15809	Set by Network.Modbus.TimeFormat
Segment.17.EndType	End type	uint8	3dc8	15816	Not applicable
Segment.17.Event1	Event 1	bool	3dda	15834	Not applicable
Segment.17.Event2	Event 2	bool	3ddb	15835	Not applicable
Segment.17.Event3	Event 3	bool	3ddc	15836	Not applicable
Segment.17.Event4	Event 4	bool	3ddd	15837	Not applicable
Segment.17.Event5	Event 5	bool	3dde	15838	Not applicable
Segment.17.Event6	Event 6	bool	3ddf	15839	Not applicable
Segment.17.Event7	Event 7	bool	3de0	15840	Not applicable
Segment.17.Event8	Event 8	bool	3de1	15841	Not applicable
Segment.17.GoBackTo	Go back to	uint8	3dd2	15826	Not applicable
Segment.17.SegmentName	Segment name	string_t	6c20	27680	Not applicable
Segment.17.Type	Type	uint8	3dc0	15808	Not applicable
Segment.17.WaitFor	Wait for	uint8	3dcd	15821	Not applicable
Segment.18.Ch1Holdback	Channel 1 holdback type	uint8	3df9	15865	Not applicable
Segment.18.Ch1HoldbackVal	Channel 1 holdback value	float32	3dfb	15867	Same as Programmer.SetUp.Ch1PVInput
Segment.18.Ch1PVEvent	Channel 1 PV event	uint8	3e04	15876	Not applicable
Segment.18.Ch1PVEventUse	Channel 1 PV event use	bool	3e12	15890	Not applicable
Segment.18.Ch1PVEventVal	Channel 1 PV event value	float32	3e06	15878	Same as Programmer.SetUp.Ch1PVInput
Segment.18.Ch1Rate	Channel 1 rate	float32	3df6	15862	Set by Programmer.SetUp.RateResolution
Segment.18.Ch1Time	Channel 1 time	time_t	3df4	15860	Set by Network.Modbus.TimeFormat
Segment.18.Ch1TSP	Channel 1 target set-point	float32	3df2	15858	Same as Programmer.SetUp.Ch1PVInput
Segment.18.Ch1UserVal	Channel 1 user value	float32	3e08	15880	Same as Programmer.SetUp.ResetCh1UserVal
Segment.18.Ch1Wait	Channel 1 Wait	uint8	3dfe	15870	Not applicable
Segment.18.Ch1WaitVal	Channel 1 wait value	float32	3e00	15872	Same as Programmer.SetUp.PVWait1
Segment.18.Ch2Holdback	Channel 2 holdback type	uint8	3dfa	15866	Not applicable
Segment.18.Ch2HoldbackVal	Channel 2 holdback value	float32	3dfc	15868	Same as Programmer.SetUp.Ch2PVInput
Segment.18.Ch2PVEvent	Channel 2 PV event	uint8	3e05	15877	Not applicable
Segment.18.Ch2PVEventUse	Channel 2 PV event use	bool	3e13	15891	Not applicable
Segment.18.Ch2PVEventVal	Channel 2 PV event value	float32	3e07	15879	Same as Programmer.SetUp.Ch2PVInput
Segment.18.Ch2Rate	Channel 2 rate	float32	3df7	15863	Set by Programmer.SetUp.RateResolution
Segment.18.Ch2Time	Channel 2 time	time_t	3df5	15861	Set by Network.Modbus.TimeFormat
Segment.18.Ch2TSP	Channel 2 target set-point	float32	3df3	15859	Same as Programmer.SetUp.Ch2PVInput
Segment.18.Ch2UserVal	Channel 2 user value	float32	3e09	15881	Same as Programmer.SetUp.ResetCh2UserVal
Segment.18.Ch2Wait	Channel 2 Wait	uint8	3dff	15871	Not applicable
Segment.18.Ch2WaitVal	Channel 2 wait value	float32	3e01	15873	Same as Programmer.SetUp.PVWait2
Segment.18.Cycles	Cycles	int16	3e03	15875	Not applicable
Segment.18.Duration	Duration	time_t	3df1	15857	Set by Network.Modbus.TimeFormat
Segment.18.EndType	End type	uint8	3df8	15864	Not applicable
Segment.18.Event1	Event 1	bool	3e0a	15882	Not applicable
Segment.18.Event2	Event 2	bool	3e0b	15883	Not applicable
Segment.18.Event3	Event 3	bool	3e0c	15884	Not applicable
Segment.18.Event4	Event 4	bool	3e0d	15885	Not applicable
Segment.18.Event5	Event 5	bool	3e0e	15886	Not applicable
Segment.18.Event6	Event 6	bool	3e0f	15887	Not applicable
Segment.18.Event7	Event 7	bool	3e10	15888	Not applicable
Segment.18.Event8	Event 8	bool	3e11	15889	Not applicable
Segment.18.GoBackTo	Go back to	uint8	3e02	15874	Not applicable
Segment.18.SegmentName	Segment name	string_t	6c35	27701	Not applicable
Segment.18.Type	Type	uint8	3df0	15856	Not applicable
Segment.18.WaitFor	Wait for	uint8	3dfd	15869	Not applicable
Segment.19.Ch1Holdback	Channel 1 holdback type	uint8	3e29	15913	Not applicable
Segment.19.Ch1HoldbackVal	Channel 1 holdback value	float32	3e2b	15915	Same as Programmer.SetUp.Ch1PVInput
Segment.19.Ch1PVEvent	Channel 1 PV event	uint8	3e34	15924	Not applicable

For parameter values and settings (enumerations), see Segment 1

5.3 PARAMETER LIST (Cont.)

Parameter path	Description	Type	Hex	Dec	Resolution
Segment.19.Ch1PVEventUse	Channel 1 PV event use	bool	3e42	15938	Not applicable
Segment.19.Ch1PVEventVal	Channel 1 PV event value	float32	3e36	15926	Same as Programmer.SetUp.Ch1PVInput
Segment.19.Ch1Rate	Channel 1 rate	float32	3e26	15910	Set by Programmer.SetUp.RateResolution
Segment.19.Ch1Time	Channel 1 time	time_t	3e24	15908	Set by Network.Modbus.TimeFormat
Segment.19.Ch1TSP	Channel 1 target set-point	float32	3e22	15906	Same as Programmer.SetUp.Ch1PVInput
Segment.19.Ch1UserVal	Channel 1 user value	float32	3e38	15928	Same as Programmer.SetUp.ResetCh1UserVal
Segment.19.Ch1Wait	Channel 1 Wait	uint8	3e2e	15918	Not applicable
Segment.19.Ch1WaitVal	Channel 1 wait value	float32	3e30	15920	Same as Programmer.SetUp.PVWait1
Segment.19.Ch2Holdback	Channel 2 holdback type	uint8	3e2a	15914	Not applicable
Segment.19.Ch2HoldbackVal	Channel 2 holdback value	float32	3e2c	15916	Same as Programmer.SetUp.Ch2PVInput
Segment.19.Ch2PVEvent	Channel 2 PV event	uint8	3e35	15925	Not applicable
Segment.19.Ch2PVEventUse	Channel 2 PV event use	bool	3e43	15939	Not applicable
Segment.19.Ch2PVEventVal	Channel 2 PV event value	float32	3e37	15927	Same as Programmer.SetUp.Ch2PVInput
Segment.19.Ch2Rate	Channel 2 rate	float32	3e27	15911	Set by Programmer.SetUp.RateResolution
Segment.19.Ch2Time	Channel 2 time	time_t	3e25	15909	Set by Network.Modbus.TimeFormat
Segment.19.Ch2TSP	Channel 2 target set-point	float32	3e23	15907	Same as Programmer.SetUp.Ch2PVInput
Segment.19.Ch2UserVal	Channel 2 user value	float32	3e39	15929	Same as Programmer.SetUp.ResetCh2UserVal
Segment.19.Ch2Wait	Channel 2 Wait	uint8	3e2f	15919	Not applicable
Segment.19.Ch2WaitVal	Channel 2 wait value	float32	3e31	15921	Same as Programmer.SetUp.PVWait2
Segment.19.Cycles	Cycles	int16	3e33	15923	Not applicable
Segment.19.Duration	Duration	time_t	3e21	15905	Set by Network.Modbus.TimeFormat
Segment.19.EndType	End type	uint8	3e28	15912	Not applicable
Segment.19.Event1	Event 1	bool	3e3a	15930	Not applicable
Segment.19.Event2	Event 2	bool	3e3b	15931	Not applicable
Segment.19.Event3	Event 3	bool	3e3c	15932	Not applicable
Segment.19.Event4	Event 4	bool	3e3d	15933	Not applicable
Segment.19.Event5	Event 5	bool	3e3e	15934	Not applicable
Segment.19.Event6	Event 6	bool	3e3f	15935	Not applicable
Segment.19.Event7	Event 7	bool	3e40	15936	Not applicable
Segment.19.Event8	Event 8	bool	3e41	15937	Not applicable
Segment.19.GoBackTo	Go back to	uint8	3e32	15922	Not applicable
Segment.19.SegmentName	Segment name	string_t	6c4a	27722	Not applicable
Segment.19.Type	Type	uint8	3e20	15904	Not applicable
Segment.19.WaitFor	Wait for	uint8	3e2d	15917	Not applicable
Segment.20.Ch1Holdback	Channel 1 holdback type	uint8	3e59	15961	Not applicable
Segment.20.Ch1HoldbackVal	Channel 1 holdback value	float32	3e5b	15963	Same as Programmer.SetUp.Ch1PVInput
Segment.20.Ch1PVEvent	Channel 1 PV event	uint8	3e64	15972	Not applicable
Segment.20.Ch1PVEventUse	Channel 1 PV event use	bool	3e72	15986	Not applicable
Segment.20.Ch1PVEventVal	Channel 1 PV event value	float32	3e66	15974	Same as Programmer.SetUp.Ch1PVInput
Segment.20.Ch1Rate	Channel 1 rate	float32	3e56	15958	Set by Programmer.SetUp.RateResolution
Segment.20.Ch1Time	Channel 1 time	time_t	3e54	15956	Set by Network.Modbus.TimeFormat
Segment.20.Ch1TSP	Channel 1 target set-point	float32	3e52	15954	Same as Programmer.SetUp.Ch1PVInput
Segment.20.Ch1UserVal	Channel 1 user value	float32	3e68	15976	Same as Programmer.SetUp.ResetCh1UserVal
Segment.20.Ch1Wait	Channel 1 Wait	uint8	3e5e	15966	Not applicable
Segment.20.Ch1WaitVal	Channel 1 wait value	float32	3e60	15968	Same as Programmer.SetUp.PVWait1
Segment.20.Ch2Holdback	Channel 2 holdback type	uint8	3e5a	15962	Not applicable
Segment.20.Ch2HoldbackVal	Channel 2 holdback value	float32	3e5c	15964	Same as Programmer.SetUp.Ch2PVInput
Segment.20.Ch2PVEvent	Channel 2 PV event	uint8	3e65	15973	Not applicable
Segment.20.Ch2PVEventUse	Channel 2 PV event use	bool	3e73	15987	Not applicable
Segment.20.Ch2PVEventVal	Channel 2 PV event value	float32	3e67	15975	Same as Programmer.SetUp.Ch2PVInput
Segment.20.Ch2Rate	Channel 2 rate	float32	3e57	15959	Set by Programmer.SetUp.RateResolution
Segment.20.Ch2Time	Channel 2 time	time_t	3e55	15957	Set by Network.Modbus.TimeFormat
Segment.20.Ch2TSP	Channel 2 target set-point	float32	3e53	15955	Same as Programmer.SetUp.Ch2PVInput
Segment.20.Ch2UserVal	Channel 2 user value	float32	3e69	15977	Same as Programmer.SetUp.ResetCh2UserVal
Segment.20.Ch2Wait	Channel 2 Wait	uint8	3e5f	15967	Not applicable
Segment.20.Ch2WaitVal	Channel 2 wait value	float32	3e61	15969	Same as Programmer.SetUp.PVWait2
Segment.20.Cycles	Cycles	int16	3e63	15971	Not applicable
Segment.20.Duration	Duration	time_t	3e51	15953	Set by Network.Modbus.TimeFormat
Segment.20.EndType	End type	uint8	3e58	15960	Not applicable
Segment.20.Event1	Event 1	bool	3e6a	15978	Not applicable
Segment.20.Event2	Event 2	bool	3e6b	15979	Not applicable
Segment.20.Event3	Event 3	bool	3e6c	15980	Not applicable
Segment.20.Event4	Event 4	bool	3e6d	15981	Not applicable
Segment.20.Event5	Event 5	bool	3e6e	15982	Not applicable
Segment.20.Event6	Event 6	bool	3e6f	15983	Not applicable
Segment.20.Event7	Event 7	bool	3e70	15984	Not applicable
Segment.20.Event8	Event 8	bool	3e71	15985	Not applicable
Segment.20.GoBackTo	Go back to	uint8	3e62	15970	Not applicable
Segment.20.SegmentName	Segment name	string_t	6c5f	27743	Not applicable
Segment.20.Type	Type	uint8	3e50	15952	Not applicable
Segment.20.WaitFor	Wait for	uint8	3e5d	15965	Not applicable
Segment.21.Ch1Holdback	Channel 1 holdback type	uint8	3e89	16009	Not applicable
Segment.21.Ch1HoldbackVal	Channel 1 holdback value	float32	3e8b	16011	Same as Programmer.SetUp.Ch1PVInput
Segment.21.Ch1PVEvent	Channel 1 PV event	uint8	3e94	16020	Not applicable
Segment.21.Ch1PVEventUse	Channel 1 PV event use	bool	3ea2	16034	Not applicable
Segment.21.Ch1PVEventVal	Channel 1 PV event value	float32	3e96	16022	Same as Programmer.SetUp.Ch1PVInput
Segment.21.Ch1Rate	Channel 1 rate	float32	3e86	16006	Set by Programmer.SetUp.RateResolution
Segment.21.Ch1Time	Channel 1 time	time_t	3e84	16004	Set by Network.Modbus.TimeFormat
Segment.21.Ch1TSP	Channel 1 target set-point	float32	3e82	16002	Same as Programmer.SetUp.Ch1PVInput

For parameter values and settings (enumerations), see Segment 1

5.3 PARAMETER LIST (Cont.)

Parameter path	Description	Type	Hex	Dec	Resolution
Segment.21.Ch1UserVal	Channel 1 user value	float32	3e98	16024	Same as Programmer.SetUp.ResetCh1UserVal
Segment.21.Ch1Wait	Channel 1 Wait	uint8	3e8e	16014	Not applicable
Segment.21.Ch1WaitVal	Channel 1 wait value	float32	3e90	16016	Same as Programmer.SetUp.PVWait1
Segment.21.Ch2Holdback	Channel 2 holdback type	uint8	3e8a	16010	Not applicable
Segment.21.Ch2HoldbackVal	Channel 2 holdback value	float32	3e8c	16012	Same as Programmer.SetUp.Ch2PVInput
Segment.21.Ch2PVEvent	Channel 2 PV event	uint8	3e95	16021	Not applicable
Segment.21.Ch2PVEventUse	Channel 2 PV event use	bool	3ea3	16035	Not applicable
Segment.21.Ch2PVEventVal	Channel 2 PV event value	float32	3e97	16023	Same as Programmer.SetUp.Ch2PVInput
Segment.21.Ch2Rate	Channel 2 rate	float32	3e87	16007	Set by Programmer.SetUp.RateResolution
Segment.21.Ch2Time	Channel 2 time	time_t	3e85	16005	Set by Network.Modbus.TimeFormat
Segment.21.Ch2TSP	Channel 2 target set-point	float32	3e83	16003	Same as Programmer.SetUp.Ch2PVInput
Segment.21.Ch2UserVal	Channel 2 user value	float32	3e99	16025	Same as Programmer.SetUp.ResetCh2UserVal
Segment.21.Ch2Wait	Channel 2 Wait	uint8	3e8f	16015	Not applicable
Segment.21.Ch2WaitVal	Channel 2 wait value	float32	3e91	16017	Same as Programmer.SetUp.PVWait2
Segment.21.Cycles	Cycles	int16	3e93	16019	Not applicable
Segment.21.Duration	Duration	time_t	3e81	16001	Set by Network.Modbus.TimeFormat
Segment.21.EndType	End type	uint8	3e88	16008	Not applicable
Segment.21.Event1	Event 1	bool	3e9a	16026	Not applicable
Segment.21.Event2	Event 2	bool	3e9b	16027	Not applicable
Segment.21.Event3	Event 3	bool	3e9c	16028	Not applicable
Segment.21.Event4	Event 4	bool	3e9d	16029	Not applicable
Segment.21.Event5	Event 5	bool	3e9e	16030	Not applicable
Segment.21.Event6	Event 6	bool	3e9f	16031	Not applicable
Segment.21.Event7	Event 7	bool	3ea0	16032	Not applicable
Segment.21.Event8	Event 8	bool	3ea1	16033	Not applicable
Segment.21.GoBackTo	Go back to	uint8	3e92	16018	Not applicable
Segment.21.SegmentName	Segment name	string_t	6c74	27764	Not applicable
Segment.21.Type	Type	uint8	3e80	16000	Not applicable
Segment.21.WaitFor	Wait for	uint8	3e8d	16013	Not applicable
Segment.22.Ch1Holdback	Channel 1 holdback type	uint8	3eb9	16057	Not applicable
Segment.22.Ch1HoldbackVal	Channel 1 holdback value	float32	3ebb	16059	Same as Programmer.SetUp.Ch1PVInput
Segment.22.Ch1PVEvent	Channel 1 PV event	uint8	3ec4	16068	Not applicable
Segment.22.Ch1PVEventUse	Channel 1 PV event use	bool	3ed2	16082	Not applicable
Segment.22.Ch1PVEventVal	Channel 1 PV event value	float32	3ec6	16070	Same as Programmer.SetUp.Ch1PVInput
Segment.22.Ch1Rate	Channel 1 rate	float32	3eb6	16054	Set by Programmer.SetUp.RateResolution
Segment.22.Ch1Time	Channel 1 time	time_t	3eb4	16052	Set by Network.Modbus.TimeFormat
Segment.22.Ch1TSP	Channel 1 target set-point	float32	3eb2	16050	Same as Programmer.SetUp.Ch1PVInput
Segment.22.Ch1UserVal	Channel 1 user value	float32	3ec8	16072	Same as Programmer.SetUp.ResetCh1UserVal
Segment.22.Ch1Wait	Channel 1 Wait	uint8	3ebe	16062	Not applicable
Segment.22.Ch1WaitVal	Channel 1 wait value	float32	3ec0	16064	Same as Programmer.SetUp.PVWait1
Segment.22.Ch2Holdback	Channel 2 holdback type	uint8	3eba	16058	Not applicable
Segment.22.Ch2HoldbackVal	Channel 2 holdback value	float32	3ebc	16060	Same as Programmer.SetUp.Ch2PVInput
Segment.22.Ch2PVEvent	Channel 2 PV event	uint8	3ec5	16069	Not applicable
Segment.22.Ch2PVEventUse	Channel 2 PV event use	bool	3ed3	16083	Not applicable
Segment.22.Ch2PVEventVal	Channel 2 PV event value	float32	3ec7	16071	Same as Programmer.SetUp.Ch2PVInput
Segment.22.Ch2Rate	Channel 2 rate	float32	3eb7	16055	Set by Programmer.SetUp.RateResolution
Segment.22.Ch2Time	Channel 2 time	time_t	3eb5	16053	Set by Network.Modbus.TimeFormat
Segment.22.Ch2TSP	Channel 2 target set-point	float32	3eb3	16051	Same as Programmer.SetUp.Ch2PVInput
Segment.22.Ch2UserVal	Channel 2 user value	float32	3ec9	16073	Same as Programmer.SetUp.ResetCh2UserVal
Segment.22.Ch2Wait	Channel 2 Wait	uint8	3ebf	16063	Not applicable
Segment.22.Ch2WaitVal	Channel 2 wait value	float32	3ec1	16065	Same as Programmer.SetUp.PVWait2
Segment.22.Cycles	Cycles	int16	3ec3	16067	Not applicable
Segment.22.Duration	Duration	time_t	3eb1	16049	Set by Network.Modbus.TimeFormat
Segment.22.EndType	End type	uint8	3eb8	16056	Not applicable
Segment.22.Event1	Event 1	bool	3eca	16074	Not applicable
Segment.22.Event2	Event 2	bool	3ecb	16075	Not applicable
Segment.22.Event3	Event 3	bool	3ecc	16076	Not applicable
Segment.22.Event4	Event 4	bool	3ecd	16077	Not applicable
Segment.22.Event5	Event 5	bool	3ece	16078	Not applicable
Segment.22.Event6	Event 6	bool	3ecf	16079	Not applicable
Segment.22.Event7	Event 7	bool	3ed0	16080	Not applicable
Segment.22.Event8	Event 8	bool	3ed1	16081	Not applicable
Segment.22.GoBackTo	Go back to	uint8	3ec2	16066	Not applicable
Segment.22.SegmentName	Segment name	string_t	6c89	27785	Not applicable
Segment.22.Type	Type	uint8	3eb0	16048	Not applicable
Segment.22.WaitFor	Wait for	uint8	3ebd	16061	Not applicable
Segment.23.Ch1Holdback	Channel 1 holdback type	uint8	3ee9	16105	Not applicable
Segment.23.Ch1HoldbackVal	Channel 1 holdback value	float32	3eeb	16107	Same as Programmer.SetUp.Ch1PVInput
Segment.23.Ch1PVEvent	Channel 1 PV event	uint8	3ef4	16116	Not applicable
Segment.23.Ch1PVEventUse	Channel 1 PV event use	bool	3f02	16130	Not applicable
Segment.23.Ch1PVEventVal	Channel 1 PV event value	float32	3ef6	16118	Same as Programmer.SetUp.Ch1PVInput
Segment.23.Ch1Rate	Channel 1 rate	float32	3ee6	16102	Set by Programmer.SetUp.RateResolution
Segment.23.Ch1Time	Channel 1 time	time_t	3ee4	16100	Set by Network.Modbus.TimeFormat
Segment.23.Ch1TSP	Channel 1 target set-point	float32	3ee2	16098	Same as Programmer.SetUp.Ch1PVInput
Segment.23.Ch1UserVal	Channel 1 user value	float32	3ef8	16120	Same as Programmer.SetUp.ResetCh1UserVal
Segment.23.Ch1Wait	Channel 1 Wait	uint8	3eee	16110	Not applicable
Segment.23.Ch1WaitVal	Channel 1 wait value	float32	3ef0	16112	Same as Programmer.SetUp.PVWait1
Segment.23.Ch2Holdback	Channel 2 holdback type	uint8	3eea	16106	Not applicable
Segment.23.Ch2HoldbackVal	Channel 2 holdback value	float32	3eec	16108	Same as Programmer.SetUp.Ch2PVInput

For parameter values and settings (enumerations), see Segment 1

5.3 PARAMETER LIST (Cont.)

Parameter path	Description	Type	Hex	Dec	Resolution
Segment.23.Ch2PVEvent	Channel 2 PV event	uint8	3ef5	16117	Not applicable
Segment.23.Ch2PVEventUse	Channel 2 PV event use	bool	3f03	16131	Not applicable
Segment.23.Ch2PVEventVal	Channel 2 PV event value	float32	3ef7	16119	Same as Programmer.SetUp.Ch2PVInput
Segment.23.Ch2Rate	Channel 2 rate	float32	3ee7	16103	Set by Programmer.SetUp.RateResolution
Segment.23.Ch2Time	Channel 2 time	time_t	3ee5	16101	Set by Network.Modbus.TimeFormat
Segment.23.Ch2TSP	Channel 2 target set-point	float32	3ee3	16099	Same as Programmer.SetUp.Ch2PVInput
Segment.23.Ch2UserVal	Channel 2 user value	float32	3ef9	16121	Same as Programmer.SetUp.ResetCh2UserVal
Segment.23.Ch2Wait	Channel 2 Wait	uint8	3eef	16111	Not applicable
Segment.23.Ch2WaitVal	Channel 2 wait value	float32	3ef1	16113	Same as Programmer.SetUp.PVWait2
Segment.23.Cycles	Cycles	int16	3ef3	16115	Not applicable
Segment.23.Duration	Duration	time_t	3ee1	16097	Set by Network.Modbus.TimeFormat
Segment.23.EndType	End type	uint8	3ee8	16104	Not applicable
Segment.23.Event1	Event 1	bool	3efa	16122	Not applicable
Segment.23.Event2	Event 2	bool	3efb	16123	Not applicable
Segment.23.Event3	Event 3	bool	3efc	16124	Not applicable
Segment.23.Event4	Event 4	bool	3efd	16125	Not applicable
Segment.23.Event5	Event 5	bool	3efe	16126	Not applicable
Segment.23.Event6	Event 6	bool	3eff	16127	Not applicable
Segment.23.Event7	Event 7	bool	3f00	16128	Not applicable
Segment.23.Event8	Event 8	bool	3f01	16129	Not applicable
Segment.23.GoBackTo	Go back to	uint8	3ef2	16114	Not applicable
Segment.23.SegmentName	Segment name	string_t	6c9e	27806	Not applicable
Segment.23.Type	Type	uint8	3ee0	16096	Not applicable
Segment.23.WaitFor	Wait for	uint8	3eed	16109	Not applicable
Segment.24.Ch1Holdback	Channel 1 holdback type	uint8	3f19	16153	Not applicable
Segment.24.Ch1HoldbackVal	Channel 1 holdback value	float32	3f1b	16155	Same as Programmer.SetUp.Ch1PVInput
Segment.24.Ch1PVEvent	Channel 1 PV event	uint8	3f24	16164	Not applicable
Segment.24.Ch1PVEventUse	Channel 1 PV event use	bool	3f32	16178	Not applicable
Segment.24.Ch1PVEventVal	Channel 1 PV event value	float32	3f26	16166	Same as Programmer.SetUp.Ch1PVInput
Segment.24.Ch1Rate	Channel 1 rate	float32	3f16	16150	Set by Programmer.SetUp.RateResolution
Segment.24.Ch1Time	Channel 1 time	time_t	3f14	16148	Set by Network.Modbus.TimeFormat
Segment.24.Ch1TSP	Channel 1 target set-point	float32	3f12	16146	Same as Programmer.SetUp.Ch1PVInput
Segment.24.Ch1UserVal	Channel 1 user value	float32	3f28	16168	Same as Programmer.SetUp.ResetCh1UserVal
Segment.24.Ch1Wait	Channel 1 Wait	uint8	3f1e	16158	Not applicable
Segment.24.Ch1WaitVal	Channel 1 wait value	float32	3f20	16160	Same as Programmer.SetUp.PVWait1
Segment.24.Ch2Holdback	Channel 2 holdback type	uint8	3f1a	16154	Not applicable
Segment.24.Ch2HoldbackVal	Channel 2 holdback value	float32	3f1c	16156	Same as Programmer.SetUp.Ch2PVInput
Segment.24.Ch2PVEvent	Channel 2 PV event	uint8	3f25	16165	Not applicable
Segment.24.Ch2PVEventUse	Channel 2 PV event use	bool	3f33	16179	Not applicable
Segment.24.Ch2PVEventVal	Channel 2 PV event value	float32	3f27	16167	Same as Programmer.SetUp.Ch2PVInput
Segment.24.Ch2Rate	Channel 2 rate	float32	3f17	16151	Set by Programmer.SetUp.RateResolution
Segment.24.Ch2Time	Channel 2 time	time_t	3f15	16149	Set by Network.Modbus.TimeFormat
Segment.24.Ch2TSP	Channel 2 target set-point	float32	3f13	16147	Same as Programmer.SetUp.Ch2PVInput
Segment.24.Ch2UserVal	Channel 2 user value	float32	3f29	16169	Same as Programmer.SetUp.ResetCh2UserVal
Segment.24.Ch2Wait	Channel 2 Wait	uint8	3f1f	16159	Not applicable
Segment.24.Ch2WaitVal	Channel 2 wait value	float32	3f21	16161	Same as Programmer.SetUp.PVWait2
Segment.24.Cycles	Cycles	int16	3f23	16163	Not applicable
Segment.24.Duration	Duration	time_t	3f11	16145	Set by Network.Modbus.TimeFormat
Segment.24.EndType	End type	uint8	3f18	16152	Not applicable
Segment.24.Event1	Event 1	bool	3f2a	16170	Not applicable
Segment.24.Event2	Event 2	bool	3f2b	16171	Not applicable
Segment.24.Event3	Event 3	bool	3f2c	16172	Not applicable
Segment.24.Event4	Event 4	bool	3f2d	16173	Not applicable
Segment.24.Event5	Event 5	bool	3f2e	16174	Not applicable
Segment.24.Event6	Event 6	bool	3f2f	16175	Not applicable
Segment.24.Event7	Event 7	bool	3f30	16176	Not applicable
Segment.24.Event8	Event 8	bool	3f31	16177	Not applicable
Segment.24.GoBackTo	Go back to	uint8	3f22	16162	Not applicable
Segment.24.SegmentName	Segment name	string_t	6cb3	27827	Not applicable
Segment.24.Type	Type	uint8	3f10	16144	Not applicable
Segment.24.WaitFor	Wait for	uint8	3f1d	16157	Not applicable
Segment.25.Ch1Holdback	Channel 1 holdback type	uint8	3f49	16201	Not applicable
Segment.25.Ch1HoldbackVal	Channel 1 holdback value	float32	3f4b	16203	Same as Programmer.SetUp.Ch1PVInput
Segment.25.Ch1PVEvent	Channel 1 PV event	uint8	3f54	16212	Not applicable
Segment.25.Ch1PVEventUse	Channel 1 PV event use	bool	3f62	16226	Not applicable
Segment.25.Ch1PVEventVal	Channel 1 PV event value	float32	3f56	16214	Same as Programmer.SetUp.Ch1PVInput
Segment.25.Ch1Rate	Channel 1 rate	float32	3f46	16198	Set by Programmer.SetUp.RateResolution
Segment.25.Ch1Time	Channel 1 time	time_t	3f44	16196	Set by Network.Modbus.TimeFormat
Segment.25.Ch1TSP	Channel 1 target set-point	float32	3f42	16194	Same as Programmer.SetUp.Ch1PVInput
Segment.25.Ch1UserVal	Channel 1 user value	float32	3f58	16216	Same as Programmer.SetUp.ResetCh1UserVal
Segment.25.Ch1Wait	Channel 1 Wait	uint8	3f4e	16206	Not applicable
Segment.25.Ch1WaitVal	Channel 1 wait value	float32	3f50	16208	Same as Programmer.SetUp.PVWait1
Segment.25.Ch2Holdback	Channel 2 holdback type	uint8	3f4a	16202	Not applicable
Segment.25.Ch2HoldbackVal	Channel 2 holdback value	float32	3f4c	16204	Same as Programmer.SetUp.Ch2PVInput
Segment.25.Ch2PVEvent	Channel 2 PV event	uint8	3f55	16213	Not applicable
Segment.25.Ch2PVEventUse	Channel 2 PV event use	bool	3f63	16227	Not applicable
Segment.25.Ch2PVEventVal	Channel 2 PV event value	float32	3f57	16215	Same as Programmer.SetUp.Ch2PVInput
Segment.25.Ch2Rate	Channel 2 rate	float32	3f47	16199	Set by Programmer.SetUp.RateResolution
Segment.25.Ch2Time	Channel 2 time	time_t	3f45	16197	Set by Network.Modbus.TimeFormat

For parameter values and settings (enumerations), see Segment 1

5.3 PARAMETER LIST (Cont.)

Parameter path	Description	Type	Hex	Dec	Resolution
Segment.25.Ch2TSP	Channel 2 target set-point	float32	3f43	16195	Same as Programmer.SetUp.Ch2PVInput
Segment.25.Ch2UserVal	Channel 2 user value	float32	3f59	16217	Same as Programmer.SetUp.ResetCh2UserVal
Segment.25.Ch2Wait	Channel 2 Wait	uint8	3f4f	16207	Not applicable
Segment.25.Ch2WaitVal	Channel 2 wait value	float32	3f51	16209	Same as Programmer.SetUp.PVWait2
Segment.25.Cycles	Cycles	int16	3f53	16211	Not applicable
Segment.25.Duration	Duration	time_t	3f41	16193	Set by Network.Modbus.TimeFormat
Segment.25.EndType	End type	uint8	3f48	16200	Not applicable
Segment.25.Event1	Event 1	bool	3f5a	16218	Not applicable
Segment.25.Event2	Event 2	bool	3f5b	16219	Not applicable
Segment.25.Event3	Event 3	bool	3f5c	16220	Not applicable
Segment.25.Event4	Event 4	bool	3f5d	16221	Not applicable
Segment.25.Event5	Event 5	bool	3f5e	16222	Not applicable
Segment.25.Event6	Event 6	bool	3f5f	16223	Not applicable
Segment.25.Event7	Event 7	bool	3f60	16224	Not applicable
Segment.25.Event8	Event 8	bool	3f61	16225	Not applicable
Segment.25.GoBackTo	Go back to	uint8	3f52	16210	Not applicable
Segment.25.SegmentName	Segment name	string_t	6cc8	27848	Not applicable
Segment.25.Type	Type	uint8	3f40	16192	Not applicable
Segment.25.WaitFor	Wait for	uint8	3f4d	16205	Not applicable
Segment.26.Ch1Holdback	Channel 1 holdback type	uint8	3f79	16249	Not applicable
Segment.26.Ch1HoldbackVal	Channel 1 holdback value	float32	3f7b	16251	Same as Programmer.SetUp.Ch1PVInput
Segment.26.Ch1PVEvent	Channel 1 PV event	uint8	3f84	16260	Not applicable
Segment.26.Ch1PVEventUse	Channel 1 PV event use	bool	3f92	16274	Not applicable
Segment.26.Ch1PVEventVal	Channel 1 PV event value	float32	3f86	16262	Same as Programmer.SetUp.Ch1PVInput
Segment.26.Ch1Rate	Channel 1 rate	float32	3f76	16246	Set by Programmer.SetUp.RateResolution
Segment.26.Ch1Time	Channel 1 time	time_t	3f74	16244	Set by Network.Modbus.TimeFormat
Segment.26.Ch1TSP	Channel 1 target set-point	float32	3f72	16242	Same as Programmer.SetUp.Ch1PVInput
Segment.26.Ch1UserVal	Channel 1 user value	float32	3f88	16264	Same as Programmer.SetUp.ResetCh1UserVal
Segment.26.Ch1Wait	Channel 1 Wait	uint8	3f7e	16254	Not applicable
Segment.26.Ch1WaitVal	Channel 1 wait value	float32	3f80	16256	Same as Programmer.SetUp.PVWait1
Segment.26.Ch2Holdback	Channel 2 holdback type	uint8	3f7a	16250	Not applicable
Segment.26.Ch2HoldbackVal	Channel 2 holdback value	float32	3f7c	16252	Same as Programmer.SetUp.Ch2PVInput
Segment.26.Ch2PVEvent	Channel 2 PV event	uint8	3f85	16261	Not applicable
Segment.26.Ch2PVEventUse	Channel 2 PV event use	bool	3f93	16275	Not applicable
Segment.26.Ch2PVEventVal	Channel 2 PV event value	float32	3f87	16263	Same as Programmer.SetUp.Ch2PVInput
Segment.26.Ch2Rate	Channel 2 rate	float32	3f77	16247	Set by Programmer.SetUp.RateResolution
Segment.26.Ch2Time	Channel 2 time	time_t	3f75	16245	Set by Network.Modbus.TimeFormat
Segment.26.Ch2TSP	Channel 2 target set-point	float32	3f73	16243	Same as Programmer.SetUp.Ch2PVInput
Segment.26.Ch2UserVal	Channel 2 user value	float32	3f89	16265	Same as Programmer.SetUp.ResetCh2UserVal
Segment.26.Ch2Wait	Channel 2 Wait	uint8	3f7f	16255	Not applicable
Segment.26.Ch2WaitVal	Channel 2 wait value	float32	3f81	16257	Same as Programmer.SetUp.PVWait2
Segment.26.Cycles	Cycles	int16	3f83	16259	Not applicable
Segment.26.Duration	Duration	time_t	3f71	16241	Set by Network.Modbus.TimeFormat
Segment.26.EndType	End type	uint8	3f78	16248	Not applicable
Segment.26.Event1	Event 1	bool	3f8a	16266	Not applicable
Segment.26.Event2	Event 2	bool	3f8b	16267	Not applicable
Segment.26.Event3	Event 3	bool	3f8c	16268	Not applicable
Segment.26.Event4	Event 4	bool	3f8d	16269	Not applicable
Segment.26.Event5	Event 5	bool	3f8e	16270	Not applicable
Segment.26.Event6	Event 6	bool	3f8f	16271	Not applicable
Segment.26.Event7	Event 7	bool	3f90	16272	Not applicable
Segment.26.Event8	Event 8	bool	3f91	16273	Not applicable
Segment.26.GoBackTo	Go back to	uint8	3f82	16258	Not applicable
Segment.26.SegmentName	Segment name	string_t	6cdd	27869	Not applicable
Segment.26.Type	Type	uint8	3f70	16240	Not applicable
Segment.26.WaitFor	Wait for	uint8	3f7d	16253	Not applicable
Steriliser.AutoCounter	Automatically increments the cycle number	bool	2e0f	11791	Not applicable
Steriliser.CycleNumber	Current cycle number	int32	2e04	11780	Not applicable
Steriliser.CycleStatus	The current cycle status. 0 = Waiting start 1 = Waiting 2 = Equilibrisation 3 = Sterilising 4 = Passed 5 = Failed 6 = Aborted 7 = Test cycle	uint8	2e08	11784	Not applicable
Steriliser.CycleTime	The total cycle time	time_t	2e25	11813	Set by Network.Modbus.TimeFormat
Steriliser.EquilibrationTime	The equilibration time period for the current cycle.	time_t	2e0c	11788	Set by Network.Modbus.TimeFormat
Steriliser.FailureDwell1	Failure alarm dwell time for input 1	time_t	2e22	11810	Set by Network.Modbus.TimeFormat
Steriliser.FailureDwell2	Failure alarm dwell time for input 2	time_t	2e2b	11819	Set by Network.Modbus.TimeFormat
Steriliser.FailureDwell3	Failure alarm dwell time for input 3	time_t	2e2c	11820	Set by Network.Modbus.TimeFormat
Steriliser.FailureDwell4	Failure alarm dwell time for input 4	time_t	2e2d	11821	Set by Network.Modbus.TimeFormat
Steriliser.FileByTag	Name historical files by cycle number and tagbool 0 = File by Tag Off; 1 = File by Tag On	2e21		11809	Not applicable
Steriliser.FileTag	Used as part of the historical filename	string_t	68f7	26871	Not applicable
Steriliser.Fvalue	F0 (A0)	time_t	2e26	11814	Set by Network.Modbus.TimeFormat
Steriliser.Input1PV	Input 1	float32	2e00	11776	0dp
Steriliser.Input2PV	Input 2	float32	2e01	11777	0dp
Steriliser.Input3PV	Input 3	float32	2e02	11778	0dp
Steriliser.Input4PV	Input 4	float32	2e03	11779	0dp

For parameter values and settings (enumerations), see Segment 1

5.3 PARAMETER LIST (Cont.)

Parameter path	Description	Type	Hex	Dec	Resolution
Steriliser.InputType1	Input type 1 0 = Off 1 = thermocouple 2 = Rising pressure 3 = Falling pressure 4 = Rise air detect 5 = Fall air detect	uint8	2e1d	11805	Not applicable
Steriliser.InputType2	Input type 2 (as Input type 1, above)	uint8	2e1e	11806	Not applicable
Steriliser.InputType3	Input type 3 (as Input type 1, above)	uint8	2e1f	11807	Not applicable
Steriliser.InputType4	Input type 4 (as Input type 1, above)	uint8	2e20	11808	Not applicable
Steriliser.IP1BandHigh	Sterilisation temperature input 1 band high.	float32	2e0a	11786	Same as Steriliser.Input1PV
Steriliser.IP1BandLow	Sterilisation temperature input 1 band low.	float32	2e0b	11787	Same as Steriliser.Input1PV
Steriliser.IP1TargetSP	Input 1 target setpoint	float32	2e07	11783	Same as Steriliser.Input1PV
Steriliser.IP2BandHigh	Sterilisation temperature input 2 band high.	float32	2e10	11792	Same as Steriliser.Input2PV
Steriliser.IP2BandLow	Sterilisation temperature input 2 band low.	float32	2e11	11793	Same as Steriliser.Input2PV
Steriliser.IP2TargetSP	Input 2 target setpoint	float32	2e16	11798	Same as Steriliser.Input2PV
Steriliser.IP3BandHigh	Sterilisation temperature input 3 band high.	float32	2e12	11794	Same as Steriliser.Input3PV
Steriliser.IP3BandLow	Sterilisation temperature input 3 band low.	float32	2e13	11795	Same as Steriliser.Input3PV
Steriliser.IP3TargetSP	Input 3 target setpoint	float32	2e17	11799	Same as Steriliser.Input3PV
Steriliser.IP4BandHigh	Sterilisation temperature input 4 band high.	float32	2e14	11796	Same as Steriliser.Input4PV
Steriliser.IP4BandLow	Sterilisation temperature input 4 band low.	float32	2e15	11797	Same as Steriliser.Input3PV
Steriliser.IP4TargetSP	Input 4 target setpoint	float32	2e18	11800	Same as Steriliser.Input4PV
Steriliser.LowLimit	Low temperature limit for the F0 calculation.	float32	2e2a	11818	0dp
Steriliser.MeasuredTemp	Measured Temperature used in the F0 calculation.	float32	2e27	11815	0dp
Steriliser.PassedOutput	1 = cycle passed; 0 = cycle failed.	uint8	2e1c	11804	Not applicable
Steriliser.Remaining	The holding time remaining for the current cycle.	time_t	2e0e	11790	Set by Network.Modbus.TimeFormat
Steriliser.RunningOutput	1 = cycle running; 0 = cycle not running	uint8	2e1b	11803	Not applicable
Steriliser.Start121	Start a predefined 121°C cycle	bool	2e19	11801	Not applicable
Steriliser.Start134	Start a predefined 134°C cycle	bool	2e1a	11802	Not applicable
Steriliser.StartCycle	Start a custom cycle	bool	2e05	11781	Not applicable
Steriliser.SterilisingTime	The total time the load was at sterilisation conditions.	time_t	2e0d	11789	Set by Network.Modbus.TimeFormat
Steriliser.TargetTemperature	Target Temperature for the F0 calculation.	float32	2e29	11817	0dp
Steriliser.TargetTime	The target time of the sterilisation period.	time_t	2e09	11785	Set by Network.Modbus.TimeFormat
Steriliser.TargetTime121	The target time for a 121°C cycle	time_t	2e23	11811	Set by Network.Modbus.TimeFormat
Steriliser.TargetTime134	The target time for a 134°C cycle	time_t	2e24	11812	Set by Network.Modbus.TimeFormat
Steriliser.ZTemperatureInterval	The Z temperature interval for the F0 calculation.	float32	2e28	11816	0dp
Timer.1.ElapsedTime	Elapsed Time	time_t	2ee0	12000	Set by Network.Modbus.TimeFormat
Timer.1.In	Trigger/Gate input	bool	2ee5	12005	Not applicable
Timer.1.Out	Output (1 = On; 0 = Off)	bool	2ee1	12001	Not applicable
Timer.1.Time	Period for the timer (hh:mm:ss)	time_t	2ee2	12002	Set by Network.Modbus.TimeFormat
Timer.1.Triggered	1 = Timer triggered; 0 = Timer not triggered	bool	2ee3	12003	Not applicable
Timer.1.Type	Type of Timer 0 = Disabled (off) 1 = On Pulse 2 = On delay 3 = One shot 4 = Min on.	uint8	2ee4	12004	Not applicable
Timer.2.ElapsedTime	Elapsed Time	time_t	2ee6	12006	Set by Network.Modbus.TimeFormat
Timer.2.In	Trigger/Gate input	bool	2eeb	12011	Not applicable
Timer.2.Out	Output (1 = On; 0 = Off)	bool	2ee7	12007	Not applicable
Timer.2.Time	Period for the timer (hh:mm:ss)	time_t	2ee8	12008	Set by Network.Modbus.TimeFormat
Timer.2.Triggered	1 = Timer triggered; 0 = Timer not triggered	bool	2ee9	12009	Not applicable
Timer.2.Type	Type of Timer (as Timer.1.Type)	uint8	2eea	12010	Not applicable
Timer.3.ElapsedTime	Elapsed Time	time_t	2eec	12012	Set by Network.Modbus.TimeFormat
Timer.3.In	Trigger/Gate input	bool	2ef1	12017	Not applicable
Timer.3.Out	Output (1 = On; 0 = Off)	bool	2eed	12013	Not applicable
Timer.3.Time	Period for the timer (hh:mm:ss)	time_t	2eee	12014	Set by Network.Modbus.TimeFormat
Timer.3.Triggered	1 = Timer triggered; 0 = Timer not triggered	bool	2eef	12015	Not applicable
Timer.3.Type	Type of Timer (as Timer.1.Type)	uint8	2ef0	12016	Not applicable
Timer.4.ElapsedTime	Elapsed Time	time_t	2ef2	12018	Set by Network.Modbus.TimeFormat
Timer.4.In	Trigger/Gate input	bool	2ef7	12023	Not applicable
Timer.4.Out	Output (1 = On; 0 = Off)	bool	2ef3	12019	Not applicable
Timer.4.Time	Period for the timer (hh:mm:ss)	time_t	2ef4	12020	Set by Network.Modbus.TimeFormat
Timer.4.Triggered	1 = Timer triggered; 0 = Timer not triggered	bool	2ef5	12021	Not applicable
Timer.4.Type	Type of Timer (as Timer.1.Type)	uint8	2ef6	12022	Not applicable
UserLin.1.NumberOfBreakpoints	Number of points in user linearisation table 1	uint8	2900	10496	Not applicable
UserLin.1.X1	User linearisation table 1 'X' value 1	float32	2901	10497	2dp
UserLin.1.X2	User linearisation table 1 'X' value 2	float32	2903	10499	2dp
UserLin.1.X3	User linearisation table 1 'X' value 3	float32	2905	10501	2dp
UserLin.1.X4	User linearisation table 1 'X' value 4	float32	2907	10503	2dp
UserLin.1.X5	User linearisation table 1 'X' value 5	float32	2909	10505	2dp
UserLin.1.X6	User linearisation table 1 'X' value 6	float32	290b	10507	2dp
UserLin.1.X7	User linearisation table 1 'X' value 7	float32	290d	10509	2dp
UserLin.1.X8	User linearisation table 1 'X' value 8	float32	290f	10511	2dp

5.3 PARAMETER LIST (Cont.)

Parameter path	Description	Type	Hex	Dec	Resolution
UserLin.1.X9	User linearisation table 1 ‘X’ value 9	float32	2911	10513	2dp
UserLin.1.X10	User linearisation table 1 ‘X’ value 10	float32	2913	10515	2dp
UserLin.1.X11	User linearisation table 1 ‘X’ value 11	float32	2915	10517	2dp
UserLin.1.X12	User linearisation table 1 ‘X’ value 12	float32	2917	10519	2dp
UserLin.1.X13	User linearisation table 1 ‘X’ value 13	float32	2919	10521	2dp
UserLin.1.X14	User linearisation table 1 ‘X’ value 14	float32	291b	10523	2dp
UserLin.1.X15	User linearisation table 1 ‘X’ value 15	float32	291d	10525	2dp
UserLin.1.X16	User linearisation table 1 ‘X’ value 16	float32	291f	10527	2dp
UserLin.1.X17	User linearisation table 1 ‘X’ value 17	float32	2921	10529	2dp
UserLin.1.X18	User linearisation table 1 ‘X’ value 18	float32	2923	10531	2dp
UserLin.1.X19	User linearisation table 1 ‘X’ value 19	float32	2925	10533	2dp
UserLin.1.X20	User linearisation table 1 ‘X’ value 20	float32	2927	10535	2dp
UserLin.1.X21	User linearisation table 1 ‘X’ value 21	float32	2929	10537	2dp
UserLin.1.X22	User linearisation table 1 ‘X’ value 22	float32	292b	10539	2dp
UserLin.1.X23	User linearisation table 1 ‘X’ value 23	float32	292d	10541	2dp
UserLin.1.X24	User linearisation table 1 ‘X’ value 24	float32	292f	10543	2dp
UserLin.1.X25	User linearisation table 1 ‘X’ value 25	float32	2931	10545	2dp
UserLin.1.X26	User linearisation table 1 ‘X’ value 26	float32	2933	10547	2dp
UserLin.1.X27	User linearisation table 1 ‘X’ value 27	float32	2935	10549	2dp
UserLin.1.X28	User linearisation table 1 ‘X’ value 28	float32	2937	10551	2dp
UserLin.1.X29	User linearisation table 1 ‘X’ value 29	float32	2939	10553	2dp
UserLin.1.X30	User linearisation table 1 ‘X’ value 30	float32	293b	10555	2dp
UserLin.1.X31	User linearisation table 1 ‘X’ value 31	float32	293d	10557	2dp
UserLin.1.X32	User linearisation table 1 ‘X’ value 32	float32	293f	10559	2dp
UserLin.1.Y1	User linearisation table 1 ‘Y’ value 1	float32	2902	10498	2dp
UserLin.1.Y2	User linearisation table 1 ‘Y’ value 2	float32	2904	10500	2dp
UserLin.1.Y3	User linearisation table 1 ‘Y’ value 3	float32	2906	10502	2dp
UserLin.1.Y4	User linearisation table 1 ‘Y’ value 4	float32	2908	10504	2dp
UserLin.1.Y5	User linearisation table 1 ‘Y’ value 5	float32	290a	10506	2dp
UserLin.1.Y6	User linearisation table 1 ‘Y’ value 6	float32	290c	10508	2dp
UserLin.1.Y7	User linearisation table 1 ‘Y’ value 7	float32	290e	10510	2dp
UserLin.1.Y8	User linearisation table 1 ‘Y’ value 8	float32	2910	10512	2dp
UserLin.1.Y9	User linearisation table 1 ‘Y’ value 9	float32	2912	10514	2dp
UserLin.1.Y10	User linearisation table 1 ‘Y’ value 10	float32	2914	10516	2dp
UserLin.1.Y11	User linearisation table 1 ‘Y’ value 11	float32	2916	10518	2dp
UserLin.1.Y12	User linearisation table 1 ‘Y’ value 12	float32	2918	10520	2dp
UserLin.1.Y13	User linearisation table 1 ‘Y’ value 13	float32	291a	10522	2dp
UserLin.1.Y14	User linearisation table 1 ‘Y’ value 14	float32	291c	10524	2dp
UserLin.1.Y15	User linearisation table 1 ‘Y’ value 15	float32	291e	10526	2dp
UserLin.1.Y16	User linearisation table 1 ‘Y’ value 16	float32	2920	10528	2dp
UserLin.1.Y17	User linearisation table 1 ‘Y’ value 17	float32	2922	10530	2dp
UserLin.1.Y18	User linearisation table 1 ‘Y’ value 18	float32	2924	10532	2dp
UserLin.1.Y19	User linearisation table 1 ‘Y’ value 19	float32	2926	10534	2dp
UserLin.1.Y20	User linearisation table 1 ‘Y’ value 20	float32	2928	10536	2dp
UserLin.1.Y21	User linearisation table 1 ‘Y’ value 21	float32	292a	10538	2dp
UserLin.1.Y22	User linearisation table 1 ‘Y’ value 22	float32	292c	10540	2dp
UserLin.1.Y23	User linearisation table 1 ‘Y’ value 23	float32	292e	10542	2dp
UserLin.1.Y24	User linearisation table 1 ‘Y’ value 24	float32	2930	10544	2dp
UserLin.1.Y25	User linearisation table 1 ‘Y’ value 25	float32	2932	10546	2dp
UserLin.1.Y26	User linearisation table 1 ‘Y’ value 26	float32	2934	10548	2dp
UserLin.1.Y27	User linearisation table 1 ‘Y’ value 27	float32	2936	10550	2dp
UserLin.1.Y28	User linearisation table 1 ‘Y’ value 28	float32	2938	10552	2dp
UserLin.1.Y29	User linearisation table 1 ‘Y’ value 29	float32	293a	10554	2dp
UserLin.1.Y30	User linearisation table 1 ‘Y’ value 30	float32	293c	10556	2dp
UserLin.1.Y31	User linearisation table 1 ‘Y’ value 31	float32	293e	10558	2dp
UserLin.1.Y32	User linearisation table 1 ‘Y’ value 32	float32	2940	10560	2dp
UserLin.2.NumberOfBreakpoints	Number of points in user linearisation table 2	uint8	29c0	10688	Not applicable
UserLin.2.X1	User linearisation table 2 ‘X’ value 1	float32	29c1	10689	2dp
UserLin.2.X2	User linearisation table 2 ‘X’ value 2	float32	29c3	10691	2dp
UserLin.2.X3	User linearisation table 2 ‘X’ value 3	float32	29c5	10693	2dp
UserLin.2.X4	User linearisation table 2 ‘X’ value 4	float32	29c7	10695	2dp
UserLin.2.X5	User linearisation table 2 ‘X’ value 5	float32	29c9	10697	2dp
UserLin.2.X6	User linearisation table 2 ‘X’ value 6	float32	29cb	10699	2dp
UserLin.2.X7	User linearisation table 2 ‘X’ value 7	float32	29cd	10701	2dp
UserLin.2.X8	User linearisation table 2 ‘X’ value 8	float32	29cf	10703	2dp
UserLin.2.X9	User linearisation table 2 ‘X’ value 9	float32	29d1	10705	2dp
UserLin.2.X10	User linearisation table 2 ‘X’ value 10	float32	29d3	10707	2dp
UserLin.2.X11	User linearisation table 2 ‘X’ value 11	float32	29d5	10709	2dp
UserLin.2.X12	User linearisation table 2 ‘X’ value 12	float32	29d7	10711	2dp
UserLin.2.X13	User linearisation table 2 ‘X’ value 13	float32	29d9	10713	2dp
UserLin.2.X14	User linearisation table 2 ‘X’ value 14	float32	29db	10715	2dp
UserLin.2.X15	User linearisation table 2 ‘X’ value 15	float32	29dd	10717	2dp
UserLin.2.X16	User linearisation table 2 ‘X’ value 16	float32	29df	10719	2dp
UserLin.2.X17	User linearisation table 2 ‘X’ value 17	float32	29e1	10721	2dp
UserLin.2.X18	User linearisation table 2 ‘X’ value 18	float32	29e3	10723	2dp
UserLin.2.X19	User linearisation table 2 ‘X’ value 19	float32	29e5	10725	2dp
UserLin.2.X20	User linearisation table 2 ‘X’ value 20	float32	29e7	10727	2dp
UserLin.2.X21	User linearisation table 2 ‘X’ value 21	float32	29e9	10729	2dp
UserLin.2.X22	User linearisation table 2 ‘X’ value 22	float32	29eb	10731	2dp
UserLin.2.X23	User linearisation table 2 ‘X’ value 23	float32	29ed	10733	2dp

5.3 PARAMETER LIST (Cont.)

Parameter path	Description	Type	Hex	Dec	Resolution
UserLin.2.X24	User linearisation table 2 ‘X’ value 24	float32	29ef	10735	2dp
UserLin.2.X25	User linearisation table 2 ‘X’ value 25	float32	29f1	10737	2dp
UserLin.2.X26	User linearisation table 2 ‘X’ value 26	float32	29f3	10739	2dp
UserLin.2.X27	User linearisation table 2 ‘X’ value 27	float32	29f5	10741	2dp
UserLin.2.X28	User linearisation table 2 ‘X’ value 28	float32	29f7	10743	2dp
UserLin.2.X29	User linearisation table 2 ‘X’ value 29	float32	29f9	10745	2dp
UserLin.2.X30	User linearisation table 2 ‘X’ value 30	float32	29fb	10747	2dp
UserLin.2.X31	User linearisation table 2 ‘X’ value 31	float32	29fd	10749	2dp
UserLin.2.X32	User linearisation table 2 ‘X’ value 32	float32	29ff	10751	2dp
UserLin.2.Y1	User linearisation table 2 ‘Y’ value 1	float32	29c2	10690	2dp
UserLin.2.Y2	User linearisation table 4 ‘Y’ value 2	float32	29c4	10692	2dp
UserLin.2.Y3	User linearisation table 4 ‘Y’ value 3	float32	29c6	10694	2dp
UserLin.2.Y4	User linearisation table 4 ‘Y’ value 4	float32	29c8	10696	2dp
UserLin.2.Y5	User linearisation table 4 ‘Y’ value 5	float32	29ca	10698	2dp
UserLin.2.Y6	User linearisation table 4 ‘Y’ value 6	float32	29cc	10700	2dp
UserLin.2.Y7	User linearisation table 4 ‘Y’ value 7	float32	29ce	10702	2dp
UserLin.2.Y8	User linearisation table 4 ‘Y’ value 8	float32	29d0	10704	2dp
UserLin.2.Y9	User linearisation table 4 ‘Y’ value 9	float32	29d2	10706	2dp
UserLin.2.Y10	User linearisation table 4 ‘Y’ value 10	float32	29d4	10708	2dp
UserLin.2.Y11	User linearisation table 4 ‘Y’ value 11	float32	29d6	10710	2dp
UserLin.2.Y12	User linearisation table 4 ‘Y’ value 12	float32	29d8	10712	2dp
UserLin.2.Y13	User linearisation table 4 ‘Y’ value 13	float32	29da	10714	2dp
UserLin.2.Y14	User linearisation table 4 ‘Y’ value 14	float32	29dc	10716	2dp
UserLin.2.Y15	User linearisation table 4 ‘Y’ value 15	float32	29de	10718	2dp
UserLin.2.Y16	User linearisation table 4 ‘Y’ value 16	float32	29e0	10720	2dp
UserLin.2.Y17	User linearisation table 4 ‘Y’ value 17	float32	29e2	10722	2dp
UserLin.2.Y18	User linearisation table 4 ‘Y’ value 18	float32	29e4	10724	2dp
UserLin.2.Y19	User linearisation table 4 ‘Y’ value 19	float32	29e6	10726	2dp
UserLin.2.Y20	User linearisation table 4 ‘Y’ value 20	float32	29e8	10728	2dp
UserLin.2.Y21	User linearisation table 4 ‘Y’ value 21	float32	29ea	10730	2dp
UserLin.2.Y22	User linearisation table 4 ‘Y’ value 22	float32	29ec	10732	2dp
UserLin.2.Y23	User linearisation table 4 ‘Y’ value 23	float32	29ee	10734	2dp
UserLin.2.Y24	User linearisation table 4 ‘Y’ value 24	float32	29f0	10736	2dp
UserLin.2.Y25	User linearisation table 4 ‘Y’ value 25	float32	29f2	10738	2dp
UserLin.2.Y26	User linearisation table 4 ‘Y’ value 26	float32	29f4	10740	2dp
UserLin.2.Y27	User linearisation table 4 ‘Y’ value 27	float32	29f6	10742	2dp
UserLin.2.Y28	User linearisation table 4 ‘Y’ value 28	float32	29f8	10744	2dp
UserLin.2.Y29	User linearisation table 4 ‘Y’ value 29	float32	29fa	10746	2dp
UserLin.2.Y30	User linearisation table 4 ‘Y’ value 30	float32	29fc	10748	2dp
UserLin.2.Y31	User linearisation table 4 ‘Y’ value 31	float32	29fe	10750	2dp
UserLin.2.Y32	User linearisation table 4 ‘Y’ value 32	float32	2a00	10752	2dp
UserLin.3.NumberOfBreakpoints	Number of points in user linearisation table 32	uint8	2a80	10880	Not applicable
UserLin.3.X1	User linearisation table 3 ‘X’ value 1	float32	2a81	10881	2dp
UserLin.3.X2	User linearisation table 3 ‘X’ value 2	float32	2a83	10883	2dp
UserLin.3.X3	User linearisation table 3 ‘X’ value 3	float32	2a85	10885	2dp
UserLin.3.X4	User linearisation table 3 ‘X’ value 4	float32	2a87	10887	2dp
UserLin.3.X5	User linearisation table 3 ‘X’ value 5	float32	2a89	10889	2dp
UserLin.3.X6	User linearisation table 3 ‘X’ value 6	float32	2a8b	10891	2dp
UserLin.3.X7	User linearisation table 3 ‘X’ value 7	float32	2a8d	10893	2dp
UserLin.3.X8	User linearisation table 3 ‘X’ value 8	float32	2a8f	10895	2dp
UserLin.3.X9	User linearisation table 3 ‘X’ value 9	float32	2a91	10897	2dp
UserLin.3.X10	User linearisation table 3 ‘X’ value 10	float32	2a93	10899	2dp
UserLin.3.X11	User linearisation table 3 ‘X’ value 11	float32	2a95	10901	2dp
UserLin.3.X12	User linearisation table 3 ‘X’ value 12	float32	2a97	10903	2dp
UserLin.3.X13	User linearisation table 3 ‘X’ value 13	float32	2a99	10905	2dp
UserLin.3.X14	User linearisation table 3 ‘X’ value 14	float32	2a9b	10907	2dp
UserLin.3.X15	User linearisation table 3 ‘X’ value 15	float32	2a9d	10909	2dp
UserLin.3.X16	User linearisation table 3 ‘X’ value 16	float32	2a9f	10911	2dp
UserLin.3.X17	User linearisation table 3 ‘X’ value 17	float32	2aa1	10913	2dp
UserLin.3.X18	User linearisation table 3 ‘X’ value 18	float32	2aa3	10915	2dp
UserLin.3.X19	User linearisation table 3 ‘X’ value 19	float32	2aa5	10917	2dp
UserLin.3.X20	User linearisation table 3 ‘X’ value 20	float32	2aa7	10919	2dp
UserLin.3.X21	User linearisation table 3 ‘X’ value 21	float32	2aa9	10921	2dp
UserLin.3.X22	User linearisation table 3 ‘X’ value 22	float32	2aab	10923	2dp
UserLin.3.X23	User linearisation table 3 ‘X’ value 23	float32	2aad	10925	2dp
UserLin.3.X24	User linearisation table 3 ‘X’ value 24	float32	2aaf	10927	2dp
UserLin.3.X25	User linearisation table 3 ‘X’ value 25	float32	2ab1	10929	2dp
UserLin.3.X26	User linearisation table 3 ‘X’ value 26	float32	2ab3	10931	2dp
UserLin.3.X27	User linearisation table 3 ‘X’ value 27	float32	2ab5	10933	2dp
UserLin.3.X28	User linearisation table 3 ‘X’ value 28	float32	2ab7	10935	2dp
UserLin.3.X29	User linearisation table 3 ‘X’ value 29	float32	2ab9	10937	2dp
UserLin.3.X30	User linearisation table 3 ‘X’ value 30	float32	2abb	10939	2dp
UserLin.3.X31	User linearisation table 3 ‘X’ value 31	float32	2abd	10941	2dp
UserLin.3.X32	User linearisation table 3 ‘X’ value 32	float32	2abf	10943	2dp
UserLin.3.Y1	User linearisation table 4 ‘Y’ value 1	float32	2a82	10882	2dp
UserLin.3.Y2	User linearisation table 4 ‘Y’ value 2	float32	2a84	10884	2dp
UserLin.3.Y3	User linearisation table 4 ‘Y’ value 3	float32	2a86	10886	2dp
UserLin.3.Y4	User linearisation table 4 ‘Y’ value 4	float32	2a88	10888	2dp
UserLin.3.Y5	User linearisation table 4 ‘Y’ value 5	float32	2a8a	10890	2dp
UserLin.3.Y6	User linearisation table 4 ‘Y’ value 6	float32	2a8c	10892	2dp

5.3 PARAMETER LIST (Cont.)

Parameter path	Description	Type	Hex	Dec	Resolution
UserLin.3.Y7	User linearisation table 4 'Y' value 7	float32	2a8e	10894	2dp
UserLin.3.Y8	User linearisation table 4 'Y' value 8	float32	2a90	10896	2dp
UserLin.3.Y9	User linearisation table 4 'Y' value 9	float32	2a92	10898	2dp
UserLin.3.Y10	User linearisation table 4 'Y' value 10	float32	2a94	10900	2dp
UserLin.3.Y11	User linearisation table 4 'Y' value 11	float32	2a96	10902	2dp
UserLin.3.Y12	User linearisation table 4 'Y' value 12	float32	2a98	10904	2dp
UserLin.3.Y13	User linearisation table 4 'Y' value 13	float32	2a9a	10906	2dp
UserLin.3.Y14	User linearisation table 4 'Y' value 14	float32	2a9c	10908	2dp
UserLin.3.Y15	User linearisation table 4 'Y' value 15	float32	2a9e	10910	2dp
UserLin.3.Y16	User linearisation table 4 'Y' value 16	float32	2aa0	10912	2dp
UserLin.3.Y17	User linearisation table 4 'Y' value 17	float32	2aa2	10914	2dp
UserLin.3.Y18	User linearisation table 4 'Y' value 18	float32	2aa4	10916	2dp
UserLin.3.Y19	User linearisation table 4 'Y' value 19	float32	2aa6	10918	2dp
UserLin.3.Y20	User linearisation table 4 'Y' value 20	float32	2aa8	10920	2dp
UserLin.3.Y21	User linearisation table 4 'Y' value 21	float32	2aaa	10922	2dp
UserLin.3.Y22	User linearisation table 4 'Y' value 22	float32	2aac	10924	2dp
UserLin.3.Y23	User linearisation table 4 'Y' value 23	float32	2aae	10926	2dp
UserLin.3.Y24	User linearisation table 4 'Y' value 24	float32	2ab0	10928	2dp
UserLin.3.Y25	User linearisation table 4 'Y' value 25	float32	2ab2	10930	2dp
UserLin.3.Y26	User linearisation table 4 'Y' value 26	float32	2ab4	10932	2dp
UserLin.3.Y27	User linearisation table 4 'Y' value 27	float32	2ab6	10934	2dp
UserLin.3.Y28	User linearisation table 4 'Y' value 28	float32	2ab8	10936	2dp
UserLin.3.Y29	User linearisation table 4 'Y' value 29	float32	2aba	10938	2dp
UserLin.3.Y30	User linearisation table 4 'Y' value 30	float32	2abc	10940	2dp
UserLin.3.Y31	User linearisation table 4 'Y' value 31	float32	2abe	10942	2dp
UserLin.3.Y32	User linearisation table 4 'Y' value 32	float32	2ac0	10944	2dp
UserLin.4.NumberOfBreakpoints	Number of points in user linearisation table 4	uint8	2b40	11072	Not applicable
UserLin.4.X1	User linearisation table 4 'X' value 1	float32	2b41	11073	2dp
UserLin.4.X2	User linearisation table 4 'X' value 2	float32	2b43	11075	2dp
UserLin.4.X3	User linearisation table 4 'X' value 3	float32	2b45	11077	2dp
UserLin.4.X4	User linearisation table 4 'X' value 4	float32	2b47	11079	2dp
UserLin.4.X5	User linearisation table 4 'X' value v5	float32	2b49	11081	2dp
UserLin.4.X6	User linearisation table 4 'X' value 6	float32	2b4b	11083	2dp
UserLin.4.X7	User linearisation table 4 'X' value 7	float32	2b4d	11085	2dp
UserLin.4.X8	User linearisation table 4 'X' value 8	float32	2b4f	11087	2dp
UserLin.4.X9	User linearisation table 4 'X' value 9	float32	2b51	11089	2dp
UserLin.4.X10	User linearisation table 4 'X' value 10	float32	2b53	11091	2dp
UserLin.4.X11	User linearisation table 4 'X' value 11	float32	2b55	11093	2dp
UserLin.4.X12	User linearisation table 4 'X' value 12	float32	2b57	11095	2dp
UserLin.4.X13	User linearisation table 4 'X' value 13	float32	2b59	11097	2dp
UserLin.4.X14	User linearisation table 4 'X' value 14	float32	2b5b	11099	2dp
UserLin.4.X15	User linearisation table 4 'X' value 15	float32	2b5d	11101	2dp
UserLin.4.X16	User linearisation table 4 'X' value 16	float32	2b5f	11103	2dp
UserLin.4.X17	User linearisation table 4 'X' value 17	float32	2b61	11105	2dp
UserLin.4.X18	User linearisation table 4 'X' value 18	float32	2b63	11107	2dp
UserLin.4.X19	User linearisation table 4 'X' value 19	float32	2b65	11109	2dp
UserLin.4.X20	User linearisation table 4 'X' value 20	float32	2b67	11111	2dp
UserLin.4.X21	User linearisation table 4 'X' value 21	float32	2b69	11113	2dp
UserLin.4.X22	User linearisation table 4 'X' value 22	float32	2b6b	11115	2dp
UserLin.4.X23	User linearisation table 4 'X' value 23	float32	2b6d	11117	2dp
UserLin.4.X24	User linearisation table 4 'X' value 24	float32	2b6f	11119	2dp
UserLin.4.X25	User linearisation table 4 'X' value 25	float32	2b71	11121	2dp
UserLin.4.X26	User linearisation table 4 'X' value 26	float32	2b73	11123	2dp
UserLin.4.X27	User linearisation table 4 'X' value 27	float32	2b75	11125	2dp
UserLin.4.X28	User linearisation table 4 'X' value 28	float32	2b77	11127	2dp
UserLin.4.X29	User linearisation table 4 'X' value 29	float32	2b79	11129	2dp
UserLin.4.X30	User linearisation table 4 'X' value 30	float32	2b7b	11131	2dp
UserLin.4.X31	User linearisation table 4 'X' value 31	float32	2b7d	11133	2dp
UserLin.4.X32	User linearisation table 4 'X' value 32	float32	2b7f	11135	2dp
UserLin.4.Y1	User linearisation table 4 'Y' value 1	float32	2b42	11074	2dp
UserLin.4.Y2	User linearisation table 4 'Y' value 2	float32	2b44	11076	2dp
UserLin.4.Y3	User linearisation table 4 'Y' value 3	float32	2b46	11078	2dp
UserLin.4.Y4	User linearisation table 4 'Y' value 4	float32	2b48	11080	2dp
UserLin.4.Y5	User linearisation table 4 'Y' value 5	float32	2b4a	11082	2dp
UserLin.4.Y6	User linearisation table 4 'Y' value 6	float32	2b4c	11084	2dp
UserLin.4.Y7	User linearisation table 4 'Y' value 7	float32	2b4e	11086	2dp
UserLin.4.Y8	User linearisation table 4 'Y' value 8	float32	2b50	11088	2dp
UserLin.4.Y9	User linearisation table 4 'Y' value 9	float32	2b52	11090	2dp
UserLin.4.Y10	User linearisation table 4 'Y' value 10	float32	2b54	11092	2dp
UserLin.4.Y11	User linearisation table 4 'Y' value 11	float32	2b56	11094	2dp
UserLin.4.Y12	User linearisation table 4 'Y' value 12	float32	2b58	11096	2dp
UserLin.4.Y13	User linearisation table 4 'Y' value 13	float32	2b5a	11098	2dp
UserLin.4.Y14	User linearisation table 4 'Y' value 14	float32	2b5c	11100	2dp
UserLin.4.Y15	User linearisation table 4 'Y' value 15	float32	2b5e	11102	2dp
UserLin.4.Y16	User linearisation table 4 'Y' value 16	float32	2b60	11104	2dp
UserLin.4.Y17	User linearisation table 4 'Y' value 17	float32	2b62	11106	2dp
UserLin.4.Y18	User linearisation table 4 'Y' value 18	float32	2b64	11108	2dp
UserLin.4.Y19	User linearisation table 4 'Y' value 19	float32	2b66	11110	2dp
UserLin.4.Y20	User linearisation table 4 'Y' value 20	float32	2b68	11112	2dp
UserLin.4.Y21	User linearisation table 4 'Y' value 21	float32	2b6a	11114	2dp
UserLin.4.Y22	User linearisation table 4 'Y' value 22	float32	2b6c	11116	2dp

5.3 PARAMETER LIST (Cont.)

Parameter path	Description	Type	Hex	Dec	Resolution
UserLin.4.Y23	User linearisation table 4 'Y' value 23	float32	2b6e	11118	2dp
UserLin.4.Y24	User linearisation table 4 'Y' value 24	float32	2b70	11120	2dp
UserLin.4.Y25	User linearisation table 4 'Y' value 25	float32	2b72	11122	2dp
UserLin.4.Y26	User linearisation table 4 'Y' value 26	float32	2b74	11124	2dp
UserLin.4.Y27	User linearisation table 4 'Y' value 27	float32	2b76	11126	2dp
UserLin.4.Y28	User linearisation table 4 'Y' value 28	float32	2b78	11128	2dp
UserLin.4.Y29	User linearisation table 4 'Y' value 29	float32	2b7a	11130	2dp
UserLin.4.Y30	User linearisation table 4 'Y' value 30	float32	2b7c	11132	2dp
UserLin.4.Y31	User linearisation table 4 'Y' value 31	float32	2b7e	11134	2dp
UserLin.4.Y32	User linearisation table 4 'Y' value 32	float32	2b80	11136	2dp
UsrVal.1.HighLimit	User Value High Limit	float32	2e8c	11916	Set by UsrVal.1.Resolution
UsrVal.1.LowLimit	User Value Low Limit	float32	2e8d	11917	Set by UsrVal.1.Resolution
UsrVal.1.Resolution	Result Resolution	uint8	2e90	11920	Not applicable
UsrVal.1.Status	User Value 1 Status (0 = Good (OK); 7 = Bad (Error))	bool	2e8f	11919	Not applicable
UsrVal.1.Units	Units of the value	string_t	68fc	26876	Not applicable
UsrVal.1.Val	The User Value	float32	2e8e	11918	Set by UsrVal.1.Resolution
UsrVal.2.HighLimit	User Value High Limit	float32	2e91	11921	Set by UsrVal.2.Resolution
UsrVal.2.LowLimit	User Value Low Limit	float32	2e92	11922	Set by UsrVal.2.Resolution
UsrVal.2.Resolution	Result Resolution	uint8	2e95	11925	Not applicable
UsrVal.2.Status	User Value 2 Status (0 = Good (OK); 7 = Bad (Error))	bool	2e94	11924	Not applicable
UsrVal.2.Units	Units of the value	string_t	6902	26882	Not applicable
UsrVal.2.Val	Thw User Value	float32	2e93	11923	Set by UsrVal.2.Resolution
UsrVal.3.HighLimit	User Value High Limit	float32	2e96	11926	Set by UsrVal.3.Resolution
UsrVal.3.LowLimit	User Value Low Limit	float32	2e97	11927	Set by UsrVal.3.Resolution
UsrVal.3.Resolution	Result Resolution	uint8	2e9a	11930	Not applicable
UsrVal.3.Status	User Value 3 Status (0 = Good (OK); 7 = Bad (Error))	bool	2e99	11929	Not applicable
UsrVal.3.Units	Units of the value	string_t	6908	26888	Not applicable
UsrVal.3.Val	The User Value	float32	2e98	11928	Set by UsrVal.3.Resolution
UsrVal.4.HighLimit	User Value High Limit	float32	2e9b	11931	Set by UsrVal.4.Resolution
UsrVal.4.LowLimit	User Value Low Limit	float32	2e9c	11932	Set by UsrVal.4.Resolution
UsrVal.4.Resolution	Result Resolution	uint8	2e9f	11935	Not applicable
UsrVal.4.Status	User Value 4 Status (0 = Good (OK); 7 = Bad (Error))	bool	2e9e	11934	Not applicable
UsrVal.4.Units	Units of the value	string_t	690e	26894	Not applicable
UsrVal.4.Val	The User Value	float32	2e9d	11933	Set by UsrVal.4.Resolution
UsrVal.5.HighLimit	User Value High Limit	float32	2ea0	11936	Set by UsrVal.5.Resolution
UsrVal.5.LowLimit	User Value Low Limit	float32	2ea1	11937	Set by UsrVal.5.Resolution
UsrVal.5.Resolution	Result Resolution	uint8	2ea4	11940	Not applicable
UsrVal.5.Status	User Value 5 Status (0 = Good (OK); 7 = Bad (Error))	bool	2ea3	11939	Not applicable
UsrVal.5.Units	Units of the value	string_t	6914	26900	Not applicable
UsrVal.5.Val	The User Value	float32	2ea2	11938	Set by UsrVal.5.Resolution
UsrVal.6.HighLimit	User Value High Limit	float32	2ea5	11941	Set by UsrVal.6.Resolution
UsrVal.6.LowLimit	User Value Low Limit	float32	2ea6	11942	Set by UsrVal.6.Resolution
UsrVal.6.Resolution	Result Resolution	uint8	2ea9	11945	Not applicable
UsrVal.6.Status	User Value 6 Status (0 = Good (OK); 7 = Bad (Error))	bool	2ea8	11944	Not applicable
UsrVal.6.Units	Units of the value	string_t	691a	26906	Not applicable
UsrVal.6.Val	The User Value	float32	2ea7	11943	Set by UsrVal.6.Resolution
UsrVal.7.HighLimit	User Value High Limit	float32	2eaa	11946	Set by UsrVal.7.Resolution
UsrVal.7.LowLimit	User Value Low Limit	float32	2eab	11947	Set by UsrVal.7.Resolution
UsrVal.7.Resolution	Result Resolution	uint8	2eae	11950	Not applicable
UsrVal.7.Status	User Value 7 Status (0 = Good (OK); 7 = Bad (Error))	bool	2ead	11949	Not applicable
UsrVal.7.Units	Units of the value	string_t	6920	26912	Not applicable
UsrVal.7.Val	The User Value	float32	2eac	11948	Set by UsrVal.7.Resolution
UsrVal.8.HighLimit	User Value High Limit	float32	2eaf	11951	Set by UsrVal.8.Resolution
UsrVal.8.LowLimit	User Value Low Limit	float32	2eb0	11952	Set by UsrVal.8.Resolution
UsrVal.8.Resolution	Result Resolution	uint8	2eb3	11955	Not applicable
UsrVal.8.Status	User Value 8 Status (0 = Good (OK); 7 = Bad (Error))	bool	2eb2	11954	Not applicable
UsrVal.8.Units	Units of the value	string_t	6926	26918	Not applicable
UsrVal.8.Val	The User Value	float32	2eb1	11953	Set by UsrVal.8.Resolution
UsrVal.9.HighLimit	User Value High Limit	float32	2eb4	11956	Set by UsrVal.9.Resolution
UsrVal.9.LowLimit	User Value Low Limit	float32	2eb5	11957	Set by UsrVal.9.Resolution
UsrVal.9.Resolution	Result Resolution	uint8	2eb8	11960	Not applicable
UsrVal.9.Status	User Value 9 Status (0 = Good (OK); 7 = Bad (Error))	bool	2eb7	11959	Not applicable
UsrVal.9.Units	Units of the value	string_t	692c	26924	Not applicable
UsrVal.9.Val	The User Value	float32	2eb6	11958	Set by UsrVal.9.Resolution

5.3 PARAMETER LIST (Cont.)

Parameter path	Description	Type	Hex	Dec	Resolution
UsrVal.10.HighLimit	User Value High Limit	float32	2eb9	11961	Set by UsrVal.10.Resolution
UsrVal.10.LowLimit	User Value Low Limit	float32	2eba	11962	Set by UsrVal.10.Resolution
UsrVal.10.Resolution	Result Resolution	uint8	2ebd	11965	Not applicable
UsrVal.10.Status	User Value 10 Status (0 = Good (OK); 7 = Bad (Error))	bool	2ebc	11964	Not applicable
UsrVal.10.Units	Units of the value	string_t	6932	26930	Not applicable
UsrVal.10.Val	The User Value	float32	2ebb	11963	Set by UsrVal.10.Resolution
UsrVal.11.HighLimit	User Value High Limit	float32	2ebe	11966	Set by UsrVal.11.Resolution
UsrVal.11.LowLimit	User Value Low Limit	float32	2ebf	11967	Set by UsrVal.11.Resolution
UsrVal.11.Resolution	Result Resolution	uint8	2ec2	11970	Not applicable
UsrVal.11.Status	User Value 11 Status (0 = Good (OK); 7 = Bad (Error))	bool	2ec1	11969	Not applicable
UsrVal.11.Units	Units of the value	string_t	6938	26936	Not applicable
UsrVal.11.Val	The User Value	float32	2ec0	11968	Set by UsrVal.11.Resolution
UsrVal.12.HighLimit	User Value High Limit	float32	2ec3	11971	Set by UsrVal.12.Resolution
UsrVal.12.LowLimit	User Value Low Limit	float32	2ec4	11972	Set by UsrVal.12.Resolution
UsrVal.12.Resolution	Result Resolution	uint8	2ec7	11975	Not applicable
UsrVal.12.Status	User Value 12 Status (0 = Good (OK); 7 = Bad (Error))	bool	2ec6	11974	Not applicable
UsrVal.12.Units	Units of the value	string_t	693e	26942	Not applicable
UsrVal.12.Val	The User Value	float32	2ec5	11973	Set by UsrVal.12.Resolution
VirtualChannel.1.Alarm1.Acknowledge	1 = acknowledge alarm	bool	01c0	448	Not applicable
VirtualChannel.1.Alarm1.Acknowledgement	1 = alarm acknowledged	bool	1c50	7248	Not applicable
VirtualChannel.1.Alarm1.Active	1 = alarm source active, or safe but not ack'd	bool	1c4b	7243	Not applicable
VirtualChannel.1.Alarm1.Amount	Rate-of-change alarm 'Amount'	float32	1c48	7240	Same as VirtualChannel.1.Main.PV
VirtualChannel.1.Alarm1.AverageTime	Rate-of-change alarm 'Average time'	time_t	1c4a	7242	Set by Network.Modbus.TimeFormat
VirtualChannel.1.Alarm1.Block	0 = Blocking alarms off; 1 = Blocking alarms on	uint8	1c42	7234	Not applicable
VirtualChannel.1.Alarm1.ChangeTime	Rate-of-change alarm 'Change Time'	uint8	1c49	7241	Not applicable
VirtualChannel.1.Alarm1.Deviation	Deviation alarm 'Deviation Value'	float32	1c47	7239	Same as VirtualChannel.1.Main.PV
VirtualChannel.1.Alarm1.Dwell	Alarm dwell time	time_t	1c45	7237	Set by Network.Modbus.TimeFormat
VirtualChannel.1.Alarm1.Hysteresis	Alarm hysteresis value	float32	1c44	7236	Same as VirtualChannel.1.Main.PV
VirtualChannel.1.Alarm1.Inactive	1 = alarm source safe and ack'd (if necessary)	bool	1c4e	7246	Not applicable
VirtualChannel.1.Alarm1.Inhibit	1 = alarm inhibited	bool	1c51	7249	Not applicable
VirtualChannel.1.Alarm1.Latch	Alarm latch type (0 = None; 1 = Auto; 2 = Manual; 3 = Trigger	uint8	1c41	7233	Not applicable
VirtualChannel.1.Alarm1.NotAcknowledged	1 = alarm has not been acknowledged	bool	1c4f	7247	Not applicable
VirtualChannel.1.Alarm1.Reference	Deviation alarm 'Reference' value	float32	1c46	7238	Same as VirtualChannel.1.Main.PV
VirtualChannel.1.Alarm1.Status	Indication of the active and acknowledge status 0 = Unacknowledged 1 = None 2 = Active 3 = Inactive 4 = Acknowledged	uint8	0122	290	Not applicable
VirtualChannel.1.Alarm1.Threshold	Alarm trigger threshold	float32	1c43	7235	Same as VirtualChannel.1.Main.PV
VirtualChannel.1.Alarm1.Type	Alarm type 0 = None 1 = Abs High 2 = Abs Low 3 = Dev high 4 = Dev Low 5 = Dev band 6 = ROC rising 7 = ROC falling 10 = Dig Off 11 = Dig High 12 = Dig Low	uint8	1c40	7232	Not applicable
VirtualChannel.1.Alarm2.Acknowledge	1 = acknowledge alarm	bool	01c1	449	Not applicable
VirtualChannel.1.Alarm2.Acknowledgement	1 = alarm acknowledged	bool	1c70	7280	Not applicable
VirtualChannel.1.Alarm2.Active	1 = alarm source active, or safe but not ack'd	bool	1c6b	7275	Not applicable
VirtualChannel.1.Alarm2.Amount	Rate-of-change alarm 'Amount'	float32	1c68	7272	Same as VirtualChannel.1.Main.PV
VirtualChannel.1.Alarm2.AverageTime	Rate-of-change alarm 'Average time'	time_t	1c6a	7274	Set by Network.Modbus.TimeFormat
VirtualChannel.1.Alarm2.Block	0 = Blocking alarms off; 1 = Blocking alarms on	uint8	1c62	7266	Not applicable
VirtualChannel.1.Alarm2.ChangeTime	Rate-of-change alarm 'Change Time	uint8	1c69	7273	Not applicable
VirtualChannel.1.Alarm2.Deviation	Deviation alarm 'Deviation Value'	float32	1c67	7271	Same as VirtualChannel.1.Main.PV
VirtualChannel.1.Alarm2.Dwell	Alarm dwell time	time_t	1c65	7269	Set by Network.Modbus.TimeFormat
VirtualChannel.1.Alarm2.Hysteresis	Alarm hysteresis value	float32	1c64	7268	Same as VirtualChannel.1.Main.PV
VirtualChannel.1.Alarm2.Inactive	1 = alarm source safe and ack'd (if necessary)	bool	1c6e	7278	Not applicable
VirtualChannel.1.Alarm2.Inhibit	1 = alarm inhibited	bool	1c71	7281	Not applicable
VirtualChannel.1.Alarm2.Latch	As VirtualChannel1.Alarm1.Latch	uint8	1c61	7265	Not applicable
VirtualChannel.1.Alarm2.NotAcknowledged	1 = alarm has not been acknowledged	bool	1c6f	7279	Not applicable
VirtualChannel.1.Alarm2.Reference	Deviation alarm 'Reference' value	float32	1c66	7270	Same as VirtualChannel.1.Main.PV
VirtualChannel.1.Alarm2.Status	As VirtualChannel1.Alarm1.Status	uint8	0123	291	Not applicable
VirtualChannel.1.Alarm2.Threshold	Alarm trigger threshold	float32	1c63	7267	Same as VirtualChannel.1.Main.PV
VirtualChannel.1.Alarm2.Type	As VirtualChannel1.Alarm1.Type	uint8	1c60	7264	Not applicable
VirtualChannel.1.Main.Descriptor	Virtual Channel descriptor	string_t	4b00	19200	Not applicable
VirtualChannel.1.Main.Disable	1 = Virtual channel disabled	bool	1c23	7203	Not applicable
VirtualChannel.1.Main.HighCutOff	High cut off value for totalisers and counters	float32	1c05	7173	Set by VirtualChannel.1.Main.Resolution
VirtualChannel.1.Main.Input1	Input 1 value	float32	1c07	7175	Set by VirtualChannel.1.Main.Resolution
VirtualChannel.1.Main.Input2	Input 2 value	float32	1c08	7176	Set by VirtualChannel.1.Main.Resolution
VirtualChannel.1.Main.LowCutOff	Low cutoff value for totalisers and counters	float32	1c04	7172	Set by VirtualChannel.1.Main.Resolution
VirtualChannel.1.Main.ModbusInput	Modbus input value	float32	1c06	7174	Set by VirtualChannel.1.Main.Resolution
VirtualChannel.1.Main.Operation	Specifies the operation of the virtual channel 0 = Off 2 = Add 3 = Subtract 4 = Multiply 5 = Divide 6 = Group avg 7 = Group min 8 = Group max 9 = Modbus i/p 11 = Copy 20 = Grp min latch 21 = Grp max latch	uint8	1c01	7169	Not applicable

5.3 PARAMETER LIST (Cont.)

Parameter path	Description	Type	Hex	Dec	Resolution
	34 = Chan max 35 = Chan min 36 = Chan avg 43 = Config rev 64 = Off 65 = On 80 = Off 81 = On				
VirtualChannel.1.Main.Period	The time period over which the calculation is made	int32	1c0a	7178	Not applicable
VirtualChannel.1.Main.Preset	Initiate preset. 0 = No; 1 = Yes	bool	1c0c	7180	Not applicable
VirtualChannel.1.Main.PresetValue	The preset value	float32	1c0d	7181	Set by VirtualChannel.1.Main.Resolution
VirtualChannel.1.Main.PV	The virtual channel output value	float32	0120	288	Set by VirtualChannel.1.Main.Resolution
VirtualChannel.1.Main.Reset	Initiate reset. 0 = No; 1 = Yes	bool	1c0b	7179	Not applicable
VirtualChannel.1.Main.Resolution	Number of decimal places (0 to 6)	uint8	1c02	7170	Not applicable
VirtualChannel.1.Main.Rollover	A pulse signal to indicate PV (output) has just rolled over	bool	1c11	7185	Not applicable
VirtualChannel.1.Main.Status	Virtual Channel output status 0 =Good 1 = Off 2 = Over range 3 = Under range 4 = HW error 5 = Ranging 6 = Overflow 7 = bad 8 = HW exceeded 9 = No data 12 = Comms channel error	uint8	0121	289	Not applicable
VirtualChannel.1.Main.TimeRemaining	Time remaining before the calculation is made	time_t	1c09	7177	Set by Network.Modbus.TimeFormat
VirtualChannel.1.Main.Trigger	Increment/decrement counter. 0 = No; 1 = Yes	bool	1c0e	7182	Not applicable
VirtualChannel.1.Main.Type	Specifies the type of virtual channel 1 = Maths; 2 = Totaliser; 3 = Counter	uint8	1c00	7168	Not applicable
VirtualChannel.1.Main.Units	Units descriptor	string_t	4b15	19221	Not applicable
VirtualChannel.1.Main.UnitsScaler	Units scaler for totalisers	float32	1c03	7171	1dp
VirtualChannel.1.Trend.Colour	Configures the trend colour for this virtual channel 0 = Red 1 = Blue 2 = Green 3 = Honey 4 = Violet 5 = Russet 6 = Dark blue 7 = Jade 8 = Magenta 9 = Dusky rose 10 = Yellow 11 = Powder blue 12 = Dark red 13 = Avocado 14 = Indigo 15 = Dark brown 16 = Aegean 17 = Cyan 18 = Aubergine 19 = Dark orange 20 = Pale yellow 21 = Hyacinth 22 = Dark green 23 = Sugar pink 24 = Bluebell 25 = Orange 26 = Pink 27 = Buttersilk 28 = Terracotta 29 = Blue babe 30 = Lime 31 = Blue jive 32 = Cucumber 33 = Eurogreen 34 = Wheatgerm 35 = Sea Blue 36 = Ginger 37 = Aqua pool 38 = Pale red 39 = Pale blue 40 = Lilac 41 = Sky blue 42 = Wild moss 43 = Turquoise 44 = Pale green 45 = Coffee 49 = Dark Grey 53 = Light grey	uint8	1c20	7200	Not applicable
VirtualChannel.1.Trend.SpanHigh	Specifies the highest PV (output value) to be displayed	float32	1c22	7202	Same as VirtualChannel.1.Main.PV
VirtualChannel.1.Trend.SpanLow	Specifies the lowest PV (output value) to be displayed	float32	1c21	7201	Same as VirtualChannel.1.Main.PV
VirtualChannel.2.Alarm1.Acknowledge	1 = acknowledge alarm	bool	01c2	450	Not applicable
VirtualChannel.2.Alarm1.Acknowledgement	1 = alarm acknowledged	bool	1cd0	7376	Not applicable
VirtualChannel.2.Alarm1.Active	1 = alarm source active, or safe but not ack'd	bool	1ccb	7371	Not applicable
VirtualChannel.2.Alarm1.Amount	Rate-of-change alarm 'Amount'	float32	1cc8	7368	Same as VirtualChannel.2.Main.PV
VirtualChannel.2.Alarm1.AverageTime	Rate-of-change alarm 'Average time'	time_t	1cca	7370	Set by Network.Modbus.TimeFormat
VirtualChannel.2.Alarm1.Block	0 = Blocking alarms off; 1 = Blocking alarms on	uint8	1cc2	7362	Not applicable
VirtualChannel.2.Alarm1.ChangeTime	Rate-of-change alarm 'Change Time'	uint8	1cc9	7369	Not applicable
VirtualChannel.2.Alarm1.Deviation	Deviation alarm 'Deviation Value'	float32	1cc7	7367	Same as VirtualChannel.2.Main.PV
VirtualChannel.2.Alarm1.Dwell	Alarm dwell time	time_t	1cc5	7365	Set by Network.Modbus.TimeFormat
VirtualChannel.2.Alarm1.Hysteresis	Alarm hysteresis value	float32	1cc4	7364	Same as VirtualChannel.2.Main.PV
VirtualChannel.2.Alarm1.Inactive	1 = alarm source safe and ack'd (if necessary)	bool	1cce	7374	Not applicable
VirtualChannel.2.Alarm1.Inhibit	1 = alarm inhibited	bool	1cd1	7377	Not applicable
VirtualChannel.2.Alarm1.Latch	As VirtualChannel1.Alarm1.Latch	uint8	1cc1	7361	Not applicable
VirtualChannel.2.Alarm1.NotAcknowledged	1 = alarm has not been acknowledged	bool	1ccf	7375	Not applicable
VirtualChannel.2.Alarm1.Reference	Deviation alarm 'Reference' value	float32	1cc6	7366	Same as VirtualChannel.2.Main.PV
VirtualChannel.2.Alarm1.Status	As VirtualChannel1.Alarm1.Status	uint8	0126	294	Not applicable
VirtualChannel.2.Alarm1.Threshold	Alarm trigger threshold	float32	1cc3	7363	Same as VirtualChannel.2.Main.PV
VirtualChannel.2.Alarm1.Type	As VirtualChannel1.Alarm1.Type	uint8	1cc0	7360	Not applicable
VirtualChannel.2.Alarm2.Acknowledge	1 = acknowledge alarm	bool	01c3	451	Not applicable
VirtualChannel.2.Alarm2.Acknowledgement	1 = alarm acknowledged	bool	1cf0	7408	Not applicable
VirtualChannel.2.Alarm2.Active	1 = alarm source active, or safe but not ack'd	bool	1ceb	7403	Not applicable
VirtualChannel.2.Alarm2.Amount	Rate-of-change alarm 'Amount'	float32	1ce8	7400	Same as VirtualChannel.2.Main.PV
VirtualChannel.2.Alarm2.AverageTime	Rate-of-change alarm 'Average time'	time_t	1cea	7402	Set by Network.Modbus.TimeFormat
VirtualChannel.2.Alarm2.Block	0 = Blocking alarms off; 1 = Blocking alarms on	uint8	1ce2	7394	Not applicable
VirtualChannel.2.Alarm2.ChangeTime	Rate-of-change alarm 'Change Time'	uint8	1ce9	7401	Not applicable
VirtualChannel.2.Alarm2.Deviation	Deviation alarm 'Deviation Value'	float32	1ce7	7399	Same as VirtualChannel.2.Main.PV
VirtualChannel.2.Alarm2.Dwell	Alarm dwell time	time_t	1ce5	7397	Set by Network.Modbus.TimeFormat
VirtualChannel.2.Alarm2.Hysteresis	Alarm hysteresis value	float32	1ce4	7396	Same as VirtualChannel.2.Main.PV
VirtualChannel.2.Alarm2.Inactive	1 = alarm source safe and ack'd (if necessary)	bool	1cee	7406	Not applicable
VirtualChannel.2.Alarm2.Inhibit	1 = alarm inhibited	bool	1cf1	7409	Not applicable
VirtualChannel.2.Alarm2.Latch	As VirtualChannel1.Alarm1.Latch	uint8	1ce1	7393	Not applicable
VirtualChannel.2.Alarm2.NotAcknowledged	1 = alarm has not been acknowledged	bool	1cef	7407	Not applicable
VirtualChannel.2.Alarm2.Reference	Deviation alarm 'Reference' value	float32	1ce6	7398	Same as VirtualChannel.2.Main.PV
VirtualChannel.2.Alarm2.Status	As VirtualChannel1.Alarm1.Status	uint8	0127	295	Not applicable
VirtualChannel.2.Alarm2.Threshold	Alarm trigger threshold	float32	1ce3	7395	Same as VirtualChannel.2.Main.PV
VirtualChannel.2.Alarm2.Type	As VirtualChannel1.Alarm1.Type	uint8	1ce0	7392	Not applicable
VirtualChannel.2.Main.Descriptor	Virtual Channel descriptor	string_t	4b1b	19227	Not applicable
VirtualChannel.2.Main.Disable	1 = Virtual channel disabled	bool	1ca3	7331	Not applicable
VirtualChannel.2.Main.HighCutOff	The highest input value that will be totalised/counted	float32	1c85	7301	Set by VirtualChannel.2.Main.Resolution
VirtualChannel.2.Main.Input1	Input 1 value	float32	1c87	7303	Set by VirtualChannel.2.Main.Resolution

5.3 PARAMETER LIST (Cont.)

Parameter path	Description	Type	Hex	Dec	Resolution
VirtualChannel.2.Main.Input2	Input 2 value	float32	1c88	7304	Set by VirtualChannel.2.Main.Resolution
VirtualChannel.2.Main.LowCutOff	The lowest input value that will be totalised/counted	float32	1c84	7300	Set by VirtualChannel.2.Main.Resolution
VirtualChannel.2.Main.ModbusInput	Modbus input value	float32	1c86	7302	Set by VirtualChannel.2.Main.Resolution
VirtualChannel.2.Main.Operation	As VirtualChannel1.Main.Operation	uint8	1c81	7297	Not applicable
VirtualChannel.2.Main.Period	The time period over which the calculation is made	int32	1c8a	7306	Not applicable
VirtualChannel.2.Main.Preset	Initiate preset. 0 = No; 1 = Yes	bool	1c8c	7308	Not applicable
VirtualChannel.2.Main.PresetValue	The Preset value	float32	1c8d	7309	Set by VirtualChannel.2.Main.Resolution
VirtualChannel.2.Main.PV	The virtual channel output value	float32	0124	292	Set by VirtualChannel.2.Main.Resolution
VirtualChannel.2.Main.Reset	Initiate reset. 0 = No; 1 = Yes	bool	1c8b	7307	Not applicable
VirtualChannel.2.Main.Resolution	Specifies the resolution/number of decimal places	uint8	1c82	7298	Not applicable
VirtualChannel.2.Main.Rollover	A pulse signal to indicate PV (output) has just rolled over	bool	1c91	7313	Not applicable
VirtualChannel.2.Main.Status	As VirtualChannel1.Main.Status	uint8	0125	293	Not applicable
VirtualChannel.2.Main.TimeRemaining	Time remaining before the calculation is made	time_t	1c89	7305	Set by Network.Modbus.TimeFormat
VirtualChannel.2.Main.Trigger	Increment/decrement counter. 0 = No; 1 = Yes	bool	1c8e	7310	Not applicable
VirtualChannel.2.Main.Type	As VirtualChannel1.Main.Type	uint8	1c80	7296	Not applicable
VirtualChannel.2.Main.Units	Units descriptor	string_t	4b30	19248	Not applicable
VirtualChannel.2.Main.UnitsScaler	Units scaler for totalisers	float32	1c83	7299	1dp
VirtualChannel.2.Trend.Colour	As VirtualChannel1.Trend.Colour	uint8	1ca0	7328	Not applicable
VirtualChannel.2.Trend.SpanHigh	Specifies the highest PV (output value) to be displayed	float32	1ca2	7330	Same as VirtualChannel.2.Main.PV
VirtualChannel.2.Trend.SpanLow	Specifies the lowest PV (output value) to be displayed	float32	1ca1	7329	Same as VirtualChannel.2.Main.PV
VirtualChannel.3.Alarm1.Acknowledge	1 = acknowledge alarm	bool	01c4	452	Not applicable
VirtualChannel.3.Alarm1.Acknowledgement	1 = alarm acknowledged	bool	1d50	7504	Not applicable
VirtualChannel.3.Alarm1.Active	1 = alarm source active, or safe but not ack'd	bool	1d4b	7499	Not applicable
VirtualChannel.3.Alarm1.Amount	Rate-of-change alarm 'Amount'	float32	1d48	7496	Same as VirtualChannel.3.Main.PV
VirtualChannel.3.Alarm1.AverageTime	Rate-of-change alarm 'Average time'	time_t	1d4a	7498	Set by Network.Modbus.TimeFormat
VirtualChannel.3.Alarm1.Block	0 = Blocking alarms off; 1 = Blocking alarms on	uint8	1d42	7490	Not applicable
VirtualChannel.3.Alarm1.ChangeTime	Rate-of-change alarm 'Change Time'	uint8	1d49	7497	Not applicable
VirtualChannel.3.Alarm1.Deviation	Deviation alarm 'Deviation Value'	float32	1d47	7495	Same as VirtualChannel.3.Main.PV
VirtualChannel.3.Alarm1.Dwell	Alarm dwell time	time_t	1d45	7493	Set by Network.Modbus.TimeFormat
VirtualChannel.3.Alarm1.Hysteresis	Alarm hysteresis value	float32	1d44	7492	Same as VirtualChannel.3.Main.PV
VirtualChannel.3.Alarm1.Inactive	1 = alarm source safe and ack'd (if necessary)	bool	1d4e	7502	Not applicable
VirtualChannel.3.Alarm1.Inhibit	1 = alarm inhibited	bool	1d51	7505	Not applicable
VirtualChannel.3.Alarm1.Latch	As VirtualChannel1.Alarm1.Latch	uint8	1d41	7489	Not applicable
VirtualChannel.3.Alarm1.NotAcknowledged	1 = alarm has not been acknowledged	bool	1d4f	7503	Not applicable
VirtualChannel.3.Alarm1.Reference	Deviation alarm 'Reference' value	float32	1d46	7494	Same as VirtualChannel.3.Main.PV
VirtualChannel.3.Alarm1.Status	As VirtualChannel1.Alarm1.Status	uint8	012a	298	Not applicable
VirtualChannel.3.Alarm1.Threshold	Alarm trigger threshold	float32	1d43	7491	Same as VirtualChannel.3.Main.PV
VirtualChannel.3.Alarm1.Type	As VirtualChannel1.Alarm1.Type	uint8	1d40	7488	Not applicable
VirtualChannel.3.Alarm2.Acknowledge	1 = acknowledge alarm	bool	01c5	453	Not applicable
VirtualChannel.3.Alarm2.Acknowledgement	1 = alarm acknowledged	bool	1d70	7536	Not applicable
VirtualChannel.3.Alarm2.Active	1 = alarm source active, or safe but not ack'd	bool	1d6b	7531	Not applicable
VirtualChannel.3.Alarm2.Amount	Rate-of-change alarm 'Amount'	float32	1d68	7528	Same as VirtualChannel.3.Main.PV
VirtualChannel.3.Alarm2.AverageTime	Rate-of-change alarm 'Average time'	time_t	1d6a	7530	Set by Network.Modbus.TimeFormat
VirtualChannel.3.Alarm2.Block	0 = Blocking alarms off; 1 = Blocking alarms on	uint8	1d62	7522	Not applicable
VirtualChannel.3.Alarm2.ChangeTime	Rate-of-change alarm 'Change Time'	uint8	1d69	7529	Not applicable
VirtualChannel.3.Alarm2.Deviation	Deviation alarm 'Deviation Value'	float32	1d67	7527	Same as VirtualChannel.3.Main.PV
VirtualChannel.3.Alarm2.Dwell	Alarm dwell time	time_t	1d65	7525	Set by Network.Modbus.TimeFormat
VirtualChannel.3.Alarm2.Hysteresis	Alarm hysteresis value	float32	1d64	7524	Same as VirtualChannel.3.Main.PV
VirtualChannel.3.Alarm2.Inactive	1 = alarm source safe and ack'd (if necessary)	bool	1d6e	7534	Not applicable
VirtualChannel.3.Alarm2.Inhibit	1 = alarm inhibited	bool	1d71	7537	Not applicable
VirtualChannel.3.Alarm2.Latch	As VirtualChannel1.Alarm1.Latch	uint8	1d61	7521	Not applicable
VirtualChannel.3.Alarm2.NotAcknowledged	1 = alarm has not been acknowledged	bool	1d6f	7535	Not applicable
VirtualChannel.3.Alarm2.Reference	Deviation alarm 'Reference' value	float32	1d66	7526	Same as VirtualChannel.3.Main.PV
VirtualChannel.3.Alarm2.Status	As VirtualChannel1.Alarm1.Status	uint8	012b	299	Not applicable
VirtualChannel.3.Alarm2.Threshold	Alarm trigger threshold	float32	1d63	7523	Same as VirtualChannel.3.Main.PV
VirtualChannel.3.Alarm2.Type	As VirtualChannel1.Alarm1.Type	uint8	1d60	7520	Not applicable
VirtualChannel.3.Main.Descriptor	Virtual Channel descriptor	string_t	4b36	19254	Not applicable
VirtualChannel.3.Main.Disable	1 = Virtual channel disabled	bool	1d23	7459	Not applicable
VirtualChannel.3.Main.HighCutOff	The highest input value that will be totalised/counted	float32	1d05	7429	Set by VirtualChannel.3.Main.Resolution
VirtualChannel.3.Main.Input1	Input 1	float32	1d07	7431	Set by VirtualChannel.3.Main.Resolution
VirtualChannel.3.Main.Input2	Input 2	float32	1d08	7432	Set by VirtualChannel.3.Main.Resolution
VirtualChannel.3.Main.LowCutOff	The lowest input value that will be totalised/counted	float32	1d04	7428	Set by VirtualChannel.3.Main.Resolution
VirtualChannel.3.Main.ModbusInput	Modbus input value	float32	1d06	7430	Set by VirtualChannel.3.Main.Resolution
VirtualChannel.3.Main.Operation	As VirtualChannel1.Main.Operation	uint8	1d01	7425	Not applicable
VirtualChannel.3.Main.Period	The time period over which the calculation is made	int32	1d0a	7434	Not applicable
VirtualChannel.3.Main.Preset	Initiate preset. 0 = No; 1 = Yes	bool	1d0c	7436	Not applicable
VirtualChannel.3.Main.PresetValue	The Preset value	float32	1d0d	7437	Set by VirtualChannel.3.Main.Resolution
VirtualChannel.3.Main.PV	The virtual channel output value	float32	0128	296	Set by VirtualChannel.3.Main.Resolution
VirtualChannel.3.Main.Reset	Initiate reset. 0 = No; 1 = Yes	bool	1d0b	7435	Not applicable
VirtualChannel.3.Main.Resolution	Number of decimal places (0 to 6)	uint8	1d02	7426	Not applicable
VirtualChannel.3.Main.Rollover	A pulse signal to indicate PV (output) has just rolled over	bool	1d11	7441	Not applicable
VirtualChannel.3.Main.Status	As VirtualChannel1.Main.Status	uint8	0129	297	Not applicable
VirtualChannel.3.Main.TimeRemaining	Time remaining before the calculation is made	time_t	1d09	7433	Set by Network.Modbus.TimeFormat
VirtualChannel.3.Main.Trigger	Increment/decrement counter. 0 = No; 1 = Yes	bool	1d0e	7438	Not applicable
VirtualChannel.3.Main.Type	As VirtualChannel1.Main.Type	uint8	1d00	7424	Not applicable
VirtualChannel.3.Main.Units	Units descriptor	string_t	4b4b	19275	Not applicable
VirtualChannel.3.Main.UnitsScaler	Units scaler for totalisers	float32	1d03	7427	1dp
VirtualChannel.3.Trend.Colour	As VirtualChannel1.Trend.Colour	uint8	1d20	7456	Not applicable
VirtualChannel.3.Trend.SpanHigh	Specifies the highest PV (output value) to be displayed	float32	1d22	7458	Same as VirtualChannel.3.Main.PV
VirtualChannel.3.Trend.SpanLow	Specifies the lowest PV (output value) to be displayed	float32	1d21	7457	Same as VirtualChannel.3.Main.PV

5.3 PARAMETER LIST (Cont.)

Parameter path	Description	Type	Hex	Dec	Resolution
VirtualChannel.4.Alarm1.Acknowledge	1 = acknowledge alarm	bool	01c6	454	Not applicable
VirtualChannel.4.Alarm1.Acknowledgement	1 = alarm acknowledged	bool	1dd0	7632	Not applicable
VirtualChannel.4.Alarm1.Active	1 = alarm source active, or safe but not ack'd	bool	1dcb	7627	Not applicable
VirtualChannel.4.Alarm1.Amount	Rate-of-change alarm 'Amount'	float32	1dc8	7624	Same as VirtualChannel.4.Main.PV
VirtualChannel.4.Alarm1.AverageTime	Rate-of-change alarm 'Average time'	time_t	1dca	7626	Set by Network.Modbus.TimeFormat
VirtualChannel.4.Alarm1.Block	0 = Blocking alarms off; 1 = Blocking alarms on	uint8	1dc2	7618	Not applicable
VirtualChannel.4.Alarm1.ChangeTime	Rate-of-change alarm 'Change Time'	uint8	1dc9	7625	Not applicable
VirtualChannel.4.Alarm1.Deviation	Deviation alarm 'Deviation Value'	float32	1dc7	7623	Same as VirtualChannel.4.Main.PV
VirtualChannel.4.Alarm1.Dwell	Alarm dwell time	time_t	1dc5	7621	Set by Network.Modbus.TimeFormat
VirtualChannel.4.Alarm1.Hysteresis	Alarm hysteresis value	float32	1dc4	7620	Same as VirtualChannel.4.Main.PV
VirtualChannel.4.Alarm1.Inactive	1 = alarm source safe and ack'd (if necessary)	bool	1dce	7630	Not applicable
VirtualChannel.4.Alarm1.Inhibit	1 = alarm inhibited	bool	1dd1	7633	Not applicable
VirtualChannel.4.Alarm1.Latch	As VirtualChannel1.Alarm1.Latch	uint8	1dc1	7617	Not applicable
VirtualChannel.4.Alarm1.NotAcknowledged	1 = alarm has not been acknowledged	bool	1dcf	7631	Not applicable
VirtualChannel.4.Alarm1.Reference	Deviation alarm 'Reference' value	float32	1dc6	7622	Same as VirtualChannel.4.Main.PV
VirtualChannel.4.Alarm1.Status	As VirtualChannel1.Alarm1.Status	uint8	012e	302	Not applicable
VirtualChannel.4.Alarm1.Threshold	Alarm trigger threshold	float32	1dc3	7619	Same as VirtualChannel.4.Main.PV
VirtualChannel.4.Alarm1.Type	As VirtualChannel1.Alarm1.Type	uint8	1dc0	7616	Not applicable
VirtualChannel.4.Alarm2.Acknowledge	1 = acknowledge alarm	bool	01c7	455	Not applicable
VirtualChannel.4.Alarm2.Acknowledgement	1 = alarm acknowledged	bool	1df0	7664	Not applicable
VirtualChannel.4.Alarm2.Active	1 = alarm source active, or safe but not ack'd	bool	1deb	7659	Not applicable
VirtualChannel.4.Alarm2.Amount	Rate-of-change alarm 'Amount'	float32	1de8	7656	Same as VirtualChannel.4.Main.PV
VirtualChannel.4.Alarm2.AverageTime	Rate-of-change alarm 'Average time'	time_t	1dea	7658	Set by Network.Modbus.TimeFormat
VirtualChannel.4.Alarm2.Block	0 = Blocking alarms off; 1 = Blocking alarms on	uint8	1de2	7650	Not applicable
VirtualChannel.4.Alarm2.ChangeTime	Rate-of-change alarm 'Change Time'	uint8	1de9	7657	Not applicable
VirtualChannel.4.Alarm2.Deviation	Deviation alarAlarm dwell timeAlarm dwell	time_t	1de5	7653	Set by Network.Modbus.TimeFormat
VirtualChannel.4.Alarm2.Hysteresis	Alarm hysteresis value	float32	1de4	7652	Same as VirtualChannel.4.Main.PV
VirtualChannel.4.Alarm2.Inactive	1 = alarm source safe and ack'd (if necessary)	bool	1dee	7662	Not applicable
VirtualChannel.4.Alarm2.Inhibit	1 = alarm inhibited	bool	1df1	7665	Not applicable
VirtualChannel.4.Alarm2.Latch	As VirtualChannel1.Alarm1.Latch	uint8	1de1	7649	Not applicable
VirtualChannel.4.Alarm2.NotAcknowledged	1 = alarm has not been acknowledged	bool	1def	7663	Not applicable
VirtualChannel.4.Alarm2.Reference	Deviation alarm 'Reference' value	float32	1de6	7654	Same as VirtualChannel.4.Main.PV
VirtualChannel.4.Alarm2.Status	As VirtualChannel1.Alarm1.Status	uint8	012f	303	Not applicable
VirtualChannel.4.Alarm2.Threshold	Alarm trigger threshold	float32	1de3	7651	Same as VirtualChannel.4.Main.PV
VirtualChannel.4.Alarm2.Type	As VirtualChannel1.Alarm1.Type	uint8	1de0	7648	Not applicable
VirtualChannel.4.Main.Descriptor	Virtual Channel descriptor	string_t	4b51	19281	Not applicable
VirtualChannel.4.Main.Disable	1 = Virtual channel disabled	bool	1da3	7587	Not applicable
VirtualChannel.4.Main.HighCutOff	The highest input value that will be totalised/counted	float32	1d85	7557	Set by VirtualChannel.4.Main.Resolution
VirtualChannel.4.Main.Input1	Input 1 value	float32	1d87	7559	Set by VirtualChannel.4.Main.Resolution
VirtualChannel.4.Main.Input2	Input 2 value	float32	1d88	7560	Set by VirtualChannel.4.Main.Resolution
VirtualChannel.4.Main.LowCutOff	The lowest input value that will be totalised/counted	float32	1d84	7556	Set by VirtualChannel.4.Main.Resolution
VirtualChannel.4.Main.ModbusInput	Modbus input value	float32	1d86	7558	Set by VirtualChannel.4.Main.Resolution
VirtualChannel.4.Main.Operation	As VirtualChannel1.Main.Operation	uint8	1d81	7553	Not applicable
VirtualChannel.4.Main.Period	Averaging period	int32	1d8a	7562	Not applicable
VirtualChannel.4.Main.Preset	Initiate preset. 0 = No; 1 = Yes	bool	1d8c	7564	Not applicable
VirtualChannel.4.Main.PresetValue	The Preset value	float32	1d8d	7565	Set by VirtualChannel.4.Main.Resolution
VirtualChannel.4.Main.PV	The virtual channel output value	float32	012c	300	Set by VirtualChannel.4.Main.Resolution
VirtualChannel.4.Main.Reset	Initiate reset. 0 = No; 1 = Yes	bool	1d8b	7563	Not applicable
VirtualChannel.4.Main.Resolution	Number of decimal places (0 to 6)	uint8	1d82	7554	Not applicable
VirtualChannel.4.Main.Rollover	A pulse signal to indicate PV (output) has just rolled over	bool	1d91	7569	Not applicable
VirtualChannel.4.Main.Status	As VirtualChannel1.Main.Status	uint8	012d	301	Not applicable
VirtualChannel.4.Main.TimeRemaining	Time remaining before the calculation is made	time_t	1d89	7561	Set by Network.Modbus.TimeFormat
VirtualChannel.4.Main.Trigger	Increment/decrement counter. 0 = No; 1 = Yes	bool	1d8e	7566	Not applicable
VirtualChannel.4.Main.Type	As VirtualChannel1.Main.Type	uint8	1d80	7552	Not applicable
VirtualChannel.4.Main.Units	Units descriptor	string_t	4b66	19302	Not applicable
VirtualChannel.4.Main.UnitsScaler	Units scaler for totalisers	float32	1d83	7555	1dp
VirtualChannel.4.Trend.Colour	As VirtualChannel1.Trend.Colour	uint8	1da0	7584	Not applicable
VirtualChannel.4.Trend.SpanHigh	Specifies the highest PV (output value) to be displayed	float32	1da2	7586	Same as VirtualChannel.4.Main.PV
VirtualChannel.4.Trend.SpanLow	Specifies the lowest PV (output value) to be displayed	float32	1da1	7585	Same as VirtualChannel.4.Main.PV
VirtualChannel.5.Alarm1.Acknowledge	1 = acknowledge alarm	bool	01c8	456	Not applicable
VirtualChannel.5.Alarm1.Acknowledgement	1 = alarm acknowledged	bool	1e50	7760	Not applicable
VirtualChannel.5.Alarm1.Active	1 = alarm source active, or safe but not ack'd	bool	1e4b	7755	Not applicable
VirtualChannel.5.Alarm1.Amount	Rate-of-change alarm 'Amount'	float32	1e48	7752	Same as VirtualChannel.5.Main.PV
VirtualChannel.5.Alarm1.AverageTime	Rate-of-change alarm 'Average time'	time_t	1e4a	7754	Set by Network.Modbus.TimeFormat
VirtualChannel.5.Alarm1.Block	0 = Blocking alarms off; 1 = Blocking alarms on	uint8	1e42	7746	Not applicable
VirtualChannel.5.Alarm1.ChangeTime	Rate-of-change alarm 'Change Time'	uint8	1e49	7753	Not applicable
VirtualChannel.5.Alarm1.Deviation	Deviation alarm 'Deviation Value'	float32	1e47	7751	Same as VirtualChannel.5.Main.PV
VirtualChannel.5.Alarm1.Dwell	Alarm dwell time	time_t	1e45	7749	Set by Network.Modbus.TimeFormat
VirtualChannel.5.Alarm1.Hysteresis	Alarm hysteresis value	float32	1e44	7748	Same as VirtualChannel.5.Main.PV
VirtualChannel.5.Alarm1.Inactive	1 = alarm source safe and ack'd (if necessary)	bool	1e4e	7758	Not applicable
VirtualChannel.5.Alarm1.Inhibit	1 = alarm inhibited	bool	1e51	7761	Not applicable
VirtualChannel.5.Alarm1.Latch	As VirtualChannel1.Alarm1.Latch	uint8	1e41	7745	Not applicable
VirtualChannel.5.Alarm1.NotAcknowledged	1 = alarm has not been acknowledged	bool	1e4f	7759	Not applicable
VirtualChannel.5.Alarm1.Reference	Deviation alarm 'Reference' value	float32	1e46	7750	Same as VirtualChannel.5.Main.PV
VirtualChannel.5.Alarm1.Status	As VirtualChannel1.Alarm1.Status	uint8	0132	306	Not applicable
VirtualChannel.5.Alarm1.Threshold	Alarm trigger threshold	float32	1e43	7747	Same as VirtualChannel.5.Main.PV
VirtualChannel.5.Alarm1.Type	As VirtualChannel1.Alarm1.Type	uint8	1e40	7744	Not applicable
VirtualChannel.5.Alarm2.Acknowledge	1 = acknowledge alarm	bool	01c9	457	Not applicable
VirtualChannel.5.Alarm2.Acknowledgement	1 = alarm acknowledged	bool	1e70	7792	Not applicable
VirtualChannel.5.Alarm2.Active	1 = alarm source active, or safe but not ack'd	bool	1e6b	7787	Not applicable

5.3 PARAMETER LIST (Cont.)

Parameter path	Description	Type	Hex	Dec	Resolution
VirtualChannel.5.Alarm2.Amount	Rate-of-change alarm ‘Amount’	float32	1e68	7784	Same as VirtualChannel.5.Main.PV
VirtualChannel.5.Alarm2.AverageTime	Rate-of-change alarm ‘Average time’	time_t	1e6a	7786	Set by Network.Modbus.TimeFormat
VirtualChannel.5.Alarm2.Block	0 = Blocking alarms off; 1 = Blocking alarms on	uint8	1e62	7778	Not applicable
VirtualChannel.5.Alarm2.ChangeTime	Rate-of-change alarm ‘Change Time’	uint8	1e69	7785	Not applicable
VirtualChannel.5.Alarm2.Deviation	Deviation alarm ‘Deviation Value’	float32	1e67	7783	Same as VirtualChannel.5.Main.PV
VirtualChannel.5.Alarm2.Dwell	Alarm dwell time	time_t	1e65	7781	Set by Network.Modbus.TimeFormat
VirtualChannel.5.Alarm2.Hysteresis	Alarm hysteresis value	float32	1e64	7780	Same as VirtualChannel.5.Main.PV
VirtualChannel.5.Alarm2.Inactive	1 = alarm source safe and ack’d (if necessary)	bool	1e6e	7790	Not applicable
VirtualChannel.5.Alarm2.Inhibit	1 = alarm inhibited	bool	1e71	7793	Not applicable
VirtualChannel.5.Alarm2.Latch	As VirtualChannel1.Alarm1.Latch	uint8	1e61	7777	Not applicable
VirtualChannel.5.Alarm2.NotAcknowledged	1 = alarm has not been acknowledged	bool	1e6f	7791	Not applicable
VirtualChannel.5.Alarm2.Reference	Deviation alarm ‘Reference’ value	float32	1e66	7782	Same as VirtualChannel.5.Main.PV
VirtualChannel.5.Alarm2.Status	As VirtualChannel1.Alarm1.Status	uint8	0133	307	Not applicable
VirtualChannel.5.Alarm2.Threshold	Alarm trigger threshold	float32	1e63	7779	Same as VirtualChannel.5.Main.PV
VirtualChannel.5.Alarm2.Type	As VirtualChannel1.Alarm1.Type	uint8	1e60	7776	Not applicable
VirtualChannel.5.Main.Descriptor	Virtual Channel descriptor	string_t	4b6c	19308	Not applicable
VirtualChannel.5.Main.Disable	1 = Virtual channel disabled	bool	1e23	7715	Not applicable
VirtualChannel.5.Main.HighCutOff	The highest input value that will be totalised/counted	float32	1e05	7685	Set by VirtualChannel.5.Main.Resolution
VirtualChannel.5.Main.Input1	Input 1 value	float32	1e07	7687	Set by VirtualChannel.5.Main.Resolution
VirtualChannel.5.Main.Input2	Input 2 value	float32	1e08	7688	Set by VirtualChannel.5.Main.Resolution
VirtualChannel.5.Main.LowCutOff	The lowest input value that will be totalised/counted	float32	1e04	7684	Set by VirtualChannel.5.Main.Resolution
VirtualChannel.5.Main.ModbusInput	Modbus input value	float32	1e06	7686	Set by VirtualChannel.5.Main.Resolution
VirtualChannel.5.Main.Operation	As VirtualChannel1.Main.Operation	uint8	1e01	7681	Not applicable
VirtualChannel.5.Main.Period	The time period over which the calculation is made	int32	1e0a	7690	Not applicable
VirtualChannel.5.Main.Preset	Initiate preset. 0 = No; 1 = Yes	bool	1e0c	7692	Not applicable
VirtualChannel.5.Main.PresetValue	The Preset value	float32	1e0d	7693	Set by VirtualChannel.5.Main.Resolution
VirtualChannel.5.Main.PV	The virtual channel output value	float32	0130	304	Set by VirtualChannel.5.Main.Resolution
VirtualChannel.5.Main.Reset	nitiate reset. 0 = No; 1 = Yes	bool	1e0b	7691	Not applicable
VirtualChannel.5.Main.Resolution	Number of decimal places (0 to 6)	uint8	1e02	7682	Not applicable
VirtualChannel.5.Main.Rollover	A pulse signal to indicate PV (output) has just rolled over	bool	1e11	7697	Not applicable
VirtualChannel.5.Main.Status	As VirtualChannel1.Main.Status	uint8	0131	305	Not applicable
VirtualChannel.5.Main.TimeRemaining	Time remaining before the calculation is made	time_t	1e09	7689	Set by Network.Modbus.TimeFormat
VirtualChannel.5.Main.Trigger	Increment/decrement counter. 0 = No; 1 = Yes	bool	1e0e	7694	Not applicable
VirtualChannel.5.Main.Type	As VirtualChannel1.Main.Type	uint8	1e00	7680	Not applicable
VirtualChannel.5.Main.Units	Units descriptor	string_t	4b81	19329	Not applicable
VirtualChannel.5.Main.UnitsScaler	Units scaler for totalisers	float32	1e03	7683	1dp
VirtualChannel.5.Trend.Colour	As VirtualChannel1.Trend.Colour	uint8	1e20	7712	Not applicable
VirtualChannel.5.Trend.SpanHigh	Specifies the highest PV (output value) to be displayed	float32	1e22	7714	Same as VirtualChannel.5.Main.PV
VirtualChannel.5.Trend.SpanLow	Specifies the lowest PV (output value) to be displayed	float32	1e21	7713	Same as VirtualChannel.5.Main.PV
VirtualChannel.6.Alarm1.Acknowledge	1 = acknowledge alarm	bool	01ca	458	Not applicable
VirtualChannel.6.Alarm1.Acknowledgement	1 = alarm acknowledged	bool	1ed0	7888	Not applicable
VirtualChannel.6.Alarm1.Active	1 = alarm source active, or safe but not ack’d	bool	1ecb	7883	Not applicable
VirtualChannel.6.Alarm1.Amount	Rate-of-change alarm ‘Amount’	float32	1ec8	7880	Same as VirtualChannel.6.Main.PV
VirtualChannel.6.Alarm1.AverageTime	Rate-of-change alarm ‘Average time’	time_t	1eca	7882	Set by Network.Modbus.TimeFormat
VirtualChannel.6.Alarm1.Block	0 = Blocking alarms off; 1 = Blocking alarms on	uint8	1ec2	7874	Not applicable
VirtualChannel.6.Alarm1.ChangeTime	Rate-of-change alarm ‘Change Time’	uint8	1ec9	7881	Not applicable
VirtualChannel.6.Alarm1.Deviation	Deviation alarm ‘Deviation Value’	float32	1ec7	7879	Same as VirtualChannel.6.Main.PV
VirtualChannel.6.Alarm1.Dwell	Alarm dwell time	time_t	1ec5	7877	Set by Network.Modbus.TimeFormat
VirtualChannel.6.Alarm1.Hysteresis	Alarm hysteresis value	float32	1ec4	7876	Same as VirtualChannel.6.Main.PV
VirtualChannel.6.Alarm1.Inactive	1 = alarm source safe and ack’d (if necessary)	bool	1ece	7886	Not applicable
VirtualChannel.6.Alarm1.Inhibit	1 = alarm inhibited	bool	1ed1	7889	Not applicable
VirtualChannel.6.Alarm1.Latch	As VirtualChannel1.Alarm1.Latch	uint8	1ec1	7873	Not applicable
VirtualChannel.6.Alarm1.NotAcknowledged	1 = alarm has not been acknowledged	bool	1ecf	7887	Not applicable
VirtualChannel.6.Alarm1.Reference	Deviation alarm ‘Reference’ value	float32	1ec6	7878	Same as VirtualChannel.6.Main.PV
VirtualChannel.6.Alarm1.Status	As VirtualChannel1.Alarm1.Status	uint8	0136	310	Not applicable
VirtualChannel.6.Alarm1.Threshold	Alarm trigger threshold	float32	1ec3	7875	Same as VirtualChannel.6.Main.PV
VirtualChannel.6.Alarm1.Type	As VirtualChannel1.Alarm1.Type	uint8	1ec0	7872	Not applicable
VirtualChannel.6.Alarm2.Acknowledge	1 = acknowledge alarm	bool	01cb	459	Not applicable
VirtualChannel.6.Alarm2.Acknowledgement	1 = alarm acknowledged	bool	1ef0	7920	Not applicable
VirtualChannel.6.Alarm2.Active	1 = alarm source active, or safe but not ack’d	bool	1eeb	7915	Not applicable
VirtualChannel.6.Alarm2.Amount	Rate-of-change alarm ‘Amount’	float32	1ee8	7912	Same as VirtualChannel.6.Main.PV
VirtualChannel.6.Alarm2.AverageTime	Rate-of-change alarm ‘Average time’	time_t	1eea	7914	Set by Network.Modbus.TimeFormat
VirtualChannel.6.Alarm2.Block	0 = Blocking alarms off; 1 = Blocking alarms on	uint8	1ee2	7906	Not applicable
VirtualChannel.6.Alarm2.ChangeTime	Rate-of-change alarm ‘Change Time’	uint8	1ee9	7913	Not applicable
VirtualChannel.6.Alarm2.Deviation	Deviation alarm ‘Deviation Value’	float32	1ee7	7911	Same as VirtualChannel.6.Main.PV
VirtualChannel.6.Alarm2.Dwell	Alarm dwell time	time_t	1ee5	7909	Set by Network.Modbus.TimeFormat
VirtualChannel.6.Alarm2.Hysteresis	Alarm hysteresis value	float32	1ee4	7908	Same as VirtualChannel.6.Main.PV
VirtualChannel.6.Alarm2.Inactive	1 = alarm source safe and ack’d (if necessary)	bool	1eee	7918	Not applicable
VirtualChannel.6.Alarm2.Inhibit	1 = alarm inhibited	bool	1ef1	7921	Not applicable
VirtualChannel.6.Alarm2.Latch	As VirtualChannel1.Alarm1.Latch	uint8	1ee1	7905	Not applicable
VirtualChannel.6.Alarm2.NotAcknowledged	1 = alarm has not been acknowledged	bool	1eef	7919	Not applicable
VirtualChannel.6.Alarm2.Reference	Deviation alarm ‘Reference’ value	float32	1ee6	7910	Same as VirtualChannel.6.Main.PV
VirtualChannel.6.Alarm2.Status	As VirtualChannel1.Alarm1.Status	uint8	0137	311	Not applicable
VirtualChannel.6.Alarm2.Threshold	Alarm trigger threshold	float32	1ee3	7907	Same as VirtualChannel.6.Main.PV
VirtualChannel.6.Alarm2.Type	As VirtualChannel1.Alarm1.Type	uint8	1ee0	7904	Not applicable
VirtualChannel.6.Main.Descriptor	Virtual Channel descriptor	string_t	4b87	19335	Not applicable
VirtualChannel.6.Main.Disable	1 = Virtual channel disabled	bool	1ea3	7843	Not applicable
VirtualChannel.6.Main.HighCutOff	The highest input value that will be totalised/counted	float32	1e85	7813	Set by VirtualChannel.6.Main.Resolution
VirtualChannel.6.Main.Input1	Input 1 value	float32	1e87	7815	Set by VirtualChannel.6.Main.Resolution
VirtualChannel.6.Main.Input2	Input 2 value	float32	1e88	7816	Set by VirtualChannel.6.Main.Resolution

5.3 PARAMETER LIST (Cont.)

Parameter path	Description	Type	Hex	Dec	Resolution
VirtualChannel.6.Main.LowCutOff	The lowest input value that will be totalised/counted	float32	1e84	7812	Set by VirtualChannel.6.Main.Resolution
VirtualChannel.6.Main.ModbusInput	Modbus input value	float32	1e86	7814	Set by VirtualChannel.6.Main.Resolution
VirtualChannel.6.Main.Operation	As VirtualChannel1.Main.Operation	uint8	1e81	7809	Not applicable
VirtualChannel.6.Main.Period	The time period over which the calculation is made	int32	1e8a	7818	Not applicable
VirtualChannel.6.Main.Preset	Initiate preset. 0 = No; 1 = Yes	bool	1e8c	7820	Not applicable
VirtualChannel.6.Main.PresetValue	The Preset value	float32	1e8d	7821	Set by VirtualChannel.6.Main.Resolution
VirtualChannel.6.Main.PV	The virtual channel output value	float32	0134	308	Set by VirtualChannel.6.Main.Resolution
VirtualChannel.6.Main.Reset	Initiate reset. 0 = No; 1 = Yes	bool	1e8b	7819	Not applicable
VirtualChannel.6.Main.Resolution	Number of decimal places (0 to 6)	uint8	1e82	7810	Not applicable
VirtualChannel.6.Main.Rollover	A pulse signal to indicate PV (output) has just rolled over	bool	1e91	7825	Not applicable
VirtualChannel.6.Main.Status	As VirtualChannel1.Main.Status	uint8	0135	309	Not applicable
VirtualChannel.6.Main.TimeRemaining	Time remaining before the calculation is made	time_t	1e89	7817	Set by Network.Modbus.TimeFormat
VirtualChannel.6.Main.Trigger	ncrement/decrement counter. 0 = No; 1 = Yes	bool	1e8e	7822	Not applicable
VirtualChannel.6.Main.Type	As VirtualChannel1.Main.Type	uint8	1e80	7808	Not applicable
VirtualChannel.6.Main.Units	Units descriptor	string_t	4b9c	19356	Not applicable
VirtualChannel.6.Main.UnitsScaler	Units scaler for totalisers	float32	1e83	7811	1dp
VirtualChannel.6.Trend.Colour	As VirtualChannel1.Trend.Colour	uint8	1ea0	7840	Not applicable
VirtualChannel.6.Trend.SpanHigh	Specifies the highest PV (output value) to be displayed	float32	1ea2	7842	Same as VirtualChannel.6.Main.PV
VirtualChannel.6.Trend.SpanLow	Specifies the lowest PV (output value) to be displayed	float32	1ea1	7841	Same as VirtualChannel.6.Main.PV
VirtualChannel.7.Alarm1.Acknowledge	1 = acknowledge alarm	bool	01cc	460	Not applicable
VirtualChannel.7.Alarm1.Acknowledgement	1 = alarm acknowledged	bool	1f50	8016	Not applicable
VirtualChannel.7.Alarm1.Active	1 = alarm source active, or safe but not ack'd	bool	1f4b	8011	Not applicable
VirtualChannel.7.Alarm1.Amount	Rate-of-change alarm 'Amount'	float32	1f48	8008	Same as VirtualChannel.7.Main.PV
VirtualChannel.7.Alarm1.AverageTime	Rate-of-change alarm 'Average time'	time_t	1f4a	8010	Set by Network.Modbus.TimeFormat
VirtualChannel.7.Alarm1.Block	0 = Blocking alarms off; 1 = Blocking alarms on	uint8	1f42	8002	Not applicable
VirtualChannel.7.Alarm1.ChangeTime	Rate-of-change alarm 'Change Time'	uint8	1f49	8009	Not applicable
VirtualChannel.7.Alarm1.Deviation	Deviation alarm 'Deviation Value'	float32	1f47	8007	Same as VirtualChannel.7.Main.PV
VirtualChannel.7.Alarm1.Dwell	Alarm dwell time	time_t	1f45	8005	Set by Network.Modbus.TimeFormat
VirtualChannel.7.Alarm1.Hysteresis	Alarm hysteresis value	float32	1f44	8004	Same as VirtualChannel.7.Main.PV
VirtualChannel.7.Alarm1.Inactive	1 = alarm source safe and ack'd (if necessary)	bool	1f4e	8014	Not applicable
VirtualChannel.7.Alarm1.Inhibit	1 = alarm inhibited	bool	1f51	8017	Not applicable
VirtualChannel.7.Alarm1.Latch	As VirtualChannel1.Alarm1.Latch	uint8	1f41	8001	Not applicable
VirtualChannel.7.Alarm1.NotAcknowledged	1 = alarm has not been acknowledged	bool	1f4f	8015	Not applicable
VirtualChannel.7.Alarm1.Reference	Deviation alarm 'Reference' value	float32	1f46	8006	Same as VirtualChannel.7.Main.PV
VirtualChannel.7.Alarm1.Status	As VirtualChannel1.Alarm1.Status	uint8	013a	314	Not applicable
VirtualChannel.7.Alarm1.Threshold	Alarm trigger threshold	float32	1f43	8003	Same as VirtualChannel.7.Main.PV
VirtualChannel.7.Alarm1.Type	As VirtualChannel1.Alarm1.Type	uint8	1f40	8000	Not applicable
VirtualChannel.7.Alarm2.Acknowledge	1 = acknowledge alarm	bool	01cd	461	Not applicable
VirtualChannel.7.Alarm2.Acknowledgement	1 = alarm acknowledged	bool	1f70	8048	Not applicable
VirtualChannel.7.Alarm2.Active	1 = alarm source active, or safe but not ack'd	bool	1f6b	8043	Not applicable
VirtualChannel.7.Alarm2.Amount	Rate-of-change alarm 'Amount'	float32	1f68	8040	Same as VirtualChannel.7.Main.PV
VirtualChannel.7.Alarm2.AverageTime	Rate-of-change alarm 'Average time'	time_t	1f6a	8042	Set by Network.Modbus.TimeFormat
VirtualChannel.7.Alarm2.Block	0 = Blocking alarms off; 1 = Blocking alarms on	uint8	1f62	8034	Not applicable
VirtualChannel.7.Alarm2.ChangeTime	Rate-of-change alarm 'Change Time'	uint8	1f69	8041	Not applicable
VirtualChannel.7.Alarm2.Deviation	Deviation alarm 'Deviation Value'	float32	1f67	8039	Same as VirtualChannel.7.Main.PV
VirtualChannel.7.Alarm2.Dwell	Alarm dwell time	time_t	1f65	8037	Set by Network.Modbus.TimeFormat
VirtualChannel.7.Alarm2.Hysteresis	Alarm hysteresis value	float32	1f64	8036	Same as VirtualChannel.7.Main.PV
VirtualChannel.7.Alarm2.Inactive	1 = alarm source safe and ack'd (if necessary)	bool	1f6e	8046	Not applicable
VirtualChannel.7.Alarm2.Inhibit	1 = alarm inhibited	bool	1f71	8049	Not applicable
VirtualChannel.7.Alarm2.Latch	As VirtualChannel1.Alarm1.Latch	uint8	1f61	8033	Not applicable
VirtualChannel.7.Alarm2.NotAcknowledged	1 = alarm has not been acknowledged	bool	1f6f	8047	Not applicable
VirtualChannel.7.Alarm2.Reference	Deviation alarm 'Reference' value	float32	1f66	8038	Same as VirtualChannel.7.Main.PV
VirtualChannel.7.Alarm2.Status	As VirtualChanneAlarm trigger thresholdAlarm threshold	float32	1f63	8035	Same as VirtualChannel.7.Main.PV
VirtualChannel.7.Alarm2.Type	As VirtualChannel1.Alarm1.Type	uint8	1f60	8032	Not applicable
VirtualChannel.7.Main.Descriptor	Virtual Channel descriptor	string_t	4ba2	19362	Not applicable
VirtualChannel.7.Main.Disable	1 = Virtual channel disabled	bool	1f23	7971	Not applicable
VirtualChannel.7.Main.HighCutOff	The highest input value that will be totalised/counted	float32	1f05	7941	Set by VirtualChannel.7.Main.Resolution
VirtualChannel.7.Main.Input1	Input 1 value	float32	1f07	7943	Set by VirtualChannel.7.Main.Resolution
VirtualChannel.7.Main.Input2	Input 2 value	float32	1f08	7944	Set by VirtualChannel.7.Main.Resolution
VirtualChannel.7.Main.LowCutOff	The lowest input value that will be totalised/counted	float32	1f04	7940	Set by VirtualChannel.7.Main.Resolution
VirtualChannel.7.Main.ModbusInput	Modbus input value	float32	1f06	7942	Set by VirtualChannel.7.Main.Resolution
VirtualChannel.7.Main.Operation	As VirtualChannel1.Main.Operation	uint8	1f01	7937	Not applicable
VirtualChannel.7.Main.Period	Averaging period	int32	1f0a	7946	Not applicable
VirtualChannel.7.Main.Preset	Initiate preset. 0 = No; 1 = Yes	bool	1f0c	7948	Not applicable
VirtualChannel.7.Main.PresetValue	The Preset value	float32	1f0d	7949	Set by VirtualChannel.7.Main.Resolution
VirtualChannel.7.Main.PV	The virtual channel output value	float32	0138	312	Set by VirtualChannel.7.Main.Resolution
VirtualChannel.7.Main.Reset	Initiate reset. 0 = No; 1 = Yes	bool	1f0b	7947	Not applicable
VirtualChannel.7.Main.Resolution	Number of decimal places (0 to 6)	uint8	1f02	7938	Not applicable
VirtualChannel.7.Main.Rollover	A pulse signal to indicate PV (output) has just rolled over	bool	1f11	7953	Not applicable
VirtualChannel.7.Main.Status	As VirtualChannel1.Main.Status	uint8	0139	313	Not applicable
VirtualChannel.7.Main.TimeRemaining	Time remaining before calculation is made	time_t	1f09	7945	Set by Network.Modbus.TimeFormat
VirtualChannel.7.Main.Trigger	Increment/decrement counter. 0 = No; 1 = Yes	bool	1f0e	7950	Not applicable
VirtualChannel.7.Main.Type	As VirtualChannel1.Main.Type	uint8	1f00	7936	Not applicable
VirtualChannel.7.Main.Units	Units descriptor	string_t	4bb7	19383	Not applicable
VirtualChannel.7.Main.UnitsScaler	Units scaler for totalisers	float32	1f03	7939	1dp
VirtualChannel.7.Trend.Colour	As VirtualChannel1.Trend.Colour	uint8	1f20	7968	Not applicable
VirtualChannel.7.Trend.SpanHigh	Specifies the highest PV (output value) to be displayed	float32	1f22	7970	Same as VirtualChannel.7.Main.PV
VirtualChannel.7.Trend.SpanLow	Specifies the lowest PV (output value) to be displayed	float32	1f21	7969	Same as VirtualChannel.7.Main.PV
VirtualChannel.8.Alarm1.Acknowledge	1 = acknowledge alarm	bool	01ce	462	Not applicable

5.3 PARAMETER LIST (Cont.)

Parameter path	Description	Type	Hex	Dec	Resolution
VirtualChannel.8.Alarm1.Acknowledgement	1 = alarm acknowledged	bool	1fd0	8144	Not applicable
VirtualChannel.8.Alarm1.Active	1 = alarm source active, or safe but not ack'd	bool	1fcb	8139	Not applicable
VirtualChannel.8.Alarm1.Amount	Rate-of-change alarm 'Amount'	float32	1fc8	8136	Same as VirtualChannel.8.Main.PV
VirtualChannel.8.Alarm1.AverageTime	Rate-of-change alarm 'Average time'	time_t	1fca	8138	Set by Network.Modbus.TimeFormat
VirtualChannel.8.Alarm1.Block	0 = Blocking alarms off; 1 = Blocking alarms on	uint8	1fc2	8130	Not applicable
VirtualChannel.8.Alarm1.ChangeTime	Rate-of-change alarm 'Change Time'	uint8	1fc9	8137	Not applicable
VirtualChannel.8.Alarm1.Deviation	Deviation alarm 'Deviation Value'	float32	1fc7	8135	Same as VirtualChannel.8.Main.PV
VirtualChannel.8.Alarm1.Dwell	Alarm dwell time	time_t	1fc5	8133	Set by Network.Modbus.TimeFormat
VirtualChannel.8.Alarm1.Hysteresis	Alarm hysteresis value	float32	1fc4	8132	Same as VirtualChannel.8.Main.PV
VirtualChannel.8.Alarm1.Inactive	1 = alarm source safe and ack'd (if necessary)	bool	1fce	8142	Not applicable
VirtualChannel.8.Alarm1.Inhibit	1 = alarm inhibited	bool	1fd1	8145	Not applicable
VirtualChannel.8.Alarm1.Latch	As VirtualChannel1.Alarm1.Latch	uint8	1fc1	8129	Not applicable
VirtualChannel.8.Alarm1.NotAcknowledged	1 = alarm has not been acknowledged	bool	1fcf	8143	Not applicable
VirtualChannel.8.Alarm1.Reference	Deviation alarm 'Reference' value	float32	1fc6	8134	Same as VirtualChannel.8.Main.PV
VirtualChannel.8.Alarm1.Status	As VirtualChannel1.Alarm1.Status	uint8	013e	318	Not applicable
VirtualChannel.8.Alarm1.Threshold	Alarm trigger threshold	float32	1fc3	8131	Same as VirtualChannel.8.Main.PV
VirtualChannel.8.Alarm1.Type	As VirtualChannel1.Alarm1.Type	uint8	1fc0	8128	Not applicable
VirtualChannel.8.Alarm2.Acknowledge	1 = acknowledge alarm	bool	01cf	463	Not applicable
VirtualChannel.8.Alarm2.Acknowledgement	1 = alarm acknowledged	bool	1ff0	8176	Not applicable
VirtualChannel.8.Alarm2.Active	1 = alarm source active, or safe but not ack'd	bool	1feb	8171	Not applicable
VirtualChannel.8.Alarm2.Amount	Rate-of-change alarm 'Amount'	float32	1fe8	8168	Same as VirtualChannel.8.Main.PV
VirtualChannel.8.Alarm2.AverageTime	Rate-of-change alarm 'Average time'	time_t	1fea	8170	Set by Network.Modbus.TimeFormat
VirtualChannel.8.Alarm2.Block	0 = Blocking alarms off; 1 = Blocking alarms on	uint8	1fe2	8162	Not applicable
VirtualChannel.8.Alarm2.ChangeTime	Rate-of-change alarm 'Change Time'	uint8	1fe9	8169	Not applicable
VirtualChannel.8.Alarm2.Deviation	Deviation alarm 'Deviation Value'	float32	1fe7	8167	Same as VirtualChannel.8.Main.PV
VirtualChannel.8.Alarm2.Dwell	Alarm dwell time	time_t	1fe5	8165	Set by Network.Modbus.TimeFormat
VirtualChannel.8.Alarm2.Hysteresis	Alarm hysteresis value	float32	1fe4	8164	Same as VirtualChannel.8.Main.PV
VirtualChannel.8.Alarm2.Inactive	1 = alarm source safe and ack'd (if necessary)	bool	1fee	8174	Not applicable
VirtualChannel.8.Alarm2.Inhibit	1 = alarm inhibited	bool	1ff1	8177	Not applicable
VirtualChannel.8.Alarm2.Latch	As VirtualChannel1.Alarm1.Latch	uint8	1fe1	8161	Not applicable
VirtualChannel.8.Alarm2.NotAcknowledged	1 = alarm has not been acknowledged	bool	1fef	8175	Not applicable
VirtualChannel.8.Alarm2.Reference	Deviation alarm 'Reference' value	float32	1fe6	8166	Same as VirtualChannel.8.Main.PV
VirtualChannel.8.Alarm2.Status	As VirtualChannel1.Alarm1.Status	uint8	013f	319	Not applicable
VirtualChannel.8.Alarm2.Threshold	Alarm trigger threshold	float32	1fe3	8163	Same as VirtualChannel.8.Main.PV
VirtualChannel.8.Alarm2.Type	As VirtualChannel1.Alarm1.Type	uint8	1fe0	8160	Not applicable
VirtualChannel.8.Main.Descriptor	Virtual Channel descriptor	string_t	4bbd	19389	Not applicable
VirtualChannel.8.Main.Disable	1 = Virtual channel disabled	bool	1fa3	8099	Not applicable
VirtualChannel.8.Main.HighCutOff	The highest input value that will be totalised/counted	float32	1f85	8069	Set by VirtualChannel.8.Main.Resolution
VirtualChannel.8.Main.Input1	Input 1 value	float32	1f87	8071	Set by VirtualChannel.8.Main.Resolution
VirtualChannel.8.Main.Input2	Input 2 value	float32	1f88	8072	Set by VirtualChannel.8.Main.Resolution
VirtualChannel.8.Main.LowCutOff	The lowest input value that will be totalised/counted	float32	1f84	8068	Set by VirtualChannel.8.Main.Resolution
VirtualChannel.8.Main.ModbusInput	Modbus input value	float32	1f86	8070	Set by VirtualChannel.8.Main.Resolution
VirtualChannel.8.Main.Operation	As VirtualChannel1.Main.Operation	uint8	1f81	8065	Not applicable
VirtualChannel.8.Main.Period	The time period over which the calculation is made	int32	1f8a	8074	Not applicable
VirtualChannel.8.Main.Preset	Initiate preset. 0 = No; 1 = Yes	bool	1f8c	8076	Not applicable
VirtualChannel.8.Main.PresetValue	The Preset value	float32	1f8d	8077	Set by VirtualChannel.8.Main.Resolution
VirtualChannel.8.Main.PV	The virtual channel output value	float32	013c	316	Set by VirtualChannel.8.Main.Resolution
VirtualChannel.8.Main.Reset	Initiate reset. 0 = No; 1 = Yes	bool	1f8b	8075	Not applicable
VirtualChannel.8.Main.Resolution	Number of decimal places (0 to 6)	uint8	1f82	8066	Not applicable
VirtualChannel.8.Main.Rollover	A pulse signal to indicate PV (output) has just rolled over	bool	1f91	8081	Not applicable
VirtualChannel.8.Main.Status	As VirtualChannel1.Main.Status	uint8	013d	317	Not applicable
VirtualChannel.8.Main.TimeRemaining	Time remaining before the calculation is made	time_t	1f89	8073	Set by Network.Modbus.TimeFormat
VirtualChannel.8.Main.Trigger	Increment/decrement counter. 0 = No; 1 = Yes	bool	1f8e	8078	Not applicable
VirtualChannel.8.Main.Type	As VirtualChannel1.Main.Type	uint8	1f80	8064	Not applicable
VirtualChannel.8.Main.Units	Units descriptor	string_t	4bd2	19410	Not applicable
VirtualChannel.8.Main.UnitsScaler	Units scaler for totalisers	float32	1f83	8067	1dp
VirtualChannel.8.Trend.Colour	As VirtualChannel1.Trend.Colour	uint8	1fa0	8096	Not applicable
VirtualChannel.8.Trend.SpanHigh	Specifies the highest PV (output value) to be displayed	float32	1fa2	8098	Same as VirtualChannel.8.Main.PV
VirtualChannel.8.Trend.SpanLow	Specifies the lowest PV (output value) to be displayed	float32	1fa1	8097	Same as VirtualChannel.8.Main.PV
VirtualChannel.9.Alarm1.Acknowledge	1 = acknowledge alarm	bool	01d0	464	Not applicable
VirtualChannel.9.Alarm1.Acknowledgement	1 = alarm acknowledged	bool	2050	8272	Not applicable
VirtualChannel.9.Alarm1.Active	1 = alarm source active, or safe but not ack'd	bool	204b	8267	Not applicable
VirtualChannel.9.Alarm1.Amount	Rate-of-change alarm 'Amount'	float32	2048	8264	Same as VirtualChannel.9.Main.PV
VirtualChannel.9.Alarm1.AverageTime	Rate-of-change alarm 'Average time'	time_t	204a	8266	Set by Network.Modbus.TimeFormat
VirtualChannel.9.Alarm1.Block	0 = Blocking alarms off; 1 = Blocking alarms on	uint8	2042	8258	Not applicable
VirtualChannel.9.Alarm1.ChangeTime	Rate-of-change alarm 'Change Time'	uint8	2049	8265	Not applicable
VirtualChannel.9.Alarm1.Deviation	Deviation alarm 'Deviation Value'	float32	2047	8263	Same as VirtualChannel.9.Main.PV
VirtualChannel.9.Alarm1.Dwell	Alarm dwell time	time_t	2045	8261	Set by Network.Modbus.TimeFormat
VirtualChannel.9.Alarm1.Hysteresis	Alarm hysteresis value	float32	2044	8260	Same as VirtualChannel.9.Main.PV
VirtualChannel.9.Alarm1.Inactive	1 = alarm source safe and ack'd (if necessary)	bool	204e	8270	Not applicable
VirtualChannel.9.Alarm1.Inhibit	1 = alarm inhibited	bool	2051	8273	Not applicable
VirtualChannel.9.Alarm1.Latch	As VirtualChannel1.Alarm1.Latch	uint8	2041	8257	Not applicable
VirtualChannel.9.Alarm1.NotAcknowledged	1 = alarm has not been acknowledged	bool	204f	8271	Not applicable
VirtualChannel.9.Alarm1.Reference	Deviation alarm 'Reference' value	float32	2046	8262	Same as VirtualChannel.9.Main.PV
VirtualChannel.9.Alarm1.Status	As VirtualChannel1.Alarm1.Status	uint8	0142	322	Not applicable
VirtualChannel.9.Alarm1.Threshold	Alarm trigger threshold	float32	2043	8259	Same as VirtualChannel.9.Main.PV
VirtualChannel.9.Alarm1.Type	As VirtualChannel1.Alarm1.Type	uint8	2040	8256	Not applicable
VirtualChannel.9.Alarm2.Acknowledge	1 = acknowledge alarm	bool	01d1	465	Not applicable
VirtualChannel.9.Alarm2.Acknowledgement	1 = alarm acknowledged	bool	2070	8304	Not applicable
VirtualChannel.9.Alarm2.Active	1 = alarm source active, or safe but not ack'd	bool	206b	8299	Not applicable

5.3 PARAMETER LIST (Cont.)

Parameter path	Description	Type	Hex	Dec	Resolution
VirtualChannel.9.Alarm2.Amount	Rate-of-change alarm 'Amount't	float32	2068	8296	Same as VirtualChannel.9.Main.PV
VirtualChannel.9.Alarm2.AverageTime	Rate-of-change alarm 'Average time'	time_t	206a	8298	Set by Network.Modbus.TimeFormat
VirtualChannel.9.Alarm2.Block	0 = Blocking alarms off; 1 = Blocking alarms on	uint8	2062	8290	Not applicable
VirtualChannel.9.Alarm2.ChangeTime	Rate-of-change alarm 'Change Time'	uint8	2069	8297	Not applicable
VirtualChannel.9.Alarm2.Deviation	Deviation alarm 'Deviation Value'	float32	2067	8295	Same as VirtualChannel.9.Main.PV
VirtualChannel.9.Alarm2.Dwell	Alarm dwell time	time_t	2065	8293	Set by Network.Modbus.TimeFormat
VirtualChannel.9.Alarm2.Hysteresis	Alarm hysteresis value	float32	2064	8292	Same as VirtualChannel.9.Main.PV
VirtualChannel.9.Alarm2.Inactive	1 = alarm source safe and ack'd (if necessary)	bool	206e	8302	Not applicable
VirtualChannel.9.Alarm2.Inhibit	Inhibit	bool	2071	8305	Not applicable
VirtualChannel.9.Alarm2.Latch	As VirtualChannel1.Alarm1.Latch	uint8	2061	8289	Not applicable
VirtualChannel.9.Alarm2.NotAcknowledged	1 = alarm has not been acknowledged	bool	206f	8303	Not applicable
VirtualChannel.9.Alarm2.Reference	Deviation alarm 'Reference' value	float32	2066	8294	Same as VirtualChannel.9.Main.PV
VirtualChannel.9.Alarm2.Status	As VirtualChannel1.Alarm1.Status	uint8	0143	323	Not applicable
VirtualChannel.9.Alarm2.Threshold	Alarm trigger threshold	float32	2063	8291	Same as VirtualChannel.9.Main.PV
VirtualChannel.9.Alarm2.Type	As VirtualChannel1.Alarm1.Type	uint8	2060	8288	Not applicable
VirtualChannel.9.Main.Descriptor	Virtual Channel descriptor	string_t	4bd8	19416	Not applicable
VirtualChannel.9.Main.Disable	1 = Virtual channel disabled	bool	2023	8227	Not applicable
VirtualChannel.9.Main.HighCutOff	The highest input value that will be totalised/counted	float32	2005	8197	Set by VirtualChannel.9.Main.Resolution
VirtualChannel.9.Main.Input1	Input 1 value	float32	2007	8199	Set by VirtualChannel.9.Main.Resolution
VirtualChannel.9.Main.Input2	Input 2 value	float32	2008	8200	Set by VirtualChannel.9.Main.Resolution
VirtualChannel.9.Main.LowCutOff	The lowest input value that will be totalised/counted	float32	2004	8196	Set by VirtualChannel.9.Main.Resolution
VirtualChannel.9.Main.ModbusInput	Modbus input value	float32	2006	8198	Set by VirtualChannel.9.Main.Resolution
VirtualChannel.9.Main.Operation	As VirtualChannel1.Main.Operation	uint8	2001	8193	Not applicable
VirtualChannel.9.Main.Period	The time period over which the calculation is made	int32	200a	8202	Not applicable
VirtualChannel.9.Main.Preset	Initiate preset. 0 = No; 1 = Yes	bool	200c	8204	Not applicable
VirtualChannel.9.Main.PresetValue	The Preset value	float32	200d	8205	Set by VirtualChannel.9.Main.Resolution
VirtualChannel.9.Main.PV	The virtual channel output value	float32	0140	320	Set by VirtualChannel.9.Main.Resolution
VirtualChannel.9.Main.Reset	Initiate reset. 0 = No; 1 = Yes	bool	200b	8203	Not applicable
VirtualChannel.9.Main.Resolution	Number of decimal places (0 to 6)	uint8	2002	8194	Not applicable
VirtualChannel.9.Main.Rollover	A pulse signal to indicate PV (output) has just rolled over	bool	2011	8209	Not applicable
VirtualChannel.9.Main.Status	As VirtualChannel1.Main.Status	uint8	0141	321	Not applicable
VirtualChannel.9.Main.TimeRemaining	Time remaining before the calculation is made	time_t	2009	8201	Set by Network.Modbus.TimeFormat
VirtualChannel.9.Main.Trigger	Increment/decrement counter. 0 = No; 1 = Yes	bool	200e	8206	Not applicable
VirtualChannel.9.Main.Type	As VirtualChannel1.Main.Type	uint8	2000	8192	Not applicable
VirtualChannel.9.Main.Units	Units descriptor	string_t	4bed	19437	Not applicable
VirtualChannel.9.Main.UnitsScaler	Units scaler for totalisers	float32	2003	8195	1dp
VirtualChannel.9.Trend.Colour	As VirtualChannel1.Trend.Colour	uint8	2020	8224	Not applicable
VirtualChannel.9.Trend.SpanHigh	Specifies the highest PV (output value) to be displayed	float32	2022	8226	Same as VirtualChannel.9.Main.PV
VirtualChannel.9.Trend.SpanLow	Specifies the lowest PV (output value) to be displayed	float32	2021	8225	Same as VirtualChannel.9.Main.PV
VirtualChannel.10.Alarm1.Acknowledge	1 = acknowledge alarm	bool	01d2	466	Not applicable
VirtualChannel.10.Alarm1.Acknowledgement	1 = alarm acknowledged	bool	20d0	8400	Not applicable
VirtualChannel.10.Alarm1.Active	1 = alarm source active, or safe but not ack'd	bool	20cb	8395	Not applicable
VirtualChannel.10.Alarm1.Amount	Rate-of-change alarm 'Amount'	float32	20c8	8392	Same as VirtualChannel.10.Main.PV
VirtualChannel.10.Alarm1.AverageTime	Rate-of-change alarm 'Average time'	time_t	20ca	8394	Set by Network.Modbus.TimeFormat
VirtualChannel.10.Alarm1.Block	0 = Blocking alarms off; 1 = Blocking alarms on	uint8	20c2	8386	Not applicable
VirtualChannel.10.Alarm1.ChangeTime	Rate-of-change alarm 'Change Time'	uint8	20c9	8393	Not applicable
VirtualChannel.10.Alarm1.Deviation	Deviation alarm 'Deviation Value'	float32	20c7	8391	Same as VirtualChannel.10.Main.PV
VirtualChannel.10.Alarm1.Dwell	Alarm dwell time	time_t	20c5	8389	Set by Network.Modbus.TimeFormat
VirtualChannel.10.Alarm1.Hysteresis	Alarm hysteresis value	float32	20c4	8388	Same as VirtualChannel.10.Main.PV
VirtualChannel.10.Alarm1.Inactive	1 = alarm source safe and ack'd (if necessary)	bool	20ce	8398	Not applicable
VirtualChannel.10.Alarm1.Inhibit	1 = alarm inhibited	bool	20d1	8401	Not applicable
VirtualChannel.10.Alarm1.Latch	As VirtualChannel1.Alarm1.Latch	uint8	20c1	8385	Not applicable
VirtualChannel.10.Alarm1.NotAcknowledged	1 = alarm has not been acknowledged	bool	20cf	8399	Not applicable
VirtualChannel.10.Alarm1.Reference	Deviation alarm 'Reference' value	float32	20c6	8390	Same as VirtualChannel.10.Main.PV
VirtualChannel.10.Alarm1.Status	As VirtualChannel1.Alarm1.Status	uint8	0146	326	Not applicable
VirtualChannel.10.Alarm1.Threshold	Alarm trigger threshold	float32	20c3	8387	Same as VirtualChannel.10.Main.PV
VirtualChannel.10.Alarm1.Type	As VirtualChannel1.Alarm1.Type	uint8	20c0	8384	Not applicable
VirtualChannel.10.Alarm2.Acknowledge	1 = acknowledge alarm	bool	01d3	467	Not applicable
VirtualChannel.10.Alarm2.Acknowledgement	1 = alarm acknowledged	bool	20f0	8432	Not applicable
VirtualChannel.10.Alarm2.Active	1 = alarm source active, or safe but not ack'd	bool	20eb	8427	Not applicable
VirtualChannel.10.Alarm2.Amount	Rate-of-change alarm 'Amount'	float32	20e8	8424	Same as VirtualChannel.10.Main.PV
VirtualChannel.10.Alarm2.AverageTime	Rate-of-change alarm 'Average time'	time_t	20ea	8426	Set by Network.Modbus.TimeFormat
VirtualChannel.10.Alarm2.Block	0 = Blocking alarms off; 1 = Blocking alarms on	uint8	20e2	8418	Not applicable
VirtualChannel.10.Alarm2.ChangeTime	Rate-of-change alarm 'Change Time'	uint8	20e9	8425	Not applicable
VirtualChannel.10.Alarm2.Deviation	Deviation alarm 'Deviation Value'	float32	20e7	8423	Same as VirtualChannel.10.Main.PV
VirtualChannel.10.Alarm2.Dwell	Alarm dwell time	time_t	20e5	8421	Set by Network.Modbus.TimeFormat
VirtualChannel.10.Alarm2.Hysteresis	Alarm hysteresis value	float32	20e4	8420	Same as VirtualChannel.10.Main.PV
VirtualChannel.10.Alarm2.Inactive	1 = alarm source safe and ack'd (if necessary)	bool	20ee	8430	Not applicable
VirtualChannel.10.Alarm2.Inhibit	1 = alarm inhibited	bool	20f1	8433	Not applicable
VirtualChannel.10.Alarm2.Latch	As VirtualChannel1.Alarm1.Latch	uint8	20e1	8417	Not applicable
VirtualChannel.10.Alarm2.NotAcknowledged	1 = alarm has not been acknowledged	bool	20ef	8431	Not applicable
VirtualChannel.10.Alarm2.Reference	Deviation alarm 'Reference' value	float32	20e6	8422	Same as VirtualChannel.10.Main.PV
VirtualChannel.10.Alarm2.Status	As VirtualChannel1.Alarm1.Status	uint8	0147	327	Not applicable
VirtualChannel.10.Alarm2.Threshold	Alarm trigger threshold	float32	20e3	8419	Same as VirtualChannel.10.Main.PV
VirtualChannel.10.Alarm2.Type	As VirtualChannel1.Alarm1.Type	uint8	20e0	8416	Not applicable
VirtualChannel.10.Main.Descriptor	Virtual Channel descriptor	string_t	4bf3	19443	Not applicable
VirtualChannel.10.Main.Disable	1 = Virtual channel disabled	bool	20a3	8355	Not applicable
VirtualChannel.10.Main.HighCutOff	The highest input value that will be totalised/counted	float32	2085	8325	Set by VirtualChannel.10.Main.Resolution
VirtualChannel.10.Main.Input1	Input 1 value	float32	2087	8327	Set by VirtualChannel.10.Main.Resolution
VirtualChannel.10.Main.Input2	Input 2 value	float32	2088	8328	Set by VirtualChannel.10.Main.Resolution

5.3 PARAMETER LIST (Cont.)

Parameter path	Description	Type	Hex	Dec	Resolution
VirtualChannel.10.Main.LowCutOff	The lowest input value that will be totalised/counted	float32	2084	8324	Set by VirtualChannel.10.Main.Resolution
VirtualChannel.10.Main.ModbusInput	Modbus input value	float32	2086	8326	Set by VirtualChannel.10.Main.Resolution
VirtualChannel.10.Main.Operation	As VirtualChannel1.Main.Operation	uint8	2081	8321	Not applicable
VirtualChannel.10.Main.Period	Averaging period	int32	208a	8330	Not applicable
VirtualChannel.10.Main.Preset	Initiate preset. 0 = No; 1 = Yes	bool	208c	8332	Not applicable
VirtualChannel.10.Main.PresetValue	The Preset value	float32	208d	8333	Set by VirtualChannel.10.Main.Resolution
VirtualChannel.10.Main.PV	The virtual channel output value	float32	0144	324	Set by VirtualChannel.10.Main.Resolution
VirtualChannel.10.Main.Reset	Initiate reset. 0 = No; 1 = Yes	bool	208b	8331	Not applicable
VirtualChannel.10.Main.Resolution	Number of decimal places (0 to 6)	uint8	2082	8322	Not applicable
VirtualChannel.10.Main.Rollover	A pulse signal to indicate PV (output) has just rolled over	bool	2091	8337	Not applicable
VirtualChannel.10.Main.Status	As VirtualChannel1.Main.Status	uint8	0145	325	Not applicable
VirtualChannel.10.Main.TimeRemaining	Time remaining before the calculation is made	time_t	2089	8329	Set by Network.Modbus.TimeFormat
VirtualChannel.10.Main.Trigger	Increment/decrement counter. 0 = No; 1 = Yes	bool	208e	8334	Not applicable
VirtualChannel.10.Main.Type	As VirtualChannel1.Main.Type	uint8	2080	8320	Not applicable
VirtualChannel.10.Main.Units	Units descriptor	string_t	4c08	19464	Not applicable
VirtualChannel.10.Main.UnitsScaler	Units scaler for totalisers	float32	2083	8323	1dp
VirtualChannel.10.Trend.Colour	As VirtualChannel1.Trend.Colour	uint8	20a0	8352	Not applicable
VirtualChannel.10.Trend.SpanHigh	Specifies the highest PV (output value) to be displayed	float32	20a2	8354	Same as VirtualChannel.10.Main.PV
VirtualChannel.10.Trend.SpanLow	Specifies the lowest PV (output value) to be displayed	float32	20a1	8353	Same as VirtualChannel.10.Main.PV
VirtualChannel.11.Alarm1.Acknowledge	1 = acknowledge alarm	bool	01d4	468	Not applicable
VirtualChannel.11.Alarm1.Acknowledgement	1 = alarm acknowledged	bool	2150	8528	Not applicable
VirtualChannel.11.Alarm1.Active	1 = alarm source active, or safe but not ack'd	bool	214b	8523	Not applicable
VirtualChannel.11.Alarm1.Amount	Rate-of-change alarm 'Amount'	float32	2148	8520	Same as VirtualChannel.11.Main.PV
VirtualChannel.11.Alarm1.AverageTime	Rate-of-change alarm 'Average time'	time_t	214a	8522	Set by Network.Modbus.TimeFormat
VirtualChannel.11.Alarm1.Block	0 = Blocking alarms off; 1 = Blocking alarms on	uint8	2142	8514	Not applicable
VirtualChannel.11.Alarm1.ChangeTime	Rate-of-change alarm 'Change Time'	uint8	2149	8521	Not applicable
VirtualChannel.11.Alarm1.Deviation	Deviation alarm 'Deviation Value'	float32	2147	8519	Same as VirtualChannel.11.Main.PV
VirtualChannel.11.Alarm1.Dwell	Alarm dwell time	time_t	2145	8517	Set by Network.Modbus.TimeFormat
VirtualChannel.11.Alarm1.Hysteresis	Alarm hysteresis value	float32	2144	8516	Same as VirtualChannel.11.Main.PV
VirtualChannel.11.Alarm1.Inactive	1 = alarm source safe and ack'd (if necessary)	bool	214e	8526	Not applicable
VirtualChannel.11.Alarm1.Inhibit	1 = alarm inhibited	bool	2151	8529	Not applicable
VirtualChannel.11.Alarm1.Latch	As VirtualChannel1.Alarm1.Latch	uint8	2141	8513	Not applicable
VirtualChannel.11.Alarm1.NotAcknowledged	1 = alarm has not been acknowledged	bool	214f	8527	Not applicable
VirtualChannel.11.Alarm1.Reference	Deviation alarm 'Reference' value	float32	2146	8518	Same as VirtualChannel.11.Main.PV
VirtualChannel.11.Alarm1.Status	As VirtualChannel1.Alarm1.Status	uint8	014a	330	Not applicable
VirtualChannel.11.Alarm1.Threshold	Alarm trigger threshold	float32	2143	8515	Same as VirtualChannel.11.Main.PV
VirtualChannel.11.Alarm1.Type	As VirtualChannel1.Alarm1.Type	uint8	2140	8512	Not applicable
VirtualChannel.11.Alarm2.Acknowledge	1 = acknowledge alarm	bool	01d5	469	Not applicable
VirtualChannel.11.Alarm2.Acknowledgement	1 = alarm acknowledged	bool	2170	8560	Not applicable
VirtualChannel.11.Alarm2.Active	1 = alarm source active, or safe but not ack'd	bool	216b	8555	Not applicable
VirtualChannel.11.Alarm2.Amount	Rate-of-change alarm 'Amount'	float32	2168	8552	Same as VirtualChannel.11.Main.PV
VirtualChannel.11.Alarm2.AverageTime	Rate-of-change alarm 'Average time'	time_t	216a	8554	Set by Network.Modbus.TimeFormat
VirtualChannel.11.Alarm2.Block	0 = Blocking alarms off; 1 = Blocking alarms on	uint8	2162	8546	Not applicable
VirtualChannel.11.Alarm2.ChangeTime	Rate-of-change alarm 'Change Time'	uint8	2169	8553	Not applicable
VirtualChannel.11.Alarm2.Deviation	Deviation alarm 'Deviation Value'	float32	2167	8551	Same as VirtualChannel.11.Main.PV
VirtualChannel.11.Alarm2.Dwell	Alarm dwell time	time_t	2165	8549	Set by Network.Modbus.TimeFormat
VirtualChannel.11.Alarm2.Hysteresis	Alarm hysteresis value	float32	2164	8548	Same as VirtualChannel.11.Main.PV
VirtualChannel.11.Alarm2.Inactive	1 = alarm source safe and ack'd (if necessary)	bool	216e	8558	Not applicable
VirtualChannel.11.Alarm2.Inhibit	1 = alarm inhibited	bool	2171	8561	Not applicable
VirtualChannel.11.Alarm2.Latch	As VirtualChannel1.Alarm1.Latch	uint8	2161	8545	Not applicable
VirtualChannel.11.Alarm2.NotAcknowledged	1 = alarm has not been acknowledged	bool	216f	8559	Not applicable
VirtualChannel.11.Alarm2.Reference	Deviation alarm 'Reference' value	float32	2166	8550	Same as VirtualChannel.11.Main.PV
VirtualChannel.11.Alarm2.Status	As VirtualChannel1.Alarm1.Status	uint8	014b	331	Not applicable
VirtualChannel.11.Alarm2.Threshold	Alarm trigger threshold	float32	2163	8547	Same as VirtualChannel.11.Main.PV
VirtualChannel.11.Alarm2.Type	As VirtualChannel1.Alarm1.Type	uint8	2160	8544	Not applicable
VirtualChannel.11.Main.Descriptor	Virtual Channel descriptor	string_t	4c0e	19470	Not applicable
VirtualChannel.11.Main.Disable	1 = Virtual channel disabled	bool	2123	8483	Not applicable
VirtualChannel.11.Main.HighCutOff	The highest input value that will be totalised/counted	float32	2105	8453	Set by VirtualChannel.11.Main.Resolution
VirtualChannel.11.Main.Input1	Input 1 value	float32	2107	8455	Set by VirtualChannel.11.Main.Resolution
VirtualChannel.11.Main.Input2	Input 2 value	float32	2108	8456	Set by VirtualChannel.11.Main.Resolution
VirtualChannel.11.Main.LowCutOff	The lowest input value that will be totalised/counted	float32	2104	8452	Set by VirtualChannel.11.Main.Resolution
VirtualChannel.11.Main.ModbusInput	Modbus input value	float32	2106	8454	Set by VirtualChannel.11.Main.Resolution
VirtualChannel.11.Main.Operation	As VirtualChannel1.Main.Operation	uint8	2101	8449	Not applicable
VirtualChannel.11.Main.Period	The time period over which the calculation is made	int32	210a	8458	Not applicable
VirtualChannel.11.Main.Preset	Initiate preset. 0 = No; 1 = Yes	bool	210c	8460	Not applicable
VirtualChannel.11.Main.PresetValue	The Preset value	float32	210d	8461	Set by VirtualChannel.11.Main.Resolution
VirtualChannel.11.Main.PV	The virtual channel output value	float32	0148	328	Set by VirtualChannel.11.Main.Resolution
VirtualChannel.11.Main.Reset	Initiate reset. 0 = No; 1 = Yes	bool	210b	8459	Not applicable
VirtualChannel.11.Main.Resolution	Number of decimal places (0 to 6)	uint8	2102	8450	Not applicable
VirtualChannel.11.Main.Rollover	A pulse signal to indicate PV (output) has just rolled over	bool	2111	8465	Not applicable
VirtualChannel.11.Main.Status	As VirtualChannel1.Main.Status	uint8	0149	329	Not applicable
VirtualChannel.11.Main.TimeRemaining	Time remaining before the calculation is made	time_t	2109	8457	Set by Network.Modbus.TimeFormat
VirtualChannel.11.Main.Trigger	Increment/decrement counter. 0 = No; 1 = Yes	bool	210e	8462	Not applicable
VirtualChannel.11.Main.Type	As VirtualChannel1.Main.Type	uint8	2100	8448	Not applicable
VirtualChannel.11.Main.Units	Units descriptor	string_t	4c23	19491	Not applicable
VirtualChannel.11.Main.UnitsScaler	Units scaler for totalisers	float32	2103	8451	1dp
VirtualChannel.11.Trend.Colour	As VirtualChannel1.Trend.Colour	uint8	2120	8480	Not applicable
VirtualChannel.11.Trend.SpanHigh	Specifies the highest PV (output value) to be displayed	float32	2122	8482	Same as VirtualChannel.11.Main.PV
VirtualChannel.11.Trend.SpanLow	Specifies the lowest PV (output value) to be displayed	float32	2121	8481	Same as VirtualChannel.11.Main.PV

5.3 PARAMETER LIST (Cont.)

Parameter path	Description	Type	Hex	Dec	Resolution
VirtualChannel.12.Alarm1.Acknowledge	1 = acknowledge alarm	bool	01d6	470	Not applicable
VirtualChannel.12.Alarm1.Acknowledgement	1 = alarm acknowledged	bool	21d0	8656	Not applicable
VirtualChannel.12.Alarm1.Active	1 = alarm source active, or safe but not ack'd	bool	21cb	8651	Not applicable
VirtualChannel.12.Alarm1.Amount	Rate-of-change alarm 'Amount'	float32	21c8	8648	Same as VirtualChannel.12.Main.PV
VirtualChannel.12.Alarm1.AverageTime	Rate-of-change alarm 'Average time'	time_t	21ca	8650	Set by Network.Modbus.TimeFormat
VirtualChannel.12.Alarm1.Block	0 = Blocking alarms off; 1 = Blocking alarms on	uint8	21c2	8642	Not applicable
VirtualChannel.12.Alarm1.ChangeTime	Rate-of-change alarm 'Change Time'	uint8	21c9	8649	Not applicable
VirtualChannel.12.Alarm1.Deviation	Deviation alarm 'Deviation Value'	float32	21c7	8647	Same as VirtualChannel.12.Main.PV
VirtualChannel.12.Alarm1.Dwell	Alarm dwell time	time_t	21c5	8645	Set by Network.Modbus.TimeFormat
VirtualChannel.12.Alarm1.Hysteresis	Alarm hysteresis value	float32	21c4	8644	Same as VirtualChannel.12.Main.PV
VirtualChannel.12.Alarm1.Inactive	1 = alarm source safe and ack'd (if necessary)	bool	21ce	8654	Not applicable
VirtualChannel.12.Alarm1.Inhibit	1 = alarm inhibited	bool	21d1	8657	Not applicable
VirtualChannel.12.Alarm1.Latch	As VirtualChannel1.Alarm1.Latch	uint8	21c1	8641	Not applicable
VirtualChannel.12.Alarm1.NotAcknowledged	1 = alarm has not been acknowledged	bool	21cf	8655	Not applicable
VirtualChannel.12.Alarm1.Reference	Deviation alarm 'Reference' value	float32	21c6	8646	Same as VirtualChannel.12.Main.PV
VirtualChannel.12.Alarm1.Status	As VirtualChannel1.Alarm1.Status	uint8	014e	334	Not applicable
VirtualChannel.12.Alarm1.Threshold	Alarm trigger threshold	float32	21c3	8643	Same as VirtualChannel.12.Main.PV
VirtualChannel.12.Alarm1.Type	As VirtualChannel1.Alarm1.Type	uint8	21c0	8640	Not applicable
VirtualChannel.12.Alarm2.Acknowledge	1 = acknowledge alarm	bool	01d7	471	Not applicable
VirtualChannel.12.Alarm2.Acknowledgement	1 = alarm acknowledged	bool	21f0	8688	Not applicable
VirtualChannel.12.Alarm2.Active	1 = alarm source active, or safe but not ack'd	bool	21eb	8683	Not applicable
VirtualChannel.12.Alarm2.Amount	Rate-of-change alarm 'Amount'	float32	21e8	8680	Same as VirtualChannel.12.Main.PV
VirtualChannel.12.Alarm2.AverageTime	Rate-of-change alarm 'Average time'	time_t	21ea	8682	Set by Network.Modbus.TimeFormat
VirtualChannel.12.Alarm2.Block	0 = Blocking alarms off; 1 = Blocking alarms on	uint8	21e2	8674	Not applicable
VirtualChannel.12.Alarm2.ChangeTime	Rate-of-change alarm 'Change Time'	uint8	21e9	8681	Not applicable
VirtualChannel.12.Alarm2.Deviation	Deviation alarm 'Deviation Value'	float32	21e7	8679	Same as VirtualChannel.12.Main.PV
VirtualChannel.12.Alarm2.Dwell	Alarm dwell time	time_t	21e5	8677	Set by Network.Modbus.TimeFormat
VirtualChannel.12.Alarm2.Hysteresis	Alarm hysteresis value	float32	21e4	8676	Same as VirtualChannel.12.Main.PV
VirtualChannel.12.Alarm2.Inactive	1 = alarm source safe and ack'd (if necessary)	bool	21ee	8686	Not applicable
VirtualChannel.12.Alarm2.Inhibit	1 = alarm inhibited	bool	21f1	8689	Not applicable
VirtualChannel.12.Alarm2.Latch	As VirtualChannel1.Alarm1.Latch	uint8	21e1	8673	Not applicable
VirtualChannel.12.Alarm2.NotAcknowledged	1 = alarm has not been acknowledged	bool	21ef	8687	Not applicable
VirtualChannel.12.Alarm2.Reference	Deviation alarm 'Reference' value	float32	21e6	8678	Same as VirtualChannel.12.Main.PV
VirtualChannel.12.Alarm2.Status	As VirtualChannel1.Alarm1.Status	uint8	014f	335	Not applicable
VirtualChannel.12.Alarm2.Threshold	Alarm trigger threshold	float32	21e3	8675	Same as VirtualChannel.12.Main.PV
VirtualChannel.12.Alarm2.Type	As VirtualChannel1.Alarm1.Type	uint8	21e0	8672	Not applicable
VirtualChannel.12.Main.Descriptor	Virtual Channel descriptorl	string_t	4c29	19497	Not applicable
VirtualChannel.12.Main.Disable	1 = Virtual channel disabled	bool	21a3	8611	Not applicable
VirtualChannel.12.Main.HighCutOff	The highest input value that will be totalised/counted	float32	2185	8581	Set by VirtualChannel.12.Main.Resolution
VirtualChannel.12.Main.Input1	Input 1 value	float32	2187	8583	Set by VirtualChannel.12.Main.Resolution
VirtualChannel.12.Main.Input2	Input 2 value	float32	2188	8584	Set by VirtualChannel.12.Main.Resolution
VirtualChannel.12.Main.LowCutOff	The lowest input value that will be totalised/counted	float32	2184	8580	Set by VirtualChannel.12.Main.Resolution
VirtualChannel.12.Main.ModbusInput	Modbus input value	float32	2186	8582	Set by VirtualChannel.12.Main.Resolution
VirtualChannel.12.Main.Operation	As VirtualChannel1.Main.Operation	uint8	2181	8577	Not applicable
VirtualChannel.12.Main.Period	The time period over which the calculation is made	int32	218a	8586	Not applicable
VirtualChannel.12.Main.Preset	Initiate preset. 0 = No; 1 = Yes	bool	218c	8588	Not applicable
VirtualChannel.12.Main.PresetValue	The Preset value	float32	218d	8589	Set by VirtualChannel.12.Main.Resolution
VirtualChannel.12.Main.PV	The virtual channel output value	float32	014c	332	Set by VirtualChannel.12.Main.Resolution
VirtualChannel.12.Main.Reset	Initiate reset. 0 = No; 1 = Yes	bool	218b	8587	Not applicable
VirtualChannel.12.Main.Resolution	Number of decimal places (0 to 6)	uint8	2182	8578	Not applicable
VirtualChannel.12.Main.Rollover	A pulse signal to indicate PV (output) has just rolled over	bool	2191	8593	Not applicable
VirtualChannel.12.Main.Status	As VirtualChannel1.Main.Status	uint8	014d	333	Not applicable
VirtualChannel.12.Main.TimeRemaining	Time remaining before the calculation is made	time_t	2189	8585	Set by Network.Modbus.TimeFormat
VirtualChannel.12.Main.Trigger	Increment/decrement counter. 0 = No; 1 = Yes	bool	218e	8590	Not applicable
VirtualChannel.12.Main.Type	As VirtualChannel1.Main.Type	uint8	2180	8576	Not applicable
VirtualChannel.12.Main.Units	Units descriptor	string_t	4c3e	19518	Not applicable
VirtualChannel.12.Main.UnitsScaler	Units scaler for totalisers	float32	2183	8579	1dp
VirtualChannel.12.Trend.Colour	As VirtualChannel1.Trend.Colour	uint8	21a0	8608	Not applicable
VirtualChannel.12.Trend.SpanHigh	Specifies the highest PV (output value) to be displayed	float32	21a2	8610	Same as VirtualChannel.12.Main.PV
VirtualChannel.12.Trend.SpanLow	Specifies the lowest PV (output value) to be displayed	float32	21a1	8609	Same as VirtualChannel.12.Main.PV
VirtualChannel.13.Alarm1.Acknowledge	1 = acknowledge alarm	bool	01d8	472	Not applicable
VirtualChannel.13.Alarm1.Acknowledgement	1 = alarm acknowledged	bool	2250	8784	Not applicable
VirtualChannel.13.Alarm1.Active	1 = alarm source active, or safe but not ack'd	bool	224b	8779	Not applicable
VirtualChannel.13.Alarm1.Amount	Rate-of-change alarm 'Amount'	float32	2248	8776	Same as VirtualChannel.13.Main.PV
VirtualChannel.13.Alarm1.AverageTime	Rate-of-change alarm 'Average time'	time_t	224a	8778	Set by Network.Modbus.TimeFormat
VirtualChannel.13.Alarm1.Block	0 = Blocking alarms off; 1 = Blocking alarms on	uint8	2242	8770	Not applicable
VirtualChannel.13.Alarm1.ChangeTime	Rate-of-change alarm 'Change Time'	uint8	2249	8777	Not applicable
VirtualChannel.13.Alarm1.Deviation	Deviation alarm 'Deviation Value'	float32	2247	8775	Same as VirtualChannel.13.Main.PV
VirtualChannel.13.Alarm1.Dwell	Alarm dwell time	time_t	2245	8773	Set by Network.Modbus.TimeFormat
VirtualChannel.13.Alarm1.Hysteresis	Alarm hysteresis value	float32	2244	8772	Same as VirtualChannel.13.Main.PV
VirtualChannel.13.Alarm1.Inhibit	1 = alarm inhibited	bool	2251	8785	Not applicable
VirtualChannel.13.Alarm1.Inactive	1 = alarm source safe and ack'd (if necessary)	bool	224e	8782	Not applicable
VirtualChannel.13.Alarm1.Latch	As VirtualChannel1.Alarm1.Latch	uint8	2241	8769	Not applicable
VirtualChannel.13.Alarm1.NotAcknowledged	1 = alarm has not been acknowledged	bool	224f	8783	Not applicable
VirtualChannel.13.Alarm1.Reference	Deviation alarm 'Reference' value	float32	2246	8774	Same as VirtualChannel.13.Main.PV
VirtualChannel.13.Alarm1.Status	As VirtualChannel1.Alarm1.Status	uint8	0152	338	Not applicable
VirtualChannel.13.Alarm1.Threshold	Alarm trigger threshold	float32	2243	8771	Same as VirtualChannel.13.Main.PV
VirtualChannel.13.Alarm1.Type	As VirtualChannel1.Alarm1.Type	uint8	2240	8768	Not applicable
VirtualChannel.13.Alarm2.Acknowledge	1 = acknowledge alarm	bool	01d9	473	Not applicable
VirtualChannel.13.Alarm2.Acknowledgement	1 = alarm acknowledged	bool	2270	8816	Not applicable

5.3 PARAMETER LIST (Cont.)

Parameter path	Description	Type	Hex	Dec	Resolution
VirtualChannel.13.Alarm2.Active	1 = alarm source active, or safe but not ack'd	bool	226b	8811	Not applicable
VirtualChannel.13.Alarm2.Amount	Rate-of-change alarm 'Amount'	float32	2268	8808	Same as VirtualChannel.13.Main.PV
VirtualChannel.13.Alarm2.AverageTime	Rate-of-change alarm 'Average time'	time_t	226a	8810	Set by Network.Modbus.TimeFormat
VirtualChannel.13.Alarm2.Block	0 = Blocking alarms off; 1 = Blocking alarms on	uint8	2262	8802	Not applicable
VirtualChannel.13.Alarm2.ChangeTime	Rate-of-change alarm 'Change Time'	uint8	2269	8809	Not applicable
VirtualChannel.13.Alarm2.Deviation	Deviation alarm 'Deviation Value'	float32	2267	8807	Same as VirtualChannel.13.Main.PV
VirtualChannel.13.Alarm2.Dwell	Alarm dwell time	time_t	2265	8805	Set by Network.Modbus.TimeFormat
VirtualChannel.13.Alarm2.Hysteresis	Alarm hysteresis value	float32	2264	8804	Same as VirtualChannel.13.Main.PV
VirtualChannel.13.Alarm2.Inactive	1 = alarm source safe and ack'd (if necessary)	bool	226e	8814	Not applicable
VirtualChannel.13.Alarm2.Inhibit	1 = alarm inhibited	bool	2271	8817	Not applicable
VirtualChannel.13.Alarm2.Latch	As VirtualChannel1.Alarm1.Latch	uint8	2261	8801	Not applicable
VirtualChannel.13.Alarm2.NotAcknowledged	1 = alarm has not been acknowledged	bool	226f	8815	Not applicable
VirtualChannel.13.Alarm2.Reference	Deviation alarm 'Reference' value	float32	2266	8806	Same as VirtualChannel.13.Main.PV
VirtualChannel.13.Alarm2.Status	As VirtualChannel1.Alarm1.Status	uint8	0153	339	Not applicable
VirtualChannel.13.Alarm2.Threshold	Alarm trigger threshold	float32	2263	8803	Same as VirtualChannel.13.Main.PV
VirtualChannel.13.Alarm2.Type	As VirtualChannel1.Alarm1.Type	uint8	2260	8800	Not applicable
VirtualChannel.13.Main.Descriptor	Virtual Channel descriptor	string_t	4c44	19524	Not applicable
VirtualChannel.13.Main.Disable	1 = Virtual channel disabled	bool	2223	8739	Not applicable
VirtualChannel.13.Main.HighCutOff	The highest input value that will be totalised/counted	float32	2205	8709	Set by VirtualChannel.13.Main.Resolution
VirtualChannel.13.Main.Input1	Input 1 value	float32	2207	8711	Set by VirtualChannel.13.Main.Resolution
VirtualChannel.13.Main.Input2	Input 2 value	float32	2208	8712	Set by VirtualChannel.13.Main.Resolution
VirtualChannel.13.Main.LowCutOff	The lowest input value that will be totalised/counted	float32	2204	8708	Set by VirtualChannel.13.Main.Resolution
VirtualChannel.13.Main.ModbusInput	Modbus input value	float32	2206	8710	Set by VirtualChannel.13.Main.Resolution
VirtualChannel.13.Main.Operation	As VirtualChannel1.Main.Operation	uint8	2201	8705	Not applicable
VirtualChannel.13.Main.Period	The time period over which the calculation is made	int32	220a	8714	Not applicable
VirtualChannel.13.Main.Preset	Initiate preset. 0 = No; 1 = Yes	bool	220c	8716	Not applicable
VirtualChannel.13.Main.PresetValue	The Preset value	float32	220d	8717	Set by VirtualChannel.13.Main.Resolution
VirtualChannel.13.Main.PV	The virtual channel output value	float32	0150	336	Set by VirtualChannel.13.Main.Resolution
VirtualChannel.13.Main.Reset	Initiate reset. 0 = No; 1 = Yes	bool	220b	8715	Not applicable
VirtualChannel.13.Main.Resolution	Number of decimal places (0 to 6)	uint8	2202	8706	Not applicable
VirtualChannel.13.Main.Rollover	A pulse signal to indicate PV (output) has just rolled over	bool	2211	8721	Not applicable
VirtualChannel.13.Main.Status	As VirtualChannel1.Main.Status	uint8	0151	337	Not applicable
VirtualChannel.13.Main.TimeRemaining	Time remaining before the calculation is made	time_t	2209	8713	Set by Network.Modbus.TimeFormat
VirtualChannel.13.Main.Trigger	Increment/decrement counter. 0 = No; 1 = Yes	bool	220e	8718	Not applicable
VirtualChannel.13.Main.Type	As VirtualChannel1.Main.Type	uint8	2200	8704	Not applicable
VirtualChannel.13.Main.Units	Units descriptor	string_t	4c59	19545	Not applicable
VirtualChannel.13.Main.UnitsScaler	Units scaler for totalisers	float32	2203	8707	1dp
VirtualChannel.13.Trend.Colour	As VirtualChannel1.Trend.Colour	uint8	2220	8736	Not applicable
VirtualChannel.13.Trend.SpanHigh	Specifies the highest PV (output value) to be displayed	float32	2222	8738	Same as VirtualChannel.13.Main.PV
VirtualChannel.13.Trend.SpanLow	Specifies the lowest PV (output value) to be displayed	float32	2221	8737	Same as VirtualChannel.13.Main.PV
VirtualChannel.14.Alarm1.Acknowledge	1 = acknowledge alarm	bool	01da	474	Not applicable
VirtualChannel.14.Alarm1.Acknowledgement	1 = alarm acknowledged	bool	22d0	8912	Not applicable
VirtualChannel.14.Alarm1.Active	1 = alarm source active, or safe but not ack'd	bool	22cb	8907	Not applicable
VirtualChannel.14.Alarm1.Amount	Rate-of-change alarm 'Amount'	float32	22c8	8904	Same as VirtualChannel.14.Main.PV
VirtualChannel.14.Alarm1.AverageTime	Rate-of-change alarm 'Average time'	time_t	22ca	8906	Set by Network.Modbus.TimeFormat
VirtualChannel.14.Alarm1.Block	0 = Blocking alarms off; 1 = Blocking alarms on	uint8	22c2	8898	Not applicable
VirtualChannel.14.Alarm1.ChangeTime	Rate-of-change alarm 'Change Time'	uint8	22c9	8905	Not applicable
VirtualChannel.14.Alarm1.Deviation	Deviation alarm 'Deviation Value'	float32	22c7	8903	Same as VirtualChannel.14.Main.PV
VirtualChannel.14.Alarm1.Dwell	Alarm dwell time	time_t	22c5	8901	Set by Network.Modbus.TimeFormat
VirtualChannel.14.Alarm1.Hysteresis	Alarm hysteresis value	float32	22c4	8900	Same as VirtualChannel.14.Main.PV
VirtualChannel.14.Alarm1.Inactive	1 = alarm source safe and ack'd (if necessary)	bool	22ce	8910	Not applicable
VirtualChannel.14.Alarm1.Inhibit	1 = alarm inhibited	bool	22d1	8913	Not applicable
VirtualChannel.14.Alarm1.Latch	As VirtualChannel1.Alarm1.Latch	uint8	22c1	8897	Not applicable
VirtualChannel.14.Alarm1.NotAcknowledged	1 = alarm has not been acknowledged	bool	22cf	8911	Not applicable
VirtualChannel.14.Alarm1.Reference	Deviation alarm 'Reference' value	float32	22c6	8902	Same as VirtualChannel.14.Main.PV
VirtualChannel.14.Alarm1.Status	As VirtualChannel1.Alarm1.Status	uint8	0156	342	Not applicable
VirtualChannel.14.Alarm1.Threshold	Alarm trigger threshold	float32	22c3	8899	Same as VirtualChannel.14.Main.PV
VirtualChannel.14.Alarm1.Type	As VirtualChannel1.Alarm1.Type	uint8	22c0	8896	Not applicable
VirtualChannel.14.Alarm2.Acknowledge	1 = acknowledge alarm	bool	01db	475	Not applicable
VirtualChannel.14.Alarm2.Acknowledgement	1 = alarm acknowledged	bool	22f0	8944	Not applicable
VirtualChannel.14.Alarm2.Active	1 = alarm source active, or safe but not ack'd	bool	22eb	8939	Not applicable
VirtualChannel.14.Alarm2.Amount	Rate-of-change alarm 'Amount'	float32	22e8	8936	Same as VirtualChannel.14.Main.PV
VirtualChannel.14.Alarm2.AverageTime	Rate-of-change alarm 'Average time'	time_t	22ea	8938	Set by Network.Modbus.TimeFormat
VirtualChannel.14.Alarm2.Block	0 = Blocking alarms off; 1 = Blocking alarms on	uint8	22e2	8930	Not applicable
VirtualChannel.14.Alarm2.ChangeTime	Rate-of-change alarm 'Change Time'	uint8	22e9	8937	Not applicable
VirtualChannel.14.Alarm2.Deviation	Deviation alarm 'Deviation Value'	float32	22e7	8935	Same as VirtualChannel.14.Main.PV
VirtualChannel.14.Alarm2.Dwell	Alarm dwell time	time_t	22e5	8933	Set by Network.Modbus.TimeFormat
VirtualChannel.14.Alarm2.Hysteresis	Alarm hysteresis value	float32	22e4	8932	Same as VirtualChannel.14.Main.PV
VirtualChannel.14.Alarm2.Inactive	1 = alarm source safe and ack'd (if necessary)	bool	22ee	8942	Not applicable
VirtualChannel.14.Alarm2.Inhibit	1 = alarm inhibited	bool	22f1	8945	Not applicable
VirtualChannel.14.Alarm2.Latch	As VirtualChannel1.Alarm1.Latch	uint8	22e1	8929	Not applicable
VirtualChannel.14.Alarm2.NotAcknowledged	1 = alarm has not been acknowledged	bool	22ef	8943	Not applicable
VirtualChannel.14.Alarm2.Reference	Deviation alarm 'Reference' value	float32	22e6	8934	Same as VirtualChannel.14.Main.PV
VirtualChannel.14.Alarm2.Status	As VirtualChannel1.Alarm1.Status	uint8	0157	343	Not applicable
VirtualChannel.14.Alarm2.Threshold	Alarm trigger threshold	float32	22e3	8931	Same as VirtualChannel.14.Main.PV
VirtualChannel.14.Alarm2.Type	As VirtualChannel1.Alarm1.Type	uint8	22e0	8928	Not applicable
VirtualChannel.14.Main.Descriptor	Virtual Channel descriptor	string_t	4c5f	19551	Not applicable
VirtualChannel.14.Main.Disable	1 = Virtual channel disabled	bool	22a3	8867	Not applicable
VirtualChannel.14.Main.HighCutOff	The highest input value that will be totalised/counted	float32	2285	8837	Set by VirtualChannel.14.Main.Resolution
VirtualChannel.14.Main.Input1	Input 1 value	float32	2287	8839	Set by VirtualChannel.14.Main.Resolution

5.3 PARAMETER LIST (Cont.)

Parameter path	Description	Type	Hex	Dec	Resolution
VirtualChannel.14.Main.Input2	Input 2 value	float32	2288	8840	Set by VirtualChannel.14.Main.Resolution
VirtualChannel.14.Main.LowCutOff	The lowest input value that will be totalised/counted	float32	2284	8836	Set by VirtualChannel.14.Main.Resolution
VirtualChannel.14.Main.ModbusInput	Modbus input value	float32	2286	8838	Set by VirtualChannel.14.Main.Resolution
VirtualChannel.14.Main.Operation	As VirtualChannel1.Main.Operation	uint8	2281	8833	Not applicable
VirtualChannel.14.Main.Period	The time period over which the calculation is made	int32	228a	8842	Not applicable
VirtualChannel.14.Main.Preset	Initiate preset. 0 = No; 1 = Yes	bool	228c	8844	Not applicable
VirtualChannel.14.Main.PresetValue	The preset value	float32	228d	8845	Set by VirtualChannel.14.Main.Resolution
VirtualChannel.14.Main.PV	The virtual channel output value	float32	0154	340	Set by VirtualChannel.14.Main.Resolution
VirtualChannel.14.Main.Reset	Initiate reset. 0 = No; 1 = Yes	bool	228b	8843	Not applicable
VirtualChannel.14.Main.Resolution	Number of decimal places (0 to 6)	uint8	2282	8834	Not applicable
VirtualChannel.14.Main.Rollover	A pulse signal to indicate PV (output) has just rolled over	bool	2291	8849	Not applicable
VirtualChannel.14.Main.Status	As VirtualChannel1.Main.Status	uint8	0155	341	Not applicable
VirtualChannel.14.Main.TimeRemaining	Time remaining before the calculation is made	time_t	2289	8841	Set by Network.Modbus.TimeFormat
VirtualChannel.14.Main.Trigger	Increment/decrement counter. 0 = No; 1 = Yes	bool	228e	8846	Not applicable
VirtualChannel.14.Main.Type	As VirtualChannel1.Main.Type	uint8	2280	8832	Not applicable
VirtualChannel.14.Main.Units	Units descriptor	string_t	4c75	19573	Not applicable
VirtualChannel.14.Main.UnitsScaler	Units scaler for totalisers	float32	2283	8835	1dp
VirtualChannel.14.Trend.Colour	As VirtualChannel1.Trend.Colour	uint8	22a0	8864	Not applicable
VirtualChannel.14.Trend.SpanHigh	Specifies the highest PV (output value) to be displayed	float32	22a2	8866	Same as VirtualChannel.14.Main.PV
VirtualChannel.14.Trend.SpanLow	Specifies the lowest PV (output value) to be displayed	float32	22a1	8865	Same as VirtualChannel.14.Main.PV
VirtualChannel.15.Alarm1.Acknowledge	1 = acknowledge alarm	bool	01de	478	Not applicable
VirtualChannel.15.Alarm1.Acknowledgement	1 = alarm acknowledged	bool	2350	9040	Not applicable
VirtualChannel.15.Alarm1.Active	1 = alarm source active, or safe but not ack'd	bool	234b	9035	Not applicable
VirtualChannel.15.Alarm1.Amount	Rate-of-change alarm 'Amount'	float32	2348	9032	Same as VirtualChannel.15.Main.PV
VirtualChannel.15.Alarm1.AverageTime	Rate-of-change alarm 'Average time'	time_t	234a	9034	Set by Network.Modbus.TimeFormat
VirtualChannel.15.Alarm1.Block	0 = Blocking alarms off; 1 = Blocking alarms on	uint8	2342	9026	Not applicable
VirtualChannel.15.Alarm1.ChangeTime	Rate-of-change alarm 'Change Time'	uint8	2349	9033	Not applicable
VirtualChannel.15.Alarm1.Deviation	Deviation alarm 'Deviation Value'	float32	2347	9031	Same as VirtualChannel.15.Main.PV
VirtualChannel.15.Alarm1.Dwell	Alarm dwell time	time_t	2345	9029	Set by Network.Modbus.TimeFormat
VirtualChannel.15.Alarm1.Hysteresis	Alarm hysteresis value	float32	2344	9028	Same as VirtualChannel.15.Main.PV
VirtualChannel.15.Alarm1.Inactive	1 = alarm source safe and ack'd (if necessary)	bool	234e	9038	Not applicable
VirtualChannel.15.Alarm1.Inhibit	1 = Alarm inhibited	bool	2351	9041	Not applicable
VirtualChannel.15.Alarm1.Latch	As VirtualChannel1.Alarm1.Latch	uint8	2341	9025	Not applicable
VirtualChannel.15.Alarm1.NotAcknowledged	1 = alarm has not been acknowledged	bool	234f	9039	Not applicable
VirtualChannel.15.Alarm1.Reference	Deviation alarm 'Reference' value	float32	2346	9030	Same as VirtualChannel.15.Main.PV
VirtualChannel.15.Alarm1.Status	As VirtualChannel1.Alarm1.Status	uint8	015a	346	Not applicable
VirtualChannel.15.Alarm1.Threshold	Alarm trigger threshold	float32	2343	9027	Same as VirtualChannel.15.Main.PV
VirtualChannel.15.Alarm1.Type	As VirtualChannel1.Alarm1.Type	uint8	2340	9024	Not applicable
VirtualChannel.15.Alarm2.Acknowledge	1 = acknowledge alarm	bool	01dd	477	Not applicable
VirtualChannel.15.Alarm2.Acknowledgement	1 = alarm acknowledged	bool	2370	9072	Not applicable
VirtualChannel.15.Alarm2.Active	1 = alarm source active, or safe but not ack'd	bool	236b	9067	Not applicable
VirtualChannel.15.Alarm2.Amount	Rate-of-change alarm 'Amount'	float32	2368	9064	Same as VirtualChannel.15.Main.PV
VirtualChannel.15.Alarm2.AverageTime	Rate-of-change alarm 'Average time'	time_t	236a	9066	Set by Network.Modbus.TimeFormat
VirtualChannel.15.Alarm2.Block	0 = Blocking alarms off; 1 = Blocking alarms on	uint8	2362	9058	Not applicable
VirtualChannel.15.Alarm2.ChangeTime	Rate-of-change alarm 'Change Time'	uint8	2369	9065	Not applicable
VirtualChannel.15.Alarm2.Deviation	Deviation alarm 'Deviation Value'	float32	2367	9063	Same as VirtualChannel.15.Main.PV
VirtualChannel.15.Alarm2.Dwell	Alarm dwell time	time_t	2365	9061	Set by Network.Modbus.TimeFormat
VirtualChannel.15.Alarm2.Hysteresis	Alarm hysteresis value	float32	2364	9060	Same as VirtualChannel.15.Main.PV
VirtualChannel.15.Alarm2.Inactive	1 = alarm source safe and ack'd (if necessary)	bool	236e	9070	Not applicable
VirtualChannel.15.Alarm2.Inhibit	1 = alarm inhibited	bool	2371	9073	Not applicable
VirtualChannel.15.Alarm2.Latch	As VirtualChannel1.Alarm1.Latch	uint8	2361	9057	Not applicable
VirtualChannel.15.Alarm2.NotAcknowledged	1 = alarm has not been acknowledged	bool	236f	9071	Not applicable
VirtualChannel.15.Alarm2.Reference	Deviation alarm 'Reference' value	float32	2366	9062	Same as VirtualChannel.15.Main.PV
VirtualChannel.15.Alarm2.Status	As VirtualChannel1.Alarm1.Status	uint8	015b	347	Not applicable
VirtualChannel.15.Alarm2.Threshold	Alarm trigger threshold	float32	2363	9059	Same as VirtualChannel.15.Main.PV
VirtualChannel.15.Alarm2.Type	As VirtualChannel1.Alarm1.Type	uint8	2360	9056	Not applicable
VirtualChannel.15.Main.Descriptor	Virtual Channel descriptor	string_t	4c7b	19579	Not applicable
VirtualChannel.15.Main.Disable	1 = Virtual channel disabled	bool	2323	8995	Not applicable
VirtualChannel.15.Main.HighCutOff	The highest input value that will be totalised/counted	float32	2305	8965	Set by VirtualChannel.15.Main.Resolution
VirtualChannel.15.Main.Input1	Input 1 value	float32	2307	8967	Set by VirtualChannel.15.Main.Resolution
VirtualChannel.15.Main.Input2	Input 2 value	float32	2308	8968	Set by VirtualChannel.15.Main.Resolution
VirtualChannel.15.Main.LowCutOff	The lowest input value that will be totalised/counted	float32	2304	8964	Set by VirtualChannel.15.Main.Resolution
VirtualChannel.15.Main.ModbusInput	Modbus input value	float32	2306	8966	Set by VirtualChannel.15.Main.Resolution
VirtualChannel.15.Main.Operation	Specifies the operation of the virtual channel	uint8	2301	8961	Not applicable
VirtualChannel.15.Main.Period	The time period over which the calculation is made	int32	230a	8970	Not applicable
VirtualChannel.15.Main.Preset	Initiate preset. 0 = No; 1 = Yes	bool	230c	8972	Not applicable
VirtualChannel.15.Main.PresetValue	Specifies the preset value	float32	230d	8973	Set by VirtualChannel.15.Main.Resolution
VirtualChannel.15.Main.PV	The virtual channel output value	float32	0158	344	Set by VirtualChannel.15.Main.Resolution
VirtualChannel.15.Main.Reset	Initiate reset. 0 = No; 1 = Yes	bool	230b	8971	Not applicable
VirtualChannel.15.Main.Resolution	Specifies the resolution/number of decimal places	uint8	2302	8962	Not applicable
VirtualChannel.15.Main.Rollover	A pulse signal to indicate PV (output) has just rolled over	bool	2311	8977	Not applicable
VirtualChannel.15.Main.Status	As VirtualChannel1.Main.Status	uint8	0159	345	Not applicable
VirtualChannel.15.Main.TimeRemaining	Time remaining before the calculation is made	time_t	2309	8969	Set by Network.Modbus.TimeFormat
VirtualChannel.15.Main.Trigger	Increment/decrement counter. 0 = No; 1 = Yes	bool	230e	8974	Not applicable
VirtualChannel.15.Main.Type	As VirtualChannel1.Main.Type	uint8	2300	8960	Not applicable
VirtualChannel.15.Main.Units	Units descriptor	string_t	4c90	19600	Not applicable
VirtualChannel.15.Main.UnitsScaler	Units scaler for totalisers	float32	2303	8963	1dp
VirtualChannel.15.Trend.Colour	As VirtualChannel1.Trend.Colour	uint8	2320	8992	Not applicable
VirtualChannel.15.Trend.SpanHigh	Specifies the highest PV (output value) to be displayed	float32	2322	8994	Same as VirtualChannel.15.Main.PV
VirtualChannel.15.Trend.SpanLow	Specifies the lowest PV (output value) to be displayed	float32	2321	8993	Same as VirtualChannel.15.Main.PV

5.3 PARAMETER LIST (Cont.)

Parameter path	Description	Type	Hex	Dec	Resolution
VirtualChannel.16.Main.Descriptor	Virtual Channel descriptor	string_t	4c96	19606	Not applicable
VirtualChannel.16.Main.Disable	1 = Virtual channel disabled	bool	23a3	9123	Not applicable
VirtualChannel.16.Main.HighCutOff	The highest input value that will be totalised/counted	float32	2385	9093	Set by VirtualChannel.16.Main.Resolution
VirtualChannel.16.Main.Input1	Input 1 value	float32	2387	9095	Set by VirtualChannel.16.Main.Resolution
VirtualChannel.16.Main.Input2	Input 2 value	float32	2388	9096	Set by VirtualChannel.16.Main.Resolution
VirtualChannel.16.Main.LowCutOff	The lowest input value that will be totalised/counted	float32	2384	9092	Set by VirtualChannel.16.Main.Resolution
VirtualChannel.16.Main.ModbusInput	Modbus input value	float32	2386	9094	Set by VirtualChannel.16.Main.Resolution
VirtualChannel.16.Main.Operation	Specifies the operation of the virtual channel	uint8	2381	9089	Not applicable
VirtualChannel.16.Main.Period	The time period over which the calculation is made	int32	238a	9098	Not applicable
VirtualChannel.16.Main.Preset	Initiate preset. 0 = No; 1 = Yes	bool	238c	9100	Not applicable
VirtualChannel.16.Main.PresetValue	Specifies the preset value	float32	238d	9101	Set by VirtualChannel.16.Main.Resolution
VirtualChannel.16.Main.PV	The virtual channel output value	float32	015c	348	Set by VirtualChannel.16.Main.Resolution
VirtualChannel.16.Main.Reset	Initiate reset. 0 = No; 1 = Yes	bool	238b	9099	Not applicable
VirtualChannel.16.Main.Resolution	Specifies the resolution/number of decimal places	uint8	2382	9090	Not applicable
VirtualChannel.16.Main.Rollover	A pulse signal to indicate PV (output) has just rolled over	bool	2391	9105	Not applicable
VirtualChannel.16.Main.Status	As VirtualChannel1.Main.Status	uint8	015d	349	Not applicable
VirtualChannel.16.Main.TimeRemaining	Time remaining before the calculation is made	time_t	2389	9097	Set by Network.Modbus.TimeFormat
VirtualChannel.16.Main.Trigger	Increment/decrement counter. 0 = No; 1 = Yes	bool	238e	9102	Not applicable
VirtualChannel.16.Main.Type	As VirtualChannel1.Main.Type	uint8	2380	9088	Not applicable
VirtualChannel.16.Main.Units	Units descriptor	string_t	4cab	19627	Not applicable
VirtualChannel.16.Main.UnitsScaler	Units scaler for totalisers	float32	2383	9091	1dp
VirtualChannel.16.Trend.Colour	As VirtualChannel1.Trend.Colour	uint8	23a0	9120	Not applicable
VirtualChannel.16.Trend.SpanHigh	Specifies the highest PV (output value) to be displayed	float32	23a2	9122	Same as VirtualChannel.16.Main.PV
VirtualChannel.16.Trend.SpanLow	Specifies the lowest PV (output value) to be displayed	float32	23a1	9121	Same as VirtualChannel.16.Main.PV
VirtualChannel.17.Main.Descriptor	Virtual Channel descriptor	string_t	4cb1	19633	Not applicable
VirtualChannel.17.Main.Disable	1 = Virtual channel disabled	bool	23e3	9187	Not applicable
VirtualChannel.17.Main.HighCutOff	The highest input value that will be totalised/counted	float32	23c5	9157	Set by VirtualChannel.17.Main.Resolution
VirtualChannel.17.Main.Input1	Input 1 value	float32	23c7	9159	Set by VirtualChannel.17.Main.Resolution
VirtualChannel.17.Main.Input2	Input 2 value	float32	23c8	9160	Set by VirtualChannel.17.Main.Resolution
VirtualChannel.17.Main.LowCutOff	The lowest input value that will be totalised/counted	float32	23c4	9156	Set by VirtualChannel.17.Main.Resolution
VirtualChannel.17.Main.ModbusInput	Modbus input value	float32	23c6	9158	Set by VirtualChannel.17.Main.Resolution
VirtualChannel.17.Main.Operation	Specifies the operation of the virtual channel	uint8	23c1	9153	Not applicable
VirtualChannel.17.Main.Period	The time period over which the calculation is made	int32	23ca	9162	Not applicable
VirtualChannel.17.Main.Preset	Initiate preset. 0 = No; 1 = Yes	bool	23cc	9164	Not applicable
VirtualChannel.17.Main.PresetValue	Specifies the preset value	float32	23cd	9165	Set by VirtualChannel.17.Main.Resolution
VirtualChannel.17.Main.PV	The virtual channel output value	float32	015e	350	Set by VirtualChannel.17.Main.Resolution
VirtualChannel.17.Main.Reset	Initiate reset. 0 = No; 1 = Yes	bool	23cb	9163	Not applicable
VirtualChannel.17.Main.Resolution	Specifies the resolution/number of decimal places	uint8	23c2	9154	Not applicable
VirtualChannel.17.Main.Rollover	A pulse signal to indicate PV (output) has just rolled over	bool	23d1	9169	Not applicable
VirtualChannel.17.Main.Status	As VirtualChannel1.Main.Status	uint8	015f	351	Not applicable
VirtualChannel.17.Main.TimeRemaining	Time remaining before the calculation is made	time_t	23c9	9161	Set by Network.Modbus.TimeFormat
VirtualChannel.17.Main.Trigger	Increment/decrement counter. 0 = No; 1 = Yes	bool	23ce	9166	Not applicable
VirtualChannel.17.Main.Type	As VirtualChannel1.Main.Type	uint8	23c0	9152	Not applicable
VirtualChannel.17.Main.Units	Units descriptor	string_t	4cc6	19654	Not applicable
VirtualChannel.17.Main.UnitsScaler	Units scaler for totalisers	float32	23c3	9155	1dp
VirtualChannel.17.Trend.Colour	As VirtualChannel1.Trend.Colour	uint8	23e0	9184	Not applicable
VirtualChannel.17.Trend.SpanHigh	Specifies the highest PV (output value) to be displayed	float32	23e2	9186	Same as VirtualChannel.17.Main.PV
VirtualChannel.17.Trend.SpanLow	Specifies the lowest PV (output value) to be displayed	float32	23e1	9185	Same as VirtualChannel.17.Main.PV
VirtualChannel.18.Main.Descriptor	Virtual Channel descriptor	string_t	4ccc	19660	Not applicable
VirtualChannel.18.Main.Disable	1 = Virtual channel disabled	bool	2523	9507	Not applicable
VirtualChannel.18.Main.HighCutOff	The highest input value that will be totalised/counted	float32	2405	9221	Set by VirtualChannel.18.Main.Resolution
VirtualChannel.18.Main.Input1	Input 1 value	float32	2407	9223	Set by VirtualChannel.18.Main.Resolution
VirtualChannel.18.Main.Input2	Input 2 value	float32	2408	9224	Set by VirtualChannel.18.Main.Resolution
VirtualChannel.18.Main.LowCutOff	The lowest input value that will be totalised/counted	float32	2404	9220	Set by VirtualChannel.18.Main.Resolution
VirtualChannel.18.Main.ModbusInput	Modbus input value	float32	2406	9222	Set by VirtualChannel.18.Main.Resolution
VirtualChannel.18.Main.Operation	Specifies the operation of the virtual channel	uint8	2401	9217	Not applicable
VirtualChannel.18.Main.Period	The time period over which the calculation is made	int32	240a	9226	Not applicable
VirtualChannel.18.Main.Preset	Initiate preset. 0 = No; 1 = Yes	bool	240c	9228	Not applicable
VirtualChannel.18.Main.PresetValue	Specifies the preset value	float32	240d	9229	Set by VirtualChannel.18.Main.Resolution
VirtualChannel.18.Main.PV	The virtual channel output value	float32	0160	352	Set by VirtualChannel.18.Main.Resolution
VirtualChannel.18.Main.Reset	Initiate reset. 0 = No; 1 = Yes	bool	240b	9227	Not applicable
VirtualChannel.18.Main.Resolution	Specifies the resolution/number of decimal places	uint8	2402	9218	Not applicable
VirtualChannel.18.Main.Rollover	A pulse signal to indicate PV (output) has just rolled over	bool	2411	9233	Not applicable
VirtualChannel.18.Main.Status	As VirtualChannel1.Main.Status	uint8	0161	353	Not applicable
VirtualChannel.18.Main.TimeRemaining	Time remaining before the calculation is made	time_t	2409	9225	Set by Network.Modbus.TimeFormat
VirtualChannel.18.Main.Trigger	Increment/decrement counter. 0 = No; 1 = Yes)	bool	240e	9230	Not applicable
VirtualChannel.18.Main.Type	As VirtualChannel1.Main.Type	uint8	2400	9216	Not applicable
VirtualChannel.18.Main.Units	Units descriptor	string_t	4ce1	19681	Not applicable
VirtualChannel.18.Main.UnitsScaler	Units scaler for totalisers	float32	2403	9219	1dp
VirtualChannel.18.Trend.Colour	As VirtualChannel1.Trend.Colour	uint8	2520	9504	Not applicable
VirtualChannel.18.Trend.SpanHigh	Specifies the highest PV (output value) to be displayed	float32	2522	9506	Same as VirtualChannel.18.Main.PV
VirtualChannel.18.Trend.SpanLow	Specifies the lowest PV (output value) to be displayed	float32	2521	9505	Same as VirtualChannel.18.Main.PV
VirtualChannel.19.Main.Descriptor	Virtual Channel descriptor	string_t	4ce7	19687	Not applicable
VirtualChannel.19.Main.Disable	1 = Virtual channel disabled	bool	2563	9571	Not applicable
VirtualChannel.19.Main.HighCutOff	The highest input value that will be totalised/counted	float32	2445	9285	Set by VirtualChannel.19.Main.Resolution
VirtualChannel.19.Main.Input1	Input 1 value	float32	2447	9287	Set by VirtualChannel.19.Main.Resolution
VirtualChannel.19.Main.Input2	Input 2 value	float32	2448	9288	Set by VirtualChannel.19.Main.Resolution
VirtualChannel.19.Main.LowCutOff	The lowest input value that will be totalised/counted	float32	2444	9284	Set by VirtualChannel.19.Main.Resolution

5.3 PARAMETER LIST (Cont.)

Parameter path	Description	Type	Hex	Dec	Resolution
VirtualChannel.19.Main.ModbusInput	Modbus input value	float32	2446	9286	Set by VirtualChannel.19.Main.Resolution
VirtualChannel.19.Main.Operation	Specifies the operation of the virtual channel	uint8	2441	9281	Not applicable
VirtualChannel.19.Main.Period	The time period over which the calculation is made	int32	244a	9290	Not applicable
VirtualChannel.19.Main.Preset	Initiate preset. 0 = No; 1 = Yes	bool	244c	9292	Not applicable
VirtualChannel.19.Main.PresetValue	Specifies the preset value	float32	244d	9293	Set by VirtualChannel.19.Main.Resolution
VirtualChannel.19.Main.PV	The virtual channel output value	float32	0162	354	Set by VirtualChannel.19.Main.Resolution
VirtualChannel.19.Main.Reset	Initiate reset. 0 = No; 1 = Yes	bool	244b	9291	Not applicable
VirtualChannel.19.Main.Resolution	Specifies the resolution/number of decimal places	uint8	2442	9282	Not applicable
VirtualChannel.19.Main.Rollover	A pulse signal to indicate PV (output) has just rolled over	bool	2451	9297	Not applicable
VirtualChannel.19.Main.Status	TAs VirtualChannel1.Main.Statusv	uint8	0163	355	Not applicable
VirtualChannel.19.Main.TimeRemaining	Time remaining before the calculation is made	time_t	2449	9289	Set by Network.Modbus.TimeFormat
VirtualChannel.19.Main.Trigger	Increment/decrement counter. 0 = No; 1 = Yes	bool	244e	9294	Not applicable
VirtualChannel.19.Main.Type	As VirtualChannel1.Main.Type	uint8	2440	9280	Not applicable
VirtualChannel.19.Main.Units	Units descriptor	string_t	4cfc	19708	Not applicable
VirtualChannel.19.Main.UnitsScaler	Units scaler for totalisers	float32	2443	9283	1dp
VirtualChannel.19.Trend.Colour	As VirtualChannel1.Trend.Colour	uint8	2560	9568	Not applicable
VirtualChannel.19.Trend.SpanHigh	Specifies the highest PV (output value) to be displayed	float32	2562	9570	Same as VirtualChannel.19.Main.PV
VirtualChannel.19.Trend.SpanLow	Specifies the lowest PV (output value) to be displayed	float32	2561	9569	Same as VirtualChannel.19.Main.PV
VirtualChannel.20.Main.Descriptor	Virtual Channel descriptor	string_t	4d02	19714	Not applicable
VirtualChannel.20.Main.Disable	1 = Virtual channel disabled	bool	25a3	9635	Not applicable
VirtualChannel.20.Main.HighCutOff	The highest input value that will be totalised/counted	float32	2485	9349	Set by VirtualChannel.20.Main.Resolution
VirtualChannel.20.Main.Input1	Input 1 value	float32	2487	9351	Set by VirtualChannel.20.Main.Resolution
VirtualChannel.20.Main.Input2	Input 2 value	float32	2488	9352	Set by VirtualChannel.20.Main.Resolution
VirtualChannel.20.Main.LowCutOff	The lowest input value that will be totalised/counted	float32	2484	9348	Set by VirtualChannel.20.Main.Resolution
VirtualChannel.20.Main.ModbusInput	Modbus input value	float32	2486	9350	Set by VirtualChannel.20.Main.Resolution
VirtualChannel.20.Main.Operation	Specifies the operation of the virtual channel	uint8	2481	9345	Not applicable
VirtualChannel.20.Main.Period	The time period over which the calculation is made	int32	248a	9354	Not applicable
VirtualChannel.20.Main.Preset	Initiate preset. 0 = No; 1 = Yes	bool	248c	9356	Not applicable
VirtualChannel.20.Main.PresetValue	Specifies the preset value	float32	248d	9357	Set by VirtualChannel.20.Main.Resolution
VirtualChannel.20.Main.PV	The virtual channel output value	float32	0164	356	Set by VirtualChannel.20.Main.Resolution
VirtualChannel.20.Main.Reset	Initiate reset. 0 = No; 1 = Yes	bool	248b	9355	Not applicable
VirtualChannel.20.Main.Resolution	Specifies the resolution/number of decimal places	uint8	2482	9346	Not applicable
VirtualChannel.20.Main.Rollover	A pulse signal to indicate PV (output) has just rolled over	bool	2491	9361	Not applicable
VirtualChannel.20.Main.Status	As VirtualChannel1.Main.Status	uint8	0165	357	Not applicable
VirtualChannel.20.Main.TimeRemaining	Time remaining before the calculation is made	time_t	2489	9353	Set by Network.Modbus.TimeFormat
VirtualChannel.20.Main.Trigger	TIncrement/decrement counter. 0 = No; 1 = Yes	bool	248e	9358	Not applicable
VirtualChannel.20.Main.Type	As VirtualChannel1.Main.Type	uint8	2480	9344	Not applicable
VirtualChannel.20.Main.Units	Units descriptor	string_t	4d17	19735	Not applicable
VirtualChannel.20.Main.UnitsScaler	Units scaler for totalisers	float32	2483	9347	1dp
VirtualChannel.20.Trend.Colour	As VirtualChannel1.Trend.Colour	uint8	25a0	9632	Not applicable
VirtualChannel.20.Trend.SpanHigh	Specifies the highest PV (output value) to be displayed	float32	25a2	9634	Same as VirtualChannel.20.Main.PV
VirtualChannel.20.Trend.SpanLow	Specifies the lowest PV (output value) to be displayed	float32	25a1	9633	Same as VirtualChannel.20.Main.PV
VirtualChannel.21.Main.Descriptor	Virtual Channel descriptor	string_t	4d1d	19741	Not applicable
VirtualChannel.21.Main.Disable	1 = Virtual channel disabled	bool	25e3	9699	Not applicable
VirtualChannel.21.Main.HighCutOff	The highest input value that will be totalised/counted	float32	24c5	9413	Set by VirtualChannel.21.Main.Resolution
VirtualChannel.21.Main.Input1	Input 1 value	float32	24c7	9415	Set by VirtualChannel.21.Main.Resolution
VirtualChannel.21.Main.Input2	Input 2 value	float32	24c8	9416	Set by VirtualChannel.21.Main.Resolution
VirtualChannel.21.Main.LowCutOff	The lowest input value that will be totalised/counted	float32	24c4	9412	Set by VirtualChannel.21.Main.Resolution
VirtualChannel.21.Main.ModbusInput	Modbus input value	float32	24c6	9414	Set by VirtualChannel.21.Main.Resolution
VirtualChannel.21.Main.Operation	Specifies the operation of the virtual channel	uint8	24c1	9409	Not applicable
VirtualChannel.21.Main.Period	The time period over which the calculation is made	int32	24ca	9418	Not applicable
VirtualChannel.21.Main.Preset	Initiate preset. 0 = No; 1 = Yes	bool	24cc	9420	Not applicable
VirtualChannel.21.Main.PresetValue	Specifies the preset value	float32	24cd	9421	Set by VirtualChannel.21.Main.Resolution
VirtualChannel.21.Main.PV	TThe virtual channel output value	float32	0166	358	Set by VirtualChannel.21.Main.Resolution
VirtualChannel.21.Main.Reset	Initiate reset. 0 = No; 1 = Yes	bool	24cb	9419	Not applicable
VirtualChannel.21.Main.Resolution	Specifies the resolution/number of decimal places	uint8	24c2	9410	Not applicable
VirtualChannel.21.Main.Rollover	A pulse signal to indicate PV (output) has just rolled over	bool	24d1	9425	Not applicable
VirtualChannel.21.Main.Status	As VirtualChannel1.Main.Status	uint8	0167	359	Not applicable
VirtualChannel.21.Main.TimeRemaining	Time remaining before the calculation is made	time_t	24c9	9417	Set by Network.Modbus.TimeFormat
VirtualChannel.21.Main.Trigger	Increment/decrement counter. 0 = No; 1 = Yes	bool	24ce	9422	Not applicable
VirtualChannel.21.Main.Type	As VirtualChannel1.Main.Type	uint8	24c0	9408	Not applicable
VirtualChannel.21.Main.Units	Units descriptor	string_t	4d32	19762	Not applicable
VirtualChannel.21.Main.UnitsScaler	Units scaler for totalisers	float32	24c3	9411	1dp
VirtualChannel.21.Trend.Colour	As VirtualChannel1.Trend.Colour	uint8	25e0	9696	Not applicable
VirtualChannel.21.Trend.SpanHigh	Specifies the highest PV (output value) to be displayed	float32	25e2	9698	Same as VirtualChannel.21.Main.PV
VirtualChannel.21.Trend.SpanLow	Specifies the lowest PV (output value) to be displayed	float32	25e1	9697	Same as VirtualChannel.21.Main.PV
VirtualChannel.22.Main.Descriptor	Virtual Channel descriptor	string_t	4d38	19768	Not applicable
VirtualChannel.22.Main.Disable	1 = Virtual channel disabled	bool	2623	9763	Not applicable
VirtualChannel.22.Main.HighCutOff	The highest input value that will be totalised/counted	float32	2505	9477	Set by VirtualChannel.22.Main.Resolution
VirtualChannel.22.Main.Input1	Input 1 value	float32	2507	9479	Set by VirtualChannel.22.Main.Resolution
VirtualChannel.22.Main.Input2	Input 2 value	float32	2508	9480	Set by VirtualChannel.22.Main.Resolution
VirtualChannel.22.Main.LowCutOff	The lowest input value that will be totalised/counted	float32	2504	9476	Set by VirtualChannel.22.Main.Resolution
VirtualChannel.22.Main.ModbusInput	Modbus input value	float32	2506	9478	Set by VirtualChannel.22.Main.Resolution
VirtualChannel.22.Main.Operation	Specifies the operation of the virtual channel	uint8	2501	9473	Not applicable
VirtualChannel.22.Main.Period	The time period over which the calculation is made	int32	250a	9482	Not applicable
VirtualChannel.22.Main.Preset	Initiate preset. 0 = No; 1 = Yes	bool	250c	9484	Not applicable
VirtualChannel.22.Main.PresetValue	Specifies the preset value	float32	250d	9485	Set by VirtualChannel.22.Main.Resolution
VirtualChannel.22.Main.PV	TThe virtual channel output value	float32	0168	360	Set by VirtualChannel.22.Main.Resolution

5.3 PARAMETER LIST (Cont.)

Parameter path	Description	Type	Hex	Dec	Resolution
VirtualChannel.22.Main.Reset	Initiate reset. 0 = No; 1 = Yes	bool	250b	9483	Not applicable
VirtualChannel.22.Main.Resolution	Specifies the resolution/number of decimal places	uint8	2502	9474	Not applicable
VirtualChannel.22.Main.Rollover	A pulse signal to indicate PV (output) has just rolled over	bool	2511	9489	Not applicable
VirtualChannel.22.Main.Status	As VirtualChannel1.Main.Status	uint8	0169	361	Not applicable
VirtualChannel.22.Main.TimeRemaining	Time remaining before the calculation is made	time_t	2509	9481	Set by Network.Modbus.TimeFormat
VirtualChannel.22.Main.Trigger	Increment/decrement counter. 0 = No; 1 = Yes	bool	250e	9486	Not applicable
VirtualChannel.22.Main.Type	As VirtualChannel1.Main.Type	uint8	2500	9472	Not applicable
VirtualChannel.22.Main.Units	Units descriptor	string_t	4d4d	19789	Not applicable
VirtualChannel.22.Main.UnitsScaler	Units scaler for totalisers	float32	2503	9475	1dp
VirtualChannel.22.Trend.Colour	As VirtualChannel1.Trend.Colour	uint8	2620	9760	Not applicable
VirtualChannel.22.Trend.SpanHigh	Specifies the highest PV (output value) to be displayed	float32	2622	9762	Same as VirtualChannel.22.Main.PV
VirtualChannel.22.Trend.SpanLow	Specifies the lowest PV (output value) to be displayed	float32	2621	9761	Same as VirtualChannel.22.Main.PV
VirtualChannel.23.Main.Descriptor	Virtual Channel descriptor	string_t	4d53	19795	Not applicable
VirtualChannel.23.Main.Disable	1 = Virtual channel disabled	bool	2663	9827	Not applicable
VirtualChannel.23.Main.HighCutOff	The highest input value that will be totalised/counted	float32	2545	9541	Set by VirtualChannel.23.Main.Resolution
VirtualChannel.23.Main.Input1	Input 1 value	float32	2547	9543	Set by VirtualChannel.23.Main.Resolution
VirtualChannel.23.Main.Input2	Input 2 value	float32	2548	9544	Set by VirtualChannel.23.Main.Resolution
VirtualChannel.23.Main.LowCutOff	The lowest input value that will be totalised/counted	float32	2544	9540	Set by VirtualChannel.23.Main.Resolution
VirtualChannel.23.Main.ModbusInput	Modbus input value	float32	2546	9542	Set by VirtualChannel.23.Main.Resolution
VirtualChannel.23.Main.Operation	Specifies the operation of the virtual channel	uint8	2541	9537	Not applicable
VirtualChannel.23.Main.Period	The time period over which the calculation is made	int32	254a	9546	Not applicable
VirtualChannel.23.Main.Preset	Initiate preset. 0 = No; 1 = Yes	bool	254c	9548	Not applicable
VirtualChannel.23.Main.PresetValue	Specifies the preset value	float32	254d	9549	Set by VirtualChannel.23.Main.Resolution
VirtualChannel.23.Main.PV	The virtual channel output value	float32	016a	362	Set by VirtualChannel.23.Main.Resolution
VirtualChannel.23.Main.Reset	Initiate reset. 0 = No; 1 = Yes	bool	254b	9547	Not applicable
VirtualChannel.23.Main.Resolution	Specifies the resolution/number of decimal places	uint8	2542	9538	Not applicable
VirtualChannel.23.Main.Rollover	A pulse signal to indicate PV (output) has just rolled over	bool	2551	9553	Not applicable
VirtualChannel.23.Main.Status	As VirtualChannel1.Main.Status	uint8	016b	363	Not applicable
VirtualChannel.23.Main.TimeRemaining	Time remaining before the calculation is made	time_t	2549	9545	Set by Network.Modbus.TimeFormat
VirtualChannel.23.Main.Trigger	Increment/decrement counter. 0 = No; 1 = Yes	bool	254e	9550	Not applicable
VirtualChannel.23.Main.Type	As VirtualChannel1.Main.Type	uint8	2540	9536	Not applicable
VirtualChannel.23.Main.Units	Units descriptor	string_t	4d68	19816	Not applicable
VirtualChannel.23.Main.UnitsScaler	Units scaler for totalisers	float32	2543	9539	1dp
VirtualChannel.23.Trend.Colour	As VirtualChannel1.Trend.Colour	uint8	2660	9824	Not applicable
VirtualChannel.23.Trend.SpanHigh	Specifies the highest PV (output value) to be displayed	float32	2662	9826	Same as VirtualChannel.23.Main.PV
VirtualChannel.23.Trend.SpanLow	Specifies the lowest PV (output value) to be displayed	float32	2661	9825	Same as VirtualChannel.23.Main.PV
VirtualChannel.24.Main.Descriptor	Virtual Channel descriptor	string_t	4d6e	19822	Not applicable
VirtualChannel.24.Main.Disable	1 = Virtual channel disabled	bool	26a3	9891	Not applicable
VirtualChannel.24.Main.HighCutOff	The highest input value that will be totalised/counted	float32	2585	9605	Set by VirtualChannel.24.Main.Resolution
VirtualChannel.24.Main.Input1	Input 1 value	float32	2587	9607	Set by VirtualChannel.24.Main.Resolution
VirtualChannel.24.Main.Input2	Input 2 value	float32	2588	9608	Set by VirtualChannel.24.Main.Resolution
VirtualChannel.24.Main.LowCutOff	The lowest input value that will be totalised/counted	float32	2584	9604	Set by VirtualChannel.24.Main.Resolution
VirtualChannel.24.Main.ModbusInput	Modbus input value	float32	2586	9606	Set by VirtualChannel.24.Main.Resolution
VirtualChannel.24.Main.Operation	Specifies the operation of the virtual channel	uint8	2581	9601	Not applicable
VirtualChannel.24.Main.Period	The time period over which the calculation is made	int32	258a	9610	Not applicable
VirtualChannel.24.Main.Preset	Initiate preset. 0 = No; 1 = Yes	bool	258c	9612	Not applicable
VirtualChannel.24.Main.PresetValue	Specifies the preset value	float32	258d	9613	Set by VirtualChannel.24.Main.Resolution
VirtualChannel.24.Main.PV	The virtual channel output value	float32	016c	364	Set by VirtualChannel.24.Main.Resolution
VirtualChannel.24.Main.Reset	Initiate reset. 0 = No; 1 = Yes	bool	258b	9611	Not applicable
VirtualChannel.24.Main.Resolution	Specifies the resolution/number of decimal places	uint8	2582	9602	Not applicable
VirtualChannel.24.Main.Rollover	A pulse signal to indicate PV (output) has just rolled over	bool	2591	9617	Not applicable
VirtualChannel.24.Main.Status	As VirtualChannel1.Main.Status	uint8	016d	365	Not applicable
VirtualChannel.24.Main.TimeRemaining	Time remaining before the calculation is made	time_t	2589	9609	Set by Network.Modbus.TimeFormat
VirtualChannel.24.Main.Trigger	Increment/decrement counter. 0 = No; 1 = Yes	bool	258e	9614	Not applicable
VirtualChannel.24.Main.Type	As VirtualChannel1.Main.Type	uint8	2580	9600	Not applicable
VirtualChannel.24.Main.Units	Units descriptor	string_t	4d83	19843	Not applicable
VirtualChannel.24.Main.UnitsScaler	Units scaler for totalisers	float32	2583	9603	1dp
VirtualChannel.24.Trend.Colour	As VirtualChannel1.Trend.Colour	uint8	26a0	9888	Not applicable
VirtualChannel.24.Trend.SpanHigh	Specifies the highest PV (output value) to be displayed	float32	26a2	9890	Same as VirtualChannel.24.Main.PV
VirtualChannel.24.Trend.SpanLow	Specifies the lowest PV (output value) to be displayed	float32	26a1	9889	Same as VirtualChannel.24.Main.PV
VirtualChannel.25.Main.Descriptor	Virtual Channel descriptor	string_t	4d89	19849	Not applicable
VirtualChannel.25.Main.Disable	1 = Virtual channel disabled	bool	26e3	9955	Not applicable
VirtualChannel.25.Main.HighCutOff	The highest input value that will be totalised/counted	float32	25c5	9669	Set by VirtualChannel.25.Main.Resolution
VirtualChannel.25.Main.Input1	Input 1 value	float32	25c7	9671	Set by VirtualChannel.25.Main.Resolution
VirtualChannel.25.Main.Input2	Input 2 value	float32	25c8	9672	Set by VirtualChannel.25.Main.Resolution
VirtualChannel.25.Main.LowCutOff	The lowest input value that will be totalised/counted	float32	25c4	9668	Set by VirtualChannel.25.Main.Resolution
VirtualChannel.25.Main.ModbusInput	Modbus input value	float32	25c6	9670	Set by VirtualChannel.25.Main.Resolution
VirtualChannel.25.Main.Operation	Specifies the operation of the virtual channel	uint8	25c1	9665	Not applicable
VirtualChannel.25.Main.Period	The time period over which the calculation is made	int32	25ca	9674	Not applicable
VirtualChannel.25.Main.Preset	Initiate preset. 0 = No; 1 = Yes	bool	25cc	9676	Not applicable
VirtualChannel.25.Main.PresetValue	Specifies the preset value	float32	25cd	9677	Set by VirtualChannel.25.Main.Resolution
VirtualChannel.25.Main.PV	The virtual channel output value	float32	016e	366	Set by VirtualChannel.25.Main.Resolution
VirtualChannel.25.Main.Reset	Initiate reset. 0 = No; 1 = Yes	bool	25cb	9675	Not applicable
VirtualChannel.25.Main.Resolution	Specifies the resolution/number of decimal places	uint8	25c2	9666	Not applicable
VirtualChannel.25.Main.Rollover	A pulse signal to indicate PV (output) has just rolled over	bool	25d1	9681	Not applicable
VirtualChannel.25.Main.Status	As VirtualChannel1.Main.Status	uint8	016f	367	Not applicable
VirtualChannel.25.Main.TimeRemaining	Time remaining before the calculation is made	time_t	25c9	9673	Set by Network.Modbus.TimeFormat
VirtualChannel.25.Main.Trigger	Increment/decrement counter. 0 = No; 1 = Yes	bool	25ce	9678	Not applicable

5.3 PARAMETER LIST (Cont.)

Parameter path	Description	Type	Hex	Dec	Resolution
VirtualChannel.25.Main.Type	As VirtualChannel1.Main.Type	uint8	25c0	9664	Not applicable
VirtualChannel.25.Main.Units	Units descriptor	string_t	4d9e	19870	Not applicable
VirtualChannel.25.Main.UnitsScaler	Units scaler for totalisers	float32	25c3	9667	1dp
VirtualChannel.25.Trend.Colour	As VirtualChannel1.Trend.Colour	uint8	26e0	9952	Not applicable
VirtualChannel.25.Trend.SpanHigh	Specifies the highest PV (output value) to be displayed	float32	26e2	9954	Same as VirtualChannel.25.Main.PV
VirtualChannel.25.Trend.SpanLow	Specifies the lowest PV (output value) to be displayed	float32	26e1	9953	Same as VirtualChannel.25.Main.PV
VirtualChannel.26.Main.Descriptor	Virtual Channel descriptor	string_t	4da4	19876	Not applicable
VirtualChannel.26.Main.Disable	1 = Virtual channel disabled	bool	2723	10019	Not applicable
VirtualChannel.26.Main.HighCutOff	The highest input value that will be totalised/counted	float32	2605	9733	Set by VirtualChannel.26.Main.Resolution
VirtualChannel.26.Main.Input1	Input 1 value	float32	2607	9735	Set by VirtualChannel.26.Main.Resolution
VirtualChannel.26.Main.Input2	Input 2 value	float32	2608	9736	Set by VirtualChannel.26.Main.Resolution
VirtualChannel.26.Main.LowCutOff	The lowest input value that will be totalised/counted	float32	2604	9732	Set by VirtualChannel.26.Main.Resolution
VirtualChannel.26.Main.ModbusInput	Modbus input value	float32	2606	9734	Set by VirtualChannel.26.Main.Resolution
VirtualChannel.26.Main.Operation	Specifies the operation of the virtual channel	uint8	2601	9729	Not applicable
VirtualChannel.26.Main.Period	The time period over which the calculation is made	int32	260a	9738	Not applicable
VirtualChannel.26.Main.Preset	Initiate preset. 0 = No; 1 = Yes	bool	260c	9740	Not applicable
VirtualChannel.26.Main.PresetValue	Specifies the preset value	float32	260d	9741	Set by VirtualChannel.26.Main.Resolution
VirtualChannel.26.Main.PV	The virtual channel output value	float32	0170	368	Set by VirtualChannel.26.Main.Resolution
VirtualChannel.26.Main.Reset	Initiate reset. 0 = No; 1 = Yes	bool	260b	9739	Not applicable
VirtualChannel.26.Main.Resolution	Specifies the resolution/number of decimal places	uint8	2602	9730	Not applicable
VirtualChannel.26.Main.Rollover	A pulse signal to indicate PV (output) has just rolled over	bool	2611	9745	Not applicable
VirtualChannel.26.Main.Status	As VirtualChannel1.Main.Status	uint8	0171	369	Not applicable
VirtualChannel.26.Main.TimeRemaining	Time remaining before the calculation is made	time_t	2609	9737	Set by Network.Modbus.TimeFormat
VirtualChannel.26.Main.Trigger	Increment/decrement counter. 0 = No; 1 = Yes	bool	260e	9742	Not applicable
VirtualChannel.26.Main.Type	As VirtualChannel1.Main.Type	uint8	2600	9728	Not applicable
VirtualChannel.26.Main.Units	Units descriptor	string_t	4db9	19897	Not applicable
VirtualChannel.26.Main.UnitsScaler	Units scaler for totalisers	float32	2603	9731	1dp
VirtualChannel.26.Trend.Colour	As VirtualChannel1.Trend.Colour	uint8	2720	10016	Not applicable
VirtualChannel.26.Trend.SpanHigh	Specifies the highest PV (output value) to be displayed	float32	2722	10018	Same as VirtualChannel.26.Main.PV
VirtualChannel.26.Trend.SpanLow	Specifies the lowest PV (output value) to be displayed	float32	2721	10017	Same as VirtualChannel.26.Main.PV
VirtualChannel.27.Main.Descriptor	Virtual Channel descriptor	string_t	4dbf	19903	Not applicable
VirtualChannel.27.Main.Disable	1 = Virtual channel disabled	bool	2763	10083	Not applicable
VirtualChannel.27.Main.HighCutOff	The highest input value that will be totalised/counted	float32	2645	9797	Set by VirtualChannel.27.Main.Resolution
VirtualChannel.27.Main.Input1	Input 1 value	float32	2647	9799	Set by VirtualChannel.27.Main.Resolution
VirtualChannel.27.Main.Input2	Input 2 value	float32	2648	9800	Set by VirtualChannel.27.Main.Resolution
VirtualChannel.27.Main.LowCutOff	The lowest input value that will be totalised/counted	float32	2644	9796	Set by VirtualChannel.27.Main.Resolution
VirtualChannel.27.Main.ModbusInput	Modbus input value	float32	2646	9798	Set by VirtualChannel.27.Main.Resolution
VirtualChannel.27.Main.Operation	Specifies the operation of the virtual channel	uint8	2641	9793	Not applicable
VirtualChannel.27.Main.Period	The time period over which the calculation is made	int32	264a	9802	Not applicable
VirtualChannel.27.Main.Preset	Initiate preset. 0 = No; 1 = Yes	bool	264c	9804	Not applicable
VirtualChannel.27.Main.PresetValue	Specifies the preset value	float32	264d	9805	Set by VirtualChannel.27.Main.Resolution
VirtualChannel.27.Main.PV	The virtual channel output value	float32	0172	370	Set by VirtualChannel.27.Main.Resolution
VirtualChannel.27.Main.Reset	Initiate reset. 0 = No; 1 = Yes	bool	264b	9803	Not applicable
VirtualChannel.27.Main.Resolution	Specifies the resolution/number of decimal places	uint8	2642	9794	Not applicable
VirtualChannel.27.Main.Rollover	A pulse signal to indicate PV (output) has just rolled over	bool	2651	9809	Not applicable
VirtualChannel.27.Main.Status	As VirtualChannel1.Main.Status	uint8	0173	371	Not applicable
VirtualChannel.27.Main.TimeRemaining	Time remaining before the calculation is made	time_t	2649	9801	Set by Network.Modbus.TimeFormat
VirtualChannel.27.Main.Trigger	Increment/decrement counter. 0 = No; 1 = Yes	bool	264e	9806	Not applicable
VirtualChannel.27.Main.Type	As VirtualChannel1.Main.Type	uint8	2640	9792	Not applicable
VirtualChannel.27.Main.Units	Units descriptor	string_t	4dd4	19924	Not applicable
VirtualChannel.27.Main.UnitsScaler	Units scaler for totalisers	float32	2643	9795	1dp
VirtualChannel.27.Trend.Colour	As VirtualChannel1.Trend.Colour	uint8	2760	10080	Not applicable
VirtualChannel.27.Trend.SpanHigh	Specifies the highest PV (output value) to be displayed	float32	2762	10082	Same as VirtualChannel.27.Main.PV
VirtualChannel.27.Trend.SpanLow	Specifies the lowest PV (output value) to be displayed	float32	2761	10081	Same as VirtualChannel.27.Main.PV
VirtualChannel.28.Main.Descriptor	Virtual Channel descriptor	string_t	4dda	19930	Not applicable
VirtualChannel.28.Main.Disable	1 = Virtual channel disabled	bool	27a3	10147	Not applicable
VirtualChannel.28.Main.HighCutOff	The highest input value that will be totalised/counted	float32	2685	9861	Set by VirtualChannel.28.Main.Resolution
VirtualChannel.28.Main.Input1	Input 1 value	float32	2687	9863	Set by VirtualChannel.28.Main.Resolution
VirtualChannel.28.Main.Input2	Input 2 value	float32	2688	9864	Set by VirtualChannel.28.Main.Resolution
VirtualChannel.28.Main.LowCutOff	The lowest input value that will be totalised/counted	float32	2684	9860	Set by VirtualChannel.28.Main.Resolution
VirtualChannel.28.Main.ModbusInput	Modbus input value	float32	2686	9862	Set by VirtualChannel.28.Main.Resolution
VirtualChannel.28.Main.Operation	Specifies the operation of the virtual channel	uint8	2681	9857	Not applicable
VirtualChannel.28.Main.Period	The time period over which the calculation is made	int32	268a	9866	Not applicable
VirtualChannel.28.Main.Preset	Initiate preset. 0 = No; 1 = Yes	bool	268c	9868	Not applicable
VirtualChannel.28.Main.PresetValue	Specifies the preset value	float32	268d	9869	Set by VirtualChannel.28.Main.Resolution
VirtualChannel.28.Main.PV	The virtual channel output value	float32	0174	372	Set by VirtualChannel.28.Main.Resolution
VirtualChannel.28.Main.Reset	Initiate reset. 0 = No; 1 = Yes	bool	268b	9867	Not applicable
VirtualChannel.28.Main.Resolution	Specifies the resolution/number of decimal places	uint8	2682	9858	Not applicable
VirtualChannel.28.Main.Rollover	A pulse signal to indicate PV (output) has just rolled over	bool	2691	9873	Not applicable
VirtualChannel.28.Main.Status	As VirtualChannel1.Main.Status	uint8	0175	373	Not applicable
VirtualChannel.28.Main.TimeRemaining	Time remaining before the calculation is made	time_t	2689	9865	Set by Network.Modbus.TimeFormat
VirtualChannel.28.Main.Trigger	Increment/decrement counter. 0 = No; 1 = Yes	bool	268e	9870	Not applicable
VirtualChannel.28.Main.Type	As VirtualChannel1.Main.Type	uint8	2680	9856	Not applicable
VirtualChannel.28.Main.Units	Units descriptor	string_t	4def	19951	Not applicable
VirtualChannel.28.Main.UnitsScaler	Units scaler for totalisers	float32	2683	9859	1dp
VirtualChannel.28.Trend.Colour	As VirtualChannel1.Trend.Colour	uint8	27a0	10144	Not applicable
VirtualChannel.28.Trend.SpanHigh	Specifies the highest PV (output value) to be displayed	float32	27a2	10146	Same as VirtualChannel.28.Main.PV
VirtualChannel.28.Trend.SpanLow	Specifies the lowest PV (output value) to be displayed	float32	27a1	10145	Same as VirtualChannel.28.Main.PV

5.3 PARAMETER LIST (Cont.)

Parameter path	Description	Type	Hex	Dec	Resolution
VirtualChannel.29.Main.Descriptor	Virtual Channel descriptor	string_t	4df5	19957	Not applicable
VirtualChannel.29.Main.Disable	1 = Virtual channel disabled	bool	27e3	10211	Not applicable
VirtualChannel.29.Main.HighCutOff	The highest input value that will be totalised/counted	float32	26c5	9925	Set by VirtualChannel.29.Main.Resolution
VirtualChannel.29.Main.Input1	Input 1 value	float32	26c7	9927	Set by VirtualChannel.29.Main.Resolution
VirtualChannel.29.Main.Input2	Input 2 value	float32	26c8	9928	Set by VirtualChannel.29.Main.Resolution
VirtualChannel.29.Main.LowCutOff	The lowest input value that will be totalised/counted	float32	26c4	9924	Set by VirtualChannel.29.Main.Resolution
VirtualChannel.29.Main.ModbusInput	Modbus input value	float32	26c6	9926	Set by VirtualChannel.29.Main.Resolution
VirtualChannel.29.Main.Operation	Specifies the operation of the virtual channel	uint8	26c1	9921	Not applicable
VirtualChannel.29.Main.Period	The time period over which the calculation is made	int32	26ca	9930	Not applicable
VirtualChannel.29.Main.Preset	Initiate preset. 0 = No; 1 = Yes	bool	26cc	9932	Not applicable
VirtualChannel.29.Main.PresetValue	Specifies the preset value	float32	26cd	9933	Set by VirtualChannel.29.Main.Resolution
VirtualChannel.29.Main.PV	The virtual channel output value	float32	0176	374	Set by VirtualChannel.29.Main.Resolution
VirtualChannel.29.Main.Reset	Initiate reset. 0 = No; 1 = Yes	bool	26cb	9931	Not applicable
VirtualChannel.29.Main.Resolution	Specifies the resolution/number of decimal places	uint8	26c2	9922	Not applicable
VirtualChannel.29.Main.Rollover	A pulse signal to indicate PV (output) has just rolled over	bool	26d1	9937	Not applicable
VirtualChannel.29.Main.Status	As VirtualChannel1.Main.Status	uint8	0177	375	Not applicable
VirtualChannel.29.Main.TimeRemaining	Time remaining before the calculation is made	time_t	26c9	9929	Set by Network.Modbus.TimeFormat
VirtualChannel.29.Main.Trigger	Increment/decrement counter. 0 = No; 1 = Yes	bool	26ce	9934	Not applicable
VirtualChannel.29.Main.Type	As VirtualChannel1.Main.Type	uint8	26c0	9920	Not applicable
VirtualChannel.29.Main.Units	Units descriptor	string_t	4e0a	19978	Not applicable
VirtualChannel.29.Main.UnitsScaler	Units scaler for totalisers	float32	26c3	9923	1dp
VirtualChannel.29.Trend.Colour	As VirtualChannel1.Trend.Colour	uint8	27e0	10208	Not applicable
VirtualChannel.29.Trend.SpanHigh	Specifies the highest PV (output value) to be displayed	float32	27e2	10210	Same as VirtualChannel.29.Main.PV
VirtualChannel.29.Trend.SpanLow	Specifies the lowest PV (output value) to be displayed	float32	27e1	10209	Same as VirtualChannel.29.Main.PV
VirtualChannel.30.Main.Descriptor	Virtual Channel descriptor	string_t	4e10	19984	Not applicable
VirtualChannel.30.Main.Disable	1 = Virtual channel disabled	bool	2823	10275	Not applicable
VirtualChannel.30.Main.HighCutOff	The highest input value that will be totalised/counted	float32	2705	9989	Set by VirtualChannel.30.Main.Resolution
VirtualChannel.30.Main.Input1	Input 1 value	float32	2707	9991	Set by VirtualChannel.30.Main.Resolution
VirtualChannel.30.Main.Input2	Input 2 value	float32	2708	9992	Set by VirtualChannel.30.Main.Resolution
VirtualChannel.30.Main.LowCutOff	The lowest input value that will be totalised/counted	float32	2704	9988	Set by VirtualChannel.30.Main.Resolution
VirtualChannel.30.Main.ModbusInput	Modbus input value	float32	2706	9990	Set by VirtualChannel.30.Main.Resolution
VirtualChannel.30.Main.Operation	Specifies the operation of the virtual channel	uint8	2701	9985	Not applicable
VirtualChannel.30.Main.Period	The time period over which the calculation is made	int32	270a	9994	Not applicable
VirtualChannel.30.Main.Preset	Initiate preset. 0 = No; 1 = Yes	bool	270c	9996	Not applicable
VirtualChannel.30.Main.PresetValue	Specifies the preset value	float32	270d	9997	Set by VirtualChannel.30.Main.Resolution
VirtualChannel.30.Main.PV	The virtual channel output value	float32	0178	376	Set by VirtualChannel.30.Main.Resolution
VirtualChannel.30.Main.Reset	Initiate reset. 0 = No; 1 = Yes	bool	270b	9995	Not applicable
VirtualChannel.30.Main.Resolution	Specifies the resolution/number of decimal places	uint8	2702	9986	Not applicable
VirtualChannel.30.Main.Rollover	A pulse signal to indicate PV (output) has just rolled over	bool	2711	10001	Not applicable
VirtualChannel.30.Main.Status	As VirtualChannel1.Main.Status	uint8	0179	377	Not applicable
VirtualChannel.30.Main.TimeRemaining	Time remaining before the calculation is made	time_t	2709	9993	Set by Network.Modbus.TimeFormat
VirtualChannel.30.Main.Trigger	Increment/decrement counter. 0 = No; 1 = Yes	bool	270e	9998	Not applicable
VirtualChannel.30.Main.Type	As VirtualChannel1.Main.Type	uint8	2700	9984	Not applicable
VirtualChannel.30.Main.Units	Units descriptor	string_t	4e25	20005	Not applicable
VirtualChannel.30.Main.UnitsScaler	Units scaler for totalisers	float32	2703	9987	1dp
VirtualChannel.30.Trend.Colour	As VirtualChannel1.Trend.Colour	uint8	2820	10272	Not applicable
VirtualChannel.30.Trend.SpanHigh	Specifies the highest PV (output value) to be displayed	float32	2822	10274	Same as VirtualChannel.30.Main.PV
VirtualChannel.30.Trend.SpanLow	Specifies the lowest PV (output value) to be displayed	float32	2821	10273	Same as VirtualChannel.30.Main.PV
Zirconia.aC_CO_O2	Carbon Activity Between CO and O2	float32	289e	10398	4dp
Zirconia.BalanceIntegral	Balance Integral	bool	289d	10397	Not applicable
Zirconia.CarbonPot	Calculated Carbon Potential	float32	2892	10386	Set by Zirconia.Resolution
Zirconia.Clean.AbortClean	1 = Abort cleaning process	bool	28b5	10421	Not applicable
Zirconia.Clean.CantClean	1 = can't clean	bool	28c3	10435	Not applicable
Zirconia.Clean.CleanAbort	1 = Cleaning cycle has been aborted	bool	28c4	10436	Not applicable
Zirconia.Clean.CleanEnable	1 = probe cleaning allowed	bool	28b2	10418	Not applicable
Zirconia.Clean.CleanFreq	Interval between probe cleaning cycles	time_t	28aa	10410	Set by Network.Modbus.TimeFormat
Zirconia.Clean.CleanMaxTemp	Maximum temperature for cleaning. If, during the cleaning cycle, the probe temperature exceeds this value, cleaning is aborted.	float32	28b4	10420	0dp
Zirconia.Clean.CleanMsgReset	1 = Clear cleaning related alarms	bool	28b3	10419	Not applicable
Zirconia.Clean.CleanProbe	1 = Initiate a probe cleaning cycle	bool	28b0	10416	Not applicable
Zirconia.Clean.CleanRecoveryTime	The time taken to recover from last clean. 0 = max. clean recovery time exceeded last time	time_t	28b6	10422	Set by Network.Modbus.TimeFormat
Zirconia.Clean.CleanTemp	1 = Clean cycle aborted because cleaning temperature was too high.	bool	28c5	10437	Not applicable
Zirconia.Clean.CleanTime	The time for which the probe is cleaned	time_t	28ab	10411	Set by Network.Modbus.TimeFormat
Zirconia.Clean.CleanValve	1 = Enable probe cleaning valve	bool	28af	10415	Not applicable
Zirconia.Clean.LastCleanMv	Probe output after last clean, in mV	float32	28b7	10423	0dp
Zirconia.Clean.MaxRcovTime	Max. recovery time after a purge	time_t	28ad	10413	Set by Network.Modbus.TimeFormat
Zirconia.Clean.MinRcovTime	Min. recovery time after a purge	time_t	28ac	10412	Set by Network.Modbus.TimeFormat
Zirconia.Clean.ProbeFault	1 = Probe failed to recover following the clean cycle	bool	28ae	10414	Not applicable
Zirconia.Clean.Time2Clean	Time to next cleaning cycle	time_t	28b1	10417	Set by Network.Modbus.TimeFormat
Zirconia.CleanFreq	Interval between cleaning cycles	time_t	2889	10377	Set by Network.Modbus.TimeFormat
Zirconia.CleanProbe	Initiates a demand cleaning cycle	bool	289a	10394	Not applicable
Zirconia.CleanState	Cleaning State (0 = Waiting, 1 = Cleaning, 2 = Recovering)	uint8	2899	10393	Not applicable
Zirconia.CleanTime	The time for which the probe is cleaned	time_t	288a	10378	Set by Network.Modbus.TimeFormat
Zirconia.CleanValve	1 = Enable probe cleaning valve	bool	2898	10392	Not applicable
Zirconia.DewPoint	Calculated Dewpoint	float32	2893	10387	Set by Zirconia.Resolution
Zirconia.GasRef	Reference value for hydrogen concentration	float32	2882	10370	1dp

5.3 PARAMETER LIST (Cont.)

Parameter path	Description	Type	Hex	Dec	Resolution
Zirconia.GasRefs.CO_Ideal	Gas ref value when Oxygen Type = Nernst	float32	28a9	10409	1dp
Zirconia.GasRefs.CO_InUse	The CO gas measurement value being used	float32	28a4	10404	1dp
Zirconia.GasRefs.CO_Local	Reference value for CO concentration	float32	28a1	10401	1dp
Zirconia.GasRefs.CO_Remote	CO concentration from remote source	float32	28a2	10402	1dp
Zirconia.GasRefs.CO_RemoteEn	1 = Allow remote gas measurement	bool	28a3	10403	Not applicable
Zirconia.GasRefs.H2_InUse	The hydrogen gas measurement value being used	float32	28a8	10408	1dp
Zirconia.GasRefs.H2_Local	Reference value for hydrogen concentration	float32	28a5	10405	1dp
Zirconia.GasRefs.H2_Remote	Hydrogen concentration from remote source	float32	28a6	10406	1dp
Zirconia.GasRefs.H2_RemoteEn	1 = Allow remote gas measurement	bool	28a7	10407	Not applicable
Zirconia.MaxRcovTime	Maximum recovery time after a purge	time_t	288c	10380	Set by Network.Modbus.TimeFormat
Zirconia.MinCalTemp	Min. temp at which the calculation is valid	float32	2886	10374	Same as Zirconia.TempInput
Zirconia.MinRcovTime	Minimum recovery time after a purge	time_t	288b	10379	Set by Network.Modbus.TimeFormat
Zirconia.NumResolution	Number of decimal places	uint8	2881	10369	Not applicable
Zirconia.Oxygen	Calculated Oxygen value	float32	2894	10388	Set by Zirconia.Resolution
Zirconia.OxygenExp	Exponent used by log oxygen calculations	int16	288d	10381	Not applicable
Zirconia.OxygenType	The oxygen equation being used.uint8 0 = Nernst 1=Nernst Bosch 2 = Nernst CP 3= Ferronova	28a0		10400	Not applicable
Zirconia.ProbeFault	Probe Clean Recovery Warning	bool	2896	10390	Not applicable
Zirconia.ProbeInput	Probe input in mV	float32	2890	10384	0dp
Zirconia.ProbeOffset	Probe offset in mV	float32	2891	10385	Set by Zirconia.Resolution
Zirconia.ProbeState	State of the probe measurement system 0 = Measuring 1 = Cleaning 2 = Clean Recovery 3 = Test impedance 4 = Impedance recovery 5 = Not ready	uint8	289f	10399	Not applicable
Zirconia.ProbeStatus	Status of Probe uint8 0 = OK 1 = mVSbr 2 = TempSbr 3 = MincalcT	289c		10396	Not applicable
Zirconia.ProbeType	Type of Probe 25 = MMI 26 = AACC 27 = Dray 28 = Accu 29 = SSI 30 = MacD 31 = Bosch 32 = Barber 33 = ferono 34 = PrbmV 35 = Eurotherm	uint8	2880	10368	Not applicable
Zirconia.ProcFactor	Process Factor (Value defined by probe manufacturer)	float32	2888	10376	1dp
Zirconia.PVFrozen	1 = PV frozen	bool	2897	10391	Not applicable
Zirconia.RemGasEn	1 = Enable use of remote gas reference	bool	2884	10372	Not applicable
Zirconia.RemGasRef	Remote Gas Reference Value	float32	2883	10371	1dp
Zirconia.SootAlm	1 = Soot alarm active	bool	2895	10389	Not applicable
Zirconia.TempInput	Probe temperature Input	float32	288e	10382	0dp
Zirconia.TempOffset	Temperature Offset	float32	288f	10383	Set by Zirconia.Resolution
Zirconia.Time2Clean	Time To Next Clean	time_t	289b	10395	Set by Network.Modbus.TimeFormat
Zirconia.Tolerance	Sooting Tolerance	float32	2887	10375	1dp
Zirconia.WrkGas	Working Reference Gas Value	float32	2885	10373	1dp

6 iTOOLS

iTools software running on a pc allows quick and easy access to the configuration of the unit. The parameters used are generally the same as those described in section 4 above, with the addition of various diagnostic parameters.

iTools also gives the user the ability to create software wiring between function blocks, such wiring being carried out using the Graphical wiring Editor feature.

A further feature - the display mode 'Promote List', is populated using iTools - see section 3.4.11 for details.

In addition to the guidance given here, there are two on-line Help systems available within iTools: Parameter help and iTools help. Parameter help is accessed by clicking on 'Help' in the toolbar (opens the complete parameter help system), by right-clicking on a parameter and selecting 'Parameter Help' from the resulting context menu, or by clicking on the Help menu and selecting 'Device Help'. iTools help is accessed by clicking on the Help menu, and selecting 'Contents'. iTools help is also available in manual format under part number HA028838, either as a physical manual or as a pdf file.

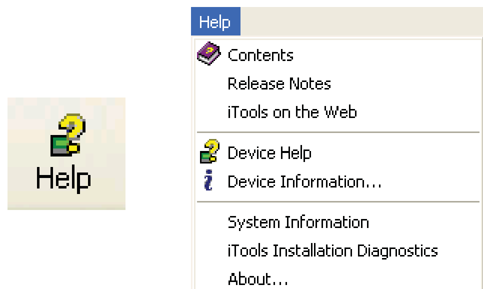


Figure 6 Help access

6.1 iTools CONNECTION

The following descriptions assume that iTools software has been correctly installed on the pc.

6.1.1 Ethernet (Modbus TCP) communications

Note: the following description is based on windows XP. Windows 'Vista' is similar.

It is first necessary to determine the IP address of the unit, as described under 'Network.Interface' in section 4.2.1.

Once the Ethernet link has been correctly installed, carry out the following actions at the pc:

1. Click on 'Start'
2. Click on 'Control Panel'. (If Control Panel opens in 'Category View' select 'Classic View' instead.)
3. Double-click on 'iTools'.
4. Click on the TCP/IP tab in the Registry settings configuration.
5. Click on 'Add...' The 'New TCP/IP Port' dialogue box opens.
6. Type-in a name for the port, then click 'Add...' again
7. Type the IP address of the unit in the 'Edit Host' box which appears. Click OK.
8. Check the details in the 'New TCP/IP Port' box, then click on 'OK'.
9. Click on 'OK' in the 'Registry settings' box to confirm the new port.

(Continued)

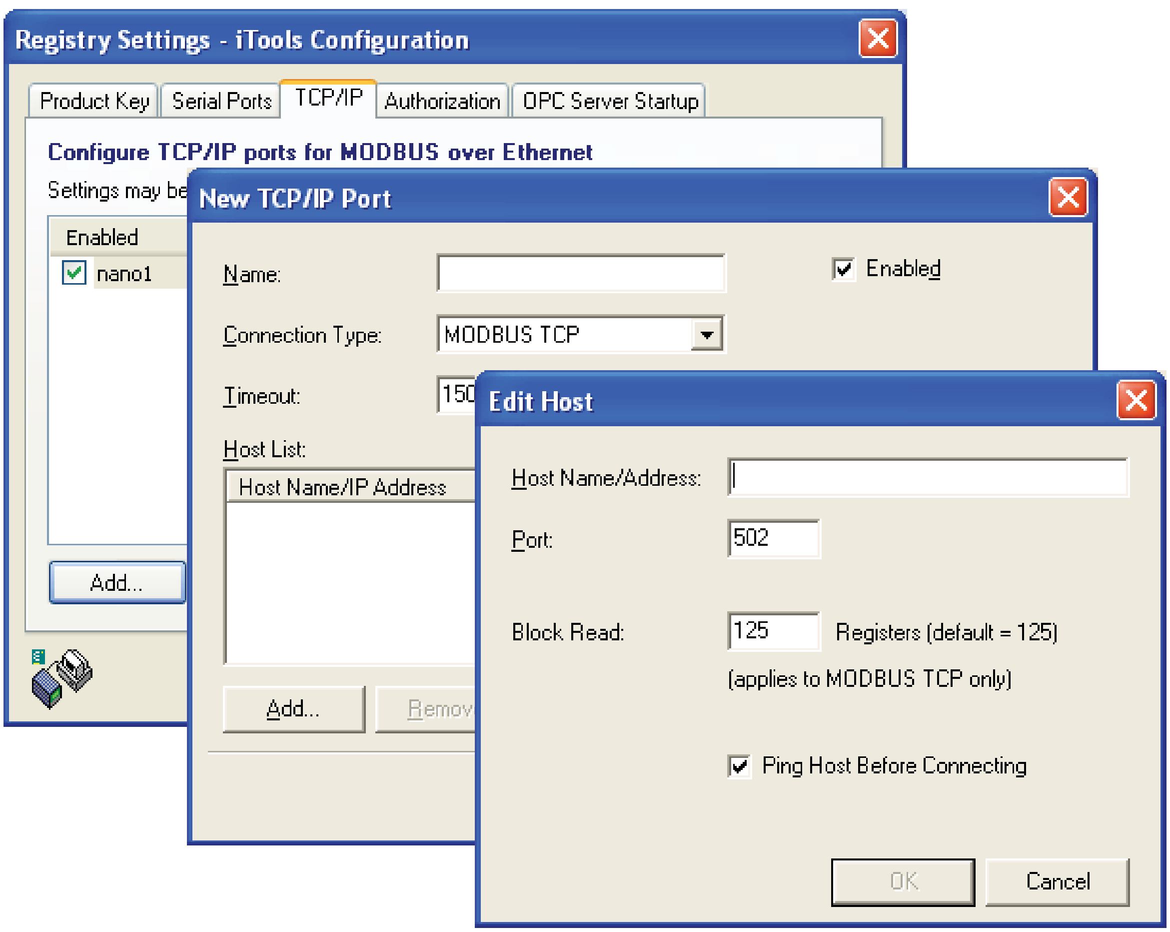


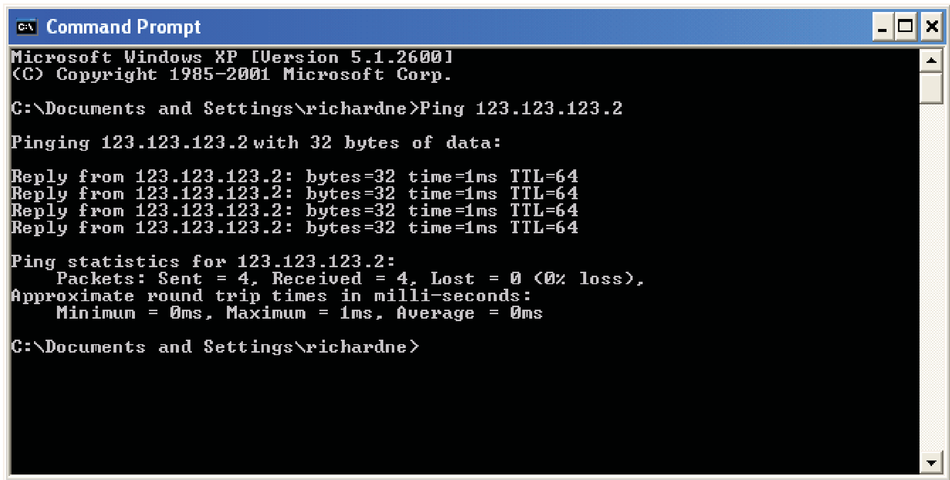
Figure 6.1.1a Adding a new Ethernet port

6.1.1 ETHERNET (TCP/IP) COMMUNICATIONS (Cont.)

To check that the pc can now communicate with the instrument, Click 'Start'. 'All Programs', 'Accessories', 'Command Prompt'

when the Command Prompt box appears, type in: Ping<Space>IP1.IP2.IP3.IP4<Enter> (where IP1 to IP4 are the IP address of the instrument).

If the Ethernet link to the instrument is operating correctly, the 'successful' reply arrives. Otherwise, the 'failed' reply arrives, in which case, the Ethernet link, IP address, and pc port details should be verified.



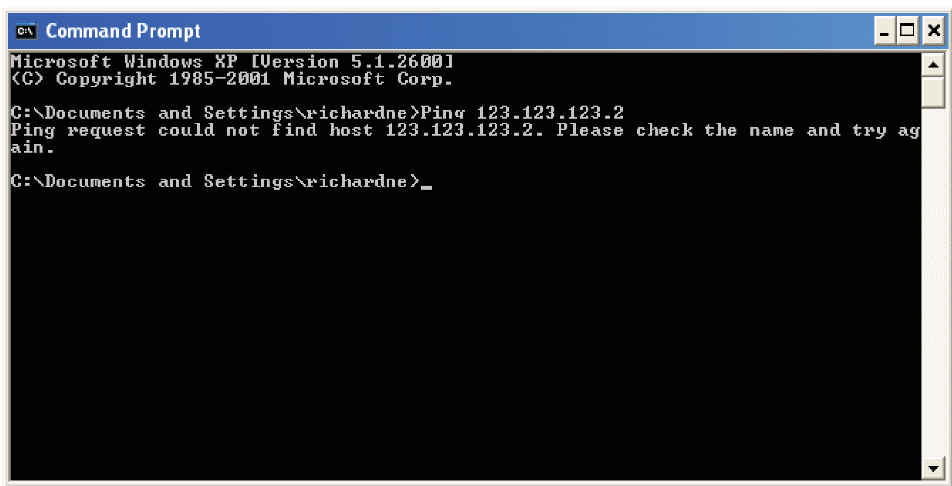
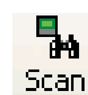


Figure 6.1.1b Command prompt 'Ping' screens (typical)

Once the Ethernet link to the instrument has been verified, iTools can be started (or shut down and restarted), and the Scan toolbar icon used, to 'find' the instrument. The scan can be stopped at any time by clicking on the Scan icon a second time.



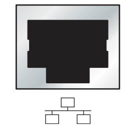
See section 6.2 for more details of the scan procedure.

6.1.2 Direct Connection

This section describes how to connect a pc directly to the instrument.

WIRING

Connection is made from the Ethernet connector at the rear of the Instrument to an Ethernet RJ45 connector, usually located at the rear of the pc. The cable can be either a 'cross-over' or 'straight through' type.



PC Ethernet connector.

Once wired correctly, and powered up, it is necessary to enter a suitable IP address and subnet mask into the Comms configuration of the Driver Module. This information can be found as follows:

1. At the pc, click 'Start'. 'All Programs', 'Accessories', 'Command Prompt'
2. When the Command Prompt box appears, type IPConfig<Enter>

   The response is a display, such as that shown below, giving the IP address and Subnet mask of the pc. Choose an address in the range covered by these two values.

   A subnet mask element of 255 means that the equivalent element of the IP address must be used unchanged. A subnet mask element of 0 means that the equivalent element of the IP address may take any value between 1 and 255 (0 is not allowed). In the example below, the range of IP addresses which may be chosen for the Driver Module is 123.123.123.2 to 123.123.123.255. (123.123.123.0 is not allowed and 123.123.123.1 is the same as the pc's address, and may therefore not be used.)

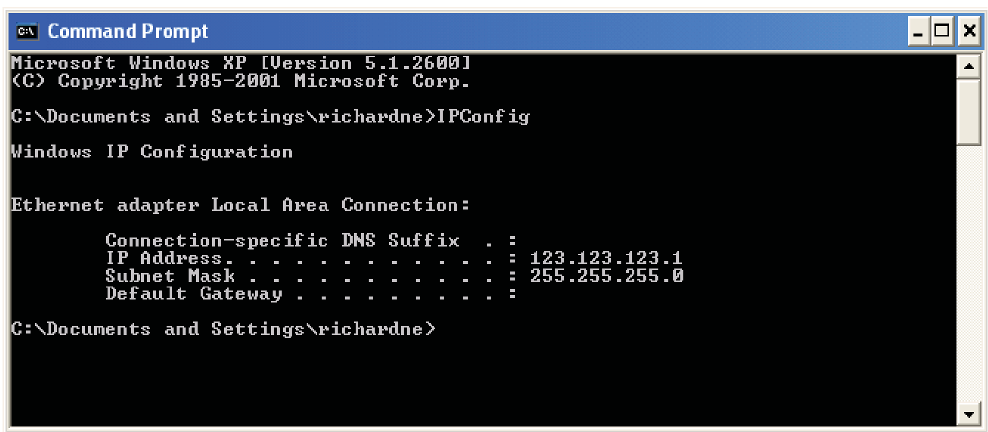


Figure 6.1.2b IP Config command

3. In Network.Interface configuration (section 4.2.1) enter the selected IP address and the subnet mask (as it appears in the command prompt window) in the relevant parts of the menu.
4. Check communications by 'pinging' as described in section 6.1.1, above.

Once the link to the instrument has been verified, iTools can be started (or shut down and re-started), and the Scan toolbar icon used, to 'find' the instrument. The scan can be stopped at any time by clicking on the Scan icon a second time.

See section 6.2 for more details of the scan procedure.

Subnet Masks and IP addresses.

Subnet Masks are most readily understood when looked at in binary format.
For example, a mask of 255.255.240.10 can be re-written as:
11111111.11111111.11110000.00001010. In such a case, IP addresses
11111111.11111111.1111xxxx.xxxx1x1x would be recognised (where x can be either a 0 or

Subnet mask	1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1	1 1 1 1 0 0 0 0	0 0 0 0 1 0 1 0
IP addresses (Binary)	1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1	1 1 1 1 x x x x	x x x x 1 x 1 x
IP addresses (decimal)	255	255	240 to 255	10, 11, 14, 15, 26, 27, 30, 31, 42, 43, 46, 47 etc.

6.2 SCANNING FOR INSTRUMENTS

Clicking on the 'Scan' toolbar icon causes a dialogue box (shown below) to appear. This allows the user to define a search range of addresses.

Notes:

1. The relevant instrument address is that entered in the Network.Modbus configuration item (section 4.2.4, and it can take any value between 1 and 254 inclusive, as long as it is unique to the comms link.
2. The default selection (Scan all device addresses...) will detect any instrument on the serial link, which has a valid address.

As the search progresses, any instruments detected by the scan appear as thumbnails (faceplates) in the 'Panel Views' area, normally located at the bottom of the iTools screen. (options/Panel Views position allows this area to be moved to the top of the window, or the Close icon can be used to close it. Once closed it can be re-opened by clicking on 'Panel Views' in the 'View' menu.)

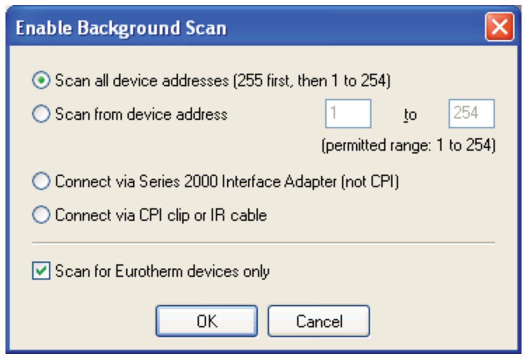


Figure 6.2a Scan range enable

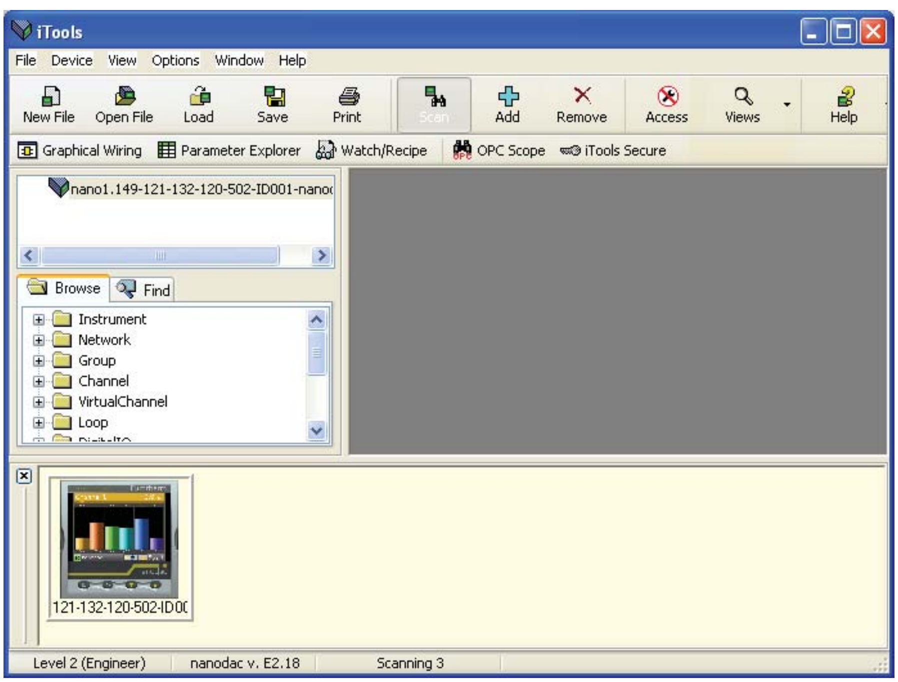


Figure 6.2b iTools initial window with one instrument detected

Once the instrument has been detected stop the scan. When the instrument has synchronised, click on the 'Access' button to enter configuration mode (a password might be required). Once the editing session is complete, click on the Access button again to quit configuration mode.

6.3 GRAPHICAL WIRING EDITOR Graphical Wiring

Clicking on the Graphical wiring Editor tool bar icon causes the Graphical wiring window for the current instrument configuration to open.

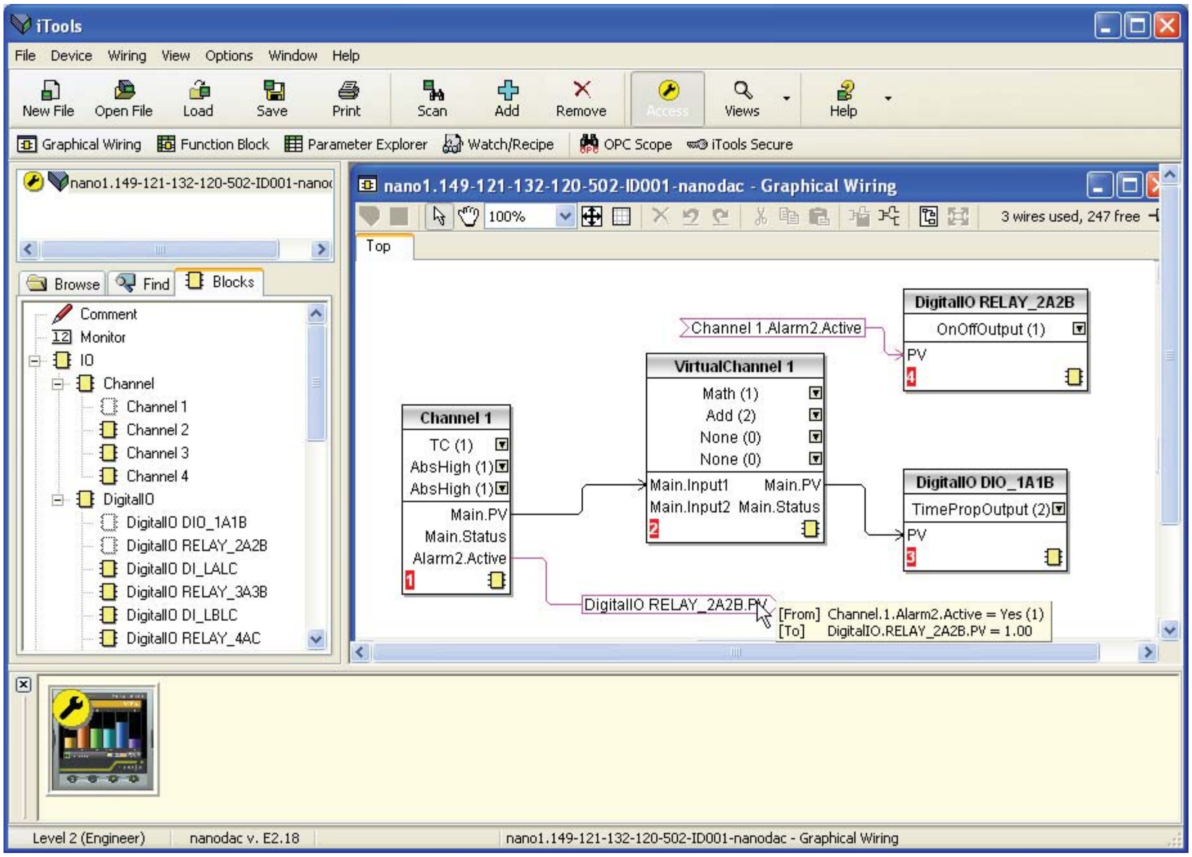


Figure 6.3 Graphical wiring Editor

The graphical wiring editor allows:

1. Function blocks, notes, comments etc. to be 'drag and dropped' into the wiring diagram from the tree list (left pane).
2. Parameters to be wired to one another by clicking on the output, the clicking on the required input.
3. Viewing and/or editing of parameter values by right-clicking on a function block and selecting 'Function Block View'.
4. The user to select parameter lists and to switch between parameter and wiring editors.
5. Completed wiring to be downloaded to the instrument (function blocks and wiring items with dashed outlines are new, or have been edited since the last download).

6.3.1 Tool bar

Download wiring to instrument

Mouse select. Select normal mouse operation. Mutually exclusive with ‘Mouse Pan’ below.

Mouse Pan. When active, this causes the mouse cursor to change to a hand-shaped icon. Allows the graphical wiring diagram to be click-dragged within the GWE window aperture.

100% Zoom. Allows the magnification factor of the wiring diagram to be selected

Pan tool. Whilst left clicked, the cursor appears as a rectangle showing which part of the wiring diagram is currently displayed. Click dragging allows the rectangle to be moved freely about the diagram. The size of the rectangle depends on the zoom setting.

Show/Hide grid. This toggles an alignment grid on and off.

Undo, redo.Allows the user to undo the last action, or, once an undo action has taken place, to undo the undo. Short cuts are <Ctrl>+<Z. for undo; <Ctrl>+<V, for undo

Cut, Copy, Paste. Normal Cut (copy and delete), Copy (copy without delete) and Paste (insert into) functions. Shortcuts are: <Ctrl> + <X> for ‘Cut’; <Ctrl> + <C> for copy and <Ctrl> + <V> for Paste.

Copy diagram fragment; Paste diagram fragment. Allows a part of the wiring diagram to be selected, named and be saved to file. The fragment may then be pasted into any wiring diagram, including the source diagram

Create compound; Flatten compound. These two icons allow compounds to be created and ‘un created’ (flattened).

6.3.2 Wiring editor operating details

COMPONENT SELECTION

Single wires are shown with boxes at ‘corners’ when selected. When more than one wire is selected, as part of a group, the wire colour changes to magenta. All other items have a dashed line drawn round them when selected.

Clicking on a single item selects it. An Item can be added to the selection by holding down the control key (ctrl) whilst clicking on the item. (A selected item can be deselected in the same way.) If a block is selected, then all its associated wires are also selected.

Alternatively, the mouse can be click-dragged on the background to create a ‘rubber band’ round the relevant area; anything within this area being selected when the mouse is released.

<Ctrl>+<A> selects all items on the active diagram.

BLOCK EXECUTION ORDER

The order in which the blocks are executed by the instrument depends on the way in which they are wired. Each block displays its place in its sequence in a coloured block in the bottom left-hand corner (figure 6.3.2a).

6.3.2 WIRING EDITOR OPERATING DETAILS (Cont.)

FUNCTION BLOCKS

A Function Block is an algorithm which may be wired to and from other function blocks to make a control strategy. Each function block has inputs and outputs. Any parameter may be wired from, but only parameters that are alterable in Operator Mode may we wired to. A function block includes any parameters that are needed to configure or operate the algorithm. The inputs and outputs which are considered to be of most use are always shown. In most cases all of these need to be wired before the block can perform a useful task.

If a function block is not faded in the tree (left hand pane) it can be dragged onto the diagram. The block can be dragged around the diagram using the mouse.

A Channel block is shown below as an example. When block type information is alterable (as in this case) click on the box with the down arrow in it to display a dialogue box allowing the value to be edited.

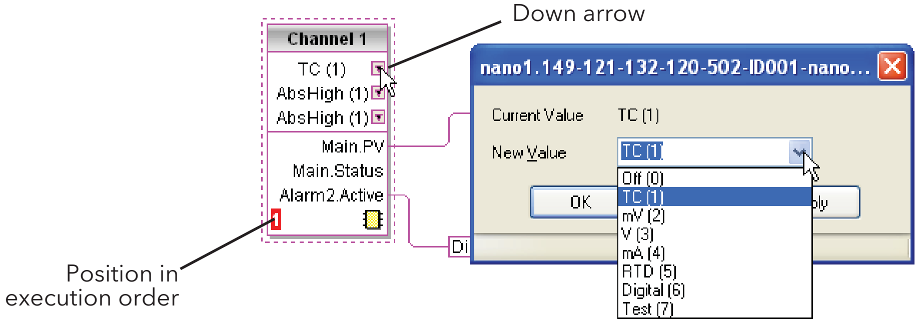
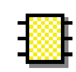


Figure 6.3.2a Function block example

If it is required to wire from a parameter, which is not shown as a recommended output, click on the 'Click to Select Output' icon in the bottom right hand corner to display a full list of parameters in the block (figure 6.3.2c, below). Click on one of these to start a wire.



FUNCTION BLOCK CONTEXT MENU

Right click in the function block to display the context menu.

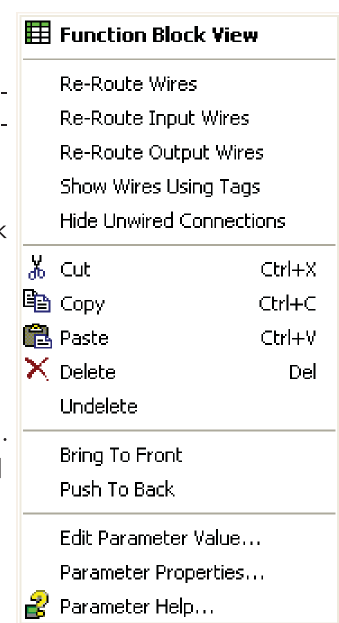


Figure 6.3.2b Function block context menu

Function block view Displays a list of parameters associated with the function block. 'Hidden' parameters can be displayed by de-selecting 'Hide Parameters and Lists when not Relevant in the options menu 'Parameter availability setting...' item

Re-Route wires Redraws all wiring associated with the function block.

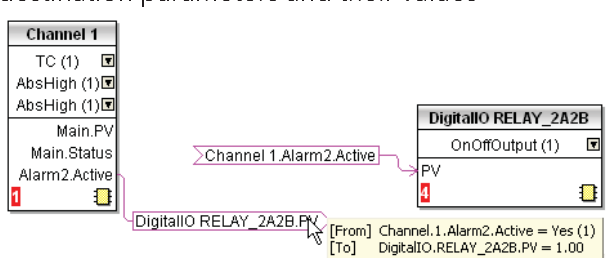
Re-route input wires Redraws all input wiring associated with the function block

Re-route output wires Redraws all output wiring associated with the function block.

Show wiring using tags

Wires are not drawn, but their start and end destinations are indicated by tags instead. Reduces wire clutter in diagrams where source and destination are widely separated.

Hovering the cursor over the tag shows both its source and destination parameters and their values



6.3.2 WIRING EDITOR OPERATING DETAILS (Cont.)

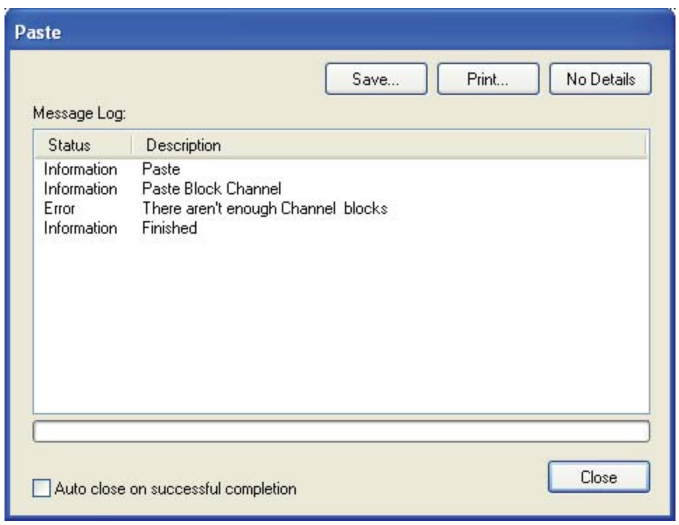
FUNCTION BLOCK CONTEXT MENU (Cont.)

Hide unwanted connections
: Causes the display to include only wired items.

Cut
: Allows one or more selected items to be moved to the Clipboard ready for pasting into another diagram or compound, or for use in a Watch window, or OPC scope. The original items are greyed out, and function blocks and wires are shown dashed until next download, after which they are removed from the diagram. Short cut = <Ctrl>+<X>. Cut operations carried out since the last download can be 'undone' by using the 'Undo' tool bar icon, by selecting 'Undelete' or by using the short cut <Ctrl>+<Z>.

Copy
: Allows one or more selected items to be copied to the Clipboard ready for pasting into another diagram or compound, or for use in a Watch window, or OPC scope. The original items remain in the current wiring diagram. Short cut = <Ctrl>+<C>. If items are pasted to the same diagram from which they were copied, the items will be replicated with different block instances. Should this result in more instances of a block than are available, an error display appears showing details of which items couldn't be copied.

Paste
: Copies items from the Clipboard to the current wiring diagram. Short cut = <Ctrl>+<V>. If items are pasted to the same diagram from which they were copied, the items will be replicated with different block instances. Should this result in more instances of a block than are available, a Paste error display appears showing details of those items which could not be copied.



Delete
: Marks all selected items for deletion. Such items are shown dashed until next download, after which they are removed from the diagram. Short cut = <Del>.

Undelete
: Reverses 'Delete' and 'Cut' operations carried out on selected item(s) since the last download.

Bring to Front
: Brings selected items to the front of the diagram.

Push to Back
: Sends the selected items to the back of the diagram.

Edit Parameter Value...
: This menu item is active if the cursor is hovering over an editable parameter. Selecting this menu item causes a pop-up window to appear, which allows the user to edit the parameter value.

Parameter Properties
: This menu item is active if the cursor is hovering over an editable parameter. Selecting this menu item causes a pop-up window to appear, which allows the user to view the parameter properties, and also, to view the parameter Help (by clicking on the 'Help' tab).

Parameter Help
: Produces Parameter Properties and Help information for the selected function block or parameter, depending on the hover position of the cursor, when the right-click occurs.

6.3.2 WIRING EDITOR OPERATING DETAILS (Cont.)

WIRES

To make a wire

1. Drag two (or more) blocks onto the diagram from the function block tree.
2. Start a wire by either clicking on a recommended output or clicking on the 'Click to Select output' icon at the bottom right corner of the block to bring up the connection dialogue, and clicking on the required parameter. Recommended connections are shown with a green plug symbol; other parameters which are available being shown in yellow. Clicking on the red button causes all parameters to be shown. To dismiss the connection dialogue either press the escape key on the keyboard, or click the cross at the bottom left of the dialogue box.
3. Once the wire has started a dashed wire is drawn from the output to the current mouse position. To complete the wire click on the required destination parameter.
4. Wires remain dashed until they are downloaded

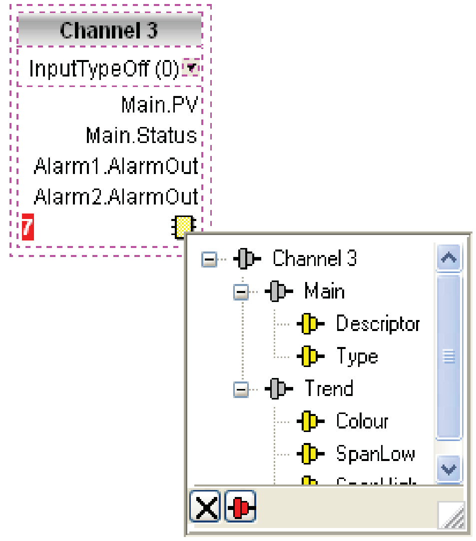


Figure 6.3.2c Output selection dialogue box.

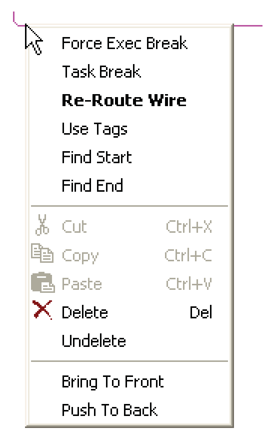
Routing wires

When a wire is placed it is auto-routed. The auto routing algorithm searches for a clear path between the two blocks. A wire can be auto-routed again using the context menus or by double clicking the wire. A wire segment can be edited manually by click-dragging. If the block to which it is connected is moved, the end of the wire moves with it, retaining as much of the path as possible.

If a wire is selected by clicking on it, it is drawn with small boxes on its corners.

Wire Context Menu

Right click on a wire to display the wire block context menu:



Force Exec Break	When wires form a loop, a break point must be introduced, where the value written to the block comes from a source which was last executed during the previous cycle. A break is automatically placed by iTools, and appears in red. Force Exec Break allows the user to define where a break must be placed. Surplus breaks appear in black.
Re-Route wire	Replaces the current wire route with a new route generated from scratch.
Use Tags	Toggles between wire and tag mode between parameters. Tag mode is useful for sources and destinations which are widely separated.
Find Start	Goes to the source of the wire.
Find End	Goes to the destination of the wire.
Cut, Copy, Paste	Not used in this context.
Delete	Marks the wire for deletion. The wire is redrawn as a dashed line (or dashed tags) until next download. Operation can be reversed until after next download.
Undelete	Reverses the effect of the Delete operation up until the next download, after which, Undelete is disabled.
Bring to Front	Brings the wire to the front of the diagram.
Push to Back	Sends the wire to the back of the diagram.

6.3.2 WIRING EDITOR OPERATING DETAILS (Cont.)

Wire Colours

Black	Normal functioning wire
Red	The wire is connected to a non-changeable parameter. Values are rejected by the destination block.
Magenta	A normal functioning wire is being hovered-over by the mouse cursor.
Purple	A red wire is being hovered-over by the mouse cursor.
Green	New Wire (dashed green wire changes to solid black after being downloaded.)

COMMENTS

Comments are added to a wiring diagram by click-dragging them from the Function Block tree onto the diagram. As soon as the mouse is released, a dialogue box opens to allow the comment text to be entered.

Carriage returns are used to control the width of the comment. Once text entry is complete, 'OK' causes the comment to appear on the diagram. There are no restrictions on the size of a comment. Comments are saved to the instrument along with the diagram layout information.

Comments can be linked to function blocks and wires by clicking on the chain icon at the bottom right-hand corner of the comment box and then clicking again on the required block or wire. A dashed line is drawn to the top of the block or to the selected wire segment (figure 6.3.2f).

> Note: Once the comment has been linked, the Chain icon disappears. It re-appears when the mouse cursor is hovered over the bottom right-hand corner of the comment box.

Comment Context Menu

Edit	Opens the Comment dialogue box to allow the comment text to be edited.
Unlink	Deletes the current link from the comment.
Cut	Moves the comment to the Clipboard, ready to be pasted elsewhere. Short cut = <Ctrl>+<X>.
Copy	Copies the comment from the wiring diagram to the Clipboard, ready to be pasted elsewhere. Short cut = <Ctrl>+<C>.
Paste	Copies a comment from the Clipboard to the wiring diagram. Short cut = <Ctrl>+<V>.
Delete	Marks the comment for deletion at next download.
Undelete	Undoes the Delete command if download has not taken place since.

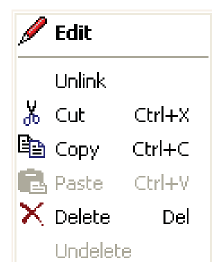


Figure 6.3.2e
Comment context menu

6.3.2 WIRING EDITOR OPERATING DETAILS (Cont.)

MONITORS

Monitor points are added to a wiring diagram by click-dragging them from the Function Block tree onto the diagram. A monitor shows the current value (updated at the iTools parameter list update rate) of the parameter to which it is linked. By default the name of the parameter is shown. To hide the parameter name either double click on the monitor box or 'Show Names' in the context (right-click) menu can be used to toggle the parameter name on and off.

Monitors are linked to function blocks and wires by clicking on the chain icon at the bottom right-hand corner of the box and then clicking again on the required parameter. A dashed line is drawn to the top of the block or the selected wire segment.

Note: Once the monitor has been linked, the Chain icon disappears. It re-appears when the mouse cursor is hovered over the bottom right-hand corner of the monitor box.

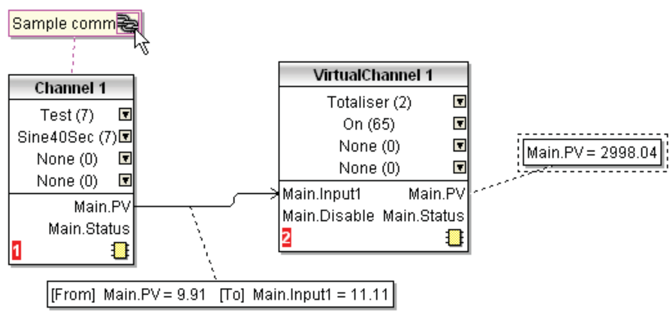


Figure 6.3.2f Comment and Monitor appearance

Monitor Context Menu

Show names	Toggles parameter names on and off in the monitor box.
Unlink	Deletes the current link from the monitor.
Cut	Moves the monitor to the Clipboard, ready to be pasted elsewhere. Short cut = <Ctrl>+<X>.
Copy	Copies the monitor from the wiring diagram to the Clipboard, ready to be pasted elsewhere. Short cut = <Ctrl>+<C>.
Paste	Copies a monitor from the Clipboard to the wiring diagram. Short cut = <Ctrl>+<V>.
Delete	Marks the monitor for deletion at next download.
Undelete	Undoes the Delete command if download has not taken place since.
Bring to Front	Moves the item to the 'top' layer of the diagram.
Push to Back	Moves the item to the 'bottom' layer of the diagram.
Parameter Help	Shows parameter help for the item.

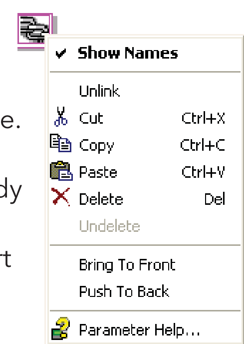


Figure 6.3.2g
Monitor context menu

DOWNLOADING

When the wiring editor is opened the current wiring and diagram layout is read from the instrument. No changes are made to the instrument function block execution or wiring until the download button is pressed. Any changes made using the operator interface after the editor is opened are lost on download.

When a block is dropped onto the diagram, instrument parameters are changed to make the parameters for that block available. If changes are made and the editor is closed without saving them there is a delay while the editor clears these parameters.

During download, the wiring is written to the instrument which then calculates the block execution order and starts executing the blocks. The diagram layout including comments and monitors is then written into instrument flash memory along with the current editor settings. When the editor is reopened, the diagram is shown positioned as it was when it was last downloaded.

6.3.2 WIRING EDITOR OPERATING DETAILS (Cont.)

COLOURS

Items on the diagram are coloured as follows:

Red	Items which totally or partially obscure other items and items which are totally or partially obscured by other items. Wires that are connected to unalterable or non-available parameters. Execution breaks.
Blue	Non-available parameters in function blocks.
Green	Items added to the diagram since last download are shown as green dashed lines.
Magenta	All selected items, or any item over which the cursor is hovering.
Purple	Red wires when being hovered over by the mouse cursor.
Black	All items added to the diagram before the last download. Redundant execution breaks. Monitor and comment text.

DIAGRAM CONTEXT MENU

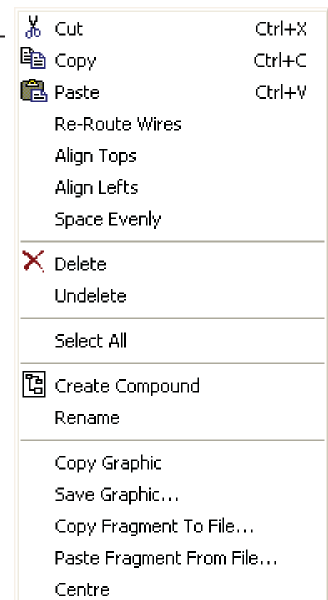


Figure 6.3.2h
Diagram context menu

Cut	Active only when the right click occurs within the bounding rectangle which appears when more than one item is selected. Moves the selection off the diagram to the Clipboard. Short cut = <Ctrl>+<X>.
Copy	As for 'Cut', but the selection is copied, leaving the original on the diagram. Short cut = <Ctrl>+<C>.
Paste	Copies the contents of the Clipboard to the diagram. Short cut = <Ctrl>+<V>.
Re-Route wires	Reroutes all selected wires. If no wires are selected, all wires are re-routed.
Align Tops	Aligns the tops of all blocks in the selected area.
Align Lefts	Aligns the left edges of all blocks in the selected area.
Space Evenly	Spaces selected items such that their top left corners are spaced evenly across the width of the diagram. Click on the item which is to be the left-most item, then <Ctrl>+<left click> the remaining items in the order in which they are to appear.
Delete	Marks the item for deletion at next download time. Can be 'Undeleted' up until download occurs.
Undelete	Reverses the action of 'Delete' on the selected item.
Select All	Selects all items on the current diagram.
Create Compound	Active only when the right click occurs, in the top level diagram, within the bounding rectangle which appears when more than one item is selected. Creates a new wiring diagram as described in 'Compound', below.
Rename	Allows a new name to entered for the current wiring diagram. This name appears in the relevant tab.
Copy Graphic	Copies the selected items (or the whole diagram if no items are selected) to the clipboard as a Windows metafile, suitable for pasting into a documentation application. Wiring entering/leaving the selection (if any) are drawn in tag mode.
Save Graphic...	As for 'Copy Graphic' above, but saves to a user-specified file location instead of the clipboard.
Copy Fragment To File...	Copies selected items to a user-named file in folder 'My iTools Wiring Fragments' located in 'My Documents'.
Paste Fragment From File	Allows the user to select a stored fragment for inclusion in the wiring diagram.
Centre	Places the display window at the centre of the selected items. If 'Select All' has previously been clicked-on, then the display widow is placed over the centre of the diagram.

6.3.2 WIRING EDITOR OPERATING DETAILS (Cont.)

COMPOUNDS

Compounds are used to simplify the top level wiring diagram, by allowing the placing of any number of function blocks within one 'box', the inputs and outputs of which operate in the same way as those of a normal function block.

Each time a compound is created, a new tab appears at the top of the wiring diagram. Initially compounds and their tabs are named 'Compound 1', 'Compound 2', etc. but they can be renamed by right clicking either on the compound in the top level diagram, or anywhere within an open Compound, selecting 'Rename' and typing in the required text string (16 characters max.).

Compounds cannot contain other compounds (i.e. they can be created only in the top level diagram).

Compound creation

1. Empty compounds are created within the top level diagram by clicking on the 'Create Compound' tool bar icon.
2. Compounds can also be created by highlighting one or more function blocks in the top level diagram and then clicking on the 'Create Compound' tool bar icon. The highlighted items are moved from the top level diagram into a new compound.

3. Compounds are 'uncreated' (flattened), by highlighting the relevant item in the top level menu and then clicking on the 'Flatten Compound' tool bar icon. All the items previously contained within the compound appear on the top level diagram.
4. Wiring between top level and compound parameters is carried out by clicking on the source parameter, then clicking on the compound (or the compound tab) and then clicking on the destination parameter. Wiring from a compound parameter to a top level parameter or from compound to compound is carried out in similar manner.
5. Unused function blocks can be moved into compounds by dragging from the tree view. Existing blocks can be dragged from the top level diagram, or from another compound, onto the tab associated with the destination compound. Blocks are moved out of compounds to the top level diagram or to another compound in a similar way. Function blocks can also be 'cut and pasted'.
6. Default compound names (e.g. 'Compound 2') are used only once, so that if, for example, Compounds 1 and 2 have been created, and Compound 2 is subsequently deleted, then the next compound to be created will be named 'Compound 3'.
7. Top level elements can be click-dragged into compounds.

TOOL TIPS

Hovering the cursor over the block displays 'tooltips' describing that part of the block beneath the cursor. For function block parameters the tooltip shows the parameter description, its OPC name, and, if downloaded, its value. Similar tooltips are shown when hovering over inputs, outputs and over many other items on the iTools screen.

A Function Block is enabled by dragging the block onto the diagram, wiring it, and finally downloading it to the instrument. Initially blocks and associated wires are drawn with dashed lines, and when in this state the parameter list for the block is enabled but the block is not executed by the instrument.

The block is added to the instrument function block execution list when the 'Download' icon is operated and the items are redrawn using solid lines.

If a block which has been downloaded is deleted, it is shown on the diagram in a ghosted form until the download button is pressed. (This is because it and any wires to/from it are still being executed in the instrument. On download it will be removed from the instrument execution list and the diagram.) A ghosted block can be 'undeleted' as described in 'Context menu', above.

When a dashed block is deleted it is removed immediately.

6.4 PARAMETER EXPLORER

This view can be displayed:

1. by clicking on the 'Parameter Explorer' toolbar icon,
2. by double clicking on the relevant block in the tree pane or in the graphical wiring editor
3. by selecting 'Function Block View' from the Function block context menu in the Graphical wiring Editor.
4. by selecting 'parameter Explorer from the 'View' menu
5. by using the short cut <Alt>+<Enter>

In each case the function block parameters appear in the iTools window in tabular form, such as the example in figure 6.4a, below.

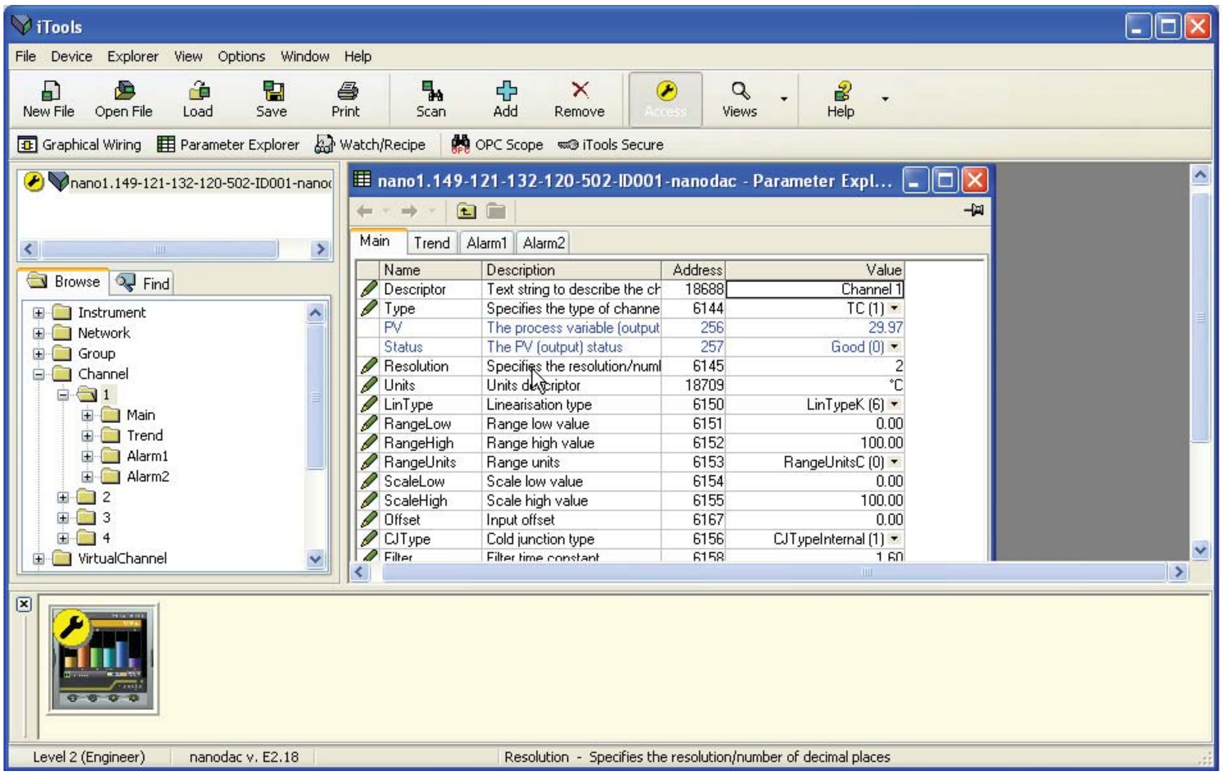


Figure 6.4a Parameter table example

The figure above shows the default table layout. Columns can be added/deleted from the view using the 'Columns' item of the Explorer or context menus (figure 6.4b).

6.4 PARAMETER EXPLORER (Cont.)

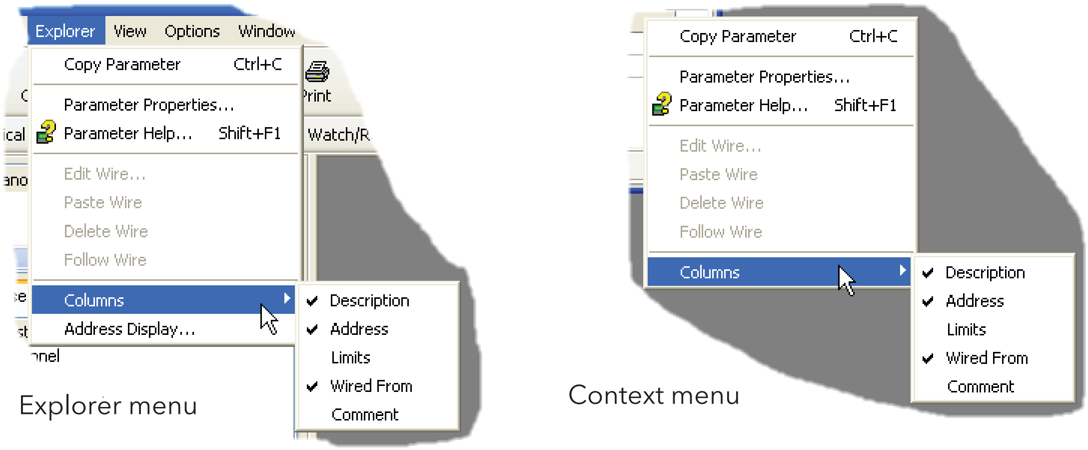
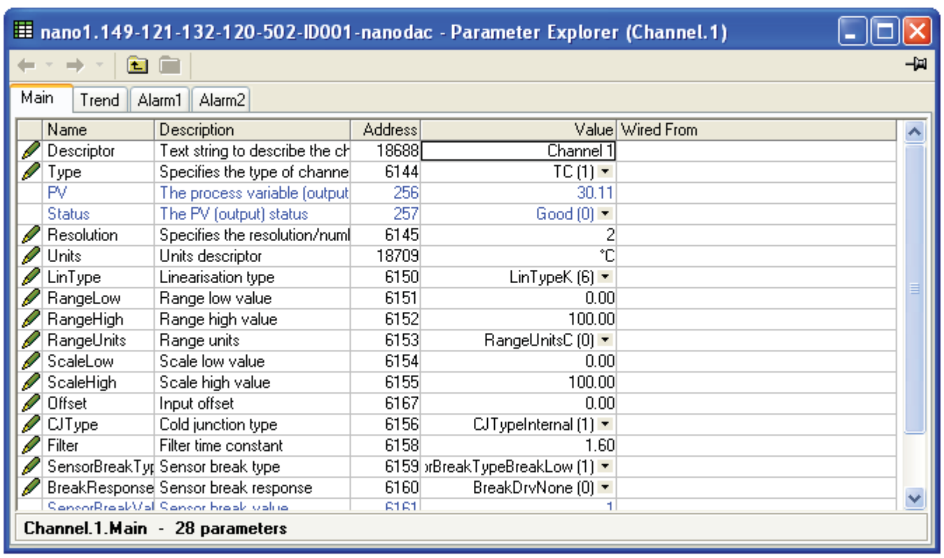


Figure 6.4b Column enable/disable

6.4.1 Parameter explorer detail

Figure 6.4.1a shows a typical parameter table. This particular parameter has a number of subfolders associated with it, and each of these is represented by a 'tab' across the top of the table.



Name	Description	Address	Value	Wired From
Descriptor	Text string to describe the ch	18688	Channel 1	
Type	Specifies the type of channe	6144	TC (1)	
PV	The process variable (output	256	30.11	
Status	The PV (output) status	257	Good (0)	
Resolution	Specifies the resolution/numl	6145	2	
Units	Units descriptor	18709	°C	
LinType	Linearisation type	6150	LinTypeK (6)	
RangeLow	Range low value	6151	0.00	
RangeHigh	Range high value	6152	100.00	
RangeUnits	Range units	6153	RangeUnitsC (0)	
ScaleLow	Scale low value	6154	0.00	
ScaleHigh	Scale high value	6155	100.00	
Offset	Input offset	6167	0.00	
CJType	Cold junction type	6156	CJTypeInternal (1)	
Filter	Filter time constant	6158	1.60	
SensorBreakTyp	Sensor break type	6159	›rBreakTypeBreakLow (1)	
BreakResponse	Sensor break response	6160	BreakDrvNone (0)	
SensorBreakVal	Sensor break value	6161	1	

Channel.1.Main - 28 parameters

Figure 6.4.1a Typical parameter table

Notes:

1. Parameters in blue are non-editable (Read only). In the example above all the parameters are read only. Read/write parameters are in black and have a 'pencil' symbol in the 'read/Write access column at the left edge of the table. A number of such items are shown in figure 6.4.1a, above.
2. Columns. The default explorer window (figure 6.4a) contains the columns 'Name', 'Description', 'Address', 'Value', and 'Wired From'. As can be seen from figure 6.4b, the columns to be displayed can be selected, to a certain extent, using either the 'Explorer' menu or the context menu. 'Limits' have been enabled for the example above.
3. Hidden Parameters. By default, iTools hides parameters which are considered irrelevant in the current context. Such hidden parameters can be shown in the table using the 'Parameter availability' settings item of the options menu (figure 6.4.1b). Such items are displayed with a shaded background.
4. The full pathname for the displayed parameter list is shown at the bottom left hand corner of the window.

6.4.1 PARAMETER EXPLORER DETAIL (Cont.)

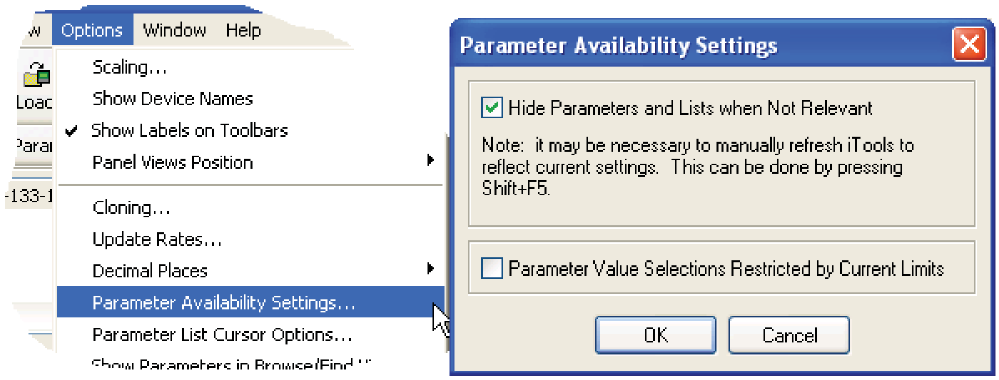


Figure 6.4.1b Show/Hide parameters

6.4.2 Explorer tools

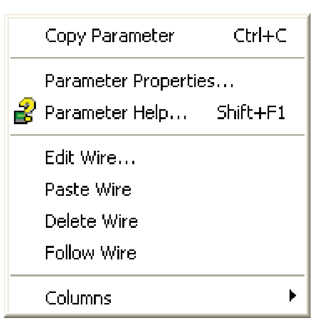
A number of tool icons appear above the parameter list:

Back to: and Forward to:. The parameter explorer contains a history buffer of up to 10 lists that have been browsed in the current instance of the window. The ‘Back to: (list name)’ and ‘Forward to: (list name)’ icons allow easy retracing or repeating of the parameter list view sequence.
If the mouse cursor is hovered over the tool icon, the name of the parameter list which will appear if the icon is clicked-on appears. Clicking on the arrow head displays a pick list of up to 10 previously visited lists which the user can select. Short cut = <Ctrl>+<B> for ‘Back to’ or <Ctrl>+<F> for ‘Forward to’.

Go Up a Level, Go Down a Level. For nested parameters, these buttons allow the user to navigate ‘vertically’ between levels. Short cut = <Ctrl>+<U> for ‘Go Up a Level’ or <Ctrl>+<D> for ‘Go Down a Level’.

Push pin to give the window global scope. Clicking on this icon causes the current parameter list to be permanently displayed, even if another instrument becomes the ‘current device’.

6.4.3 Context Menu



Copy Parameter Copies the clicked-on parameter to the clipboard
Parameter properties
Displays parameter properties for the clicked-on parameter
Parameter Help... Displays help information for the clicked-on parameter
Edit/Paste/Delete/Follow Wire
Not used in this application
Columns Allows the user to enable/disable a number of parameter table columns (figure 6.1.4b).

6.5 WATCH/RECIPE EDITOR

The watch/recipe editor is opened by clicking on the Watch/Recipe tool icon, by selecting ‘Watch/Recipe’ in the ‘Views’ menu or by using the short cut <Ctrl>+<A>. The window is in two parts: the left part containing the watch list; the right-hand part containing one or more data sets, initially empty and unnamed.

The Watch/Recipe window is used:

1. To monitor a list of parameters. This list can contain parameters from many different, and otherwise unrelated parameter lists within the same device. It cannot contain parameters from different devices.
2. To create ‘data sets’ of parameter values which can be selected and downloaded to the device in the sequence defined in the recipe. The same parameter may be used more than once in a recipe.

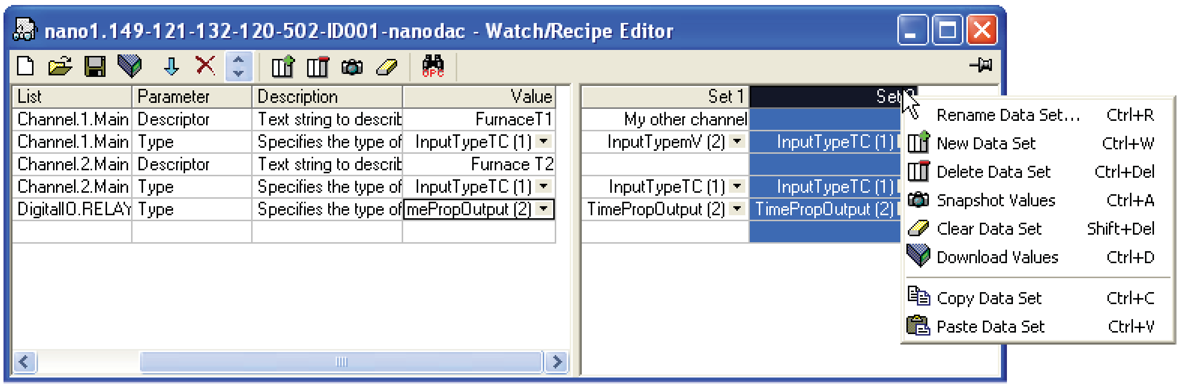


Figure 6.5 Watch/Recipe Editor window (with context menu)

6.5.1 Creating a Watch List

After opening the window, parameters can be added to it as described below. The values of the parameters update in real-time, allowing the user to monitor a number of values simultaneously.

ADDING PARAMETERS TO THE WATCH LIST

1. Parameters can be click-dragged into the watch list from another area of the iTools window (for example, the parameter explorer window, the graphical wiring editor, the browse tree). The parameter is placed either in an empty row at the bottom of the list, or if it is dragged on top of an already existing parameter, it is inserted above this parameter, with the remaining parameters being moved down one place.
2. Parameters can be dragged from one position in the list to another. In such a case, a copy of the parameter is produced, the source parameter remaining in its original position.
3. Parameters can be copied <Ctrl>+<C> and pasted <Ctrl>+<V> either within the list, or from a source external to it, for example the parameter browse window or the graphical wiring editor.
4. The ‘Insert item...’ tool button the ‘Insert Parameter’ item in the Recipe or context menu or the short cut <Insert> can be used to open a browse window from which a parameter is selected for insertion above the currently selected parameter.

DATA SET CREATION

Once all the required parameters have been added to the list, select the empty data set by clicking on the column header. Fill the data set with current values using one of the following methods:

1. Clicking on the ‘Capture current values into a data set’ tool icon (also known as the ‘Snapshot Values’ tool).
2. Selecting ‘Snapshot Values’ from the Recipe or Context (right-click) menu.
3. Using the short cut <Ctrl>+<A>.

6.5.1 CREATING A WATCH LIST (Cont.)

DATA SET CREATION (Cont.)

Individual data values can now be edited by typing directly into the grid cells. Data values can be left blank or cleared, in which case, no values will be written for those parameters at download. Data values are cleared by deleting all the characters in the cell then either moving to a different cell or typing <Enter>.

The set is called 'Set 1' by default, but it can be renamed by either by using the 'Rename data set...' item in the Recipe or context menus, or by using the short cut <Ctrl>+<R>.

New, empty data sets can be added using one of the following:

1. Clicking on the 'Create a new empty data set' toolbar icon.
2. Selecting 'New Data Set' in the Recipe or context menus
3. Using the short cut <Ctrl>+<W>

Once created, the data sets are edited as described above.

Finally, once all the required data sets have been created, edited and saved, they can be downloaded the instrument, one at a time, using the Download tool, the 'Download Values' item in the Recipe or context menus, or the short cut <Ctrl>+<D>.

6.5.2 Watch Recipe toolbar icons


Create a new watch/recipe list. Creates a new list by clearing out all parameters and data sets from an open window. If the current list has not been saved, confirmation is requested. Short cut <ctrl>+<N>


Open an existing watch/recipe file. If the current list or data set has not been saved, confirmation is requested. A file dialogue box then opens allowing the user to select a file to be opened. Short cut <ctrl>+<O>


Save the current watch/recipe list. Allows the current set to be saved to a user specified location. Short cut <ctrl>+<S>.


Download the selected data set to the device. Short cut <ctrl>+<D>


Insert item ahead of selected item. Short cut <Insert>.


Remove recipe parameter. Short cut <ctrl>+<Delete>.


Move selected item. Up arrow moves selected parameter up the list; down arrow move the selected parameter down the list.


Create a new empty data set. Short cut <ctrl>+<w>.


Delete an empty data set. Short cut <ctrl>+<Delete>


Capture current values into a data set. Fills the selected data set with values. Short cut <ctrl>+<A>.


Clear the selected data set. Removes values from the selected data set. Short cut <Shift>+<Delete>.


Open OPC Scope. Opens a separate utility that allows trending, data logging and Dynamic Data Exchange (DDE). OPC Scope is an OPC explorer program that can connect to any OPC server that is in the windows registry.
(OPC is an acronym for 'OLE for Process Control, where OLE stands for 'Object Linking and Embedding'.)

6.5.3 Watch/Recipe Context Menu

The Watch/Recipe Context menu items have the same functions as described above for toolbar items.

6.6 PROGRAMMER OPTION 

Clicking on the Programmer tool bar icon opens the programmer configuration window, displaying the program currently loaded in the instrument, in Segment Parameter view. If no program is loaded, the programmer display opens with just one segment, defined as an 'End' Segment.

Figure 6.6 shows a simple program for example purposes. Parameters are defined in section 3.4.9 and section 4.8.

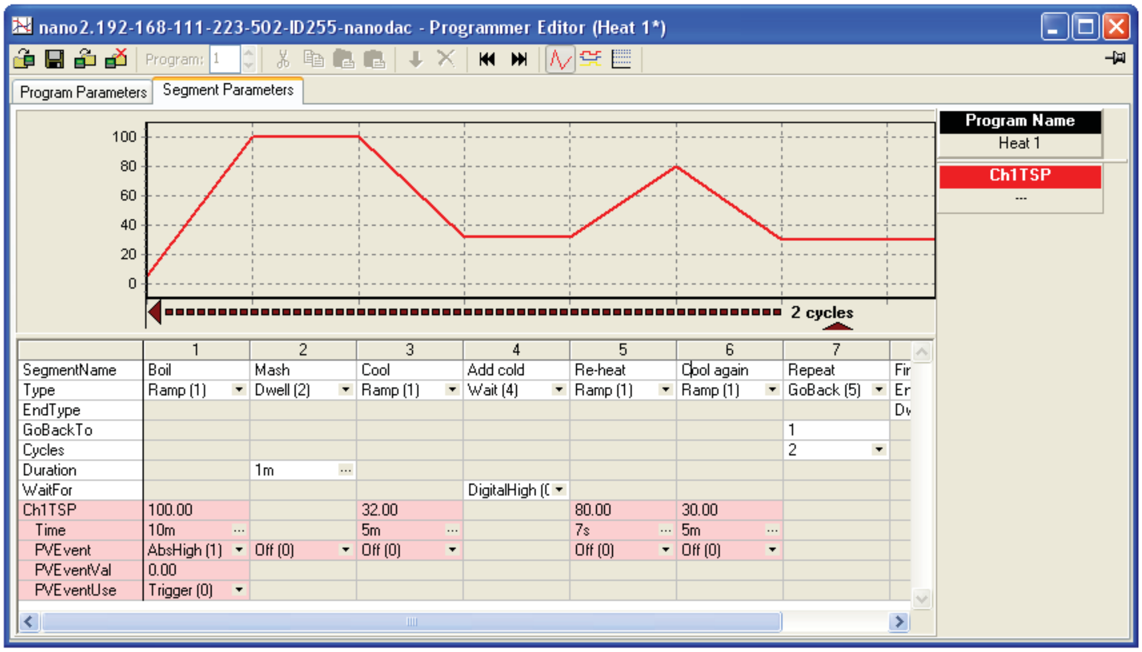


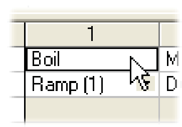
Figure 6.6 Programmer display

As can be seen from the example, the segments appear below a graphical representation of the program.

6.6.1 Segment parameter editing

SEGMENT NAME

To edit the segment name, click in the segment name field (as shown), and type in the required text, of up to 20 characters. Alternatively, double click on the existing name and edit it as desired.

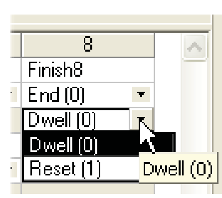


SEGMENT TYPE

Clicking on the down arrow symbol to the right of the existing segment type field, produces a pick list from which a segment type can be selected. The type of segment selected defines which configuration fields appear for that segment.

END TYPE

Allows the selection of 'Dwell' or 'Reset' as the action to be taken by the End segment.



6.6.1 SEGMENT EDITING (Cont.)

GO BACK TO

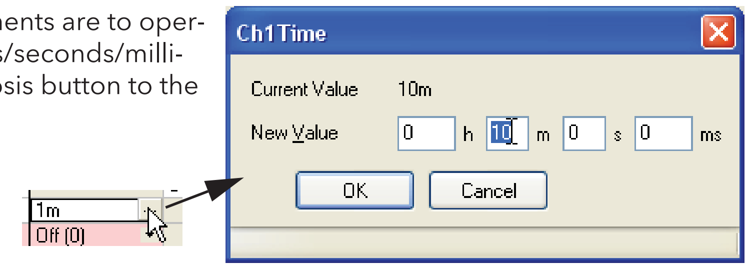
For GoBack segments only, this allows the user to enter a segment number for the program to return to.

CYCLES

For GoBack segments only, this allows the number of times the program returns to the 'Go Back To' segment, before continuing.

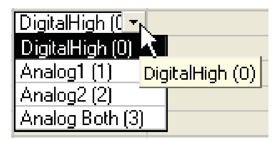
DURATION

Sets the amount of time for which Dwell segments are to operate. Times are entered using a hours/minutes/seconds/milliseconds display which appears when the ellipsis button to the right of the duration field is clicked on.



WAIT FOR

Select an analogue or digital input as the wait criterion. For single channel programs only one analogue input is available; for two-channel programmers one digital and two analoge inputs are available, as shown.



CH1 (2) TSP

The channel 1 (2) target setpoint, editable by the user in a similar way as that used for segment name editing, described above. Ch2 TSP appears only for two channel programmers.

TIME

For programs where 'Ramp Style' = 'Time', this allows the user to enter time periods for ramp segments, in a similar way, as described for 'Duration', above. For two channel programmers, two times can be entered, and if the two times are different, the channel with the shorter time waits at its setpoint value until the other channel's time has elapsed.

RATE

For programs where 'Ramp Style' = 'Rate', this allows the user to eneter a rate value for Ramp segments. This value is entered in the same way as that used for segment name editing, described above. For two channel programmers, two rates can be entered.

OTHER PARAMETERS

Holdback, PV Event etc. parameters may or may not appear depending on the programmer features enabled, and they are all edited in the ways described above.

6.6.2 Digital Event display

Clicking on the 'Digital Events Output' tool bar icon produces a segment display, allowing the user to select the events on or off as required, for each segment. Figure 6.6.2 shows a programmer where the number of events is four.

The number of events which appear (maximum eight) is configured in the Programmer Setup menu as described in section 4.8.3

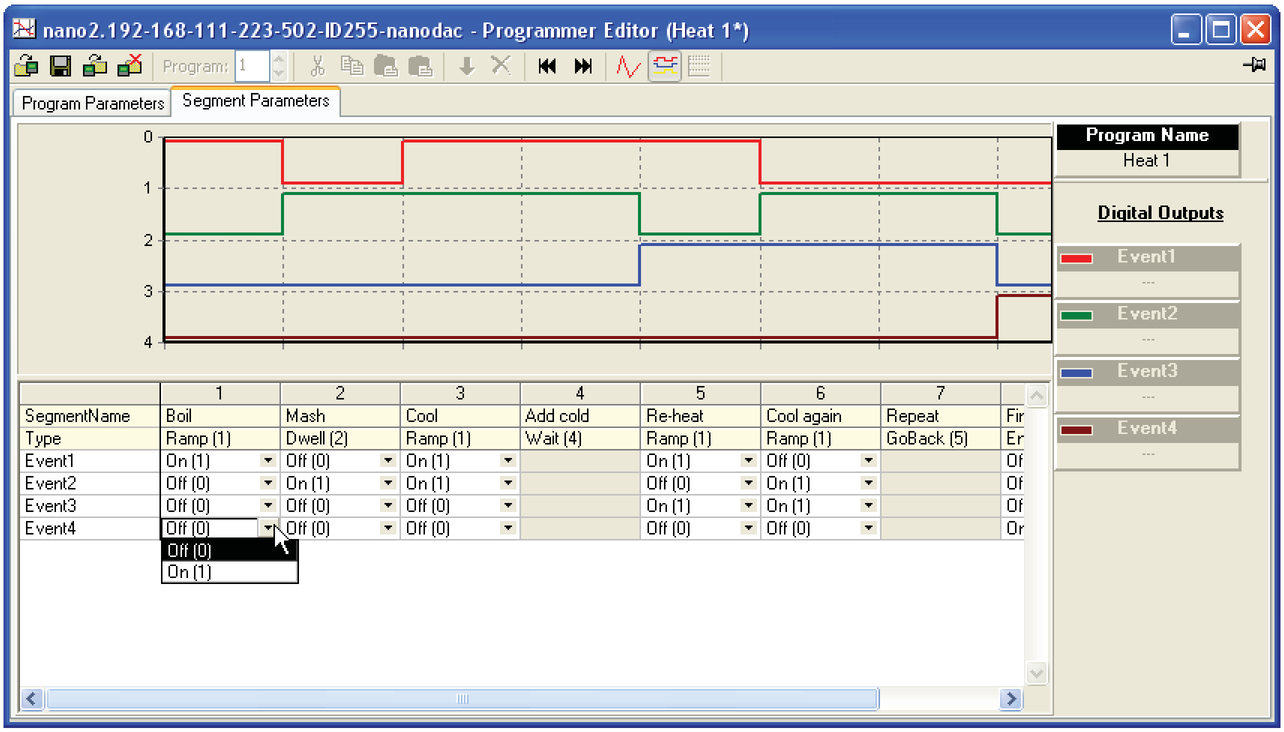


Figure 6.6.2 Event on/off configuration

6.6.3 Program parameters

The number of parameters which appear in this display depends on which program features are enabled. Figure 6.6.3 shows a basic set of parameters which allows the user to select Rate or Time as the Ramp style, and to select a value for Rate units.

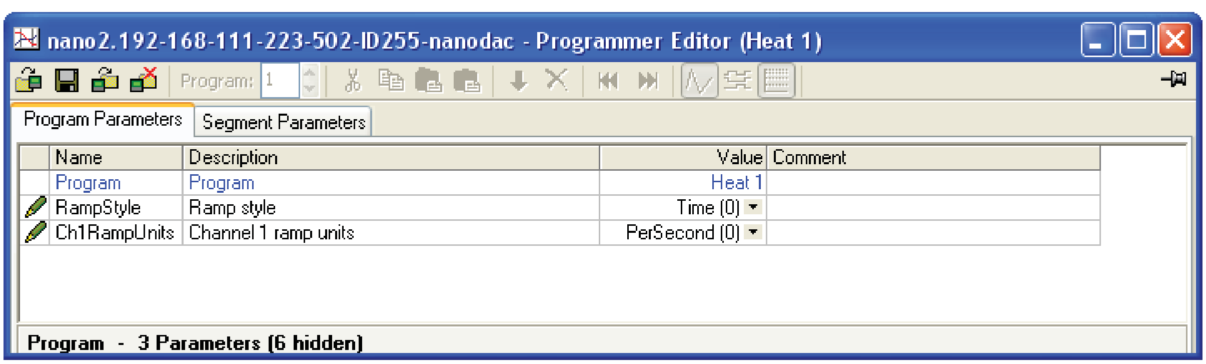


Figure 6.6.3 Program parameter display

6.6.4 Adding and deleting segments.

INSERT SEGMENT

As shown in figure 6.6.4, to insert a segment, click in the segment number field of the segment to the right of where the new segment is to be located. This causes the whole segment to highlight. Click on the blue down arrow tool icon to insert the new segment. The new segment name is the segment number, and the segment configuration is that of the segment to the right, unless that segment is a dwell or End segment, in which case the new segment is a ramp segment.

To insert more than one segment, operate the shift key whilst clicking on the range of contiguous segments to be copied.

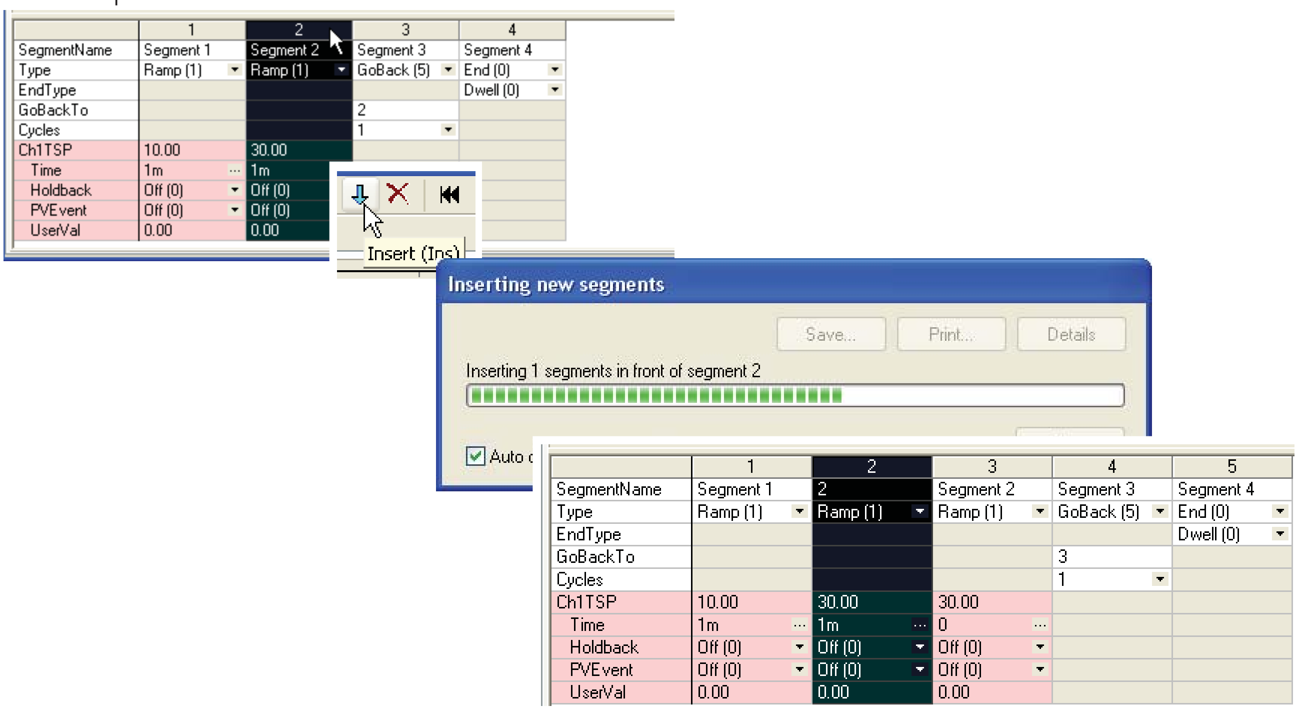


Figure 6.6.4 Insert a segment

Alternatively the mouse can be right-clicked anywhere in a segment, and the 'Insert segment' item selected, or one or more segment can be highlighted and the 'Insert' key on the pc keyboard used to initiate the process. See section 6.6.7 for more details of the right-click (context) menu.

CUTTING, COPYING AND PASTING SEGMENTS 

The process of highlighting one or more segments causes the cut and copy toolbar icons to become active.

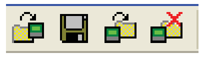
The cut tool removes the highlighted segments from the program and stores them on the pasteboard ready for re-use.

The copy tool copies the selected segment(s) to the paste board, leaving the original segment(s) in place.

Once one or more segments have been cut or copied, the 'Paste insert' and 'Paste over' icons become active allowing the user to paste the contents of the pasteboard in front of a selected segment (Paste insert), or to overwrite the existing highlighted segment(s) (Paste over). When using the Paste over tool, the number of segments being pasted over must match the number of segments on the paste board.

DELETING SEGMENTS

Once one or more segments have been highlighted, the highlighted segments can be removed using the Delete toolbar icon, by using the Delete Segment item in the right-click (context) menu, or by operating the pc keyboard 'Ctrl' and Delete' keys simultaneously.

6.6.5 Loading and Saving programs 

The four program operation keys at the top left of the programmer window allow the user to load a program from or save a program to either the currently connected instrument or to a pc.

The fourth icon allows the user to select a program to be deleted from the connected instrument.

See section 6.6.6 for more details.

6.6.6 Toolbar icons

The toolbar icons appearing at the top of the programmer window have the following properties:

- Load Program. Opens a browser window allowing the user to select a program on the pc, or a program stored in the connected instrument to load. Short cut: <Ctrl> + <L>.
- Save current program to file. Opens a browser window allowing the user to select a location on the pc in which to save the current program. This file is saved with a '.upiz' extension and can be saved to a USB memory stick for downloading to an instrument, or it can be transferred to the instrument via an ftp server. Short cut: <Ctrl> + <S>.
- Store current program on device. Allows the user to save the program to the program store on the instrument. Short cut: <Shift key> + <Ctrl> + <S>.
- Delete Programs from Device. Allows the user to delete programs from the program store on the connected instrument. Short cut: <Ctrl> + <F>.
- Cut. Removes the highlighted segment(s) from the program and places them on the pasteboard. Short cut: <Ctrl> + <X>.
- Copy. Copies the selected segment(s) to the pasteboard, leaving the original segments in place. Short cut: <Ctrl> + <C>.
- Paste insert. Inserts the segments on the pasteboard into a location to the left of the highlighted segment. Short cut: <Ctrl> + <V>.
- Paste over. Overwrites the highlighted segment(s) with the segment(s) on the pasteboard. The number of segments on the pasteboard must match the number of segments being overwritten. Short cut: <Shift key> + <Ctrl> + <V>.
- Insert. Inserts a new segment to the left of the highlighted segment. If more than one segment is highlighted, then the same number of segments are inserted as are highlighted. Copies the segment type of the segment to the right of the insertion point except if that segment is an 'End' or 'GoBack' segment, when newly inserted segments are of type 'Ramp'. Short cut: <Insert>.
- Delete. Deletes the highlighted segment(s). Short cut: <Ctrl> + <Delete>.
- Go to first. Moves the user to the first segment. Useful in very long programs. Short cut: <Ctrl> + <Left arrow>.
- Go to last. Moves the user to the end segment. Useful in very long programs. Short cut: <Ctrl> + <Right arrow>.
- Analog. Selects the analogue trace chart for display and segment configuration. Short cut: <Ctrl> + <G>.
- Digital Event Outputs. Selects the Event output chart for display and configuration.Short cut: <Ctrl> + <D>.
- Logarithmic. Switches the vertical scale to logarithmic. Short cut: <Ctrl> + <M> (figure 6.6.6)

6.6.6 TOOLBAR ICONS (Cont.)

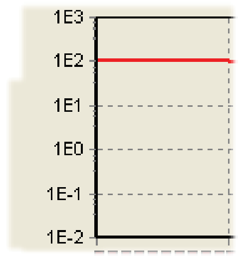
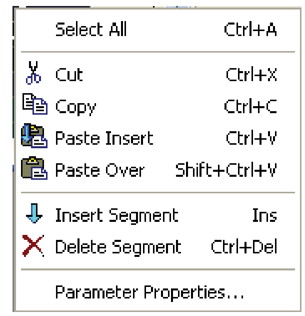


Figure 6.6.6 Logarithmic scale example

6.6.7 Context menus

SEGMENT CONTEXT MENU

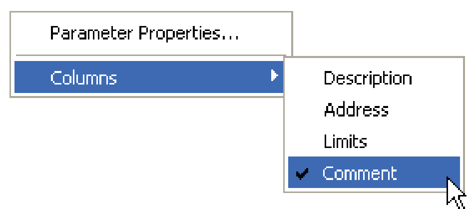
Right-clicking when the mouse cursor is hovering over a segment in the analogue segment parameters view produces the segment context menu shown. The various items copy the relevant tool bar icons described above, with the following additions:



Select All	Selects all parameters
Parameter properties	Displays the properties window for the parameter right-clicked on, including a 'Help' tag for that parameter.

PROGRAM CONTEXT MENU

Right-clicking when the mouse cursor is hovering in the program parameters view produces the program context menu shown.



Parameter properties	Displays the properties window for the parameter right-clicked on, including a 'Help' tag for that parameter.
Columns	Allows the user to enable/disable columns in the program parameters display.

CHART CONTEXT MENU

Right-clicking when the mouse cursor is hovering over the analogue chart or the digital event chart produces the segment context menu shown. This allows the user to copy the chart to the pasteboard, from where it can be pasted into (for example) a standard word procesing document.

6.6.8 Programmer menu

Clicking on the 'Programmer' menu item near the top of the iTools window causes the Programmer menu (figure 6.6.8) to appear. The items contained within this menu are described in the 'Toolbar icons' and 'Context menu' sections (sections 6.6.6 and 6.6.7 respectively) above.

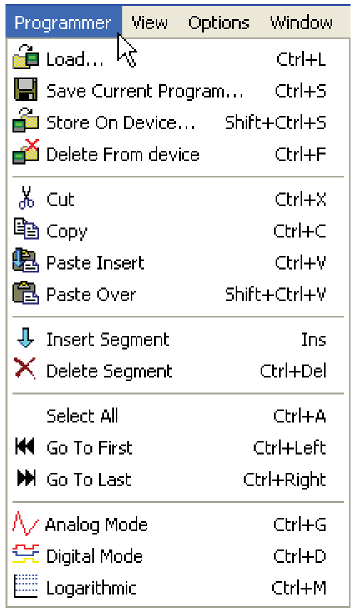


Figure 6.6.8 Programmer menu

6.6.9 Two channel programs

The display and editing of segment and program parameters for two-channel programmers is carried out in the same way as described above, for single channel programs. The major difference in apearance is that there are two sets of parameters for each segment, instead of one. The background colour for channel 1 parameters is pink; that for channel 2 parameters is green.

The number of channels and the program features enabled are set up at the instrument as desribed in section 3.4.9 and section 4.8.

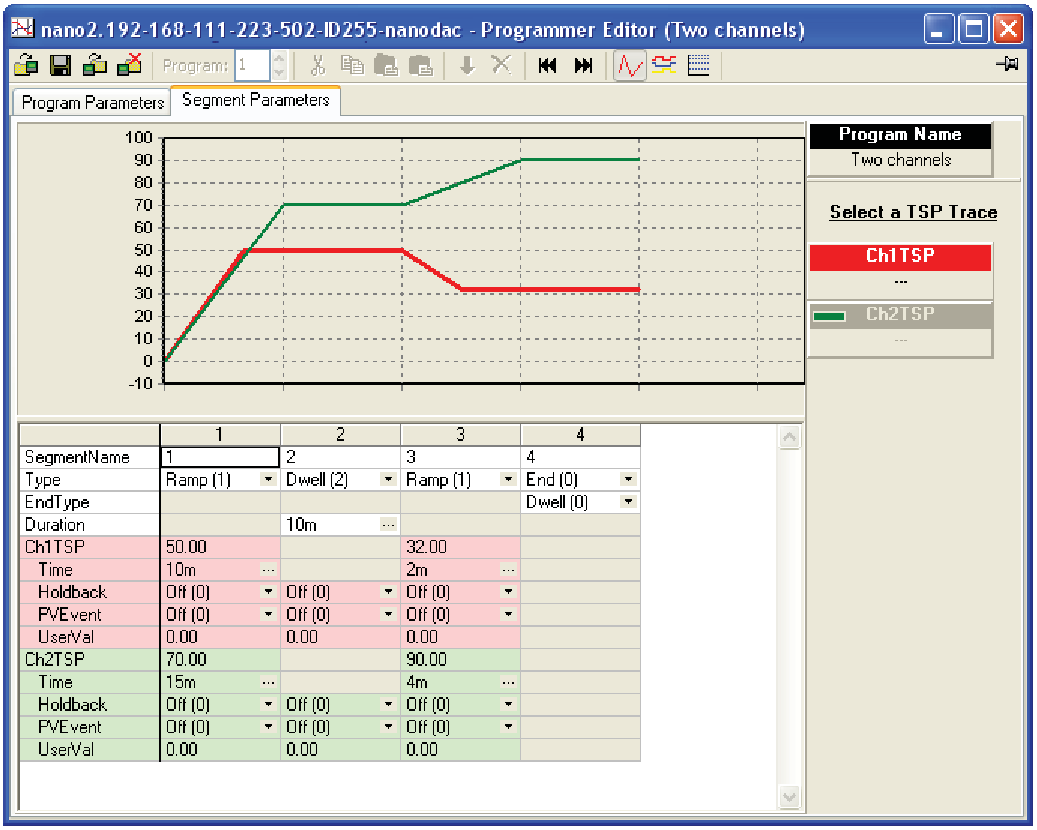


Figure 6.6.9 Two channel program display

7 USER WIRING

User wiring, created from the instrument front panel, allows parameters to be wired together so that, for example, a counter can be configured to be incremented when an alarm goes active. This can be used as an alternative to iTools.

This section is presented as two examples that show the general techniques used to create and delete wires from the instrument user interface.

Notes:

1. These examples refer to Channel Configuration and to Virtual Channel configuration, descriptions of which are to be found in sections 4.4 and 4.5 respectively.
2. The destination parameter field has a small green triangle at the top left corner to indicate that it has a wire routed to it. 

7.1 DRIVE RELAY EXAMPLE

To drive the relay whose terminal contacts are 3A/3B, whilst the temperature being measured by Channel 2 exceeds 30°C. For this example Channel 2 alarm 1 and a hysteresis of 4°C will be used.

1. In channel 2, Alarm 1 page (see note), set the following parameters:
   Type: Abs. High
   Threshold: 30
   Hysteresis: 4
   Latch: None
   Block: Off
   Dwell:00:00:00
   Acknowledge: No

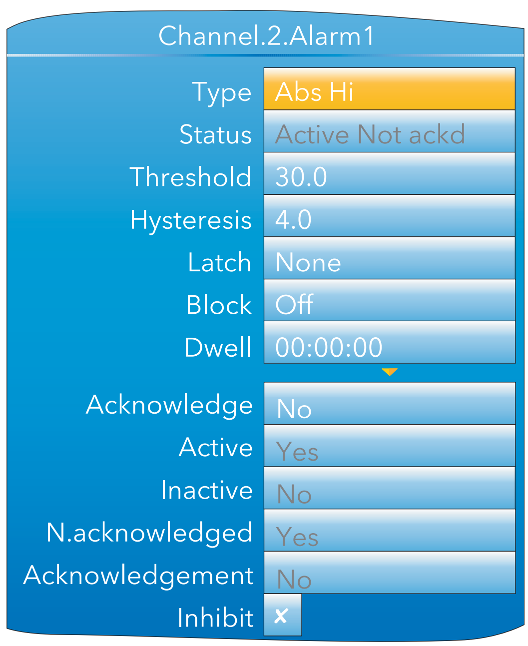


Figure 7.1a Channel 2, Alarm 1 set up

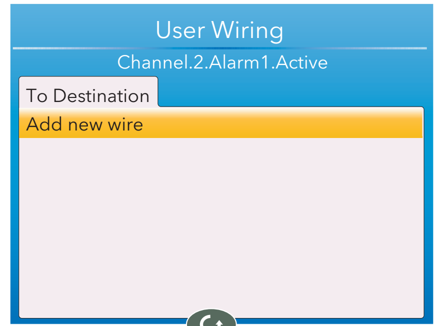
Note: the channel alarm areas of configuration become accessible only once the channel with which they are associated has been configured with a suitable 'Type' (section 4.4.1).

7.1 DRIVE RELAY EXAMPLE (Cont.)

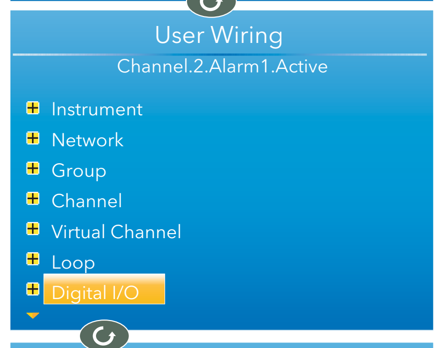
2. Highlight the 'Active' field, and press and hold the scroll button for a few seconds, until the top level User Wiring page appears.

   The name of the selected parameter appears at the top of the page. Any already existing wires from this parameter would appear below the 'Add new wire' area.

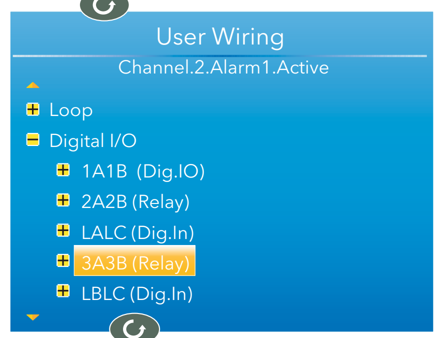
3. With 'Add new wire' highlighted operate the Scroll button.



4. Use the down arrow to highlight 'Digital I/O' and press the scroll button.

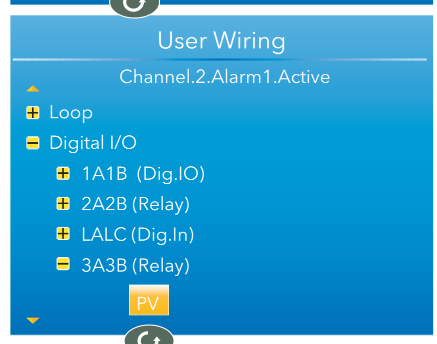


5. Use the down arrow to highlight '3A3B (Relay)' and press the scroll button.



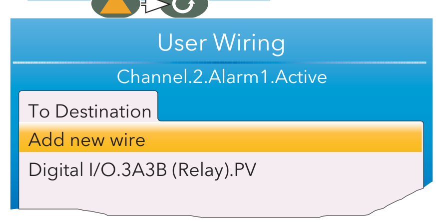
6. Use the down arrow to highlight 'PV' and press the scroll button.

Note: If this parameter is already wired-to, the 'wired' symbol appears to the left of the parameter.



7. When the confirmation window appears, use the up or down arrow to highlight 'Ok', then operate the scroll button again.

8. The top level user wiring page reappears, showing the destination parameter.



7.1.1 Wire removal

At the top level user wiring page, use the up and down arrow buttons to highlight the wire to be deleted, and operate the scroll key. In the 'Delete Wire' confirmation window, highlight 'Ok' and operate the scroll key again. The wire is deleted without further confirmation.

7.2 COUNTER EXAMPLE

This example shows how to set up a counter to be incremented each time Channel 1 Alarm 1 becomes active, and reset each time channel 2, alarm 1 is acknowledged. For this example, Virtual Channel 3 will be configured as the counter, with a preset value of 0.

1. At Channel.1.Main, set:

   Type = test
   Test Signal = Sine 4 min.
   Scale Low = 0
   Scale High = 100

2. At Channel.1.Alarm1, set:

   Type = Abs Hi
   Threshold = 50
   Latch = None

3. At Channel.2.Main, set:

   Type = Test
   Test Signal = Sine 40 min.
   Scale Low = 0
   Scale High = 100

4. At Channel.2.Alarm 1, set:

   Type = Abs Hi
   Threshold = 90
   Latch = Manual

5. At Virtual Channel.3.Main, set:

   Type = Counter
   Operation = On
   Input = 1

All the other parameters can be left at their defaults.

6. Still at Virtual Channel 3 (Main), use the up/down arrow buttons to highlight 'Trigger'. Press and hold the scroll key. The top level User Wiring page appears, this time with a 'From Source' tab as well as the 'To Destination' tab of example 1. This is because this parameter is read/write, whereas Alarm Active is read only (i.e. its value may be read but not changed).
7. Use the up (or down) arrow button to select the 'From Source' tab.

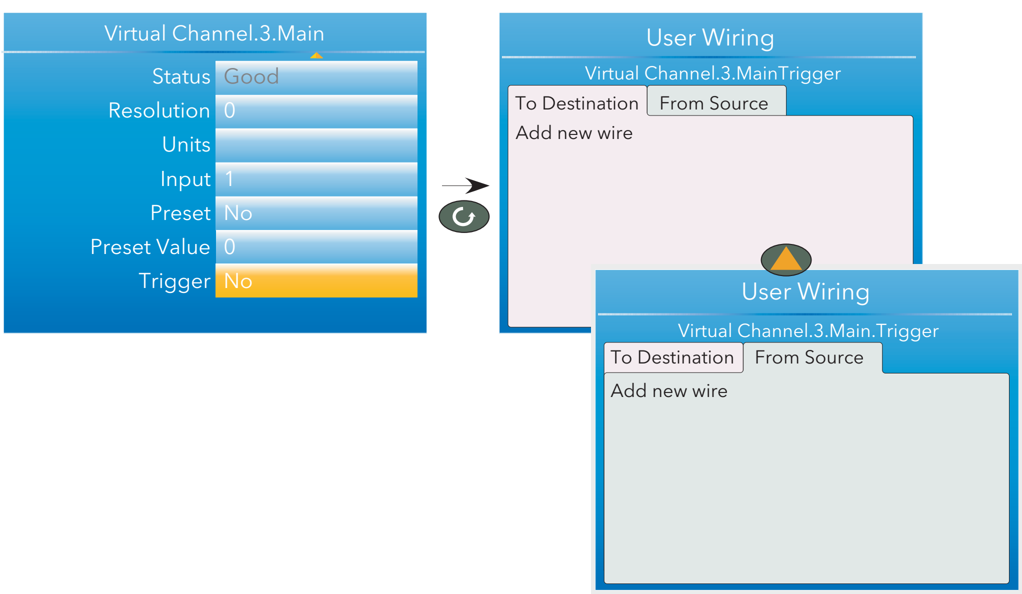


Figure 7.2a Wiring a counter: part 1

7.2 COUNTER EXAMPLE (Cont.)

8. Operate the Scroll key to highlight 'Add new wire', then again to display the top level parameter list.
9. Use the down arrow button to highlight 'Channel' and operate the scroll button.
10. Operate the scroll button to select '1'.
11. Highlight 'Alarm 1' and operate the scroll button.
12. Use the down arrow button to highlight 'Active'. Operate the Scroll button again, and create the new wire.
13. Use the Page button twice to return to the Virtual Channel 3 menu.

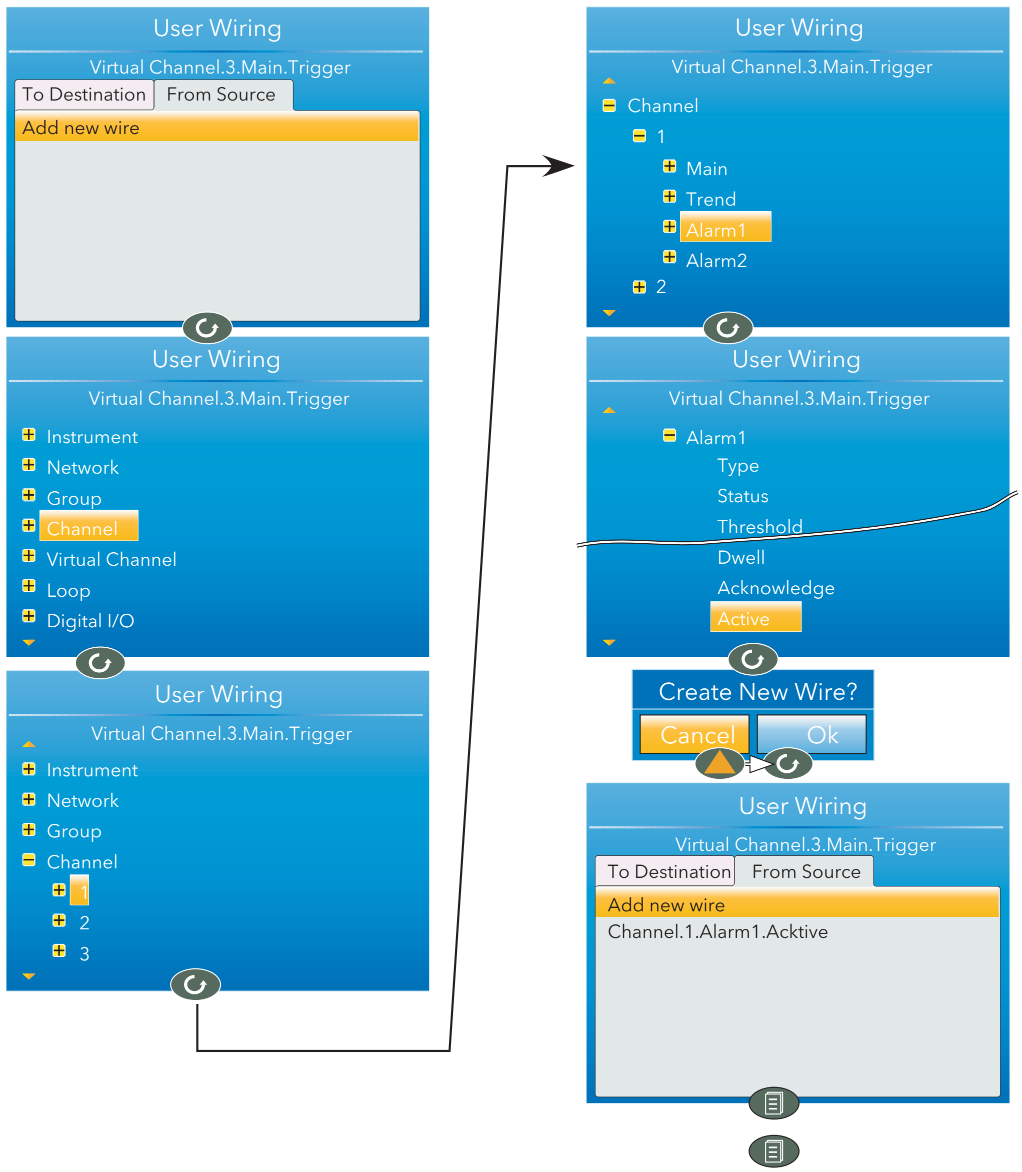


Figure 7.2b Wiring a counter: part 2

7.2 COUNTER EXAMPLE (Cont.)

14. At Virtual Channel.3.Main, use the down arrow to select 'Preset'. Press and hold the scroll key. The top level User Wiring page appears.
15. Use the up (or down) arrow button to select the 'From Source' tab, if not already selected.
16. Operate the Scroll key to highlight 'Add new wire', then again to display the top level parameter list.
17. Use the down arrow button to highlight 'Channel' and operate the scroll button.
18. Use the down arrow button to highlight '2' and operate the scroll button.
19. Highlight 'Alarm 1' and operate the scroll button.
20. Use the down arrow button to highlight 'Acknowledgement' (not 'Acknowledge'). Operate the Scroll button again, and create the new wire.

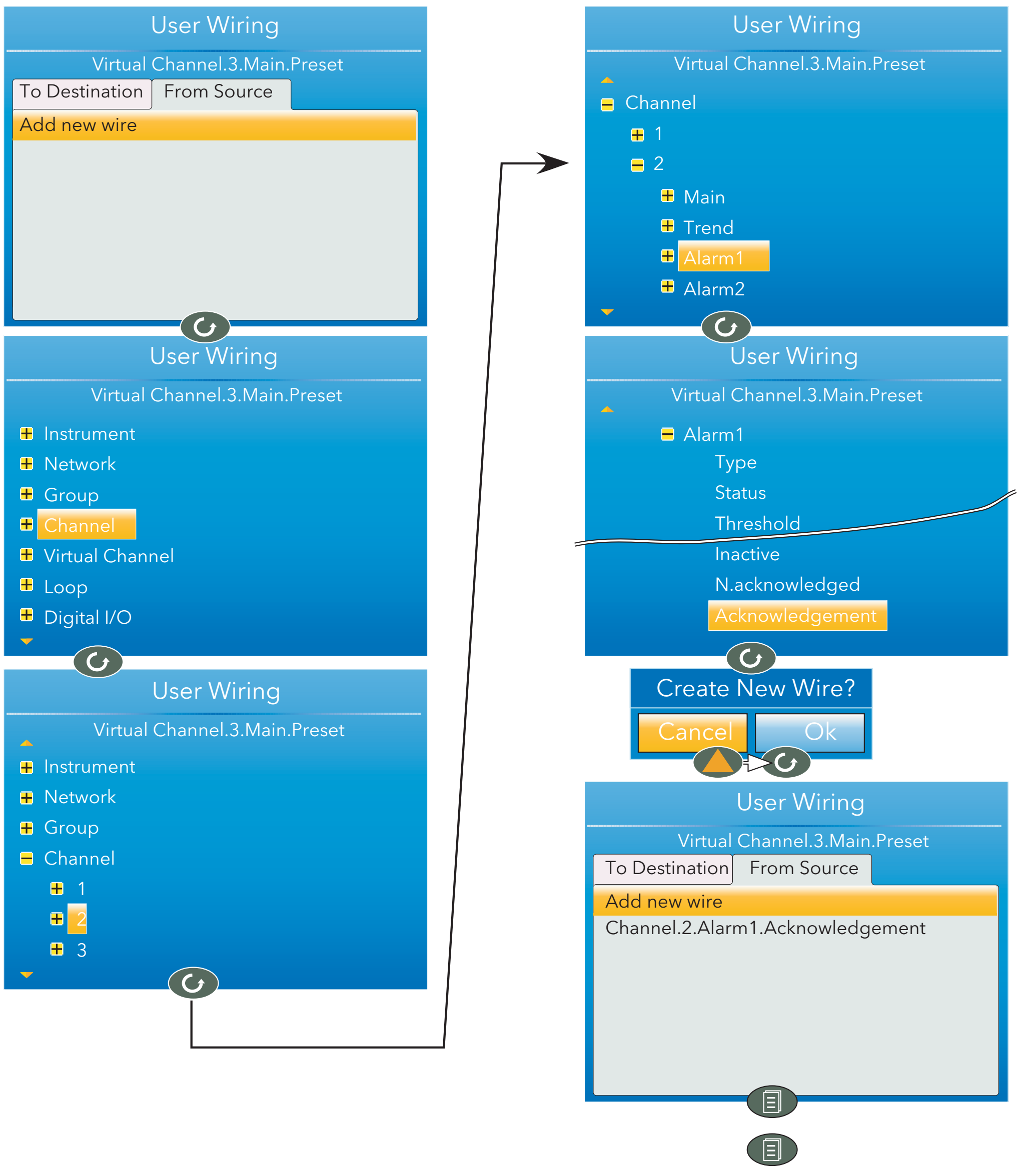


Figure 7.2c Wiring a counter: part 3

8 USB DEVICES

The devices listed below can be plugged into the USB connector at the back of the instrument, providing that the maximum current required is less than 100 mA.

1. Memory Stick
2 Bar code reader
3. Keyboard

Notes:
1. See 'USB device precautions' in the Safety Notes preamble section of the manual.
2. See Section A2 for the USB port specification
3. The use of USB hubs is not supported by this instrument.

8.1 MEMORY STICK

The use of the memory stick as an archiving device, or to facilitate software upgrades is well documented in the relevant sections of this manual.

8.2 BAR CODE READER

If 'USB Auto Scan is set to 'Yes' in Display Configuration (section 4.1.3) then, with the bar code reader plugged into the USB port, the scanned data input stream is packaged into a general message displayed on the trend page and included in the .uhh history file. The format of the message is: DD/MM/YY HH:MM:SS 123--13 (where 123--13 represents the ASCII data read from the bar code.

If 'USB auto Scan' is set to 'No, the ASCII data read from the bar code is displayed as a message ready for editing prior to being sent to the display etc. Figure 8.2 shows an example.

Note: the bar code reader must be configured to use a carriage return (decimal 13) terminating character.

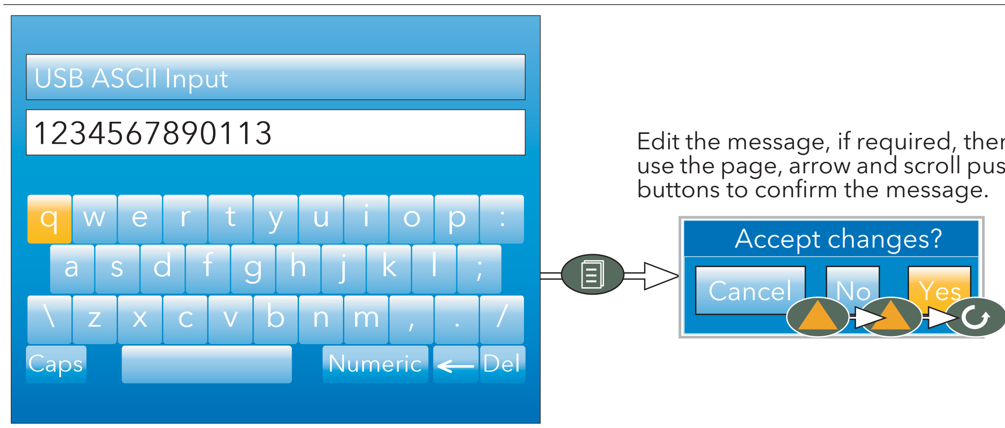


Figure 8.2 Bar Code reader display

8.3 USB KEYBOARD

A QWERTY keyboard may be plugged into the rear USB port to act in parallel with the virtual keyboard. The editing keys listed below are supported in addition to the standard alpha-numeric characters.

Left arrow	Moves the cursor left-wards through the text string (stops at the start of the string).
Right arrow	Moves the cursor right-wards through the text string (stops at the end of the string).
Backspace	Deletes the character immediately to the left of the cursor.
Delete	Removes the character immediately to the right of the cursor.
End	Moves the cursor to the end of the string
Home	Moves the cursor to the start of the string
Insert	Highlights the entire string, for overwriting
Esc	Exit without saving changes.

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Appendix A: TECHNICAL SPECIFICATION

A1 INSTALLATION CATEGORY AND POLLUTION DEGREE

This product has been designed to conform to BS EN61010 installation category II and pollution degree 2, defined as follows:

Installation category II

The rated impulse voltage for equipment on nominal 230V mains is 2500V.

Pollution degree 2

Normally, only non-conductive pollution occurs. Occasionally, however, a temporary conductivity caused by condensation shall be expected.

A2 RECORDER SPECIFICATION

I/O types

Analogue i/p	Four (eight if dual input option fitted)
Digital i/p	Two
Digital (logic) o/p	See table A2 for options
Relay o/p	See table A2 for options
DC output	See table A2 for options
Features	CSV archive format EtherNet/IP (Option) File transfer protocol (FTP) Messages Modbus Master (Option) Modbus TCP slave Set point programmer (option) uhh (history file) archiving USB port at rear of instrument User linearisation tables (four) Two control loops (optional) Advanced Loop (optional) Zirconia probe support (optional) 15 Virtual channels (each configurable as maths, totaliser or counter). 30 Virtual channels if Modbus Master or EtherNet/IPoptions fitted (no alarms on virtual channels 16 to 30)

IO1	OP2	OP3	OP4	OP5	
L	R	R	R	R	Default
L	R	D	R	R	Options
L	L	R	R	R	Options
R	D	D	R	R	Options
D	D	D	R	R	Options

L = Logic output; R = Relay; D = DC output
OP4 and OP5 share Common terminals.

Table A2 Output options

Environmental performance

Ambient temperature range	
Operating:	0 to 55°C
Storage:	-20 to +70°C
Humidity range Operating:	5% to 85% RH non condensing
storage:	5% to 85% RH non condensing
Protection Front panel (Standard):	IP65
Front panel (Wash down):	IP66, NEMA4X (International)
Behind panel:	IP10 (International)
Shock/Vibration	To BS EN61131-2 (5 to 150 Hz. at 1g; 1 octave per min.)
Altitude	<2000 metres
Atmosphere	Not suitable for use in explosive or corrosive atmospheres.
Electrical safety	BS EN61010-1 (Installation category II; Pollution degree 2)
Electromagnetic compatibility	
Emissions (standard units):	BS EN61326 Class B - Light industrial.
Emissions (Low voltage option):	BS EN61326 Class A - Heavy industrial
Immunity	BS EN61326 Industrial

Other approvals and compliance details

General:	CE and cUL, EN61010
PV input	AMS2750D compliant
RoHS	EU; China
Packaging	BS EN61131-2 section 2.1.3.3.

Physical

Panel mounting	1/4 DIN
Weight	0.44kg (15.52 oz.)
Panel cutout dimension	92 mm x 92 mm (both -0.0 +0.8) or 3.62 in x 3.62 in (both -0.00 +0.03 in) (figure 2.1)
Depth behind panel	90 mm (3.54 in) (figure 2.1) excluding wiring.

Operator interface

Display	3.5" TFT colour display (320 pixels wide x 240 pixels high)
Controls	Four navigation pushbuttons below the display screen (Page, Scroll, Lower and Raise)

Power requirements

Supply voltage Standard:	100 to 230Vac ± 15% at 48 to 62Hz.
Low voltage option:	24Vac (+10% - 15%), at 48 to 62 Hz, or 24Vdc (+20% -15%)
Power dissipation	9 W
Fuse type	None
Interrupt protection Standard:	Holdup >10ms at 85V RMS supply voltage.
Low voltage option:	Holdup >10ms at 20.4V RMS supply voltage.

Battery backup

Stored data	Time, date.
Support time (for real-time clock)	Minimum of 1 year with unit unpowered.
Replacement period	Three years typical
Type	poly-carbonmonofluoride / lithium (BR2330) (PA260195)

Ethernet communications

Type:	10/100baseT Ethernet (IEEE802.3)
Protocols:	Modbus TCP/IP slave, FTP, DHCP
Cable type	Category 5
Maximum length	100metres (110 yards)
Termination	RJ45. Green LED illuminated = link connected; Amber LED flashing shows link activity.

A2 RECORDER SPECIFICATION (Cont.)

USB port

Number of ports	One at rear of instrument
Standard	USB1.1
Transmission speeds	1.5Mbits/sec (low speed device)
Maximum current	<100mA

Peripherals supported Memory stick (8GB max), Bar code reader, QWERTY keyboard

Update/Archive rates

Sample rate (input/output)	8Hz (4Hz for digital inputs) (4Hz for dual input channels)
Trend update	8 Hz max
Archive sample value	Latest value at archive time
Display value	Latest value at display update time.

A3 ANALOGUE INPUT SPECIFICATION

General

Number of anaologue inputs	Four
Input types Standard:	dc Volts, dc mV, dc mA (external shunt required), thermocouple, RTD (2-wire and 3-wire), digital (contact closure).
Optional:	dual mA, dual mV, dual thermocouple.
Input type mix	Freely configurable
Sample rate	8Hz (125ms)
Conversion method	16 bit delta sigma.
Input ranges	See below.
Mains rejection (48 to 62Hz)	
Series mode:	>95dB
Common mode:	>179dB
Common mode voltage	250Vac max.
Series mode voltage	280mV at lowest range; 5V peak-to-peak, at highest range.
Input impedance	See relevant Range specification, below.
Overvoltage protection Continuous:	± 30V RMS
Transient (<1ms):	±200V pk-pk between terminals.
Sensor break detection Type	ac sensor break on each input giving quick response with no associated dc errors.
Recognition time:	<3 secs.
Minimum break resistance:	40mV, 80mV ranges: 5kΩ; other ranges: 12.5kΩ
Shunt (mA inputs only) Values	1Ω to 1kΩ, mounted externally.
additional error due to shunt:	0.1% input
Isolation Channel to channel:	300V RMS or dc (double insulation)
Channel to common electronics:	300V RMS or dc (double insulation)
Channel to ground:	300V RMS or dc (double insulation)
Dielectric strength Test:	BS EN61010, 1 minute type test
Channel to channel:	2500 Vac
Channel to ground:	1500 Vac

DC input ranges

Ranges	40mv, 80mV, 2V; 10V (-4.0 to +10V)
40mV Range Range:	-40mV to + 40mV
Resolution	1.9μV (unfiltered)
Measurement noise:	1.0μV peak-to-peak with 1.6s input filter
Linearity error:	0.003% (best fit straight line)
Calibration error:	±4.6μV ±0.053% of measurement at 25°C ambient
Temperature coefficient:	±0.2μV/°C ± 13ppm/°C of measurement from 25°C ambient
Input leakage current:	±14nA
Input resistance:	100MΩ
80mV Range Range:	-80mV to + 80mV
Resolution	3.2μV (unfiltered)
Measurement noise:	3.3μV peak-to-peak with 1.6s input filter
Linearity error:	0.003% (best fit straight line)
Calibration error:	±7.5μV ±0.052% of measurement at 25°C ambient
Temperature coefficient:	±0.2μV/°C ± 13ppm/°C of measurement from 25°C ambient
Input leakage current:	±14nA
Input resistance:	100MΩ
2V Range Range:	±2V
Resolution	82μV
Measurement noise:	90μV peak-to-peak with 1.6s input filter
Linearity error:	0.003% (best fit straight line)
Calibration error:	±420μV ±0.044% of measurement at 25°C ambient
Temperature coefficient:	±125μV/°C ± 13ppm/°C of measurement from 25°C ambient
Input leakage current:	±14nA
Input resistance:	100MΩ

A3 ANALOGUE INPUT SPECIFICATION (Cont.)

DC Input ranges (Cont.)

10V Range
Range: -3V to +10V
Resolution 500µV
Measurement noise: 550µV peak-to-peak with 1.6s input filter
Linearity error: 0.007% (best fit straight line) for zero source resistance. Add 0.003% for each 10Ω source and lead resistance
Calibration error: ±1.5mV ±0.063% measurement at 25°C ambient
Temperature coefficient: ±66µV/°C ± 45ppm/°C of measurement from 25°C ambient
Input resistance: 62.5kΩ for input voltages > 5.6V. 667kΩ for input ranges < 5.6V.

Note: 10V range not available for dual input channels

Resistance input ranges
Temperature scale: ITS90
RTD Types, ranges and accuracies: See table
Maximum source current: 200µA

Resistance input figures
Range: 0 to 400Ω (-200 to +850°C)
Resolution: 0.05°C
Measurement noise: 0.05°C peak-peak with 1.6s input filter
Linearity error: 0.0033% (best fit straight line)
Calibration error: ±0.31°C ±0.023% of measurement in °C at 25°C ambient
Temperature coefficient: ±0.01°C/°C ±25ppm/°C measurement in °C from 25°C ambient
Lead resistance: 0 to 22Ω matched lead resistances
Bulb current: 200µA nominal

RTD type	Overall range °C	Standard	Max. linearisation error
Cu10	-20 to + 400	General electric Co.	0.02°C
Cu53	-70 to + 200	RC21-4-1966	<0.01°C
JPT100	-220 to + 630	JIS C1604:1989	0.01°C
Ni100	-60 to + 250	DIN43760:1987	0.01°C
Ni120	-50 to + 170	DIN43760:1987	0.01°C
Pt100	-200 to + 850	IEC751	0.01°C
Pt100A	-200 to + 600	Eurotherm Recorders SA	0.09°C

Table A3a RTD type details

Thermocouple data
Temperature scale: ITS90
CJC Types: Off, internal, external, remote.
Remote CJC source: Any input channel
Internal CJC error: <1 °C max, with instrument at 25 °C
Internal CJC rejection ratio: 40:1 from 25°C
Upscale/downscale drive: High, low or none independently configurable for each channel's sensor break detection.
Types, ranges and accuracies: See table A3b

T/C type	Overall range (°C)	Standard	Max. linearisation error
B	0 to + 1820	IEC584.1	0 to 400°C = 1.7°C 400 to 1820°C = 0.03°C
C	0 to + 2300	Hoskins	0.12°C
D	0 to + 2495	Hoskins	0.08°C
E	-270 to + 1000	IEC584.1	0.03°C
G2	0 to + 2315	Hoskins	0.07°C
J	-210 to + 1200	IEC584.1	0.02°C
K	-270 to + 1372	IEC584.1	0.04°C
L	-200 to + 900	DIN43710:1985 (to IPTS68)	0.02°C
N	-270 to + 1300	IEC584.1	0.04°C
R	-50 to + 1768	IEC584.1	0.04°C
S	-50 to + 1768	IEC584.1	0.04°C
T	-270 to + 400	IEC584.1	0.02°C
U	-200 to + 600	DIN43710:1985	0.08°C
NiMo/NiCo	-50 to + 1410	ASTM E1751-95	0.06°C
Platinel	0 to + 1370	Engelhard	0.02°C
Mi/NiMo	0 to + 1406	Ipsen	0.14°C
Pt20%Rh/Pt40%/Rh	0 to + 1888	ASTM E1751-95	0.07°C

Table A3b Thermocouple types, ranges and accuracies

A4 RELAY AND LOGIC I/O SPECIFICATION

OP1, OP2, OP3 logic input, logic output and relay specification.

Active (current on) current sourcing logic output		
Voltage output across terminals		+11V min; +13V max.
Short circuit output current		6mA min. (steady state); 44mA max. (switch current)
Inactive (current off) current sourcing logic output (OP1 or OP2 only)		
Voltage output across terminals		0V (min.); 300mV (max)
Output source leakage current	into short circuit	0µA (min.); 100µA max
Active (current on) contact closure sourcing logic input (OP1 only)		
Input current	Input at 12V:	0mA (min.); 44mA (max.)
	inout at 0V:	6mA min. (steady state); 44mA max. (switch current)
Open circuit input voltage		11V (min.); 13V (max.)
Open circuit (inactve) resistance		500Ω (min.); ∞ (max.)
Closed circuit (active) resistance		0Ω (min.); 150Ω (max.)
Relay contacts		
Contact switching power (resistive)		Max: 2A at 230V RMS ±15%; Min: 100mA @ 12V.
Maximum current through terminals		2A

A5 DIGITAL INPUTS

DigInA, DigInB, contact closure logic input

Contact closure	
Short circuit sensing current (source)	5.5mA (min.); 6.5mA (max.)
Open circuit (inactive) resistance	600 Ω (min.); ∞ (max.)
Closed circuit (active) resistance	0Ω (min.); 300Ω (max.)
Maximum frequency	8 Hz
Minimum pulse width	62.5 ms

A6 DC OUTPUTS

OP1, OP2, OP3 DC analogue outputs

Current outputs (OP1, OP2 and OP3)	
Output ranges	Configurable within 0 to 20mA
Load resistance	500Ω Max.
Calibration accuracy	<±100µA ±1% of reading
Voltage outputs (OP3 only)	
Output range	Configurable within 0 to 10V
Output impedance	500Ω Min.
Calibration accuracy	<±50mV ±1% of reading
General	
Isolation	300Vac double insulated from instrument and other I/O
Resolution	>11 bits
Thermal drift	<100ppm/°C

A7 BLOCKS SUPPORTED

A7.1 'TOOLKIT' BLOCKS

BCD input
Eight-input logic
Eight input multiplexer
Timers
Two-input logic
Two-input maths
User values

A7.2 APPLICATION BLOCKS

Humidity
Steriliser
Zirconia

Appendix B CONTROL LOOPS

Note: See section 4.6 for Loop configuration details

B.1 INTRODUCTION

With this recorder, two control loops are available, each loop containing two outputs (Channel 1 and Channel 2) which can be individually configured for PID, On/Off or valve position. For temperature control, channel 1 is normally configured for heating and channel 2 for cooling.

B1.1 EXAMPLE (HEAT ONLY)

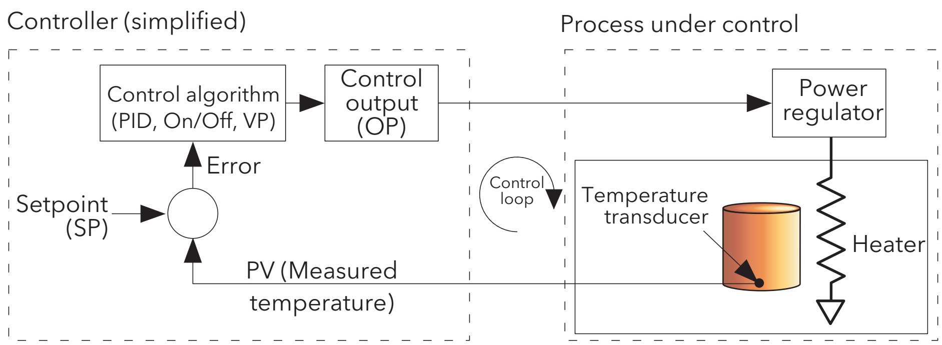


Figure B1.1 Control loop example

The measured temperature (process variable, or 'PV') is connected to the input of the controller, where it is compared with the 'Setpoint' (SP) (the target temperature). If there is a difference between the PV and the SP, the controller calculates and outputs a heating demand. This output is applied to the process heating device, which in turn causes a change in the PV in a direction intended to result in a zero error.

B2 CONTROL LOOP DEFINITIONS

B2.1 AUTO/MANUAL

In manual mode, if 'On/Off' control is configured, the output power may be edited by the user but the only power values allowed are: +100% (heat on; cool off) for positive user entries, 0% (heat off; cool off) for zero entry or -100%. (heat off; cool on) for negative entries.

In manual mode, for 'PID' control the output may be edited between +100% and (if 'cool' is configured), -100%. The actual output value is subject to limiting and output rate limit.

In manual mode, for valve position control, the up and down arrow buttons directly control (nudge) the raise and lower relay outputs respectively. It is also possible to control the valve by sending nudge commands over a serial link, or by software wiring from a suitable parameter. A single nudge command moves the valve by 1 minimum on time; longer nudge demands produce longer valve movements. See section B2.6.10 for more details.

If sensor break occurs while the controller is in automatic the controller outputs the sensor break output power. In such a case the user can switch to manual control and edit the output power. On returning to automatic control, the controller checks again for sensor break.

If autotune is enabled while in manual mode, the autotune remains in a reset state such that when the user puts the controller into automatic control the autotune starts.

B2.2 TYPES OF CONTROL LOOP

B2.2.1 On/Off control

This form of control turns heating power on when the process value is below the setpoint, and turns it off when it is above the setpoint (see also figure B2.6.9a). If cooling is configured, it has its own relay which operates in a similar way. In Direct Acting mode, the behaviour is inverted. On/off is suitable for controlling switching devices such as relays.

Because of the thermal inertia of the load, a certain amount of oscillation will take place, and this can affect the quality of the product. For this reason, On/Off control is not recommended for critical applications.

Depending on the nature of the process being controlled, some hysteresis may have to be included to prevent continuous operation or chatter in the controlling device.

B2.2.2 PID Control

Also known as 'three term control', this type of control continuously adjusts the output demand, according to a set of rules, in order to control the process as closely as possible to requirements. PID provides more stable control than On/Off control but is more complex to set up as the parameters must match the characteristics of the process under control.

The three major parameters are: Proportional band (PB), Integral time (Ti) and Derivative time (Td) and the output from the controller is the sum of these three terms. This output is a function of the size and duration of the error value and the rate-of-change of the process value.

It is possible to disable the integral and/or derivative terms and control on proportional only, on proportional plus integral (PI) or proportional plus derivative (PD).

PI control is often used when the PV is noisy and/or subject to rapid variations, where derivative action would cause the output power to fluctuate wildly.

PROPORTIONAL BAND

The proportional band (PB) delivers an output which is proportional to the size of the error signal. It is the range over which the output power is continuously adjustable in a linear fashion from 0% to 100% (for a heat only controller). Below the proportional band the output is full on (100%), above the proportional band the output is full off (0%) as shown in figure B2.2.2a.

The width of the proportional band determines the magnitude of the response to the error. If PB is too narrow (high gain) the system oscillates; if it is too wide (low gain) control is sluggish. The ideal situation is when the proportional band is as narrow as possible without causing oscillation.

Figure B2.2.2a also shows the effect of narrowing proportional band to the point of oscillation. A wide proportional band results in straight line control but with an appreciable initial error between setpoint and actual temperature. As the band is narrowed the temperature gets closer to setpoint until eventually, it becomes unstable.

The proportional band may be set in engineering units or as a percentage of the controller range.

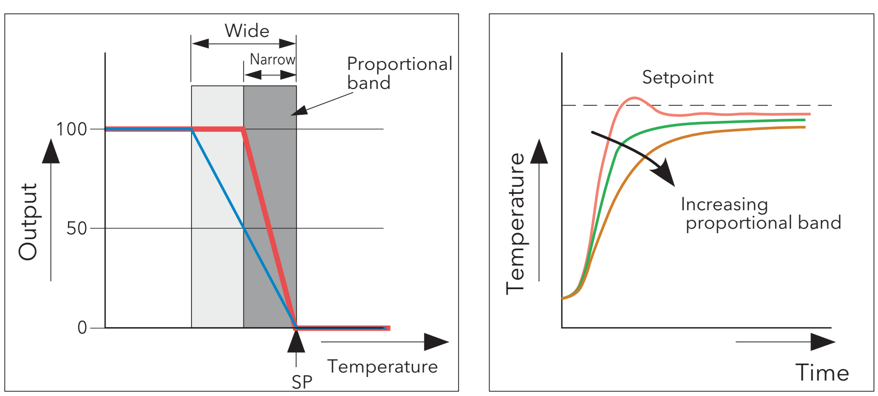


Figure B2.2.2a Proportional band action (reverse acting)

B2.2 TYPES OF CONTROL LOOP (Cont.)

INTEGRAL TERM

In a proportional only controller, as seen in the previous section, an error must exist between setpoint and PV in order for the controller to deliver power. Integral is used to achieve zero steady state control error.

The integral term slowly modifies the output level as a result of any error between setpoint and measured value. If the measured value is below setpoint the integral action gradually increases the output in an attempt to correct the error. If it is above setpoint integral action gradually decreases the output or increases the cooling power to correct the error.

Figure B2.2.2b shows proportional plus integral action.

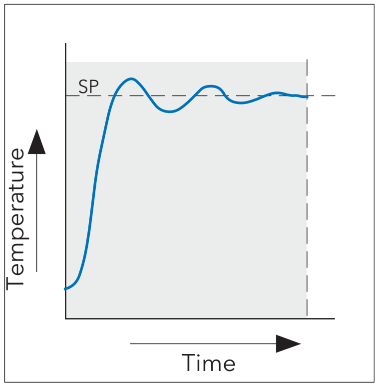


Figure B2.2.2b: Proportional + Integral Control

The integral term is set in seconds. The longer the integral time constant, the more slowly the output is modified and the more sluggish the response. Too small an integral time causes the process to overshoot, and perhaps to start oscillating. The integral action may be disabled by setting its value to Off.

DERIVATIVE TERM

Derivative (or rate) action provides a sudden change in output linked to the rate of change in error, whether this is caused by PV alone (derivative on PV) or by a change in the SP as well (derivative on error selection). If the measured value falls quickly, derivative provides a large change in output in an attempt to correct the perturbation before it goes too far. It is most beneficial in recovering from small perturbations.

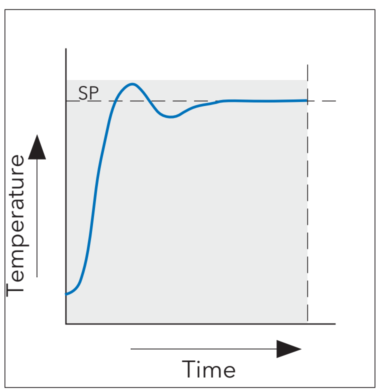


Figure B2.2.2c Proportional + Integral + Derivative Action

Derivative is used to improve the performance of the loop. There are, however, situations where derivative may be the cause of instability. For example, if the PV is noisy, then derivative can amplify that noise and cause excessive output changes, in these situations it is often better to disable the derivative and re-tune the loop.

B2.2 TYPES OF CONTROL LOOP (Cont.)

Derivative should not be used to curb overshoot in situations when the output is saturated at Op High or Op Low for extended periods, such as process start up, since to do so degrades the steady state performance of the system. Overshoot inhibition is best left to the approach control parameters, High and Low Cutback.

If Derivative is set to Off, no derivative action will be applied.

Derivative can be calculated on change of PV or change of Error. If configured on error, then changes in the setpoint will be transmitted to the output. For applications such as furnace temperature control, it is common practice to select Derivative on PV to prevent thermal shock caused by a sudden change of output as a result of a change in setpoint.

B2.2.3 Motorised valve control

Designed specifically for driving motorised valves this type of control can operate in 'Unbounded' mode (VPU) or 'Bounded' mode (VPB). Relay outputs are used to drive the valve motor.

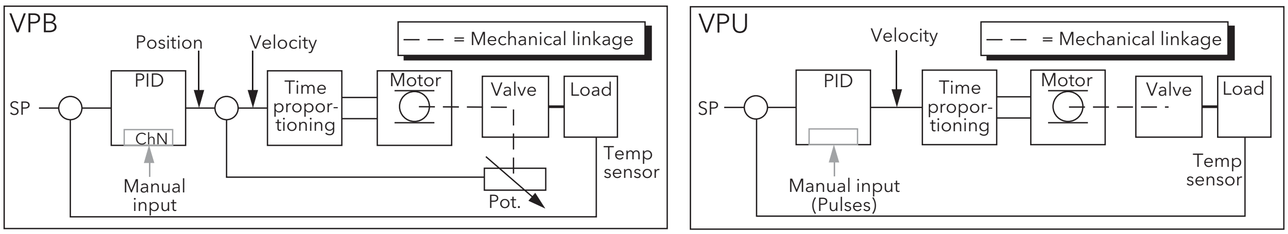


Figure B2.2.3 VPB and VPU comparison

Unbounded valve positioning (VPU) does not require a position feedback potentiometer in order to operate because it controls directly the direction and velocity of the movement of the valve in order to minimise the error between the setpoint (SP) and the process variable (PV). Control is performed by delivering a 'raise' or 'lower' pulse to control the velocity of the valve in response to the control demand signal.

Bounded VP (VPB) control uses PID (or any other combination of the three terms) to set a required valve position. A feedback potentiometer linked to the valve provides a signal giving actual valve position. This allows the control loop to calculate the difference between required and actual position dynamically, and adjust control output accordingly. Control is performed by delivering a 'raise' or 'lower' pulse to adjust the valve position.

MANUAL MODE

Bounded VP controls in manual mode because the inner positional loop is still running against the potentiometer feedback, so it is operating as a position loop.

In boundless mode the algorithm is a velocity mode positioner. When manual is selected then the up and down arrow produce +100% or –100% velocity respectively for the duration of the key press.

In boundless mode it is essential that the motor travel time is set accurately in order to allow the integral time to calculate correctly. Motor travel time is defined as (valve fully open – valve fully closed). This is not necessarily the time printed on the motor since, if mechanical stops have been set on the motor, the travel time of the valve may be different.

Every time the valve is driven to its end stops the algorithm is reset to 0% or 100% to compensate for any changes which may occur due to wear in linkages or other mechanical parts.

This technique makes boundless VP look like a positional loop in manual even though it is not. This enables combinations of heating and cooling e.g. PID heat, VPU cool with manual mode working as expected.

MOTORISED VALVE OUTPUT CONNECTIONS

The loop output which has been configured as valve position can be wired to the PV input of one of the pairs of relays 2A2B/3A3B or 4AC/5AC which has been configured as Type = 'Valve Raise'. Only one relay input needs to be wired as the other relay of the pair will be automatically set to 'Valve Lower'. For example, if Loop 1 Channel 1 output is wired to Relay 2A2B and the 'Type' is configured as 'Valve Raise' then the Type for Relay 3A3B will be 'Valve Lower'.

B2.3 LOOP PARAMETERS

B2.3.1 Relative cool gain (R2G)

This is the gain of channel 2 control output, relative to the channel 1 control output and is used to compensate for the different quantities of power available to heat and to cool a process. For example, water cooling applications might require a relative cool gain of 0.25 because cooling is 4 times greater than the heating process at the operating temperature.

By default, this parameter is set automatically when an Autotune is performed, but setting the Tune menu parameter 'AT.R2G' to 'No' causes the R2G value(s) entered in the PID menu to be used instead.

B2.3.2 High and Low cutback

Cutback high 'CBH' and Cutback low 'CBL' are values that modify the amount of overshoot, or undershoot, that occurs during large step changes in PV under start-up conditions, for example. They are independent of the PID terms which means that the PID terms can be set for optimal steady state response and the cutback parameters used to modify any overshoot which may be present.

Cutback involves moving the proportional band towards the cutback point nearest the measured value whenever the latter is outside the proportional band and the power is saturated (at 0 or 100% for a heat only controller). The proportional band moves downscale to the lower cutback point and waits for the measured value to enter it. It then escorts the measured value with full PID control to the setpoint. In some cases it can cause a 'dip' in the measured value as it approaches setpoint as shown in figure B2.3.2 but generally decreases the time to needed to bring the process into operation.

The action described above is reversed for falling temperature.

If cutback is set to Auto the cutback values are automatically configured to 3 × PB.

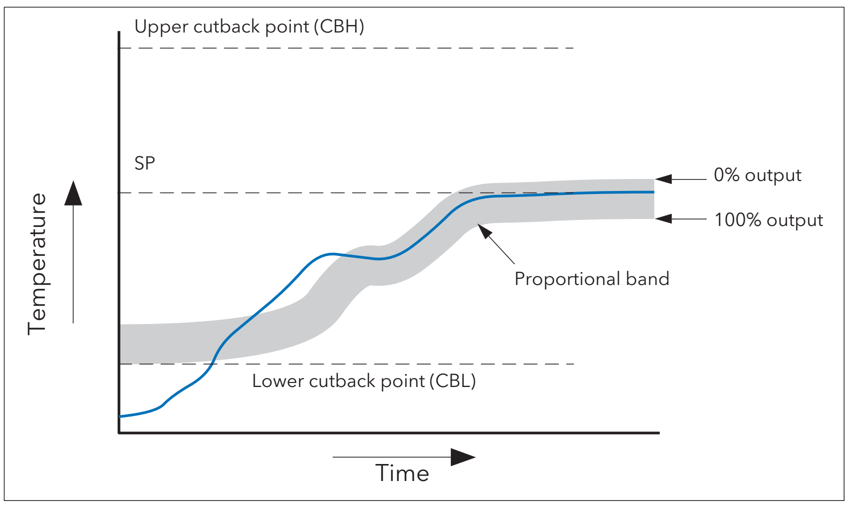


Figure B2.3.2 Cutback operation

Briefly, if PV < CBL then the output is set to its maximum.

If PV > CBH, then the output is set to its minimum

If PV lies within the range CBH-CBL, then PID calculations take control.

B2.3.3 Manual Reset

With PID control, the integral term automatically removes the steady state error from the setpoint. With PD control, the integral term is set to 'OFF', and the measured value will not settle precisely at the setpoint. The Manual Reset parameter (MR in the PID menu) represents the value of the power output that will be delivered when the error is zero. This value must be set manually in order to remove the steady state error.

B2.3 LOOP PARAMETERS (Cont.)

B2.3.4 Integral Hold

If 'Integral Hold' (Main menu) is set to 'Yes', the integral component of the PID calculation is frozen, that is, it holds its current value but does not integrate any disturbances in the plant. This is equivalent to switching into PD control with a manual reset value preconfigured.

Integral Hold may be used, in a situation where the loop is expected to open. For example, it may be necessary to turn heaters off for a short period or to switch into manual at low power. In this case it may be advantageous to wire Integral Hold to a digital input which activates when the heaters are turned off. When the heaters are switched on again, because the integral is at its previous value, overshoot is minimised.

B2.3.5 Integral De-bump

This feature is not accessible to the user. When changing from Manual to Auto control. the integral component is forced to: (out put value – proportional component – derivative component) (I = OP – P – D).

This ensures that no change occurs in output at the point of switch over, ('Bumpless Transfer**').** The output power then gradually changes in accordance with the demand from the PID algorithm.

If manual mode = 'Track', bumpless transfer also occurs when changing from Auto to Manual control. At the point of changeover the output power remains the same as the demand in the auto state. The value can then be altered by the operator. For other modes, the output steps to the 'Forced output' or 'Last MOP' value as appropriate. See 'Manual Mode in the Output menu for further details

B2.3.6 Loop Break

Loop Break attempts to detect loss of restoring action in the control loop by checking the control output, the process value and its rate of change. Since response times vary from process to process, the Loop Break Time (LBT) parameter (PID menu) allows a time to be set before a Loop Break Alarm (Loop Break - Diagnostics menu) becomes active. LBT is set automatically in Autotune.

The Loop Break Alarm parameter has no direct effect on control. In order to define behaviour under Loop Break conditions, the parameter must be wired, for example, to a relay, which can then activate an external indicator.

It is assumed that, so long as the requested output power is within the output power limits of a control loop, the loop is operating in linear control and is therefore not in a loop break condition. If, however, the output becomes saturated then the loop is operating outside its linear control region. If the output remains saturated at the same output power for a significant duration, then this might be symptomatic of a fault in the control loop. The source of the loop break is not important, but the loss of control could be catastrophic.

Since the worst case time constant for a given load is usually known, a worst case time can be calculated over which the load should have responded with a minimum movement in temperature. By performing this calculation the corresponding rate of approach towards setpoint can be used to determine if the loop can no longer control at the chosen setpoint. If the PV was drifting away from the setpoint or approaching the setpoint at a rate less than that calculated, the loop break condition would be met.

If an autotune is performed the loop break time is automatically set to Ti × 2 for a PI or PID loop, or to 12 × Td for a PD loop. For an On/Off controller loop break detection is based on loop range settings as 0.1 × Span where Span = Range High – Range Low. Therefore, if the output is at limit and the PV has not moved by 0.1Span in the loop break time a loop break will occur.

If the loop break time is 0 (off) the loop break time can be set manually. Then, if the output is in saturation and the PV has not moved by >0.5 × Pb in the loop break time, a loop break condition is considered to have occurred.

B2.3.7 Gain Scheduling

In some processes the tuned PID set may be different at low temperatures from that at high temperatures particularly in control systems where the response to the cooling power is significantly different from that of the heating power, or when changes in the process have occurred. Gain scheduling allows a number of PID sets to be stored and provides automatic transfer of control between one set of PID values and another. For this instrument, the maximum number of sets is three which means that two boundaries are provided to select when the next PID set is used. When a boundary is exceeded the next PID set is selected bumplessly. Hysteresis is used to stop scheduling oscillation at the boundaries.

Gain scheduling is basically a look up table which can be selected using different strategies or types. Auto tune tunes to the active scheduled PID set.

The following Gain Scheduled types are offered using the PID menu parameter 'Sched Type':

Set	Required set selected by the user. Alternatively soft wiring may be used to control the PID set selection
Setpoint	Transfer between sets is dependent on the setpoint value
PV	Transfer between sets is dependent on the process value
Error	Transfer between sets is dependent on the Error value
Output	Transfer between sets is dependent on the output demand value
Remote	A remote parameter may be wired into the scheduler. The PID set is then selected according to the value of this input.

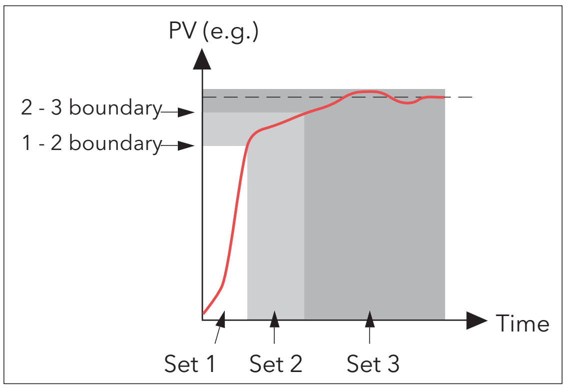


Figure B2.3.7 gain scheduling

B2.4 TUNING

B2.4.1 Introduction

The balancing of the P, I and D terms varies from process to process. In a plastics extruder, for example, there are different responses to a die, casting roll, drive loop, thickness control loop or pressure loop. In order to achieve the best performance from an extrusion line all loop tuning parameters must be set to their optimum values.

Tuning involves setting the following PID menu parameters:

Proportional Band (PB), Integral Time (Ti), Derivative Time (Td), Cutback High (CBH), Cutback Low (CBL), and Relative Cool Gain (R2G - applicable to heat/cool systems only).

The recorder/controller is shipped with these parameters set to default values. In many cases the default values give adequate, stable, straight-line control, but the response of the loop may not be ideal. Because process characteristics vary it is often necessary to adjust the control parameters to achieve best control. To determine the optimum values for any particular loop or process it is necessary to carry out a procedure called loop tuning. If significant changes are later made to the process which affect the way in which it responds it may be necessary to retune the loop.

Users have the choice of tuning the loop automatically or manually. Both procedures require the loop to oscillate and both are described in the following sections.

B2.4.2 Loop Response

Ignoring loop oscillation, there are three categories of loop performance *viz* Under damped, Critically damped and Over damped:

UNDER DAMPED

In this situation the parameters are set to prevent oscillation but lead to an overshoot of the Process Value (PV) followed by decaying oscillation until the PV finally settles at the Setpoint. This type of response can give a minimum time to Setpoint but overshoot may cause problems in certain situations and the loop may be sensitive to sudden changes in PV, resulting in further decaying oscillations before settling once again.

CRITICALLY DAMPED

This represents an ideal situation where noticeable overshoot to small step changes does not occur and the process responds to changes in a controlled, non oscillatory manner.

OVER DAMPED

In this situation the loop responds in a controlled but sluggish manner which results in a non-ideal and unnecessarily slow loop performance.

B2.4.3 Initial Settings

In addition to the tuning parameters listed above, there are a number of other parameters which can affect loop response. These parameters must be correctly configured before tuning is initiated. Parameters include, but are not limited to:-

SETPOINT

Before tuning, the loop conditions should be set as closely as practicable to the actual conditions which will be met in normal operation. For example, in a furnace or oven application a representative load should be included, an extruder should be running, etc.

OUTPUT HIGH, OUTPUT LOW

These Output menu heat and cool limits define the overall maximum and minimum power which may be delivered to the process by the control loop. For a heat only controller the default values are 0 and 100%. For a heat/cool controller the defaults are -100 and 100%. Although most processes are designed to work between these limits there may be instances where it is desirable to limit the power delivered to the process.

REM. OUTPUT LOW, REM. OUTPUT HIGH

If these Remote Output Limits parameters (Output menu) are used, they are effective only if they lie within the Heat/Cool Limits above.

CH2 DEADBAND

Heat/Cool Dead band If a second (cool) channel is configured, a parameter 'Ch2 Deadband' is also available in the Output menu which sets the distance between the heat and cool proportional bands. The default value is 0% which means that heating will cease to be available at the same time as cooling becomes available. The dead band may be set to ensure that there is no possibility of the heat and cool channels operating together, particularly when cycling output stages are installed.

MINIMUM ON TIME

If either or both of the output channels is fitted with a relay or logic output, the parameter 'Min On Time' appears in the output menu. This is the cycling time for a time proportioning output and should be set correctly before tuning is started.

FILTER

The 'Filter' parameter is found in the Channel 'Main' menu (section 4.4). It is used to remove noise from slowly changing signals so that the underlying trend can be seen more clearly.

B2.4.3 INITIAL SETTINGS (Cont.)

RATE

Sets the maximum PID rate-of-change. The output rate limit is active during tuning and can affect the tuning results. Rate is useful in preventing rapid changes in output from damaging the process or heater elements. The parameter 'Rate' is found in the 'Setpoint' menu.

CH1 TRAVEL TIME, CH2 TRAVEL TIME

Valve Travel Time. If the output is a motor valve positioner the 'Ch1 Travel Time' and Ch2 Travel Time' Output menu parameters must be set correctly. The valve travel time is the time taken for the valve to travel from 0% (closed) to 100% (open). This may be different from the motor travel time limits because the mechanical linkage between the motor and the valve, setting of limit switches etc. can modify behaviour. In a valve positioner application, the channel output is wired to the 'PV' input of relay 2A2B or 4AC. Configuring this relay as Type = Valve Raise causes the associated relay (3A3C or 5AC respectively) to be configured automatically as Type = Valve Lower, and the action of the relay pair is controlled by the single wire. In a heat/cool application, channel one is the heat valve and channel two is the cool valve.

B2.4.4 Other tuning considerations

If a process includes adjacent interactive zones, each zone should be tuned independently with the adjacent zones at operating temperature.

It is recommended that a tuning process be initiated when the PV and setpoint are far apart. This allows start up conditions to be measured and cutback values to be calculated more accurately. Cutback is not set for 'Tune at setpoint'.

In a programmer/controller tuning should only be attempted during dwell periods and not during ramp stages. If a programmer/controller is tuned automatically the controller should be placed in 'Hold' during each dwell period whilst autotune is active.

Note: Tuning, carried out in dwell periods which are at different extremes of temperature may give different results owing to non linearity of heating (or cooling). This may provide a convenient way to establish values for Gain Scheduling.

If an auto tune is initiated there are two further parameters (High Output' and 'Low Output') which need to be set. These are found in the 'Tune' menu.

High Output	Sets a high output limit to be imposed during autotune. Must be ≤ Output High, set in the Output menu.
Low Output	Sets a low output limit to be imposed during autotune. Must be ≥ Output Low, set in the Output menu.

The above values must be set correctly, otherwise sufficient power to achieve SP might not be available during tuning, and the tune will eventually fail.

B2.4.5 Autotune

Autotune automatically sets the following PID menu parameters:

PB	Proportional band.
Ti	Integral time. If previously set to 'Off' Ti will remain off after an autotune.
Td	Derivative time. If previously set to 'Off' Td will remain off after an autotune.
CBH, CBL	Cutback high and low values. If either is set to 'Auto', it will remain so after auto tuning. In order that Autotune set the cutback values for the user, a value other than 'Auto' must be selected before Autotune is initiated. Autotune never returns cutback values less than 1.6 × PB
R2G	Calculated only if the unit is configured as Heat/Cool. Following an Autotune, R2G lies between 0.1 and 10. If the calculated value lies outside this range, a 'Tune Fail' alarm is set.
LBT	Loop break time. Following an autotune, LBT is set to 2 × Ti (if Ti was not previously set 'Off'), or to 12 × Td (if Ti was previously set to 'Off').

B2.4.5 AUTOTUNE (Cont.)

Autotune can be performed at any time, but normally it is performed only once, during the initial commissioning of the process. However, if the process under control subsequently becomes unsatisfactory (because its characteristics have changed), it may be necessary to tune again for the new conditions.

The auto tune algorithm reacts in different ways depending on the initial conditions of the plant. The explanations given later in this section are for the following example conditions:-

1. Initial PV is below the setpoint and, therefore, approaches the setpoint from below for a heat/cool control loop
2. As above, but for a heat only control loop
3. Initial PV is at the same value as the setpoint (tune at setpoint). That is, within 0.3% of the range of the controller if 'PB Units' (Setup menu) is set to 'Percent', or $\pm$1 engineering unit (1 in 1000) if the 'PB Units' is set to 'Eng'. Range is defined as 'Range High' – 'Range Low' for process inputs or the thermocouple or RTD range defined in section A3 for temperature inputs. If the PV is just outside the range stated above the autotune will attempt a tune from above or below SP.

AUTOTUNE AND SENSOR BREAK

When the controller is autotuning and sensor break occurs, the autotune aborts and the controller outputs the sensor break output power 'Sbrk OP' set up in the Output menu. Autotune must be re-started when the sensor break condition is no longer present.

AUTOTUNE AND INHIBIT

If the controller is in autotune when 'Inhibit' is asserted, the tune goes to the Off state (Stage = Reset). On inhibit being released the controller will re-start autotune.

AUTOTUNE AND GAIN SCHEDULING

When gain scheduling is enabled and an autotune is performed, the calculated PID values are written into the PID set that is active, on completion of the tune. Therefore, the user may tune within the boundaries of a set and the values will be written into the appropriate PID set. However, if the boundaries are close (because the range of the loop is not large), then, at the completion of the tune, it cannot be guaranteed that the PID values will be written to the correct set particularly if the schedule type is PV or OP. In this situation the scheduler ('Sched Type') should be switched to 'Set' and the 'active set' chosen manually.

INITIAL CONDITIONS

Configure the parameters described in sections B2.4.3 and B2.4.4, above.

Notes:
1. The 'tighter' power limit applies. For example, if 'High Output' is set to 80% and 'Output High' is set to 70% then the output power will be limited to 70%
2. The PV must oscillate to some degree to allow the tuner to calculate the relevant values. The limits must be set so as to allow oscillation about the setpoint.

INITIATING THE AUTOTUNE

In the Loop Tune menu for the relevant loop, set 'TuneEn' to 'On'.

B2.4.5 AUTOTUNE (Cont.)

EXAMPLE 1: AUTOTUNE FROM BELOW SP (HEAT/COOL)

The point at which Automatic tuning is performed (Tune Control Point) lies just below the setpoint at which the process is normally expected to operate (Target Setpoint). This ensures that the process is not significantly overheated or overcooled. The Tune Control Point is calculated as follows:-

Tune Control Point = Initial PV + 0.75(Target Setpoint – Initial PV).

The Initial PV is the PV measured after a 1 minute settling period (point 'B' in the figure below).

Examples:

If Target Setpoint = 500°C and Initial PV = 20°C, then the Tune Control Point is 380°C.

If Target Setpoint = 500°C and Initial PV = 400°C, then the Tune Control Point is 475°C.

This is because the overshoot is likely to be less as the process temperature approaches the target setpoint.

Figure B2.4.5a shows the auto tune sequence.

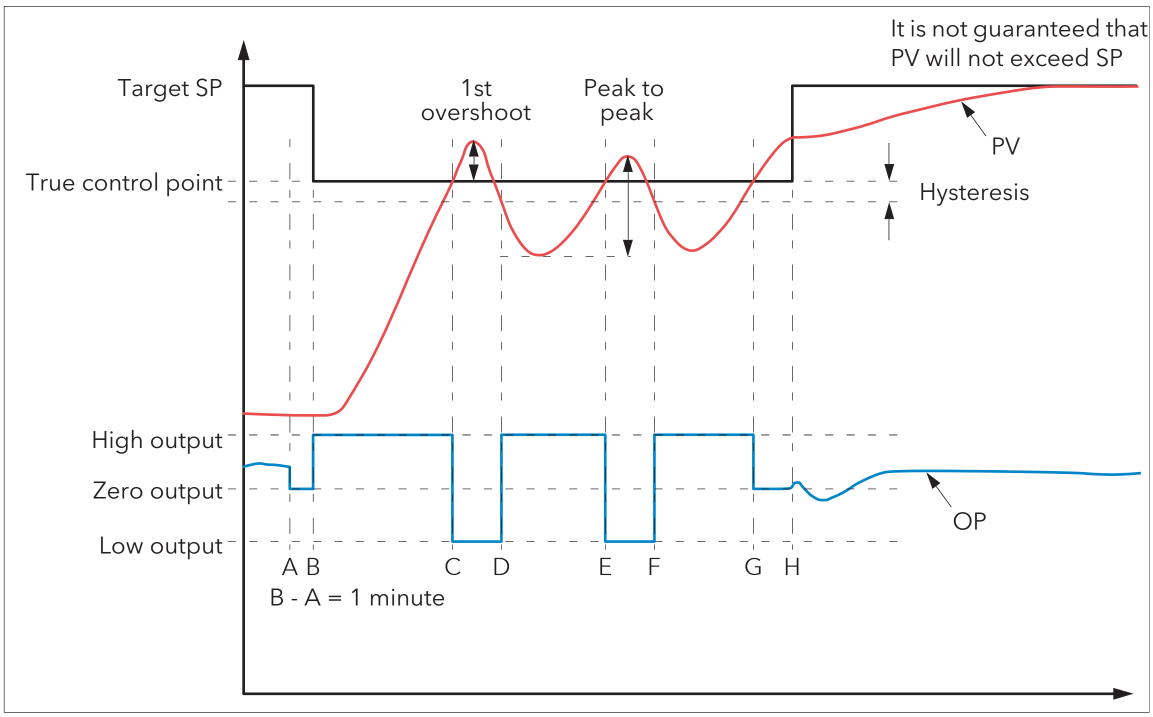


Figure B2.4.5a Autotune heat/cool process

KEY

A	Start of Autotune
A to B	Heating and Cooling off for one minute allows steady state conditions to be established.
B to D	First heat/cool cycle to establish first overshoot. Cutback low (CBL) value calculated from the overshoot magnitude (unless CBL set to 'Auto').
B to F	Two cycles of oscillation allow peak-to-peak value and oscillation period to be determined. PID terms are calculated.
F	Heating is switched on.
G	Heating (and cooling) are switched off allowing the plant to respond naturally. Measurements over the period F to G are used to calculate the Relative Cool Gain (R2G). Cutback High is calculated from the equation (CBH = CBL × R2G).
H	Autotune is turned off and the process is allowed to control at the target setpoint using the new control terms.

Note: Controlling from above SP is identical except that heating and cooling are reversed.

B2.4.5 AUTOTUNE (Cont.)

EXAMPLE 2: AUTOTUNE FROM BELOW SP (HEAT ONLY)

The sequence of operation for a heat only loop is the same as that described above for a heat/cool loop, except that the sequence ends at 'F' since there is no need to calculate 'R2G' (R2G is set to 1.0 for heat only processes). At 'F' autotune is turned off and the process is allowed to control using the new control terms.

For a tune from below setpoint 'CBL' is calculated on the basis of the size of the overshoot (assuming it was not set to Auto in the initial conditions). CBH is then set to the same value as CBL.

Note: Autotune can also occur when the initial PV is above SP. The sequence is the same as tuning from below setpoint except that the sequence starts with natural cooling applied at 'B' after the first one minute settling time. In this case CBH is calculated and CBL is then set to the same value as CBH.

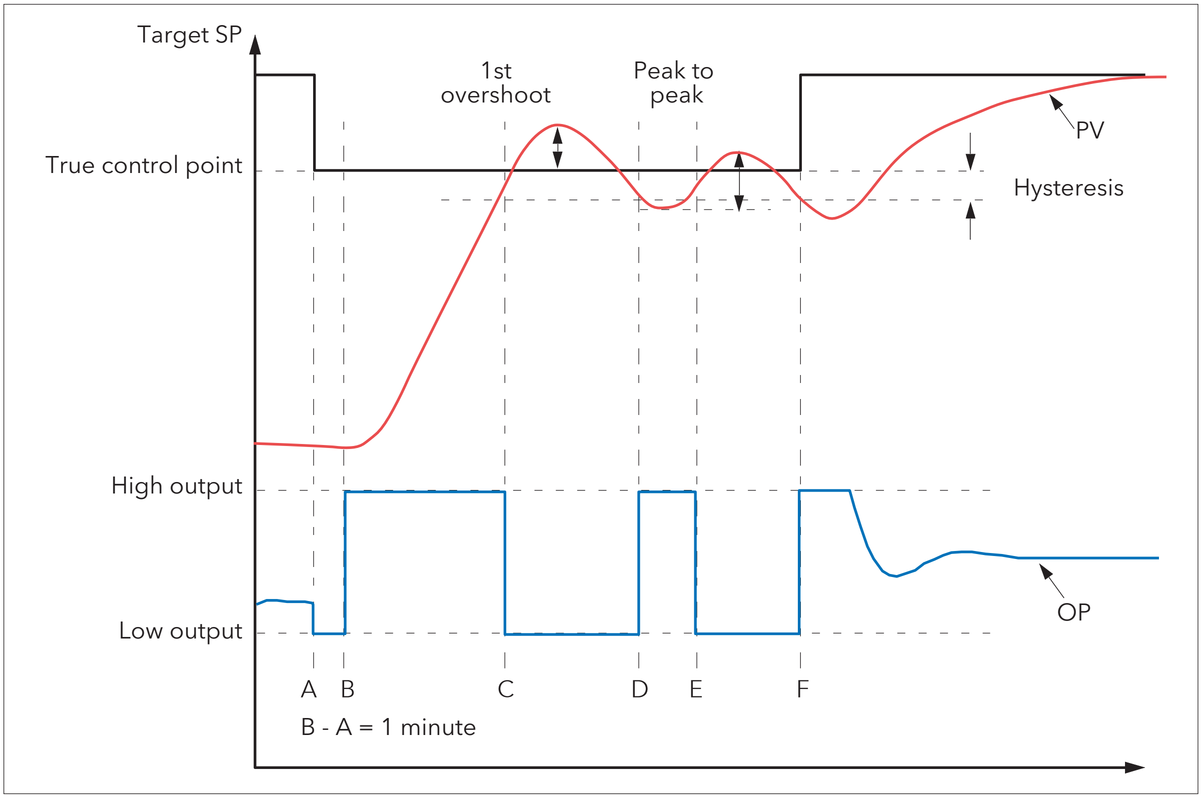


Figure B2.4.5b Autotune heat only process (from below SP)

A	Start of Autotune
A to B	Heating off for one minute to allow steady state conditions to be established.
B to D	First heat cycle to establish first overshoot. Cutback low (CBL) value calculated from the overshoot magnitude (unless CBL set to 'Auto').
D to F	Calculate PID terms.
F	Autotune is turned off and the process is allowed to control at the target setpoint using the new control terms.

B2.4.5 AUTOTUNE (Cont.)

EXAMPLE 3: AUTOTUNE AT SP (HEAT /COOL)

It is sometimes necessary to tune at the actual setpoint being used as shown below.

For a tune at setpoint, autotune does not calculate cutback since there was no initial start up response to the application of heating or cooling. Cutback values of less than 1.6 × PB will not be returned.

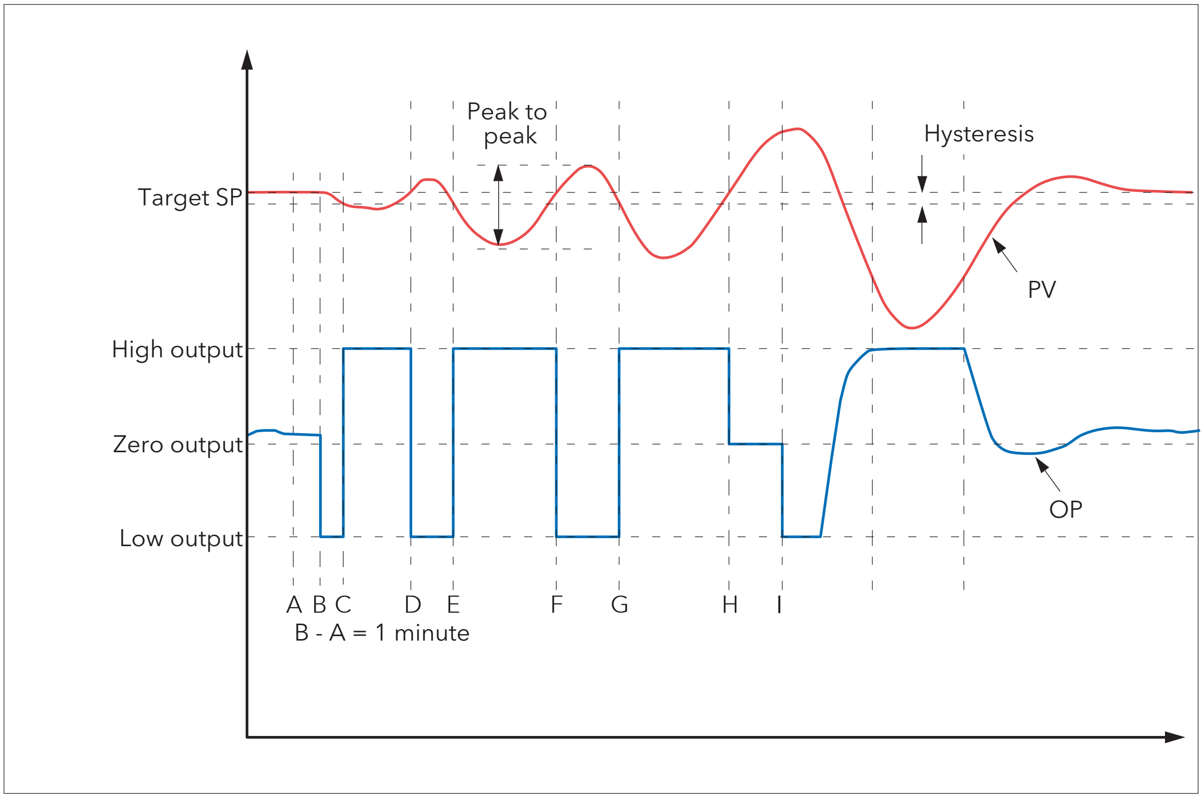


Figure B2.4.5c Autotune at setpoint

A	Start of Autotune. A test is done at the start of autotune to establish conditions for a tune at setpoint. Conditions are that SP must remain within 0.3% of the range of the controller if 'PB Units' (Setup menu) is set to 'Percent', or ±1 engineering unit (1 in 1000) if the 'PB Units' is set to 'Eng'. Range is defined as 'Range High' – 'Range Low' for process inputs or the thermocouple or RTD range defined in section A3 for temperature inputs.
A to B	The output is frozen at he current value for one minute, and the conditions are continuously monitored during this period. If the conditions specified above are met, then an autotune at setpoint is initiated at 'B'. If PV drifts outside the condition limits at any time during this period, tuning at SP is abandoned, and tuning resumes as a 'tune from above' or 'tune from below', depending on the direction of drift. Since the loop is already at setpoint, a Tune Control setpoint is not calculated; the loop is forced to oscillate about the Target SP.
C to G	The process is forced to oscillate by switching the output between the output limits. The oscillation period and the peak-to-peak response are determined, and the PID terms calculated.
G to H	An extra heating stage is initiated, then all heating and cooling are switched off at H, allowing the plant to respond naturally. The relative cool gain (R2G) is calculated.
I	Autotune is switched off and the process is allowed to control at the target setpoint using the newly calculated terms.

B2.4.5 AUTOTUNE (Cont.)

AT.R2G

Some load types and process conditions can cause autotune to set an incorrect value for R2G resulting in an instability in the system after an autotune has completed, In such circumstances, the value of R2G should be checked, and if it is low (approaching 0.1) a manual entry should be made as follows:

1. In the Tune menu, set the AT.R2G parameter to 'No'.
2. In the PID menu, enter the new R2G value (calculated as described below)
3. In the Tune menu, enter a value for Low Output, calculated from: Low Output = -High Output x R2G
4. In the Tune menu, set 'TuneEn' On.

R2G CALCULATION

1. In the Main menu, set the controller to Manual mode
2. Turn heating on (limited by the value of 'Output High' in the Output menu) and measure the heating rate ('H' °C/minute).
3. Allow the process to heat to, say, 10% above the setpoint value then turn the heating off and allow the temperature to settle.
4. Turn cooling power on (limited by the value of 'Output Low' in the Output menu) and measure the cooling rate ('C' °C/minute) whilst allowing the temperature to fall below the setpoint value.
5. Calculate the value of R2G from the equation R2G = (H/C) x (Output Low/output High)

Example:

For a measured heating rate (H) of 10°C per min and a measured cooling rate (C) of 25° per minute and with, Output High = 80% and Output Low = 40%, then R2G = (10/25) x (40/80) = 0.4 x 0.5 = 0.2.

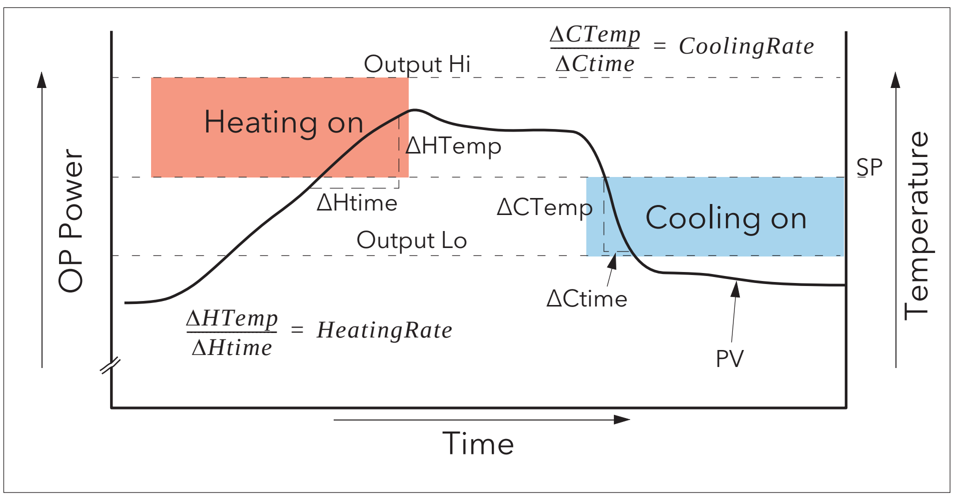


Figure 2.4.5d R2G calculation

Note: This is not a very accurate method as it does not take natural cooling into account. Its main advantage is that it is simple to achieve.

B2.4.5 AUTOTUNE (Cont.)

FAILURE MODES

The conditions for performing an autotune are monitored by the Tune menu parameter 'State'. If autotune is not successful error conditions are read by this parameter as follows:

Timeout	Set if any one stage is not completed within an hour. Possible causes are the loop being open circuit, or not responding to the controller demands. Some heavily lagged systems may produce a timeout if the cooling rate is very slow.
TI Limit	This is set if Autotune calculates a value for the integral term which is greater than the maximum allowable (99999 seconds). This indicates that the loop is not responding or that the tune is taking too long.
R2G Limit	Error occurs if the calculate value of R2G is outside the range 0.1 to 10.0. R2G limit can occur if the gain difference between heating and cooling is too large, or if the controller is configured for heat/cool, but the heating and/or cooling device is turned off or not working correctly.

B2.4.6 Manual tuning

If, for any reason, automatic tuning gives unsatisfactory results the controller can be tuned manually. There are a number of standard methods for manual tuning, the Zeigler-Nichols method being described here:

1. Adjust the setpoint to its normal running conditions (assumed to be above the PV so that 'heat only' is applied.
2. Set the integral and derivative times (Ti and Td) to 'Off'
3. Set High and Low cutback (CBH and CBL) to 'Auto'.
4. If the PV is stable (not necessarily at the setpoint), reduce the proportional band (PB) such that the PV just starts to oscillate, leaving time between adjustments to allow the loop to stabilise. Make a note of the PB at this point (PB′), and also note the oscillation period ('T').
   If the PV is already oscillating measure the oscillation period ('T') and then gradually increase PB to the point at which oscillation just ceases. Make a note of the PB (PB′) at this point.
5. If the controller is fitted with a cooling channel, enable this now.
6. Observe the oscillation waveform and adjust 'R2G' until a symmetrical wave form is observed (Figure B2.4.6).
7. Set PB, Ti and Td according to table B2.4.6.

Control type	PB	Ti	Td
Proportional only	2 × PB′	Off	Off
P + I	2.2 × PB′	0.8 × T	Off
P + I + D	1.7 × PB′	0.5 × T	0.12 × T

Table B2.4.6 Calculate parameter values

B2.4.6 MANUAL TUNING (Cont.)

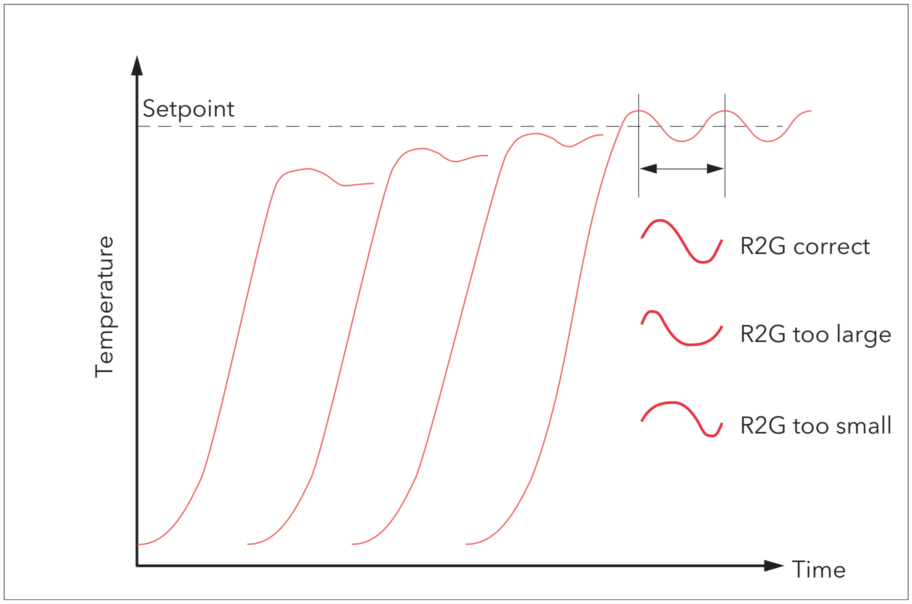


Figure 2.4.6a Relative Cool Gain

CUTBACK VALUES

The PID terms calculated from Table 2.4.6, above, should be entered before the cutback values are set.

The above procedure sets up the parameters for optimum steady state control. If unacceptable levels of overshoot or undershoot occur during start-up, or for large step changes in PV, then the cutback parameters should be set manually, as follows:

1. Initially set the cutback values to one proportional bandwidth converted into display units. This can be calculated by taking the value in percent that has been installed into the parameter 'PB' and entering it into the following formula:

   PB/100 × Span of controller = Cutback High and Cutback Low
   For example, if PB = 10% and the span of the controller is 0 to 1200°C, then
   Cutback High = Cutback Low = 10/100 × 1200 = 120
2. If overshoot is observed following the correct settings of the PID terms increase the value of 'CBL' by the value of the overshoot in display units. If undershoot is observed increase the value of the parameter 'CBH' by the value of the undershoot in display units.

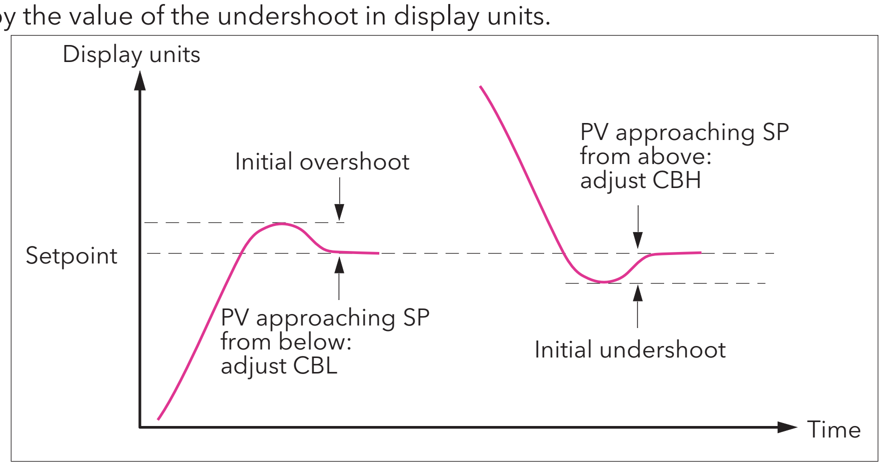


Figure 2.4.6b Manual Cutback setting

B2.5 SETPOINT

The controller setpoint is the Working Setpoint which can be derived from:-

1. SP1 or SP2, both of which are manually set by the user and can be switched into use by an external signal or via the user interface.
2. From an external (remote) analogue source
3. The output of a programmer function block.

B2.5.1 Setpoint function block

As well as providing a setpoint, the function block also provides:

1. The ability to limit the rate of change of the setpoint before it is applied to the control algorithm.
2. Upper and lower limits. These are defined as setpoint limits, 'SP High Limit' and 'SP Low Limit', for the local setpoints and instrument range high and low for other setpoint sources.

> Note: All setpoints are limited by 'Range High' and 'Range Low' so that if 'SP High Limit', for example, is set higher than 'Range High', then 'SP High Limit' is ignored and the setpoint is limited at the 'Range High' value.

User configurable methods for tracking are available, such that the transfers between setpoints and between operating modes do not cause 'bumps' in the setpoint.

Figure B2.5.1, below, shows the function block schematic.

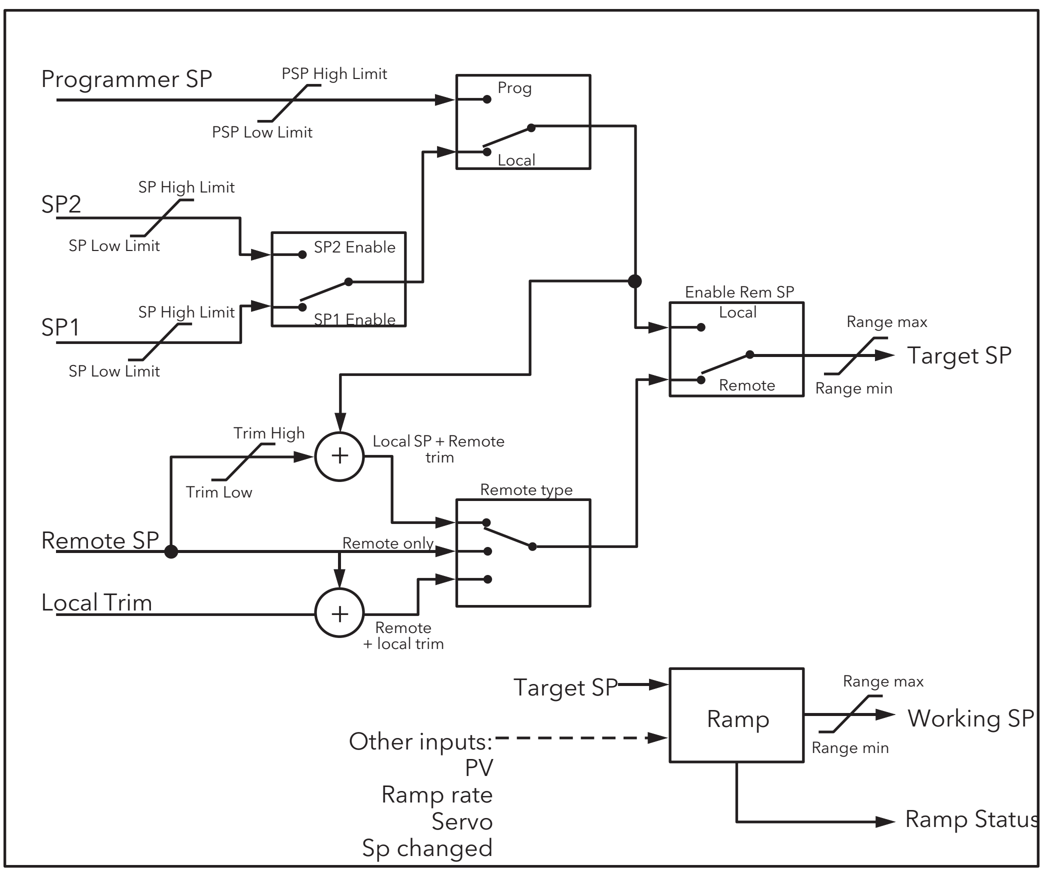


Figure 2.5.1 Setpoint Function block

B2.5.2 Setpoint Limits

The setpoint generator provides limits for each of the setpoint sources as well as an overall set of limits for the loop. These are summarised in figure 2.5.2, below.

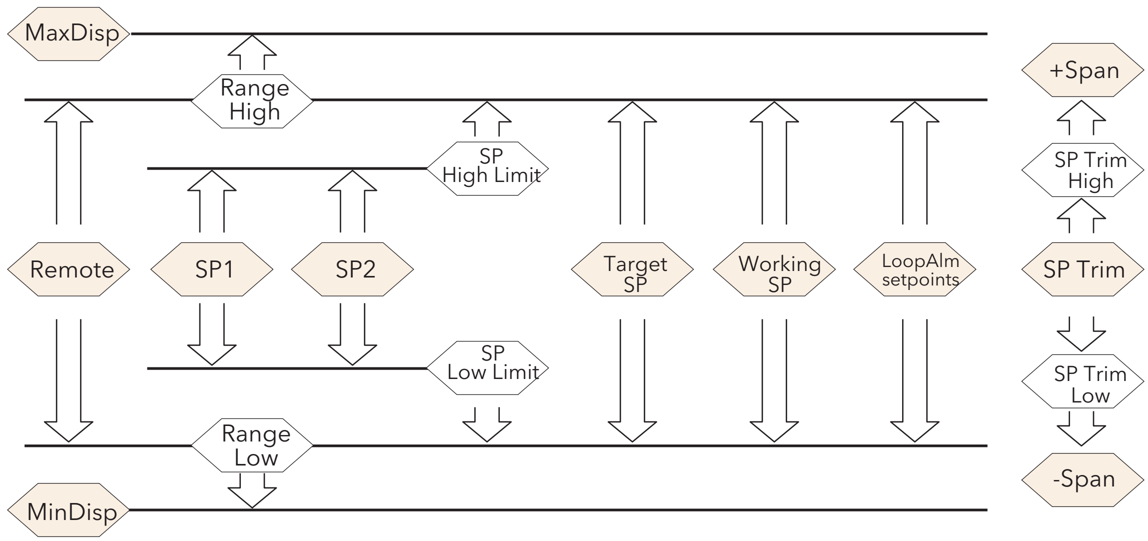


Figure 2.5.2 Setpoint Limits

'Range High' and 'Range Low' provide the range information for the control loop. They are used in control calculations to generate proportional bands. Span = Range High – Range Low.

B2.5.3 Setpoint Rate Limit

This symmetrical rate limiter allows the rate of change of setpoint to be controlled, preventing step changes in the setpoint. The limit is applied to the working setpoint which includes setpoint trim.

Rate limiting is enabled using the 'Rate' parameter. If this is set to '0' then any change made to the setpoint will be effective immediately. If it is set to any other value, then a change in the setpoint will be have rate limiting applied at the value set, in units per minute. Rate limit applies to SP1, SP2 and Remote SP.

When rate limit is active 'Rate Done' displays 'No'. When the setpoint has been reached the value changes to 'Yes'.

When 'Rate' is set to a value (other than 'Off') an additional parameter 'SP Rate Disable' is displayed which allows the setpoint rate limit to be turned off and on without the need to adjust the 'Rate' parameter between Off and a working value.

If the PV is in sensor break, the rate limit is suspended and the working setpoint takes the value of 0. On sensor break being released the working setpoint goes from 0 to the selected setpoint value at the rate limit.

B2.5.4 Setpoint Tracking

The setpoint used by the controller may be derived from a number of sources. For example:-

1. Local setpoints SP1 and SP2. These may be selected through the front panel using the parameter 'SP Select', through digital communications or by configuring a digital input which selects either SP1 or SP2. This might be used, for example, to switch between normal running conditions and standby conditions. If Rate Limit is switched off the new setpoint value is adopted immediately when the switch is changed.
2. A programmer generating a setpoint which varies over time. When the programmer is running, the 'Track SP' and 'Track PV' parameters update continuously so that the programmer can perform its own servo. This is sometimes referred to as 'Program Tracking'.
3. From a Remote analogue source. The source could be an external analogue input into an analogue input module wired to the 'Alt SP' parameter or a User Value wired to the 'Alt SP' parameter. The remote setpoint is used when the parameter 'Alt SP Enable' is set to 'Yes'.

Setpoint tracking (sometimes referred to as Remote Tracking) ensures that the Local setpoint adopts the Remote setpoint value when switching from Local to Remote to maintain bumpless transfer from Remote to Local. Bumpless transfer does not take place when changing from Local to Remote.

Note: If Rate Limit is applied, the setpoint will change at the set rate, when changing from Local to Remote.

B2.5.5 Manual Tracking

When the controller is operating in manual mode the currently selected SP (SP1 or SP2) tracks the PV. When the controller resumes automatic control there will be no step change in the resolved SP. Manual tracking does not apply to the remote setpoint or programmer setpoint.

B2.6 OUTPUT

B2.6.1 Introduction

The output function block selects the correct output sources to be used, determines whether to heat or cool and then applies limits. Power feed forward and non-linear cooling are also applied.

It is this block that manages the output in exception conditions such as start up and sensor break.

The outputs, 'Ch1 Output' and 'Ch2 Output', are normally wired to a digital I/O where they are converted into analogue or time proportioned signals for electrical heating, cooling or valve movement.

B2.6.2 Output Limits

Figure B2.6.2 shows where output limits are applied.

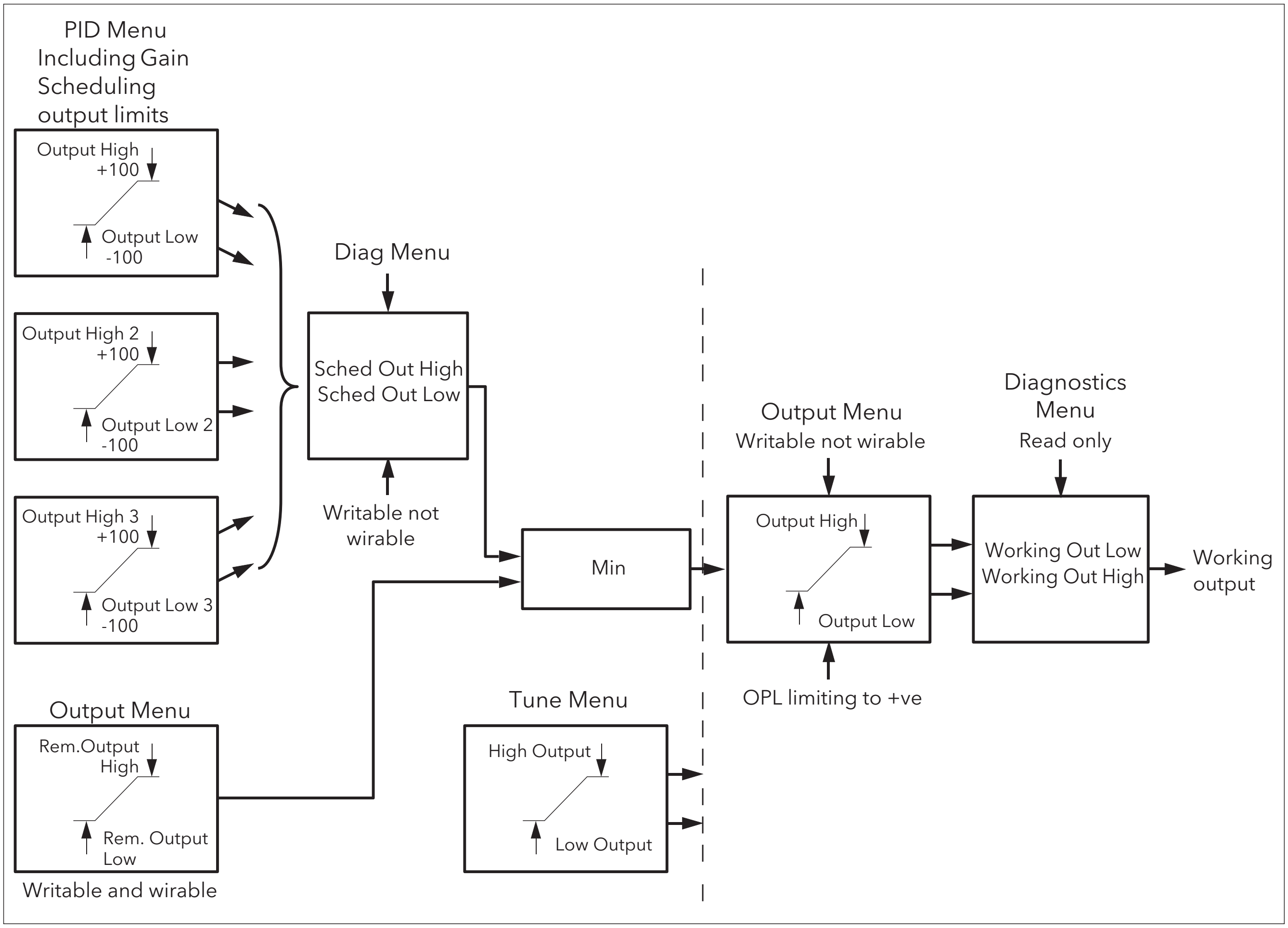


Figure B2.6.2 Output Limits

Notes:

1. Individual output limits may be set in the PID list for each set of PID parameters when gain scheduling is in use.
2. Limits may also be applied from an external source. These are 'Rem.Output High' and 'Rem. Output Low' found in the Output menu. These parameters are wireable; for example they may be wired to an analogue input module so that a limit may applied through some external strategy. If these parameters are not wired ±100% limit is applied every time the instrument is powered up.

(Continued)

B2.6.2 OUTPUT LIMITS (Cont.)

Notes (Continued)

3. The tightest limits (between Remote and PID) are connected to the output where an overall limit is applied using parameters 'Output High' and 'Output Low'.
4. 'Working Out High' and 'Working Out low' found in the Diagnostics list are read only parameters showing the overall working output limits.
5. The tune limits are a separate part of the algorithm and are applied to the output during the tuning process. The overall limits 'Output Hi' and 'Output Lo' always have priority.

B2.6.3 Output Rate Limit

The output rate limiter is a rate-of-change limiter, set in (%/sec) which prevents step changes in output power being demanded. Rate limiting is performed by determining the direction in which the output is changing, and then incrementing or decrementing the Working Output (Main menu) until it equals the required output (Target OP).

The amount to increment or decrement is calculated using the sampling rate of the algorithm (125ms) and the selected rate limit. If the change in output is less than the rate limit increment the change takes effect immediately.

The rate limit direction and increment is calculated on every execution of the rate limit. Therefore, if the rate limit is changed during execution, the new rate of change takes immediate effect. If the output is changed whilst rate limiting is taking place, the new value takes immediate effect on the direction of the rate limit and in determining whether the rate limit has completed.

The rate limiter is self-correcting such that if the increment is small it is accumulated until it takes effect.

The output rate limit is active when the loop is in both auto and manual modes, and during autotune.

B2.6.4 Sensor Break Mode

If a Sensor break is detected by the measurement system the loop reacts in one of two ways, according to the configuration of 'Sbrk Mode' ('Safe' or 'Hold'). On exit from sensor break the transfer is bumpless – the power output starts controlling again from the current operating setpoint and moves, under PID closed-loop control, from its pre-set value to the control value.

SAFE

If set to 'Safe', the output adopts a pre-set level (Sbrk OP). If rate limit is not configured, the output steps to the Sbrk OP value, otherwise it ramps to this value at the rate limit.

HOLD

If set to 'Hold' the output remains at its current value. If Output Rate Limit (Rate) has been configured a small step may be seen as the working output will limit to the value existing two iterations ago.

B2.6.5 Forced Output

This feature enables the user to specify what the output of the loop should do when moving from automatic control to manual control. The default is that the output power is maintained but it is then adjustable by the user.

If Manual Mode is set to 'Step', the user can set a manual output power value and on transition to manual the output will be forced to that value.

If Manual Mode is set to 'Track' the output steps to the forced manual output and then subsequent edits to the output power are tracked back into the manual output value.

If Manual Mode is set to 'Last Man. Out' then when moving from automatic to manual mode, the output adopts the last manual output value.

B2.6.6 Power Feed Forward

Power feed forward is used when driving an electrical heating element. It monitors the line voltage and compensates for fluctuations before they affect the process temperature. The use of this will give better steady state performance when the line voltage is not stable.

It is mainly used for digital type outputs which drive contactors or solid state relays. Because it only has value in this type of application it can be switched off using the parameter 'Pff En'. It should also be disabled for any non-electric heating process. It is not necessary when Eurotherm analogue thyristor control is used since compensation for power changes is included in the thyristor driver.

Consider a process running at 25% power, with zero error and then the line voltage falls by 20%. The heater power would drop by 36% because of the square law dependence of power on voltage. A drop in temperature would result. After a time, the thermocouple and controller would sense this fall and increase the ON-TIME of the contactor just enough to bring the temperature back to set point. Meanwhile the process would be running a bit cooler than optimum which may cause some imperfection in the product.

With power feed forward enabled the line voltage is monitored continuously and ON-TIME increased or decreased to compensate immediately. In this way the process need never suffer a temperature disturbance caused by a line voltage change.

'Power Feed forward' should not be confused with 'Feed forward' which is described in section B2.6.8.

B2.6.7 Cool Type

Cooling methods vary from application to application. For example, an extruder barrel may be cooled by forced air (from a fan), or by circulating water or oil around a jacket. The cooling effect will be different depending on the method. 'Cool Type' (appears only if the 'setup' parameter 'Ch2 Control' is set to 'PID') is used to accommodate different types of cooling methods as follows:

LINEAR

The cooling algorithm may be set to linear where the controller output changes linearly with the PID demand signal.

OIL COOLING

'Cool Type' = 'Oil'. As oil is, to all intents and purposes, non-evaporative, oil cooling is pulsed in a linear manner.

WATER COOLING

If the area being cooled is running well above 100°C, then the first few pulses of water flash into steam giving greatly increased cooling due to the latent heat of evaporation. When the area cools, less (or even no) evaporation takes place and the cooling is less effective.

Setting 'Cool Type' to 'Water' delivers much shortened pulses of water for the first few percent of the cooling range, when the water is likely to be flashing into steam. This compensates for the transition out of the initial strong evaporative cooling.

FAN COOLING

'Cool Type = 'Fan'. Fan cooling is much gentler than water cooling and not so immediate or decisive (because of the long heat transfer path through the process mechanics). With fan cooling, a cool gain setting of three upwards is typical. Delivery of pulses to the blower is non linear, this non-linearity being caused by a combination of forced air movement and fan efficiency as a function of air velocity (e. g. the efficiency of a fan when producing a low speed (laminar) air flow is different from its efficiency when producing a high-speed, turbulent flow.

B2.6.8 Feed forward

Feed forward is a method of adding an extra scalable component to the PID output, before any limiting. It can be used, for example, in the implementation of cascade loops and constant head control or it can be used to pre-load the control signal with a value close to that which is required to achieve the setpoint, thus improving system response. Feed forward (FF) is applied such that the PID output is limited by trim limits and acts as a trim on a FF value. The FF value is derived either from the PV or setpoint by scaling the PV or SP by the 'FF Gain' and 'FF Offset'. Alternatively, a remote value may be used for the FF value, but this is not subject to any scaling. The resultant FF value is added to the limited PID OP and becomes the PID output as far as the output algorithm is concerned. The feedback value then generated must then have the FF contribution removed before being used again by the PID algorithm. The diagram below shows how feed forward is implemented.

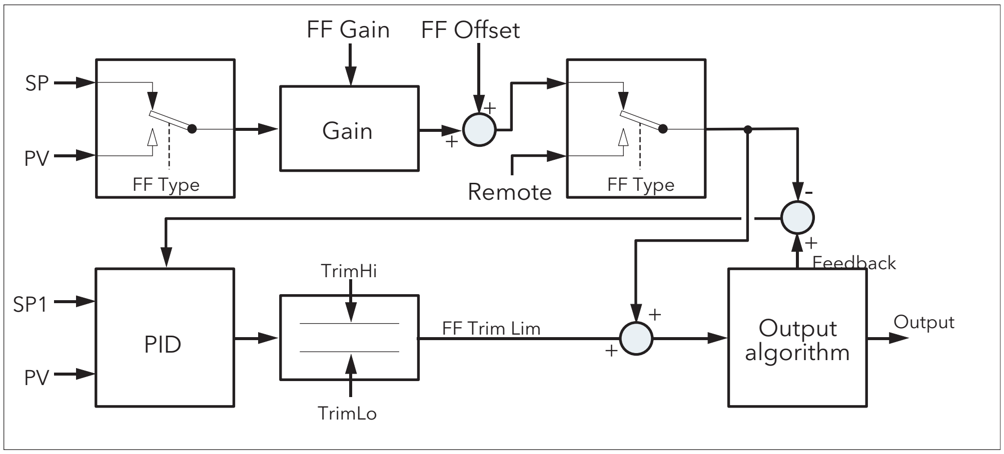


Figure B2.6.8 Implementation of Feed forward

B2.6.9 Effect of Control Action, Hysteresis and Deadband

CONTROL ACTION

For temperature control 'Control Act' should be set to 'Rev'. For a PID controller this means that the heater power decreases as the PV increases. For an on/off controller, output 1 (usually heat) will be on (100%) when PV is below the setpoint and output 2 (usually cool) will be on when PV is above the setpoint.

HYSTERESIS

Hysteresis applies to on/off control only and is set in the units of the PV. In heating applications the output will turn off when the PV is at setpoint. It will turn on again when the PV falls below SP by the hysteresis value. This shown in Figures B2.6.9a and B2.6.9b below for a heat and cool controller.

Hysteresis is intended to prevent the output from repeated switching on and off 'chattering' at the control setpoint. If the hysteresis is set to 0 then even the smallest change in the PV when at setpoint will cause the output to switch. Hysteresis should be set to a value which provides an acceptable life for the output contacts, but which does not cause unacceptable oscillations in the PV.

If this performance is unacceptable, it is recommended that PID control be used instead.

DEADBAND

Deadband 'Ch2 Deadband' can operate on both on/off control or PID control where it has the effect of extending the period when no heating or cooling is applied. In PID control the effect is modified by both the integral and derivative terms. Deadband might be used in PID control, for example, where actuators take time to complete their cycle thus ensuring that heating and cooling are not being applied at the same time. Deadband is likely to be used, therefore, in on/off control only. Figure B2.6.9b, below, adds a deadband of 20 to the first example in figure B2.6.9a.

B2.6.9 EFFECT OF CONTROL ACTION, HYSTERESIS AND DEADBAND (Cont.)

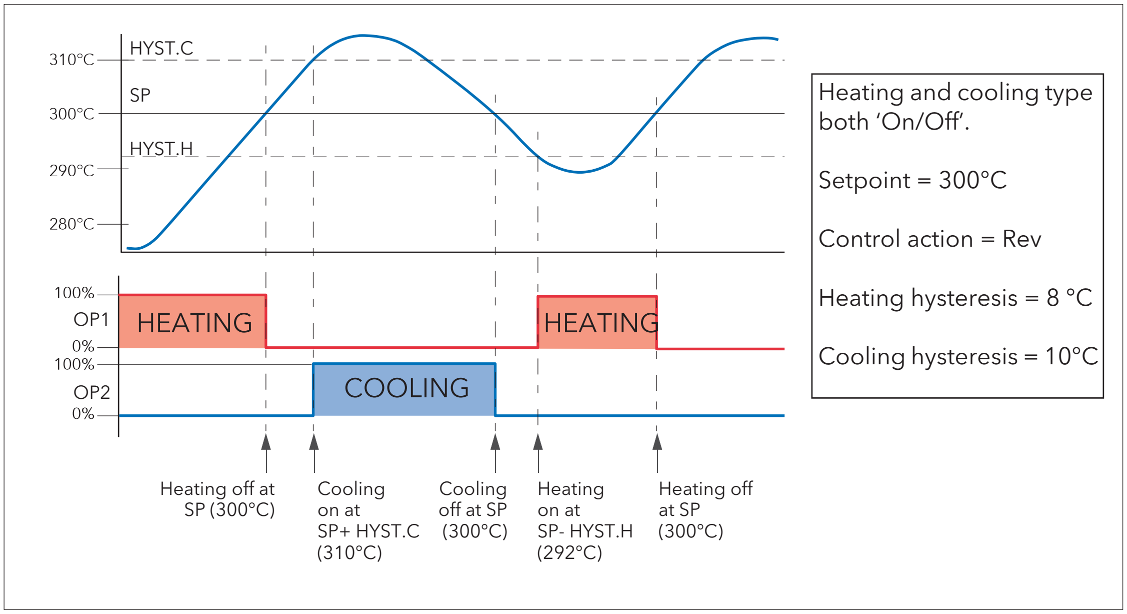


Figure B2.6.9a Deadband OFF

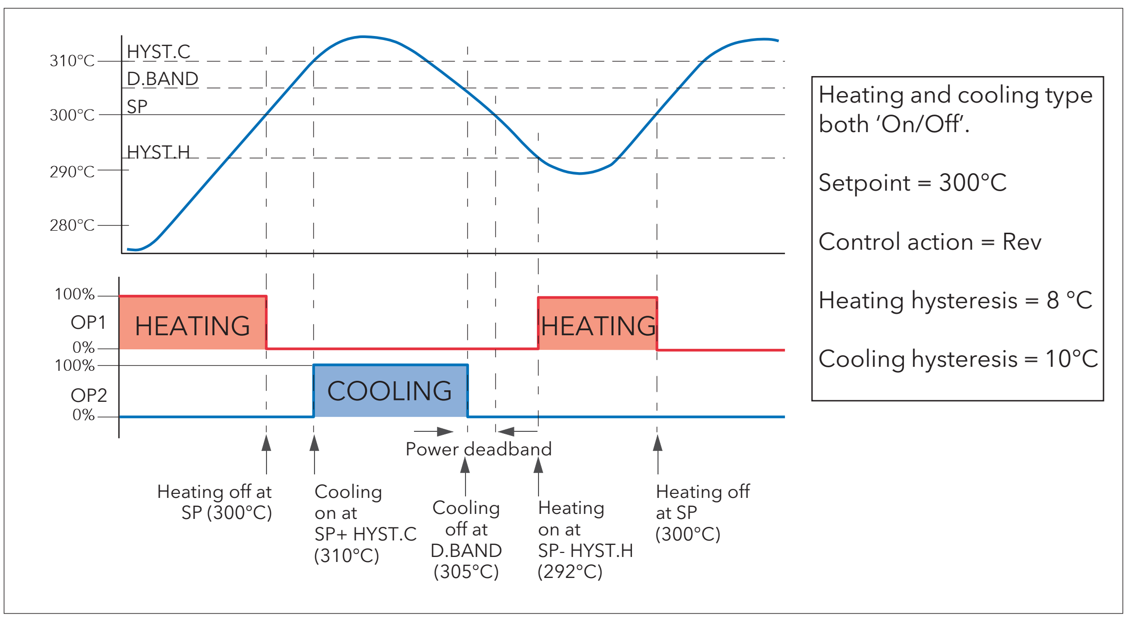


Figure B2.6.9b Deadband ON set at 50% of Cooling.

B2.6.10 Valve nudge

For systems configured as Unbounded Valve Positioning (VPU) - set up in Loop Setup configuration Ch1(2) control), it is possible to move the valve in small increments towards the open position (Nudge Raise) or towards the closed position (Nudge Lower). The trigger for such nudging can be a digital input (e.g. contact closure) 'wired' to the nudge raise or lower parameter, the up or down arrow keys or a command received over the serial link.

The nudge command causes the valve drive output to drive the valve for either the minimum on time, or for as long as the command is 'true', whichever is the longer (note 2). The default minimum on time is 125ms, but this can be edited in the configuration for the relevant output relay (section 4.11.2).

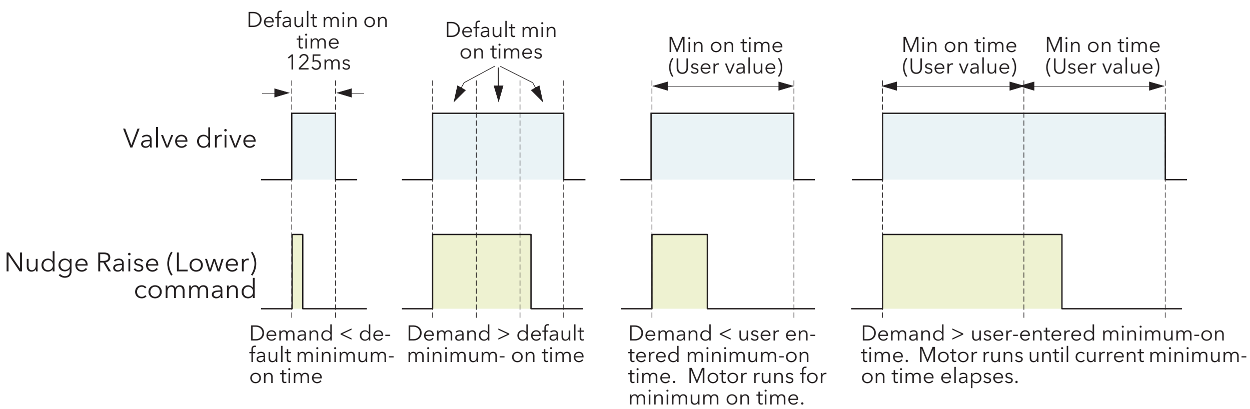


Figure B2.6.10 Valve nudge examples

Notes:

1. If Ch1 is set to VPU, Nudge operates the channel 1 valve, no matter what Ch2 is set to. If Ch1 is not set to VPU, and Ch2 is set to VPU then the nudge operates on channel 2 valve.
2. The minimum on time is continuously retriggered. This means that if a minimum on time of (say) 10 seconds has been configured, then the valve may continue to move for up to 10 seconds after the command has been removed. That is, it continues until the current minimum on time period has expired.

B2.6.11 Time Proportioning

PID controllers somtimes use Time Proportioning to control the average power to the load. This is done by repeatedly switching the output on for a period (T_{on}) and then off for a period (T_{off}). The total period (T_{on} + T_{off}) is called the 'cycle time'. During each cycle, the average power delivered to the load is:

$P_{Avg} = P_{Heater}$ x Duty cycle,

where 'P_{Heater}' is the actual transferred heater (or cooler) power and Duty cycle = $T_{on}/(T_{on} + T_{off})$, normally represented as a percentage value.

The PID controller calculates the Duty Cycle (the PID output control signal from 0 to 100%) and provides a Minimum on time between 100ms to 150 seconds.

Figure B2.6.11 shows how T_{on}, T_{off} and cycle time vary with demand %.

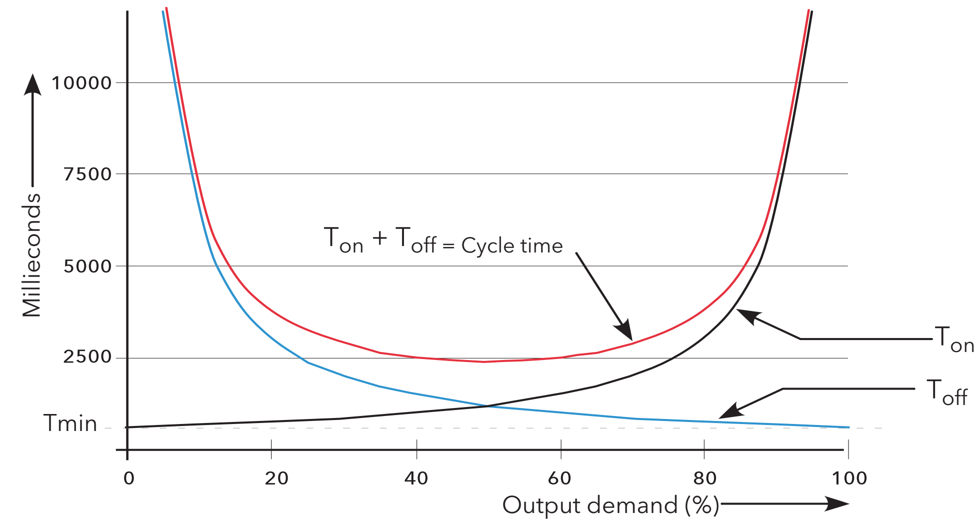


Figure B2.6.11 Time proportioning curves (Minimum on time = 625ms)

Note: For this instrument, only 'Min on time' is configurable

B2.7 DIAGNOSTICS

See section 4.6.7 for definitions of these parameters

Appendix C: REFERENCE

C1 BATTERY REPLACEMENT

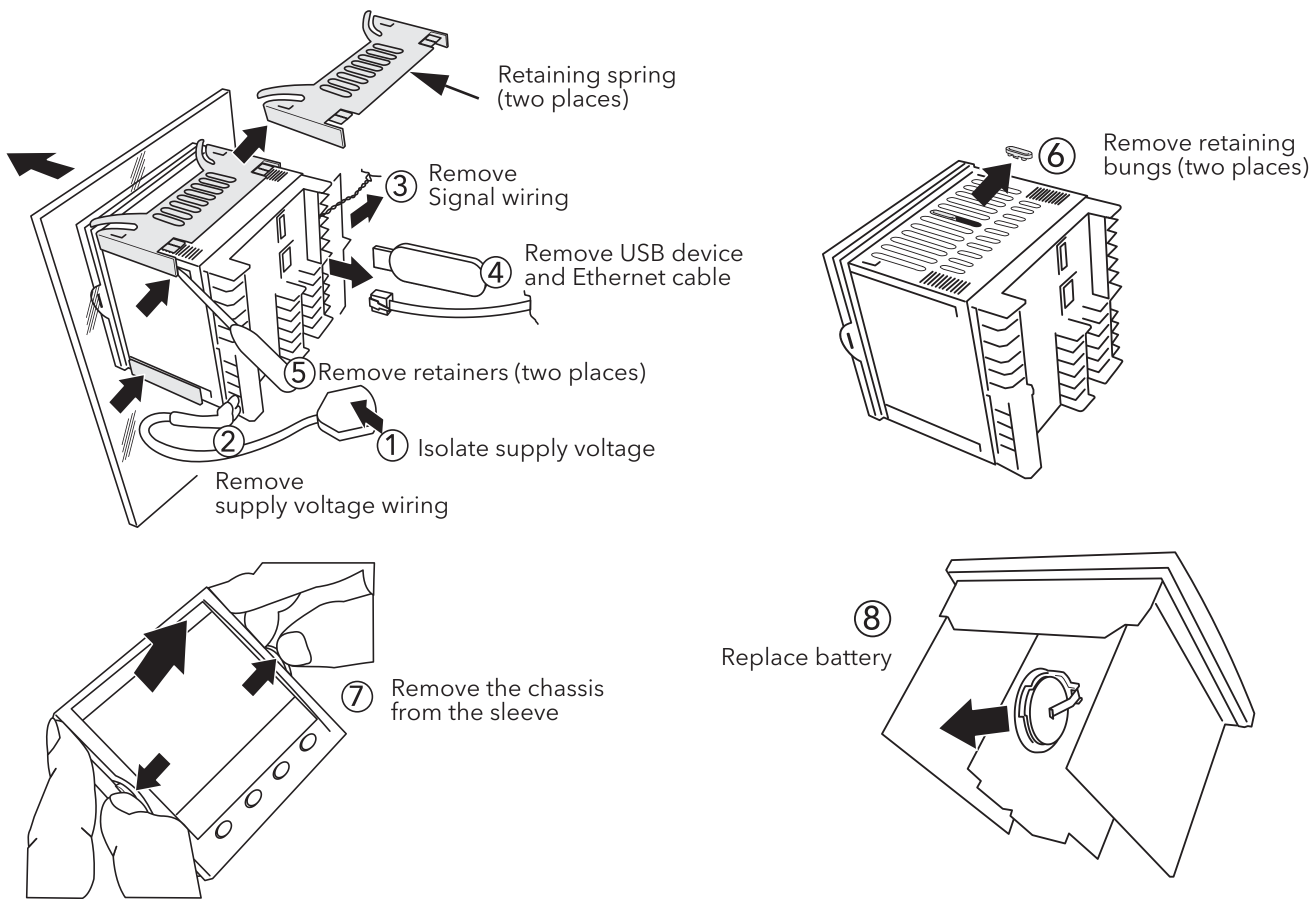
The battery can be replaced only after the unit has been withdrawn from the panel. It is therefore normally necessary to unwire the instrument before changing the battery.

WARNING

Before removing the supply voltage wiring, isolate the supply voltage and secure it against unintended operation.

Note: The new battery must be installed within 10 seconds of the exhausted battery's removal, or data will be lost.

1. Isolate the supply voltage and secure it against accidental operation.
2. Remove supply voltage wiring from the rear terminals.
3. Remove all signal wiring
4. Remove the Ethernet cable and USB device if fitted.
5. Remove the two securing springs, using a small screwdriver if necessary.
6. Prise the two chassis-retaining bungs, using a small screwdriver if necessary.
7. Ease the latching ears outwards, whilst pulling forwards on the bezel, until the chassis is free of the sleeve.
8. Replace the battery. Recycle the exhausted battery according to local procedures.
9. Reinsert the chassis into the sleeve, and secure it using the chassis-retaining bungs previously removed.
10. Reinstall the chassis into the panel and secure it using the retaining springs previously removed.
11. Reinstall all wiring, the Ethernet cable and USB device, if any.
12. Reset the date and time as described in section 4.1.1.

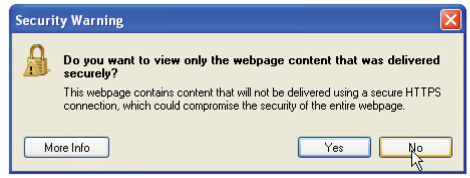


C2 SETTING UP AN FTP SERVER USING FILEZILLA

C2.1 DOWNLOADING

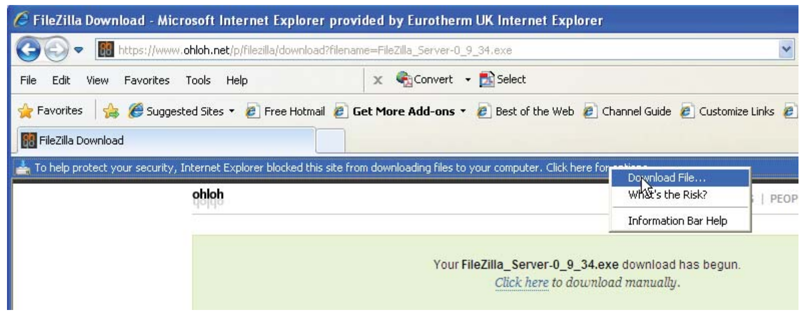
'FileZilla' is a free download from the internet (search for 'FileZilla server download').

1. Download the latest version, following the instructions on the screen.



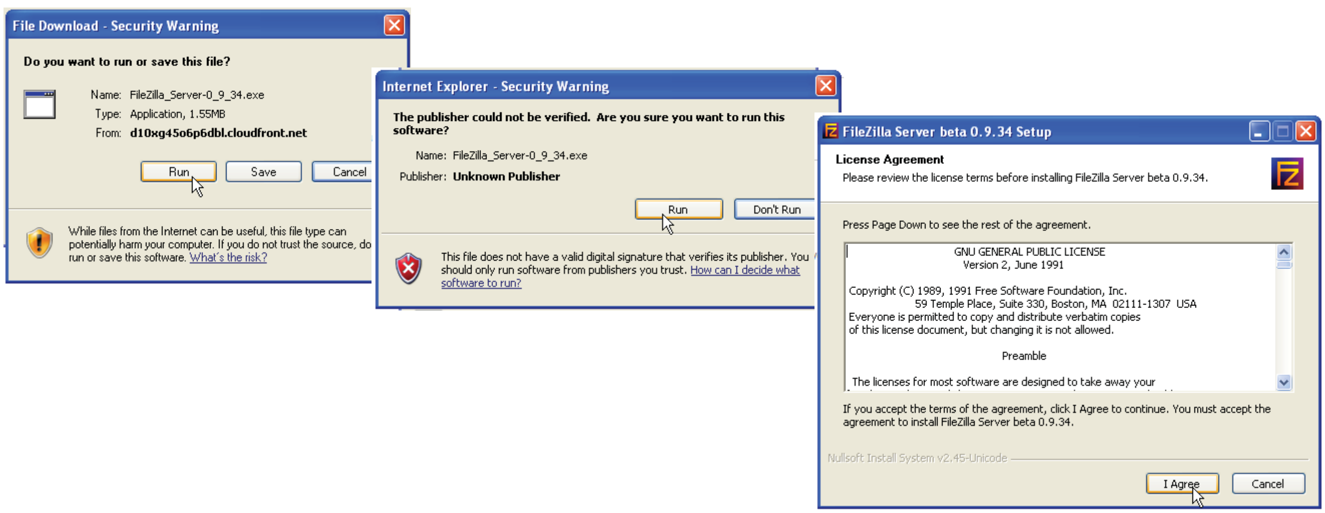
2. Answer 'No' to the question 'Do you want to view only the webpage content that was delivered securely'.

3. If necessary enable file download.

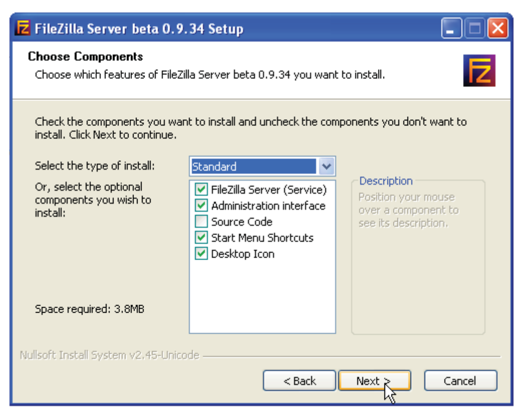


4. In the 'Do you want to run or save this file' Security Warning window- click on 'Run'

5. In the 'The Publisher could not be verified..., Security Warning window, click on 'Run'

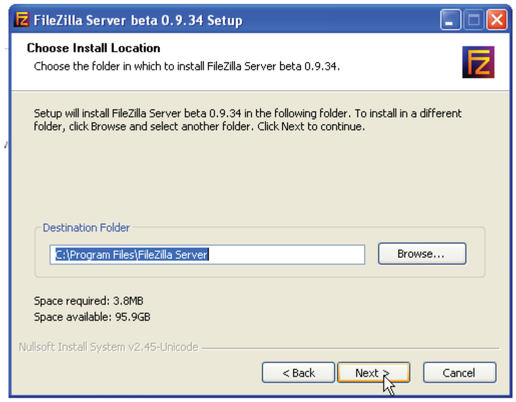


6. Agree or cancel the License agreement. If 'Agree', choose 'Standard' as the type of install.

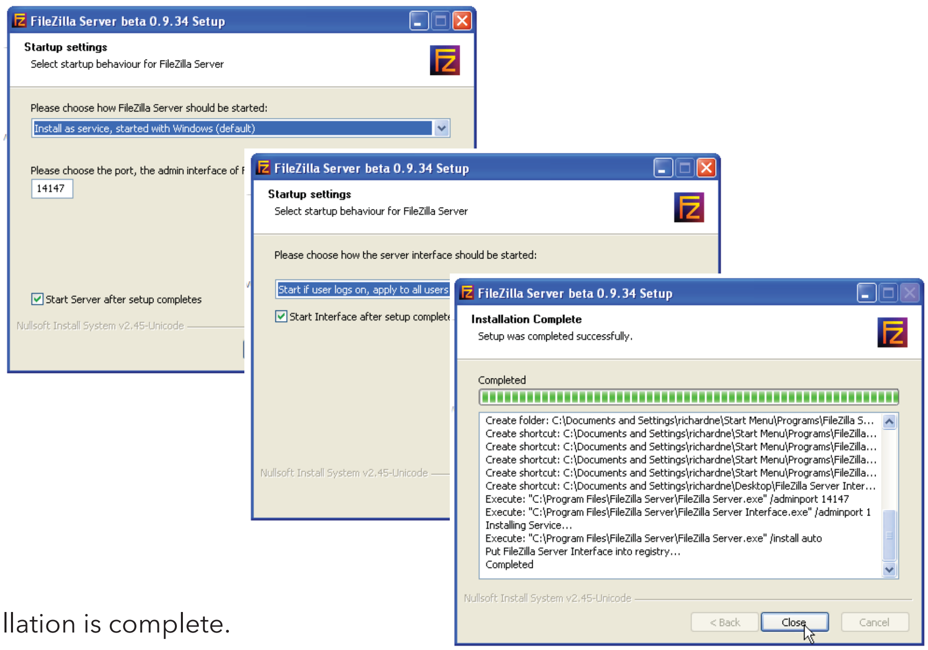


C2.1 DOWNLOADING (Cont.)

7. Choose the destination for the file

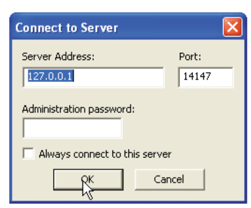


8. Select startup settings



9. Click on Close when Installation is complete.

10. Click 'OK' in the 'Connect to Server' window.

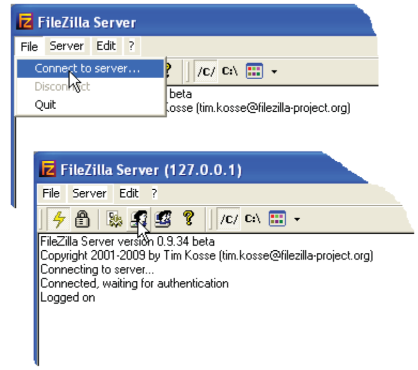


C2.2 SERVER SETUP

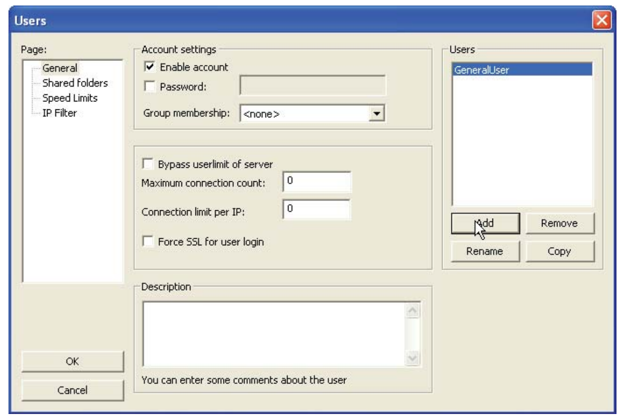
1. Create a new folder (directory) called, for this example, 'Archive' in a suitable location such as the C drive, or the desktop.

2. In the Filezilla server window, click on 'File' and select 'Connect to Server'.

   The 'Logged on' message appears



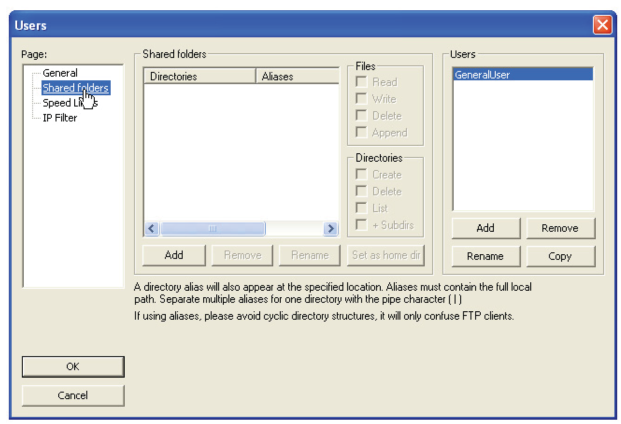
3 In the Edit menu, select 'Users' and in the 'General' page, click on 'Add' and enter a name for the user, then click 'OK'. For this example, 'GeneralUser' has been used, but it may be more advantageous to use 'Anonymous' because this is the default name in the recorder/controller. Click on 'OK'.



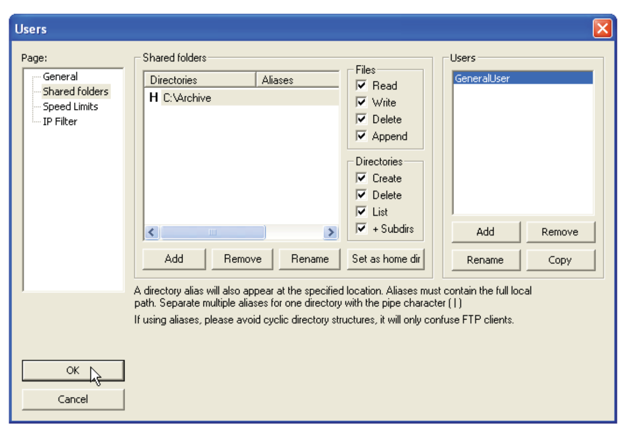
4 In the Edit menu, select 'Users' and in the 'Shared Folders' page, click on 'Add'

   A browse window opens allowing the user to select the new folder ('Archive') created in step 1, above.

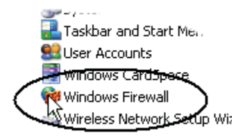
   When OK has been clicked to confirm the selection, the new folder appears in the centre window (with an 'h' next to it to indicate that this is the home folder for this ftp user setup.



5. Click on the relevant folder to enable the tick boxes. Click on all the 'File' and 'Directory' enable tick boxes, then click OK

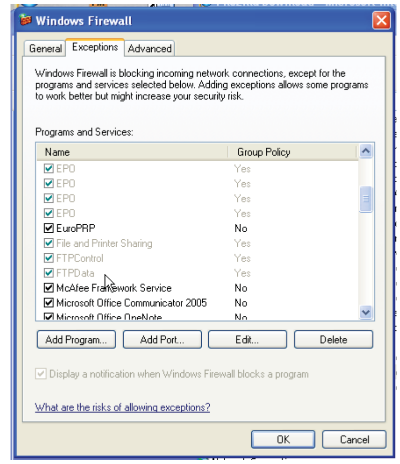


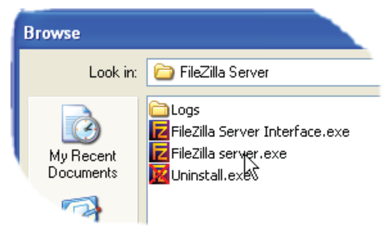
C2.3 PC SETUP



1. Operate the 'Start' button, and select 'Control Panel' from the window that appears. Double click on 'Windows Firewall'

2. Click on the 'Exceptions' tab in the window that appears, and check that both 'FTPControl' and 'FTPData' are enabled (ticked). If not, the user's IT department should be contacted for advice.

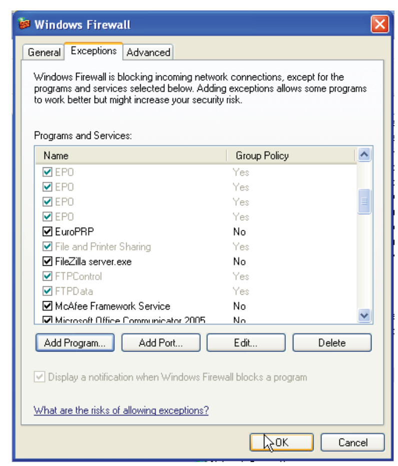




3. Click on 'Add Program...' and browse to the Filezilla destination defined in step 7 of the download section (C2.1). Select 'FileZilla server.exe' and click on 'Open'

   'FileZilla server.exe' appears in the Exceptions list.

Click on 'OK'



C2.4 RECORDER/CONTROLLER SET UP

In Network Archiving (section 4.2.2):

1. Enter the IP address of the pc in which the FTP server has been enabled in the 'Primary Server' field.
2. Enter the Primary User name, as entered in step three of the Server setup procedure (section C2.2) above (GeneralUser in this example).
3. Enter the IP address of another suitable pc which has been configured as an ftp server in the 'Sec. Server' field, and enter the relevant 'Sec. User' name.
4. Configure the other unattended archive parameters as required (section 4.2.2).

> Note: For the example above, 'Password' was not enabled in the User Accounts setup page (section C2.2), so for this example any Primary (Sec.) password entry is ignored. If a password had been entered in the User Accounts setup, then the Primary (Sec.) Password field would have to contain this password.

C2.5 ARCHIVE ACTIVITY

Once a demand or unattended archive is initiated, the FileZilla Server page shows the activity status as the archive progresses. Figure C2.5 shows a typical page. The top of the page shows the transaction details between the server and any clients to which it is connected. The bottom portion shows details of the files currently being transferred. These files are archived to the 'Archive' folder.

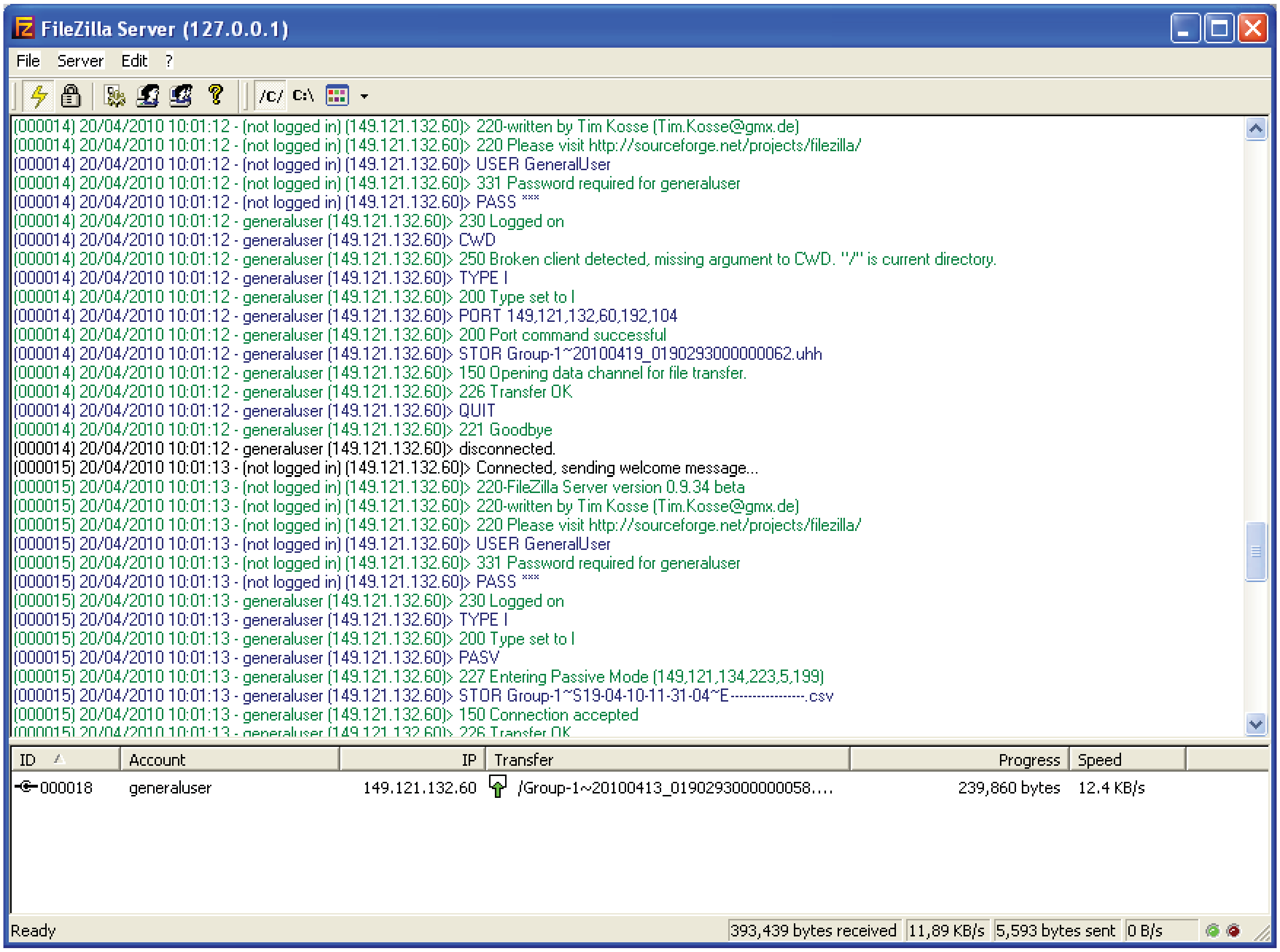


Figure C2.5 FileZilla Server archive activity page

C3 FUNCTION BLOCK DETAILS

C3.1 EIGHT INPUT OR BLOCK

An eight input logical OR block whose output is high (1, On) if any one or more inputs is high (1, On). If more than eight inputs are required, a second block is automatically introduced, as shown in figure C3.1a. The blocks in the figure are given the names 'A' and 'B', where 'A' and 'B' can be any of the 12 available instances.

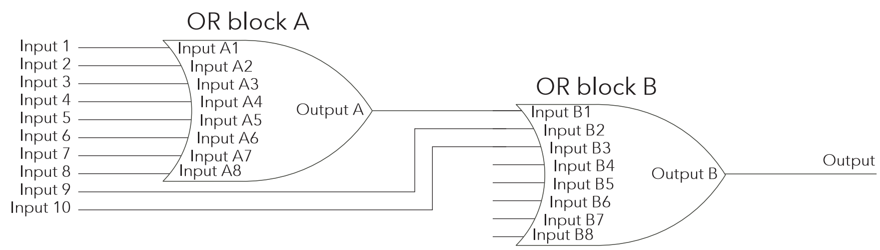


Figure C3.1a Eight input OR block

OR blocks are used automatically by the 'user wiring' when more than one source is wired to the same destination parameter. For example, it may be required that Relay (Digital I/O 2A2B) is to operate if channel 1 alarm 1 and/or channel 2 alarm 1 channels goes active. In such a case, the 'Active' parameter for the two channel alarms would be wired to the same relay's 'PV' parameter.

OR blocks are invisible to the user interface, but the iTools graphical wiring page for this configuration (figure C3.1b), shows that an OR block has been introduced to OR the two alarm outputs together.

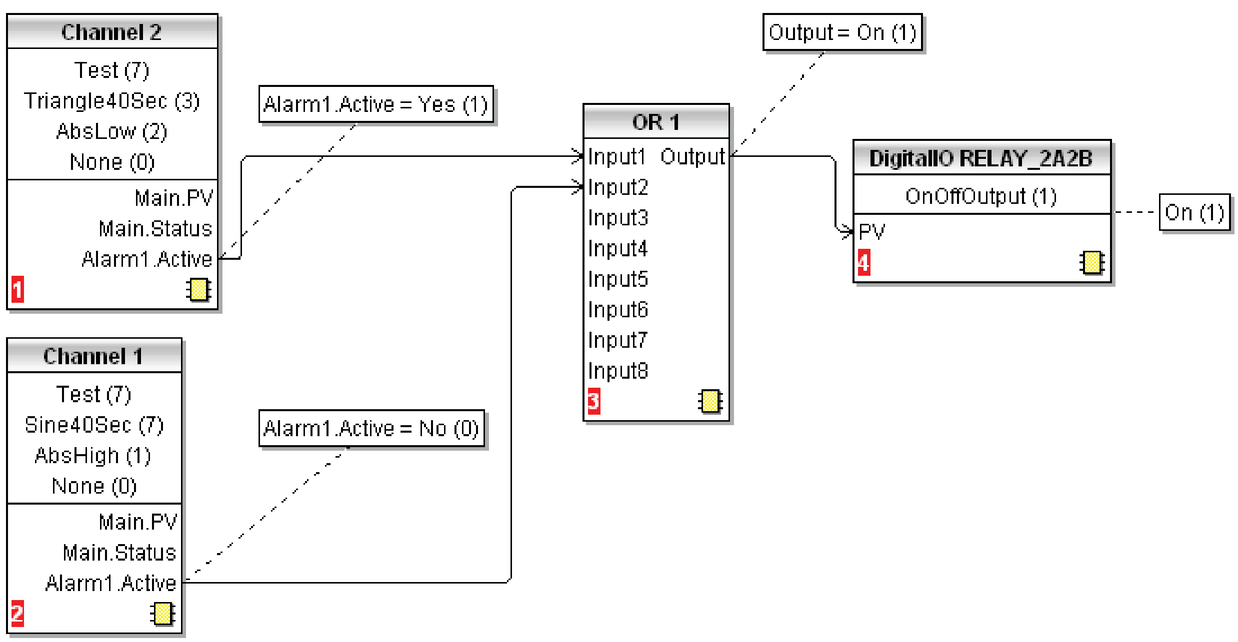


Figure C3.1b iTools representation of OR block usage

C4 TCP PORT NUMBERS

The following TCP ports are made use of by the instrument.

Port	Usage
20	File Transfer protocol (FTP) data
21	FTP control
502	Modbus TCP communications

C5 ISOLATION DIAGRAM

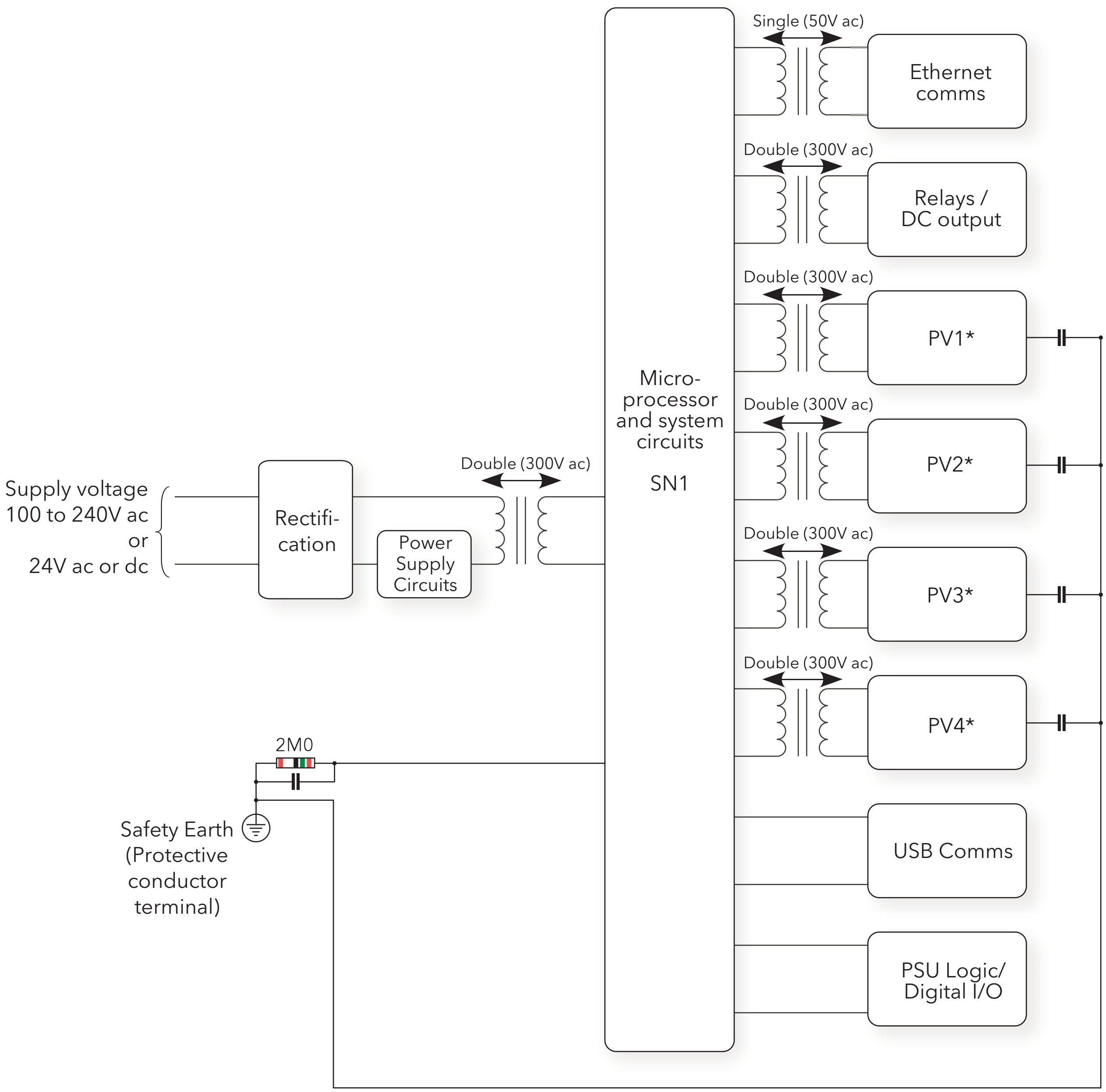


Figure C5 Isolation diagram

* Note: Each 'PV' is double isolated (300VRMS) from all other 'PV's.

Appendix D: CONFIGURATION MENU OVERVIEW

This appendix contains an overview of the configuration menus for the instrument, including all options as follows:

D1 INSTRUMENT CONFIGURATION MENUS

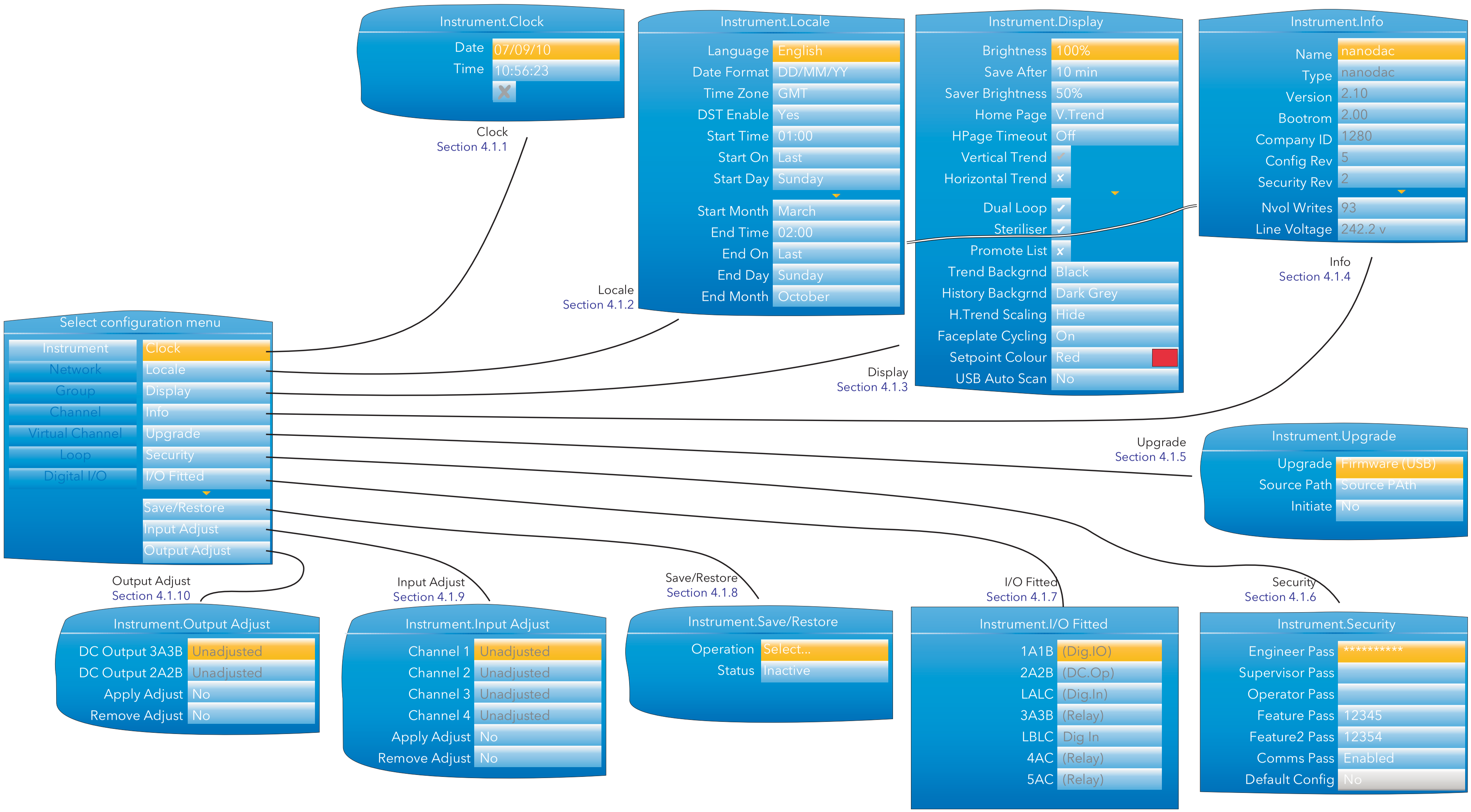


Figure D1 Instrument configuration menus

D2 NETWORK CONFIGURATION MENUS

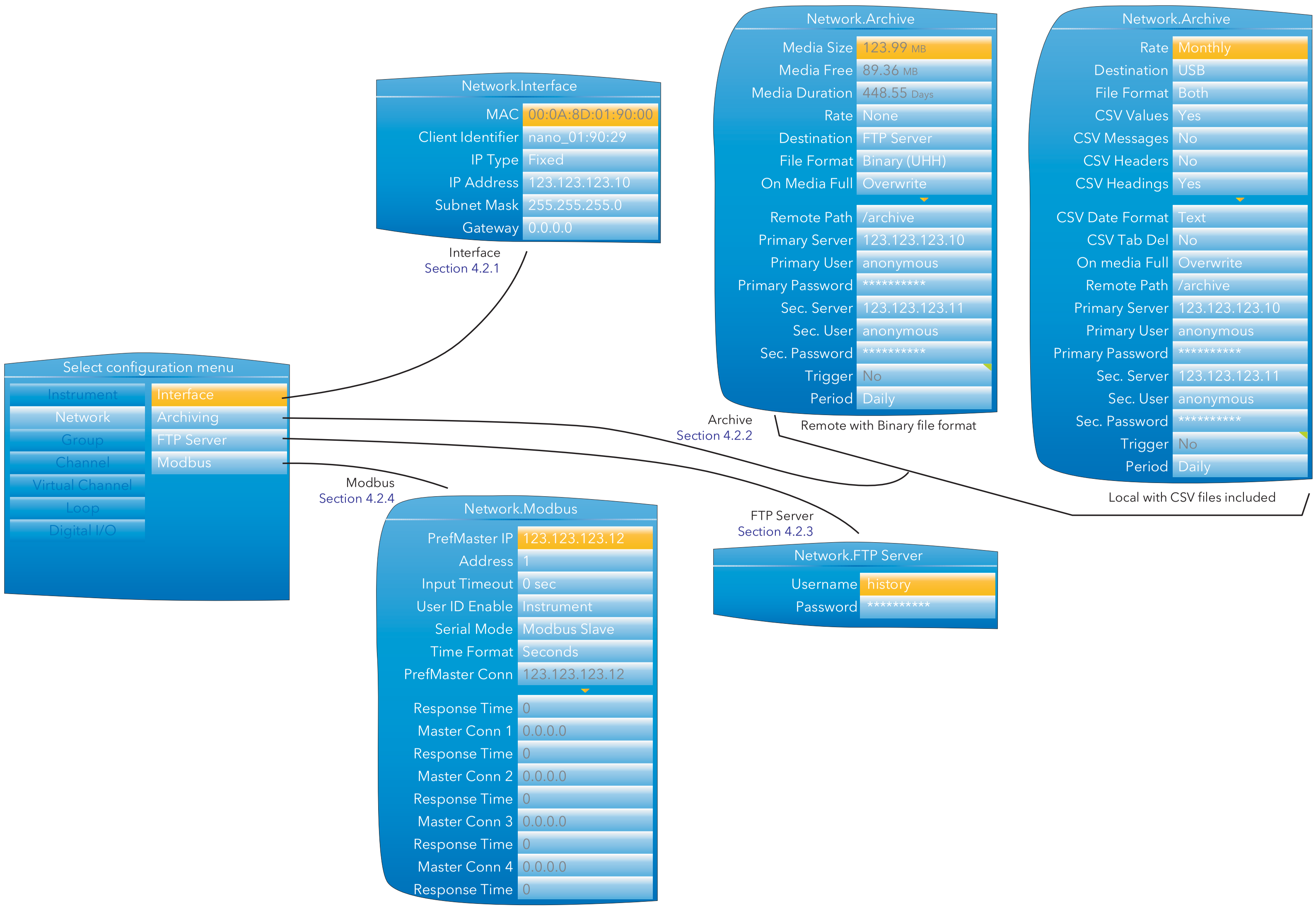


Figure D2 Network configuration menus

D3 GROUP CONFIGURATION MENU

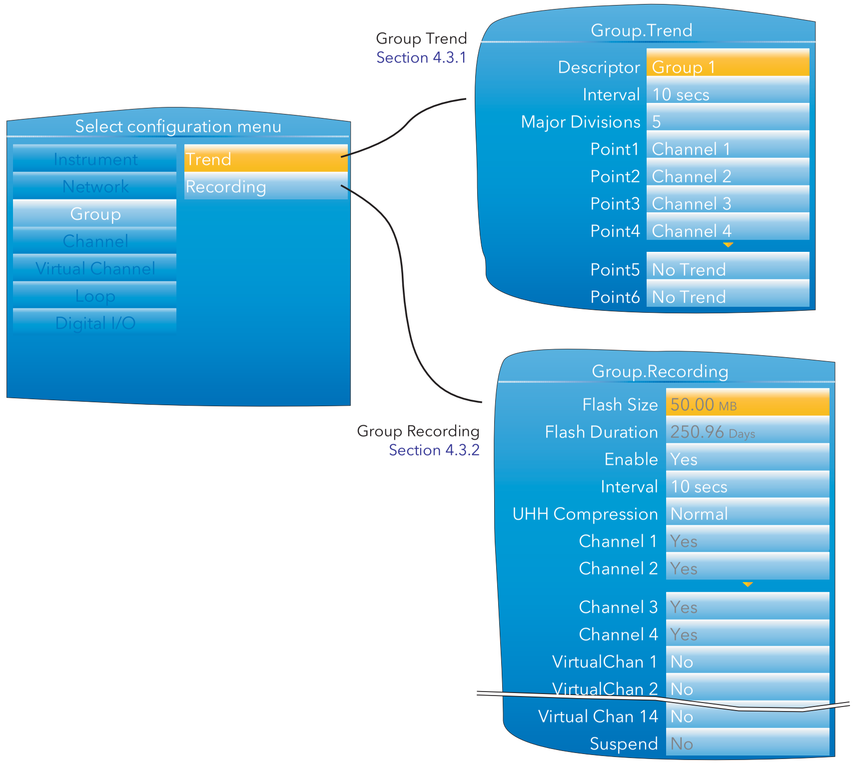


Figure D3 Group configuration menus

D4 CHANNEL CONFIGURATION MENU

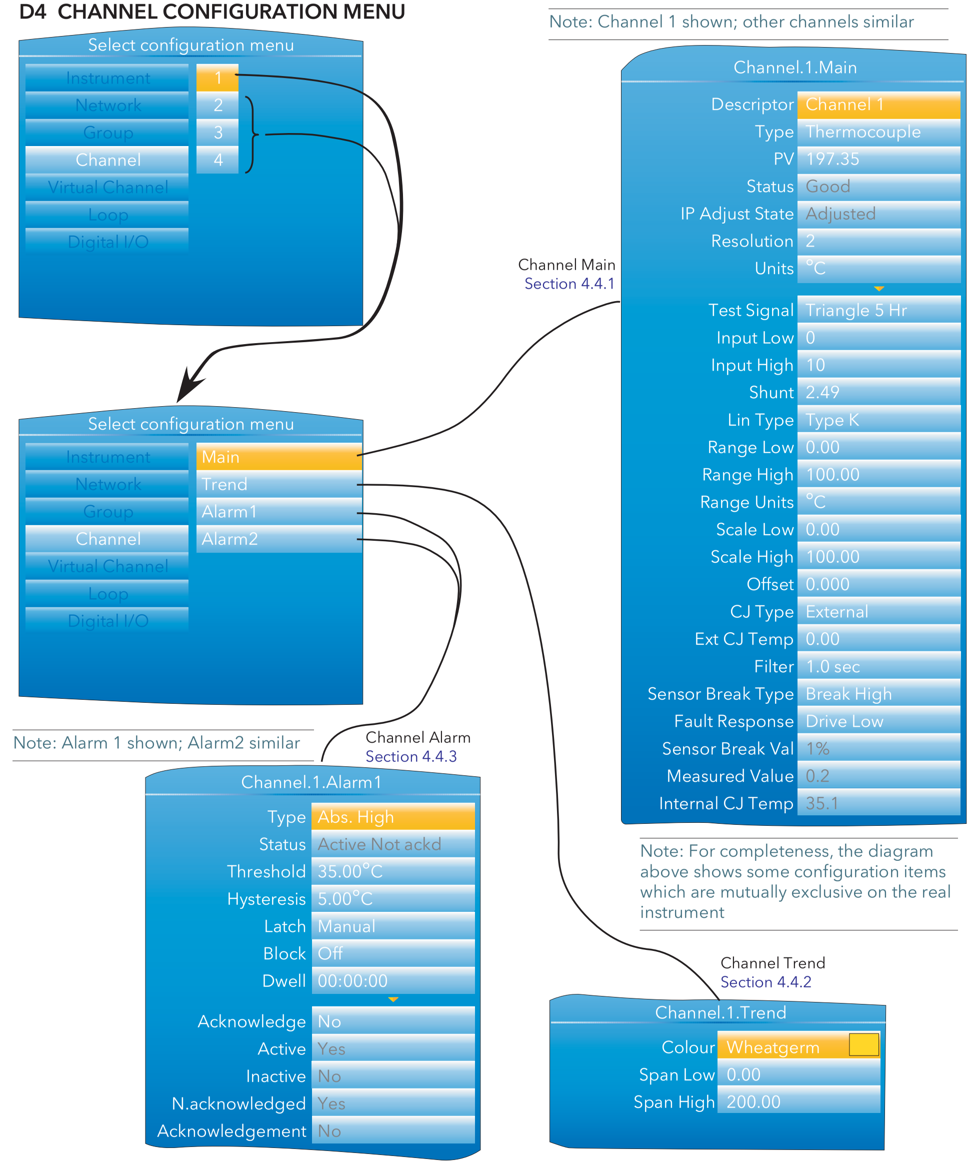
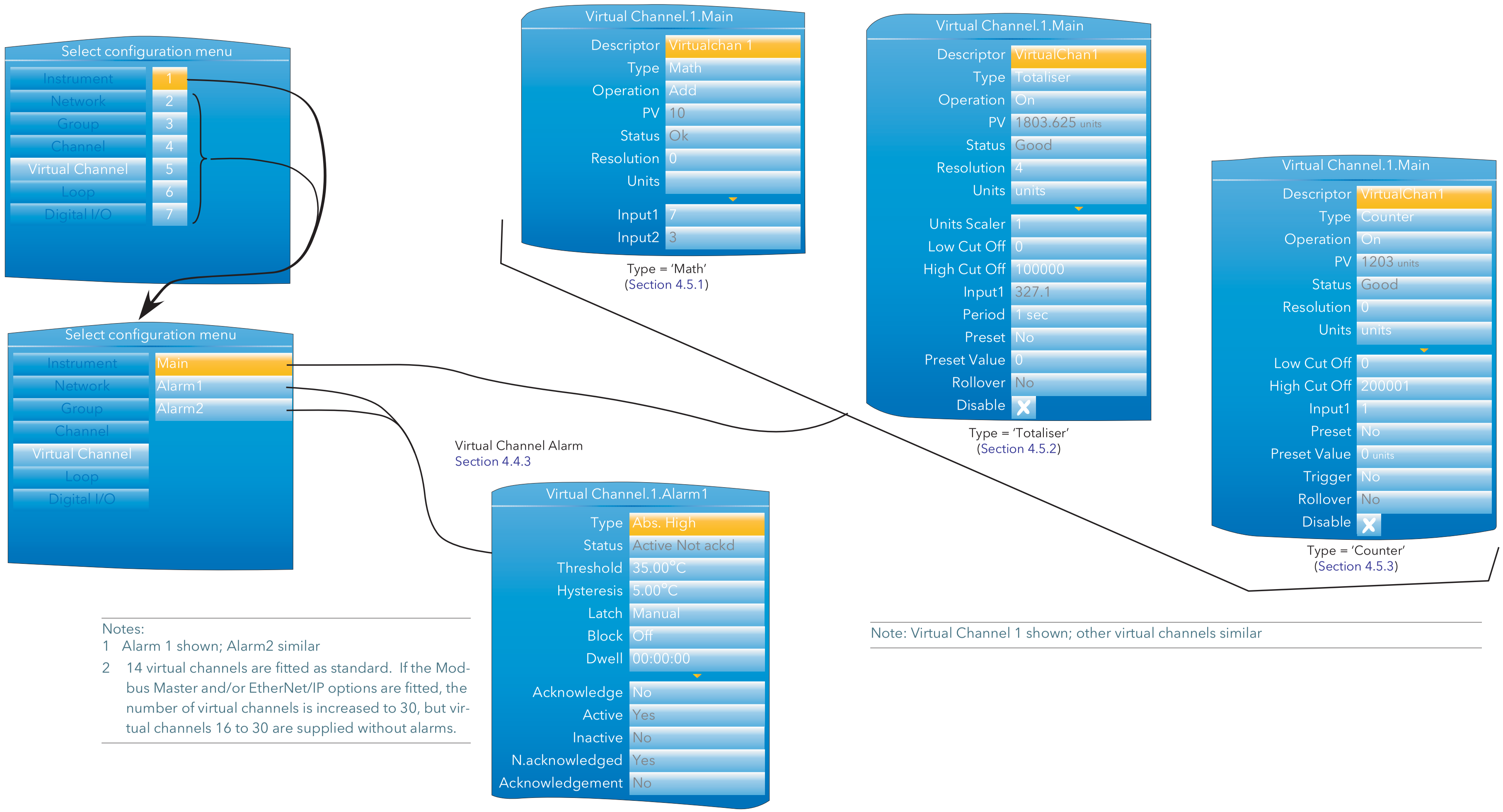


Figure D4 Channel configuration menus

D5 VIRTUAL CHANNEL CONFIGURATION MENU



Notes:
1 Alarm 1 shown; Alarm2 similar
2 14 virtual channels are fitted as standard. If the Modbus Master and/or EtherNet/IP options are fitted, the number of virtual channels is increased to 30, but virtual channels 16 to 30 are supplied without alarms.

Note: Virtual Channel 1 shown; other virtual channels similar

Figure D5 Virtual channel configuration menus

D6 LOOP CONFIGURATION MENUS

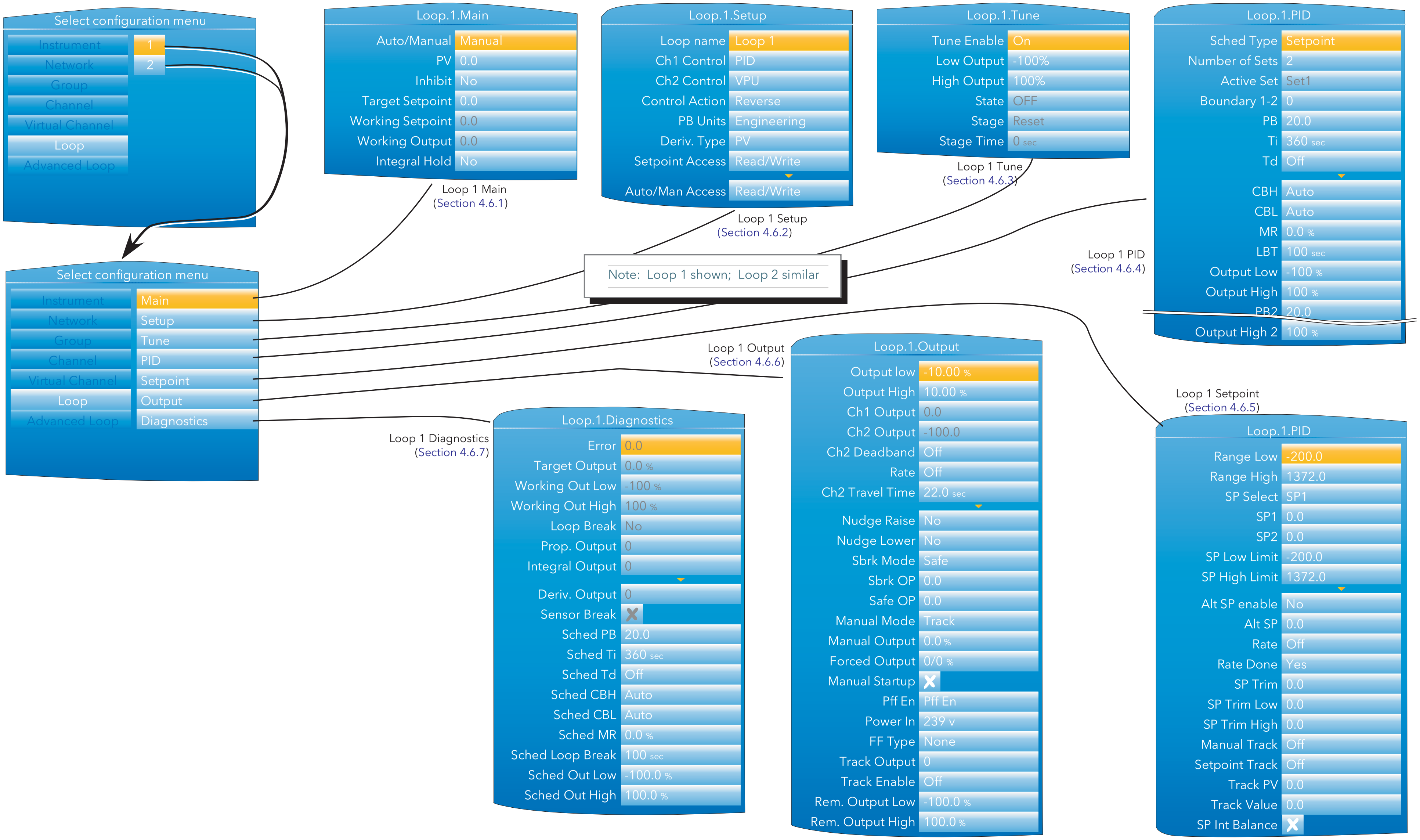


Figure D6 Loop Configuration menus

D7 ADVANCED LOOP CONFIGURATION MENUS

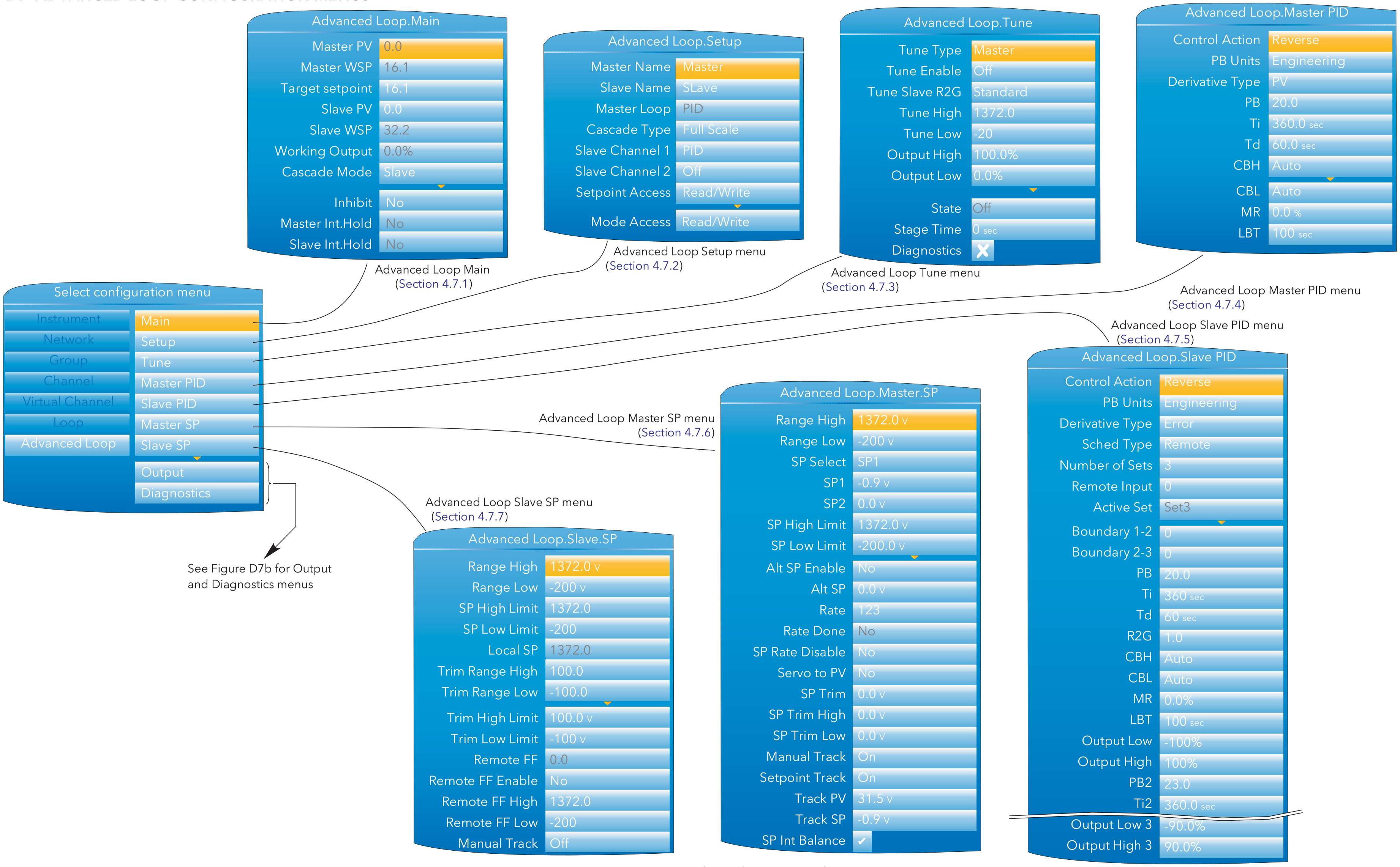


Figure D7a Advanced Loop menus sheet 1

D7 ADVANCED LOOP CONFIGURATION (Cont.)

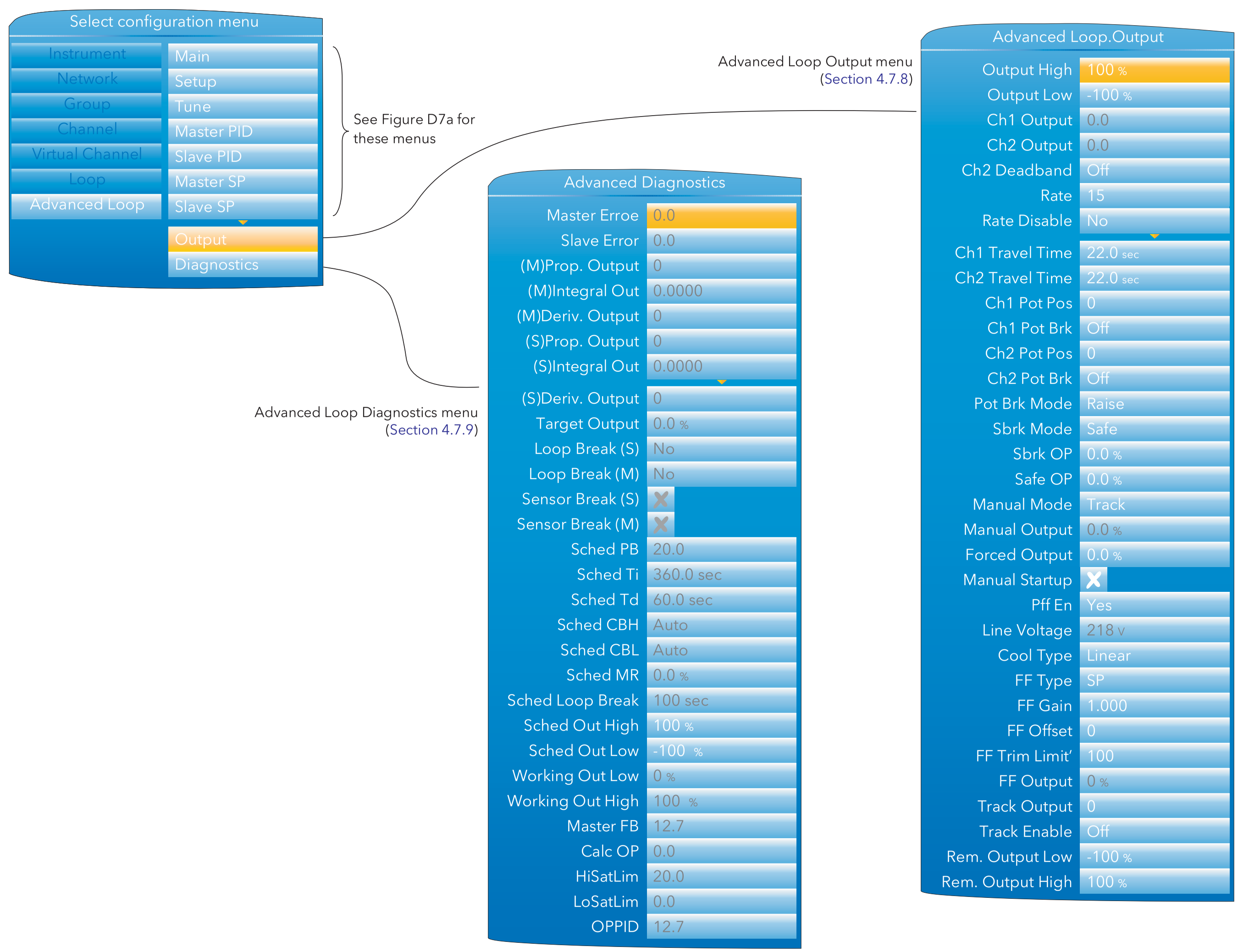
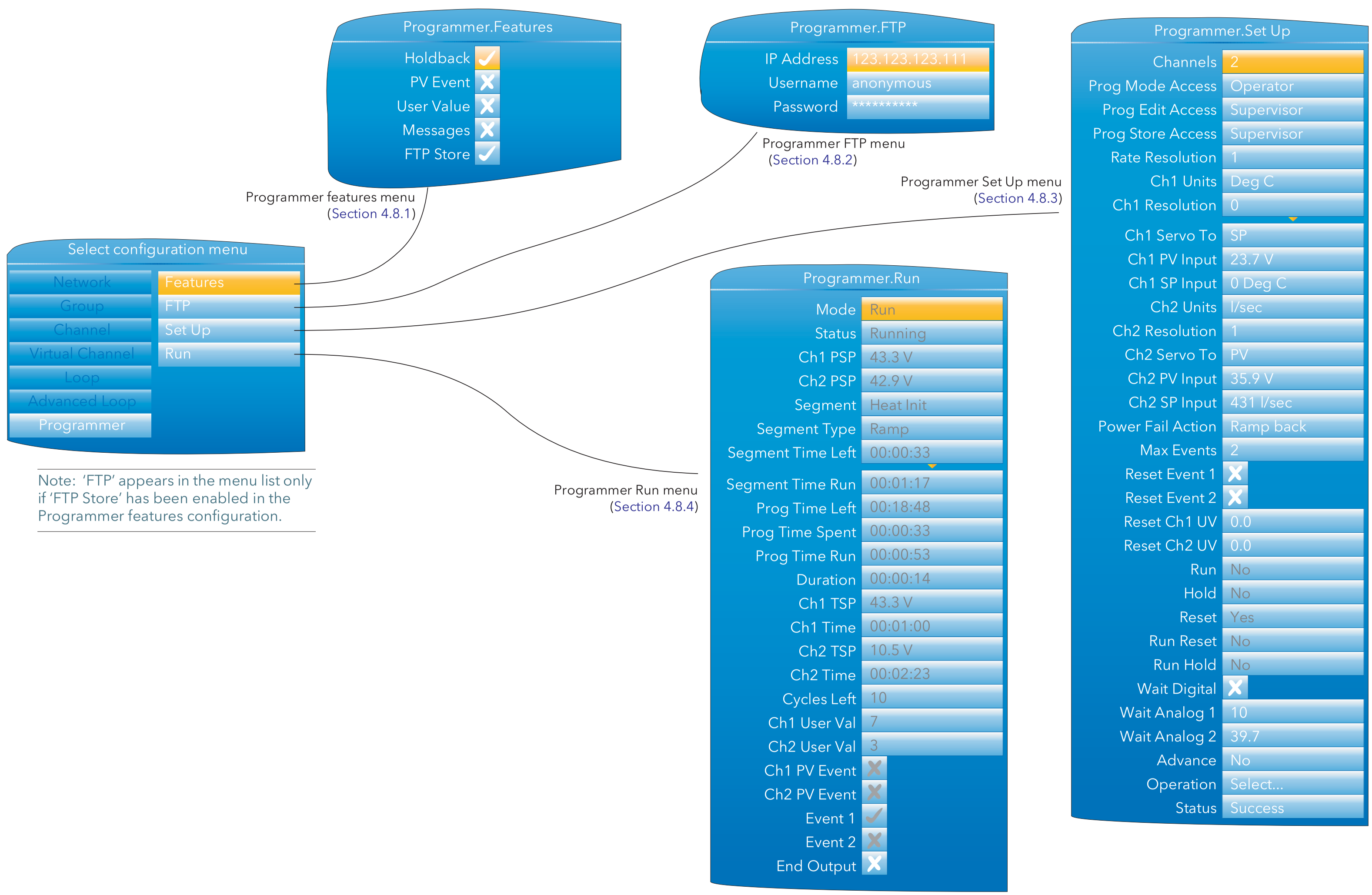


Figure D7b Advanced Loop menus sheet 2

D8 PROGRAMMER CONFIGURATION



Note: 'FTP' appears in the menu list only if 'FTP Store' has been enabled in the Programmer features configuration.

Figure D8 Programmer menus

D9 MODBUS MASTER CONFIGURATION

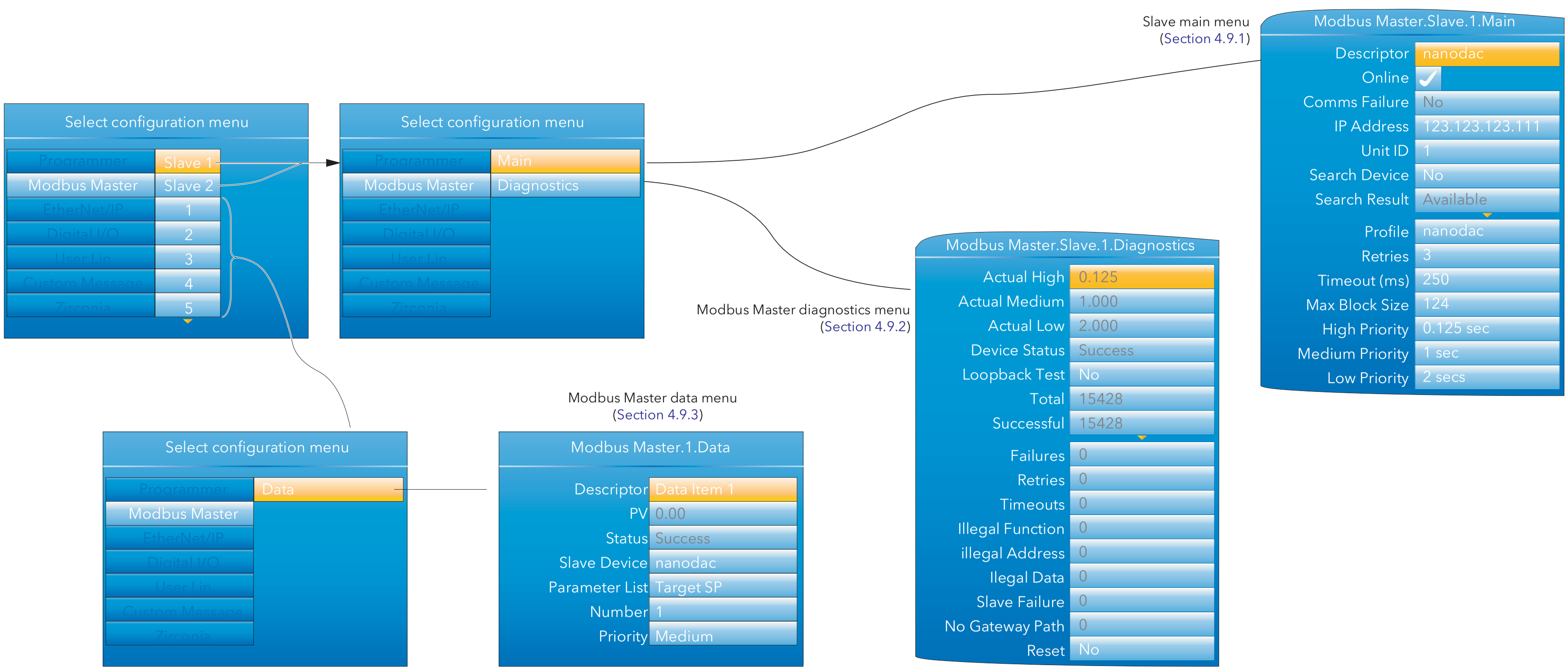


Figure D9 Modbus Master menus

D10 ETHERNET/IP CONFIGURATION

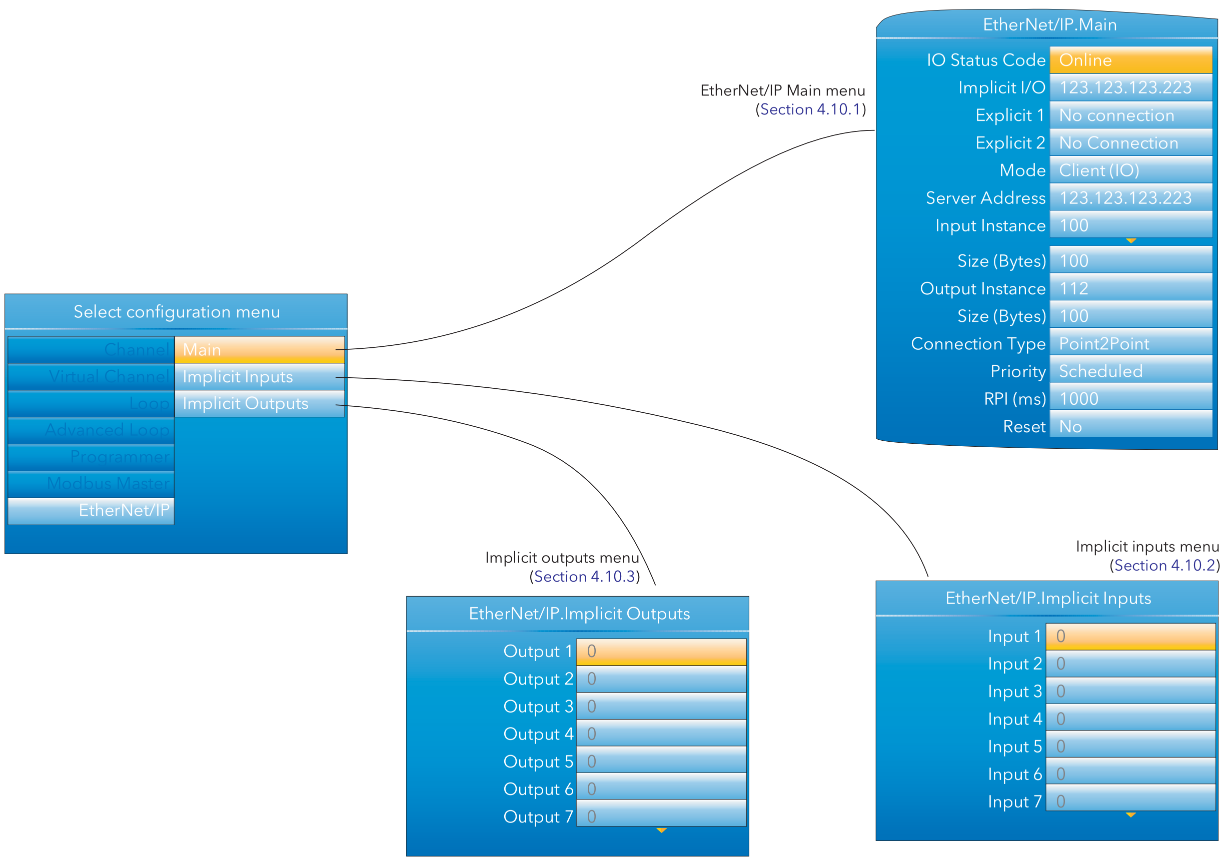


Figure D10 EtherNet/IP menus

D11 DIGITAL I/O CONFIGURATION MENUS

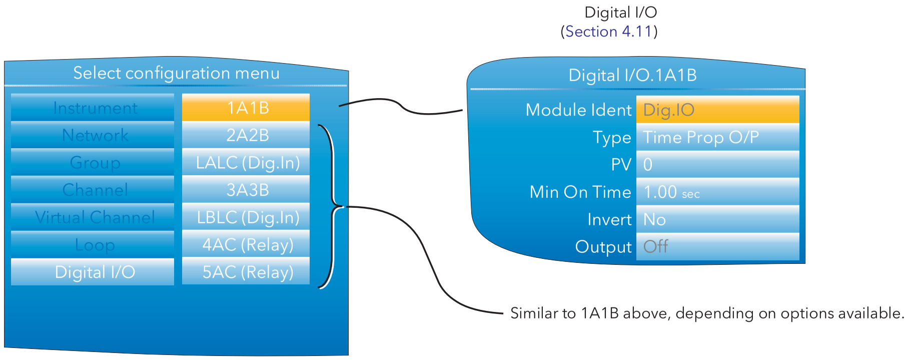


Figure D11 Digital I/O configuration menus

D12 DC OUTPUT CONFIGURATION MENUS

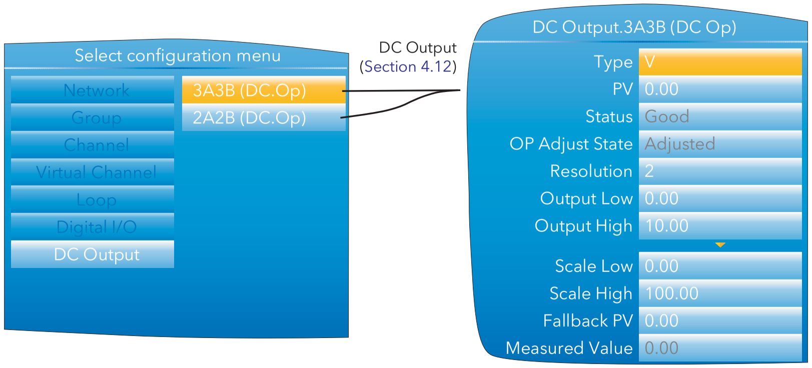


Figure D12 DC output configration menus

D13 USER LINEARISATION TABLE CONFIGURATION MENU

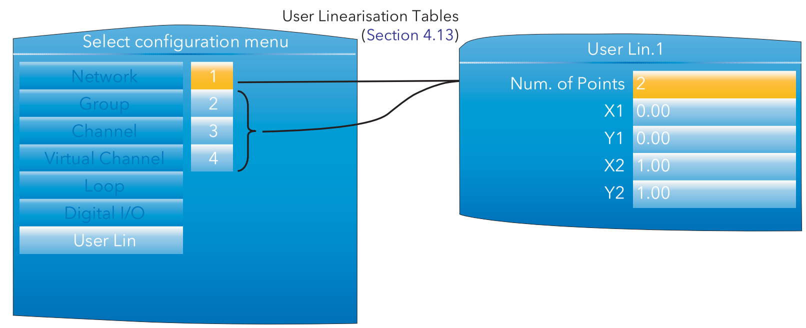


Figure D13 User Linearisation tble menus

D14 CUSTOM MESSAGES CONFIGURATION MENU

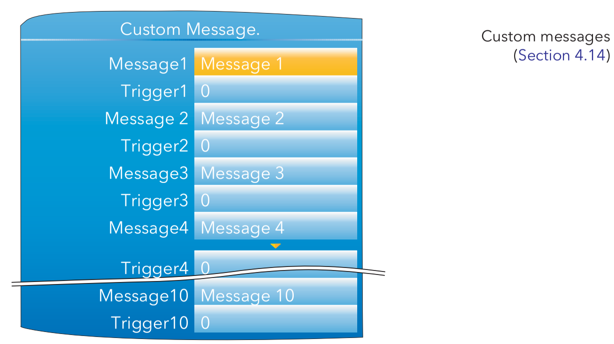


Figure D14 Custom messages configuration

D15 ZIRCONIA BLOCK CONFIGURATION

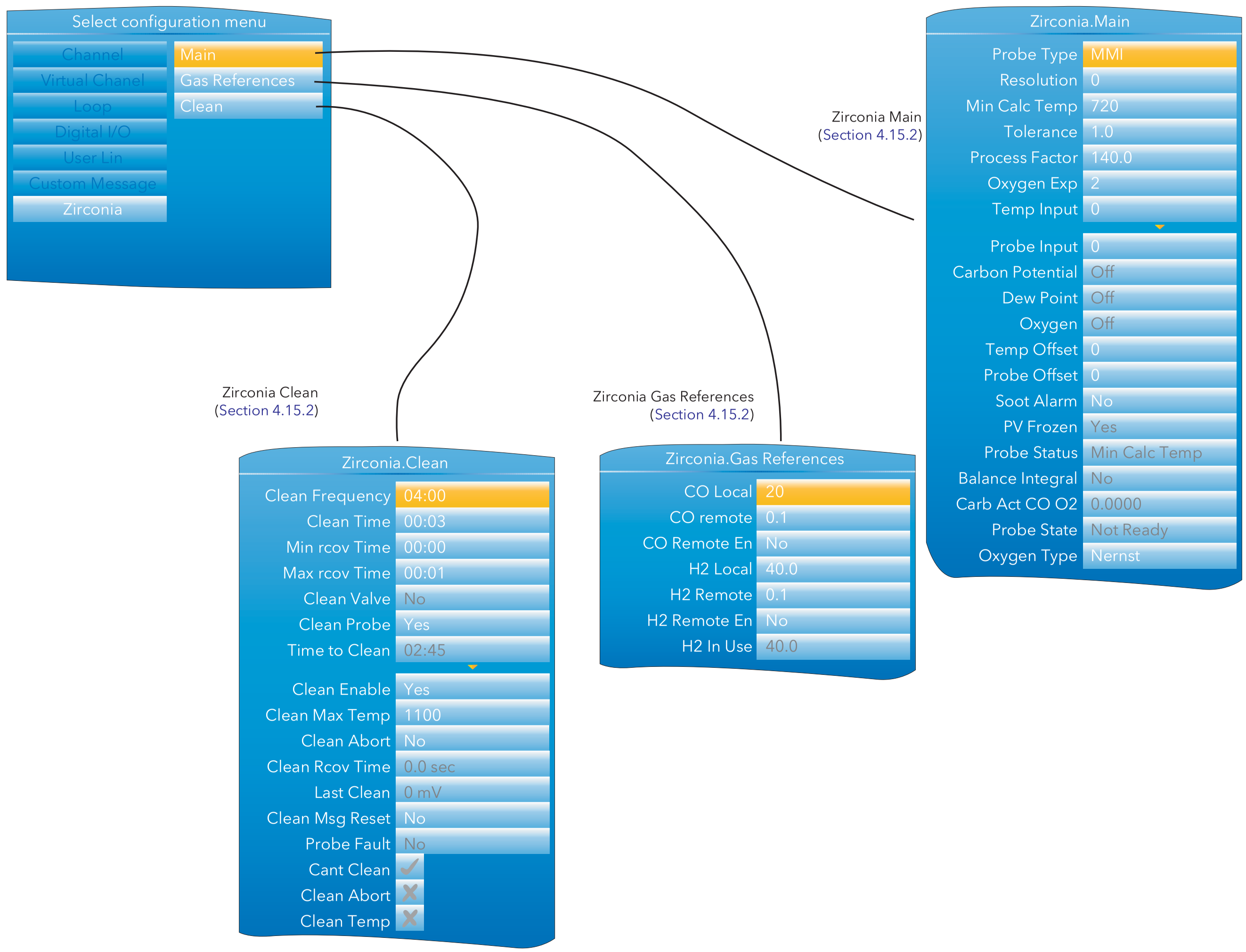


Figure D15 Zirconia block configuration menus

D16 STERILISER BLOCK CONFIGURATION MENU

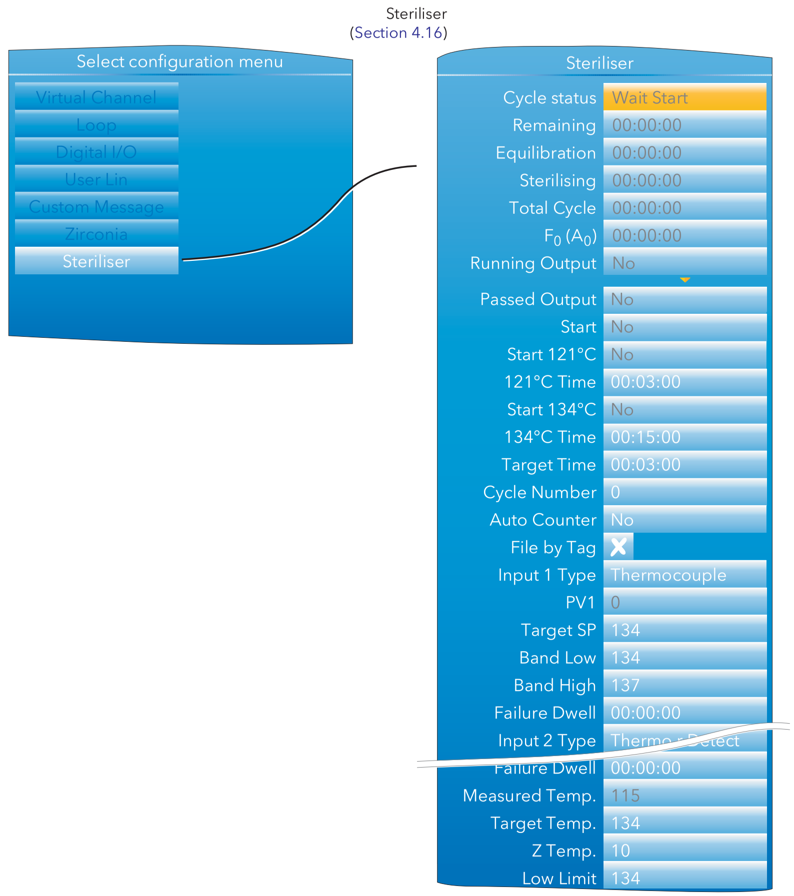


Figure D16 Steriliser menu

D17 HUMIDITY BLOCK CONFIGURATION MENU

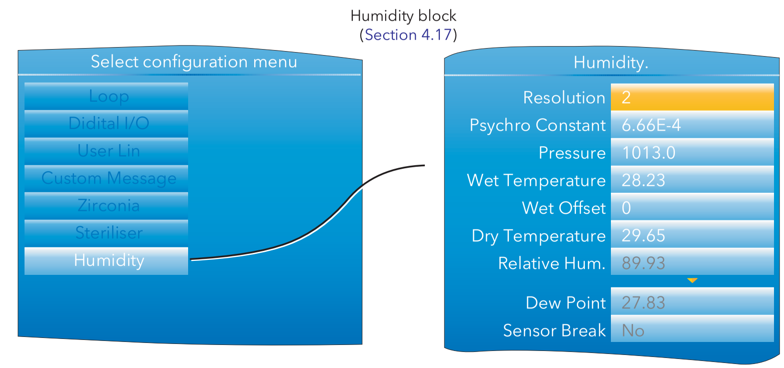


Figure D17 Humidity Block configuration menu

D18 BCD INPUT BLOCK CONFIGURATION MENU

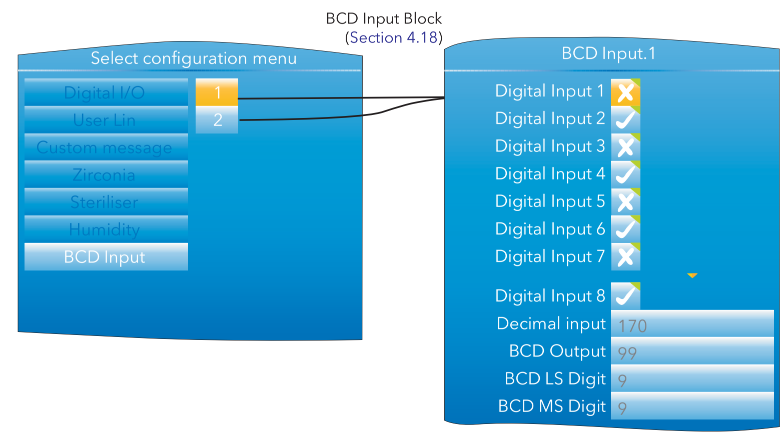


Figure D18 BCD input block menu

D19 LOGIC (2 INPUT) CONFIGURATION MENU

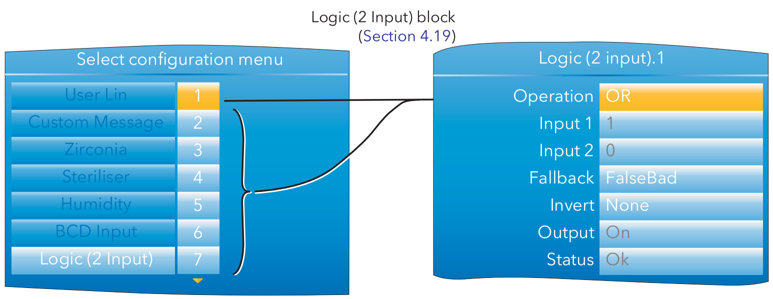


Figure D19 logic (2 input) configuration menu

D20 LOGIC (8 INPUT) CONFIGURATION MENU

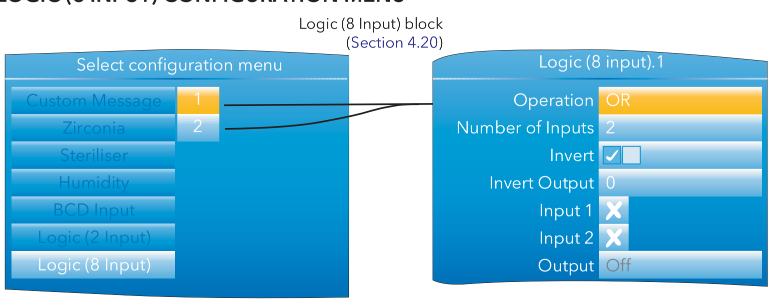


Figure D20 logic (8 input) configuration menu

D21 MULTIPLEXER BLOCK CONFIGURATION MENU

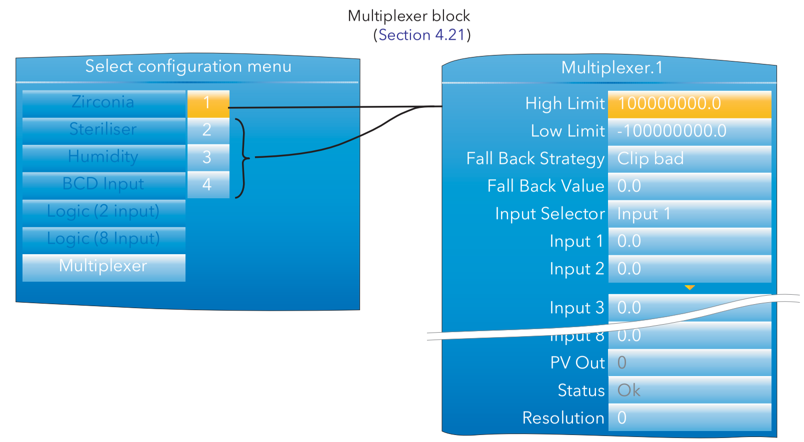


Figure D21 Logic (2 input) configuration menu

D22 MATH (2 INPUT) CONFIGURATION MENU

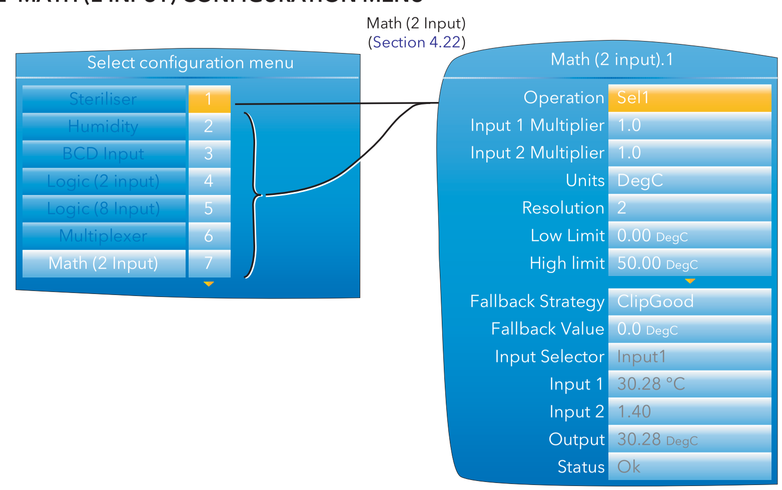


Figure D22 Math (2 Input) configuration menu

D23 TIMER CONFIGURATION MENU

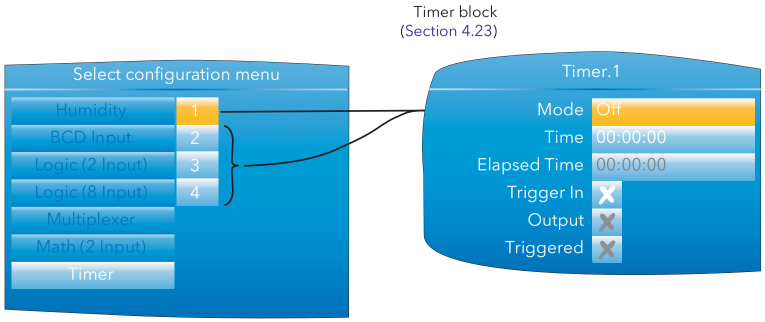


Figure D23 Timer configuration menu

D24 USER VALUES CONFIGURATION MENU

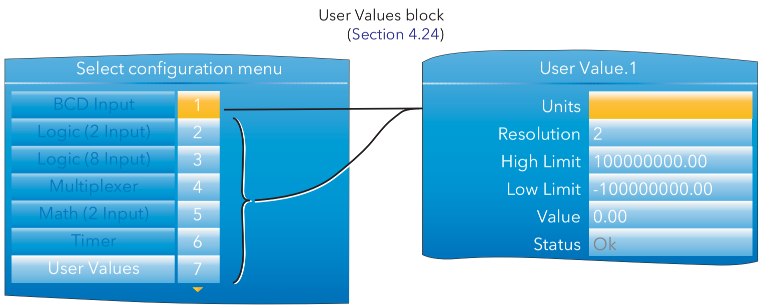


Figure D24 User Values configuration menu

D25 REAL TIME EVENTS CONFIGURATION MENU

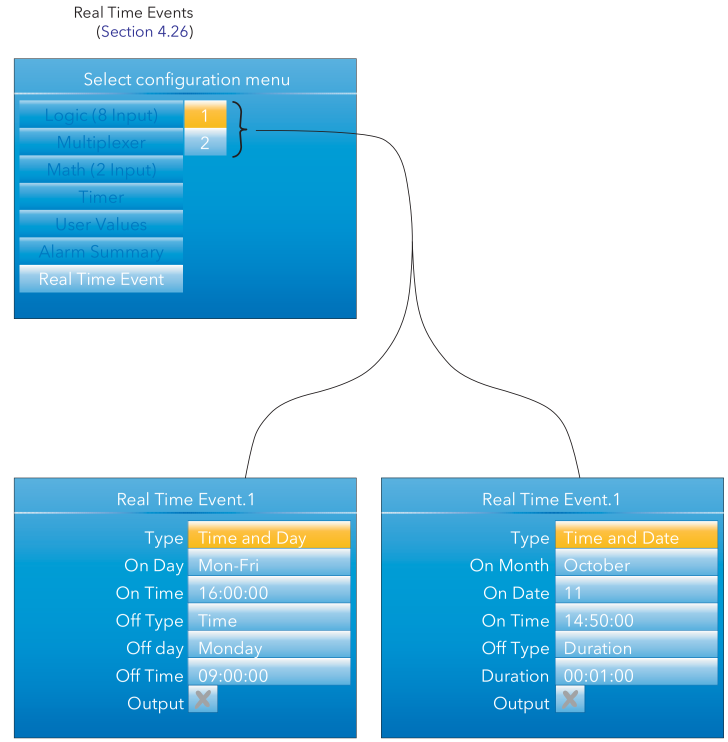


Figure D25 Real Time Event Configration

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Modbus parameter list (Cont.)

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Chapter 36 WATER FILTER

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36.3 **MUNICIPAL HOUSING MUNI-8-2FL-304**

36.4 **HURRICANE CARTIDGE FIL-074-0020-08268 HC/170-20**

36.5 **HURRICANE CARTIDGE FIL-074-0046-08577 HC/170-5**

36.6 **HURRICANE CARTIDGE FIL-074-0046-08576 HC/170-LT2**

HARMSCO® MUNICIPAL

Filtration Systems

SHOP DRAWING

This review is solely for the verification of general design quality and does not alleviate the responsibility of the contractor for insuring that all specification, space and installation requirements are met.

Reviewed By: M.M.

Date: 26 Mar 2015

☒ Reviewed
☐ Reviewed as noted
☐ Resubmit

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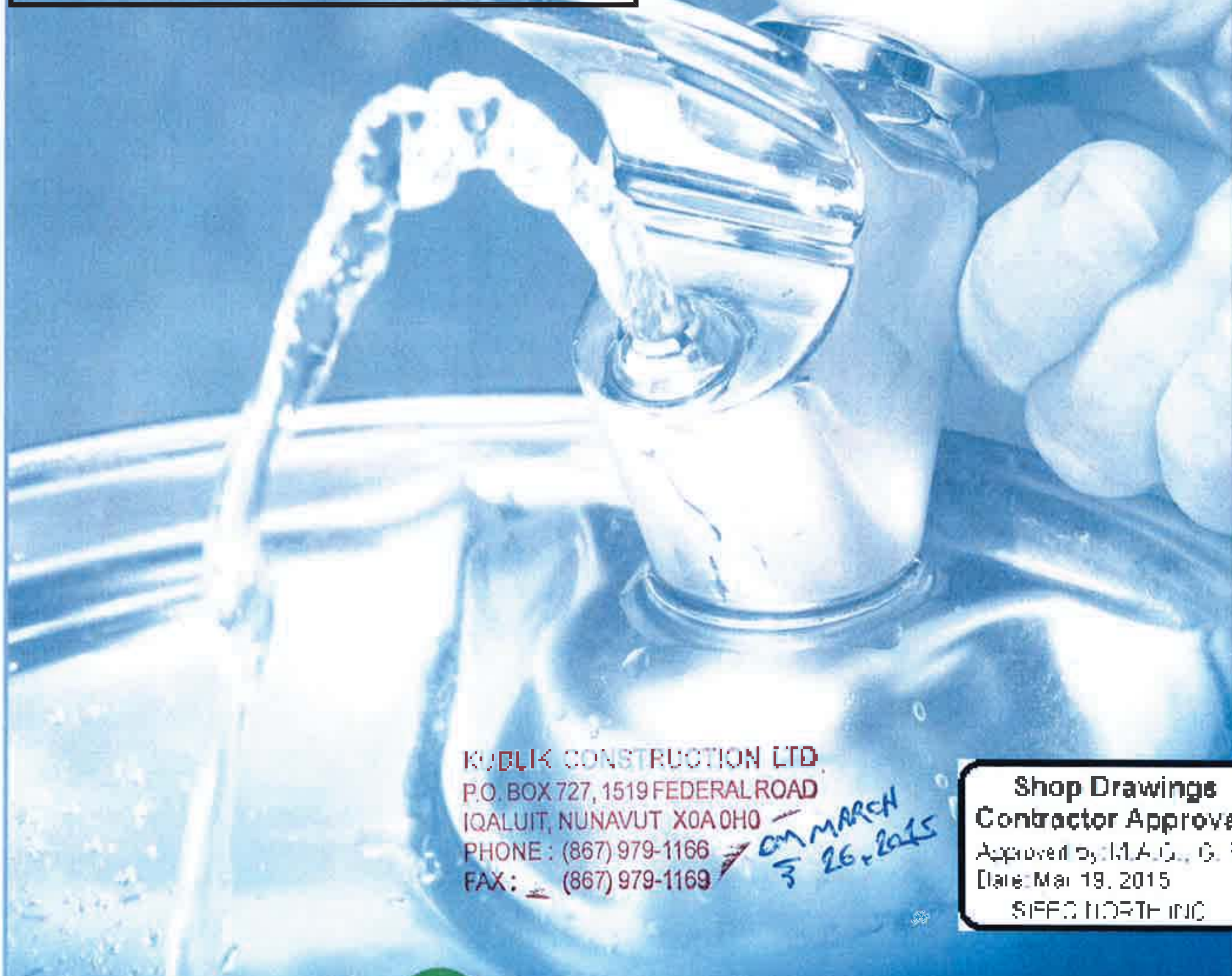

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on MARCH 26, 2015

Shop Drawings
Contractor Approval
Approved by: M.A.G., G. F.
Date: Mar 19, 2015
SIFFC NORTH INC

Meet your EPA LT2 requirements today

Harmsco's Cost-effective Solutions for LT2 Compliance

FACTS

What is Long Term 2 Enhanced Surface Water Treatment Rule (LT2 Rule)?

The EPA has developed the LT2 ESWTR (LT2 Rule) to improve your drinking water quality and provide additional protection from disease-causing microorganisms and contaminants.

Why is the EPA concerned about *Cryptosporidium*?

Cryptosporidium is a significant concern in drinking water because it contaminates most drinking water sources, it is resistant to chlorine and other disinfectants, and has caused waterborne disease outbreaks. Consuming water with ***Cryptosporidium*** can cause gastrointestinal illness which may be severe and sometimes fatal for people with weakened immune systems including infants and the elderly. The EPA estimates that full compliance with LT2 ESWTR will reduce the incidence of cryptosporidiosis by 89,000 to 1,459,000 cases per year, with an associated reduction of 20 to 314 premature deaths.

Who does this rule apply to?

The LT2 ESWTR applies to all public water systems that use surface water, or ground water under the direct influence of surface water. This includes about 14,000 systems serving approximately 180 million people.

COMPLIANCE

LT2 ESWTR Toolbox Manual (April, 2010)

- All components used in drinking water treatment process should be evaluated for contaminant leaching and Certified under **ANSI/NSF Standard 61**.

- The **filter housing and cartridge** must be challenge tested per **LT2 ESWTR Toolbox Guidance Manual** with specific instructions regarding:
  - Full scale filter testing, challenge particulate, test solution concentration, challenge test duration, water quality of test solution, maximum design flow rate, challenge particulate seeding method and concentration, sampling procedures and calculation of log removal.

- Testing is product specific, not site specific, meaning it does not have to be tested at every water system seeking removal credit. Instead, a manufacturer or independent third party would challenge test each of its products in order to obtain a 2.0- or 2.5-log Cryptosporidium removal rating:
  - Up to 2.0-log removal for individual cartridge filters showing a minimum of 3.0-log removal in challenge testing.
  - Up to 2.5-log removal for cartridge filters in series showing a minimum of 3.0-log removal in challenge testing.

- A minimum of two (2) bag or cartridge filter housings should be provided to ensure continuous water treatment in the event of failure in the filter operation and to allow for filter maintenance and replacement.

Shop Drawings
Contractor Approval
Approved by: M.A.G., G. F.
Date: Mar 19, 2015
SIFEC NORTH INC

For more information, please visit: http://water.epa.gov/lawsregs/rulesregs/sdwa/lt2/basicinformation.cfm

Harmsco® LT2 Cartridges for Cyst-free Drinking Water

Harmsco® LT2 cartridges and housings exceed the three-log (99.9%) removal requirement described in LT2 ESWTR Toolbox Guidance Manual 8.4.1. for cyst-sized particles. For this reason, Harmsco® LT2 filter cartridge elements are ideal to control cryptosporidium, giardia cysts and other harmful microorganisms to help ensure safe drinking water.

Shop Drawings
Contractor Approval
Approved by: M.A.G., G. F.
Date: Mar 19, 2015
SIFEC NORTH INC

Independent Lab Validated

To verify the performance of the Harmsco® LT2 cartridge and NSF filter housing, Pace/IBR, highly respected independent testing facilities, were selected to conduct challenge tests as outlined in the LT2 ESWTR Toolbox Guidance Manual 8.4.1. This defines the maximum challenge particulate based on detection limit and acceptable cryptosporidium surrogate…2 microns in these tests. The "terminal" pressure drop was determined by Harmsco® to be 30 psi. The Harmsco® LT2 cartridges were tested via single pass protocol per the EPA at 3 separate points: 1.) after initial flushing (clean cartridge), 2.) at 50% of terminal pressure drop (15 psid) and 3.) after terminal pressure loss has been reached (30 psid).

Results of Challenge Test Conducted by IBR

Cartridge Tested	Filter Housing	Tested Flow Rate	Sample Point	Minimum Log Removal
HC/170-LT2	MUNI-1-2FL-304	100 GPM	Initial Efficiency	3.6
			50% Terminal Pressure Drop: 15 psi	3.8
			100% Terminal Pressure Drop: 30 psi	3.7

Features & Benefits

- NSF-61 Listed cartridge filter system removes cyst-sized particles providing safe drinking water
- Pleated microfiber media provides exceptional surface area for longer filter life and increased particle removal
- Patented Dual Durometer end caps ensure positive end cap sealing
- End caps, center tubes and media are thermally bonded as one integral component for added strength while providing superior sealing
- 120 sq. ft. media (surface area) in a single cartridge design
- FDA Listed Materials: Manufactured from materials which are listed for food contact applications in Title 21 of the U.S. Code of Federal Regulations

SHOP DRAWING

This review is solely for the verification of general design quality and does not alleviate the responsibility of the contractor for insuring that all specification, space and installation requirements are met.

Reviewed By: M.M.

Date: 26 Mar 2015

- [x] Reviewed
- [ ] Reviewed as noted
- [ ] Resubmit

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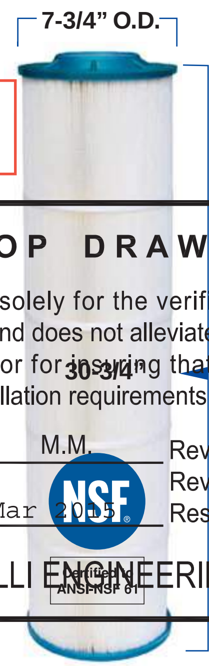
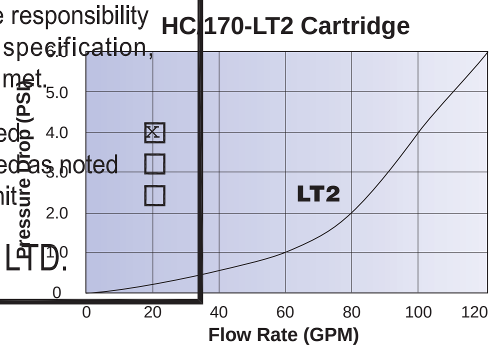


LT2 Cartridge
Length and O.D.

Low Pressure Drop

Initial pressure drop using HC/170-LT2 cartridges is exceptionally low due to our pleated design and increased surface area. Pressure drop data is shown below, calculated for new cartridges in clear water.



Specifications

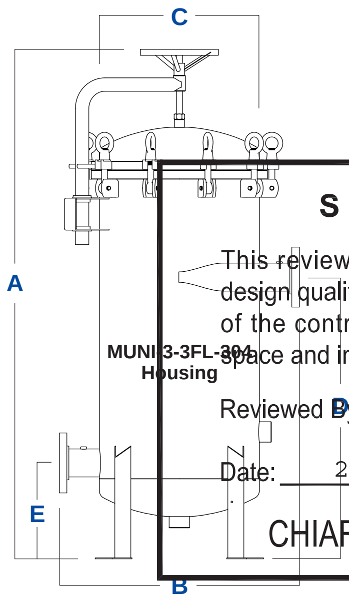
- **Filter Media:** FDA borosilicate microglass with acrylic binder
- **Support Media:** spun-bonded polyester laminated on both upstream and downstream sides
- **Center Tubes:** rigid PVC with perforations
- **End Caps:** plastisol (pliable PVC)
- **Heat-seal Bags:** standard on HC/170-LT2 cartridge
- **Flow Rate:** 100 GPM (recommended) per HC/170-LT2 cartridge; > 3.6 Log removal
- **Temperature:** 140˚F (60˚C) max*

* Temperature limits vary and depend on pressure and time under load.

- **Maximum Change Out:** 30 PSI (2.07 Bar) ΔP
- **Surface Area:** 120 sq. ft. (HC/170-LT2)
- **Dimensions:** 7-3/4" O.D.; 4" I.D.; 30-3/4" L.
- **pH:** 3 to 11

HARMSCO® MUNICIPAL Filtration Systems

Shop Drawings
Contractor Approval
Approved by: M.A.G., G. F.
Date: Mar 19, 2015
SIFEC NORTH INC



Certified to ANSI-NSF 61

Certified: NSF/ANSI Standard 61

Drinking Water System Components - Health Effects

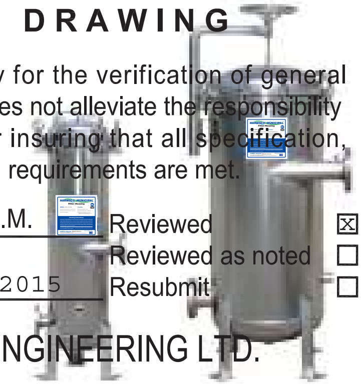
SHOP DRAWING

This review is solely for the verification of general design quality and does not alleviate the responsibility of the contractor for insuring that all specification, space and installation requirements are met.

Reviewed By: M.M. — Reviewed ☒ / Reviewed as noted ☐ / Resubmit ☐

Date: 26 Mar 2015

CHIARELLI ENGINEERING LTD.



MUNI-1-2FL-304 MUNI-3-3FL-304

MUNI-5-4FL-304

MUNI-8-6FL-304

	Filter Model	A Filter Height	B Width	C Diameter	D Inlet	E Outlet	Pipe Size I/O NPS	Drain Size NPT	Floor Space	Service Height	Shipping Wt. (lbs.)
	MUNI-1-2FL-304	48”	15-1/2”	11”	23-5/8”	9-3/4”	2” Flange	3/4”	1.8 ft²	77”	150
	MUNI-3-3FL-304	64”	30”	20”	35-1/4”	12”	3” Flange	1-1/2”	3.7 ft²	98-1/2”	420
X2	MUNI-5-4FL-304	74”	37-1/2”	30”	38”	14-1/8”	4” Flange	1-1/2”	7.6 ft²	98-1/2”	1,100
X1	MUNI-8-6FL-304	84”	44-1/4”	35-3/8”	44-1/4”	20-1/2”	6” Flange	1-1/2”	13 ft²	98-1/2”	1,600

Design Recommendations

Pre-filtration is always recommended due to potential changes in environmental conditions. Turbidity must not exceed 1-NTU prior to final filtration stage (HC/170-LT2 cartridge). For more information please contact Harmsco Filtration Products.

Pre-Filtration

Filter Model	NO. of Cartridges	Pleated Media Area (sq.ft.)	Max Flow Rate (GPM)	Max Flow Rate (LPM)	Max Flow Rate (M³/HR)
MUNI-1-2FL-304	1	170	150	568	34
MUNI-3-3FL-304	3	510	450	1,703	102
MUNI-5-4FL-304	5	850	750	2,839	170
MUNI-8-6FL-304	8	1360	1200	4,542	272

Final Stage

Filter Model	NO. of Cartridges	Pleated Media Area (sq.ft.)	Max Flow Rate (GPM)	Max Flow Rate (LPM)	Max Flow Rate (M³/HR)
MUNI-1-2FL-304	1	120	100	568	34
MUNI-3-3FL-304	3	360	300	1,703	102
MUNI-5-4FL-304	5	600	500	2,839	170
MUNI-8-6FL-304	8	960	800	4,542	272

Filter Specifications

- 304L or 316L stainless steel, electropolished
- Built to ASME design standards (not code stamped)
- Standpipe - 304L or 316L stainless steel
- Inlet/Outlet - flanged connections
- NSF 61 Listed Ball Valves (2) - 316 stainless steel
- O-ring housing seal, swing bolt closure
- NSF 61 Listed Pressure Gauges (2) - 316 stainless steel
- Pressure - 150 psi (10 bar) max.
- Temperature* - up to 140˚F (60˚C) with standard cartridges

* Temperature ratings based on pressure and time under load.

HARMSCO® MUNICIPAL Filtration Systems
www.harmsco.com
P.O. Box 14066, North Palm Beach, FL 33408
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Made in USA

HARMSCO® MUNICIPAL LT2

3. Log Remo al

Pleated Microglass Cartridges

Meets Long Term 2 (LT2) Requirements for Ground Water Under Direct Influence of Surface Water (GWUDI)

Certified: N F/ N I tandard
rin ing ater stem Components - Health ffects

Shop Drawings
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SIFEC NORTH INC

- High flow capabilit
- Low initial pressure drop
- Lower o erall operating cost
- Increased contaminant remo al
- Longer filter runs for fewer change-outs

SHOP DRAWING

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Reviewed By: M.M. Reviewed ☒
Reviewed as noted ☐
Date: 26 Mar 2016 Resubmit ☐

CHIARELLI ENGINEERING LTD.

Pleated Microglass Cartridges

Features

- NSF-61 Listed filter media removes cyst-si ed particles for safe, cyst-free drinking water
- Pleated microfiber media provides more surface area for longer filter life and increased particle removal
- Patented Dual Durometer end caps ensure positive end cap sealing
- End caps, center tubes and media are thermally bonded as one integral component for added strength and to provide superior end sealing
- 120 s . ft. media (surface area) in a single cartridge design
- FDA Listed Materials Manufactured from materials which are listed for food contact applications in Title 21 of the U.S. Code of Federal Regulations

Applications

- Surface Water Treatment Rule (SWTR) LT2
- Ground Water Under Direct Influence (GWUDI)
- Municipal Drinking Water
- Reverse Osmosis Pre-filtration
- Food Beverage Filtration
- Desalination Pre-filtration
- Commercial / Residential Drinking Water
- Marine / A uatic Filtration

HARMSCO® MUNICIPAL Filtration Systems

Specifications

- **Filter Media** FDA borosilicate microglass with acrylic binder
- **Support Media** spun-bonded polyester laminated on both upstream and downstream sides
- **Center Tubes** rigid P C with perforations
- **End Caps** plastisol (pliable P C)
- **Shrink Wrap** standard on HC/170-LT2 cartridge
- **Dimensions** 7-3/4” O.D.; 4” I.D.; 30-3/4” L.
- **Flow Rate** 100 GPM (recommended) per HC/170-LT2 cartridge; 3.6 Log removal
- **Temperature** 140 F (60 C) max*

  * Temperature limits vary and depend on pressure and time under load.
- **Change Out** 25 - 30 PSI (1.72 - 2.07 Bar) ΔP
- **Surface Area** 120 s . ft. (HC/170-LT2)
- **pH** 3 to 11

Shop Drawings
Contractor Approval
Approved by: M.A.G., G. F.
Date: Mar 19, 2015
SIFEC NORTH INC

INDEPENDENT LAB VALIDATED

To verify the performance of the Harmsco LT2 cartridge and NSF lter housing, IBR, a highly respected independent testing facility, was selected to conduct a challenge test outlined in the LT2 ESWTR Toolbox Guidance Manual 8.4.1. This de nes the maximum challenge particulate based on detection limit and acceptable cryptosporidium surrogate 2 microns in this test. The terminal” pressure drop was determined by Harmsco to be 30 psi. The Harmsco LT2 cartridge was tested in a single-pass challenge test at 3 points after initial ushing, at 15 psi differential, and again at 30 psi differential.

Results of Challenge Test

Using 2-micron surrogate beads.

ample Point	Log Remo al
Initial Ef ciency	3.6
50 Terminal Pressure Drop 15 psi	3.8
100 Terminal Pressure Drop 30 psi	3.7

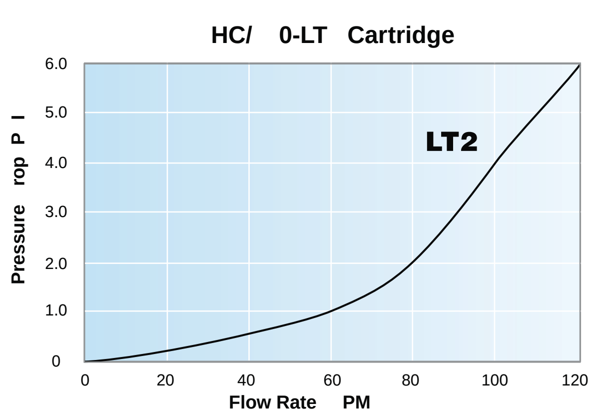
Cartridge Selection/Sizing Guide

Product Code	Pleated Media rea s . ft.	Length in.	O. . in.	I. . in.	Recommended Flow Rate gpm for 3. log remo al
LT2 Pleated Microglass Cartridges - Packed one cartridge per case.					
HC/170-LT2	120	30-3/4	7-3/4	4	100

Meets the Challenge Test Method de ned in the LT2 ESWTR Tool Box Guidance Manual 8.4.1

Low Pressure Drop

Initial pressure drop using HC/170-LT2 cartridges is exceptionally low due to our pleated design and increased surface area. Pressure drop data is shown below, calculated for new cartridges in clear water.



LT2 End Cap

Genuine Harmsco NSF Listed LT2 cartridges come standard with patented dual durometer end caps to ensure positive sealing.

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HARMSCO®

Premium Hurricane® Polyester Cartridges

Maximum Surface Area

Designed for Hurricane® and WaterBetter® Filter Housings

High Flow Performance

Lower Operation Cost with Hurricane Cartridges

- High   ow capabilit
- Lower o erall operating cost
- Reduced waste disposal
- Longer   lter runs for fewer change-outs
- Increased contaminant remo al
- Operator friendl

Certified to ANSI-NSF 61

Shop Drawings
Contractor Approval
Approved by: M.A.G., G. F.
Date: Mar 19, 2015
SIFEC NORTH INC

Premium Hurricane®
Polyester Cartridges

Features

- Fewer cartridges for fewer change-outs and lower maintenance cost
- Pleated Polyester-Plus   lter media provides higher   ow rates and lower initial pressure drop
- Pleated surface area provides higher loading capacity for longer   lter life and increased particle removal
- End cap, center tube and media are thermally bonded as one integral component for added strength
- Offered in three si es (40, 90 and 170) and eight micron ratings (0.35, 1, 5, 10, 20, 50, 100 and 150) to meet all your high   ow re uirements

SHOP DRAWING

This review is solely for the verification of general design quality and does not alleviate the responsibility of the contractor for insuring that all specification, space and installation requirements are met.

Reviewed By: M.M.
Date: 26 Mar 2015

- [x] Reviewed
- [ ] Reviewed as noted
- [ ] Resubmit

CHIARELLI ENGINEERING LTD.

Applications

- Reverse Osmosis Pre- ltration
- Municipal Drinking Water Filtration
- Commercial/Residential Drinking Water Filtration
- Desalination Pre- ltration
- Industrial Water Filtration
- Cooling Tower Filtration
- Chill Water Loop Filtration
- Food   Beverage Filtration
- Marine/A uatic Filtration
- Industrial Coolant Filtration

Premium Hurricane® Polyester Cartridges

Specifications

- **Micron Ratings:** Nominal micron ratings of 0.35, 1, 5, 10, 20, 50, 100, 150
- **Filter Media:** nominal pleated Polyester-Plus
- **nd Caps:** Pliable P C with sealing surface built-in
- **Center Tubes:** ABS or P C
- **Temperature:** 140 F (60 C) temperature limit*

* Temperature limits vary and depend on pressure and time under load.

Cleanable/Reusable in most filtration applications and micron ratings.

NSF

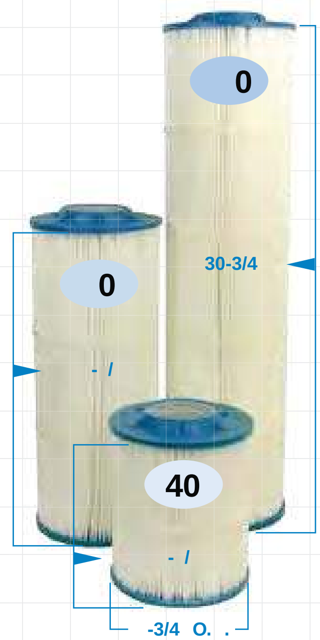
Certified to ANSI-NSF 61

Cartridge Selection/Sizing Guide

7-3/4" O.D. For Harmsco Hurricane and ater etter ingle-cartridge Filter Housings

Cartridge Length	Product Code	Nominal Micron Rating	Media s ft	Recommended Flow Rate* (GPM)	Max Flow Rate* (GPM)	Max Flow Rate* (LPM)	Max Flow Rate* (M³/HR)	No./ Carton	Carton Size
	Premium Hurricane® Polyester Cartridges - rated up to 140 F (60 C).								
- /	HC/40-0.35	0.35	40	35	50	189	12	1	9x9x11
	HC/40-1	1	40	35	50	189	12	1	9x9x11
	HC/40-5	5	40	35	50	189	12	1	9x9x11
	HC/40-10	10	40	35	50	189	12	1	9x9x11
	HC/40-20	20	40	35	50	189	12	1	9x9x11
	HC/40-50	50	40	35	50	189	12	1	9x9x11
	HC/40-100	100	40	35	50	189	12	1	9x9x11
	HC/40-150	150	40	35	50	189	12	1	9x9x11
- /	HC/90-0.35	0.35	90	70	100	378	24	1	9x9x21
	HC/90-1	1	90	70	100	378	24	1	9x9x21
	HC/90-5	5	90	70	100	378	24	1	9x9x21
	HC/90-10	10	90	70	100	378	24	1	9x9x21
	HC/90-20	20	90	70	100	378	24	1	9x9x21
	HC/90-50	50	90	70	100	378	24	1	9x9x21
	HC/90-100	100	90	70	100	378	24	1	9x9x21
	HC/90-150	150	90	70	100	378	24	1	9x9x21
30-3/4	HC/170-0.35	0.35	170	105	150	568	36	1	9x9x32
	HC/170-1	1	170	105	150	568	36	1	9x9x32
	HC/170-5	5	170	105	150	568	36	1	9x9x32
	HC/170-10	10	170	105	150	568	36	1	9x9x32
	HC/170-20	20	170	105	150	568	36	1	9x9x32
	HC/170-50	50	170	105	150	568	36	1	9x9x32
	HC/170-100	100	170	105	150	568	36	1	9x9x32
	HC/170-150	150	170	105	150	568	36	1	9x9x32

*Harmsco recommends operation at 70 of maximum flow rate for optimum performance.

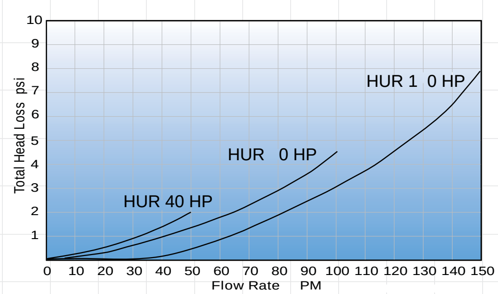


Premium Hurricane® Polyester Cartridges

Length and O. .

Pressure Drop

Pressure drop shown at right is for lter housing and 20 micron lter cartridge in clean water.



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Note: This publication is to be used as a guide. The data within has been obtained from many sources and is considered to be accurate. Harmsco does not assume liability for the accuracy and/or completeness of this data. Changes to the data can be made without notification. Temperature, Pressure, Flow Rates, Differential Pressures, Chemical Combinations and other unknown factors can affect performance in unknown ways. **Limited arrant :** Harmsco warrants their products to be free of material and workmanship defects. Determination of suitability of Harmsco products for uses and applications contemplated by Buyer shall be the sole responsibility of Buyer. The end user/installer/buyer shall be liable for the product s performance and suitability regarding their specific intended applications. End users should perform their own tests to determine suitability for each application.

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Made in USA

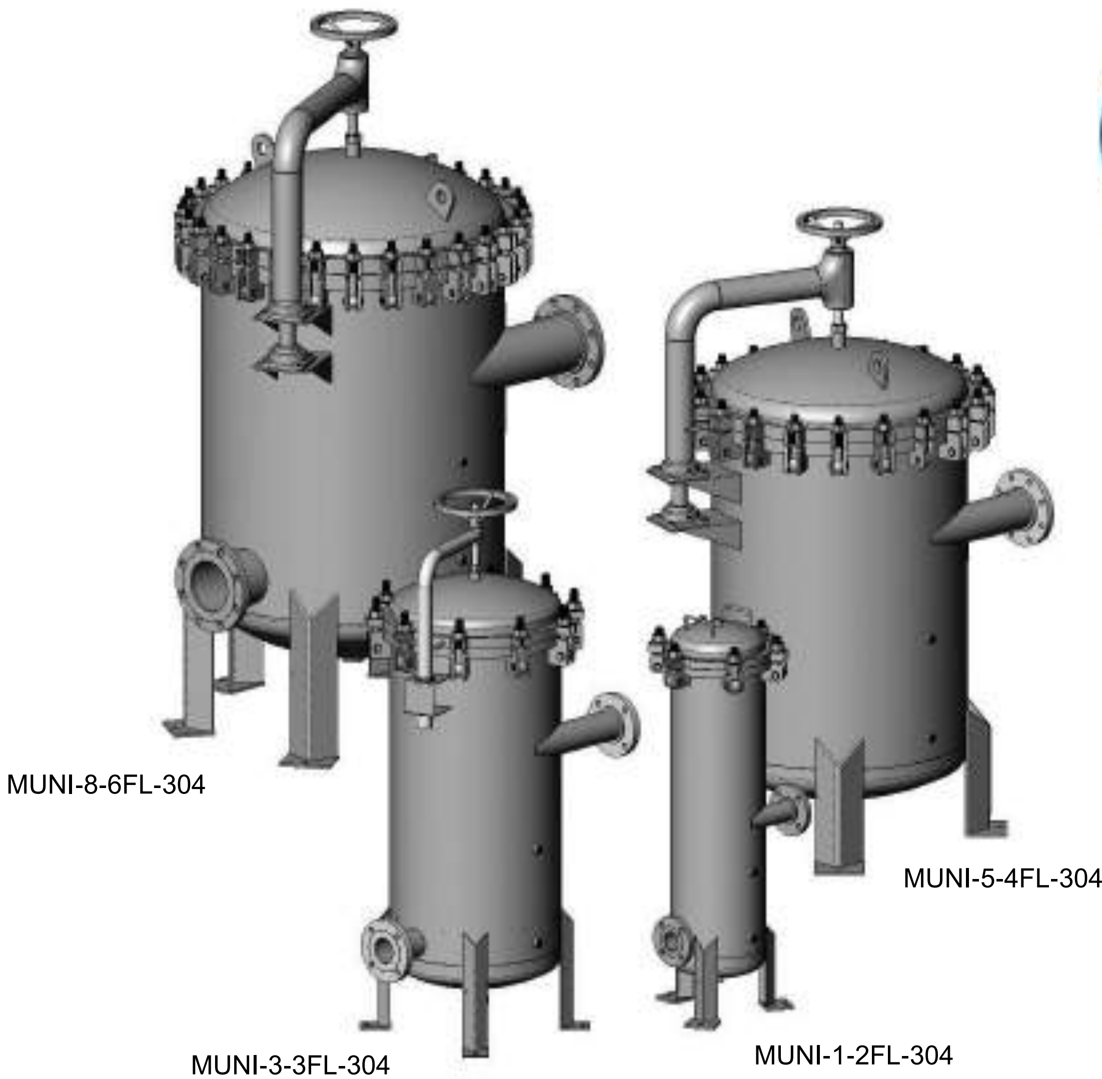
HARMSCO® MUNICIPAL

Filtration Systems

Models: MUNI-1-2FL-304, MUNI-3-3FL-304
MUNI-5-4FL-304, & MUNI-8-6FL-304

INSTALLATION AND OPERATION MANUAL

NSF®



Harmsco® Filtration Products

With Patented Up-Flow and Tangential/Rotational Flow Filtration Technology

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1243-MUNI, MANUAL - MUNI FL SWINGBOLTS
Revised - 7/14

565/665

HARMSCO® Municipal Filtration Systems

INTRODUCTION

The Harmsco® Municipal Filtration System is a water filtration device that utilizes the Harmsco® Hurricane® HC/170 size cartridge filter in various quantities from one per housing (MUNI-1-2FL-304) to 8 per housing (MUNI-8-6FL-304).

The Hurricane® HC/170 cartridges are available in many micron ratings, styles and materials of construction. To meet the EPA LT2 requirement Part Number HC/170-LT2 cartridge is required. Consult the Harmsco® Product Catalog (www.harmsco.com) or a Sales Representative for more details.

All of the Harmsco® Municipal Fitration System housings; **MUNI-1-2FL-304**, **MUNI-3-3FL-304**, **MUNI-5-4FL-304** & **MUNI-8-6FL-304** are equipped with pipe flanges on both the inlet and the outlet, & cartridge lifting handle(s) (part # 362-L). All models are NSF Certified per Standard 61 when used with Genuine Harmsco® Hurricane® HC/170 cartridges.

The Harmsco® Municipal Hurricane® Swing Bolt Water Filter is designed as a strong economical filter that continuously improves the water quality with minimal maintenance.

CONTENTS

HARMSCO® Municipal Filtration Systems

INSTALLATION & OPERATION MANUAL

Safety Precautions:

Before using and installing this product or its components please read this entire manual. Failure to do so could result in serious personal injury or damage to the equipment and assembled components.

This product and all of its components MUST NOT be installed or used in any manner other than that which is specified in this manual.

! WARNINGS !

1. **Seek qualified assistance for installation. Piping shall conform to all applicable State and Local codes and be independently supported.**
2. **Do not install the unit where a temperature of 32° F or lower can occur. Damage caused by freezing shall void all warranties.**
3. **The unit shall be properly bonded in accordance with all applicable State and Local codes. A grounding lug is provided.**
4. **After unit is installed, flush (through outlet) to drain for 10 minutes at recommended flow rates prior to use.**
5. **Always isolate unit and relieve pressure before servicing.**
6. **Utilizes Genuine Harmsco® Hurricane® HC/170 filter cartridges, available in many micron ratings and styles.**
   The use of any filter cartridges other than Genuine Harmsco® Hurricane® filter cartridges will void certifications by NSF International.

This product is manufactured under one or more of the following patents: U.S. NO. 4,187,179; 3,720,322; CANADA NO. 977,693; GT. BRIT. NO. 1,372,014; W. GERMANY NO. 2,261,817; FRANCE NO. 7,246,864; EUROPEAN NO. 0,191,844. Other patents pending.

Notice: The information contained in this publication is considered accurate and is intended to be used as a guide. This information is subject to change without notification. Contact Harmsco® Filtration Products for the latest and most up to date specifications. Harmsco® Filtration Products does not assume any liability for the accuracy and completeness of the data in this publication.

HARMSCO® Municipal Filtration Systems

REQUIREMENTS

- Only qualified personnel are to perform the installation.
- Flush unit (through outlet) to drain for 10 minutes at recommended flow rates prior to use.
- Install shut off valves on both the inlet and the outlet to isolate unit while servicing.

RECOMMENDATIONS

- Attach drains with supplied ball valves to reduce service time.
- Include a by-pass with shut off valves between the inlet and outlet. See installation Block Diagram on page 7.
- Install supplied pressure gauges and fittings into the gauge ports provided.
- Install plug or appropriate valve into the vent port provided.
- Lubricate Swing Bolt Assemblies (all models) & Davit Assemblies (MUNI-3-3FL-304, MUNI-5-4FL-304 & MUNI-8-6FL-304) using Food Grade grease with PTFE and NSF rated H1 only.
- Replace cartridge(s) when certain conditions exist.
  For example:
  1. Differential pressure is greater than 30 psi.
  2. Quality of water is unacceptable.
  3. Flow rate has diminished.
  4. Every 6 months
- **Spare Parts:**
  1. Sufficient supply of replacement cartridges.
     Note: Harmsco® Hurricane® HC/170-LT2
  2. Housing O-ring Seal:

Model #	Part # EPDM (std)	BunaN	Viton
MUNI-1-2FL-304	361-E	361-B	361-V
MUNI-3-3FL-304	363-E	363-B	363-V
MUNI-5-4FL-304	365-E	365-B	365-V
MUNI-8-6FL-304	368-E	368-B	368-V

  3. Additional: Cartridge Lifting Handle, Part #362-L

HARMSCO® Municipal Filtration Systems

INSTALLATION/SET-UP

The following instructions & diagrams show the Harmsco® Municipal Filtration System housing with typical plumbing hook-up requirements. All steps of the installation are to be performed by qualified personnel.

1. Always adhere to state and local plumbing codes and requirements for design and installation.
2. Mount and secure housing using the holes at the base of the legs - see Installation Diagrams, pages 8-11.
   Models MUNI-5-4FL-304 & MUNI-8-6FL-304 have two lifting lugs welded onto the lid for positioning of the housing. Swing bolts must be engaged and the housing must be empty prior to using the lifting lugs.
3. Bond the filter housing utilizing the grounding lug on the leg.
   - must be performed by a qualified electrician.
4. Install incoming water supply with shut off valve to flange marked "Inlet".
5. Install return line with shut off valve to flange marked “Outlet”.
6. Install supplied ball valves in drain lines into the FPT couplings located at the bottom center and side of housing.
7. Install supplied pressure gauges and fittings into the gauge ports.
8. Install air relief valve into the vent port.
9. Refer to Specifications, Installation Block Diagram & Installation Diagrams for more details, pages 6-11.

Notes:

- Shut-off valves shall be installed on inlet and outlet to isolate the filter when servicing.
- To protect against electrolysis, all filters shall be bonded.
  Failure to properly bond the filter will void all warranties.
- NSF STD 61 listed drain valves and pressure gauges are provided.
- Use gaskets, sealants and/or expansion/vibration coupling materials appropriate for the application.
- Flush unit (through outlet) to drain for 10 minutes at recommended flow rates prior to use.
- For cartridge replacement, see pgs. 12 - 18.
- For models MUNI-3-3FL-304, MUNI-5-4FL-304 & MUNI-8-6FL-304, make sure sufficient space is available to rotate lid away from housing allowing access to all cartridges.

HARMSCO® Municipal Filtration Systems

SPECIFICATIONS

	MUNI-1-2FL-304	MUNI-3-3FL-304	MUNI-5-4FL-304	MUNI-8-6FL-304
Cartridge Quantity[1]	1	3	5	8
Max. Flow Rate, gal/min[2]	100	300	500	800
Pressure Rating, P.S.I.G. Max.	150	150	150	150
Height, inches	48"	63-1/2"	74"	84"
Service Height, inches	77"	98-1/2"	98-1/2"	104-1/2"
Housing Diameter	11"	20"	30"	35-3/8"
Inlet/Outlet[3]	2" Flange	3" Flange	4" Flange	6" Flange
Height of Inlet, inches	23-5/8"	35-1/4"	38"	44-1/4"
Height of Outlet, inches	9-3/4"	12"	14-1/8"	20-1/2"
Drain (Qty 2, Female)	3/4" NPT	1-1/2" NPT	1-1/2" NPT	1-1/2" NPT
Weight, Dry	150 lbs.	435 lbs.	1,130 lbs.	1,640 lbs.
Weight, Wet	284 lbs.	944 lbs.	2,314 lbs.	3,575 lbs.
Floor Contact Area	.188 ft^2	.292 ft^2	.776 ft^2	1.164 ft^2
Floor Load (approx.)[3,4]	1,515 lbs/ft^2	3,250 lbs/ft^2	3,000 lbs/ft^2	3,100 lbs/ft^2
Floor Space[5]	1.6 ft^2	4.5 ft^2	8.5 ft^2	14.0 ft^2

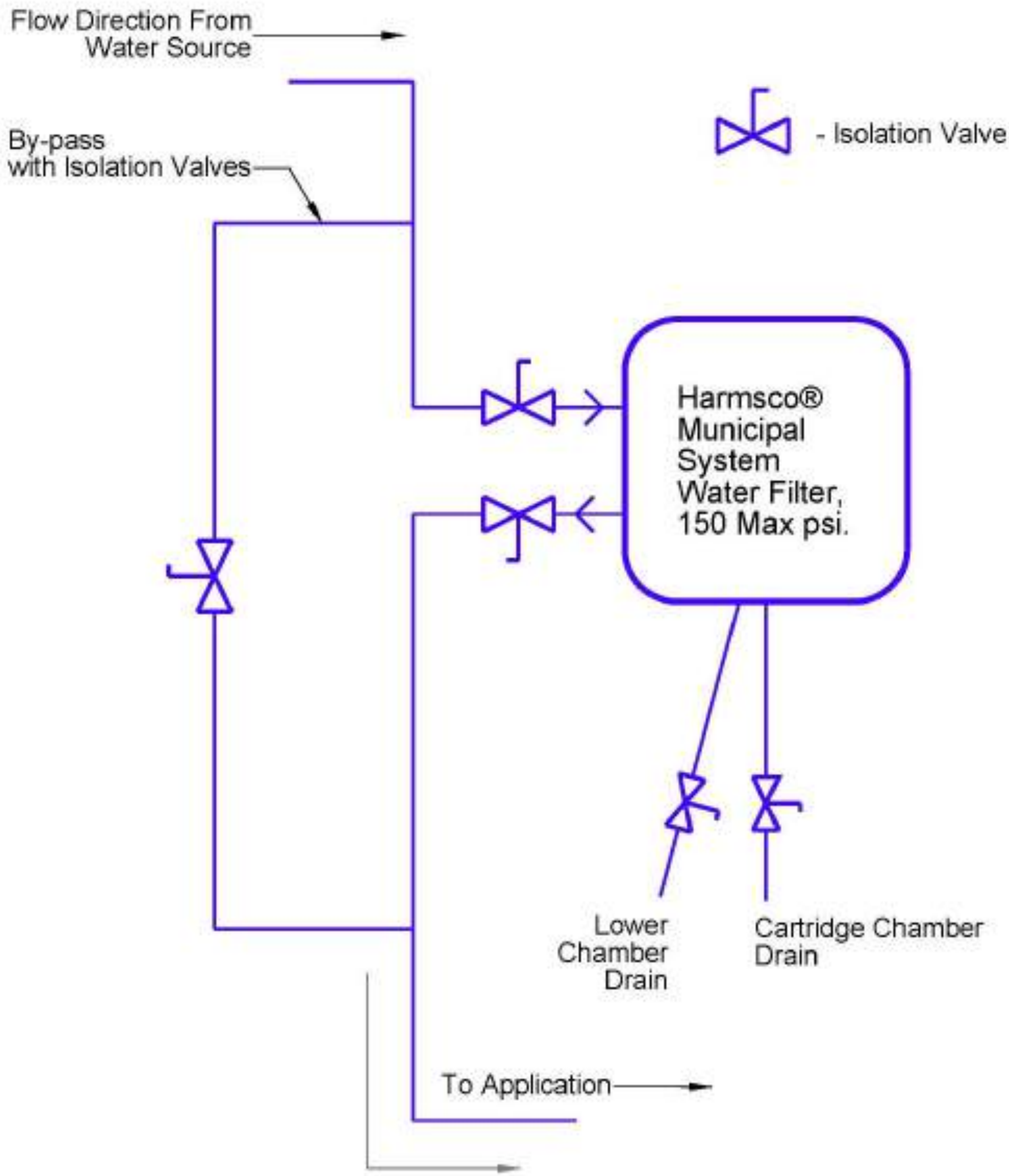
Bonding:	Housing shall be bonded in accordance with all applicable codes. A grounding lug is provided on the leg.
Housing Material:	Stainless Steel Construction. Wetted metallic components are 304/304L ASTM A-240
Finish:	Electro-polish
O-ring Material:	EPDM is standard. Buna-N & Viton are available
Temperature Rating:	Up to 140°F, Note: Higher temperatures are possible, check cartridge specifications and contact a Harmsco® sales engineer.

Notes:

1. Utilizes Genuine Harmsco® Hurricane® HC/170 cartridges.
   - The use of cartridges other than Genuine Harmsco® Hurricane® HC/170 filter cartridges will void certifications by NSF International.
2. HC/170-LT2 Cartridge Flow Rate
   - Higher flow rates can be realized for pre-filtration applications. Contact your Harmsco Municipal Customer Service Representative for further information.
3. Piping shall conform to all applicable codes and be independently supported.
4. If floor strength is suspect, use appropriate measures to adequately distribute load.
5. Does not include Cover/Davit swing position for models MUNI-3-3FL-304, MUNI-5-4FL-304 & MUNI-8-6FL-304. See Installation Diagrams, pages 9-11.

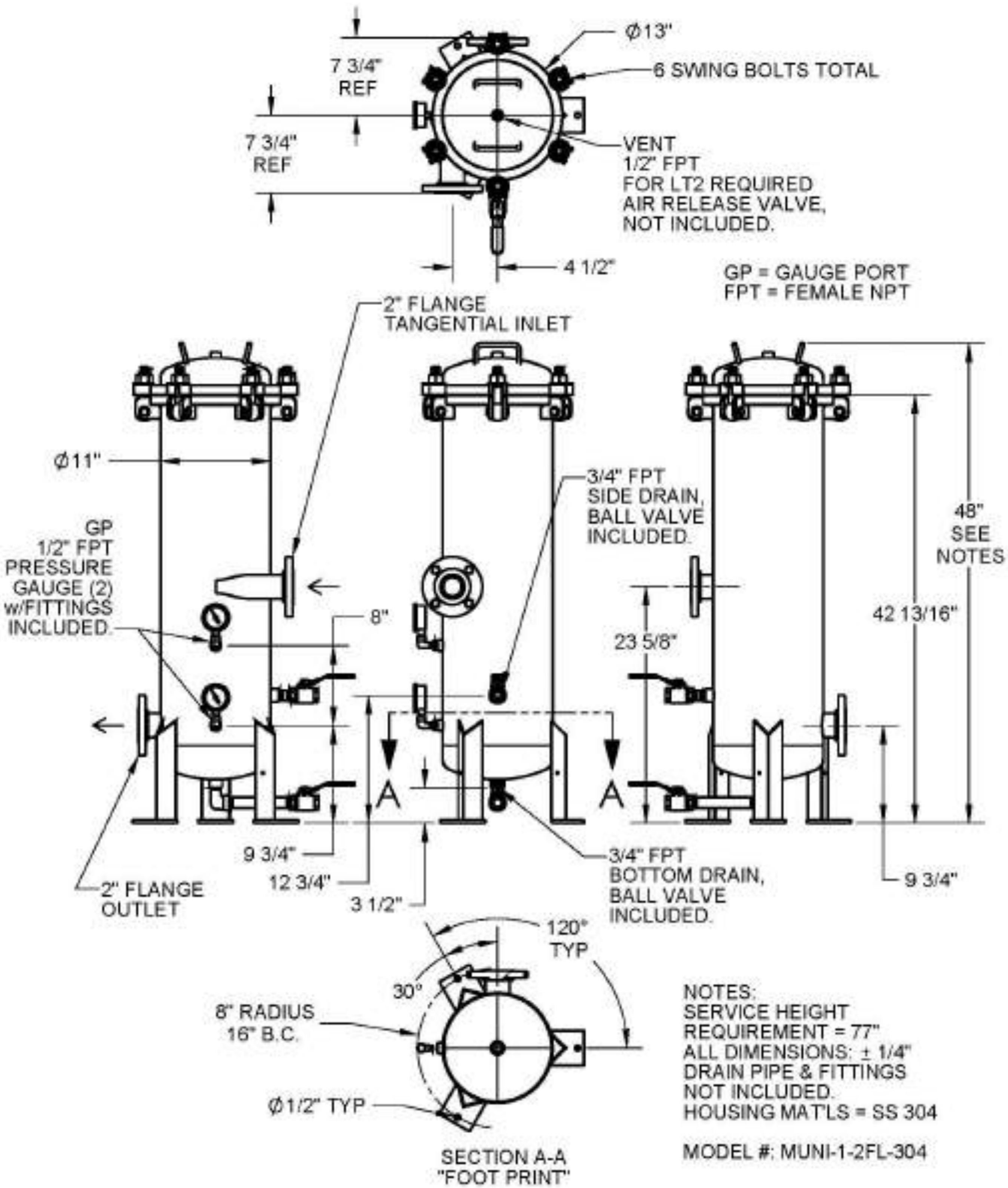
HARMSCO® Municipal Filtration Systems

Installation Block Diagram



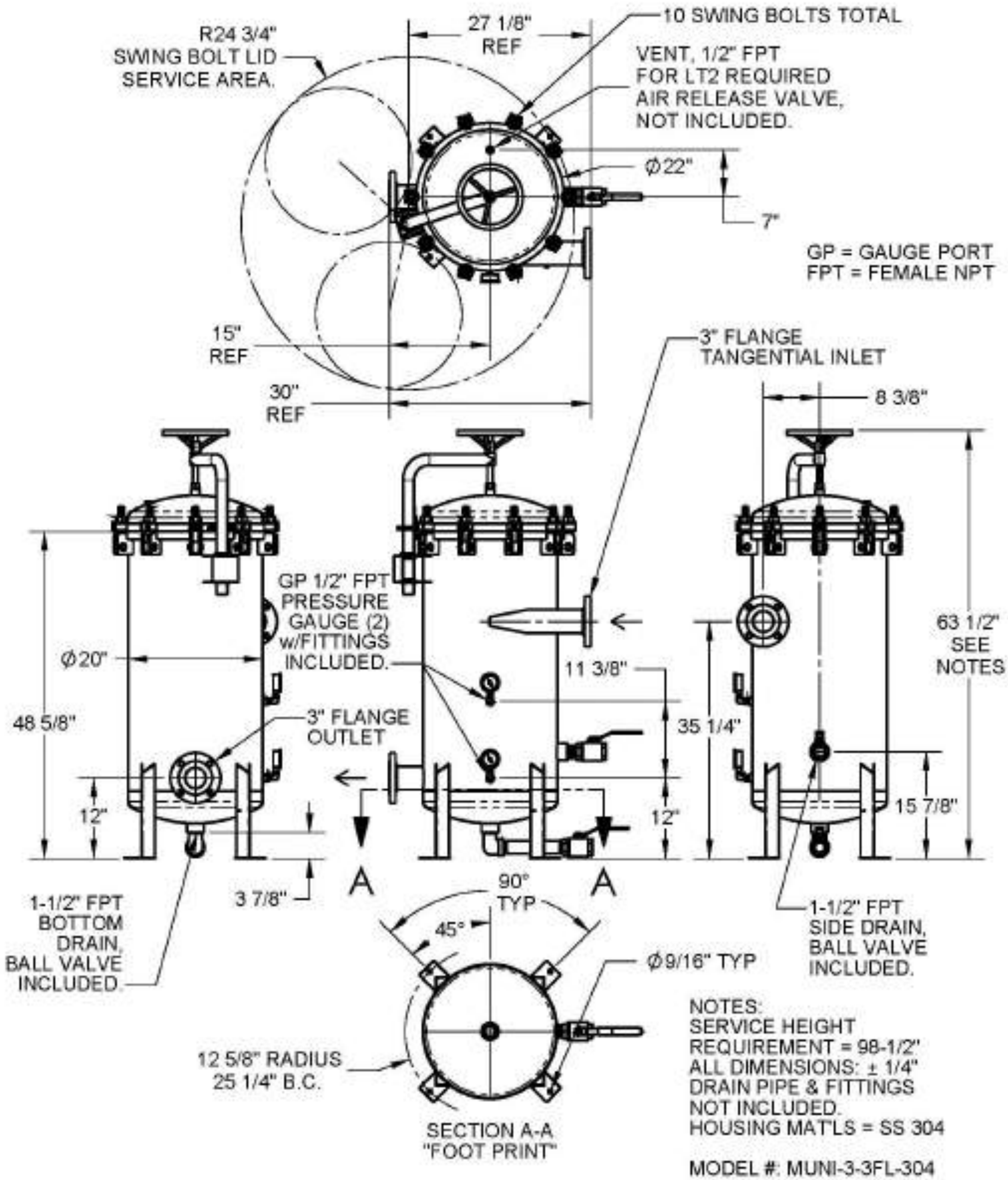
HARMSCO® Municipal Filtration Systems

Installation Diagram
Model MUNI-1-2FL-304



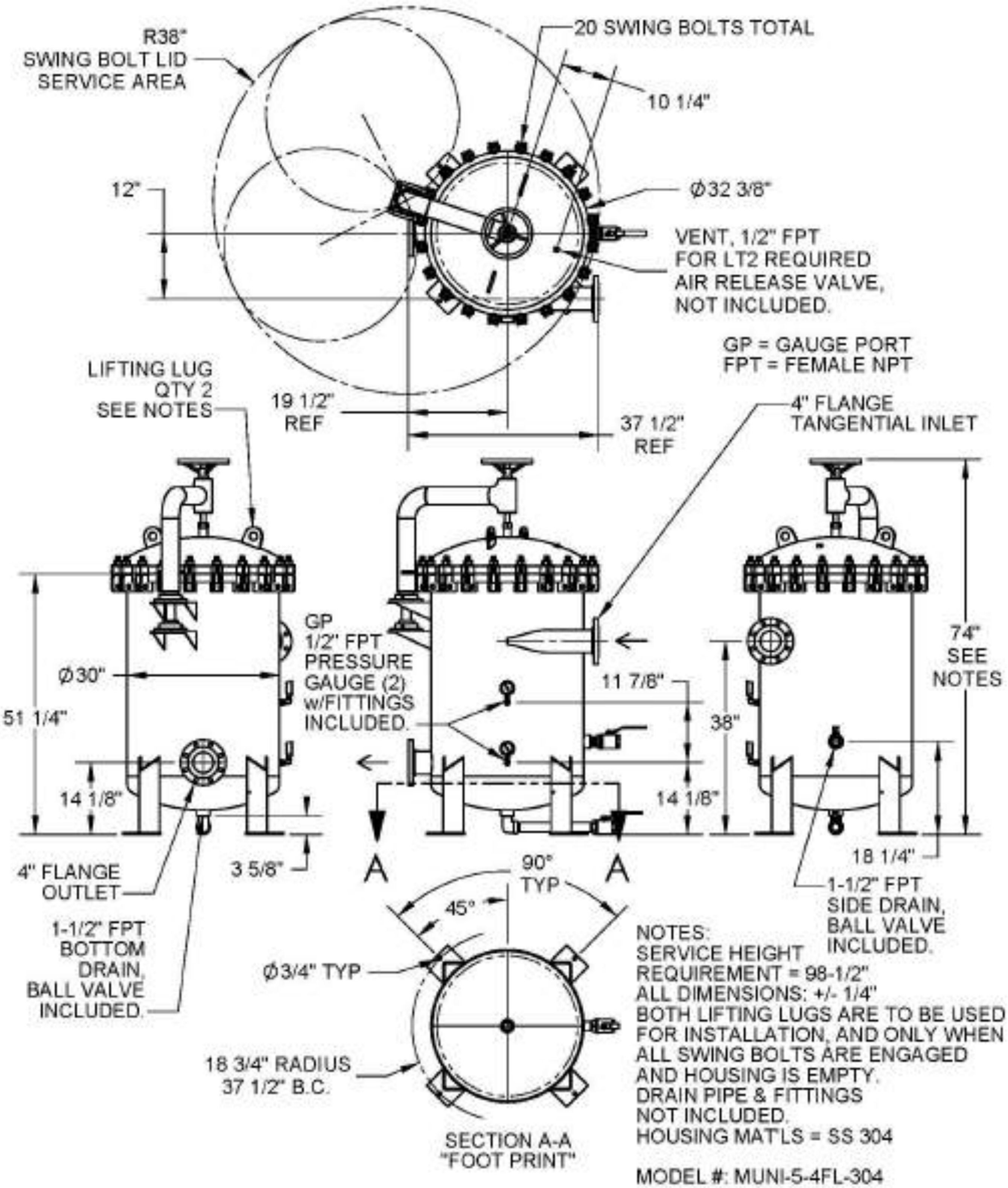
HARMSCO® Municipal Filtration Systems

Installation Diagram
Model MUNI-3-3FL-304



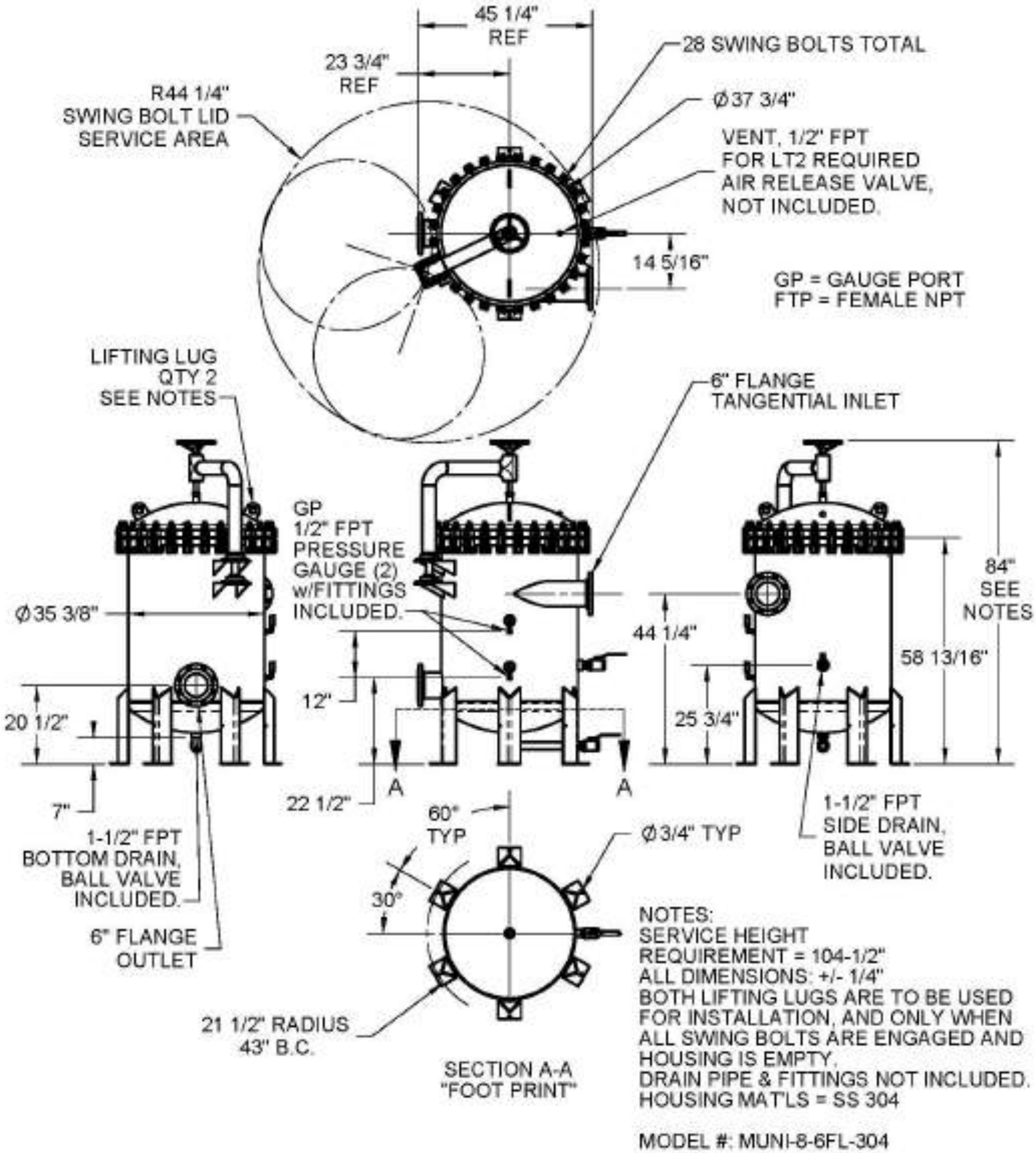
HARMSCO® Municipal Filtration Systems

Installation Diagram
Model MUNI-5-4FL-304



HARMSCO® Municipal Filtration Systems

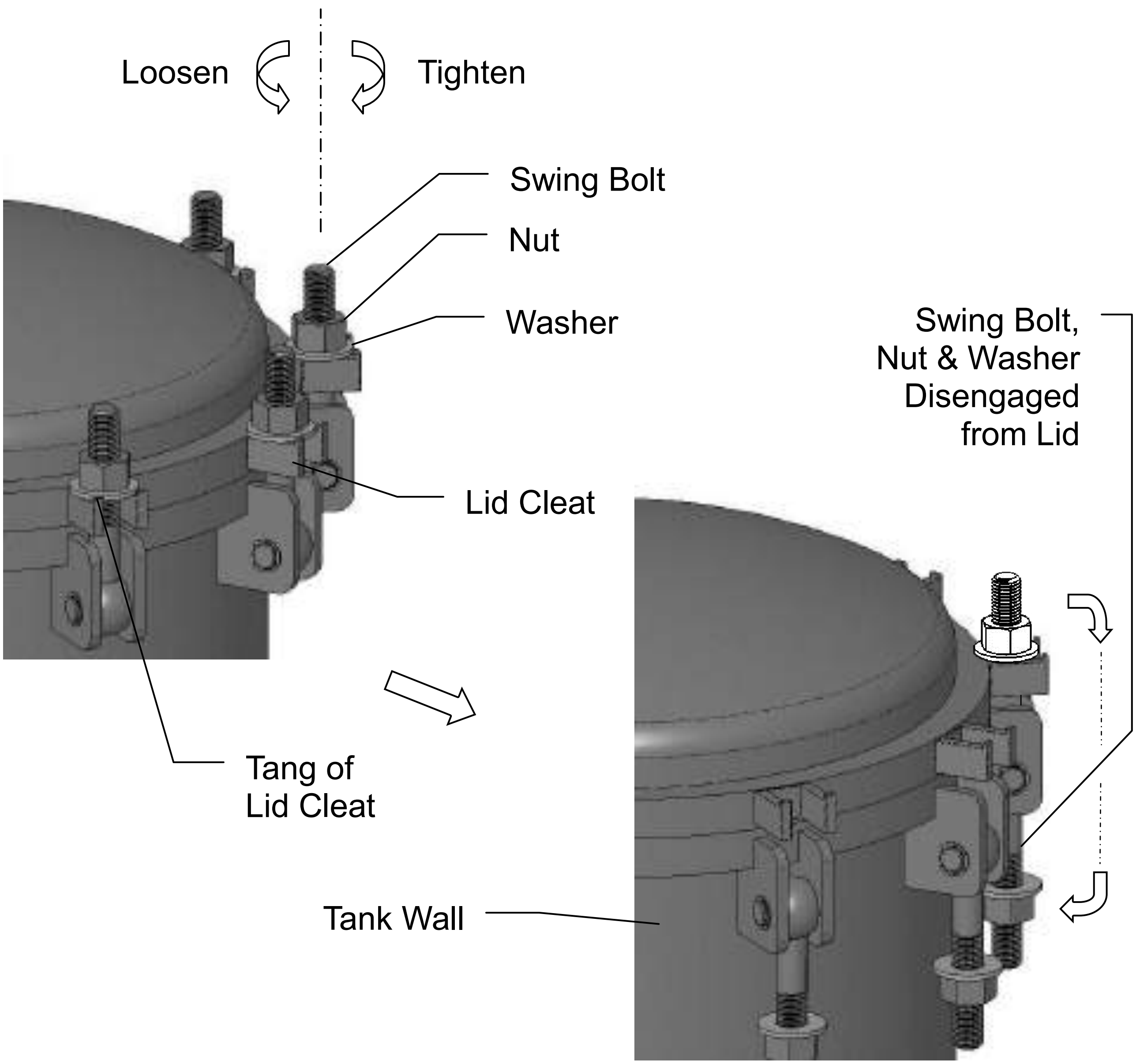
Installation Diagram
Model MUNI-8-6FL-304



HARMSCO® Municipal Filtration Systems

CARTRIDGE REPLACEMENT

1. Isolate unit from all water sources (close I/O lines) and relieve pressure to housing by first opening the housing's "Bottom Drain" and let drain completely. See Installation Diagrams (pgs. 8-11). This will protect the cartridges (installed) from experiencing a reverse flow that could cause damage.
2. Open Side Drain and let housing drain completely.
3. Loosen all Nuts of Swing Bolts by 1/2 turn increments counter-clockwise to gradually step down load applied to swing bolts. Repeat process as needed.
4. Fully loosen Nuts but do not remove from Swing Bolt. Lift Washer above Tangs in Lid Cleats and allow Swing Bolt to rotate downward along the side of the housing's Tank Wall.

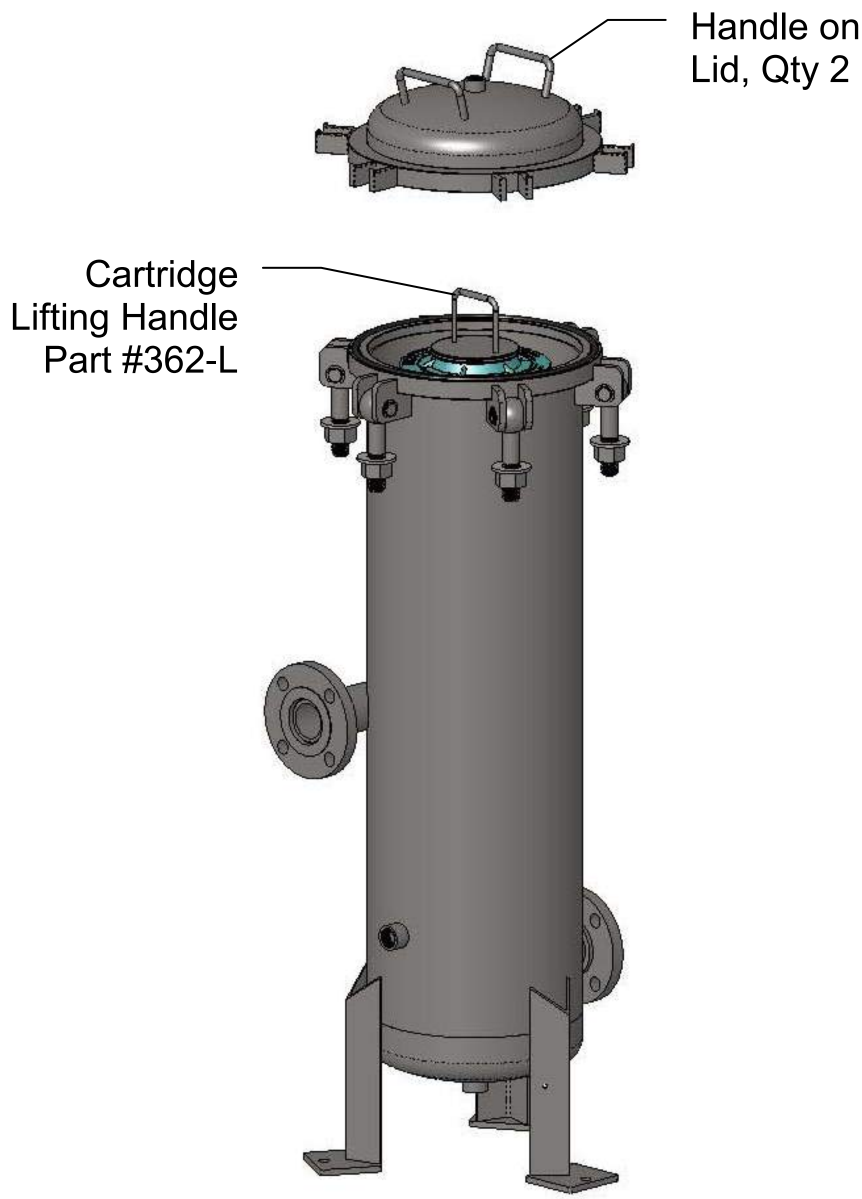


HARMSCO® Municipal Filtration Systems

CARTRIDGE REPLACEMENT cont.

5. When all of the Swing Bolt hardware is disengaged, the Lid can be removed.

5 a. For Model MUNI-1-2FL-304 the Handles on the Lid are used to raise and remove the Lid.
Note: The Lid must be raised sufficiently to clear the Cartridge Lifting Handle prior to removal.



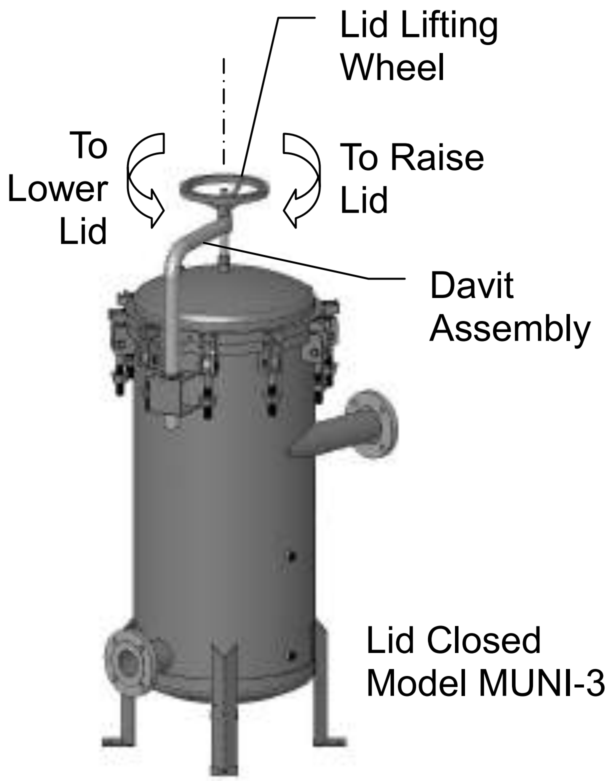
Model MUNI-1-2FL-304

HARMSCO® Municipal Filtration Systems

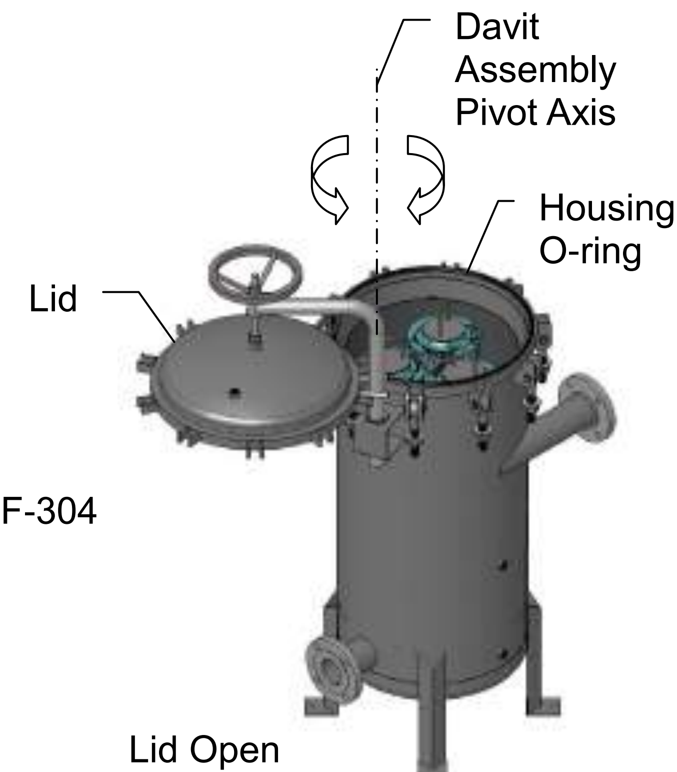
CARTRIDGE REPLACEMENT cont.

5 b. Models MUNI-3-3FL-304, MUNI-5-4FL-304 & MUNI-8-6FL-304 all have a Davit Assembly and Lid Lifting Wheel to raise and lower the Lid.
To raise Lid, turn Lid Lifting Wheel clockwise. To lower Lid, turn Wheel counter-clockwise.
Note: Housing O-ring may stick to Lid. To prevent this, it is suggested to raise the Lid about 1/8” inch and move the Lid/Davit Assembly slightly sideways to free the O-ring from Lid while keeping the O-ring in its housing channel.
Continue raising Lid approximately 1” to clear housing. Swing Lid and Davit Assembly until cartridge compartment is fully exposed.
Secure Lid in open position and apply “Warning” measures in accordance with safety regulations.

Caution: The Lid is to be secured while in the “open” position for servicing.



Lid Closed
Model MUNI-3-3F-304

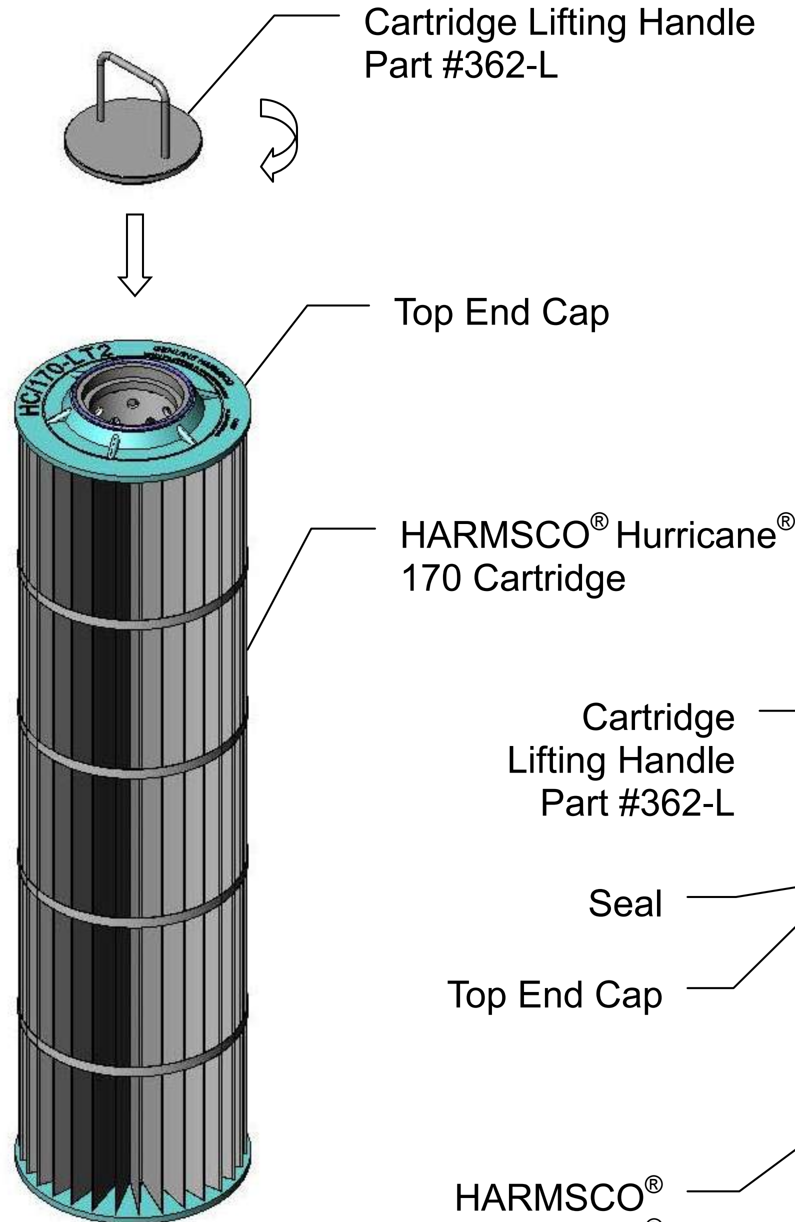


Lid Open
Model MUNI-3-3FL-304

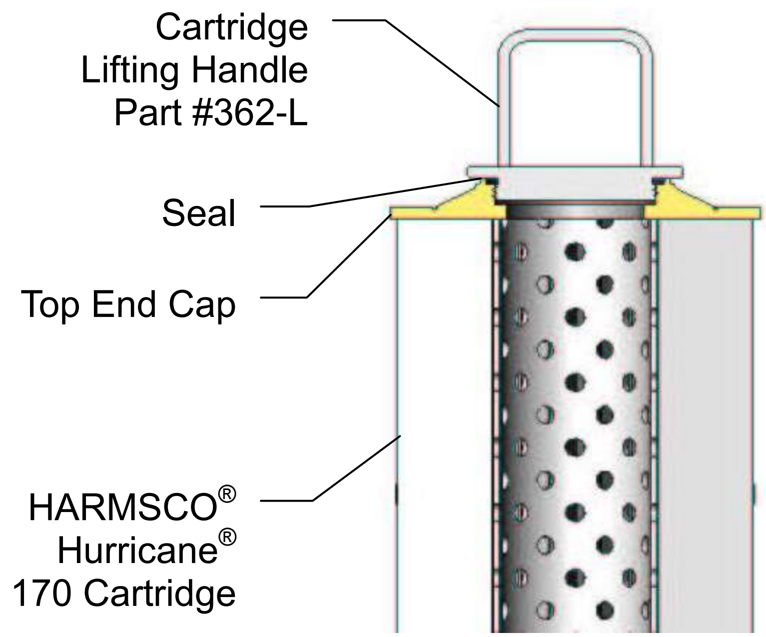
HARMSCO® Municipal Filtration Systems

CARTRIDGE REPLACEMENT cont.

6. Install Cartridge Handle(s), part #362-L, to Cartridge(s). Tighten securely to seal with Top End Cap to prevent by-passing of the Cartridge.



Exploded View

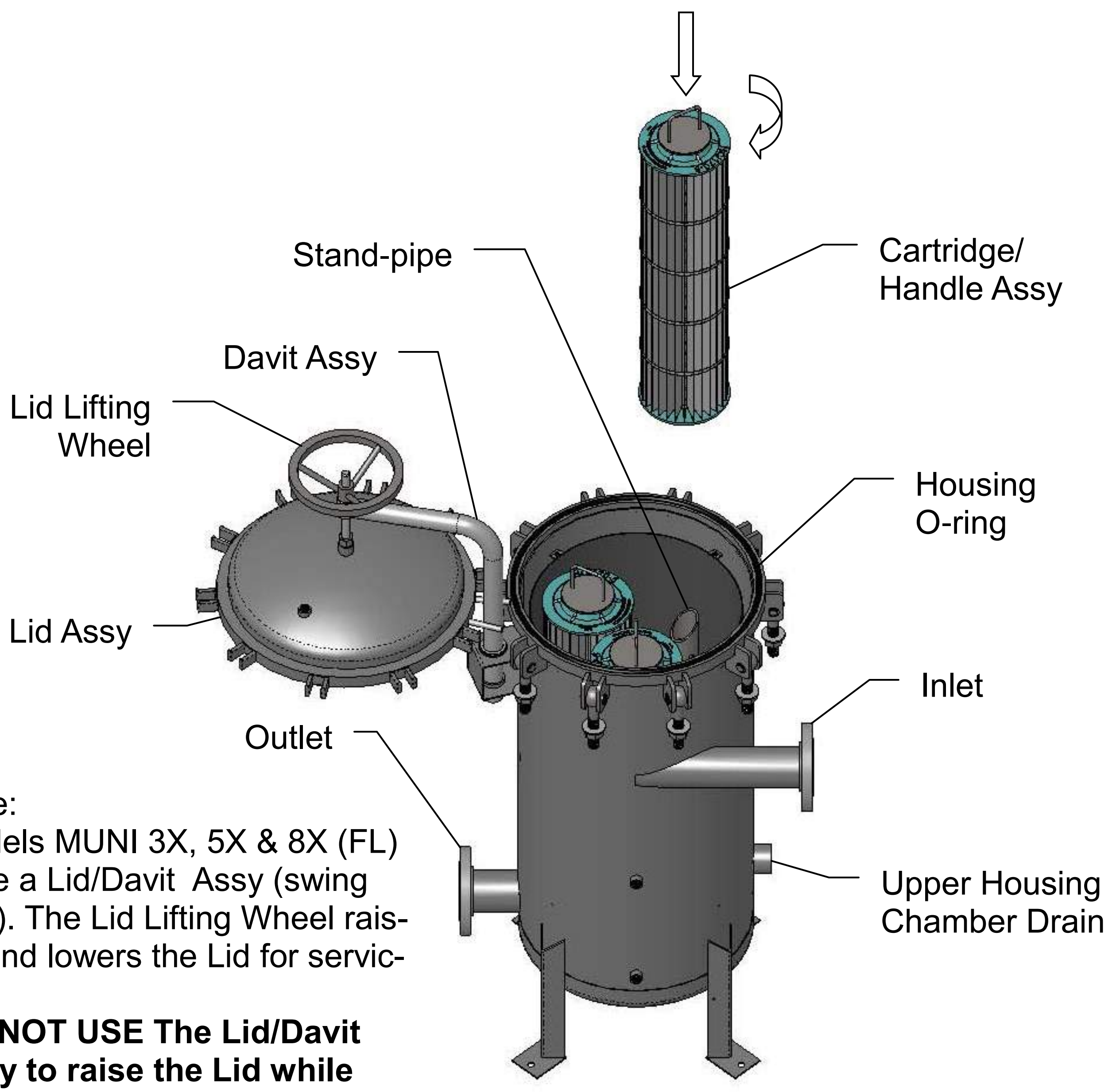


Partial Sectional View

HARMSCO® Municipal Filtration Systems

CARTRIDGE REPLACEMENT cont.

7. With swing bolts disengaged and lid removed, install Cartridge/Handle assembly(s) onto Stand-pipe(s). Position Cartridge/Handle assembly downward until Cartridge's Bottom End Cap contacts the housing's Tube Sheet. The Cartridge's Bottom End Cap will seal with the Stand-pipe Coupling to prevent by-passing. A clockwise rotating motion will help to position the Cartridge while engaging the Stand-pipe Coupling. Confirm all Cartridge/Handle assemblies are fully installed with all Cartridge Bottom End Caps contacting the housing's Tube Sheet, see illustrations on page 17.

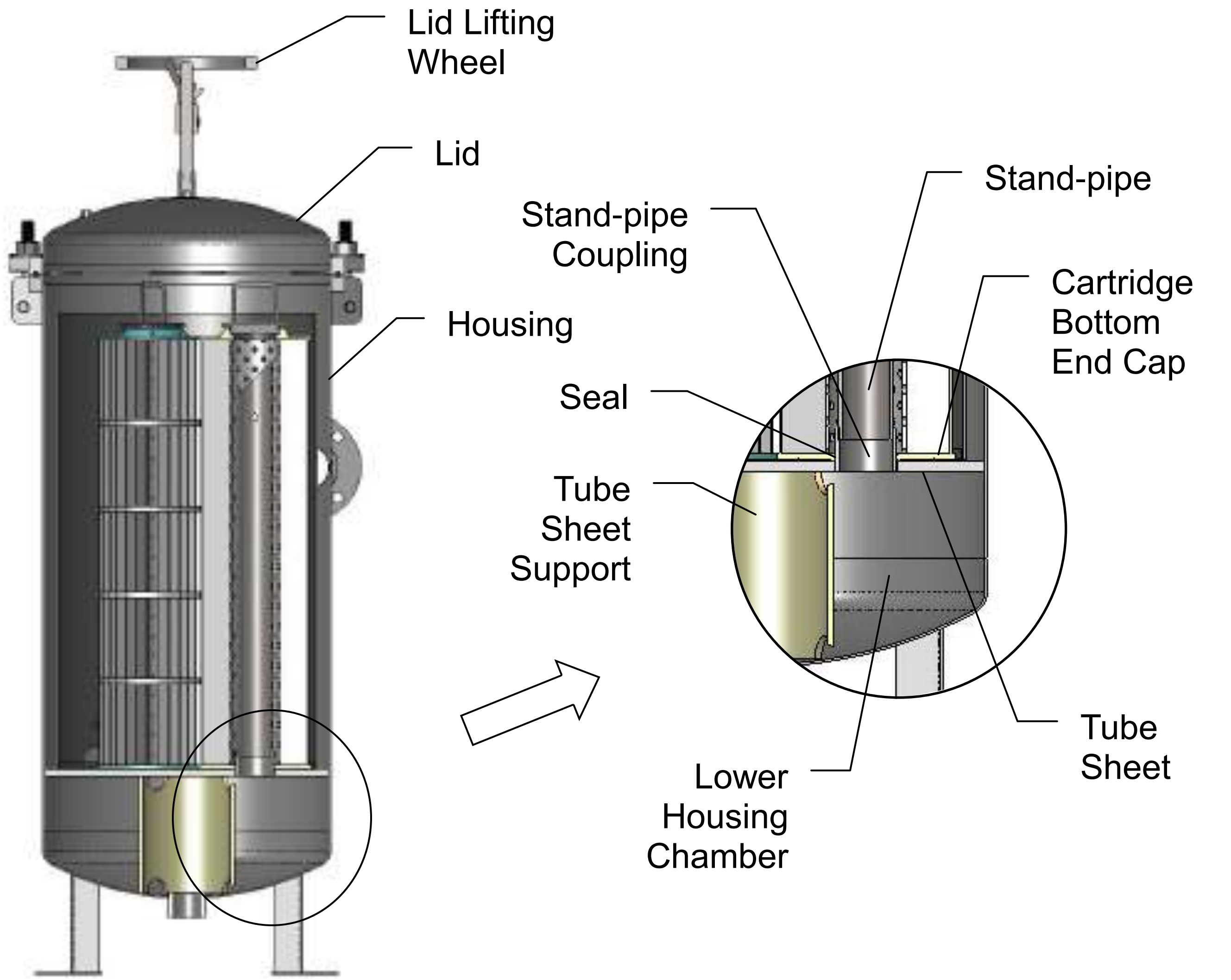


Note:
Models MUNI 3X, 5X & 8X (FL) have a Lid/Davit Assy (swing arm). The Lid Lifting Wheel raises and lowers the Lid for servicing.
DO NOT USE The Lid/Davit Assy to raise the Lid while swing bolts are engaged.

Model MUNI-3-3fl-304

HARMSCO® Municipal Filtration Systems

CARTRIDGE REPLACEMENT cont.



Section View
Model MUNI-3-3fl-304

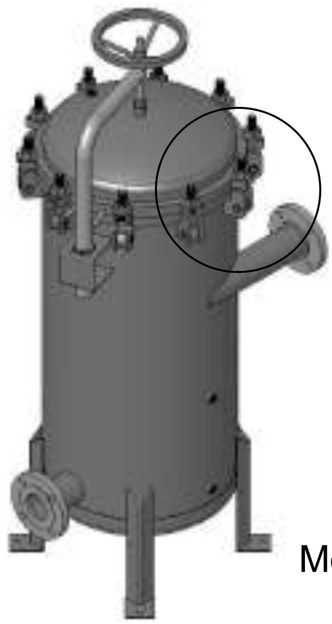
8. Inspect Housing O-ring and make sure that it is free from cracks and debris.
9. Clean Housing and Lid O-ring mating surfaces.
10. Place Housing O-ring into channel of Housing.
11. Return Lid to closure position and maintain alignment of Lid on Housing. Lower lid onto Housing O-ring. Make sure O-ring stays in the channel of the Housing. Do not allow tilting or cocking of Lid on the O-ring.

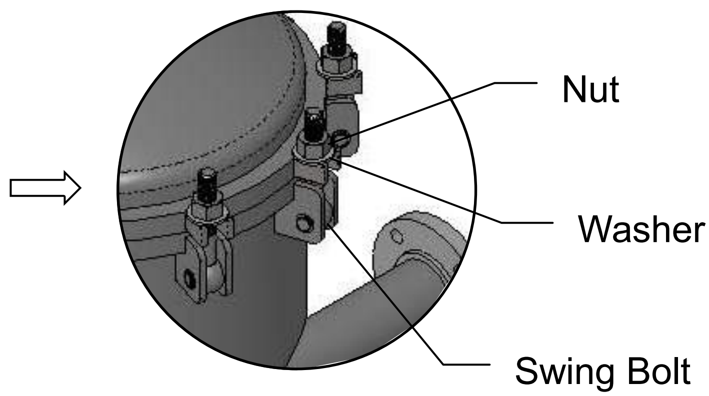
Note: The Lid/Davit Assembly is NOT to be carrying any load from the Lid at this time.

HARMSCO® Municipal Filtration Systems

CARTRIDGE REPLACEMENT cont.

12. Return all Swing Bolts, Nuts, & Washers to their closure position.
13. Tighten all Nuts in a “star/criss-cross” pattern several times until all Nuts are torqued to 10 ft-lbs. Make sure Lid position and alignment to Housing is maintained.





Model MUNI-3-3fl-304

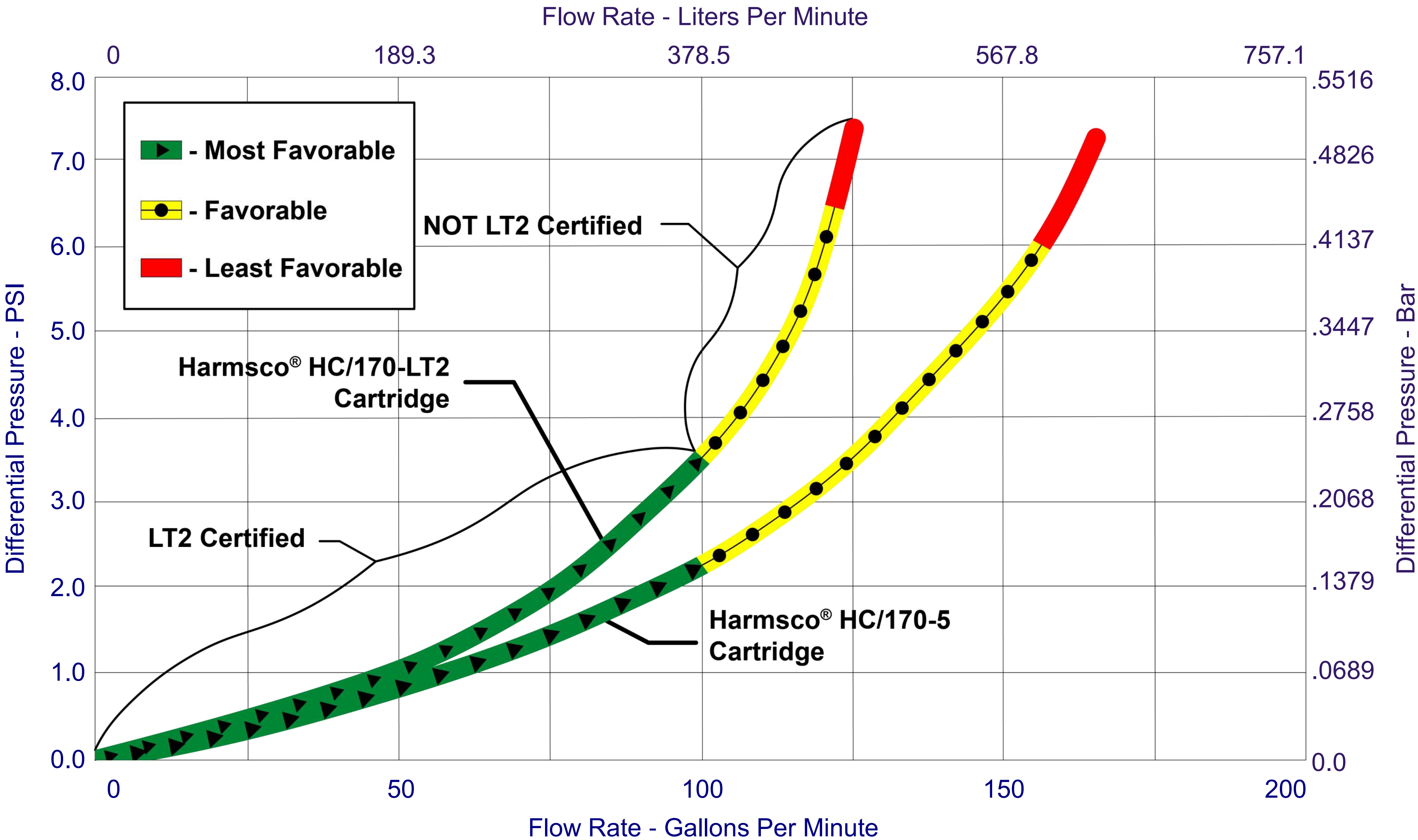
All Nuts are to be equally torqued to **10 ft-lbs**. prior to start-up.

14. Start the flow of water by first opening the inlet valve and allow the housing to completely fill, then, open the outlet valve.
15. Flush unit at recommended flow rate for 10 minutes prior to use. Inspect closure for any leaks. If a leak is observed, **Isolate and Remove Pressure in Housing,** then repeat steps 1 through 5 and 8 through 15.

The Harmsco® Municipal Filtration System is now operational.

1243-MUNI, MANUAL - MUNI FL SWINGBOLTS

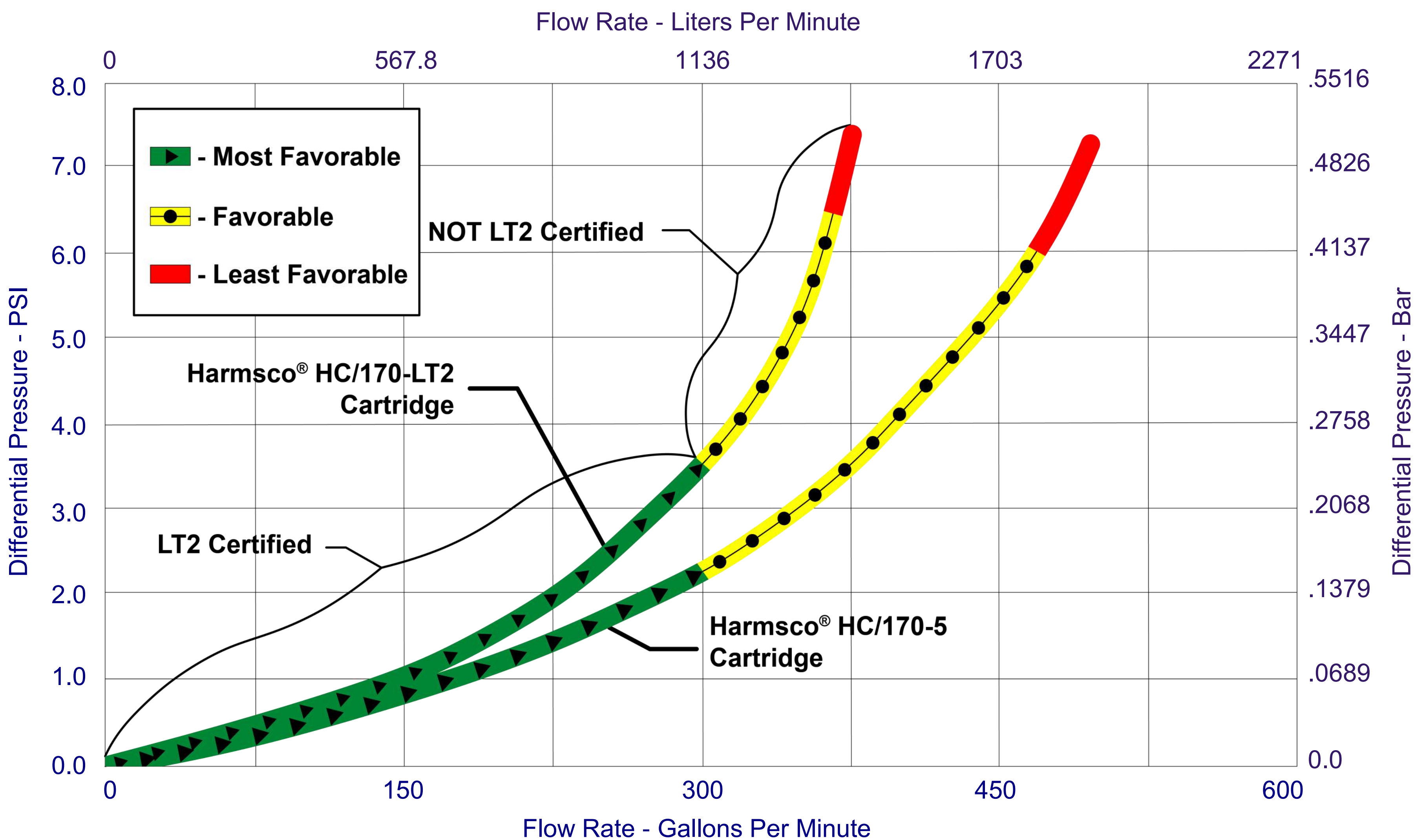
Pressure Drop vs. Flow Rate Curves
Harmsco® MUNI-1-2FL-304



583/665

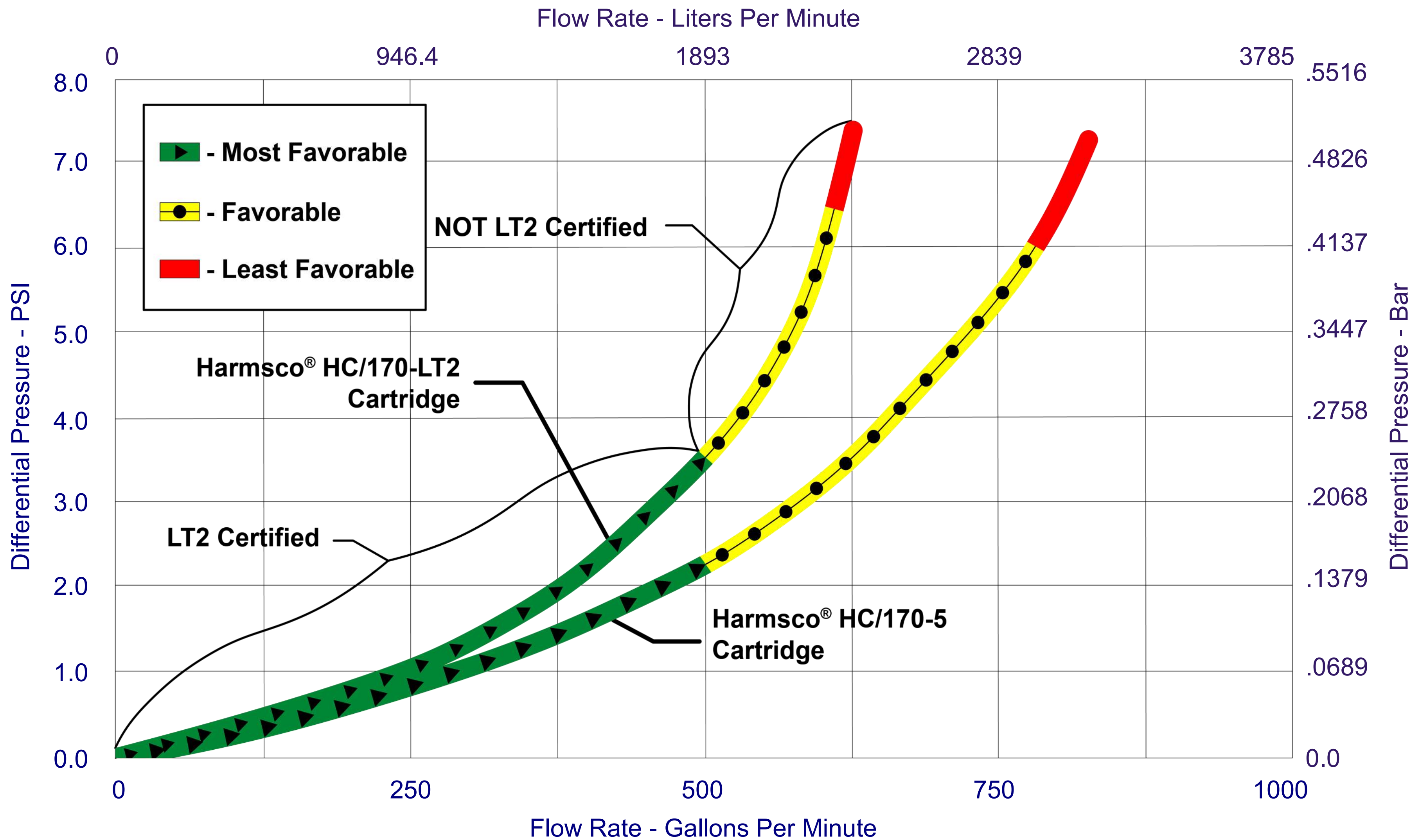
1243-MUNI, MANUAL - MUNI FL SWINGBOLTS

Pressure Drop vs. Flow Rate Curves
Harmsco® MUNI-3-3FL-304



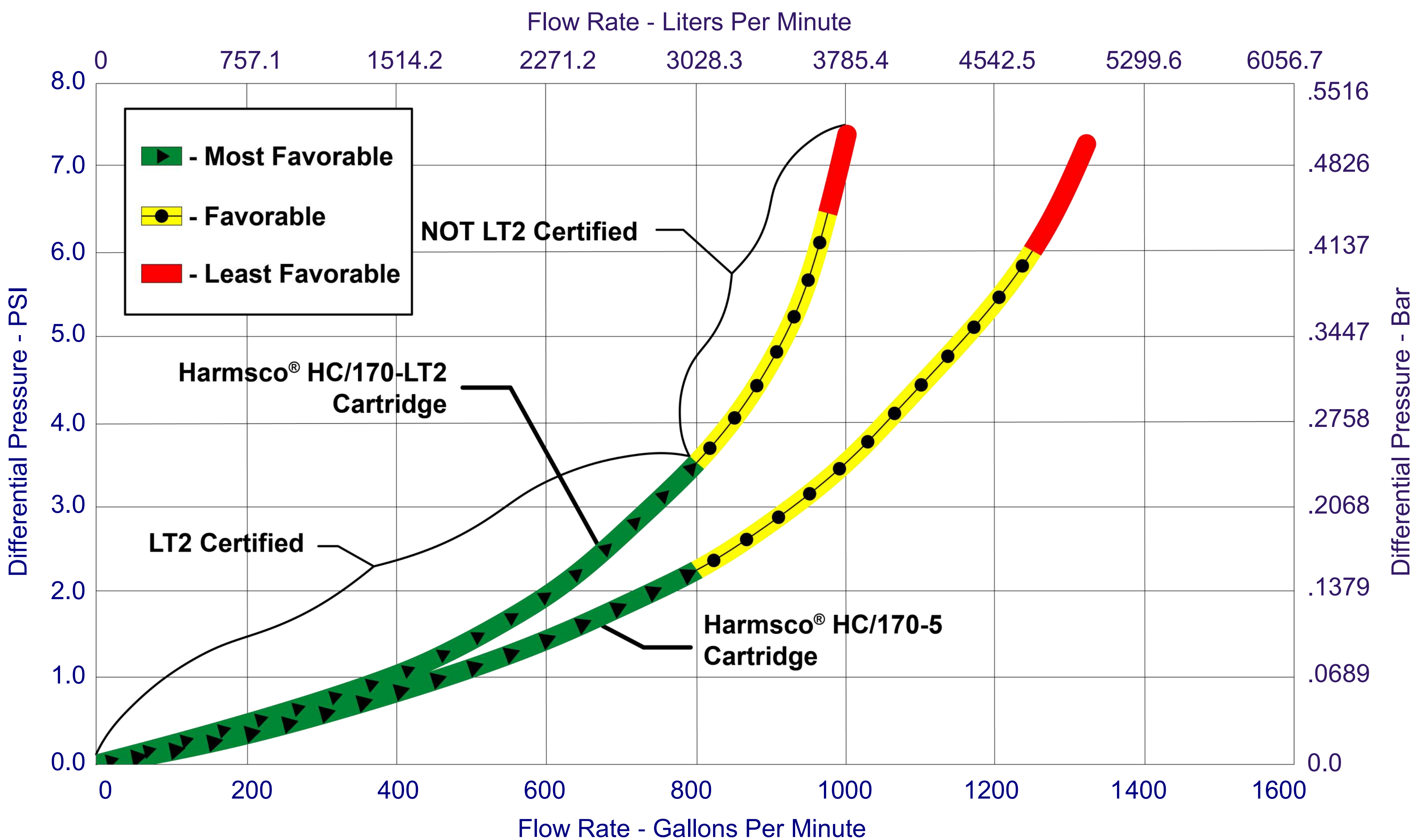
584/665

Pressure Drop vs. Flow Rate Curves
Harmsco® MUNI-5-4FL-304



585/665

Pressure Drop vs. Flow Rate Curves
Harmsco® MUNI-8-6FL-304



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1243-MUNI, MANUAL - MUNI FL SWINGBOLTS

HARMSCO® Municipal Filtration Systems

Cartridge Replacement Instructions (Quick Reference):

For Filter Housings With Swing Bolt Closure.

*** * NOTICE * ***

THE FOLLOWING INSTRUCTIONS MUST BE READ AND FOLLOWED PRIOR TO USE.

1. **Always Isolate And Remove Pressure From Housing Before Servicing.** Housing is to be shut off and drained of fluid by first opening the lower drain.
2. Open filter housing by turning Nuts counter-clockwise, disengaging Swing Bolts, and removing Lid. Take out used cartridge(s) and remove cartridge lifting handle(s).
3. Remove new cartridge(s) from packaging and make sure center cores are clear of all obstructions, dessicants and shipping materials.
4. Install cartridge lifting handle(s) onto new cartridge(s).
5. Insert Cartridge(s) into housing and onto Stand-pipe(s), cartridge(s) is(are) to contact Tube Sheet of housing.
6. Position housing O-ring into groove of housing.
7. Position Lid onto housing and properly align on O-ring before applying Swing Bolts. Do not allow tilting or cocking of Lid on the O-ring.
8. Close filter housing by tightening Nuts clockwise. Use a “star/criss-cross” pattern several times and tighten all of the Nuts equally to 10 ft-lbs torque.
9. Open inlet valve and allow fluid to fill housing.
10. Open outlet valve.
11. Flush unit (through outlet) to drain for 10 minutes at recommended flow rates prior to use.

Should a leak appear at the housing O-ring, isolate and relieve pressure, then repeat steps 6 through 11. Always isolate and remove pressure from housing before servicing any part of the filter.

This product is manufactured under one or more of the following patents: U.S. NO. 4,187,179; 3,720,322; CANADA NO. 977,693; GT. BRIT. NO. 1,372,014; W. GERMANY NO. 2,261,817; FRANCE NO. 7,246,864; EUROPEAN NO. 0,191,844, Other patents pending.

Harmsco® Filtration Products

With Patented Up-Flow Filtration Technology

www.harmsco.com

(561) 848-9628

Harmsco® Filtration Products Limited Warranty

1. Harmsco® warrants its line of Water Filters to be free of defects in material and workmanship for a period of one year from the date of installation.
2. This warranty does not cover any equipment purchased for use in applications in which the product is not suited. It is the responsibility of the buyer to determine if a product is suitable for a particular application.

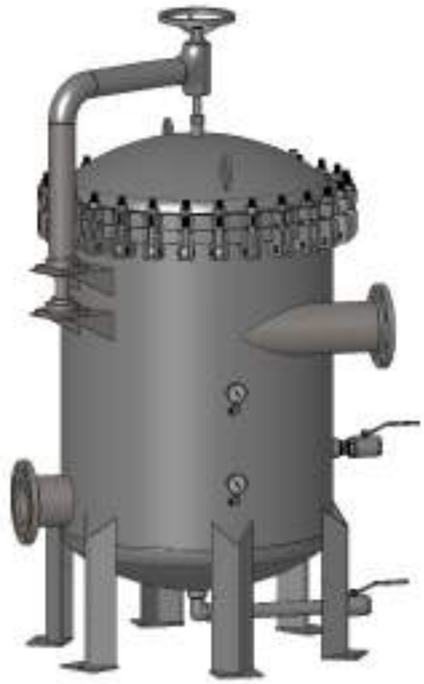
3. **THIS WARRANTY EXCLUDES THE FOLLOWING:**
   A. Any fresh water unit installed for salt water use.
   B. Damage caused by improper installation, operation or care.
   C. Chemical attack.
   D. Modification or alteration by other than Harmsco® employees.
   E. Rubber type parts and normal wear items, i.e. "O" rings, rim gaskets.
   F. Any costs of labor or expenses expended in the removal and/or installation of a unit, or any surrounding device.
   G. Damage caused by galvanic or electrolytic attack.
   H. Altering or removing the Harmsco® information label.
   I. Any unit not grounded.
4. Service under this warranty is to be provided by the dealer who sold the unit to the user. If the dealer is unable to provide warranty service, contact:

Harmsco Filtration Products, P.O. Box 14066
North Palm Beach, Florida, 33408, U.S.A.
Phone: (561) 848-9628 • Fax: (561) 845-2474

A Returned Goods Authorization (RGA) number must be received from the above office and placed on all shipments to and correspondence with Harmsco® Filtration Products. Please be prepared with the following information: 1. Model number and serial number. 2. Date of installation. 3. Name of installer. 4. Nature of problem. 5. Your address and telephone number.

****NOTICE****
Some of the information contained in this publication has been obtained from outside sources and is considered accurate. Temperature ratings, flow rates and chemical resistance can be affected by a number of unknown factors. For this reason, we do not assume any liability for the accuracy or completeness of the data in this publication. End users should perform their own tests to determine suitability for each application.

PRODUCT SPECIFICATION
Harmsco® Model #: MUNI-8-6FL-304



Description: Tangential Entry, Up-Flow Cartridge Filter Housing with; Swing Bolt Closure, Davit Cover Lift, and Flanged Connections.

Details:

1. Stainless steel construction, wetted metallic components are 304/304L ASTM A-240.
2. Electro-polish finish.
3. Swing bolt style housing closure. Swing bolts are SS alloy per ASTM A-193 B7.
4. NSF Certified using Genuine Harmsco® Hurricane® replacement filter cartridges.*
5. Tangential inlet and the integral inner-can, create a centrifugal flow that induces pre-filtration by heavy particulate separation.
6. Patented "Up-Flow" design that;
   a. Self purges housing of air.
   b. Eliminates by-pass contamination during servicing.
   c. Improves efficiency by creating an even flow distribution across filtering media.
7. Strong, durable, built to ASME Design Standards.
8. Utilizes eight (8) Genuine Harmsco® Hurricane® HC/170 series filter cartridges. *
9. Inlet & Outlet are NPS 6 Flanges ANSI/ASME B16.5 Class 150
10. Drains (Qty 2) are 1-1/2" Female NPT (FPT) Couplings, Class 1000
11. Ball Valves (Qty 2) 1-1/2" NSF 61 316SS included.
12. Vent is 1/2" Female NPT (FPT) Coupling, Class 1000
13. Gauge Ports (Qty 2) are 1/2" Female NPT (FPT) Couplings, Class 1000
14. Pressure Gauges (Qty 2, w/fittings) NSF 61 316SS included.
15. Closure Gasket is EPDM 70 Durometer O-ring.
16. Pressure Rating - 150 P.S.I.G.
17. Temperature Rating – Up to 140°F
    Note: Higher temperatures are possible, check cartridge specifications. **
18. Flow Rate – 800 GPM Max. with HC/170-LT2 cartridges.
    *(1200 gpm max for **pre-filtration only** utilizing Harmsco Premium Series cartridges 5u and above)*
    See Pressure Drop vs. Flow Rate Curve, page 2.
19. One person can perform maintenance.

Requirements:

Floor Load: Dry weight = 1,640 lbs.
Volume = 232 US gallons x 8.337 lbs./US gallon (water) = 1,935 lbs.
Total weight = 1,640 + 1,935 = 3,575 lbs. (housing + water)
Floor contact area = 1.164 ft².
Floor Load = 3,575 lbs. divided by 1.164 ft² = **3,100 pounds per square foot** (approx.)
Note: Piping shall conform to all applicable codes and be independently supported.
If floor strength is suspect, use appropriate measures to adequately distribute load.

Floor Space: **14 ft²** (does not include Cover/Davit swing position), See Installation Diagram, page 3.
Service Height: 104-1/2", See Installation Diagram, page 3.
Bonding: Housing shall be bonded in accordance with all applicable codes. A grounding lug is provided.

Recommended Spare Parts:
Closure Gasket O-ring: PN 368-E
Set of 8 Harmsco® Hurricane® HC/170 replacement cartridges

* The use of any filter cartridges other than Genuine Harmsco® Hurricane® filter cartridges in this filter housing voids certifications by NSF International.
** Contact a Harmsco® sales representative for Harmsco® Hurricane® HC/170 filter cartridge specifications.

This product is manufactured under one or more of the following patents: U.S. NO. 4,187,179; 3,720,322; CANADA NO. 977,693; GT. BRIT. NO. 1,372,014; W. GERMANY NO. 2,261,817; FRANCE NO. 7,246,864; EUROPEAN NO. 0,191,844, Other patents pending.
Notice: The information contained in this publication is considered accurate, and is intended to be used as a guide. This information is subject to change without notification. Contact Harmsco® Filtration Products for the latest, most up to date, specifications. Harmsco® Filtration Products does not assume any liability for the accuracy and completeness of the data in this publication. Temperature ratings, flow rates and chemical resistance can be affected by a number of unknown factors. End users should perform their own tests to determine suitability for each application.

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P.O. Box 14066, North Palm Beach, FL 33408 • www.harmsco.com • (561) 848-9628
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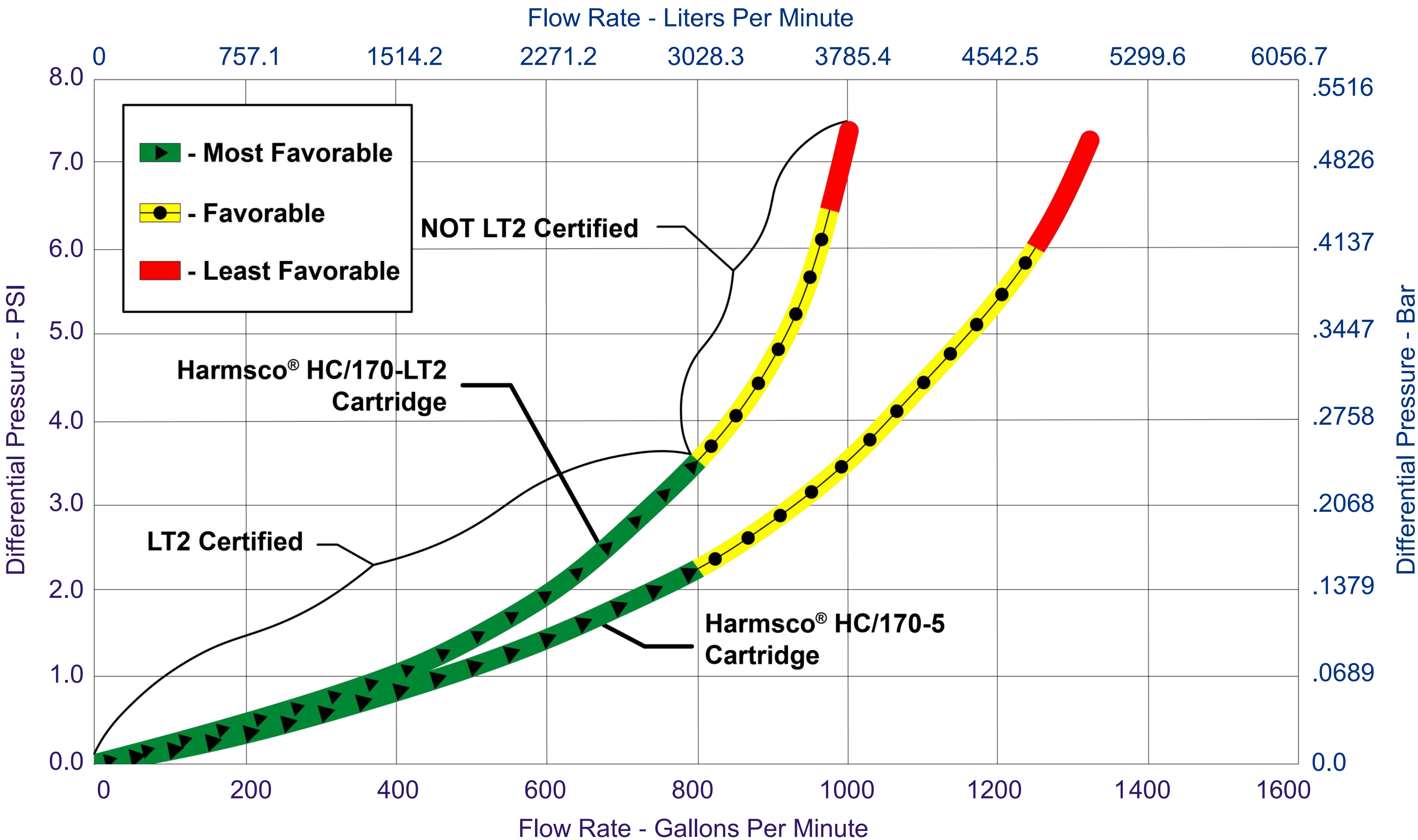
Pressure Drop vs. Flow Rate Curves
Harmsco® MUNI-8-6FL-304



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Revised: 7-25-14
File Name:
SPECIFICATION MUNI-8-6FL-304 (pg. 2 of 3)

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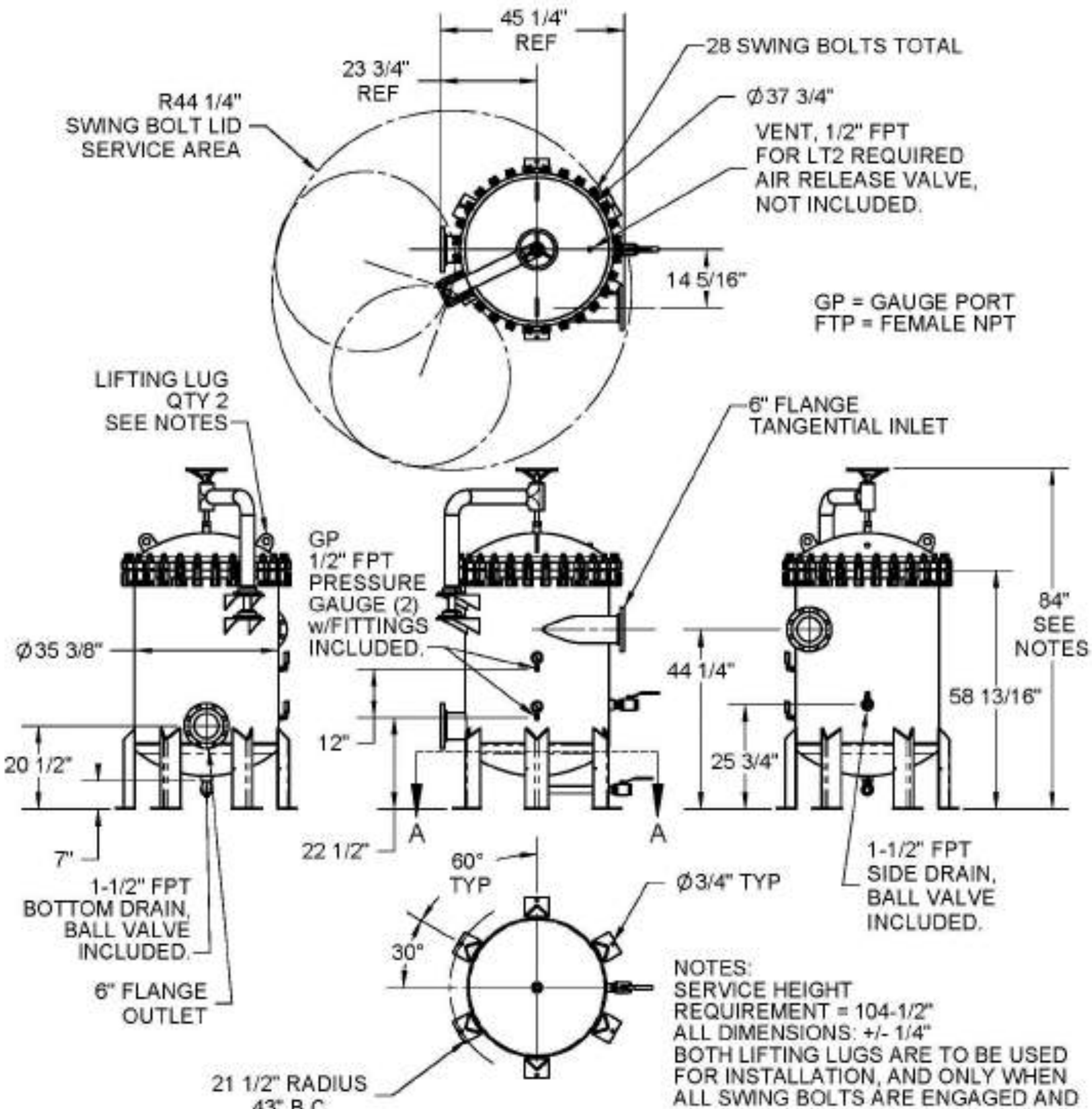
Harmsco® Filtration Products
Installation Diagram
MUNI-8-6FL-304 Swing Bolt Housing



NOTES:
SERVICE HEIGHT REQUIREMENT = 104-1/2"
ALL DIMENSIONS: +/- 1/4"
BOTH LIFTING LUGS ARE TO BE USED FOR INSTALLATION, AND ONLY WHEN ALL SWING BOLTS ARE ENGAGED AND HOUSING IS EMPTY.
DRAIN PIPE & FITTINGS NOT INCLUDED.
HOUSING MAT'LS = SS 304

MODEL #: MUNI-8-6FL-304

Revised: 7-25-14
File Name:
SPECIFICATION MUNI-8-6FL-304 (pg. 3 of 3)

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PRODUCT SPECIFICATION
Harmsco® Model #: MUNI-5-4FL-304

Description: Tangential Entry, Up-Flow Cartridge Filter Housing with; Swing Bolt Closure, Davit Cover Lift, and Flanged Connections.

Details:

1. Stainless steel construction, wetted metallic components are 304/304L ASTM A-240.
2. Electro-polish finish.
3. Swing bolt style housing closure. Swing bolts are SS alloy per ASTM A-193 B7.
4. NSF Certified using Genuine Harmsco® Hurricane® replacement filter cartridges.*
5. Tangential inlet and the integral inner-can, create a centrifugal flow that induces pre-filtration by heavy particulate separation.
6. Patented "Up-Flow" design that;
   a. Self purges housing of air.
   b. Eliminates by-pass contamination during servicing.
   c. Improves efficiency by creating an even flow distribution across filtering media.
7. Strong, durable, built to ASME Design Standards.
8. Utilizes five (5) Genuine Harmsco® Hurricane® HC/170 series filter cartridges. *
9. Inlet & Outlet are NPS 4 Flanges ANSI/ASME B16.5 Class 150
10. Drains (Qty 2) are 1-1/2" Female NPT (FPT) Couplings, Class 1000
11. Ball Valves (Qty 2) 1-1/2" NSF 61 316SS included.
12. Vent is 1/2" Female NPT (FPT) Coupling, Class 1000
13. Gauge Ports (Qty 2) are 1/2" Female NPT (FPT) Couplings, Class 1000
14. Pressure Gauges (Qty 2, w/fittings) NSF 61 316SS included.
15. Closure Gasket is EPDM 70 Durometer O-ring.
16. Pressure Rating - 150 P.S.I.G.
17. Temperature Rating – Up to 140°F
    Note: Higher temperatures are possible, check cartridge specifications. **
18. Flow Rate – 500 GPM Max. with HC/170-LT2 cartridges.
    *(750 gpm max for **pre-filtration only** utilizing Harmsco Premium Series cartridges 5u and above)*
    See Pressure Drop vs. Flow Rate Curve, page 2.
19. One person can perform maintenance.

Requirements:

Floor Load: Dry weight = 1,130 lbs.
Volume = 142 US gallons x 8.337 lbs./US gallon (water) = 1,184 lbs.
Total weight = 1,130 + 1,184 = 2,314 lbs. (housing + water)
Floor contact area = .776 ft²
Floor Load = 2,314 lbs. divided by .776 ft² = **3,000 pounds per square foot** (approx.)
Note: Piping shall conform to all applicable codes and be independently supported.
If floor strength is suspect, use appropriate measures to adequately distribute load.

Floor Space: **8.5 ft²** (does not include Cover/Davit swing position), See Installation Diagram, page 3.
Service Height: 98-1/2", See Installation Diagram, page 3.
Bonding: Housing shall be bonded in accordance with all applicable codes. A grounding lug is provided.

Recommended Spare Parts:
Closure Gasket O-ring: PN 365-E
Set of 5 Harmsco® Hurricane® HC/170 replacement cartridges

* The use of any filter cartridges other than Genuine Harmsco® Hurricane® filter cartridges in this filter housing voids certifications by NSF International.
** Contact a Harmsco® sales representative for Harmsco® Hurricane® HC/170 filter cartridge specifications.

This product is manufactured under one or more of the following patents: U.S. NO. 4,187,179; 3,720,322; CANADA NO. 977,693; GT. BRIT. NO. 1,372,014; W. GERMANY NO. 2,261,817; FRANCE NO. 7,246,864; EUROPEAN NO. 0,191,844, Other patents pending.

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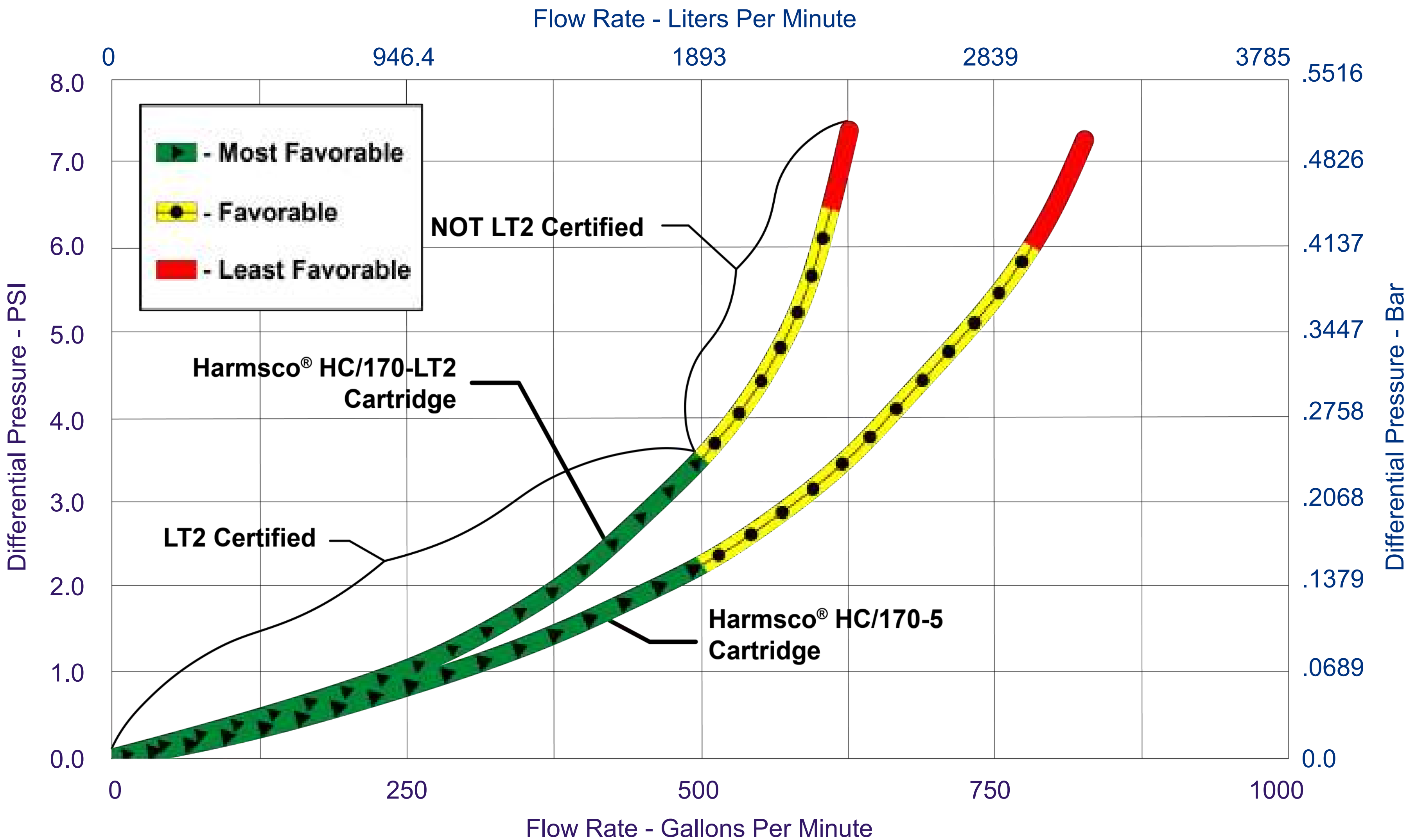
Pressure Drop vs. Flow Rate Curves
Harmsco® MUNI-5-4FL-304



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Revised: 7-25-14
File Name:
SPECIFICATION MUNI-5-4FL-304 (pg. 2 of 3)

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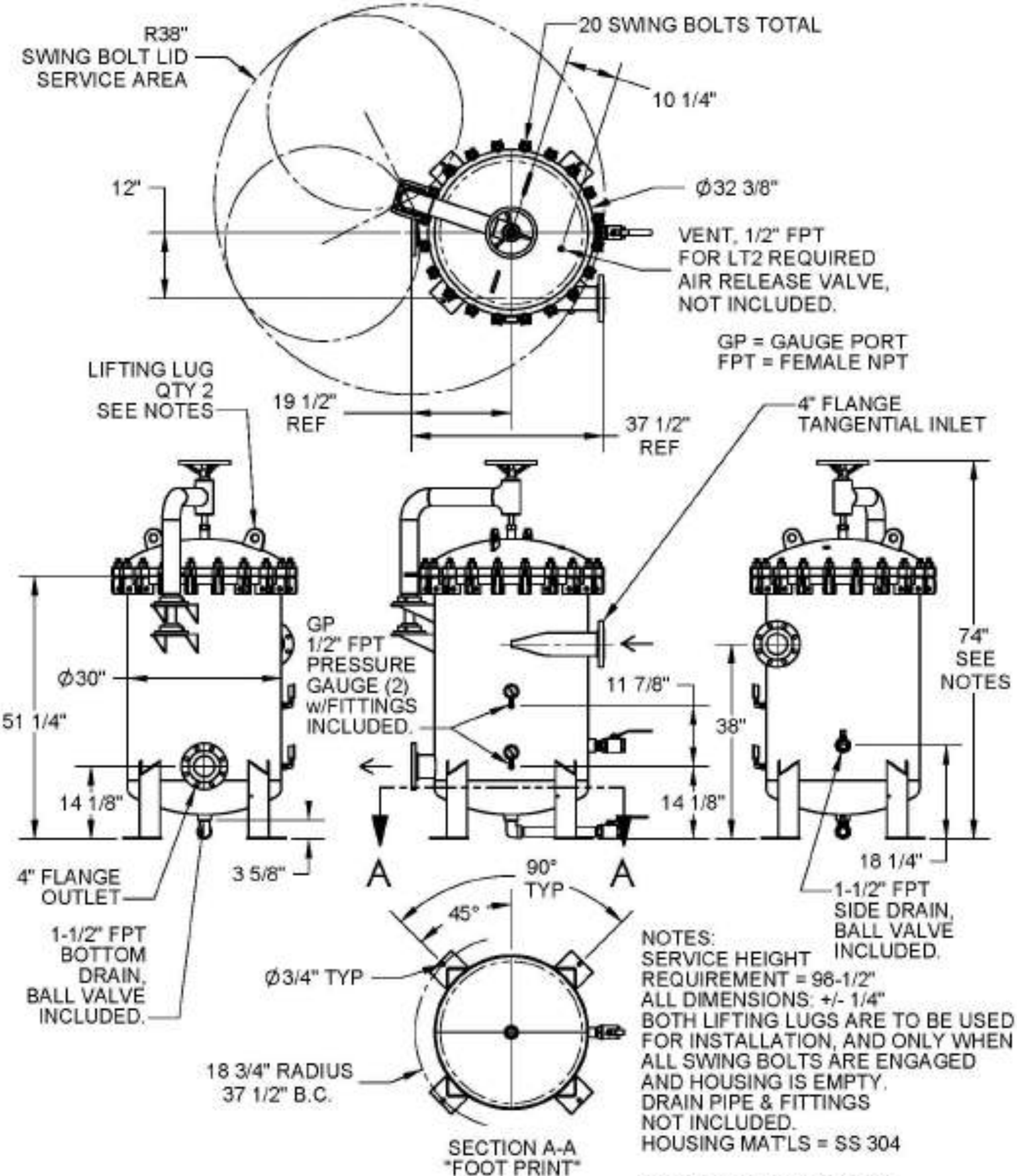
Harmsco® Filtration Products
Installation Diagram
MUNI-5-4FL-304 Swing Bolt Housing



NOTES:
SERVICE HEIGHT REQUIREMENT = 98-1/2"
ALL DIMENSIONS: +/- 1/4"
BOTH LIFTING LUGS ARE TO BE USED FOR INSTALLATION, AND ONLY WHEN ALL SWING BOLTS ARE ENGAGED AND HOUSING IS EMPTY.
DRAIN PIPE & FITTINGS NOT INCLUDED.
HOUSING MAT'LS = SS 304

MODEL #: MUNI-5-4FL-304

Revised: 7-25-14
File Name:
SPECIFICATION MUNI-5-4FL-304 (pg. 3 of 3)

Chapter 37 GENERATOR GROUP

MANUFACTURER/DISTRIBUTOR:

Génératrice Drummond
A/S Guy St-Onge
2997 RUE WATT
STE-FOY, P.Q., G1X 3W1
Email:
GSTOnge@generatricedrummond.com
Tel:(418) 780-3535
Fax:(418) 780-3435

Generator and transfer switch

GENERATOR SET

SHOP DRAWINGS

PROJECT

Truck Fill Station, Pangnirtung, NU

REF: GDM-1701

CUSTOMER :	Kudlik Construction LTD 1519, Federal road P.O. 727 Iqualuit, NU X0A 0H0
ENGINEER :	Chiarelle Engineerring Management Ltd 203-100 Craig Henry DR Nepean, Ontario K2G 5W3
PREPARED BY :	GÉNÉRATRICE DRUMMOND 243, RUE DES ARTISANS ST-GERMAIN DE GRANTHAM, QUÉBEC J0C 1K0
DATE :	February, 27 2015

SALES REPRESENTATIVE : Guy St-Onge

TECHNICAL SUPPORT : Michelle Roy

SALES COORDINATOR : Véronique Audet

Shop Drawings
Contractor Approval
Approved by: M.A.G., G. F.
Date: Mar 03, 2015
SIFEC NORTH INC

Phone : 819-472-4076 · Montreal : 514-875-0554 · Toll free : 1-800-567-3835
Fax : 819-395-5517 · www.generatricedrummond.com

Generator and
transfer switch

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SHOP DRAWING

This review is solely for the verification of general design quality and does not alleviate the responsibility of the contractor for insuring that all specification, space and installation requirements are met.

Reviewed By: M.M. Reviewed ☒
Reviewed as noted ☐
Date: 19 Mar 2015 Resubmit ☐

CHIARELLI ENGINEERING LTD.

SECTION 1

Generator set

Generator and transfer switch

DIESEL GENERATOR SET
MTU 4R0113 DS80

SHOP DRAWING

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CHIARELLI ENGINEERING LTD.

80 kWe / 60 Hz / Standby
208 - 600V

Reference MTU 4R0113 DS80 (80 kWe) for Prime Rating Technical Data

SYSTEM RATINGS

Standby

Voltage (L-L)	240V**	240V**	208V**	240V**	480V**	600V**
Phase	1	1	3	3	3	3
PF	1	1	0.8	0.8	0.8	0.8
Hz	60	60	60	60	60	60
kW	80	80	80	80	80	80
kVA	80	80	100	100	100	100
Amps	333	333	278	241	120	96
skVA@30% Voltage Dip	157	310	216	216	288	235
Generator Model	363CSL1607	363CSL1617	362CSL1604	362CSL1604	362CSL1604	362PSL1635
Temp Rise	130 °C/40 °C	130 °C/40 °C	130 °C/40 °C	130 °C/40 °C	130 °C/40 °C	130 °C/40 °C
Connection	12 LEAD ZIG-ZAG	4 LEAD	12 LEAD LOW WYE	12 LEAD HI DELTA	12 LEAD HI WYE	4 LEAD WYE

** UL 2200 Offered

CERTIFICATIONS AND STANDARDS

// **Emissions –** EPA Tier 3 Certified

// **Generator set is designed and manufactured in facilities certified to standards ISO 9001:2008 and ISO 14001:2004**

// **Seismic Certification – Optional**
– IBC Certification
– OSHPD Pre-Approval

// **UL 2200 / CSA – Optional**
– UL 2200 Listed
– CSA Certified

// **Performance Assurance Certification (PAC)**
- Generator Set Tested to ISO 8528-5 for Transient Response
- Verified product design, quality and performance integrity
- All engine systems are prototype and factory tested

// **Power Rating**
- Accepts Rated Load in One Step Per NFPA 110

Generator and transfer switch

STANDARD FEATURES*

- // MTU Onsite Energy is a single source supplier
- // Global Product Support
- // 2 Year Standard Warranty
- // 4045HF285 Diesel Engine
  - 4.5 Liter Displacement
  - 4-Cycle
- // Engine-generator resilient mounted
- // Complete Range of Accessories
- // Generator
  - Brushless, Rotating Field Generator
  - 2/3 Pitch Windings
  - 300% Short Circuit Capability with Optional PMG
- // Digital Control Panel(s)
  - UL Recognized, CSA Certified, NFPA 110
  - Complete System Metering
  - LCD Display
- // Cooling System
  - Integral Set-Mounted
  - Engine Driven Fan

STANDARD EQUIPMENT*

// Engine

Air Cleaners
Oil Pump
Oil Drain Extension & S/O Valve
Full Flow Oil Filter
Fuel Filter with Water Separator
Jacket Water Pump
Thermostat
Blower Fan & Fan Drive
Radiator - Unit Mounted
Electric Starting Motor - 12V
Governor – Electronic Isochronous
Base - Formed Steel
SAE Flywheel & Bell Housing
Charging Alternator - 12V
Battery Box & Cables
Flexible Fuel Connectors
Flexible Exhaust Connection
EPA Certified Engine

// Generator

NEMA MG1, IEEE and ANSI standards compliance for temperature rise and motor starting
Self-Ventilated and Drip-Proof
Superior Voltage Waveform
Solid State, Volts-per-Hertz Regulator
±1% Voltage Regulation No Load to Full Load
Brushless Alternator with Brushless Pilot Exciter
4 Pole, Rotating Field
130 °C Maximum Standby Temperature Rise
1 Bearing, Sealed
Flexible Coupling
Full Amortisseur Windings
125% Rotor Balancing
3-Phase Voltage Sensing
100% of Rated Load - One Step
5% Maximum Total Harmonic Distortion

// Digital Control Panel(s)

Digital Metering
Engine Parameters
Generator Protection Functions
Engine Protection
SAE J1939 Engine ECU Communications
Windows®-Based Software
Multilingual Capability
Remote Communications to RDP-110 Remote Annunciator
Programmable Input and Output Contacts
UL Recognized, CSA Certified, CE Approved
Event Recording
IP 54 Front Panel Rating with Integrated Gasket
NFPA 110 Compatible

* Represents standard product only. Consult Factory/MTU Onsite Energy Distributor for additional configurations.

Generator and transfer switch

APPLICATION DATA

// Engine

Manufacturer	John Deere
Model	4045HF285
Type	4-Cycle
Arrangement	4-Inline
Displacement: L (in^3)	4.5 (275)
Bore: cm (in)	10.6 (4.19)
Stroke: cm (in)	12.7 (5)
Compression Ratio	19:1
Rated RPM	1,800
Engine Governor	JDEC
Maximum Power: kWm (bhp)	118 (158)
Speed Regulation	±0.25%
Air Cleaner	Dry

// Liquid Capacity (Lubrication)

Total Oil System: L (gal)	12 (3.2)
Engine Jacket Water Capacity: L (gal)	12.5 (3.3)
System Coolant Capacity: L (gal)	20.1 (5.3)

// Electrical

Electric Volts DC	12
Cold Cranking Amps Under -17.8 °C (0 °F)	925

// Fuel System

Fuel Supply Connection Size	3/8" NPT
Fuel Return Connection Size	3/8" NPT
Maximum Fuel Lift: m (ft)	2 (6.7)
Recommended Fuel	Diesel #2
Total Fuel Flow: L/hr (gal/hr)	74.6 (19.7)

// Fuel Consumption

At 100% of Power Rating: L/hr (gal/hr)	23.1 (6.1)
At 75% of Power Rating: L/hr (gal/hr)	18.5 (4.9)
At 50% of Power Rating: L/hr (gal/hr)	13.2 (3.5)

// Cooling - Radiator System

Ambient Capacity of Radiator: °C (°F)	50 (122)
Maximum Allowable Static Pressure on Rad. Exhaust: kPa (in. H_20)	0.12 (0.5)
Water Pump Capacity: L/min (gpm)	180 (48)
Heat Rejection to Coolant: kW (BTUM)	56 (3,190)
Heat Rejection to Air to Air: kW (BTUM)	17.6 (1,002)
Heat Radiated to Ambient: kW (BTUM)	10.5 (596)
Fan Power: kW (hp)	6.5 (8.7)

// Air Requirements

Aspirating: *m^3/min (SCFM)	7.7 (273)
Air Flow Required for Rad. Cooled Unit: *m^3/min (SCFM)	187 (6,587)
Remote Cooled Applications; Air Flow Required for Dissipation of Radiated Gen-set Heat for a Max of 25 °F Rise: *m^3/min (SCFM)	38 (1,343)

* Air density = 1.184 kg/m^3 (0.0739 lbm/ft^3)

// Exhaust System

Gas Temp. (Stack): °C (°F)	560 (1,040)
Gas Volume at Stack Temp: m^3/min (CFM)	21.2 (750)
Maximum Allowable Back Pressure: kPa (in. H_20)	7.5 (30)

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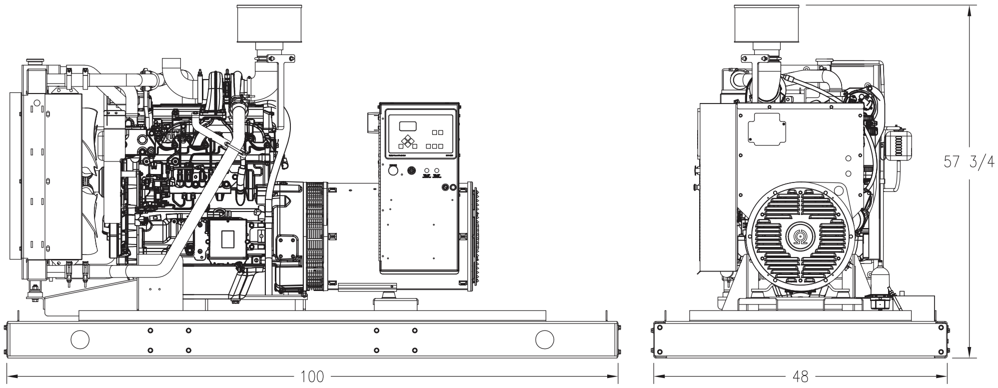
CHIARELLI ENGINEERING LTD.

Generator and transfer switch

WEIGHTS AND DIMENSIONS



Drawing above for illustration purposes only, based on standard open power 480 volt generator set. Lengths may vary with other voltages. Do not use for installation design. See website for unit specific template drawings.

System	Dimensions (L x W x H)	Weight (less tank)
Open Power Unit (OPU)	2,540 x 1,219 x 1,467 mm (100 x 48 x 57.75 in)	867 kg (1,912 lb)

Weights and dimensions are based on open power units and are estimates only. Consult the factory for accurate weights and dimensions for your specific generator set.

SOUND DATA

Unit Type	Standby Full Load
Level 0: Open Power Unit dB(A)	83.6

Sound data is provided at 7 m (23 ft). Generator set tested in accordance with ISO 8528-10 and with infinite exhaust.

EMISSIONS DATA

NO_x + NMHC	CO	PM
4.03	0.73	0.08

All units are in g/hp-hr and shown at 100% load (not comparable to EPA weighted cycle values). Emission levels of the engine may vary with ambient temperature, barometric pressure, humidity, fuel type and quality, installation parameters, measuring instrumentation, etc. The data was obtained in compliance with US EPA regulations. The weighted cycle value (not shown) from each engine is guaranteed to be within the US EPA Standards.

RATING DEFINITIONS AND CONDITIONS

// Standby ratings apply to installations served by a reliable utility source. The standby rating is applicable to varying loads for the duration of a power outage. No overload capability for this rating. Ratings are in accordance with ISO 3046-1, BS 5514, and AS 2789. Average load factor: ≤ 85%.

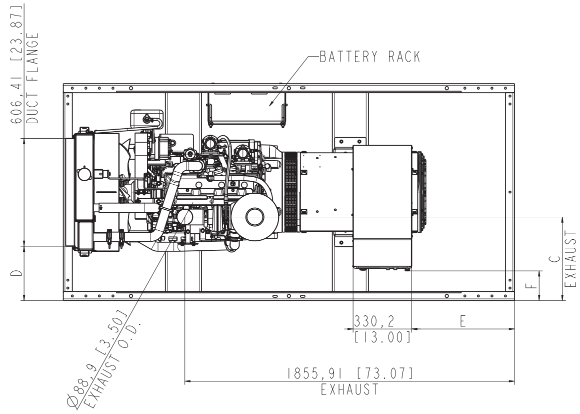
// Deration Factor:
Altitude: Consult your local MTU Onsite Energy Power Generation Distributor for altitude derations.
Temperature: Consult your local MTU Onsite Energy Power Generation Distributor for temperature derations.

C/F = Consult Factory/MTU Onsite Energy Distributor
N/A = Not Available

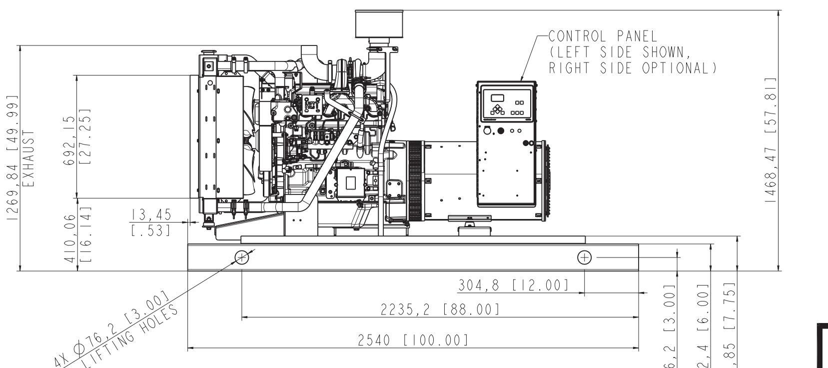
MODELS:
- DS0080D6SDA (240V)
- DS0080D6SGA (240V)
- DS0080D6SPA (208V)
- DS0080D6SJA (240V)
- DS0080D6SRA (480V)
- DS0080D6SNA (600V)
- DS0100D6SDA (240V)
- DS0100D6SGA (240V)
- DS0100D6SPA (208V)
- DS0100D6SJA (240V)
- DS0100D6SRA (480V)
- DS0100D6SNA (600V)

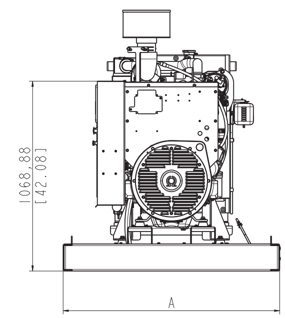
	GENERATOR FRAME	A	B	C	D	E	F
STANDARD WIDTH BASE	362	1219,2 [48.00]	1168,4 [46.00]	469,4 [18.48]	305,1 [12.01]	657,9 [25.90]	166,4 [6.55]
	363 (SHOWN)	1219,2 [48.00]	1168,4 [46.00]	469,4 [18.48]	305,1 [12.01]	578,5 [22.77]	166,4 [6.55]
	431	1219,2 [48.00]	1168,4 [46.00]	469,4 [18.48]	305,1 [12.01]	518,4 [20.41]	100,6 [3.96]
→ NARROW WIDTH BASE	→ 362	1066,8 [42.00]	1016,0 [40.00]	393,2 [15.48]	228,9 [9.01]	657,9 [25.90]	90,2 [3.55]
	363	1066,8 [42.00]	1016,0 [40.00]	393,2 [15.48]	228,9 [9.01]	578,5 [22.77]	90,2 [3.55]
	431	1066,8 [42.00]	1016,0 [40.00]	393,2 [15.48]	228,9 [9.01]	518,4 [20.41]	24,4 [0.96]

TOP VIEW



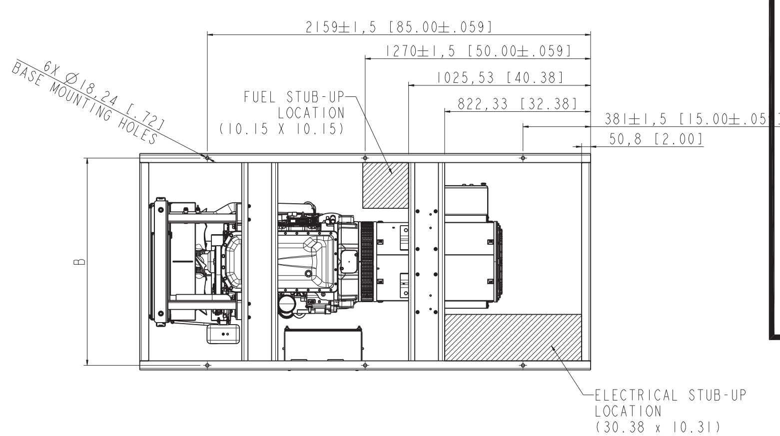
LEFT VIEW





BACK VIEW

BOTTOM VIEW



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CHIARELLI ENGINEERING LTD.

Generator and transfer switch

STANDARD SCOPE OF SUPPLY DIMENSIONAL

80, 100 KW REVELATION OPU TEMPLATE

Scale 1:10 — A0

Drawing No. 100021-OPU

onsite energy

Generator and transfer switch

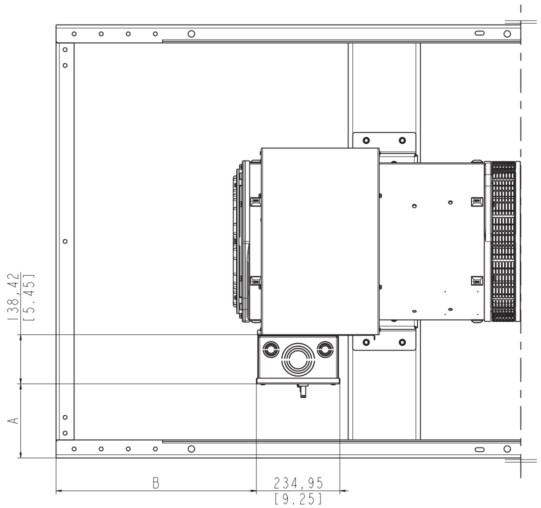
20-250 AMP - SQUARE D, H- & J-FRAME BREAKER

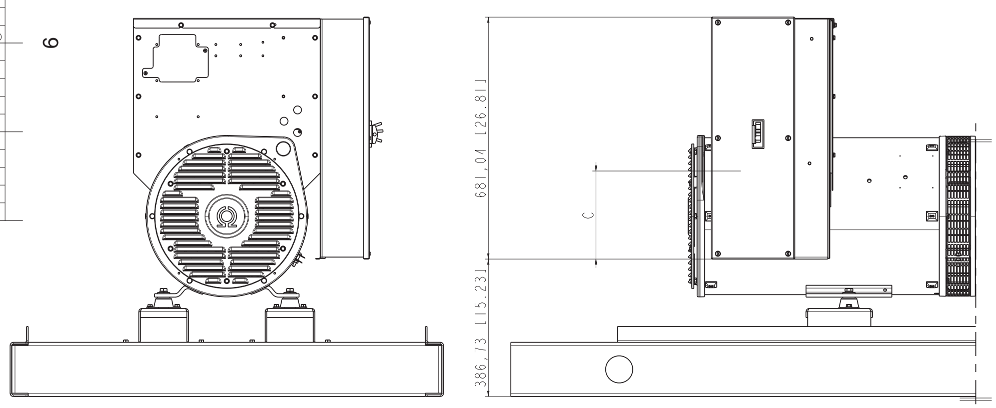
	GENERATOR FRAME	A	B
STANDARD WIDTH BASE	362	208,6 [8.21]	643,5 [25.33]
	363 (SHOWN)	208,6 [8.21]	563,9 [22.20]
	431	142,9 [5.63]	504,0 [19.84]
NARROW WIDTH BASE	362	132,4 [5.21]	643,5 [25.33]
	363	132,4 [5.21]	563,9 [22.20]
	431	66,7 [2.63]	504,0 [19.84]

RIGHT SIDE SHOWN, LEFT SIDE OPTIONAL

20-250 AMP - SQUARE D H- & J-FRAME BREAKER BOTTOM LUG CONNECTIONS

CIRCUIT BREAKER	C
H-FRAME	262,1 [10.32]
J-FRAME	247,9 [9.76]





UP TO 480V ONLY

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CHIARELLI ENGINEERING LTD.

80, 100 KW REVELATION OPU TEMPLATE

1000021-OPU

Scale 1:5 — A0

onsite energy

Generator and transfer switch

DIGITAL GENERATOR SET CONTROLLER

MGC-2000 Series Data Sheet

MTU Onsite Energy Generator Set Controllers (MGC Series) are highly advanced integrated digital generator set control systems. The MGC-2000 Series is perfectly focused, combining rugged construction and microprocessor technology to offer a product that will hold up to almost any environment and is flexible enough to meet your application's needs. The MGC-2000 Series provides generator set control, transfer switch control, metering, protection, and programmable logic in a simple, easy-to-use, reliable, rugged, and cost effective package.

PRODUCT HIGHLIGHTS

- Three-phase generator metering
- Engine metering
- Generator set control
- Engine protection
- Generator protection
- Var sharing over Ethernet
- BESTCOMS*Plus*®
  - Windows®-based software for optional remote operation (Software can be downloaded at www.mtuonsiteenergy.com)
  - Programming and setup software
  - Intuitive and powerful
  - Remote control and monitoring
  - Programmable logic
  - USB communications
- Automatic transfer switch compatible
- Exercise timer
- Suitable for use on rental generator sets with high/low line sensing, single or three phase sensing override, and wye/delta/grounded delta
- SAE J1939 Engine Control Unit (ECU) communications
- Automatic generator configuration detection
- Selection of integrating reset of instantaneous reset characteristics for overcurrent protection
- Multilingual capability
- Remote annunciation to RDP-110
- Extremely rugged, fully potted design
- 16 programmable contact inputs, 12 programmable contact outputs
- ModBus™ communications with RS-485 (optional)
- UL recognized, CSA certified, CE approved
- Highly Accelerated Life Tests (HALT) tested
- IP 54 front panel rating with integrated gasket
- NFPA-110 compatible
- Microprocessor based
- Complete system metering
- Expandable to meet customer needs

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CHIARELLI ENGINEERING LTD.

Generator and transfer switch

FUNCTIONS, Generator Set Protection, continued:

Pre-Alarms (Warnings)

- Low Oil Pressure
- High Coolant Temperature
- Low Coolant Temperature
- Battery Overvoltage
- Weak Battery Voltage
- AEM Comms Failure
- Breaker Open Failure
- CEM Comms Failure
- Reverse Rotation
- Engine kW Overload
- Maintenance Interval
- Low Coolant Level
- Low Fuel Level
- High Fuel Level
- Active DTC
- Breaker Close Failure
- Low Battery Voltage
- ECU Coms Fail
- Checksum Failure
- Loss of Sensing

All alarms and pre-alarms can be enabled or disabled via the BESTCOMS*Plus*® PC software or the front panel. Additional custom alarms and pre-alarms are available upon request.

Generator Set Metering

- Generator parameters include voltage, current, real power (watts), apparent power (VA), and power factor (PF).
- Engine parameters include oil pressure, coolant temperature, battery voltage, speed, fuel level, engine load, coolant level (from ECU), ECU specific parameters, and run-time statistics.

Engine Control

- Cranking Control: Cycle or Continuous (Quantity and Duration fully programmable)
- Engine Cooldown: Smart Cooldown function saves fuel and engine life
- Successful Start Counter: Counts and records successful engine starts
- Timers:
  - Engine Cooldown Timer
  - Engine Maintenance Timer
  - Pre-Alarm Time Delays for Weak/Low Battery Voltage
  - Alarm Time Delay for Overspeed
  - Alarm Time Delay for Sender Failure
  - Arming Time Delays after Crank Disconnect:
    - Low Oil Pressure
    - High Coolant Temperature
  - Pre-Crank Delay
  - Continuous or Cycle Cranking Time Delay
  - Programmable Logic Timers

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CHIARELLI ENGINEERING LTD.

DIGITAL GENERATOR SET CONTROLLER
MGC-2000 Series Data Sheet

FUNCTIONS, continued:

Event Recording

The MGC-2000 Series has an event recorder that provides a record of alarms, pre-alarms, engine starts, engine runtime loaded, engine runtime unloaded, last run date, and many other events that are all date and time stamped to help the user determine the cause and effect of issues related to the generator set. Contains 30 event records each retaining up to 99 occurrences in memory. Time, date, and engine hour detail is available for the most current 30 occurrences within each event record.

Transfer Switch Control (Mains Failure)

The MGC-2000 Series has the ability to detect a mains failure via a single- or three-phase bus input. A mains failure is established when any one of the following conditions are met:

- Any phase of bus voltage falls below the dead bus threshold
- Any phase of bus voltage is unstable due to overvoltage or undervoltage
- Any phase of bus voltage is unstable due to overfrequency or underfrequency

When conditions are met, the MGC-2000 Series will start the generator set and, when ready, will send generator and mains breaker commands to apply power to the load from the generator set. The MGC-2000 Series implements open or closed breaker transitions to and from the mains. When the mains returns and is considered stable, the MGC-2000 Series will transfer the load back to the mains and stop the engine.

ModBus™ RTU

When utilized, the user can send and receive information from the MGC-2000 Series via the RS-485 communications port and ModBus™ RTU protocol. This feature allows the MGC-2000 Series controlled generator set to be fully integrated into the building management system. Please see the *Instruction Manual* for the ModBus™ register list.

Programmable Logic

The MGC-2000 Series offers a very powerful, yet easy-to-use, programmable logic scheme, BESTlogic™*Plus*, for custom programming of the various inputs, outputs, alarms, and pre-alarms. It allows these elements to be integrated into a complete logic scheme so that the user can meet even the most complex specification. The programmable logic control includes the selection of logic gates and timers, with drag-and-drop technology to make it fast and simple.

Remote Display Panel Annunciation

The MGC-2000 Series can communicate to a remote display panel, Model RDP-110. This requires only two wires to annunciate all of the alarms and pre-alarms required by NFPA-110 Level I and II. External power is required.

External Modem Interface

The external modem is connected to the MGC-2000 Series via RS-232. A dial-out modem enables remote control, monitoring, and setting of the MGC-2000 Series. When an alarm or pre-alarm condition occurs, the MGC-2000 Series can dial up to four telephone numbers in sequence until an answer is received and the condition is annunciated.

DIGITAL GENERATOR SET CONTROLLER
MGC-2000 Series Data Sheet

FUNCTIONS, continued:

SAE J1939 Communications

SAE J1939 CANBus communications allows the MGC-2000 Series to communicate with the ECU to gather critical engine information like oil pressure, engine coolant temperature, RPM, battery voltage, and much more. By utilizing the ECU, the addition of analog engine senders is no longer required. This can save substantial money for the installer. It also eliminates any errors or discrepancies between the ECU data and the data displayed on the MGC-2000 Series that may be present due to analog sender inaccuracies or incompatibility. An additional benefit is access to the ECU's diagnostic troubleshooting codes (DTCs). The DTCs provide information about the engine's operating conditions and communicates these, via SAE J1939, to the MGC-2000 Series, eliminating the need for hand-held service tools to diagnose simple engine issues.

SPECIFICATIONS

Operating Power

- Nominal: 12 or 24 VDC
- Range: 6 to 32 VDC
- Power Consumption:
  - Sleep Mode: 5W with all relays non-energized
  - Normal Operational Mode: 7.9W - Run mode, LCD heater off, six relays energized
- Battery Ride-Through: Withstands cranking ride-through down to 0 V for 50 ms, starting at 10 VDC.

Current Sensing (5 A CT Inputs)

- Continuous Rating: 0.1 to 5.0 Aac
- One Second Rating: 10 Aac
- Burden: 1 VA

Voltage Sensing

- Range: 12 to 576 V rms, line-to-line
- Frequency Range: 10 to 72 Hz
- Burden: 1 VA
- One Second Rating: 720 V rms

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Input Contacts

Contact sensing inputs include one emergency stop input and 16 programmable inputs. The emergency stop input accepts normally closed, dry contacts. The remote emergency stop is limited to 75 ft. standard. Extended runs are available with optional relay. All programmable inputs accept normally open, dry contacts. The factory utilizes up to three of these inputs.

Engine System Inputs

- Fuel Level Sensing Resistance Range: 0 to 250 Ω nominal
- Coolant Temperature Sensing Resistance Range: 10 to 2,750 Ω nominal
- Oil Pressure Sensing Resistance Range: 0 to 250 Ω nominal
- Engine Speed Sensing:
  - Magnetic Pickup or CANBus
    - Magnetic Pickup Voltage Range: 3 to 35 V peak (6 to 70 V peak to peak)
    - Magnetic Pickup Frequency Range: 32 to 10,000 Hz
  - Generator Frequency (alternate or redundant)
    - Voltage Range: 12 to 576 V rms

Generator and transfer switch

mtu onsite energy

SPECIFICATIONS, continued:

Output Contacts

- (15) Total Programmable Outputs: (3) 30 A @ 28 VDC and (12) 2 A @ 30 VDC
- The factory utilizes the following on each generator set which can be reprogrammed as needed:
  - (3) 30 A @ 28 VDC for Pre-start, Start, and Run
  - (12) 2 A @ 30 VDC for General Purpose

Metering

- Generator and Bus Voltage (rms)
  - Metering Range: 0 to 576 VAC (direct measurement); up to 9,999 VAC (with appropriate voltage transformer)
  - Accuracy: ±1% of programmed rated voltage of ±2 VAC (subject to accuracy of voltage transformer when used)
- Generator Current (rms)
  - Generator current is measured at the secondary windings of 5 A CTs.
  - Metering Range: 0 to 5,000 Aac
  - CT Primary Range: 1 to 5,000 Aac, in primary increments of 1 Aac
  - Accuracy: ±1% of programmed rated current or ±2 Aac (subject to accuracy of CTs)
- Generator and Bus Frequency
  - Metering Range: 10 to 72 Hz
  - Accuracy: ±0.25% or 0.05 Hz
- Apparent Power
  - Indicates total kVA and individual line kVA (four-wire, line-to-neutral or three-wire, line-to-line).
  - Accuracy: ±3% or the full-scale indication or ±2 kVA
- Power Factor
  - Metering Range: 0.2 leading to 0.2 lagging
  - Accuracy: ±0.02
- Real Power
  - Indicates total kW and individual line kW (four-wire, line-to-neutral or three-wire, line-to-line)
  - Accuracy: ±3% of the full-scale indication or ±2 kW
- Oil Pressure
  - Metering Range: 0 to 150 psi or 0 to 1,034 kPa
  - Accuracy: ±3% of actual indication or ±2 psi or ±12 kPa (subject to accuracy of sender)
- Coolant Temperature
  - Metering Range: 0 °C to 204 °C (32 °F to 410 °F)
  - Accuracy: ±3% of actual indication or ±2° (subject to accuracy of sender)
- Fuel Level
  - Metering Range: 0 to 100%
  - Accuracy: ±2% (subject to accuracy of sender)
- Battery Voltage
  - Metering Range: 6 to 32 VDC
  - Accuracy: ±3% of actual indication or ±0.2 VDC
- Engine RPM
  - Metering Range: 0 to 4,500 rpm
  - Accuracy: ±2% of actual indication or ±2 rpm

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CHIARELLI ENGINEERING LTD.

Generator and transfer switch

DIGITAL GENERATOR SET CONTROLLER
MGC-2000 Series Data Sheet

mtu onsite energy

SPECIFICATIONS, Metering, continued:

- Engine Run Time
  - Engine run time is retained in non-volatile memory.
  - Metering Range: 0 to 99,999 h; Update Interval: 6 min
  - Accuracy: ±1% of actual indication or ±12 min
- Maintenance Timer
  - Maintenance timer indicates the time remaining until generator set service is due. Value is retained in non-volatile memory.
  - Metering Range: 0 to 5,000 h; Update Interval: 6 min
  - Accuracy: ±1% of actual indication or ±12 min

Generator Protection Functions

- Overvoltage (59) and Undervoltage (27)
  - Pickup Range: 70 to 576 VAC
  - Activation Delay Range: 0 to 30 s
- Overfrequency (81O) and Underfrequency (81U)
  - Pickup Range: 45 to 66 Hz
  - Pickup Increment: 0.1 Hz
  - Activation Delay Range: 0 to 30 s
- Reverse Power (32)
  - Pickup Range: −50 to 5%
  - Pickup Increment: 0.1%
  - Hysteresis Range: 1 to 10%
  - Hysteresis Increment: 0.1%
  - Activation Delay Range: 0 to 30 s
  - Activation Delay Increment: 0.1 s
- Loss of Excitation (40Q)
  - Pickup Range: −150 to 0%
  - Pickup Increment: 0.1%
  - Hysteresis Range: 1 to 10%
  - Hysteresis Increment: 0.1%
  - Activation Delay Range: 0 to 30 s
  - Activation Delay Increment: 0.1 s
- Overcurrent (51)
  - Pickup Range: 0.18 to 1.18 Aac (1 A current sensing)
  - Time Dial Range: 0
- Phase Imbalance (47)
  - Pickup Range: 5 to 100 VAC
  - Pickup Increment: 1 VAC
  - Activation Delay Range: 0 to 30 s
  - Activation Delay Increment: 0.1 s
- ROCOF (81R) (optional)
  - Pickup Range: 0.2 to 10 Hz/s
  - Pickup Increment: 0.1 Hz/s
  - Activation Delay Range: 0 to 10,000 ms
  - Activation Delay Increment: 1 ms
  - Accuracy: 0.2 Hz/s

SHOP DRAWING

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Reviewed By: M.M.
Date: 19 Mar 2015

- [x] Reviewed
- [ ] Reviewed as noted
- [ ] Resubmit

CHIARELLI ENGINEERING LTD.

Generator and transfer switch

DIGITAL GENERATOR SET CONTROLLER
MGC-2000 Series Data Sheet

mtu onsite energy

SPECIFICATIONS, Generator Protection Functions, continued:

- Vector Shift (78) (optional)
  - Pickup Range: 2 to 90°
  - Pickup Increment: 1°
  - Accuracy: ±1°

Environmental

- Temperature
  - Operating: -40 °C to 70 °C (-40 °F to 158 °F)
  - Storage: -40 °C to 85 °C (-40 °F to 185 °F)
- Humidity: IEC 68-2-38
- Salt Fog: ASTM B 17-73, IEC 68-2-11 (tested while operational)
- Ingress Protection: IEC IP54 for front panel
- Shock: 15 G in three perpendicular planes
- Vibration: 5 to 29 to 5 Hz at 1.5 G peak for 5 min.
  29 to 52 to 29 Hz at 0.036” DECS-A for 2.5 min.
  52 to 500 to 52 Hz at 5 G peak for 7.5 min.
  - Swept over the above ranges for 12 sweeps in each of three mutually perpendicular planes with each 15 minute sweep.

Agency Approvals

- UL/CSA Approvals: “cURus” approved to UL 6200 and CSA C22.2 No.14
- NFPA Compliance: Complies with NFPA Standard 110, Standard for Emergency and Standby Power
- CE Marked: Complies with applicable EC Directives

ADDITIONAL SPECIFICATIONS

Battery Backup for Real Time Clock

The MGC-2000 Series provides a real-time clock with an internal backup battery. The battery will maintain timekeeping for approximately 10 years (depending on conditions) after power is removed from the controller. The clock is used by the event recorder and sequence of events functions to time-stamp events, and the exercise timer is used to start and stop the generator set when the exercise feature is utilized.

Breaker Management

The MGC-2000 Series is capable of controlling the generator breaker and the mains breaker. The status of the breakers is determined by using BESTlogic™*Plus* programmable logic to set up the GENBRK and MAINSBRK logic blocks. These logic blocks have outputs that can be configured to energize an output contact and control a breaker, as well as inputs for breaker control and status. The MGC-2000 Series will attempt to close a breaker only after verifying that it can be closed. If the breaker cannot be closed, the close request will be ignored. Only one breaker can be closed at a time. Synchronization is required before closing the breaker to a live bus. Closure to a dead bus can be performed after meeting dead bus threshold and timing requirements set by the user.

SHOP DRAWING

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Reviewed By: M.M. — Reviewed ☒ Reviewed as noted ☐

Date: 19 Mar 2015 — Resubmit ☐

CHIARELLI ENGINEERING LTD.

Generator and transfer switch

MAGNAPLUS®

MARATHON ELECTRIC
SYNCHRONOUS AC GENERATOR
TYPICAL SUBMITTAL DATA

Basic Model 362CSL1604 **Date: 4-27-05**

Kilowatt ratings at	**1800** RPM		**60** Hertz			**12** Leads		
kW (kVA)	**3** Phase		**0.8** Power Factor			**Dripproof or Open** Enclosure		
	Class B	**Class F**				**Class H**		
Voltage*	**80° C ① Continuous**	**90° C ① Lloyds**	**95° C ① ABS**	**105° C † British Standard**	**105° C ① Continuous**	**130° C ① Standby**	**125° C † British Standard**	**125° C ① Continuous**	**150° C ① Standby**
240/480	**75 (94)**	**77 (96)**	**77 (96)**	**84 (105)**	**84 (105)**	**90 (113)**	**90 (113)**	**90 (113)**	**95 (119)**
230/460	**71 (89)**	**73 (91)**	**73 (91)**	**80 (100)**	**80 (100)**	**86 (107)**	**86 (107)**	**86 (107)**	**90 (113)**
220/440	**68 (85)**	**70 (88)**	**70 (88)**	**76 (95)**	**76 (95)**	**84 (105)**	**84 (105)**	**84 (105)**	**89 (112)**
208	**65 (81)**	**67 (84)**	**67 (84)**	**72 (90)**	**72 (90)**	**80 (100)**	**80 (100)**	**80 (100)**	**85 (106)**
190/380	**60 (75)**	**60 (75)**	**60 (75)**	**65 (81)**	**65 (81)**	**72 (90)**	**72 (90)**	**72 (90)**	**77 (96)**

① Rise by resistance method, Mil-Std-705, Method 680.1b. *† Rating per BS 5000.*

Submittal Data: 480 Volts, 100 kVA, 1800 RPM, 60 Hz, 3 Phase

Mil-Std-705B

Method	**Description**	**Value**
301.1b	Insulation Resistance	> 1.5 Meg
302.1a	High Potential Test	
	Main Stator	2000 Volts
	Main Rotor	1500 Volts
	Exciter Stator	1500 Volts
	Exciter Rotor	1500 Volts
401.1a	Stator Resistance, Line to Line	
	High Wye Connection	0.138 Ohms
	Rotor Resistance	1.05 Ohms
	Exciter Stator	23.5 Ohms
	Exciter Rotor	0.12 Ohms
410.1a	No Load Exciter Field Amps at 480 Volts Line to Line	0.52 A DC
420.1a	Short Circuit Ratio	0.634
421.1a	Xd Synchronous Reactance	1.864 pu
422.1a	X2 Negative Sequence Reactance	0.148 pu
423.1a	X0 Zero Sequence Reactance	0.038 pu
425.1a	X'd Transient Reactance	0.127 pu
426.1a	X"d Subtransient Reactance	0.098 pu
427.1a	T'd Transient Short Circuit Time Constant	0.05 sec.
428.1a	T"d Subtransient Short Circuit Time Constant	0.007 sec.
430.1a	T'do Transient Open Circuit Time Constant	0.8 sec.
432.1a	Ta Short Circuit Time Constant of Armature Winding	0.01 sec.

Mil-Std-705B

Method	**Description**	**Value**
505.3b	Overspeed	2250 RPM
507.1c	Phase Sequence CCW-ODE	ABC
601.4a	L-L Harmonic Maximum - Total (Distortion Factor)	3.5%
601.4a	L-L Harmonic Maximum - Single	2.5%
601.1c	Deviation Factor	7.0%
---	TIF (1960 Weightings)	<50

Additional Prototype Mil-Std Methods are Available on Request.

--	Generator Frame	360
--	Type	Ext. Voltage Regulated, Brushless
--	Insulation	Class H
--	Coupling - Single Bearing	Flexible
--	Amortisseur Windings	Full
--	Cooling Air Volume	700 CFM
--	Exciter	Rotating
--	Voltage Regulator	SE350
--	Voltage Regulation	1%

SHOP DRAWING

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Reviewed as noted ☐
Date: 19 Mar 2015 Resubmit ☐

CHIARELLI ENGINEERING LTD.

* Voltage refers to wye (star) connection, unless otherwise specified.

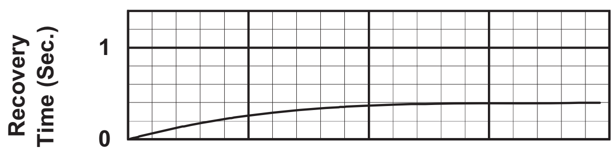
Generator and transfer switch

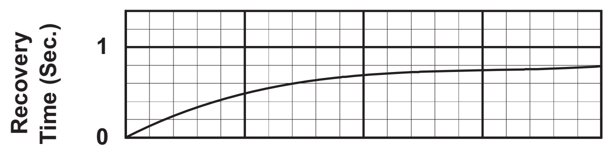
MAGNAPLUS®

MARATHON ELECTRIC
SYNCHRONOUS AC GENERATOR
TYPICAL DYNAMIC CHARACTERISTICS

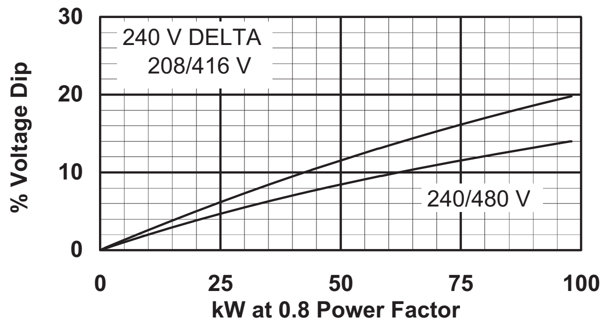
Basic Model 362CSL1604 **Date: 6-1-00**

60 HERTZ





LOAD APPLICATION



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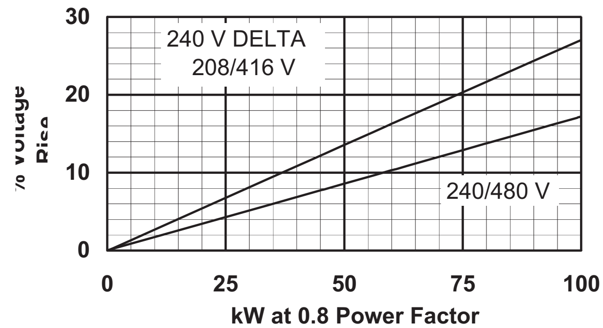
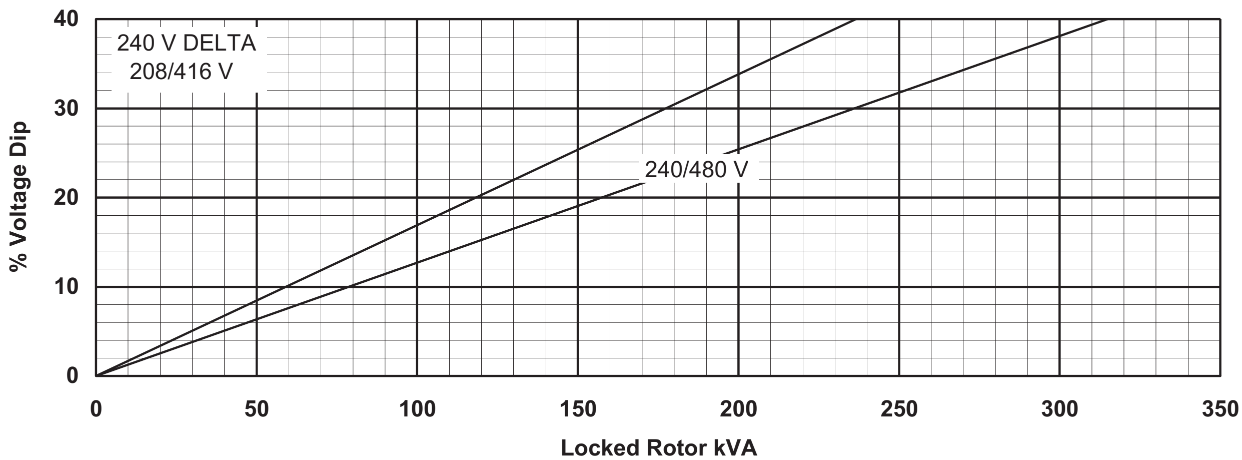
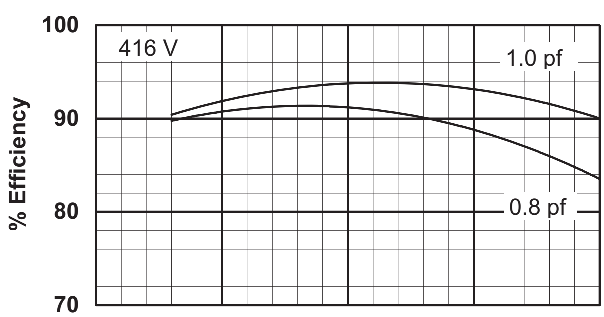
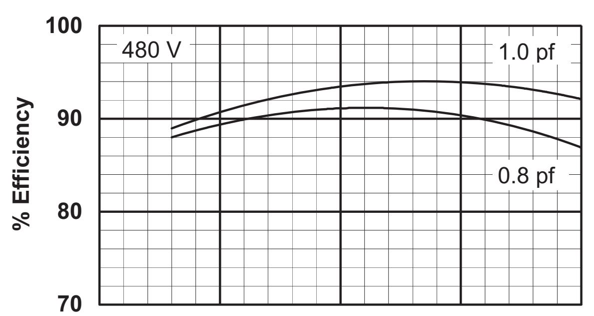


TYPICAL MOTOR STARTING CHARACTERISTICS



TYPICAL GENERATOR EFFICIENCY





0 Voltage refers to wye (star) connection, unless otherwise specified. 25 50 75 100

kW Output kW Output

Generator and
transfer switch

SECTION 2

Accessories

SHOP DRAWING

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Date: 19 Mar 2015

- [x] Reviewed
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- [ ] Resubmit

CHIARELLI ENGINEERING LTD.

Generator and
transfer switch

Liste de matériel

GÉNÉRATRICE DRUMMOND

No de projet 2014-12-2469B

Dossier 1701GDM

Projet Truck Fill Station, Pangnirtung, NU

Groupe DS80D6S, 362CSL1604, 80kW/100kVA, 278A, 120/208V, narrow skid

No de la pièce	Description	Quantité
	Inverseur	
3ATSA3400CGXC	Automatic Transfer Switch Asco 400A 120/208V 3Ph 3P Nema 1	1,00
22SN	Solid neutral 400-600A	1,00
11BE	Exerciser	1,00
14A	Aux. Contact Normal Closed	1,00
14B	Aux. Contact Emergency Closed	1,00
	Système de refroidissement	
	Block Heater Kim Hotstart, 1500W/120V	1,00
	Système électrique	
DD31P925	Battery EAST PENN 925CCA 12V (EPM)	1,00
	Battery Charger GUEST 12-6A	1,00
MGC-2020	Controler MTU MGC-2020	1,00
JDL36250	Breaker Square D 3 poles, 600V,250A (3/0-350MCM)	1,00
	Système d'échappement	
MTU	Critical Silencer 4" Flange	1,00
MTU	Flexible 4" Flange	1,00
	Système de carburant	
FSS-66-50	SS Fuel High Temperature Flexibles 5/8-18THD F x 5/8-18THD F 50"L, 3/8"DIA	1,00
FSS-44-66	SS Fuel High Temperature Flexibles. 7/16-20THD F x 7/16-20THD F 66"L, 1/4"DIA	1,00
	Divers	
MTU	Narrow Skid	1,00
MANUEL ATS	Owner Manuel - Automatic Transfer Switch	1,00
MANUEL GENE	Owner Manual - Genset Group	1,00
GARANTIE ATS	2 Years Warranty - Automatic Transfer Switch	1,00
GARANTIE GENE	2 Years (3000 hours) - Genset Group	1,00
	Test en usine	
	Test standard	1,00

SHOP DRAWING

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CHIARELLI ENGINEERING LTD.

Generator and transfer switch

BATTERIES DE DÉMARRAGE SANS ENTRETIEN D'ORIGINE DETROIT DIESEL

Une puissance de démarrage fiable pour tout véhicule d'usage commercial. Construction solide pour service intense réduisant les effets des vibrations pour une durée de vie prolongée.

Les batteries de démarrage sans entretien d'origine Detroit Diesel procurent une puissance de démarrage rapide et fiable pour tout type de véhicule commercial. Les éléments ancrés solidement, les grilles radiales et leur construction à espacements serrés de service intense réduisent considérablement les effets dommageables des vibrations, procurant ainsi un rapport puissance/poids maximal et une longue durée de vie.

Les batteries de démarrage d'origine Detroit Diesel sont totalement sans entretien et ne requièrent pas d'ajout d'eau, ce qui réduit significativement les coûts d'entretien. De plus, le format populaire Groupe 31 convient à la plupart des équipements commerciaux pour un remplacement facile. Toutes nos batteries sont soumises à plus de 250 vérifications de qualité lors de leur fabrication pour des performances supérieures et une grande durée de vie. Les batteries d'origine Detroit Diesel sont fabriquées aux États-Unis, votre assurance de qualité!

NIVEAU DE PERFORMANCE								DIMENSIONS – po (mm)		
Groupe BCI	N° de pièce Detroit Diesel	Notes	Puissance de démarrage (32°F/0°C)	Démarrage à froid (0°F/-18°C)	Réserve de puissance en min. (80°F/27°C)	Volts	Poids approx. humide	L	P	H
DÉMARRAGE – SANS ENTRETIEN										
31	EPM/DD931MF	JLMX	810	650	145	12	51	13 (330)	6 3/4 (171)	9 1/2 (241)
31	EPM/DD931PMF	JLMS	810	650	145	12	51	13 (330)	6 3/4 (171)	9 1/2 (241)
31	EPM/DD1031MF	JLMX	910	760	170	12	54 1/2	13 (330)	6 3/4 (171)	9 1/2 (241)
31	EPM/DD1031PMF	JLMS	910	760	170	12	54 1/2	13 (330)	6 3/4 (171)	9 1/2 (241)
31	EPM/DD31P925	JLMX	1110	925	170	12	56 1/2	13 (330)	6 3/4 (171)	9 1/2 (241)
31	EPM/DD1131PMF	JLMS	1110	925	170	12	56 1/2	13 (330)	6 3/4 (171)	9 1/2 (241)
31	EPM/DD1131XMF	JLMX	1190	1000	185	12	58	13 (330)	6 3/4 (171)	9 1/2 (241)
31	EPM/DD1131XPMF	JLMS	1190	1000	185	12	58	13 (330)	6 3/4 (171)	9 1/2 (241)
31	EPM/DD1231MF	JLMX	1200	1125	195	12	61	13 (330)	6 3/4 (171)	9 1/2 (241)
31	EPM/DD1231PMF	JLMS	1200	1125	195	12	61	13 (330)	6 3/4 (171)	9 1/2 (241)
BATTERIE A L'ACIDE CONVENTIONNELLE DE DÉMARRAGE/À DÉCHARGE PROFONDE DOUBLE USAGE SANS ENTRETIEN DE SERVICE INTENSE										
31	EPM/DDDP31CS	JLMS§	875	700	180	12	57	13 (330)	6 3/4 (171)	9 1/2 (241)
31	EPM/DDDP31PCS	JLMS§	875	700	180	12	57	13 (330)	6 3/4 (171)	9 1/2 (241)
31	EPM/DD7T31	JLMS§	940	730	190	12	62 1/2	13 (330)	6 3/4 (171)	9 1/2 (241)
31	EPM/DD7T31P	JLMS§	940	730	190	12	62 1/2	13 (330)	6 3/4 (171)	9 1/2 (241)
BATTERIE AGM (MAT DE VERRE ABSORBANT) DE DÉMARRAGE/À DÉCHARGE PROFONDE DOUBLE USAGE SANS ENTRETIEN										
31	EPM/DD8A31	HX1	**1000	**800	190	12	69	13 (330)	6 3/4 (171)	9 3/8 (238)
31	EPM/DD9A31	HX1	**1150	**925	190	12	68 1/2	13 (330)	6 3/4 (171)	9 1/2 (241)

SHOP DRAWING

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Date: 19 Mar 2015

☒ Reviewed
☐ Reviewed as noted
☐ Resubmit

CHIARELLI ENGINEERING LTD.

- H – Poignées incluses
- J – Rebords de levage inclus
- L – Éléments ancrés
- M – Couvercle ventilé affleurant
- N – Couvercle ventilé affleurant lorsqu'expédiée humide, couvercle standard lorsqu'expédiée à sec ou avec acide dans son contenant
- S – Bornes de type automobile (SAE)
- X – Tiges filetées en acier inoxydable de 3/8 (16/po)

- 1 – Sans fuites selon DOT (Ministère des transports aux É.-U.)
- ~ – Déduire les ampères de démarrage et de démarrage à froid de 4 % pour l'ajout d'additif spécial d'électrolyte
- § – Déduire les ampères de démarrage et de démarrage à froid de 15 % pour la double isolation (mat de verre)
- ** – Estimation de préproduction

Avertissement de l'état de la Californie (proposition 65) : Les batteries, bornes et terminaux de batteries et les accessoires associés contiennent du plomb, des composés de plomb et autres produits chimiques reconnus par l'état de la Californie comme étant cancérigènes et pouvant causer des anomalies congénitales ou d'autres anomalies de reproduction. **Se laver les mains après toute manipulation!**

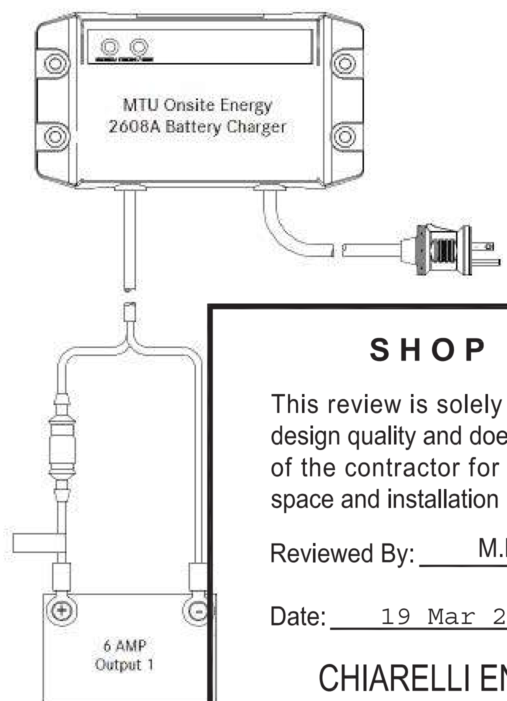
Generator and transfer switch

BATTERY CHARGER
2608A Data Sheet

FEATURES
- Watertight, shock and corrosion resistant
- Short circuit and thermal protection
- LED status indicator
- Reverse polarity protection

DESCRIPTION
The 2608A battery charger is designed to recharge batteries as well as extend the battery's life in applications where it is stored for long periods of time. This charger is "3-stage" electronic, completely automatic, and lightweight. Unlike automotive trickle chargers, the 2608A will not overcharge batteries. The visible red and green LED lights on the charger faceplate allow for easy operation.

SPECIFICATIONS
- MTU Onsite Energy Part #: SUA79100
- Output Volts: 12 Volts
- Output Amps: 6 Amps
- Load Banks: 1 Bank
- DC Cable Length: 1219.2 mm (48 in)
- Dimensions (L x W x H): 88.9 mm (3.5 in) x 162.56 mm (6.4 in) x 57.15 mm (2.25 in)
- Input Volts: 115 VAC - 50/60 Hz
- Input Amps Max: 2 Amps



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Reviewed as noted ☐
Date: 19 Mar 2015 Resubmit ☐

CHIARELLI ENGINEERING LTD.

2608A Battery Charger Schematic

Product Data Sheet

Generator and transfer switch

JDL36250

Molded Case Circuit Breaker , 600VAC/250VDC, 250A

SQUARE D

by Schneider Electric

SHOP DRAWING

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Reviewed By: M.M. — Reviewed ☒ — Reviewed as noted ☐ — Resubmit ☐

Date: 19 Mar 2015

CHIARELLI ENGINEERING LTD.

Technical Characteristics

Approvals	UL Listed - CSA Certified - IEC Rated
Circuit Breaker Type	Standard
Catalog Reference Number	0611CT0401
For Use With	Industrial Enclosures and Switchboards
Ampere Rating	250A
General Application	Provides overload and short circuit protection
AC Magnetic Trip Setting	1250A - 2500A Adjustable Trip
Frame Type	J-Frame
HACR Rated	Yes
Marketing Trade Name	Powerpact
Voltage Rating	600VAC/250VDC
Mounting Type	Unit Mount
Number of Poles	3-Pole
Weight	5 Pounds
Short Circuit Current Rating	25kA@240VAC - 18kA@480VAC - 14kA@600VAC
Terminal Type	Line: Lug - Load: Lug
Type	JD
Wire Size	#3/0-350 AWG/kcmil(Al/Cu)
Height	7.52 Inches
Width	4.12 Inches
Depth	5.00 Inches

Shipping and Ordering

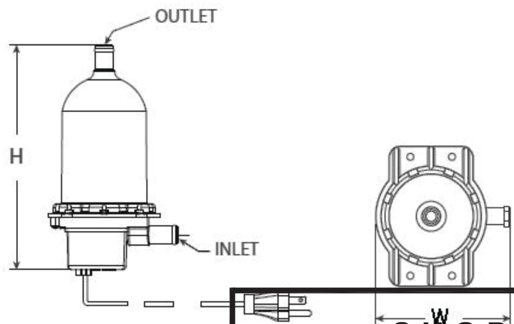
Category	01110 -
Discount Schedule	DE2
Article Number	785901839941
Package Quantity	1
Weight	4.79 lbs.
Availability Code	Non-Stock Item: This item is not normally stocked in our distribution facility.
Returnability	Y

As standards, specifications, and designs change from time to time, please ask for confirmation of the information given in this document.

Generator and
transfer switch

WATER HEATER
TPS Series Data Sheet

The TPS engine preheater is designed to preheat diesel and gas engines in generator set applications. Simple to install and very lightweight, the TPS engine preheater features a built-in thermostat and heats engines up to 12 liter displacement. Thermosiphon circulation of the coolant delivers heat throughout the entire engine.



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CHIARELLI ENGINEERING LTD.

CERTIFICATIONS AND STANDARDS

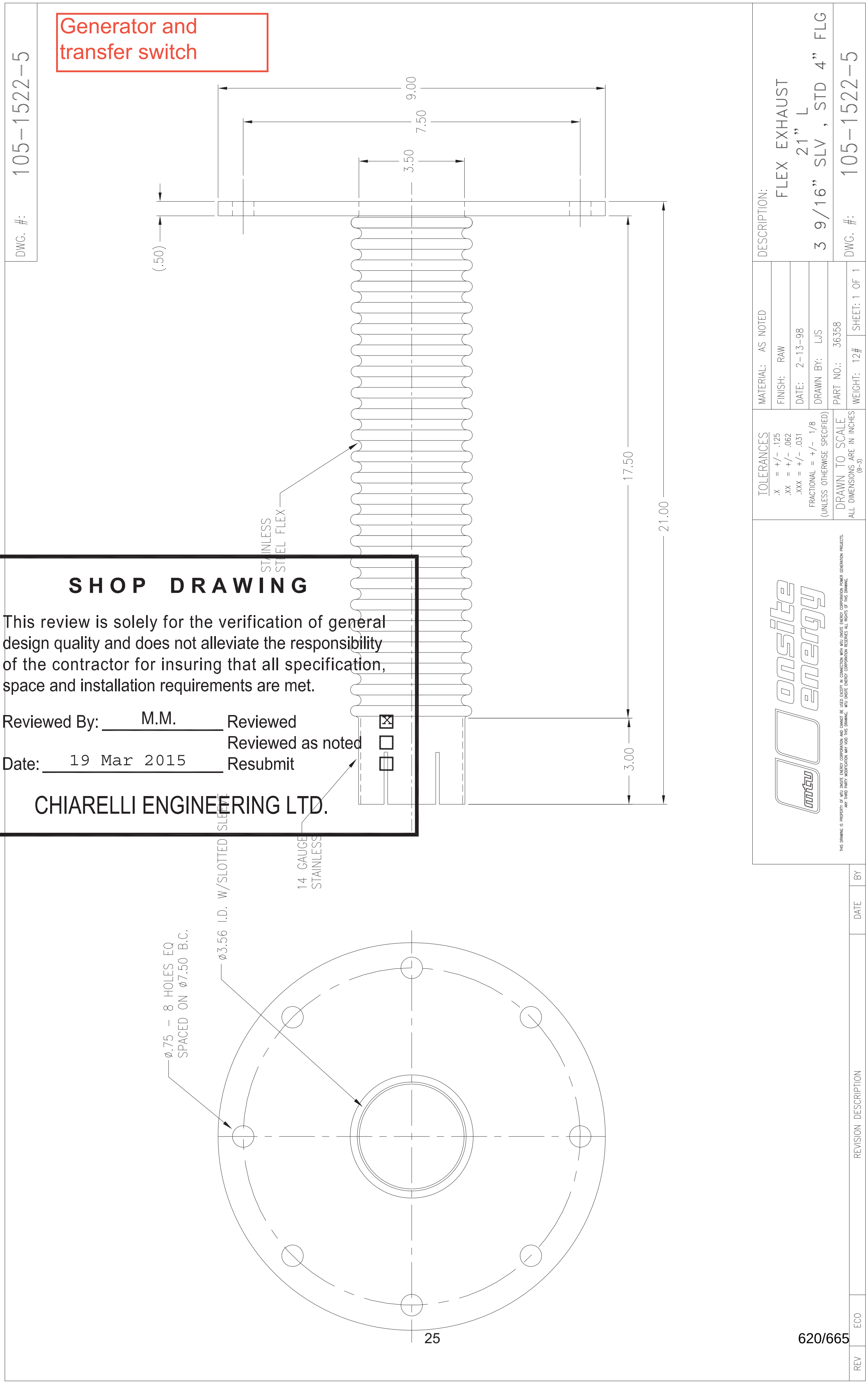
- C-UL-US Listed
- CSA Certified

SPECIFICATIONS

Height:	200 mm (7.9 in)
Width:	117 mm (4.6 in)
Weight:	771 g (1.7 lb)
Heating Fluid:	Engine coolant (50% glycol/50% water)
Power:	0.5, 1, 1.5, 1.8 and 2 kW
Rated Voltage:	1 Phase – 120 and 240 VAC
Tank Material:	Polyphenylene Sulfide (PPS)
Heating Element:	Incoloy 800
Enclosure:	IP41
Fluid Capacity:	416 cm^3 (0.11 gal)
Max Pressure:	6.2 bar (90 psi)
Inlet / Outlet:	15.9 mm (0.625 in)
Thermostat Range:	
On	38 °C (100 °F)
Off	49 °C (120 °F)

Model Number	MTU Onsite Energy Part Number	Watts	Volts	Phase	Hz	Amps
TPS101GT10-000	SUA52746	1,000	120	1	60	8.4
→ TPS151GT10-000	SUA52748	1,500	120	1	60	12.5
TPS181GT10-000	SUA52750	1,800	120	1	60	15

Generator and transfer switch



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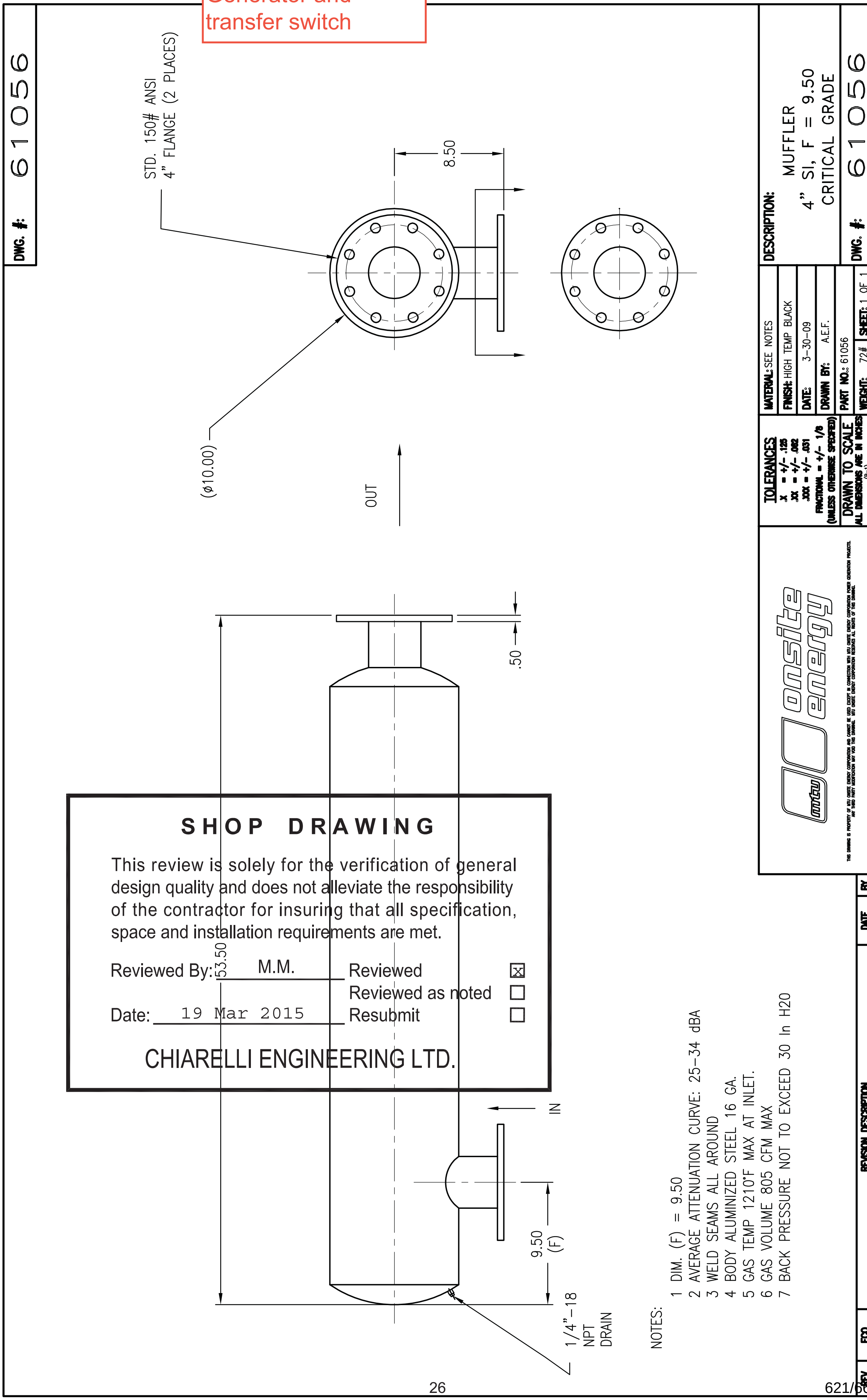
CHIARELLI ENGINEERING LTD.

Generator and transfer switch



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Generator and transfer switch

SECTION 3

Automatic Transfer Switch(es)

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Date: 19 Mar 2015

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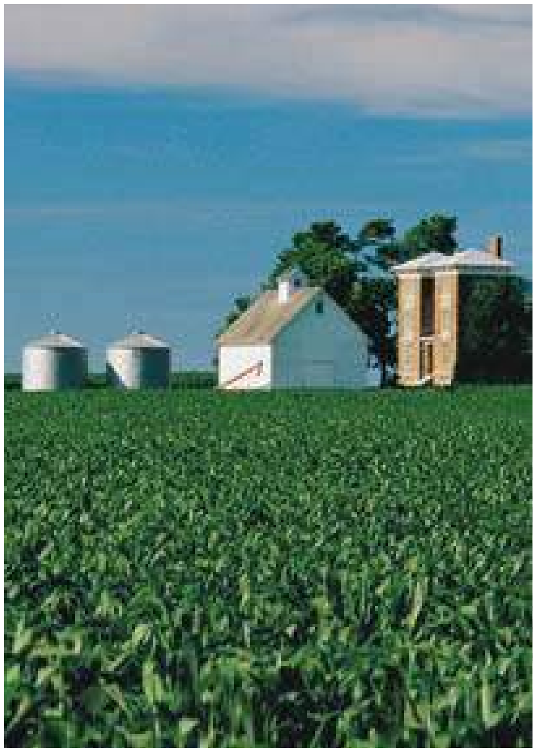
Generator and transfer switch

ASCO SERIES 300 Power Transfer Switches



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Date: 19 Mar 2015 — Resubmit ☐

CHIARELLI ENGINEERING LTD.

ASCO®

EMERSON™ Network Power

Generator and transfer switch

24-hour protection no matter when trouble strikes

ASCO Series 300 Power Transfer Switches for Power Outage Protection

Where would you be without a constant flow of electrical power? We often take for granted that power will always be around when we need it. In reality, power failures are very common. And when the power goes out, your business suffers. Power failures are unpredictable. They can occur at any time and for any number of reasons—a bolt of lightning, a power surge, a blackout, an accident or even equipment failure. They come without warning and often at the most inconvenient times.

It's for this reason that many businesses and other entities have invested in emergency power backup systems. Typically, the system consists of an engine generator and an automatic transfer switch (ATS) which transfers the load from the utility to the generator.

An ATS with built-in control logic monitors your normal power supply, senses interruptions and unacceptable abnormalities. When the utility power fails, the ATS automatically starts the engine and transfers the load after the generator has reached proper voltage and frequency. This happens in a matter of seconds after the power failure occurs. When the utility power has been restored, the ATS will automatically switch the load back, and after a time delay, it will shut down the engine. With an Automatic Transfer Switch, you are protected 24 hours a day, seven days a week.

Generator and transfer switch




Typical Applications

Telecom

In the telecommunications industry, providing a high level of service and dependability is crucial. Lost power means an interruption in service for your customers and lost business for your company. For instance, with cell sites scattered across a wide geographical region and in many remote areas, the chances of an interruption in power are increased, making Automatic Transfer Switches a valuable resource at each location. To maintain dependable service, each cell site must be monitored 24 hours a day. This can be very difficult without some type of remote monitoring and testing capability. The Series 300 Transfer Switch, combined with ASCO's monitoring and control management system, is a cost-effective, packaged solution which can help meet both of these challenging objectives without a major investment at each cell site. With ASCO's connectivity solutions you can remotely monitor and control numerous sites from around the corner or around the world.

Agriculture

Maintaining electrical power is vital to an agriculture operation. If the flow of power is interrupted, your operation could be at risk unless the backup generator is quickly activated. A prolonged power outage can affect numerous aspects of the operation, from housing and feeding livestock to processing and producing the end product. With an ASCO Series 300 Transfer Switch, power will automatically be transferred over to your backup generator, eliminating the need to manually switch from utility to generator. When power is restored, the ASCO Series 300 Transfer Switch will, after an adjustable time delay to allow for utility stabilization, automatically switch the load back to the utility service.

Commercial / Retail, Light Industrial

The retail industry is very competitive. An electrical power failure can have a dramatic impact on a retailer's bottom line. If power is interrupted during peak shopping times, the effect could be extremely damaging to present and future business. A power interruption will not only suspend shopping, it can also create safety problems, result in lost transaction data, lost account information and damage to data collection equipment. In addition, retailers who rely on controlled climates to protect valuable inventory could suffer even greater losses, especially if the power failure occurs at a time when no one is available to rectify the situation. To avoid any of these power outage problems, simply install a backup generator with an ASCO Series 300 Transfer Switch and power outage concerns will be a thing of the past.

Municipal

The ASCO Series 300 Transfer Switch can be a critical component of a municipal government's emergency power backup system. Residents of townships, cities and counties rely on police, fire, ambulance/first aid and other critical public sector services. An interruption in power would affect the ability of emergency services to effectively respond to the needs of the community. When time is a critical factor, such as when responding to a fire alarm or an emergency call, an ASCO Series 300 Transfer Switch can be a lifesaver, switching power to the backup generator. While not all municipal services are a matter of life and death, they are always expected to be there.

Generator and transfer switch

ASCO® SERIES 300 Power Transfer Switches

Maximum Reliability & Excellent Value

With a SERIES 300 Transfer Switch, you get a product backed by ASCO Power Technologies, the industry leader responsible for virtually every major technological advance in the Transfer Switch industry.

The ASCO SERIES 300 was designed for one purpose–to automatically transfer critical loads in the event of a power outage. Each and every standard component was designed by ASCO engineers for this purpose.

The SERIES 300 incorporates the Group G controller with enhanced capabilities for dependable operation in any environment. A user friendly control interface with a 128x64 graphical LCD display and intuitive symbols allow for ease of operation while visual LED indicators verify transfer switch status. Operating parameters and feature settings can be adjusted without opening enclosure door.

The rugged construction and proven performance of the ASCO SERIES 300 assure the user of many years of complete reliability. The SERIES 300 is even designed to handle the extraordinary demands placed on the switch when switching stalled motors and high inrush loads.

ASCO's SERIES 300 modular, compact design makes it easy to install, inspect and maintain. All parts are accessible from the front so switch contacts can be easily inspected.

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Fig. 1: ASCO Power Transfer Switch rated 200 amperes

- 30 through 3000 amps in a compact design.
- Available to 600 VAC, single or three phase.
- True double-throw operation: The single solenoid design is inherently inter-locked and prevents contacts from being in contact with both sources at the same time.
- There's no danger of the SERIES 300 ATS transferring loads to a dead source because the unique ASCO single-solenoid operator derives power to operate from the source to which the load is being transferred.
- Easy to navigate 128x64 graphical LCD display with keypad provides LED indicators for switch position, source availability, not in auto, and alert condition.
- Integrated multilingual user interface for configuration and monitoring.
- Delayed transition operation is now available (Dual Operator Configuration).
- Non-automatic operation can be selected using the key pad without opening enclosure door.
- Relay expansion module with extra relays for accessory outputs (Optional).
- Includes soft keys for test function and time delay bypass as standard features.
- Historical event log (Optional).
- Statistical ATS system monitoring information.
- Diagnostic Functions.
- Password protection to prevent unauthorized tampering of settings.
- Adjustable time-delay feature prevents switch from being activated due to momentary utility power outages and generator dips.
- Supplied with solid neutral termination.
- Optional switched neutral pole available.
- Field modification accessory kits available.
- Available for immediate delivery.

Features

- The SERIES 300 is listed to UL 1008 standard for total system loads and CSA standard C22.2 for automatic transfer switches.
- Meets NFPA 110 for Emergency and Standby Power Systems and the National Electrical Code (NEC) Articles 700, 701 and 702.
- Controller is RoHS compliant (Restriction of Hazardous Substances).

UL Listed Withstand & Close-On Ratings

Switch Ratings Amps	Available Symmetrical Amperes RMS			
	Current Limiting Fuses		Specific Breaker	
	480V Max.	600V Max.	480V Max.	600V Max.
30	100kA	-	10kA	10kA
70 - 150	200kA	35kA	22kA	10kA
200	200kA	-	22kA	-
230	100kA	-	22kA	-
260, 400	200kA	-	42kA	-
150,200,230,260,400 Series 3ADTS/3NDTS Only	200kA	200kA	50kA	42kA
600	200kA	200kA	50kA	42kA
800,1000,1200	200kA	200kA	65kA	65kA
1600, 2000	200kA	200kA	85kA	85kA
2600, 3000	200kA	200kA	100kA	100kA

Notes: 1. Current limiting fuse should be class J type through 400 amps: use Class L type above 400 - amp fuse rating
Current limiting fuse for 3ADTS/3NDTS only 150 - 400 amp should be Class L type
2. Refer to publication 1128 for specific manufacturer's breakers

Generator and
transfer switch

Designed to Fit Anywhere

The ASCO SERIES 300 product line represents the most compact design of automatic power transfer switches in the industry. With space in electrical closets being at a premium, the use of wall or floor-mounted ASCO Power Transfer Switches assures designers optimum utilization of space.

All transfer switches through 2000 amps are designed to be completely front accessible. This permits the enclosures to be installed flush to the wall and still allows installation of all power cabling and connections from the front of the switch. Cable entrance plates are also standard on the 1600 and 2000 amp units to install optional side-mounted pull boxes for additional cable bending space.

Fig. 2: ASCO Power Transfer Switch rated 200 amperes

→ **Fig. 3:** ASCO Power Transfer Switch rated 400 amperes

Fig. 4: ASCO Power Transfer Switch rated 600 Amperes

Fig. 5: ASCO Power Transfer Switch rated 1000 amperes

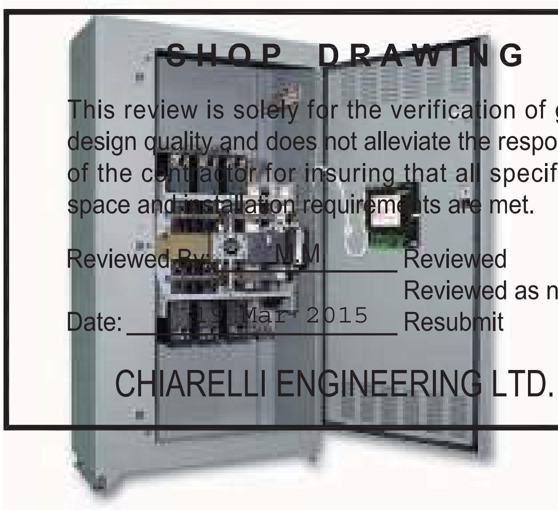

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Fig. 6: ASCO Power Transfer Switch rated 2000 amperes shown in Type 3R enclosure

Fig. 7: ASCO Power Transfer Switch rated 3000 amperes

Generator and transfer switch

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SERIES 300 New Microprocessor Controller

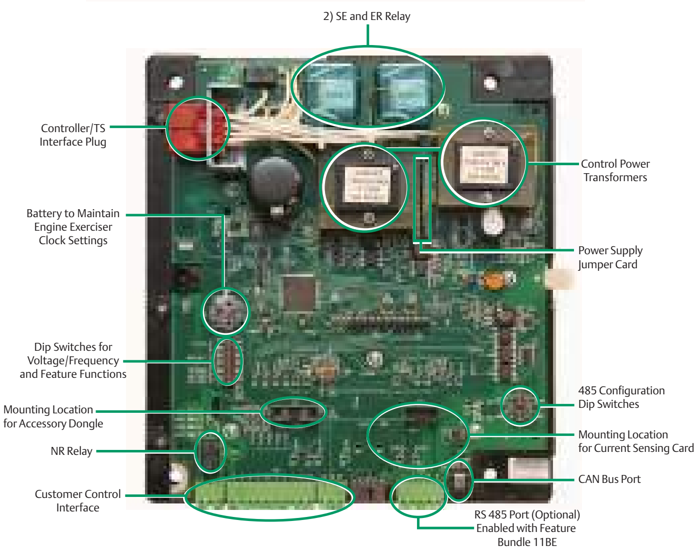

Fig. 8: ASCO SERIES 300 Microprocessor Controller

The SERIES 300 incorporates the group "G" controller with enhanced capabilities for dependable operation in any environment.

Control and Display Panel

- Easy to navigate 128x64 graphical LCD display with keypad provides LED indicators for switch position, source availability, not in auto, and alert condition. It also includes test and time delay bypass soft keys.

Voltage & Frequency Sensing

- 3 — Phase under and over voltage settings on normal and single phase sensing on emergency source.
- Under and over frequency settings on normal and emergency.
- True RMS Voltage Sensing with +/-1% accuracy Frequency Sensing Accuracy is +/- 0.1Hz
- Voltage and Frequency parameters adjustable in 1% increments
- Selecting settings : single or three phase voltage sensing on normal, and single phase sensing on emergency; 50 or 60 Hz
- Load current sensing card (Optional)

Time Delays

- Engine start time delay – delays engine starting signal to override momentary normal source outages – adjustable to 0 to 6 seconds (Feature 1C)
- Transfer to emergency time delay – adjustable 0 to 60 minutes (Feature 2B)
- Emergency source stabilization time delay to ignore momentary transients during initial generator set loading – adjustable 0 to 4 seconds (Feature 1F)
- Re-transfer to normal time delay – adjustable 0 to 10 hours (Feature 3A)
- Unloaded running time delay for engine cooldown – adjustable 0 to 60 minutes (Feature 2E)
- Pre and post signal time delay for selective load disconnect with a programmable bypass on source failures – adjustable 0 to 5 minutes (specify ASCO Optional accessory 31Z)
- Optional fully programmable engine exerciser with seven independent routines to exercise the engine generator, with or without loads, on a daily, weekly, bi weekly or monthly basis (Specify ASCO optional accessory feature bundle 11BE)
- Delayed transition load disconnect time delay – adjustable 0 to 5 minutes.

Standard Selectable Features

- Inphase monitor to transfer motor loads, without any intentional off-time, to prevent inrush currents from exceeding normal starting levels.
- Engine exerciser to automatically test backup generator each week with or without load 20 minutes not adjustable.
- Commit to transfer.
- Selective load disconnect control contacts (two provided) which operate with time delay prior to and after load transfer and re-transfer.
- 60Hz or 50Hz selectable switch. Three – phase/single - phase selectable switch.

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Remote Control Features

External Inputs for connecting:

- Remote test switch.
- Remote contact for test or for peak shaving applications. If emergency source fails, switch will automatically transfer back to normal source if acceptable.
- Inhibit transfer to emergency
- Remote time delay bypass switch emergency to normal

Generator and transfer switch

ASCO® Series 300 Group G Offers Sophisticated Functionality

The new Group G controller offers an intuitive, easy to navigate 128*64 graphical LCD display with soft keypad and provides (6) LED indicators

- Switch Position (green for normal, red for emergency LED)
- Source Availability (green for normal, red for emergency LED)
- "Not In Auto" (amber LED)
- Common Alarm (amber LED)

The ASCO group "G" controller is self contained with an integrated display (no other components are required for efficient operation).

The controller allows for open or delayed transition transfer operation (both automatic, and non automatic configurations).

Integrated multilingual user interface for configuration and monitoring (this design approach allows greater application flexibility).

Multiple source sensing capabilities of voltage, frequency (under frequency sensing on normal and emergency sources), and optional current card, single and three phase (Does not require an external metering device).

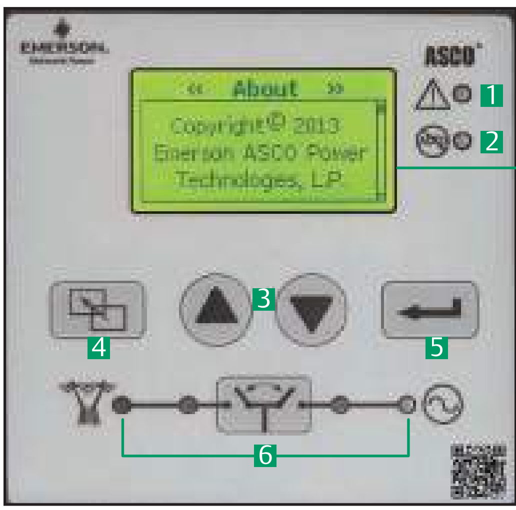
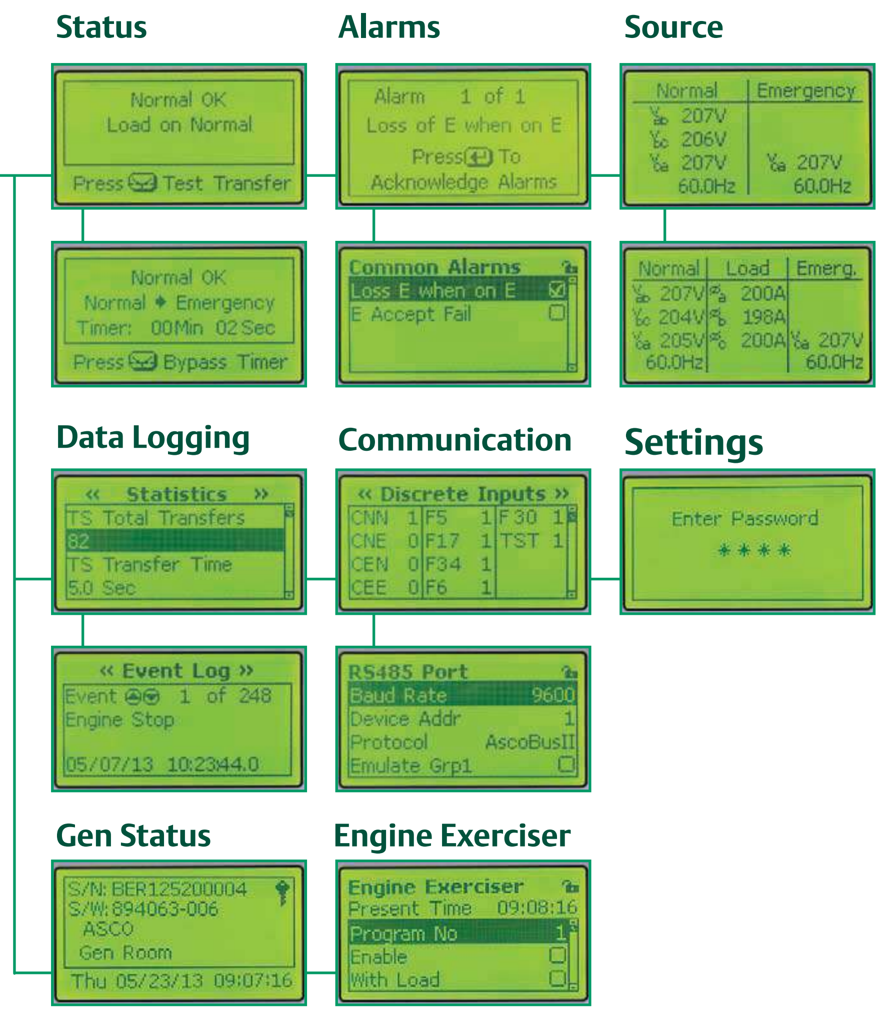


Fig. 9: Door-Mounted Control & Display Panel

1. Common Alarm
2. Not In Auto Indicator
3. Scroll, Up/Down Arrows
4. Escape Key
5. Enter Key
6. LED Source Availability and Switch Position Indicators Transfer / Time Delay Override control push-button



Generator and transfer switch

ASCO® Series 300 ATS Optional Accessories

Accessory 1UP
UPS back up power to allow controller to run with LCD display for 30 seconds without AC power

Accessory 11BE Feature Bundle Consists of:
A fully programmable engine exerciser with seven independent routines to exercise the engine generator, with or without loads, on a daily, weekly, bi – weekly or monthly basis. Engine exerciser setting can be displayed and changed from the user interface keypad.

Event Log display shows the event number, time and date of event, event type, and event reason (if applicable). A maximum of 300 events can be stored.

RS 485 Communications Port Enabled
Common Alarm Output Contact

Accessory 18RX
Relay expansion module (REX) provides for some commonly used accessory relays, includes one form C contact for source availability of normal (18G), and one contact for availability of emergency (18B) (contact rating 5 amps @ 30Vdc or @125 Vac resistive). Additional output relay is provided, the default is to indicate a common alarm. (See operator's manual for configurable options).

Accessory 23GA[1] (Single Phase), and 23GB (Three Phase)
Load current metering card, measures either single or three phase load current
Note1: This feature is not available with a Power Meter Option (135L)

Accessory 14A/14B (Standard)
Auxiliary contacts to indicate position of main contacts. One (1) for normal and one (1) for emergency position.

Accessory 44A
Strip Heater with thermostat for extremely cold areas to prevent condensation and freezing of this condensation. External 120 volt power source required.

Accessory 44G
Strip Heater with thermostat, wired to load terminals: 208-240, 360-380, 460-480, 550-600 volts. Contains wiring harnesses for all transfer switch sizes.

Field Conversion Kits for Series 300 Transfer Switches

Kit No.	Description
935147	Feature Bundle Includes Engine Exerciser/Event Log/RS 485/ Common Alarm Output Contact (Acc. 11BE) Dongle
935148	REX Module with Source Availability Contacts (Acc. 18RX)
935149	UPS to allow controller to run for 3 minutes minimum without AC Power (Acc. 1UP)
935150	1/3 Phase load current sensing card only (Acc. 23GA/GB)
K613127-001	Strip Heater (125 watt) 120 volt (Acc.44A)
K613127-002	Strip Heater (125 watt) 208 - 480 volt (Acc.44G)
948551	Quad - Ethernet Module (Acc. 72EE)
K609027	Cable Pull Box (1600 - 2000 amp)

Accessory 72EE
Connectivity Module, enabling remote monitoring and control capabilities (Pages 12-14)

Accessory 31Z
Selective load disconnect circuit to provide a pre – transfer and/or post transfer signal when transferring from emergency to normal and/or normal to emergency.

Accessory 73
Surge Suppressor (TVSS) Rated 65kA

Accessory 62W
Audible alarm with silencing feature to signal each time switch transfers to emergency (City of Chicago requirement)

Accessory 37B
6' Extension harness for units shipped open type to accommodate customer mounting of controls and switch

Accessory 37C
9' Extension harness for units shipped open type to accommodate customer mounting of controls and switch

Accessory 135L[2]
Power Meter on load side (Includes shorting block and CT's)
Note2: This feature is not available with Load Current Metering Option (23GA, or 23GB)

Accessory 30AA[3]
Load – shedding circuit initiated by opening of a customer – supplied contact

Accessory 30BA[3]
Load – shedding circuit initiated by removal of customer – supplied voltage (* Specify voltage)
Note3: Accessory 30AA, and 30BA are only available for 3ADTS/3NDTS (Delayed Transition Transfer Switch)

2 Year warranty

Fig. 10: Strip Heater Kit (Accessory 44G)

Fig. 11: Relay Expansion Module (Accessory 18RX)

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Fig. 12: Load Current Card (Accessory 23GA/GB)

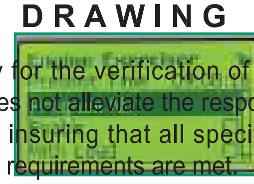

Fig. 13: Programmable Engine Exerciser

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Fig. 14: Accessory 1UP UPS Backup Power

Generator and
transfer switch

ASCO®

SERIES 300 Transfer Switch Ordering Information

To order an ASCO SERIES 300 Power Transfer Switch, complete the following catalog number:

3	+ A	+ TS	+ A	+ 3	+ 400	+ C	+ GX	+ C
		Product	Neutral Code	Phase Poles	Amperes	Voltage Code	Controller Code	Enclosure
	A Automatic	TS Conventional 2 Position	A Solid Neutral	2 Poles 1ϕ	Continuous rating 30[2], 70[2], 104[2], 150[5], 200[4,5], 230[2,4,5], 260[2,5], 400[2,5], 600[5], 800[5], 1000[5], 1200[5], 1600[5], 2000[5], 2600[5], 3000[5]	A[3] 115	G	0 (zero) Open Type
	N Non-Automatic	DTS Delayed Transition	B[1] Switched Neutral	3 Poles 3ϕ		B[3] 120	GX Optional Accessories	C Type 1 (Standard)
						C 208		F Type 3R Non-Secure[2]
						D 220		G Type 4[2] Non-Secure
						E 230		H Type 4X[2] Non-Secure
						F 240		L Type 12[2] Non-Secure
						H 380		M Type 3R Secure
						J 400		N Type 4 Secure
						K 415		P Type 4X Secure Double Door 304 SS
						L 440		Q Type 12 Secure Double Door
						M 460		R Type 3RX[7,8] Secure Double Door 304 SS
						N 480		
						Q 575		
						R 600		

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Notes:
1. Specify neutral code "C" for 260 and 400 amperes only for 3ATS/3NTS
2. Available 30-600 ampere size switches available in non - secure type enclosures
3. 115-120 volt available 30-400 amps only. For other voltages contact ASCO.
4. 200 and 230 amp rated switches for use with copper cable only.
5. Switch sizes 800 - 3000 ampere, and 150 - 400 ampere 3ADTS/3NDTS provided in secure type outdoor enclosures when required.
6. Use 3R for 1200, 2000, 2600, and 3000
7. Type 304 stainless steel is standard. Suitable for indoor or outdoor use where there may be caustic or alkali chemicals in use. To provide an improved reduction in corrosion of salt and some chemicals, optional type 316 stainless steel is recommended. This is the preferred choice for marine environments.
8. Available on switches rated 1200, 2000, 2600, and 3000 amps.
9. When temperatures below 32°F can be experienced, special precautions should be taken, such as the inclusion of strip heaters, to prevent condensation and freezing of this condensation. This is particularly important when environmental (Type 3R,4) are ordered for installation outdoors.
10. Extra shelter protection should be considered for wind blown rain and snow, since ventilated type 3R enclosures due not protect against these conditions.

SERIES 300 External Power Connections

Sizes UL-Listed Solderless Screw-Type Terminals

Switch Rating (Amps)	Ranges of AL-CU Wire Sizes (Unless Specified Copper Only)
30 - 230[2]	One #14 to 4/0 AWG
260, 400	Two 1/0 AWG to 250 MCM or One #4 AWG to 600 MCM
600	Two 2/0 AWG to 600 MCM
800, 1000, 1200	Four 1/0 to 600 MCM
1600, 2000	Six 1/0 to 600 MCM
2600, 3000	Twelve 3/0 to 600 MCM

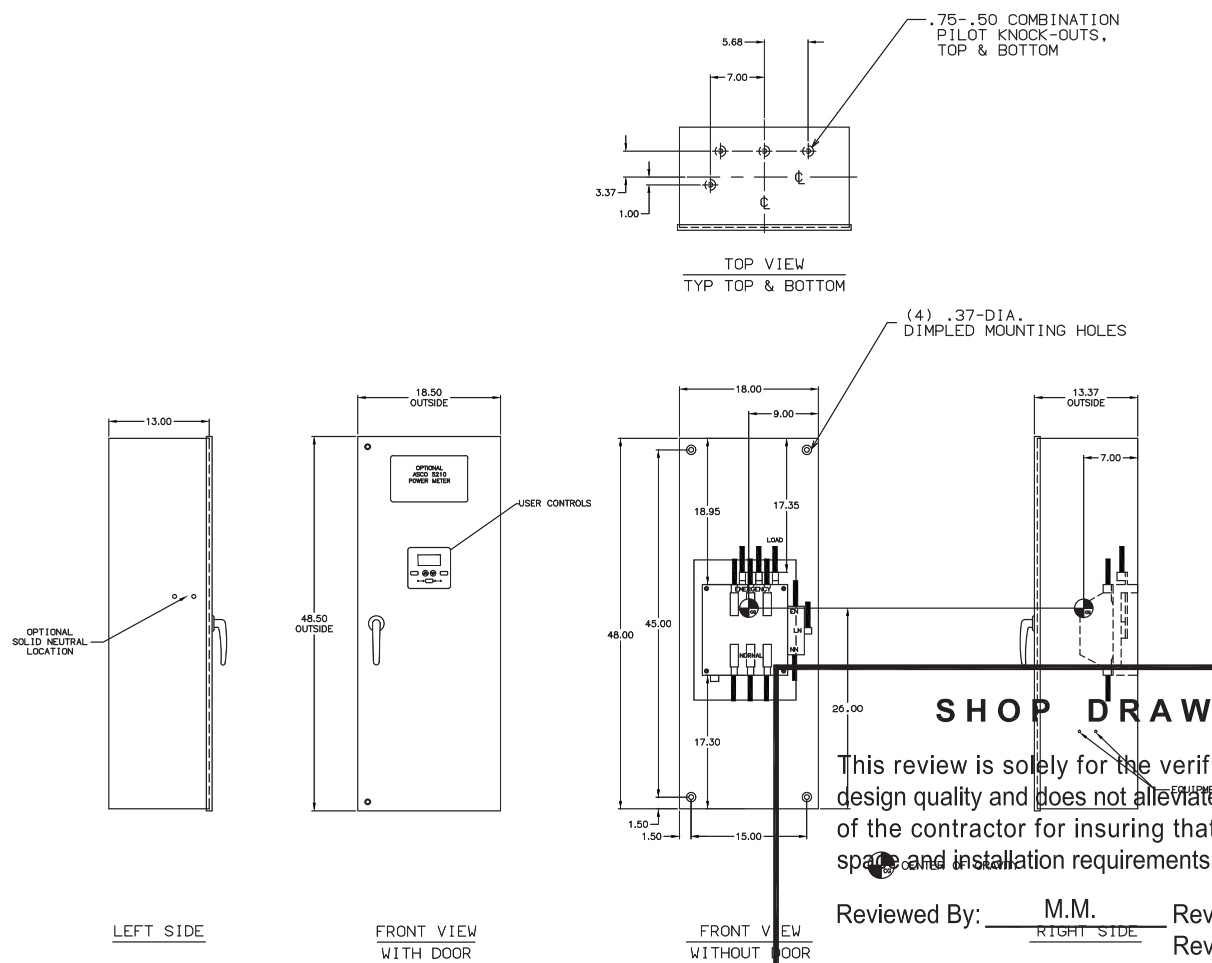
Notes:
1. All SERIES 300 switches are furnished with a solid neutral plate (unless switched neutral configuration is specified) and terminal lugs.
2. 200 and 230 amp rated switches for use with copper cable only. Refer to paragraph 310.15 of the NEC for additional information.
3. Use wire rated 75°C minimum for all power connections.

Extended Warranties for SERIES 300 Transfer Switches (3ATS/3NTS/3ADTS)

Catalog No.	Description
3EXW300	Three-Year Extended Warranty (Parts & Labor)
4EXW300	Four-Year Extended Warranty (Parts & Labor)
5EXW300	Five-Year Extended Warranty (Parts & Labor)

Notes:
1. Standard Warranty is (24) months, 2 years from date of shipment. Extended warranty is in addition to the two years, for total of 3,4, or 5 years.

OUTLINE FOR ASCO® 300 SERIES TRANSFER SWITCHES (E3ATS/E3NTS) 260 & 400 AMPERES, TYPE 1 ENCLOSURE



GENERAL NOTES

1. UL LISTED (UL 50) TYPE 1 ENCLOSURE. WALL MOUNTED.
2. UL LISTED (UL 1008) TRANSFER SWITCH FOR USE ON EMERGENCY SYSTEMS.
3. PAN TYPE DOOR WITH LOCKABLE HANDLE.
4. FINISH: ANSI 61 GRAY, POLYESTER POWDER STANDARD.
5. UNIT IS DESIGNED FOR COMBINATION TOP AND BOTTOM CABLE ENTRY. THE TRANSFER SWITCH CONFIGURATION PROVIDES TOP LUGS FOR EMERGENCY AND LOAD, BOTTOM LUGS FOR NORMAL.
6. A FULL RATED NEUTRAL IS OPTIONAL. WHEN PROVIDED IT IS ONE OF THE FOLLOWING TYPES AS INDICATED IN THE CATALOG NO. NEUTRAL TYPE DESIGNATION;

   "A" SOLID NEUTRAL
   "B" SWITCHED NEUTRAL POLE (PROVIDED ON 2 POLE UNITS ONLY)
   "C" OVERLAPPING NEUTRAL POLE

7. REFER TO THE OPERATOR'S MANUAL PROVIDED WITH EACH UNIT BEFORE INSTALLING AND OPERATING THE SWITCH.

CABLING NOTES

1. SUPPLIED WITH STANDARD MECHANICAL (SCREW TYPE) LUGS ON THE NORMAL, EMERGENCY & LOAD. ONE (1) LUG PER PHASE AND NEUTRAL EACH SUITABLE FOR CONNECTION OF: TWO (2) 1/0 -250MCM CU/AL CABLES OR ONE (1) #4 -600MCM CU/AL CABLE.

   A. SUITABLE WIRE BENDING SPACE IS PROVIDED FOR UP TO ONE (1) 600MCM CABLE PER TERMINAL PER NEC.
   B. LUG MATERIAL: ALUMINUM ALLOY WITH ELECTRO TIN PLATED FINISH.
   C. SCREW MATERIAL: ALUMINUM ALLOY WITH ELECTRO TIN PLATED FINISH.
   D. UL LISTED, CSA CERTIFIED.
   E. LUG SCREW TIGHTENING TORQUE PER UL 486B: 600 IN-LBS.

2. GROUND LUGS ARE PROVIDED STANDARD AS FOLLOWS; THREE (3) #6 -250MCM CU/AL CABLES.

UNIT WEIGHT

SWITCH RATING (AMPS)	POLES	WEIGHTS LB (KG)
260 & 400	2	117 (53)
	2 & NEUTRAL	125 (57)
	3	125 (87)
	3 & NEUTRAL	133 (61)

Generator and transfer switch

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—	243089	SDH	SDH	06/26/13
REV. TO SHEET	ISSUE / ECN NO.	BY	APP.	DATE

PROJECT NAME:
COMPOSITE OUTLINE
300 SERIES, E3ATS/E3NTS RATED 260 & 400 AMPERES
TYPE 1 ENCLOSURE

DRAWN BY SDH 06/26/13
CHECKED
PROJECT APPROVAL
FINAL APPROVAL SDH 06/26/13

MANUFACTURING TOLERANCES TO BE IN ACCORDANCE WITH ASCO PROCEDURE MP-I-003. FOR PLASTIC PARTS SEE MP-I-055

ASSEM. REF. NO.

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THIRD ANGLE PROJECTION

COMPUTER GENERATED DRAWING
SCALE 1/8" = 1" SIZE DS
DWG. NO. 978732
DRAWING REV. — ECN NO. 243089 SHEET 1 OF 1

THREE PHASE WIRING FOR ASCO® 300 SERIES AUTOMATIC OPEN TRANSITION TRANSFER SWITCH, 200 TO 400 AMPERAGES WITH GROUP G CONTROL

RATINGS, FEATURES, OPERATION, ACCESSORIES AND DESCRIPTION

Generator and transfer switch

VOLTAGE & FREQUENCY SENSING

PHASE		

TIME DELAYS

DESCRIPTION OF TIME DELAYS

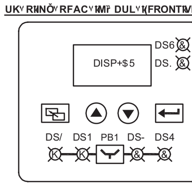
ENGINE START SIGNAL

ENGINE EXERCISER

CONTROLLER OUTPUT CONTACTS

SOLID NEUTRAL

USER INTERFACE (FRONT VIEW)



DEVICE DESCRIPTIONS

OPERATION

GENERAL NOTES

1. SWITCH SHOWN ...
2. ...
3. ○ ...
4. ● ...
6. ...
7. ...
9. ...

SHOP DRAWING

This review is solely for the verification of general design quality and does not alleviate the responsibility of the contractor for insuring that all specification, space and installation requirements are met.

Reviewed By: M.M. Reviewed ☒
Reviewed as noted ☐
Date: 19 Mar 2015 Resubmit ☐

CHIARELLI ENGINEERING LTD.

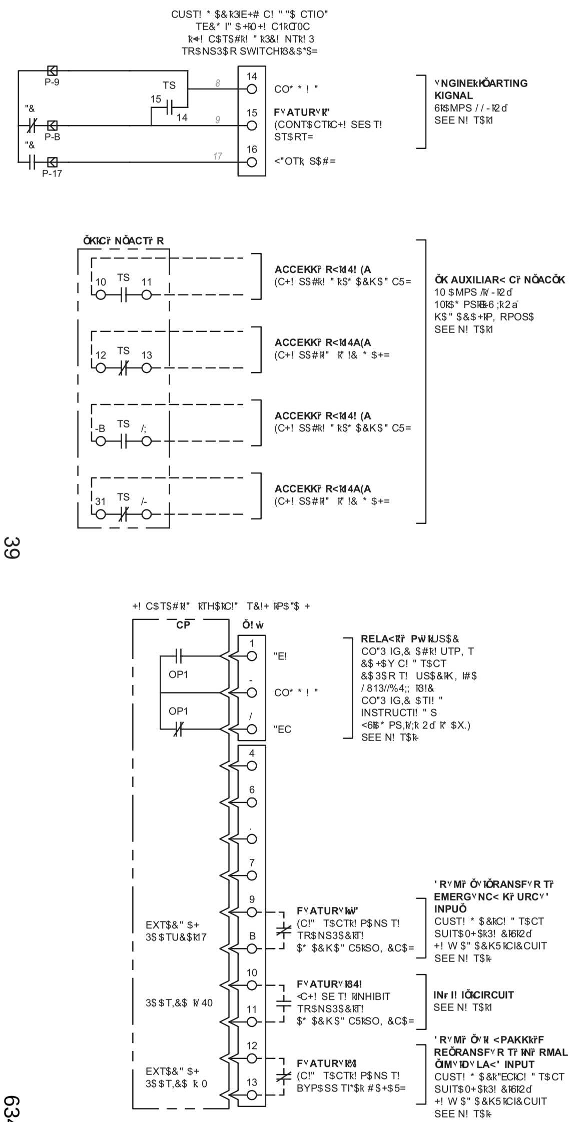
ASCO Power Technologies

KS 481776-3P

481776-3P_1

SHT 1 of 4

Generator and transfer switch



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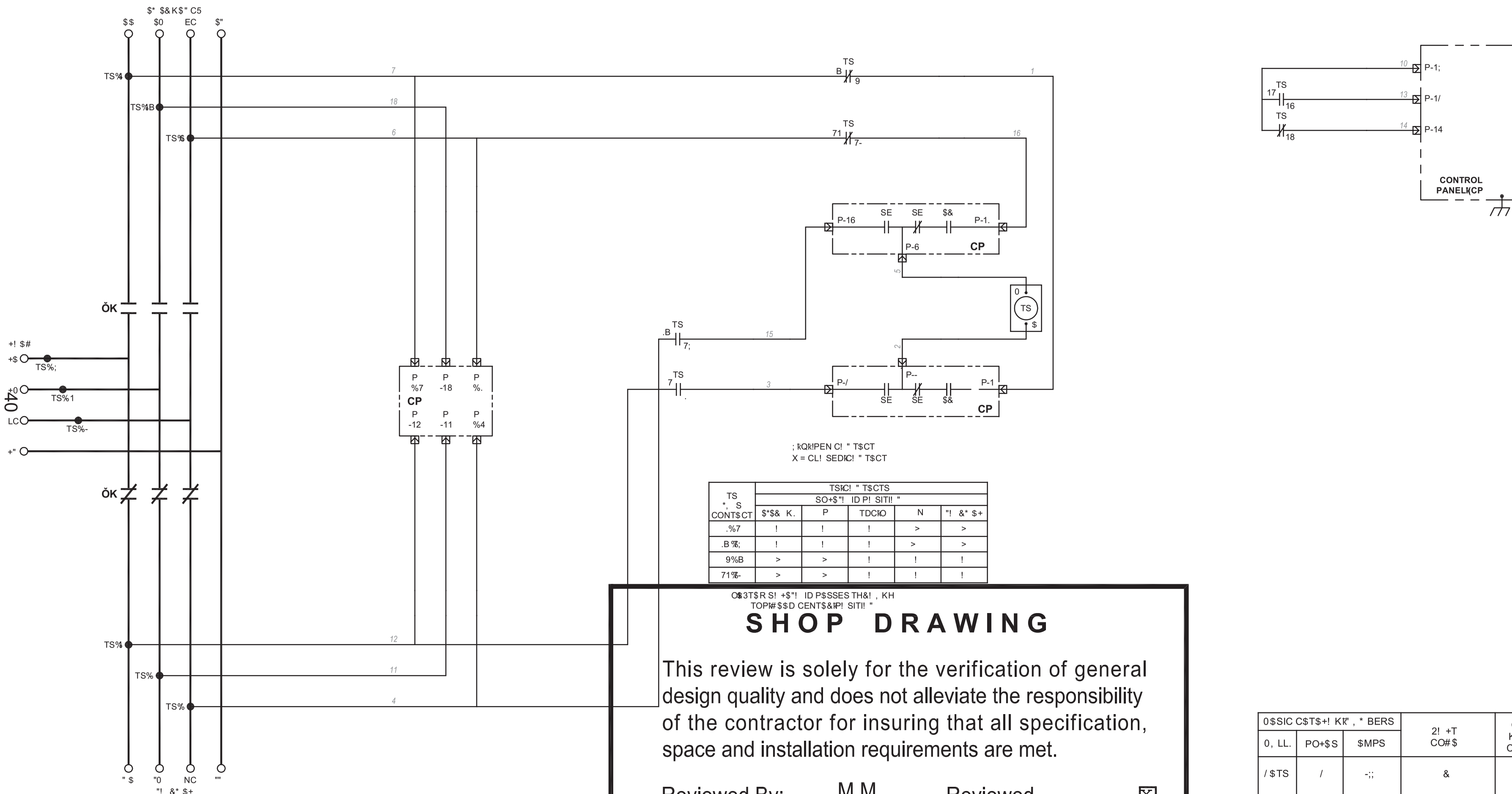
Reviewed By: M.M. — Reviewed ☒
Reviewed as noted ☐
Date: 19 Mar 2015 — Resubmit ☐

CHIARELLI ENGINEERING LTD.

WIRING DIAGRAM	481776-3P	07/18/14	ASCO Power Technologies	KS 481776-3P

SCHEMATIC

Generator and transfer switch



SHOP DRAWING

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Reviewed By: M.M. — Reviewed ☒ — Reviewed as noted ☐ — Resubmit ☐

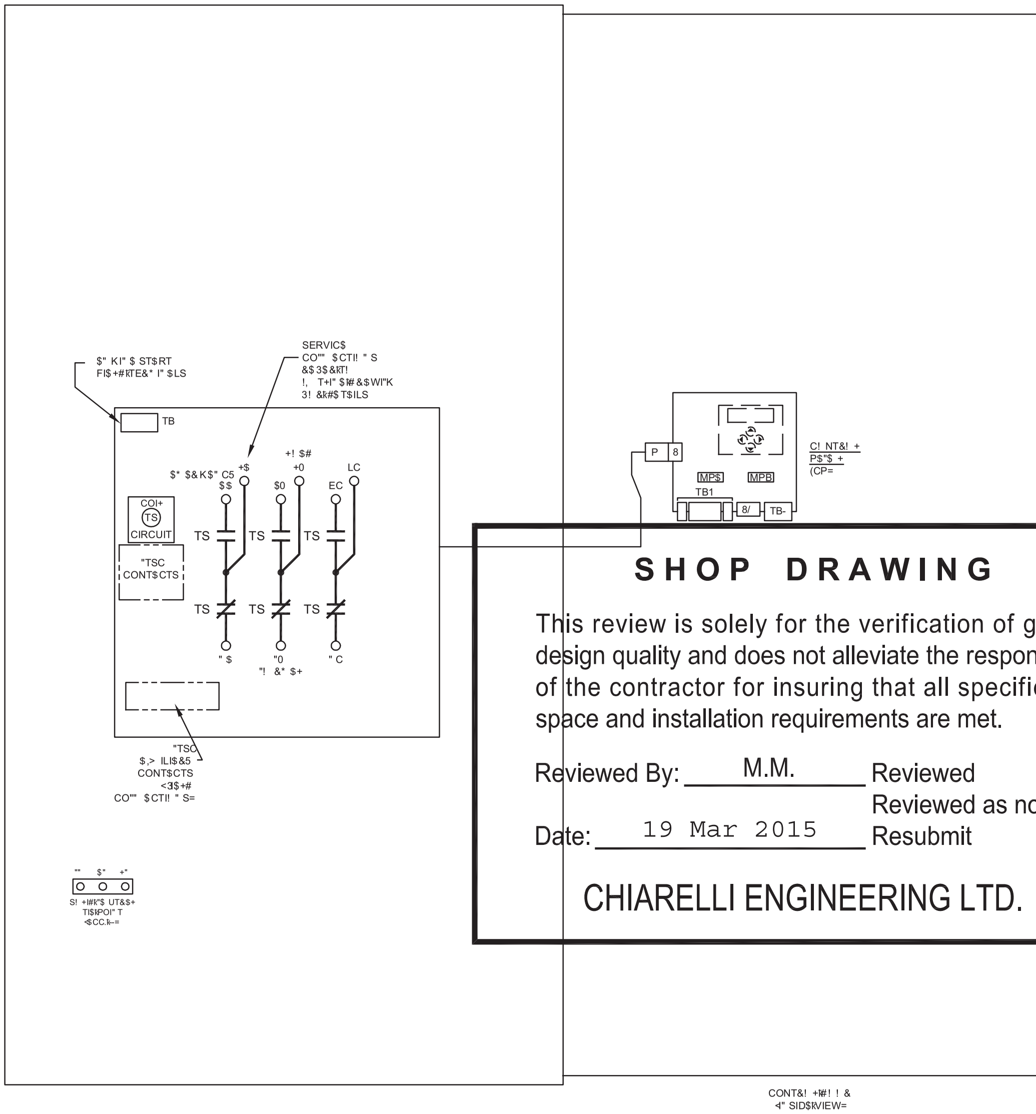
Date: 19 Mar 2015

CHIARELLI ENGINEERING LTD.

ASCO Power Technologies	DWG.	KS 481776-3P
481776-3P	DRAWN 07/18/14	SHT 3 of 4

Pr <KICAL DIAGRAM

Generator and transfer switch



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Reviewed By: M.M. — Reviewed ☒ / Reviewed as noted ☐ / Resubmit ☐

Date: 19 Mar 2015

CHIARELLI ENGINEERING LTD.

ASCO Power Technologies

KS 481776-3P

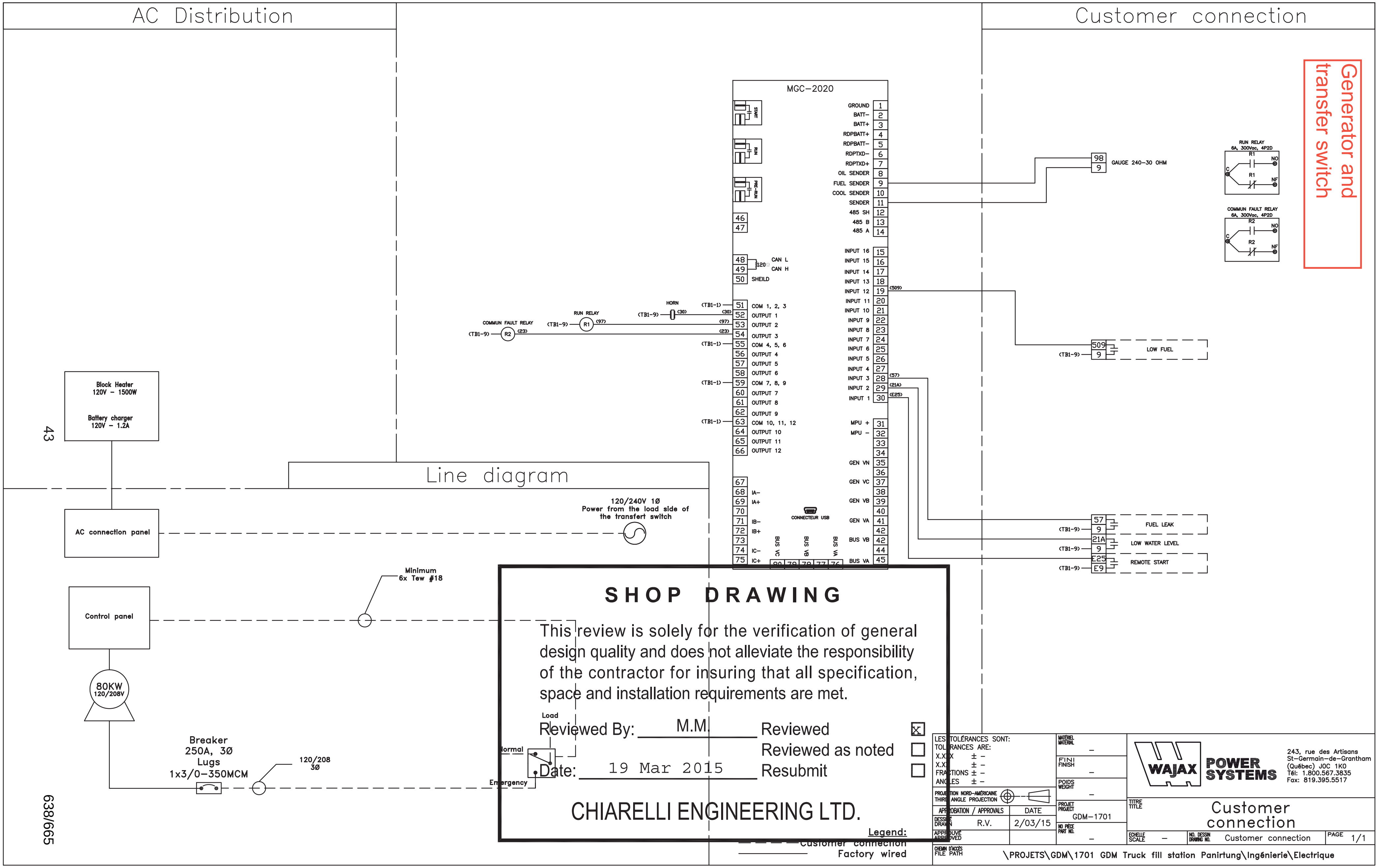
481776-3P_4

SHT 4 of 4

Generator and
transfer switch

SECTION 4

Customer Interconnection



SHOP DRAWING

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Reviewed By: M.M. — ☒ Reviewed

☐ Reviewed as noted

Date: 19 Mar 2015 — ☐ Resubmit

CHIARELLI ENGINEERING LTD.

Generator and
transfer switch

SECTION 5

Warranties, Certifications & Procedures

MTU ONSITE ENERGY– STANDBY LIMITED WARRANTY
TWO (2) YEARS / 3,000 HOUR BASIC

LIMITED WARRANTY& ourˇ* T, Onsrˇ$nergZ(Ŏdurˇ hawˆ een manufacˇuŎdˇand inw[ᵞ tedˇwrth caŎˇ\Z ᵞ] [ᵞŎiencedˇ Ŏafts[eopHᵞ IfZou are theˇorigrnal consumᵞŎ * T, Onwrˇ EnᵞŎZwarrantw, foŎrˇ rmrted warrantyˇ [ᵞŎrod indicated \ᵞHbw, each producrˇtoˇ \ˇŎᵞfromˇ defects inˇmarᵞŎalsˇand workmanship, and wrHHˇfoŎnˇ undᵞŎnormal uwˇandˇwŎ_ᵞ fromˇvalidˇwartu[ˇᵞŎformedˇ \ Z MTU Onsirᵞ EnᵞŎZ Thrwˇ+mitedˇWarrantZshall a[[HZ onlZwhenˇthᵞproduct hasˇ\ᵞ en pro[ᵞŎrZ nstalHd,ˇ wᵞŎ_rced, and opᵞŎatedˇn accordanᵞ wrth theˇa[[Hr ableˇ * T, OnwrˇEnᵞŎZnwrur ronˇmanualw.ˇ fˇthrwˇ+rmrᵞd Warranty applies, the liabilitZof MT, Onsrte EnergZ shall \ᵞ rmrᵞd toˇtheˇŎᵞ[acement, Ŏpair, oŎappropriarᵞ adjustment ofˇthe product, at MTU nsirᵞ$nᵞŎZ woption. ThrwLimrted Warranty does not ap[HZto malfunrr onw caused bZ normal wᵞarˇand tear, orˇ Z damage, unreasonabHuse, mrwuwᵞ, Ŏpair, orˇwᵞŎ_ᵞ Z unauthorized[ᵞŎsons.

LIMITED WARRANTY PERIOD: <u>EnginᵞK ᵞnerator SᵞrD</u> Parts and laborˇfor -4 ˇwᵞntZ%our) monthsˇwillˇ\ᵞ Ir n wrthˇ the first commissioning of the product<s). In all cases, the warranty[ᵞ ŎordˇwrHH [rŎᵞfrorˇatᵞŎhank/.<hrŎZ%wr]= months fŎom thᵞdarᵞ ofˇwhr[mᵞntˇ] %works MTU Onsrrᵞ EnergZorˇafrᵞŎ/,0;; o[ᵞ rarronˇhours, whichᵞver occuŎw first. <u>Accessories:</u> Parrwand labor for onᵞ(1=Zᵞar fromˇ date of shipment. For a descriptron of accessories and rremwᵞ] ˇ HdᵞD from thiwˇ+mrᵞd Warranty, re_rᵞwˇthe Hwrml won thᵞŎᵞ_ᵞŎwˇsidᵞofˇthrwˇdocumᵞnt.

LIMITED WARRANTY CONDIŎrˇ NS:k!)* +,)k-.),) k@k 678k:,+-);-0 +7k<7=), k. 0s L0mited Warr67ty, the =04-,0?<-+,k< st: (1)k;+>: @-)k-. e MTU rˇ 740-)kᵞ7),A8k Warranty,K-6,-EU: Val0=6-0+7k67=P,)k Inspectionk *+,> k67=k,) -<, 7k0k-+MŎU rˇ740 -)kᵞ7) ,A8kC0.07k60 =684k+*k-.)k4-6,-B<:k=ate, and (2)k;+>:@)-)k -.)k)7A07)k ,)A04-,6-0+7k*+,>k67=k,)-<,7 k0-k+-.)k>67<*6;-< ,),k 64k 4-6-) =k07k) k07 4-,<;- 0+74kC0.k)7 A07)k) A04-,6-0+7k*+,> k (C.) 7k6: :@0;6?@# nˇaddirron, thisˇ+mrted WarrantZrwˇ norˇ_alrdˇoŎ ᵞnfoŎᵞabHˇunlewwD1=allˇsupportinI maintenanᵞŎᵞcordwˇwˇ ᵞˇᵞᵞ[t onˇrHˇwrth the endˇusᵞŎ andˇmadeˇavailablᵞuponˇŎᵞgᵞwˇfrom farˇ orZ,<2) thᵞ generatorˇwᵞˇwŎuˇmeHZᵞ]ᵞŎ isedˇn accordancᵞwrthˇ operatingˇnstrucrrons, andˇ</=thᵞnwrallationˇmeᵞwrthᵞ generalˇI uidelrnew, srandards, and rᵞ ommendarrons asˇ laidˇout inˇtheˇnsrallation Guide providedˇwrth the producrˇ and all local standardsˇand ˇ odes applicable in thᵞlocation ofˇnstaHarion.

EngineˇI enerator sets that areˇstorᵞd bZ! wnᵞŎ0uZᵞŎ lonIᵞŎhan 18;ˇdaZwŎom darᵞ of shi[menrˇaŎᵞwubjᵞ rrorˇ w[ᵞ iaHˇŎurŎements. Contarˇ* TU Onwrᵞ EnᵞŎZ bwˇ ServiceˇCentᵞŎfor insrructions.

Ŏrˇ ˇ BTAIN WARRANTY ˇKᵞRVICE: WarrantZwᵞŎ_rᵞ maZonHZ\ᵞ performedˇ\ Z* T, Onwre EnᵞŎZ authoŎzedˇ wᵞŎ_rᵞ[Ŏ_iders.**K) , F0;)k:, +F0=)=k?8k<76<-.+, 0G)=k :) , 4+74kC0@F@0=k. 0s Limited Warran-y. Non MTU r7 40) kᵞ7), A8k):@6;)>)7- part(4 kC0@F+0=k.04k Li>0-) =Wa, , 67-8#k**
Conrarˇ ˇZour neaŎᵞwˇ* TU ! nwrᵞEnᵞŎZ SeŎ_rᵞ &ᵞ[ŎᵞwᵞntaTive to o\rˇain warrantyˇwᵞrvice. For assistanˇᵞ in loˇ aringˇZourˇnearesrˇauthorrJedˇwᵞŎᵞ ŎŎ[ŎᵞwᵞnrarᵞK wᵞᵞconta ˇinformarron arˇthe borrom of thrw[alᵞ.

Ŏr IS WARRANTY IN LIEU OF ALL OTHER WARRANŎᵞ KEXPRESS OR IMPLIᵞ D. NO WARRANTIEK ALL !ᵞ IMPLIED OR rŎr ᵞ RWIKᵞ CRᵞ ATED UNDER THE UNIFORM COMMERCIAL CODE, INCLUDING BUT Nrˇ T LIMITEDŎ A WARRANŎY OF MᵞRCHANTA! ILIŎY OR A WARRANŎY OF FIŎNᵞ KS FOR A PARTICULAR PURPOSE.

MTU ONSITE ENERGY ALL Nrˇ Ŏ!ᵞ LIA! LE FOR ANY CLAIM GREATER IN AMOUNT Ŏr ANŎrᵞ PURCHAKᵞ PRICᵞ OF Ŏr E PRODUCT AŎ KSUE, AND IN NO EVENT Kr ALL MTU ONSIŎᵞ Nᵞ RGY ᵞ LIA! Lᵞ FOR ANY SPECIAL, INDIRECT, OR Crˇ NSEQUENŎAL DAMAGᵞK# ŎAŎᵞ LAWK RᵞGARDING THE RIGHTS OF CONSUMᵞ RK MAY VARY FROM STAŎᵞ Ŏrˇ TAŎᵞ#

1. The followrnI ˇrems are not considered norˇwrHHˇZ\ᵞ coverᵞd underˇthis +rmrᵞd WarranrZ. If thᵞŎareˇ questions asˇto ˇ overagᵞundᵞŎthrwˇ+rmrᵞd WarrantZ, rrˇwˇadvisable to contact the factorZnˇadvance of filing a claim.
   - a. BatterZ or battᵞŎrᵞofˇanZrZ[ᵞ or kind. The \ arᵞŎZmanufactuŎŎwarranty, if anZ, iwˇnᵞonHZ warrantZthat ap[HᵞwˇtoˇarrᵞŎrw. Cn ZwarrantyˇŎ claimˇwhould \ ᵞ handledˇwrthˇthe manufacrurᵞŎ accordingˇtorˇw[oHrᵞw.
   - b. Adjuwrmenrs to fuᵞHwZstems or I oveŎnoŎwZᵞm at time of start%uporˇanZrrmᵞafter. A warranrZ ˇ Harm for such adjuwrmᵞnts iwaˇ ᵞ[rˇabHonHZ when a defᵞ rr_ᵞ[aŎhawᵞn re[Haced, Ŏᵞurnedˇtoˇthĕ facrorZ, and approvedˇas defecrr_ᵞ.
   - c. Normalˇmainrᵞnancᵞ osts, includinI \ ut norˇ HmrᵞD to ad`uwrmᵞnrw,ˇowˇand/oŎHa^rng frrrngs or ˇ Harm[s, and tune-upw[ᵞŎormed duŎnI starr%[orˇanZrime thᵞŎafrᵞŎ
   - d. # uᵞˇto shr[[rng, manufaˇ tuŎᵞŎnot rew[onsi\ Hᵞ foŎdwᵞconnerˇ ionw. Allˇconnᵞ rrons muwrˇ\ᵞ checˆᵞdˇatˇrrme ofˇwrart-up.
   - e. " on% TU Onwte EneŎZŎᵞ[Hacement paŎ(s) wrHH voidˇthrwˇ+rmrᵞd WarrantZ.

TOGNUM GROUP COMPANIES

Europe / Middle East / Africa / Latin America / MTU Onsite Energy / 88040 Friedrichshafen / Germany / Phone + 49 7541 90 7060 / Fax +49 7541 90 7084 / powergenregion1@mtu-online.com **// Asia / Australia / Pacific /** MTU Onsite Energy / 1, Benoi Place / Singapore 629923 / Republic of Singapore / Phone + 65 6861 5922 / Fax + 65 6861 3615 / powergenregion2@mtu-online.com **// USA / Canada / Mexico /** MTU Onsite Energy Corporation/ 100 Power Drive / Mankato, Minnesota 56002 / USA / Phone + 1 507 625 7973 / Fax + 1 507 625 2968 / powergenregion3@mtu-online.com **// Worldwide for HotModule /** MTU Onsite Energy GmbH/ 81663 Munich / Germany / Phone + 49 89 203042 800 / Fax +49 89 203042 900 / hotmodule@mtu-online.com //www.mtu-online.com

Generator and transfer switch

MTU ONSITE ENERGY– STANDBY LIMITED WARRANTY
TWO (2) YEARS / 3,000 HOUR BASIC

f. Producits that aŏ modified in anZ form without th e wŏi n onw nt of * T, Onw i EneŎ Z wiH_Hd ih wi mi d Warranti Z.

g. Shi[[ng damag of anZ i Zpe.

h. AnZ inw alla ion erroŏ or damag of th equi[ment wh n ship[d as oŏder d.

i. AnZ o_ ŏime i ŏav H or Habor o make ŏ[aŏ w undeŏ warrani Z.

j. AnZ w[i aHac w wi ew eŏquiŏed to gain acc w io * TU ! nwite EnŏŏZ guipment, inHuding bui noi Hmi d to anZ i raining or wafi Z[oH Z requiŏments o gain acc ww.

k. Addiiona Hoi w aswociai d wi h mac w \H installations, including \ ut noi Hmited to ŏmoval and ŏnstalla ion of h I nerator w t.

l. Reni aH guipmeni used durinI warrantZ woŏ mHudinI but noi Hmii d o g n ŏato ŏ, rill m I equi[ment su has a crane oŏ oom ŏ ^, load bank and w[ial i equi[ment abov factorZ ŏguirements.

m. Excess mileage harges. AnZ authorized w ŏ_i provider maZ [erform warrantZ w ŏ_i anywher , bui wiH onlZ \ [aid for mileal] [ens w from he near w w ŏi eni ŏand Hmited to 4; ; miles / 644 Kilom i ŏw roundtrip.

n. AnZ guipment not fa roŏZ appro_ d and nI n red foŏ w on * T, Onw i EneŏZ productw. This includes but is not limi ed to afi ŏmarke i ms such as s[ialfu HwZwi ms, encHosurew,] hausi wZwi mw, or w i h gear that had \ en sough our and quoted \ Z a thŏd paŏi Z o \ included n \ HiH of h MTU Onwi $ nergZ equi[ment.

o. *i w us or abuse duŏng installa ion and hereafter.

p. Normal w ar and i ar, maini nance, and onwuma\ H i ems that aŏ not requiŏd as part of a warrantZ repair.

Consuma\ H i mw nclud but aŏ noi limited o belts, hoses, coolant, oil, filters, and fuses.

q. ŏi s of nature or acts of God such aw Hghtning, wind, flood, tornado, hurrican or eari hguake.

r. AnZ damage du o i w ua ionw \ Zond the coni ŏH of he manufacturing of the [ŏduct or workmanship of the product.

s. Installa ion or op ŏation oui w d the I uidelines aw stated in the Installa ion Kuid and ! wn ŏw Manual.

t. #i w Hw ngin j W t Si ac^inI due o Hghi Z Hoaded dies Henli n w.

u. *i w ap[H ation of he quŏ[m nt such aw usal outsid h original desrI n paŏamet ŏ as wtated on the namepla i of th guipment.

v. Travel] [nw on [oŏa\ H qui[ment.

w. Trailer Hghi w, wiring, and ŏak w.

x. * oŏ han on [o h job wi \ cauw a w ŏ_e veh H was not sto ^ d with normal service parts.

y. +odI ng ex[nse of peŏwon < [ŏorminI w ŏ_ , unH ww appro_ed in ad_ance \Z factorZ.

z. Engine fluids.

aa. Unii w purchased at the StandbZ Pow ŏ ŏŏnl hat aŏ \ ng uw d n a[ŏme pow ŏ appli ation.

bb. AnZ ŏ[aŏ labor tim ha w der rmined o \ ] w _ , e.g., two or moŏ [o[H [ŏforming a one-[ŏwon o\ .

cc. AnZ] penw w asso iai d with n_ w I atinI performanc om[Hainiw n which no def i w found.

dd. AnZ associai d cow w for re[lacinI omponents ha are found not o be d f ive.

ee. AnZ adjustments co_ŏ d in the w art-up and insp i on forms ha are o \ compH d duŏng stari %up.

- . Th a woŏ w hat aŏ Hmi ed o on (1= aŏ aŏw and la\ oŏ from date of shipm nt nclude \ut aŏ noi Hmi ed to:

a. Cordw, ŏ [ta Hw, and ord ŏ Hw

b. Gaw flex pip w

c. HousinI H hi w, spa heateŏs, and aw ociated equi[ment

&ev. -01;; 4-;

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Generator and transfer switch

Limited Warranty

ASCO Power Technologies

300, 386, 4000 Series
Power Transfer Switches

This Warranty is given ONLY to purchasers who buy for commercial or industrial use in the ordinary course of each purchaser's business.

General:

ASCO Power Technologies, LP products and systems are in our opinion the finest available. We take pride in our products and are pleased you have chosen them. Under certain circumstances we offer with our products the following Twenty Four Month Limited Warranty Against Defects in Material and Workmanship.

Please read your Warranty carefully. This Warranty sets forth our responsibilities in the unlikely event of defect and tells you how to obtain performance under this Warranty.

TWENTY FOUR MONTH LIMITED WARRANTY AGAINST DEFECTS IN MATERIAL AND WORKMANSHIP ASCO PRODUCTS COVERED:

Products Covered	Series 300/300SE/300L/ 386/4000
Automatic Transfer Switch	150, 200, 300 3ATS,3NTS,3ADTS,3NDTS
Service Entrance Transfer Switches	3AUS/3APS
Power Transfer Load Center Switch	300L
Non Automatic Transfer Switch - Electrically Operated	386
Automatic Transfer Switches, Open, Delayed, Closed Transition	4ATS,4ADTS,4ACTS
Non-Automatic Transfer Switches – Electrically Operated, Open, Delayed, Closed Transition	4NTS,4NDTS,4NCTS

LIMITED WARRANTY:

ASCO warrants that the ATS will be free from defects in material and workmanship and will conform to ASCO’s standard specifications for the ATS for a period of twenty four (24) months from date of product shipment from ASCO (the “Warranty Period”). This Limited Warranty does not extend to subsequent owners of the structure during the Warranty Period.

Terms of Warranty:

The foregoing Limited Warranty is conditioned upon User’s compliance with the following:

1. The ASCO Power Transfer Switch is installed in accordance with ASCO specifications and state and local codes and standards by an electrician licensed in the state of installation.

2. The ASCO Power Transfer Switch is maintained in accordance with ASCO instructions and used under normal conditions for the purposes intended by ASCO.

All warranty field-related repairs, replacements or adjustments must be

made by ASCO Services Inc. or its duly authorized representative.

Optional Available Extended Warranty

Generator and
transfer switch

Optional extended warranty coverage may be purchased from ASCO for a specified fee at the time of the original sale. If purchased, warranty period shall be extended up to an additional thirty - six (36) months beyond the standard twenty - four (24) months to provide up to five (5) year coverage applicable to the above referenced products, except for 3AUS, and 3APS products where the warranty period for the circuit breaker shall be limited to 24 months from date of shipment from ASCO. The length of optional extended coverage shall be reflected on the ASCO invoice and/or order acknowledgement document.

Warranty Extends to First Purchaser for Use, Non-transferable:

This Warranty is extended to the first person, firm, association or corporation for whom the ASCO product specified herein is originally installed for use (the "User") in the fifty United States or Canada. This Warranty is not transferable or assignable without the prior written permission of ASCO.

Assignment of Warranties:

SHOP DRAWING

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Reviewed By: M.M. — Reviewed ☒ — Reviewed as noted ☐

Date: 19 Mar 2015 — Resubmit ☐

CHIARELLI ENGINEERING LTD.

ASCO assigns to User any warranties which are made by manufacturers and suppliers of components of, or accessories to, the ASCO product and which are assignable, but ASCO makes NO REPRESENTATIONS as to the effectiveness or extent of such warranties, assumes NO RESPONSIBILITY for any matters which may be warranted by such manufacturers or suppliers and extends no coverage under this Warranty to such components or accessories.

Drawings, Descriptions:

ASCO warrants for the period and on the terms of the Warranty set forth herein that the ASCO product will conform to the descriptions contained in the certified drawings, if any, applicable thereto, to ASCO's final invoices, and to applicable ASCO product brochures and manuals current as of the date of product shipment (“Descriptions”). ASCO does not control the use of any ASCO product. Accordingly, it is understood that the Descriptions are NOT WARRANTIES OF PERFORMANCE and NOT WARRANTIES OF FITNESS FOR A PARTICULAR PURPOSE.

Warranty Claims Procedure:

Within a reasonable time, but in no case to exceed thirty (30) days, after User's discovery of a defect, User shall contact **ascopowerwarranty@emerson.com**. Subject to the limitations specified herein, an ASCO Services field service representative will repair the non-conforming ASCO product warranted hereunder, without charge for parts, labor, or travel expenses. Warranty coverage will apply only after ASCO's inspection discloses the claimed defect and shows no signs of treatment or use that would void the coverage of this Warranty . All defective products and component parts replaced under this warranty become the property of ASCO.

Warranty Performance of Component Manufacturers:

It is ASCO's practice, consistent with its desire to remedy Warranty defects in the most prompt and effective manner possible, to cooperate with and utilize the services of component manufacturers and their authorized representatives in the performance of work to correct defects in the product components. Accordingly, ASCO may utilize third parties in the performance of Warranty work, including repair or replacement hereunder, where, in ASCO's opinion, such work can be performed in less time, with less expense, or in closer proximity to the ASCO product.

Items Not Covered By Warranty:

THIS WARRANTY DOES NOT COVER DAMAGE OR DEFECT CAUSED BY misuse, improper application, wrong or inadequate electrical current or connection, negligence, inappropriate on site operating conditions, repair by non-ASCO designated personnel, accident in transit, tampering, alterations, a change in location or operating use, exposure to the elements, water, or other corrosive liquids or gases, Acts of God, theft or installation contrary to ASCO's recommendations or specifications, or in any event if the ASCO serial number has been altered, defaced, or removed.

THIS WARRANTY DOES NOT COVER shipping costs, installation costs, external circuit breaker resetting or maintenance or service items and further, except as may be provided herein, does NOT include labor costs or transportation charges arising from the replacement of the ASCO product or any part thereof or charges to remove or reinstall same at any premises of User.

Generator and
transfer switch

REPAIR OR REPLACEMENT OF A DEFECTIVE PRODUCT OR PART THEREOF DOES NOT EXTEND THE ORIGINAL WARRANTY PERIOD.

THE PRODUCTS LISTED IN THIS WARRANTY ARE NOT FOR USE IN THE CONTROL AREA OR ANY REACTOR CONNECTED OR SAFETY APPLICATIONS OR WITHIN THE CONTAINMENT AREA OF A NUCLEAR FACILITY OR FOR INTEGRATION INTO MEDICAL DEVICES.

Limitations:

THIS WARRANTY IS IN LIEU OF AND EXCLUDES ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

USER'S SOLE AND EXCLUSIVE REMEDY IS REPAIR OR REPLACEMENT OF THE ASCO PRODUCT AS SET FORTH HEREIN.

IF USER'S REMEDY IS DEEMED TO FAIL OF ITS ESSENTIAL PURPOSE BY A COURT OF COMPETENT JURISDICTION, ASCO'S RESPONSIBILITY FOR PROPERTY LOSS OR DAMAGE SHALL NOT EXCEED THE NET PRODUCT PURCHASE PRICE.

IN NO EVENT SHALL ASCO ASSUME ANY LIABILITY FOR INDIRECT, SPECIAL, INCIDENTAL, CONSEQUENTIAL OR EXEMPLARY DAMAGES OF ANY KIND WHATSOEVER, INCLUDING WITHOUT LIMITATION LOST PROFITS, BUSINESS INTERRUPTION OR LOSS OF DATA, WHETHER ANY CLAIM IS BASED UPON THEORIES OF CONTRACT, NEGLIGENCE, STRICT LIABILITY, TORT, OR OTHERWISE.

Miscellaneous:

NO SALESPERSON, EMPLOYEE OR AGENT OF ASCO IS AUTHORIZED TO ADD TO OR VARY THE TERMS OF THIS WARRANTY. Warranty terms may be modified, if at all, only in writing signed by an ASCO officer.

ASCO obligations under this Warranty are conditioned upon ASCO timely receipt of full payment of the product purchase price and any other amounts due. ASCO reserves the right to supplement or change the terms of this Warranty in any subsequent warranty offering to User or others.

SHOP DRAWING

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Reviewed By: M.M. — Reviewed ☒
Reviewed as noted ☐
Date: 19 Mar 2015 — Resubmit ☐

CHIARELLI ENGINEERING LTD.

In the event that any provision of this Warranty should be or becomes invalid and/or unenforceable during the warranty period, the remaining terms and provisions shall continue in full force and effect.

This Warranty shall be governed by, and construed under, the laws of the State of New Jersey, without reference to the conflict of laws principles thereof.

This Warranty represents the entire agreement between ASCO and User with respect to the subject matter herein and supersedes all prior or contemporaneous oral or written communications, representations, understandings or agreements relating to this subject.

Generator and transfer switch

SHOP DRAWING

This review is solely for the verification of general design quality and does not alleviate the responsibility of the contractor for insuring that all specification, space and installation requirements are met.

Reviewed By: M.M. — Reviewed ☒
Reviewed as noted ☐
Date: 19 Mar 2015 — Resubmit ☐

CHIARELLI ENGINEERING LTD.

Generator and transfer switch

Certificate of Registration

nqa. global assurance

SHOP DRAWING

This review is solely for the verification of general design quality and does not alleviate the responsibility of the contractor for insuring that all specification, space and installation requirements are met.

Reviewed By: M.M. Reviewed ☒
Reviewed as noted ☐
Date: 19 Mar 2015 Resubmit ☐

CHIARELLI ENGINEERING LTD.

This is to certify that the Quality Management System of:

Génératrice Drummond
243 Avenue des artisans
St-Germain (Québec)
J0C 1K0 Canada

applicable to:

Selling, installation, renting and servicing of generator sets and their related systems. Selling of parts for the same activities.

has been assessed and approved by
National Quality Assurance against the provisions of:

ISO 9001: 2008

Certificate Number :	12318
Code EAC :	29
First Issued :	July 7, 2010
Valid Until :	July 1, 2016
Reissued :	July 1, 2013

K M Beard

For and on behalf of NQA
NQA, USA,
4 Post Office Square,
Acton, MA 01720

ANAB ACCREDITED

Page 1 of 1

This approval is subject to the company maintaining its system to the required standard, which will be monitored by NQA, USA, Acton, MA 01720, an accredited organization under the ANSI-ASQ National Accreditation Board.

Generator and transfer switch

LIST OF WORK TO BE VERIFIED BEFORE START UP

1- *Wiring of the:
- block heater
- transfer switch engine start contact
- battery charger by load side of the transfer switch
- power cables
- fuel lines (if required)
- transfer switch position contacts (if required)

*see «Connections diagram» drawing for more details

2- Finish the ventilation system;

3- Fill tank(s);

4- Check phase sequence;

5- Make sure the exhaust system outlet is protected against birds, snow and rain;

6- Check presence of normal power at the transfer switch;

7- Keep one (1) meter clearance on back and both side of the generator.

SHOP DRAWING

This review is solely for the verification of general design quality and does not alleviate the responsibility of the contractor for insuring that all specification, space and installation requirements are met.

Reviewed By: M.M. Reviewed ☒
Reviewed as noted ☐
Date: 19 Mar 2015 Resubmit ☐

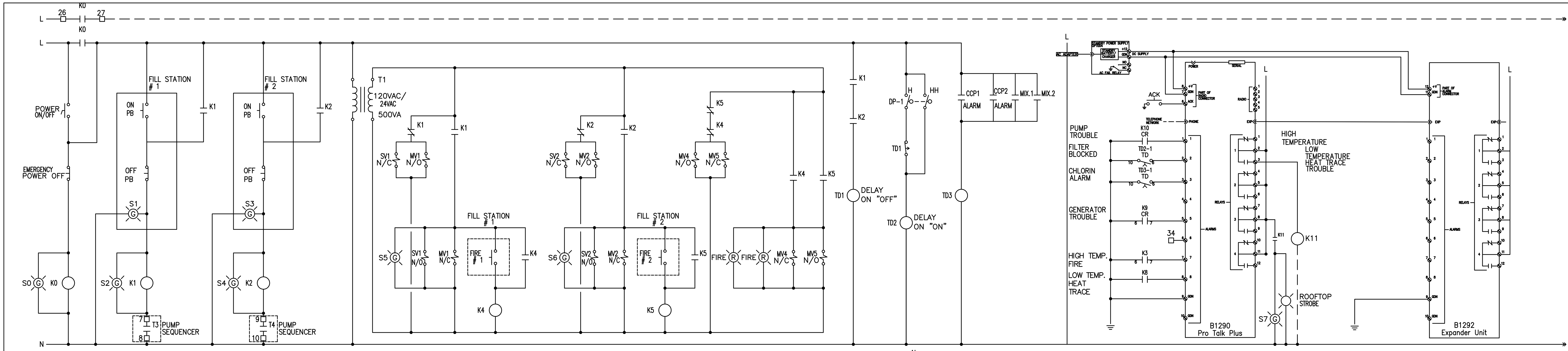
CHIARELLI ENGINEERING LTD.

Chapter 38 CONTROL

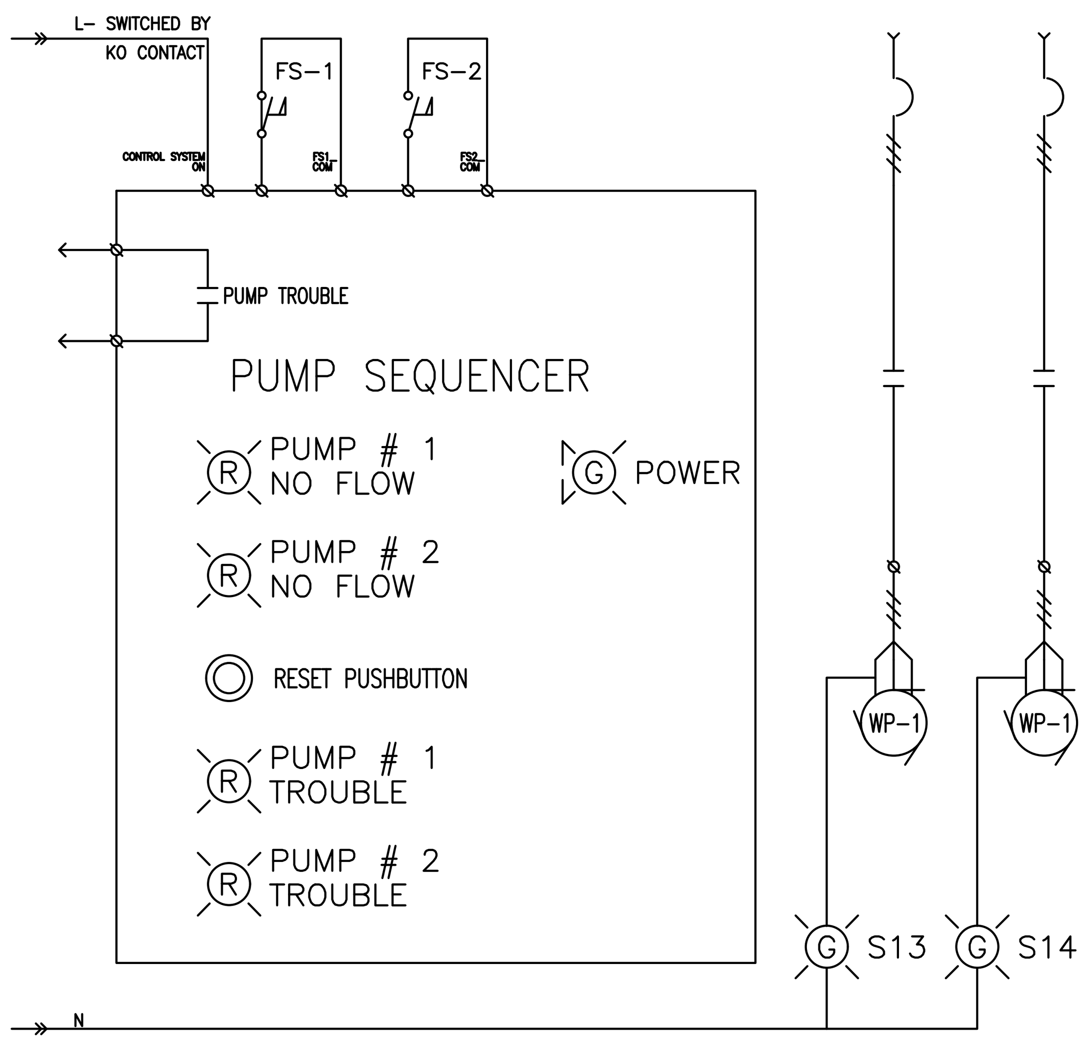
MANUFACTURER/DISTRIBUTOR:

DEVCAR INC
6 rue du Tutor
Lachute, QC
J8H 3R8
Phone: 450-562-7391
Fax: 450-562-7391

38.1 CONTROLS



1 / E5 PUMP CONTROL SYSTEM & ALARM SYSTEM LADDER LOGIC DIAGRAM
N/A



Alarms:

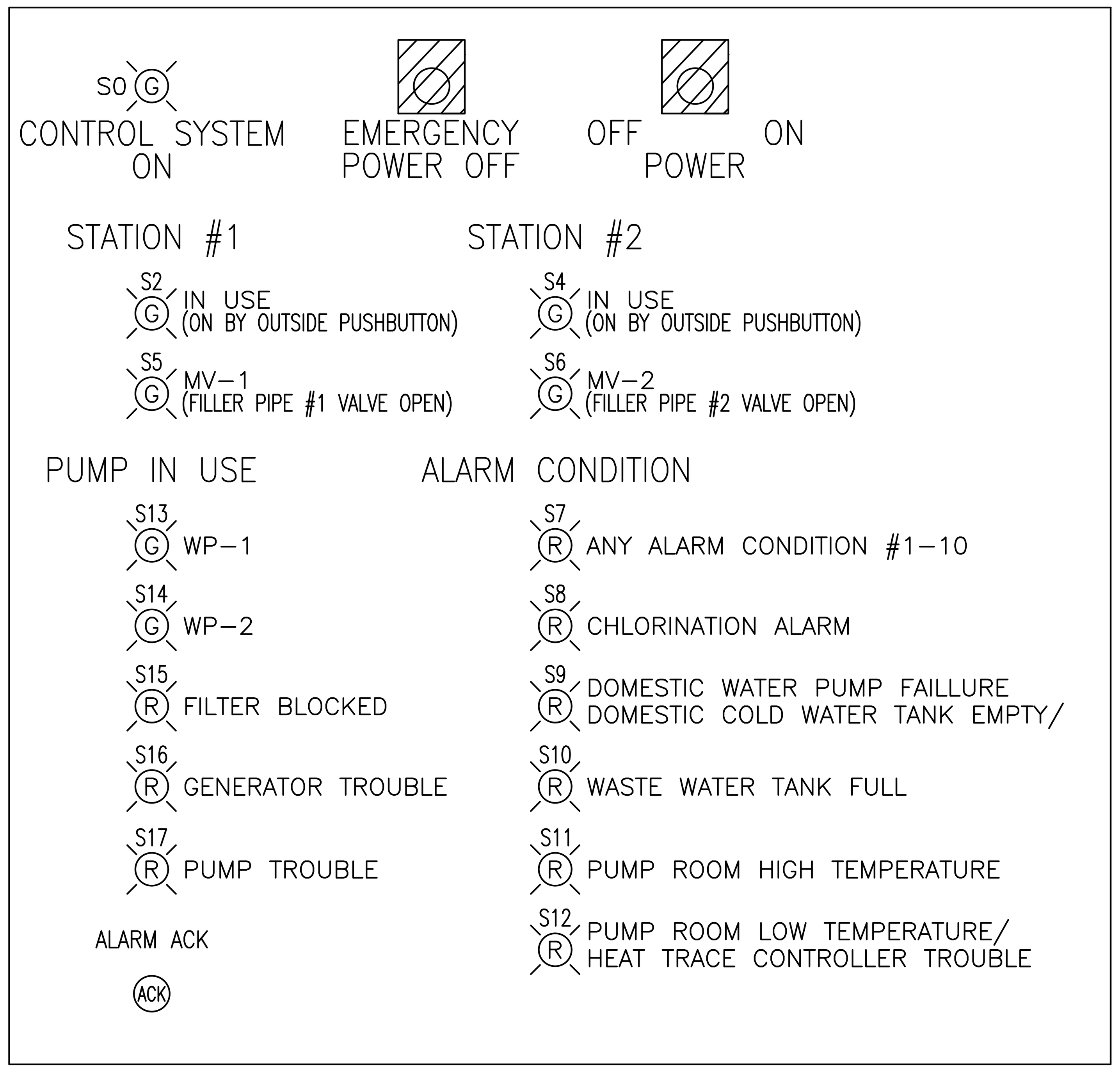
1- ALARM ACTIVATES IF A FLOW SWITCH (FS-1 OR FS-2) SENSE NO FLW IN 15 (ADJUSTABLE) SECONDS AFTER ITS RELEVANT PUMP (WP-1 OR WP-2, TIMER TD-1 AND TD-2) IS TURN ON
ACTION: CHECK THE PUMP CONTROLLER, DETERMINE WHICH PUMP FAILED AND WHY. REPAIR THE PROBLEM, RESET THE PUMP SEQUENCER AND ACKNOWLEG=DGE THE ALARM CONTROLLER.
2- ALARM ACTIVATES IF A DIFFERENTIAL PRESSURE SWITCH (DP-1) SENSES HIGHER THAN SET (H) (ADJUSTEBLE) PRESSURE ACROSS FILTERS IN 15 SECONDS (ADJUSTABLE) AFTER ONE PUMP IS TURNED ON. ALARM ACTIVATES IF A DIFFERETIAL PRESSURE METER (DP-1) SENSE HIGHER THAN SET H/H (ADJUSTABLE) PRESSURE ACROSS FILTERS IN 15 SECONDS (ADJUSTABLE) AFTER TWO PUMPS ARE TURNED ON.
ACTION: CLEAN ALL 3 WATER FILTRES, ONE AT THE TIME. ACKNOLEDGE ALARME CONTROLLER.
3- ALARM ACTIVATES IF EITHER CHLORINATION CONTROLLER PANNRLS CCP1 OR CCP2 SENSES OUT-OF-SPEC CONDICTION FOR 15 SECONDS (ADJUSTABLE).
ACTION: DETERMINE THE REASON FOR THE CHLORINATION CONTROLLER ALARM. FIX THE PROBLEM AND RESET THE CHLORINATION CONTROLLERS AND ACKNOLEDGE THE ALARM CONTROLLER.
4- ALARM ACTIVATES IF CHLORINE MIXING SYSTEM SENSES TROUBLE.
ACTION: CHECK THE CHLORINATION MIXING SYSTEM AND FIX THE PROBLEM. RESET THE CHLORINE MIXING SYSTEM AND ACKNOLEDGE ALAMR CONTROLLER.
5- ALARM ACTIVATES IF GENERATOR CONTROLLER SENSES OUT-OF-SPEC CONDITION WITH GENERATOR.
ACTION: CHECK THE GENERATOR CONTROLLER AND DETERMINE THE CAUSE FOR THE ALRM. FIS THE PROBLEM AND RESET THE GENERATOR CONTROLLER AND ACKNOLEDGE ALEARM CONTROLLER.
6- ALARM ACTIVATES IF NORMAL GRID POWER IS LOST AND AUTOMATIC TRANSFER SWITCH ENGAGES EMERGENCY GENERATOR.
ACTION: DETERMINE THE REASON WHY THE GENERATOR IS RUNNING. ENSURE THE GENERATOR HAS ENOUGH FUEL IF THE POWER OUTAGE IS PROLONGED. ACKNOLEDGE ALARM CONTROLLER.
7- ALARM ACTIVATES IF DOMESTIC COLD WATER STORAGE TANK(DCWST) LOW LEVEL FLOAT SWITCH (LS-DCW)DETECTS LOW WATER LEVEL. THIS ALARM IS ONLY A LOCAL ALARM.
ACTION: ARRANGE TO RE-FILL THE DCWST AND ACKNOLEDGE THE ALARM.
8- ALARM ACTIVATES IF WASTE WATER STORAGE TANK (WWST) HIGH LEVEL FLOAT SWITCH (LS-WW) DETECTS HIGH WATER LEVEL. THIS ALARM IS ONLY A LOCAL ALARM.
ACTION: ARRANGE TO PUMP OUT THE WWST AND ACKNOLEDGE THE ALARM.
9- ALARM ACTIVATES IFANY OF THE ROOM FIRE ALARM HEAT DETECTORS (SD-1,-2 OR -3) SENSE HIGH ROOM TEMPERATURE.
ACTION: DETERMINE THE REASON FOR THE HIGH TEMPERATURE. FIX THE PROBLEM. ACKNOLEDGE THE ALARM.
10- ALARM ACTIVATES IF THE ROOM THERMOSTAT (TS-2) SENSES LOW ADJUSTABLE ROOM TEMPERATURE OR IF ANY OF THE 2 HEAT TRACE CONTROLLERS SENSES TROUBLE WITH THE HEAT TRACE CABLES.
ACTION: DETERMINE WHAT IS CAUSING THE ALARM. TAKE APPRPRIATE ACTION(A) PROVIDE TEMPORARY HEAT SOURCE FOE THE PUMP ROOM IF THE ROOM TEMPERATURE FALLS BELOW SET POINT (10°C ADJUSTABLE), OR (B) DETERMINE WHICH HEAT TRACE CONTROLLER ALARMED AND TAKE ACTION TO FIX THE PROBLEM. ACKNOLEDGE THE ALARM.

ALARM REPORTING UNIT RELAYS:

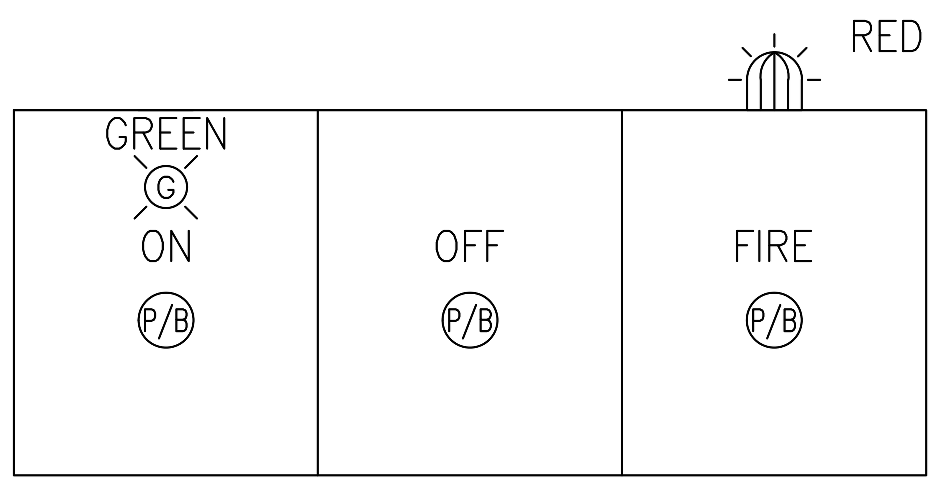
1- PROGRAMMED TO TURN "ON" WITH ANY OF THE 1-10 ALARM INPUTS TURN "ON" AN OUTDOOR STROBE BEACON LOCATED OUTSIDE THE PUMP STATION TO DISPLAY THAT THE PUMP STATION REQUIRES ATTENTION. TURN "ON" AN INDICATOR LIGHT ON THE MAIN LABELED "ANY ALARM CONDITION #1-10".

PUMP SEQUENCER OPERATION:

BY DEPRESSING THE "ON" PUSHBUTTON AT FILL STATION #1 OR #2 (SEQUENCER INPUT CONTACTS S1ON OR S2ON) THE SEQUENCER STARTS THE "NEXT" PUMP WITH THE DELAYS OF 3 SECONDS. DEPRESSING THE SAME "ON" PUSHBUTTON AGAIN WILL DO NOTHING UNTIL THE RELEVANT "OFF" BUTTON IS PRESSED. ONCE THE PUMP IS RUNNING, IT CAN BE TURNED "OFF" BY DEPRESSING THE "OFF" PUSH BUTTON (SEQUENCER INPUT CONTACTS S1OFF OR S2OFF) AT THE INITIATING FILL STATION. DEPRESSING THE SAME "OFF"PUSHBUTTON AGAIN WILL DO NOTHING. BASED ON THE ABOVE, 1 OR 2 PUMPS CAN RUN SIMULTANEOUSLY.
THE SEQUENSER OF THE "NEXT PUMP" IS WP-1 -> WP-2 -> WP-1 -> WP-2 -> ETC....
FLOW SWITCHES WILL PROVIDE FEEDBACK SO THAT WHEN A PUMP IS TURNED "ON" IT ACTUALLY DELIVERS WATER. THE "NEXT" PUMP "ON". THIS WILL CAUSE THE AFFECTED PUMP TO BE TAKEN OUT FROM THE SEQUENCER OF THE "NEXT PUMP". IT WILL ALSO TURN "ON" A "PUMP # TROUBLE" ALARM LIGHT AND TURN "ON" A SET OF DRY OUTPUT ALARM CONTACTS "PUMP TROUBLE". LATCHING OF A FAILED PUMP "OFF" CAN BE RESET BY DEPRESSING A "RESET" BUTTON ON THE PUMP SEQUENCER.



2 / E5 PUMP CONTROL SYSTEM PANEL BOARD LAYOUT
N/A



CONTROLS TO BE PLACED ON FILL ARM IN MID-ROAD LOCATION FOR BOTH TRUCK FILL SPOTS

3 / E5 FILL ARM CONTROL BOX LAYOUT
N/A

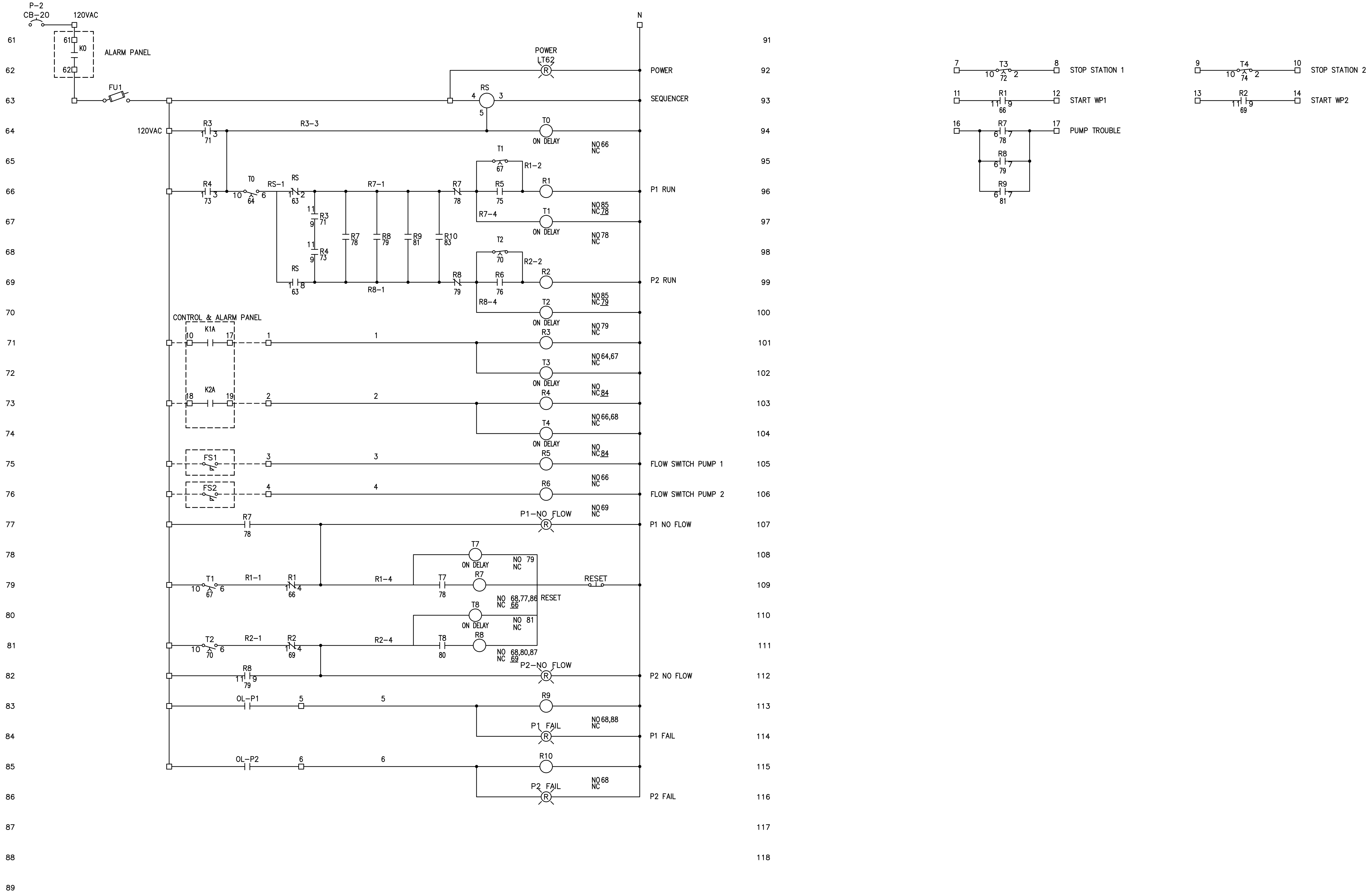
ALARM REPORTING UNIT			
ALARM #	ALARM DESCRIPTION	ALARM CONDITION	ALARM GENERATED BY
1	PUMP TROUBLE	NO FLOW WATER WHEN PUMP TURN ON	PUMP SEQUENCER & WATER PUMP FLOW SWITCHES FS-1--2
2	FILTER BLOCKED	INSUFFICIENT FLOW OF WATER WHEN PUMP IS RUNNING	DIFFERENTIAL PRESSURE SWITCH DP-1
3	CHLORINATION STOPPED	INSUFFICIENT FLOW OF CHLORINE WHEN CCP-1 OR CCP-2 IS RUNNING	CHLORINATION CONTROLLER PANEL CCP-1 OR CCP-2
4	CHLORINE FEED TROUBLE	CHLORINE MIXING SYSTEM TROUBLE	CHLORINE MIXING SYSTEM CMS-1 OR CMS-2
5	EMERGENCY GENERATOR TROUBLE	ANY OUT-OF-SPEC CONDITION	GENERATOR CONTROLLER
6	EMERGENCY GENERATOR RUNNING	NORMAL GRID POWER LOST	AUTOMATIC TRANSFER SWITCH ATS
7	WATER STORAGE TANK EMPTY	LOW LEVEL IN DOMESTIC COLD WATER STORAGE TANK	FRESH WATER STORAGE TANK LOW LEVEL FLOAT SWITCH LS-DCW
8	WASTE WATER TANK FULL	HIGH LEVEL IN WASTE WATER STORAGE TANK	WASTE WATER STORAGE TANK HIGH LEVEL FLOAT SWITCH LS-WW
9	PUMP STATION HIGH TEMPERATURE	HIGH PUMP STATION ROOM TEMPERATURE	3 ROOM HEAT DETECTORS HD-1--3
10	PUMP STATION LOW TEMPERATURE	LOW PUMP STATION ROOM TEMPERATURE	ROOM THERMOSTAT & 2 HEAT TRACE CONTROLLERS

REV.	DESCRIPTION	DATE	BY
0	ISSUED_FOR_APPROVAL	-	-
1	AS_BUILT	29/09/16	GF
2	---		

Controles OPTOINFO INC.
TEL:450-436-6050
FAX:450-436-4846
Canada, J7Z-2B1

PANGNIRTUNG, NUNAVUT
TRUCK FILL STATION

DRAWN BY: _ CHECKED BY: _	SCALE: NTS	SHEET NO 1 OF 4
CADD SYSTEM AutoCAD	DWG NO. PUMP CONTROL SYSTEM	CONTRACT -



REV.	DESCRIPTION	DATE	BY
0	ISSUED_FOR_APPROVAL	–	–
1	AS_BUILT	29/09/16	GF
2	---		

Controles OPTOINFO INC.
TEL:450-436-6050
FAX:450-436-4846
Canada, J7Z-2B1

PANGNIRTUNG, NUNAVUT
TRUCK FILL STATION

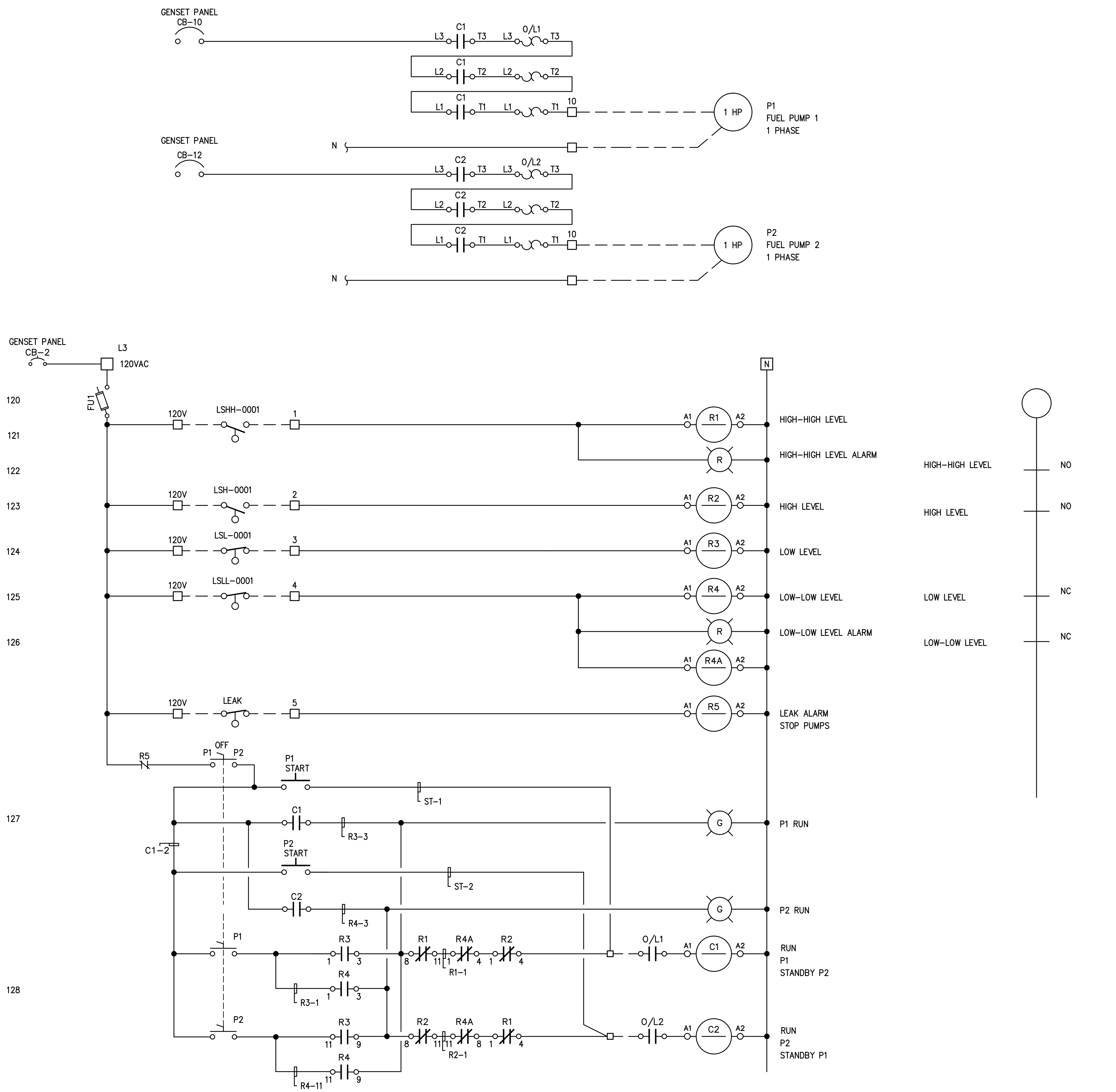
DRAWN BY: _ CHECKED BY: _	SCALE: NTS	SHEET NO 2 OF 4
CADD SYSTEM AutoCAD	DWG NO. PUMP SEQUENCER PANEL	CONTRACT -

REV.	DESCRIPTION	DATE	BY
0	ISSUED_FOR_APPROVAL	–	–
1	AS_BUILT	29/09/16	GF
2	---		

Controles OPTOINFO INC.
TEL:450-436-6050
FAX:450-436-4846
Canada, J7Z-2B1

PANGNIRTUNG, NUNAVUT
TRUCK FILL STATION

DRAWN BY: _
CHECKED BY: _
SCALE: NTS
SHEET NO 3 OF 4
CADD SYSTEM AutoCAD
DWG NO. PUMP CONTROL & ALARM SYSTEM
CONTRACT -



NOTE:
1. TO REPRIME, FOLLOWING OUTSIDE OIL SHORTAGE OR O.L. TRIP, HOLD AND MAINTAIN P1 AND P2 UNTIL CONTROL RESUME OPERATION.

REV.	DESCRIPTION	DATE	BY
0	ISSUED_FOR_APPROVAL	-	-
1	AS_BUILT	29/09/16	GF
2	---		

Controles
OPTOINFO INC.
TEL:450-436-6050
FAX:450-436-4846
Canada, J7Z-2B1

PANGNIRTUNG, NUNAVUT
FUEL CONTROL PANEL

DRAWN BY: _ CHECKED BY: _	SCALE: NTS	SHEET NO 4 OF 4
CADD SYSTEM AutoCAD	DWG NO. FUEL CONTROL SCHEMATICS	CONTRACT -

WATERTITE® Pushbutton Control for AC and DC Motors

Watertite® Pushbutton Control for AC and DC Motors are CSA certified and meet NEMA 1, 2, 3, 3R, 4, 4X, 6, 12, and 13, military specifications and OSHA requirements. It features a nylon MAX-LOC® (F2-1/2 in. NPT) cord grip with four grommets to accommodate cord sizes from .312–.625 O.D. The switches are a single speed, double throw, momentary contact type and can be wired normally-open or normally-closed. It also features a nylon enclosure and coverplate with rubber pushbutton diaphragm that provides water tight integrity. The 4052 PC consists of a 4052 pendant station with a 24VDC indicating light in the bottom position, five feet of #16/5 cord, and a Brad Harrison® 5 pole Mini-Change® connector. The parts call system provides a quick and effective means of communication for assembly-line manufacturing. Consult factory for more details or variations.

BEST SELLERS!

Pushbutton Pendant Control
• single speed

part no. 4052

Switch Characteristics

Contact Arrangement: Single speed SPDT-DB	
Continuous 10A @ 125 TO 250VAC 1/2 HP @ 125VAC 3/4 HP @ 250VAC 1 HP @ 125VAC OR 250VAC 7A 28VDC IND. 10A 28VDC RES.	Control 120VAC 60A MAKE 6A BREAK 240VAC 30A MAKE 3A BREAK A-300 CONTACT RATING PER U.L. STD. 508

Pushbutton Pendant Controls

PART NO.	DESCRIPTION	CORD DIAMETER RANGE
4052	2-BUTTON SINGLE SPEED	0.312-0.625"
4052PC	PARTS CALL SYSTEM PENDANT	0.250-0.625"

Wire Mesh Grip Kit For Pendant Station, Plastic Nut

PART NO.	NUT	MESH	SIZE	CORD DIA. RANGE
5630M	PLASTIC	STAINLESS STEEL	F2	0.312-0.375"
5630NM	PLASTIC	NON-METALLIC	F2	0.312-0.375"
5631M	PLASTIC	STAINLESS STEEL	F2	0.375-0.437"
5631NM	PLASTIC	NON-METALLIC	F2	0.375-0.437"
5632M	PLASTIC	STAINLESS STEEL	F2	0.437-0.500"
5632NM	PLASTIC	NON-METALLIC	F2	0.437-0.500"

Replacement Parts

PART NO.	DESCRIPTION
42-2190	REPLACEMENT SWITCH – ONE SPEED, MOMENTARY SWITCH
00-5150	RUBBER SWITCH DIAPHRAGM
31-5800	LEGEND KIT – LABELS: FUNCTION, PUSHBUTTON STATION
105002A01F060	6' OF #16/5 CORD AND BRAD HARRISON 5 POLE MINI-CHANGE® CONNECTOR

Pushbutton Pendant Control
• parts call system pendant

part no. 4052pc

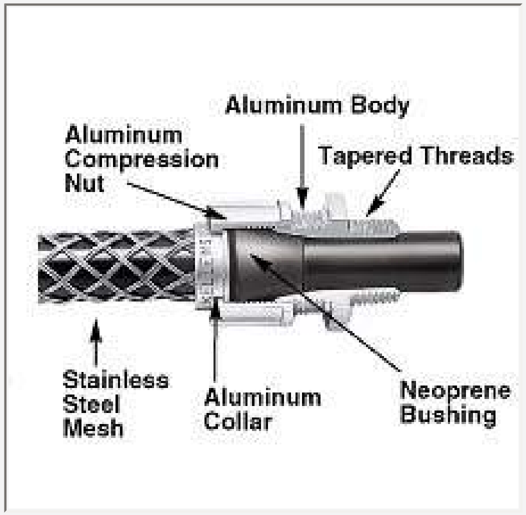
MOST WOODHEAD PRODUCTS HAVE U.L. AND/OR CSA APPROVALS.
FOR A LISTING OF APPROVALS BY PART NUMBER, SEE PAGES 262-269.

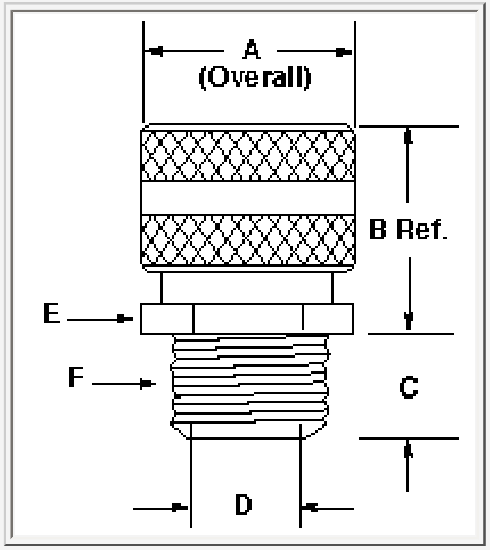
07401008 -- Deluxe Cord Grips

Deluxe Cord Grips completely eliminate pull tension on terminals, control cable arc-of-bend, prevent cord pull-out, and provide a liquidtight seal. They are offered with either aluminum, stainless steel or nylon fittings.

Product Specifications	
Product Type	Deluxe Cord Grips
Thread Type	N.P.T.
Grip Style and Material	Straight Aluminum Connector Stainless Grip
Grip Cord Range (Diameter)	.375"- .500" (.95- 1.27)
Grip Thread Size	1/2"
Deluxe Grip Form Size	F2
Operating Temperature	-30°F to +225°F (-34°C to +107°C)
Mesh Grip Flammability Rating	UL 94-HB
Fitting Flammability Rating	UL 94-V2
Recommended Knockout Hole Size	.859 to .906 (2.18 to 2.30)
Hazardous Locations	Suitable for use in hazardous locations per Class I, Div. 2, Class II, Div. 1 & 2, Class III, Div. 1 & 2.
Dimension A	1.13" (2.87) Dia.

Dimension B	1.10" (2.79) Ref.
Dimension C	.55" (1.40)
Dimension D	.64" (1.63) Throat Dia.
Dimension E A/C	1.11" (2.82)
Dimension E A/F	1.00" (2.54)
Dimension F	1/2" - 14
Certifications	UL Listed CSA Certified
M Drawings	Click here for M-Drawing
Catalog Page	Click here for catalog page T60
Catalog Section	Click here for Section-T
UPC Number	78358532189
Weight in LBs	0.3

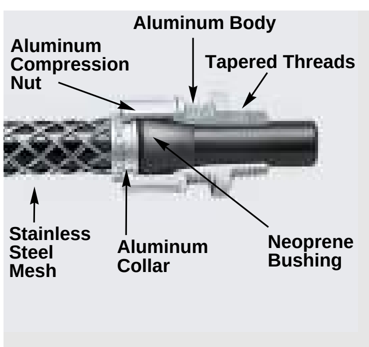



A
(Overall)
B Ref.
E
F
C
D

Strain Relief
Deluxe Cord Grips
Aluminum Fittings, Stainless Steel Mesh, Liquidtight, for Insulated Cables

Read This Data
It is important that you read all breaking strength, safety and technical data relating to this product on pages T-68 through T-74.

Straight Male



Straight Male Thread

Grip Diameter Range Inches	(cm)	Thread Size N.P.T. (Inches)	Form Size	Catalog Numbers
.250”-.312”	(.63-.79)	3/8”	F1	**07401001**
.312”-.375”	(.79-.95)			**07401002**
.375”-.437”	(.95-1.11)			**07401003**
.187”-.250”	(.47-.63)	1/2”	F2	**07401004**
.250”-.375”	(.63-.95)			**07401006**
.375”-.500”	(.95-1.27)			**07401008**
.500”-.625”	(1.27-1.59)			**07401010**
.625”-.750”	(1.59-1.90)	1/2”	F3	**074011247***
.750”-.875”	(1.90-2.22)			**074011248***
.187”-.250”	(.47-.63)	3/4”	F2	**07401011**
.250”-.375”	(.63-.95)			**07401013**
.375”-.500”	(.95-1.27)			**07401015**
.500”-.625”	(1.27-1.59)			**07401017**
.625”-.750”	(1.59-1.90)	3/4”	F3	**07401018**
.750”-.875”	(1.90-2.22)			**074011249***
.375”-.500”	(.95-1.27)	1”	F4	**074011195**
.500”-.625”	(1.27-1.59)			**07401019**
.625”-.750”	(1.59-1.90)			**07401021**
.750”-.875”	(1.90-2.22)			**07401023**
.875”-1.000”	(2.22-2.54)			**07401025**
1.000”-1.125”	(2.54-2.86)			**074011250***
1.125”-1.250”	(2.86-3.17)	1”	F5	**074011028***
1.250”-1.375”	(3.17-3.49)			**074011029***
.750”-.875”	(1.90-2.22)	1 1/4”	F5	**074011251**
.875”-1.000”	(2.22-2.54)			**07401026**
1.000”-1.125”	(2.54-2.86)			**07401027**
1.125”-1.250”	(2.86-3.17)			**07401028**
1.250”-1.375”	(3.17-3.49)			**074011178***
.750”-.875”	(1.90-2.22)	1 1/2”	F5	**074011252**
.875”-1.000”	(2.22-2.54)			**07401029**
1.000”-1.125”	(2.54-2.86)			**07401030**
1.125”-1.250”	(2.86-3.17)			**07401031**
1.250”-1.375”	(3.17-3.49)			**07401032**
1.312”-1.437”	(3.33-3.65)	1 1/2”	F6	**074011253**
1.437”-1.562”	(3.65-3.97)			**074011254***
1.562”-1.687”	(3.97-4.28)			**074011255***
1.687”- 1.812”	(4.28-4.60)			**074011256***
1.750”-1.875”	(4.44-4.76)			**074011257***
1.250”-1.375”	(3.17-3.49)	2”	F6	**074011258**
1.312”-1.437”	(3.33-3.65)			**074011259**
1.437”-1.562”	(3.65-3.97)			**07401033**
1.562”-1.687”	(3.97-4.28)			**07401034**
1.687”-1.812”	(4.28-4.60)			**07401035**
1.750”- 1.875”	(4.44-4.76)			**074011260**
1.812”-1.937”	(4.60-4.92)	2”	F7	**074011261**
1.937”-2.062”	(4.92-5.24)			**074011262***
2.062”-2.187”	(5.24-5.55)			**074011263***
2.187”-2.312”	(5.55-5.87)			**074011264***
2.312”-2.437”	(5.87-6.19)			**074011265***
1.688”-1.812”	(4.29-4.60)	2 1/2”	F7	**074011030**
1.812”-1.937”	(4.60-4.92)			**074011031**
1.937”-2.062”	(4.92-5.24)			**074011032**
2.062”-2.187”	(5.24-5.55)			**074011033**
2.187”-2.312”	(5.55-5.87)			**074011034**
2.312”-2.437”	(5.87-6.19)			**074011266***
1.937”-2.062”	(4.92-5.24)	3”	F7	**074011036**
2.062”-2.187”	(5.24-5.55)			**074011037**
2.187”-2.312”	(5.55-5.87)			**074011038**
2.312”-2.437”	(5.87-6.19)			**074011039**
2.437”-2.625”	(6.19-6.67)	3”	F8	**074011186**
2.625”-2.812”	(6.67-7.14)			**074011187**
2.812”-3.000”	(7.14-7.62)			**074011188**
3.000”-3.250”	(7.62-8.25)			**074011189***

Cable jacket may have to be stripped to pass through connector body.

Kellems® Deluxe Cord Grips are suitable for use in hazardous locations per Class I Div. 2, Class II Div. 1 & 2, Class III Div. 1 & 2 of the National Electric Code Sections 501-4(b), 502-4(a), 502-4(b), 503-3(a) and 503 3(b).