

Chapter 29 SUBMERSIBLE PUMP STARTER (VFD)

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 ABB VFD DRIVE



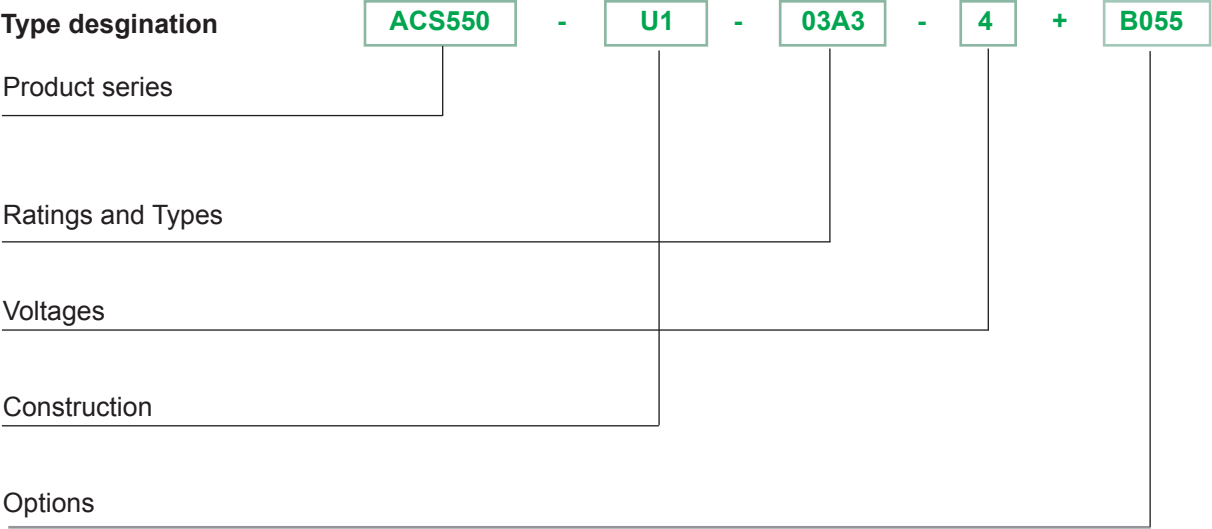
ABB low voltage drives ACS550, 0.75 - 550 Hp Technical Catalog

Selecting and ordering your drive

Type designation is a unique reference number that clearly identifies the drive by construction, power and voltage rating and selected options. Using the type designation you can specify your drives from the wide range of options available. Options are added to the type designation using the corresponding “plus” (+) code.

Build up your own ordering code using the type designation key below or contact your local ABB drives sales office and let them know what you want. Use page 3 as a reference section for more information.

ACS550-U1-088A-2



ACS550

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Introduction to ACS550

ACS550 - U1 - 03A3 - 4 + B055

What is the ACS550 Customer Value?

- Reduced commissioning and installation costs
 - Many assistants including Start-up, Drive Optimizer, Real-time Clock, Diagnostics, Maintenance, Serial and PID.
 - Two soft-keys that change according to the operator panel state
 - Field upgradeable firmware
 - Easy connection of cables
 - New conduit box is suitable for US and Europe
 - Built-in brake chopper (10Hp, 230V / 15Hp, 480V and 600 V)
 - Optional plug-in fieldbus modules
 - Reduced size and weight with Patented Swinging Choke (R1-R6) - equivalent to a 5% Line Impedance
 - 3% Impedance AC Line Reactor (R8)
 - Removable operator panel
 - Only Class T fuses required for high speed short circuit protection
 - NEMA 12 enclosure does not require derating
 - Smaller physical size of internal option slots
 - FlashDrop programming (unpowered drive)
- Reduced energy costs without power factor penalties and correction capacitors
 - Patented swinging choke provides substantially reduced harmonics, more inductance to the correct load and higher power factor
 - Up to 25% less THD v. traditional DC choke
 - Daily timer controls for time-of-day backoff e.g. start/stop process changes
- Reduced Drive-Motor system failures and costs
 - Preventative “Maintenance Assistant” annunciation feature schedules Drive-Motor system maintenance

The ABB ACS550 AC drive combines a sophisticated micro-processor with an advanced IGBT power switching technology to deliver V/Hz, Closed Loop Flux Vector and Sensorless Vector control of AC motors. Its intuitive control panel offers numerous benefits making it the most user-friendly panel in the drives industry. The extensive library of pre-programmed application macros maximizes convenience and minimizes start-up time. This drive can handle the most demanding industrial applications in an efficient, dependable and economic manner.

Where can it be used?

The ABB ACS550 standard drive can be used in a wide range of industries. Typical applications include pump, fan and constant torque use, such as conveyors. The ABB ACS550 standard drive is ideal for those situations where there is a need for simplicity to install, commission and use and where customizing or special product engineering is not required.

ABB ACS550 standard drive promises

- Quick delivery
- Easy installation
- Trouble-free start-up
- Intuitive operation

Highlights:

- Advanced control panel permitting intuitive operation
- Patented swinging choke for superior harmonic reduction (R1-R6) and AC line reactor (R8)
- Sensorless vector control
- Integral EMC filter as standard
- Built-in Modbus RTU and numerous internally mountable fieldbus adapters
- FlashDrop
- Coated boards for harsh environments
- UL, cUL, C-Tick and Gost-R approved
- Built-in brake chopper (10Hp, 230V / 15Hp, 480V and 600 V)
- Many assistants including Start-up, Drive Optimizer, Real-time Clock, Diagnostics, Maintenance, Serial and PID
- Seismic Certification to ICC AC-156 Criteria

Main features

Feature	Note	Benefit
Advanced Control Panel	Two soft-keys change according to the state of the panel Built-in "Help" button Real-time clock, allows timed tracing of faults and setting of parameters at various times of day Changed parameter menu	Easy commissioning Fast set-up Easier configuration Rapid fault diagnostics Quick access to recent parameter changes
Brake Chopper	Built-in up to 15 Hp (480 and 600V) and up to 10 Hp (240V)	Reduced installation cost
Chokes	5% equivalent impedance swinging choke-matches the right inductance to the right load, suppressing and reducing harmonics (R1-R6), 3% impedance AC line reactor (R8)	Reduces Total Harmonic Distortion (THD) emissions up to 25%
Connectivity	Simple to install: Easy connection of cables Easy connection of external fieldbus systems through multiple I/Os and plug-in options	Reduced installation time Secure cable connections
Assistants (v3.11a+)	Diagnostic assistant activated when fault occurs Maintenance assistant monitors running hours or motor rotation Start-up assistant guides user through all essential settings without going to parameter list and offers option for parameter backup automatically PID Controller assistant guides user set-up without going to parameter list Real-time clock assistant helps user adjust time and date functions Serial communications assistant provides a convenient way to set-up fieldbus connections Drive optimizer permits user to choose drive set-up for low noise, drive & motor efficiency or motor control accuracy	Quick fault diagnostics Takes care of drive preventative maintenance Easy set-up of parameters Simplifies closed loop process control adjustment Allows quick adjustment of time and date Provides easy set-up of fieldbus connectivity Quickly tailors drive to application
Built-in EMC	Built-in category C2 (1st environment) filter	No need for external filtering
Sensorless vector control	Improve motor control performance	Enables wider range of applications
Switching frequency control	Permits the highest possible switching frequency based on operating and ambient conditions	Considerable motor noise reduction and improved efficiency
Flashdrop	Faster and easier drive set-up and programming	New fast, safe and trouble free method to download parameters available without powering the drive - patented
Coated boards	Longer lifetime in hostile environments. Reduced servicing requirements	Protections against moisture and hostile particles as standard
Flange Mounting Kits	Allows mounting the drive with the heatsink external to a 3rd party enclosure - frame size R1-R6.	Reduces heat and enclosure size

Ratings, Types and Voltages

Type code

This is the unique reference number that clearly identifies the drive by mounting configuration, power rating and voltage. Once you have selected the type code, the frame size can be used to determine the drives dimensions, shown on the next page.

Voltages

The ACS550 is available in three voltage ranges:

2 = 208 - 240V

4 = 380 - 480V

6 = 500 - 600V

Notes

1. I_{2N} : continuous base current with 110% overload for 1 minute / 10 minutes.
2. I_{2hd} : continuous base current with 150% overload for 1 minute / 10 minutes.
3. 180% I_{hd} continuous base current available for 2 seconds / 1 minute.
4. The rated current of the ACS550 must be greater than or equal to the rated motor current to achieve the rated motor power given in the table.
5. All -U1 models come with a conduit box and advanced control panel as standard.
6. Horsepower is based on NEMA motor ratings for most 4-pole motors (1800 rpm). Check motor nameplate current for compatibility.
7. All 230V product can be operated on 230V single-phase power, using a de-rate of the output current of 50%.
8. All -U2 models come standard with US conduit openings, top entry / top exit, common mode filter for drives larger than 200 HP, fused disconnect and extended enclosure with advanced control panel.

Type Code UL Type 1 NEMA 1 ^(5,8)	Nominal Ratings				Frame Size
	Normal Duty (CT) (110% I _{2N})		Heavy Duty (CT) (150% I _{2hd})		
	I _A ^{2N} ^(1,7)	P _{HP} ^N ^(4,6)	I _A ^{2hd} ^(2,3,7)	P _{HP} ^{hd} ^(4,6)	
ACS550-U1-04A6-2	4.6	1.0	3.5	0.75	R1
ACS550-U1-06A6-2	6.6	1.5	4.6	1.0	R1
ACS550-U1-07A5-2	7.5	2.0	6.6	1.5	R1
ACS550-U1-012A-2	11.8	3.0	7.5	2	R1
ACS550-U1-017A-2	16.7	5.0	11.8	3	R1
ACS550-U1-024A-2	24.2	7.5	16.7	5	R2
ACS550-U1-031A-2	30.8	10	24.2	7.5	R2
ACS550-U1-046A-2	46.2	15	30.8	10	R3
ACS550-U1-059A-2	59.4	20	46.2	15	R3
ACS550-U1-075A-2	74.8	25	59.4	20	R4
ACS550-U1-088A-2	88	30	74.8	25	R4
ACS550-U1-114A-2	114	40	88	30	R4
ACS550-U1-143A-2	143	50	114	40	R6
ACS550-U1-178A-2	178	60	150	50	R6
ACS550-U1-221A-2	221	75	178	60	R6
ACS550-U1-248A-2	248	100	192	75	R6
ACS550-U1-03A3-4	3.3	1.5	2.4	1	R1
ACS550-U1-04A1-4	4.1	2	3.3	1.5	R1
ACS550-U1-06A9-4	6.9	3	5.4	2	R1
ACS550-U1-08A8-4	8.8	5	6.9	3	R1
ACS550-U1-012A-4	11.9	7.5	8.8	5	R1
ACS550-U1-015A-4	15.4	10	11.9	7.5	R2
ACS550-U1-023A-4	23	15	15.4	10	R2
ACS550-U1-031A-4	31	20	23	15	R3
ACS550-U1-038A-4	38	25	31	20	R3
ACS550-U1-045A-4	44	30	38	25	R3
ACS550-U1-059A-4	59	40	44	30	R4
ACS550-U1-072A-4	72	50	59	40	R4
ACS550-U1-078A-4	77	60	65	50	R4
ACS550-U1-097A-4	96	75	77	60	R4
ACS550-U1-125A-4	124	100	96	75	R5
ACS550-U1-157A-4	157	125	124	100	R6
ACS550-U1-180A-4	180	150	156	125	R6
ACS550-U1-246A-4	245	200	192	150	R6
ACS550-U2-316A-4	316	250	240	200	R8
ACS550-U2-368A-4	368	300	302	250	R8
ACS550-U2-414A-4	414	350	368	300	R8
ACS550-U2-486A-4	486	400	414	350	R8
ACS550-U2-526A-4	526	450	477	400	R8
ACS550-U2-602A-4	602	500	515	450	R8
ACS550-U2-645A-4	645	550	590	500	R8
ACS550-U1-02A7-6	2.7	2	2.4	1.5	R2
ACS550-U1-03A9-6	3.9	3	2.7	2.0	R2
ACS550-U1-06A1-6	6.1	5	3.9	3.0	R2
ACS550-U1-09A0-6	9	7.5	6.1	5.0	R2
ACS550-U1-011A-6	11	10	9	7.5	R2
ACS550-U1-017A-6	17	15	11	10	R2
ACS550-U1-022A-6	22	20	17	15	R3
ACS550-U1-027A-6	27	25	22	20	R3
ACS550-U1-032A-6	32	30	27	25	R4
ACS550-U1-041A-6	41	40	32	30	R4
ACS550-U1-052A-6	52	50	41	40	R4
ACS550-U1-062A-6	62	60	52	50	R4
ACS550-U1-077A-6	77	75	62	60	R6
ACS550-U1-099A-6	99	100	77	75	R6
ACS550-U1-125A-6	125	125	99	100	R6
ACS550-U1-144A-6	144	150	125	125	R6

Construction

"U1" within the type code indicates the drive mounting configuration. U1 models are wall-mounted, while "U2" models are free-standing with an extended enclosure and fused disconnect. Choose the correct one for your needs from the table below:

U1

- Wall mounted, frame size R1-R6
- 0.75 - 200 HP
- UL Type 1 (IP21) NEMA 1 or UL Type 12 (IP54) NEMA 12
- Built-in EMC filter
- Standard software
- Built-in Modbus RTU interface
- Cable connection box
- Brake chopper in frame sizes R1-R2
- Advanced control panel
- Swinging choke (Frames R1-R6)

U2

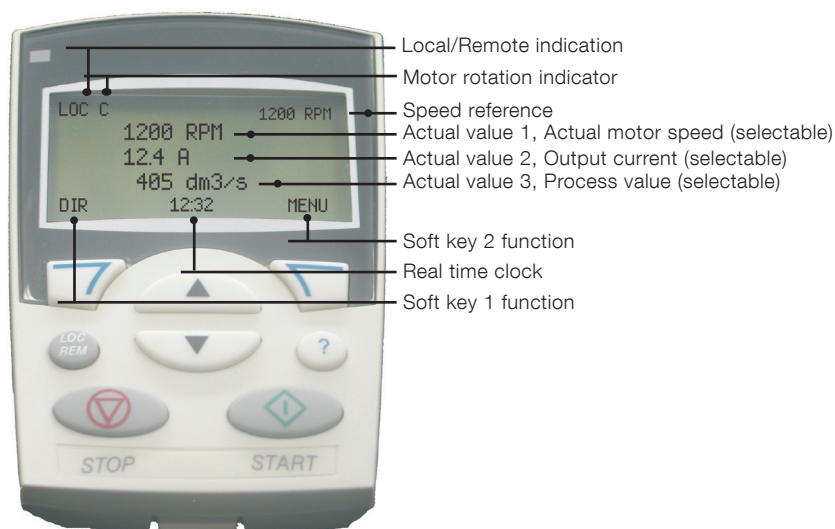
- Free standing, frame size R8
- 250 - 550Hp
- UL Type 1 (IP21) NEMA 1
- Standard software
- Built-in Modbus RTU interface
- Free-standing with extended enclosure and fused disconnect
- Advanced control panel
- AC Reactor (Frame R8)

Advanced Control Panel

For easy drive programming, a detachable, multilingual alphanumeric advanced control panel is delivered as standard. The control panel has various assistants and built-in help functions to guide the user. It includes a real time clock, which can be used during fault logging and in

controlling the drive, such as start/stop and maintenance reminders. The control panel can be used for copying parameters for back up or for downloading to another drive. A large graphical display and soft keys make it extremely easy to navigate.

	Name	Function
	Start	Initiates operation of drive
	Stop	Ceases operation of drive
	Up	Changes parameters and their value/ increases reference
	Down	Changes parameters and their value/ decreases reference
	Loc/Rem	Changes drive state from local control to remote control (I/O or other external source)
	HELP	Built-in "Help" button
	Soft key 1 Function	changes according to state of panel
	Soft key 2 Function	changes according to state of panel



Options

Control Interfaces

How to select options

The options shown below are available for use with the ACS550. Each item has a 4-digit option code, which is shown in the table below. This code is added to the end of the type code above using a '+'. Ordering options using the plus option code provides a factory installed option, while using the field kit code provides a field installable kit (-KIT).

Available options

Plus Option Code	Description	Field Kit Code
Protection class		
+B055	UL Type 12 (IP54) NEMA 12	
Slot 1 Options		
+L511	Relay Output Extension	OREL-01-KIT
+L502	Pulse Encoder Interface	OTAC-01-KIT
Slot 2 Options		
+L512	115/230V Digital Input Interface	OHDI-01-KIT
+K451	DeviceNet	RDNA-01-KIT
+K454	Profibus-DP	RPBA-01-KIT
+K462	ControlNet	RCNA-01-KIT
+K466	EtherNet/IP and Modbus/TCP	RETA-01-KIT
+K457	CANopen	RCAN-01-KIT
+K467	PROFINET and Modbus/TCP	RETA-02-KIT

NOTE:
- Only one option can be installed in each option slot.
- Embedded Modbus RTU

Panel Mounting Kit (OPMP-01)

The panel mounting kit, OPMP-01, enables mounting of control panels on cabinet doors. This kit includes a 10 ft (3 m) extension cable, a gasket, mounting screws and a mounting template.



ACS-CP-EXT: permits permanent mounting of panel to external surface of NEMA 1 or NEMA 12 enclosures.

ACS-CP-EXT-IP66: permits permanent mounting of panel to external surface of NEMA 4X enclosures.

DriveWindow Light 2 (3AFE64532871)

DriveWindow Light 2 is a PC software used for rapid commissioning, operating and programming of drives. It has features for programming, monitoring, troubleshooting and maintenance.

It is also a set-up and control tool which is Win98, WinNT, Win2000 and WinXP compatible.

DriveWindow Light 2 operates both off- and on-line. No additional PC hardware is required. It uses the PC's RS-232 port. It is also compatible with drive types ACS350, ACS800, DCS400 and DCS800.

DriveWindow Light 2 features:

- Graphical start-up wizards
- Off- and on-line viewing and changing of drive parameters
- Backup and restore parameters. In a fault situation, the parameters can be reloaded resulting in time savings
- Graphical monitoring of actual signal values
- I/O mapping table
- Control of the drive

DrivePM

DrivePM (Parameter Manager) is a software tool designed to create, edit and copy parameter sets included with a FlashDrop. For each parameter, and parameter group, the user can change the default or hide the parameter or entire group. FlashDrop does not require the drive to have power applied. FlashDrop is also compatible with the ACS150 and ACS350.

FlashDrop MFDT-01

FlashDrop is a powerful palm-sized tool for fast and easy parameter selecting and setting. This tool can be used to download parameters to a drive in less than three seconds. Using this tool, it is possible to hide selected parameters to protect the machine. Only parameters needed in the application are shown. FlashDrop does not require the drive to be powered. The MFDT-01 includes Drive PM (Drive Parameter Manager) software tool to create, edit and copy parameter sets.



FlashDrop
(MFDT-01)

Options

Plug-in Options

Relay Output Extension Module (+L511)

This plug-in option offers three additional relay outputs. They can be used to actuate motor starters for pumps using a lead-lag alternation scheme with the built-in Pump-Fan Macro. All relays can be programmed to on/off by using the advanced control panel's clock. Alternatively, fieldbus adapters can be used to control any external components in the system.

Pulse Encoder Interface (+L502)

The Pulse Encoder Interface module offers a differential or single ended interface for a digital pulse encoder connection. The module is capable of operating from either a 15 or 24 VDC signal with a maximum frequency of 200kHz.

115/230V Digital Input Interface (+L512)

The 115/230V Digital Input Interface module offers six (6) 115V or three (3) 230V rated relays mounted on a common board used to drive DI1 through DI6 of the ACS550. The 115/230V must be provided by the user. The module cannot be used in conjunction with any fieldbus module as it occupies the same option slot.

Plug-in Fieldbus Modules

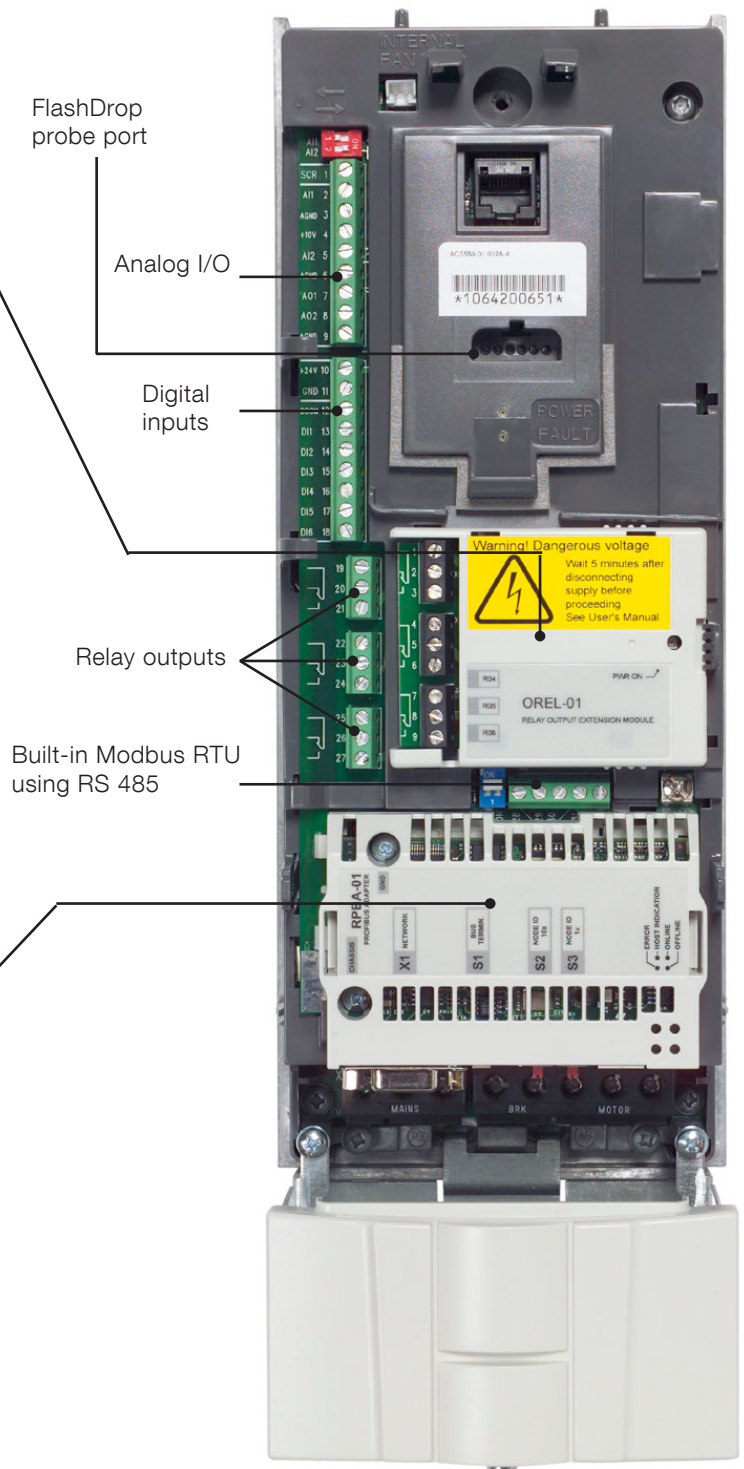
The plug-in fieldbus options bring connectivity to major automation systems. A single twisted pair avoids large amounts of conventional cabling, thereby reducing cost and increasing system reliability.

The ACS550 supports the following fieldbus options:

- CANopen
- ControlNet™
- DeviceNet™
- Embedded Modbus® RTU
- EtherNet/IP™ Modbus/TCP®
- Profibus-DP®
- PROFINET IO®

NOTE:

- Only one option can be installed in each option slot.



Options

External Options

Brake Units and Choppers

Frame sizes R1 to R2 are delivered with integrated brake choppers as standard. Other units can use an external brake chopper and resistor. For more information, please refer to the ABB Low Voltage Drives PowerOhm Resistors Price List. (LVD-PNPL02U-EN).

Flange Mounting Kits

Flange Mounting Kits for the ACS550 drives allow mounting of the drive with the heatsink external to a 3rd party enclosure. Use of the flange kit requires removal of the drive cover, reducing protection to IP00. The flange kit can be used with 3rd party UL Type 1 & 12 (NEMA 1 & 12) enclosures. R5 and R6 kits provide NEMA 1 protection only.

Flange Mounting Kits

Frame Size	Field Kit Code
R1	FMK-A-R1
R2	FMK-A-R2
R3	FMK-A-R3
R4	FMK-A-R4
R5	AC8-FLNGMT-R5
R6	AC8-FLNGMT-R6

Technical Data

Cooling

Cooling Air Flow 208 - 240V Units

Type Code	Frame Size	W	BTU/Hr	m³/h	ft³/min
-04A6-2	R1	55	189	44	26
-06A6-2	R1	73	249	44	26
-07A5-2	R1	81	276	44	26
-012A-2	R1	118	404	44	26
-017A-2	R1	161	551	44	26
-024A-2	R2	227	776	88	52
-031A-2	R2	285	973	88	52
-046A-2	R3	420	1434	134	79
-059A-2	R3	536	1829	134	79
-075A-2	R4	671	2290	280	165
-088A-2	R4	786	2685	280	165
-114A-2	R4	1014	3463	280	165
-143A-2	R6	1268	4331	405	238
-178A-2	R6	1575	5379	405	238
-221A-2	R6	1952	6666	405	238
-248A-2	R6	2189	7474	405	238

Cooling Air Flow 500 - 600V Units

Type Code	Frame Size	W	BTU/Hr	m³/h	ft³/min
-02A7-6	R2	46	157	88	52
-03A9-6	R2	68	232	88	52
-06A1-6	R2	124	423	88	52
-09A0-6	R2	170	581	88	52
-011A-6	R2	232	792	88	52
-017A-6	R2	337	1150	88	52
-022A-6	R3	457	1560	134	79
-027A-6	R3	562	1918	134	79
-032A-6	R4	667	2276	280	165
-041A-6	R4	907	3096	280	165
-052A-6	R4	1120	3820	280	165
-062A-6	R4	1295	4420	280	165
-077A-6	R6	1504	5136	405	238
-099A-6	R6	1821	6219	405	238
-125A-6	R6	2442	8339	405	238
-144A-6	R6	2813	9607	405	238

Cooling Air Flow 380 - 480V Units

Type Code	Frame Size	W	BTU/Hr	m³/h	ft³/min
-03A3-4	R1	40	137	44	26
-04A1-4	R1	52	178	44	26
-06A9-4	R1	97	331	44	26
-08A8-4	R1	127	434	44	26
-012A-4	R1	172	587	44	26
-015A-4	R2	232	792	88	52
-023A-4	R2	337	1151	88	52
-031A-4	R3	457	1561	134	79
-038A-4	R3	562	1919	134	79
-045A-4	R3	667	2278	134	79
-059A-4	R4	907	3098	280	165
-072A-4	R4	1120	3825	280	165
-078A-4	R4	1300	4300	280	165
-097A-4	R4	1440	4918	280	165
-125A-4	R5	1940	6625	350	205
-157A-4	R6	2310	7889	405	238
-180A-4	R6	2810	9897	405	238
-246A-4	R6	3850	13148	540	318
-316A-4	R8	4550	15539	1220	718
-368A-4	R8	6850	23394	1220	718
-414A-4	R8	7400	25000	1220	718
-486A-4	R8	7850	26809	1220	718
-526A-4	R8	7600	25955	1220	718
-602A-4	R8	8100	27663	1220	718
-645A-4	R8	9100	31078	1220	718

ACS550 are configured with cooling air fans. The cooling air must be free from corrosive materials with a maximum ambient temperature of 40oC (50oC with derating).

Free space requirements

Enclosure Type	Space above mm / in	Space below mm / in	Space on left and right mm / in
U1 - Wall Mount	200 / 7.9	200 / 7.9	0
U2 - Floor Mount	200 / 7.9	0	0

Technical Data

Fuse connections

Standard fuses can be used with ABB standard drives. For fuse connections see table below.

Recommended input protection fuses

Type Code	Frame Size	Input Current A	Mains Fuses	
			IEC269 gG (A)	UL Class T (A)
-04A6-2	R1	4.6	10	10
-06A6-2	R1	6.6	10	10
-07A5-2	R1	7.5	10	10
-012A-2	R1	11.8	16	15
-017A-2	R1	16.7	25	25
-024A-2	R2	24.2	25	30
-031A-2	R2	30.8	40	40
-046A-2	R3	46.2	63	60
-059A-2	R3	59.4	63	80
-075A-2	R4	74.8	80	100
-088A-2	R4	88.0	100	110
-114A-2	R4	114.0	125	150
-143A-2	R6	143.0	200	200
-178A-2	R6	178.0	250	250
-221A-2	R6	221.0	315	300
-248A-2	R6	248.0	315	350
-03A3-4	R1	3.3	10	10
-04A1-4	R1	4.1	10	10
-06A9-4	R1	6.9	10	10
-08A8-4	R1	8.8	10	15
-012A-4	R1	11.9	16	15
-015A-4	R2	15.4	16	20
-023A-4	R2	23.0	25	30
-031A-4	R3	31.0	35	40
-038A-4	R3	38.0	50	50
-045A-4	R3	44.0	50	60
-059A-4	R4	59.0	63	80
-072A-4	R4	72.0	80	90
-078A-4	R4	77.0	80	100
-097A-4	R4	96.0	125	125
-125A-4	R5	124.0	160	175
-157A-4	R6	157.0	200	200
-180A-4	R6	180.0	250	250
-246A-4	R6	245.0	250	250
-316A-4	R8	316.0	400	400
-368A-4	R8	368.0	400	400
-414A-4	R8	414.0	500	500
-486A-4	R8	486.0	500	500
-526A-4	R8	526.0	630	630
-602A-4	R8	602.0	630	630
-645A-4	R8	645.0	800	800
-02A7-6	R2	2.7	10	10
-03A9-6	R2	3.9	10	10
-06A1-6	R2	6.1	10	10
-09A0-6	R2	9.0	16	15
-011A-6	R2	11.0	16	15
-017A-6	R2	17.0	25	25
-022A-6	R3	22.0	25	25
-027A-6	R3	27.0	35	40
-032A-6	R4	32.0	35	40
-041A-6	R4	41.0	50	50
-052A-6	R4	52.0	60	60
-062A-6	R4	62.0	80	80
-077A-6	R6	77.0	80	100
-099A-6	R6	99.0	125	150
-125A-6	R6	125.0	160	175
-144A-6	R6	144.0	200	200

Technical Specification

Input power connection	
Voltage and power range	3-phase, 208 to 240 V, +10/-15%, 0.75 - 100Hp 3-phase, 380 to 480 V, +10/-15%, 1 - 550Hp 3-phase, 500 to 600V, +10/-15%, 1.5 - 150Hp
Frequency	48 to 63 Hz
Power factor	0.98

Motor connection	
Voltage	3-phase, from 0 to U_{SUPPLY}
Frequency	0 to 500 Hz
Continuous loading capability (constant torque at a max ambient temperature of 40°C)	Rated output current I_{2N}
Overload capacity (at a max. ambient temperature of 40°C)	At normal use $1.1 \times I_{2N}$ for 1 minute every 10 minutes At heavy-duty use $1.5 \times I_{2N}$ for 1 minute every 10 minutes Always $1.8 \times I_{2N}$ for 2 seconds every 60 seconds
Switching frequency	
Standard	Default 4 kHz
Selectable	0.75 - 150Hp - 1 kHz, 4 kHz, 8 kHz, 12 kHz up to 550Hp - 1 kHz, 4 kHz
Acceleration time	0.1 to 1800 s
Deceleration time	0.1 to 1800 s

Environmental limits	
Ambient temperature	-15 to 40°C (5 to 104°F) 40 to 50°C (104 to 122°F) No frost allowed f_{switch} 4 kHz, P_N and I_2 derated to 90%
Altitude	
Output current	Rated current available at 0 to 1000 m (3300 ft) reduced by 1% per 100 m over 1000 m (3300 ft) to 2000 m (6600 ft)
Relative humidity	lower than 95% (without condensation)
Protection class	UL Type 1 or 12 (NEMA 1 or NEMA 12)
Enclosure color	NCS 1502-Y, RAL 9002, PMS 420 C
Contamination levels	IEC 721-3-3 No conductive dust allowed
Transportation	Class 1C2 (chemical gases), Class 1S2 (solid particles)
Storage	Class 2C2 (chemical gases), Class 2S2 (solid particles)
Operation	Class 3C2 (chemical gases), Class 3S2 (solid particles)

Motor Control	
Speed Control	
Open Loop	20% of motor nominal slip
Closed Loop	0.1% of motor nominal speed
Open Loop	< 1% s with 100% torque step
Closed Loop	0.5% s with 100% torque step
Motor Control	
Open Loop	<10ms with nominal torque
Closed Loop	<10ms with nominal torque
Open Loop	±5% with nominal torque
Closed Loop	±2% with nominal torque

Programmable control connections	
Two analog inputs	
Voltage signal	0 (2) to 10 V, $R_{in} > 312 \text{ k}\Omega$ single-ended
Current signal	0 (4) to 20 mA, $R_{in} = 100 \Omega$ single-ended
Potentiometer reference value	10 V ±2% max. 10 mA, $R < 10 \text{ k}\Omega$
Maximum delay	12...32 ms
Resolution	0.1%
Accuracy	±1%
Two analog outputs	0 (4) to 20 mA, load < 500 Ω
Accuracy	±3%
Auxiliary voltage	24 V DC ±10%, max. 250 mA
Six digital inputs	12 V... 24 V DC with internal or external supply, PNP and NPN
Input impedance	2.4 k Ω
Maximum delay	5 ms ± 1ms
Three relay outputs	
Maximum switching voltage	250 V AC/30 V DC
Maximum switching current	6 A/30 V DC; 1500 V A/230 V AC
Maximum continuous current	2 A rms
Serial communication	
RS 485	Built-in Modbus RTU protocol

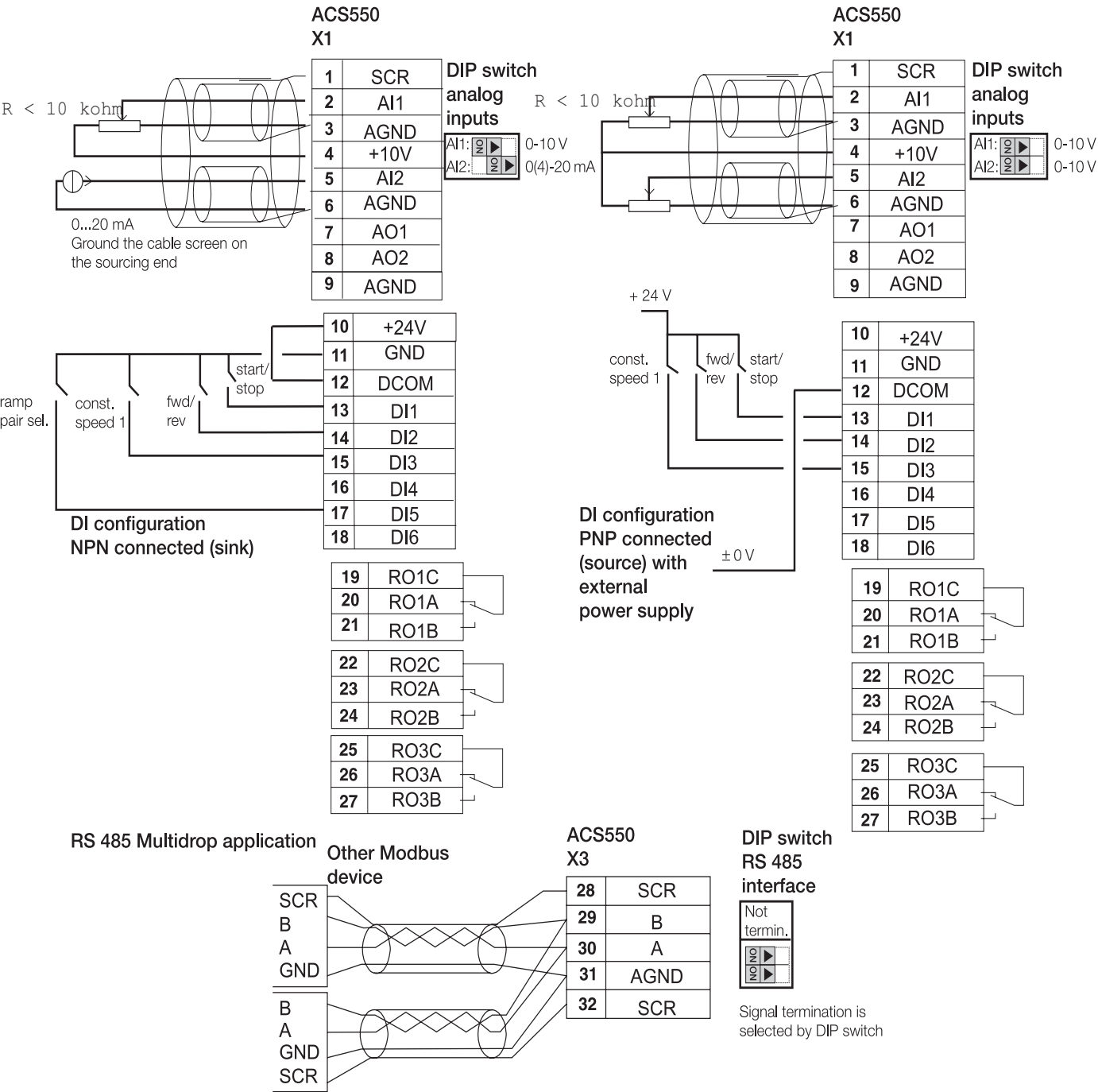
Product compliance	
240V products: UL, cUL, CSA, CE, C-TICK, and GOST-R approvals	
480V products: UL, cUL, CSA, CE, C-TICK, and GOST-R approvals	
600V products: UL, cUL, CSA, C-TICK, and GOST-R approvals	
Low Voltage Directive 73/23/EEC with supplements	
Machinery Directive 98/37/EC	
EMC Directive 89/336/EEC with supplements	
Quality assurance system ISO 9001 and Environmental system ISO 14001	
Seismic Certification to ICC AC-156	

EMC according to EN61800-3	
1st environment restricted distribution for frame sizes R3, R4 with 75 m motor cables and for frame sizes R1, R2, R5, R6 with 100 m motor cables.	
2nd environment unrestricted distribution for frame sizes R1 - R4 with 300 m cable and for frame sizes R5 - R8 with 100 m motor cables as standard.	
These cable lengths are for EMC purposes only. For long motor cable lengths, external EMC filters are available on request.	

EMC standards in general		
EN 61800-3/A11 (2000), product standard	EN 61800-3 (2004), product standard	EN 55011, product family standard for industrial, scientific and medical (ISM) equipment
1st Environment, unrestricted distribution	Category C1	Group 1 Class B
1st Environment, restricted distribution	Category C2	Group 1 Class A
2nd Environment, unrestricted distribution	Category C3	Group 2 Class A
2nd Environment, restricted distribution	Category C4	Not Applicable

Control Connections

These connections are shown as examples only. Please refer to the ACS550 User's Manual (3AUA0000001609) for more detailed information.



Fieldbus Control

Gateway to your process



ABB AC drives have the connectivity to major automation systems. This is achieved with a dedicated gateway concept between the fieldbus systems and ABB drives.

The fieldbus gateway is a snap-on module that can be easily mounted inside the drive. As a result of the wide range of fieldbus gateways, your choice for an automation system becomes independent of your decision to use first-class ABB AC drives.

Manufacturing Flexibility

Drive control

The drive Control Word (16 bit) provides a wide variety of functions from Start, Stop and Reset to Ramp Generator control. Typical setpoint values like Speed, Torque and Position can be transmitted to the drive with 15 bit accuracy.

Drive monitoring

A set of drive parameters and/or actual signals, like torque, speed, position, current etc., can be selected for cyclic data transfer providing fast data for operators and the manufacturing process.

Drive diagnostics

Accurate and reliable diagnostic information can be obtained via the drive Alarm, Limit and Fault Words reducing the down time of the drive and therefore, also the down time of the manufacturing process.

Drive parameter handling

Total integration of the drives in the production process is achieved by single parameter read/write up to complete parameter set-up or download.

Easy to expand

Serial communication simplifies the latest trend of modular machine design enabling expansion of the installation at a later stage with low effort.

Reduced Installation and Engineering Effort

Cabling

Substituting the large amount of conventional Drive Control cabling with a single twisted pair reduces costs and increases system reliability.

Design

The use of Fieldbus Control reduces engineering time at installation due to the modular structure of the hardware and software.

Commissioning and assembly

The modular machine configuration allows pre-commissioning of single machine sections and provides easy and fast assembly of the complete installation.

Currently Available Gateways

- CANopen
- ControlNet™
- DeviceNet™
- Embedded Modbus® RTU
- Modbus/TCP®
- EtherNet/IP™
- Profibus-DP®
- PROFINET IO®

ABB ACS550 Packaged Drives

ACS550 Packaged Drive

ACS550-PC and PD packaged drives combine ACS550 AC drives with the disconnect arrangement of your choice in one coordinated, easy to install package. Packages are available with an input disconnect switch and fast acting, current limiting fuses (ACS550-PD) or an input circuit breaker (ACS550-PC). Units with a circuit breaker disconnect at and above ratings of 30 HP at 208/240V and 75 HP at 480 & 600V are also equipped with fast acting, drive input fuses to limit damage to the drive and provide for the possibility of drive repair in the unlikely event that a short circuit or ground fault should develop within the input power structure of the drive.

Disconnects are externally operable and interlocked with the enclosure door. The cover mounted disconnect operating handle may be padlocked in the off position with up to three padlocks. The multilingual, alphanumeric drive control panel is provided on the cover of NEMA 1 and NEMA 12 enclosed devices, and on the drive within NEMA 3R enclosed units.

Vertical Wall Mount Enclosures

NEMA 1 and NEMA 12 enclosed ACS550-PC and PD Drives with Disconnect through 25 HP at 208/240V and 60 HP at 480 and 600V are provided in vertical wall mount enclosures. This unique construction provides a minimum footprint advantageous for use in overcrowded electrical rooms or mezzanines, or for direct mounting on machines or columns. Input and output conduit entry is at the bottom of the enclosure.



Oversized Wall Mounting Enclosures

For NEMA 1 and NEMA 12 enclosed ACS550-PC and PD Drives with Disconnect from 30 to 100 HP at 208/240V, 75 to 200 HP at 480 & 600V, wall mounting enclosures are sized to accommodate the field addition of components that users frequently desire to include at these higher horsepower ratings. A removable conduit plate is provided at the top of the enclosure.



Free Standing Packages

From 250 HP to 550 HP at 480V, ACS550-PC enclosures will accommodate the field installation of additional components. Where additional enclosure panel space is required, an auxiliary enclosure section is available. A molded case circuit breaker provides the disconnect means function while fast acting, current limiting drive input fuses provide short circuit protection. A removable conduit mounting plate is provided at the top of the enclosure.



NEMA 3R Enclosures

For outdoor applications, the ACS550 Drive with Disconnect is available in NEMA 3R enclosures up to 100 HP at 208/240V and 200 HP at 480 & 600V. Construction is sheet steel with a tough powder coat paint finish for corrosion resistance. A 100 watt, thermostatically controlled space heater and thermostatic control of the force ventilated cooling system are provided as standard.

ABB ACS550 Packaged Drives

ACS550 Packaged Drive with Bypass

ACS550 Packaged Drive with Bypass

The ACS550-CC is a complete Drive with Bypass Package that includes an ACS550 Adjustable Frequency Drive, a bypass function that allows the motor to be run at full voltage in the event the drive is shut down for service, a main disconnect means and branch circuit short circuit and ground fault protection. Complete, pre-engineered packages reduce time, effort and the cost of installing the popular drive bypass option.

The bypass function is configured entirely of standard industrial control components. It includes two electrically interlocked contactors, a motor overload relay, a control power transformer with primary and secondary fusing, and a cover mounted DRIVE-OFF-BYPASS selector switch.

Bypass is accomplished by means of the two contactors. One is the bypass contactor used to connect the motor directly to the power line. The other is the output contactor that disconnects the motor from the drive output when operating in the bypass mode. This prevents the “back feeding” that would occur if line voltage were applied to the drive output terminals. The drive output contactor and the bypass contactor are electrically interlocked to prevent simultaneous operation.

Externally Operated Devices

ACS550 Drive with Bypass Packages include an input circuit breaker with a door mounted external operating handle that is interlocked with the enclosure door and lockable in the OFF position with up to three padlocks. The multilingual, alphanumeric drive control panel is mounted on the door of the enclosure. An optional drive service switch (+F267) isolates the drive from the power source for service and provides superior functionality to a three-contactor arrangement.

Drive Input Fuses Standard

Fast acting, current limiting drive input fuses are provided as standard to limit damage and allow for possible drive repair if a short circuit or ground fault should develop in the drive input bridge. This is particularly pertinent for drives at the higher ratings where it is generally more economical to repair rather than replace the drive. The drive fuses are also intended to provide for immediate operation of the bypass function after such a fault.

Enclosure Options

Drive with Bypass Packages are available in NEMA 1 and NEMA 12 enclosures through 100 HP at 208/240V, 400 HP at 480V and 150 HP at 600V. For outdoor applications, NEMA 3R enclosed packages are available through 100 HP at 208/240V and 200 HP at 480 & 600V. NEMA 3R enclosures are sheet steel construction with a tough powder coat paint finish for corrosion resistance and include a 100 watt, thermostatically controlled space heater and thermostatic control of the force ventilated cooling system as standard.



NEMA 1 Wall Mount



NEMA 1 Floor Mount



NEMA 3R Floor Mount

Ratings, Types and Voltages

System Voltage	Base Drive Type Code	Frame Size	Nominal Ratings				Base Drive NEMA 1 Dim Ref UX1	Base Drive NEMA 12 Dim Ref UX12	Bypass NEMA 1 Dim Ref CX1	Bypass NEMA 12 Dim Ref CX12	Bypass NEMA 3R Dim Ref CX3R	Input Disconnect NEMA 1 Dim Ref PX1	Input Disconnect NEMA 12 Dim Ref PX12	Input Disconnect NEMA 3R Dim Ref PX3R
			I _{2N} A	P _N HP	I _{2hd} A	P _{hd} HP								
208/240 V	ACS550-XX-04A6-2	R1	4.6	1	3.5	0.75	1	1	1	1	1	1	1	1
	ACS550-XX-06A6-2	R1	6.6	1.5	4.6	1	1	1	1	1	1	1	1	1
	ACS550-XX-07A5-2	R1	7.5	2	6.6	1.5	1	1	1	1	1	1	1	1
	ACS550-XX-012A-4	R1	11.8	3	7.5	2	1	1	1	1	1	1	1	1
	ACS550-XX-017A-2	R1	16.7	5	11.8	3	1	1	1	1	1	1	1	1
	ACS550-XX-024A-2	R2	24.2	7.5	16.7	5	2	2	3	3	2	2	2	2
	ACS550-XX-031A-2	R2	30.8	10	24.2	7.5	2	2	3	3	2	2	2	3
	ACS550-XX-046A-2	R3	46.2	15	30.8	10	3	3	4	5	3	3	3	3
	ACS550-XX-059A-2	R3	59.4	20	46.2	15	3	3	4	5	3	3	3	3
	ACS550-XX-075A-2	R4	74.8	25	59.4	20	4	4	6	6	4	4	4	4
	ACS550-XX-088A-2	R4	88	30	74.8	25	4	4	9	7	5	5	5	5
	ACS550-XX-114A-2	R4	114	40	88	30	4	4	9	7	5	5	5	5
	ACS550-XX-143A-2	R6	143	50	114	40	6	6	10	10	7	6	6	6
	ACS550-XX-178A-2	R6	178	60	150	50	6	6	10	10	7	6	6	6
480V	ACS550-XX-221A-2	R6	221	75	178	60	6	6	11	10	8	6	6	6
	ACS550-XX-248A-2	R6	248	100	192	75	6	6	11	10	8	6	6	6
	ACS550-XX-03A3-4	R1	3.3	1.5	2.4	1	1	1	1	1	1	1	1	1
	ACS550-XX-04A1-4	R1	4.1	2	3.3	1.5	1	1	1	1	1	1	1	1
	ACS550-XX-06A9-4	R1	6.9	3	5.4	2	1	1	1	1	1	1	1	1
	ACS550-XX-08A8-4	R1	8.8	5	6.9	3	1	1	1	1	1	1	1	1
	ACS550-XX-012A-4	R1	11.9	7.5	8.8	5	1	1	1	1	1	1	1	1
	ACS550-XX-015A-4	R2	15.4	10	11.9	7.5	2	2	2	2	2	2	2	2
	ACS550-XX-023A-4	R2	23	15	15.4	10	2	2	2	2	2	2	2	2
	ACS550-XX-031A-4	R3	31	20	23	15	3	3	4	4	3	3	3	3
	ACS550-XX-038A-4	R3	38	25	31	20	3	3	4	4	3	3	3	3
	ACS550-XX-045A-4	R3	44	30	38	25	3	3	4	5	3	3	3	3
	ACS550-XX-059A-4	R4	59	40	44	30	4	4	5	6	4	4	4	4
	ACS550-XX-072A-4	R4	72	50	59	40	4	4	5	6	4	4	4	4
	ACS550-XX-078A-4	R4	77	60	65	50	4	4	5	6	4	4	4	4
	ACS550-XX-097A-4	R4	96	75	77	60	4	4	6	7	5	5	5	5
	ACS550-XX-125A-4	R5	124	100	96	75	5	5	7	8	6	5	5	6
	ACS550-XX-157A-4	R6	157	125	124	100	6	6	10	9	7	6	6	6
	ACS550-XX-180A-4	R6	180	150	156	125	6	6	10	9	7	6	6	6
	ACS550-XX-246A-4	R6	245	200	192	150	6	6	11	10	8	6	6	6
	ACS550-XX-316A-4	R8	316	250	240	200	8		12	11		8	8	
	ACS550-XX-368A-4	R8	368	300	302	250	8		13	12		8	8	
	ACS550-XX-414A-4	R8	414	350	368	300	8		13	12		8	8	
	ACS550-XX-486A-4	R8	486	400	414	350	8		13	12		8	8	
	ACS550-XX-526A-4	R8	526	450	477	400	8						8	
	ACS550-XX-602A-4	R8	602	500	515	450	8						8	
	ACS550-XX-645A-4	R8	645	550	590	500	8						8	
600V	ACS550-XX-02A7-6	R2	2.7	2	2.4	1.5	2	2	2	2	2	2	2	2
	ACS550-XX-03A9-6	R2	3.9	3	2.7	2	2	2	2	2	2	2	2	2
	ACS550-XX-06A1-6	R2	6.1	5	3.9	3	2	2	2	2	2	2	2	2
	ACS550-XX-09A0-6	R2	9	7.5	6.1	5	2	2	2	2	2	2	2	2
	ACS550-XX-011A-6	R2	11	10	9	7.5	2	2	2	2	2	2	2	2
	ACS550-XX-017A-6	R2	17	15	11	10	2	2	2	2	2	2	2	2
	ACS550-XX-022A-6	R3	22	20	17	15	3	3	4	4	3	3	3	3
	ACS550-XX-027A-6	R3	27	25	22	20	3	3	4	4	3	3	3	3
	ACS550-XX-032A-6	R4	32	30	27	25	4	4	5	6	4	4	4	4
	ACS550-XX-041A-6	R4	41	40	32	30	4	4	5	6	4	4	4	4
	ACS550-XX-052A-6	R4	52	50	41	40	4	4	5	6	4	4	4	4
	ACS550-XX-062A-6	R4	62	60	52	50	4	4	5	6	4	4	4	4
	ACS550-XX-077A-6	R6	77	75	62	60	6	6	8	9	6	6	6	6
	ACS550-XX-099A-6	R6	99	100	77	75	6	6	8	9	6	6	6	6
	ACS550-XX-125A-6	R6	125	125	99	100	6	6	10	9	6	6	6	6
	ACS550-XX-144A-6	R6	144	150	125	125	6	6	10	9	6	6	6	6

Notes:

xx = construction designations:

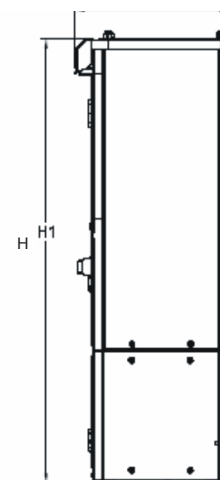
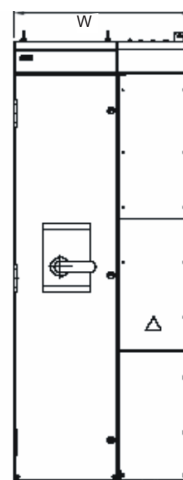
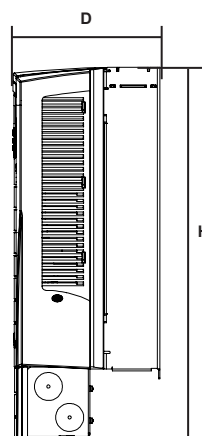
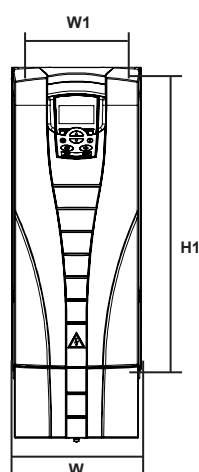
U1 = Base Drive - Wall mount
U2 = Base Drive - Floor mount

PD = Packaged Drive with Switch and Fuse
PC = Packaged Drive with Circuit Breaker

CC = Packaged Drive with Bypass

Dimensions

ACS550-UX, NEMA 1/UL Type 1

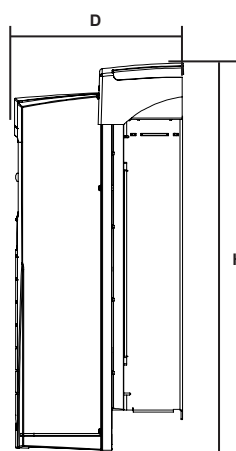
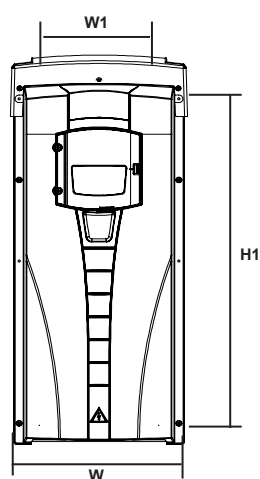


Wall Mount (UX1-1 - UX1-6)

Floor Mount (UX1-7 - UX1-8)

Dim	Frame	Mounting Dimensions			Shipping Dimensions				Dimension Drawing
		H1	W1	Mounting Hardware	H	W	D	Weight	
UX1-1	R1	12.5	3.9	#10	14.5	4.9	8.3	14.3	3AUA0000001559 - sheet 1
UX1-2	R2	16.4	3.9	#10	18.5	4.9	8.7	19.5	3AUA0000001560 - sheet 1
UX1-3	R3	18.6	6.3	#10	23	8	9.1	35	3AUA0000001571 - sheet 1
UX1-4	R4	22.8	6.3	#10	27.1	8	10.3	59	3AUA0000001572 - sheet 1
UX1-5	R5	23.2	9.4	0.25	29	10.5	11.3	75	3AUA0000004629 - sheet 1
UX1-6	R6	26.6	10.4	0.25	35	11.9	15.8	152	3AUA0000004633 - sheet 1
UX1-7	R7	Free Standing		NA	59.2	24	19.5	430	Consult Factory
UX1-8	R8	Free Standing		NA	83.9	31.5	23	827	Consult Factory

ACS550-UX, NEMA 12/UL Type 12

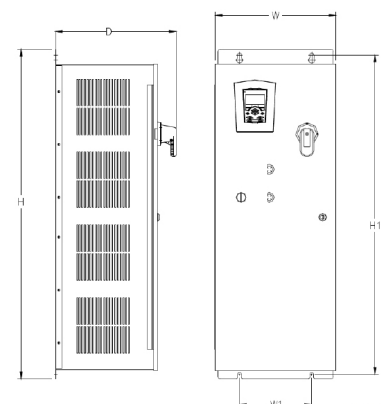


Wall Mount (UX12-1 - UX12-6)

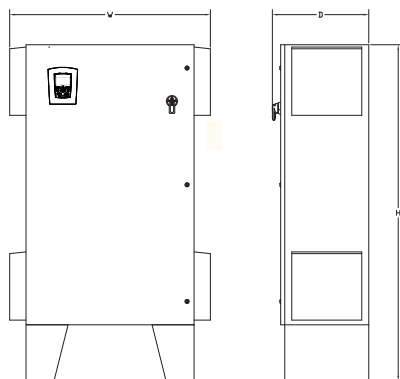
Dim	Frame	Mounting Dimensions			Shipping Dimensions				Dimension Drawing
		H1	W1	Mounting Hardware	H	W	D	Weight	
UX12-1	R1	12.5	3.9	#10	18.1	8.4	9.2	17.6	3AUA0000004031 - sheet 1
UX12-2	R2	16.4	3.9	#10	22.1	8.4	9.6	24.3	3AUA0000004032 - sheet 1
UX12-3	R3	18.6	6.3	#10	24.8	10.1	10	37.5	3AUA0000004029 - sheet 1
UX12-4	R4	22.8	6.3	#10	29.9	10.1	11.2	57.3	3AUA0000004043 - sheet 1
UX12-5	R5	23.2	9.4	0.25	30.5	14.5	12.2	92.6	3AUA0000004634 - sheet 1
UX12-6	R6	26.6	10.4	0.25	36.4	16.1	16.7	190	3AUA0000004635 - sheet 1

Dimensions

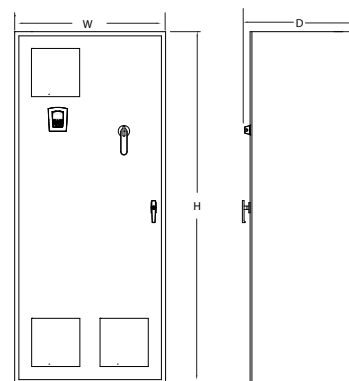
ACS550-Cx NEMA 1 / UL Type 1



Wall Mount (CX1-1 - CX1-8)



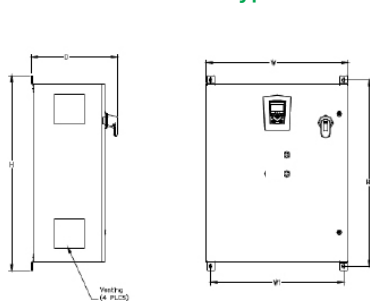
Wall Mount (CX1-9 - CX1-11)



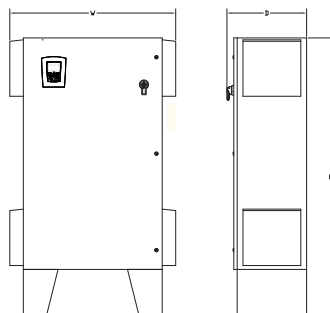
Floor Mount (CX1-12 - CX1-13)

Dim	Mounting Dimensions			Shipping Dimensions			Weight	Dimension Drawing
	H1	W1	Mounting Hardware	H	W	D		
CX1-1	36.2	8.2	0.375	37.3	13.7	13.7	77	3AUA0000012797 - sheet 4
CX1-2	36.2	8.2	0.375	37.3	13.7	13.7	82	3AUA0000012797 - sheet 4
CX1-3	53.2	10	0.375	54.3	16.3	14.6	108	3AUA0000012798 - sheet 4
CX1-4	53.2	10	0.375	54.3	16.3	14.6	134	3AUA0000012798 - sheet 4
CX1-5	53.2	10	0.375	54.3	16.3	14.6	168	3AUA0000012798 - sheet 4
CX1-6	61.7	13	0.375	62.8	19.3	19.2	198	3AUA0000012799 - sheet 4
CX1-7	61.7	13	0.375	62.8	19.3	19.2	262	3AUA0000012799 - sheet 4
CX1-8	61.7	13	0.375	62.8	19.3	19.2	340	3AUA0000012799 - sheet 4
CX1-9	Free Standing		Ø0.56	74.1	35	20.7	278	3AUA0000012800 - sheet 4
CX1-10	Free Standing		Ø0.56	74.1	35	20.7	419	3AUA0000012800 - sheet 4
CX1-11	Free Standing		Ø0.56	72	36	23	545	3AUA0000024944 - sheet 4
CX1-12	Free Standing		N/A	84	36	33.4	1276	3AUA0000013236 - sheet 4
CX1-13	Free Standing		N/A	84	60	33.4	1459	3AUA0000013223 - sheet 4

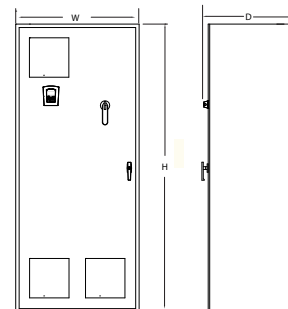
ACS550-Cx NEMA 12 / UL Type 12



Wall Mount (CX12-1 - CX12-9)



Wall Mount (CX12-10)

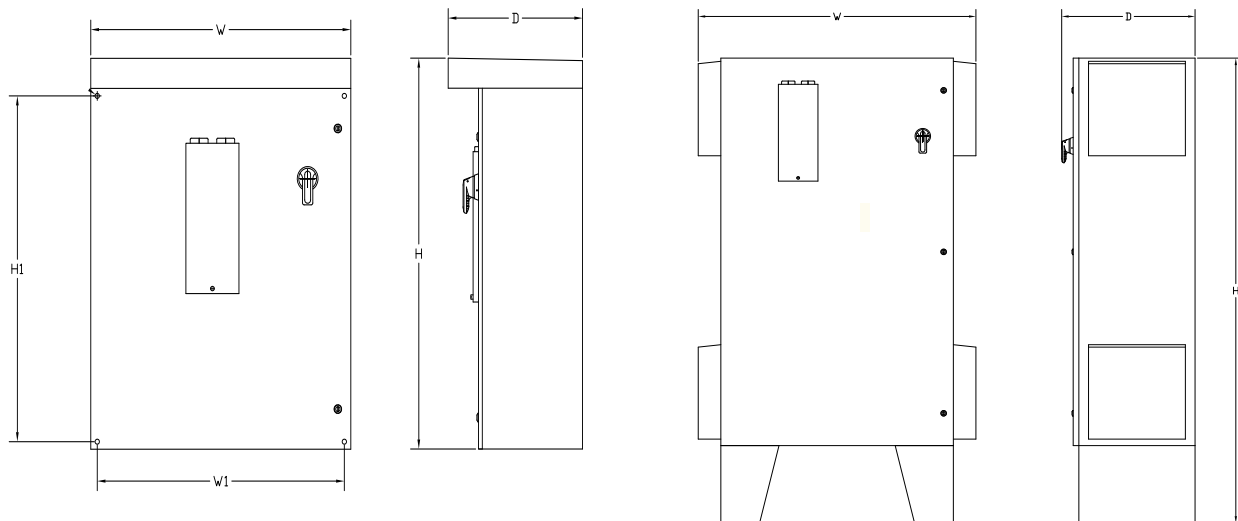


Floor Mount (CX12-11 - CX12-13)

Dim	Mounting Dimensions			Shipping Dimensions			Weight	Dimension Drawing
	H1	W1	Mounting Hardware	H	W	D		
CX12-1	25.5	16.5	0.375	27	18	14.5	79	3AUA0000012801 - sheet 4
CX12-2	25.5	16.5	0.375	27	18	14.5	84	3AUA0000012801 - sheet 4
CX12-3	31.5	22.5	0.375	33	24	14.5	112	3AUA0000012802 - sheet 4
CX12-4	31.5	22.5	0.375	33	24	14.5	141	3AUA0000012802 - sheet 4
CX12-5	37.5	28.5	0.375	39	30	14.5	172	3AUA0000012803 - sheet 4
CX12-6	37.5	28.5	0.375	39	30	14.5	205	3AUA0000012803 - sheet 4
CX12-7	49.5	34.5	0.375	51.4	36	22.5	260	3AUA0000012804 - sheet 4
CX12-8	49.5	34.5	0.375	51.4	36	22.5	324	3AUA0000012804 - sheet 4
CX12-9	49.5	34.5	0.375	51.4	36	22.5	401	3AUA0000012804 - sheet 4
CX12-10	Free Standing		Ø0.56	72	36	23	545	3AUA0000012805 - sheet 4
CX12-11	Free Standing		N/A	84	36	33.4	1276	3AUA0000013237 - sheet 4
CX12-12	Free Standing		N/A	84	60	33.4	1459	3AUA0000013224 - sheet 4

Dimensions

ACS550-Cx UL Type 3R / NEMA 3R

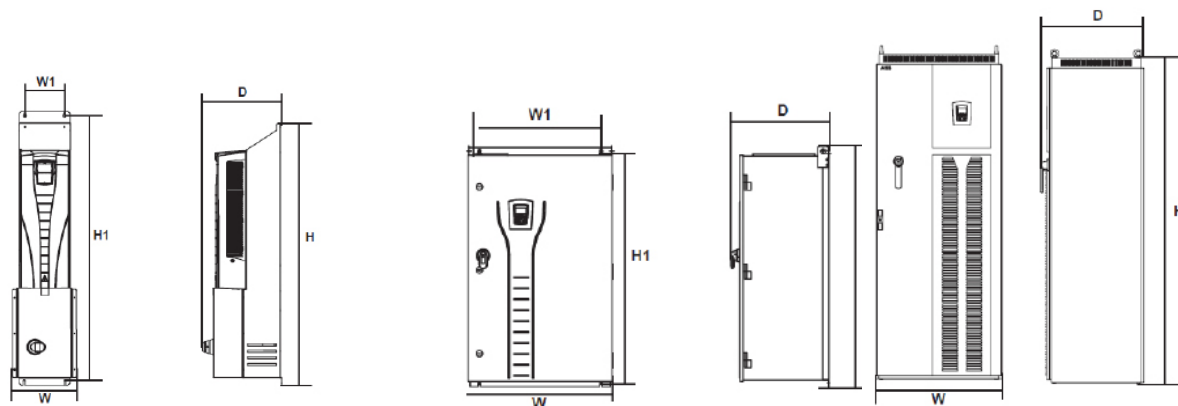


Wall Mount (CX3R-1-7)

Floor Mount (CX3R-8)

Dim	Mounting Dimensions			Shipping Dimensions				Dimension Drawing
	H1	W1	Mounting Hardware	H	W	D	Weight	
CX3R-1	22.5	16.5	0.375	27	18	13.5	82	3AUA0000060121 - sheet 4
CX3R-2	22.5	16.5	0.375	27	18	13.5	88	3AUA0000060121 - sheet 4
CX3R-3	28.5	22.5	0.375	33	24	13.5	145	3AUA0000060122 - sheet 4
CX3R-4	34.5	28.5	0.375	39	30	15.5	213	3AUA0000060123 - sheet 4
CX3R-5	46.5	34.5	0.375	51	36	21.5	268	3AUA0000060124 - sheet 4
CX3R-6	46.5	34.5	0.375	51	36	21.5	332	3AUA0000060124 - sheet 4
CX3R-7	46.5	34.5	0.375	51	36	21.5	409	3AUA0000060124 - sheet 4
CX3R-8	Free Standing		0.375	72	43	20.7	554	3AUA0000060125 - sheet 4

ACS550-Px UL Type 1 / NEMA 1



Wall Mount (PX1-1 - PX1-4)

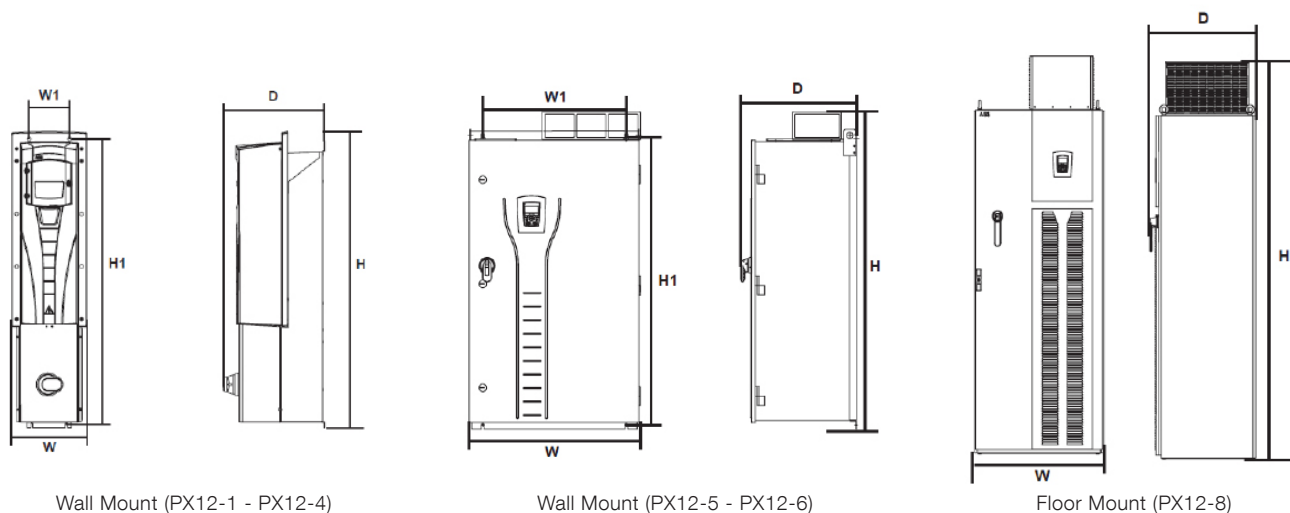
Wall Mount (PX1-5 - PX1-6)

Floor Mount (PX1-8)

Dim	Mounting Dimensions			Shipping Dimensions				Dimension Drawing
	H1	W1	Mounting Hardware	H	W	D	Weight	
PX1-1	28	3.9	0.25	28.7	7.8	11.2	33	3AUA0000008216 - sheet 1
PX1-2	32	3.9	0.25	32.6	7.8	11.6	42	3AUA0000008218 - sheet 1
PX1-3	38.7	6.3	0.25	39.9	10.2	11.9	75	3AUA0000008220 - sheet 1
PX1-4	44	6.3	0.25	45.2	10.2	13.1	95	3AUA0000008221 - sheet 1
PX1-5	46.3	23.6	0.375	47.7	28.1	19	267	3AUA0000021148 - sheet 1
PX1-6	46.3	23.6	0.375	47.7	28.1	19	359	3AUA0000021148 - sheet 1
PX1-8	Free Standing		Ø0.63	83.7	31.7	25.9	794	3AUA0000021152 - sheet 1

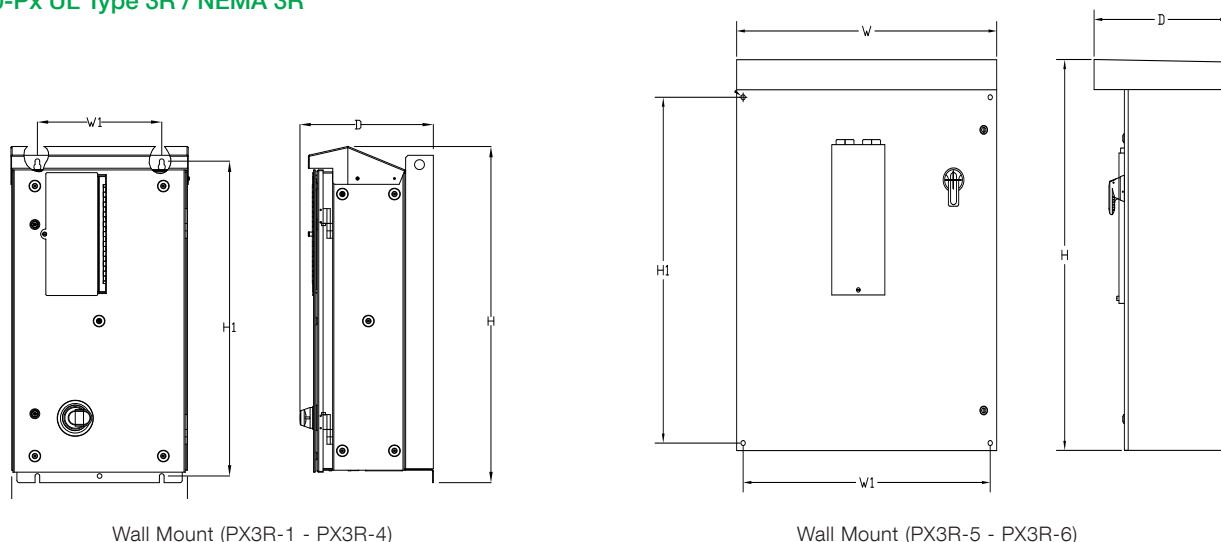
Dimensions

ACS550-Px UL Type 12 / NEMA 12



Dim	Mounting Dimensions			Shipping Dimensions				Dimension Drawing
	H1	W1	Mounting Hardware	H	W	D	Weight	
PX12-1	28	3.9	0.25	29.3	8.7	11.2	37	3AUA0000008216 - sheet 2
PX12-2	32	3.9	0.25	33.2	8.7	11.6	46	3AUA0000008218 - sheet 2
PX12-3	38.7	6.3	0.25	40.6	10.5	11.9	79	3AUA0000008220 - sheet 2
PX12-4	44	6.3	0.25	45.8	10.5	13.1	99	3AUA0000008221 - sheet 2
PX12-5	46.3	23.6	0.375	54.3	28.1	19	267	3AUA0000021149 - sheet 1
PX12-6	46.3	23.6	0.375	54.3	28.1	19	359	3AUA0000021149 - sheet 1
PX12-8	Free Standing		Ø0.63	93.6	31.7	25.9	838	3AUA0000021153 - sheet 1

ACS550-Px UL Type 3R / NEMA 3R



Dim	Mounting Dimensions			Shipping Dimensions				Dimension Drawing
	H1	W1	Mounting Hardware	H	W	D	Weight	
PX3R-1	31.9	12.6	0.375	34	17.8	13.5	128	3AUA0000016377 - sheet 1
PX3R-2	31.9	12.6	0.375	34	17.8	13.5	134	3AUA0000016377 - sheet 1
PX3R-3	36.1	15.7	0.375	38.1	20.9	15.3	176	3AUA0000016380 - sheet 1
PX3R-4	36.1	15.7	0.375	38.1	20.9	15.3	194	3AUA0000016380 - sheet 1
PX3R-5	34.5	28.5	0.375	39	30	15.5	203	3AUA0000060123 - sheet 2
PX3R-6	46.5	34.5	0.375	51	36	21.5	203	3AUA0000060124 - sheet 2

Secure uptime throughout the drive life cycle

ABB follows a four-phase model for managing the life cycles of its drives. The life cycle phases are active, classic, limited and obsolete. Within each phase, every drive series has a defined set of services.

Examples of individual services are drive selection and dimensioning, installation and commissioning, preventive and corrective maintenance, remote monitoring and intelligent diagnostics, technical support, upgrade and retrofit, replacement and recycling plus training and learning.

In the active phase the drive is in serial production. The drive, with complete life cycle services, is available for purchase.

In the classic phase, the serial production of the drive has ended. The drive, with complete life cycle services, is available for plant extensions.

In the limited phase, the drive is no longer available. The life cycle services are limited. Spare parts as well as maintenance and repair services are available as long as materials can be obtained.

In the obsolete phase, the drive is not available. ABB cannot guarantee availability of services for technical reasons or within reasonable cost.

To ensure the availability of complete life cycle services, ABB recommends that a drive is kept in the active or classic phase by upgrading, retrofitting or replacing.

In the classic phase ABB carries out an annual review for each drive life cycle plan. Should any changes to the availability or duration of the services be necessary, ABB gives a life cycle announcement indicating eventual change of life cycle phase and/or any change in the duration of services.

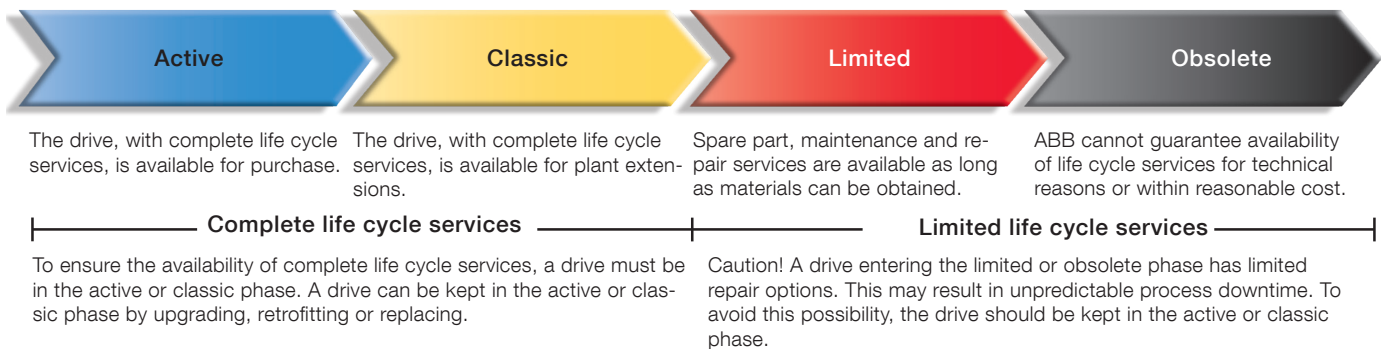
In the limited phase, ABB issues a life cycle phase change an-

nouncement, half a year prior to shifting the product into the obsolete phase.

Maximizing return on investment

The four-phase life cycle management model provides customers with a transparent method for managing their investment in drives. In each phase, customers clearly see what life cycle services are available, and more importantly, what services are not available. Decisions on upgrading, retrofitting or replacing drives can be made with confidence.

ABB drive life cycle management model



Contact us

ABB Inc.

Discrete Automation and Motion

Drives and Controls

16250 W. Glendale Drive

New Berlin, WI 53151

Telephone (800) 752-0696

Website www.abb.com/drives

ACS550-PHTC01U-EN REVJ Effective 09/18/2014

ACS550

User's Manual

ACS550-01 Drives (0.75...160 kW)

ACS550-U1 Drives (1...200 hp)



List of related manuals

GENERAL MANUALS

ACS550-01/U1 User's Manual (0.75...160 kW) / (1...200 hp)

3AFE64804588 ([3AUA0000001418](#)) (English)

Flange Mounting Instructions

Kit, IP21 / UL type 1	Frame size	Code (English)
FMK-A-R1	R1	100000982
FMK-A-R2	R2	100000984
FMK-A-R3	R3	100000986
FMK-A-R4	R4	100000988
AC8-FLNGMT-R5 ¹	R5	ACS800-
AC8-FLNGMT-R6 ¹	R6	PNTG01U-EN

1. Not available for ACS550-01 series

Kit, IP54 / UL type 12	Frame size	Code (English)
FMK-B-R1	R1	100000990
FMK-B-R2	R2	100000992
FMK-B-R3	R3	100000994
FMK-B-R4	R4	100000996

OPTION MANUALS

(delivered with optional equipment)

MFD01 FlashDrop User's Manual

[3AFE68591074](#) (English)

OHDI-01 115/230 V Digital Input Module User's Manual

[3AUA0000003101](#) (English)

OREL-01 Relay Output Extension Module User's Manual

[3AUA0000001935](#) (English)

OTAC-01 User's Manual Pulse Encoder Interface Module User's Manual

[3AUA0000001938](#) (English)

RCAN-01 CANopen Adapter User's Manual

[3AFE64504231](#) (English)

RCNA-01 ControlNet Adapter User's Manual

[3AFE64506005](#) (English)

RDNA-01 DeviceNet Adapter User's Manual

[3AFE64504223](#) (English)

RECA-01 EtherCAT Adapter Module User's Manual

[3AUA00000043520](#) (English)

REPL-01 Ethernet POWERLINK Adapter Module User's Manual

[3AUA00000052289](#) (English)

REPL-02 Ethernet POWERLINK Adapter Module User's Manual

[3AUA00000090411](#) (English)

RETA-01 Ethernet Adapter Module User's Manual

[3AFE64539736](#) (English)

RETA-02 Ethernet Adapter Module User's Manual

[3AFE68895383](#) (English)

RPBA-01 PROFIBUS DP Adapter User's Manual

[3AFE64504215](#) (English)

SREA-01 Ethernet Adapter User's Manual

[3AUA00000042896](#) (English)

Typical contents

- Safety
- Installation
- Programming/Start-up
- Diagnostics
- Technical data

MAINTENANCE MANUALS

Guide for Capacitor Reforming in ACS50, ACS55, ACS150, ACS310, ACS350, ACS355, ACS550, ACH550 and R1-R4 OINT-/SINT-boards

[3AFE68735190](#) (English)

[ACS550-01 manuals](#)



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ACS550-01/U1 Drives
0.75...160 kW
1...200 hp

User's Manual

3AFE64804588 (3AUA0000001418) Rev H
EN

EFFECTIVE: 2014-07-04

SUPERSEDES: 3AFE64804588 (3AUA0000001418) Rev G 2009-07-07

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Safety instructions

Use of warnings and notes

There are two types of safety instructions throughout this manual:

- Notes draw attention to a particular condition or fact, or give information on a subject.
- Warnings caution you about conditions which can result in serious injury or death and/or damage to the equipment. They also tell you how to avoid the danger. The warning symbols are used as follows:



Electricity warning warns of hazards from electricity which can cause physical injury and/or damage to the equipment.



General warning warns about conditions, other than those caused by electricity, which can result in physical injury and/or damage to the equipment.

General safety



WARNING! Obey these instructions. If you ignore them, injury or death, or damage to the equipment can occur.

- Use safety shoes to avoid foot injury.
- Handle the drive carefully.
- Beware of hot surfaces. Some parts, such as heatsinks, remain hot for a while after disconnection of the electrical supply. See chapter [Technical data](#) on page 277.
- Keep the drive in its package or protect it otherwise from dust and burr from drilling and grinding until you install it. Protect also the installed drive against dust and burr. Electrically conductive debris inside the drive can cause damage or malfunction.

Electrical safety



WARNING! The ACS550 adjustable speed AC drive should **ONLY** be installed by a qualified electrician.



WARNING! Even when the motor is stopped, dangerous voltage is present at the power circuit terminals U1, V1, W1 and U2, V2, W2 and, depending on the frame size, UDC+ and UDC-, or BRK+ and BRK-.



WARNING! Dangerous voltage is present when input power is connected. After disconnecting the supply, wait at least 5 minutes (to let the intermediate circuit capacitors discharge) before removing the cover.



WARNING! Even when power is switched off from the input terminals of the ACS550, there may be dangerous voltage (from external sources) on the terminals of the relay outputs RO1...RO3.



WARNING! When the control terminals of two or more drives are connected in parallel, the auxiliary voltage for these control connections must be taken from a single source which can either be one of the drives or an external supply.



WARNING! If you install the drive on an IT system (an ungrounded power system or a high-resistance-grounded [over 30 ohms] power system), disconnect the internal EMC filter, otherwise the system will be connected to ground potential through the EMC filter capacitors. This can cause danger or damage the drive.

If you install the drive on a corner-grounded TN system, disconnect the internal EMC filter, otherwise the system will be connected to ground potential through the EMC filter capacitors. This will damage the drive.

Note: Disconnecting the internal EMC filter increases the conducted emission and reduces the drive EMC compatibility considerably.

See section [Disconnecting the internal EMC filter](#) on page 27. Also see sections [IT systems](#) on page 286 and [Corner-grounded TN systems](#) on page 285.



WARNING! Do not attempt to install or remove EM1, EM3, F1 or F2 screws while power is applied to the drive's input terminals.

Maintenance



WARNING! The ACS550-01/U1 is not field repairable. Never attempt to repair a malfunctioning drive; contact your local ABB representative for replacement.

Control of the drive and motor



WARNING! Do not control the motor with the disconnecting device (disconnecting means); instead, use the control panel start and stop keys  and , or commands via the I/O board of the drive. The maximum allowed number of charging cycles of the DC capacitors (i.e. power-ups by applying power) is five in ten minutes.



WARNING! The ACS550 will start up automatically after an input voltage interruption if the external run command is on.

Note: For more technical information, contact your local ABB representative.

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Contents of this manual

Compatibility

This manual covers ACS550-01/U1 drives. The manual is compatible with the ACS550-01/U1 drive firmware version 3.14e or later. See parameter 3301 FIRMWARE on page [155](#).

Intended use

The ACS550-01/U1 is a general purpose drive. The macros should only be applied to the applications defined in the respective section.

Intended audience

This manual is intended for personnel who install, commission, operate and service the drive. Read the manual before working on the drive. The reader is expected to know the fundamentals of electricity, wiring, electrical components and electrical schematic symbols.

Installation

Study these installation instructions carefully before proceeding. **Failure to observe the warnings and instructions may cause a malfunction or personal hazard.**



WARNING! Before you begin read chapter [Safety instructions](#) on page 5.

Note: The installation must always be designed and made according to applicable local laws and regulations. ABB does not assume any liability whatsoever for any installation which breaches the local laws and/or other regulations. Furthermore, if the recommendations given by ABB are not followed, the drive may experience problems that the warranty does not cover.

Installation flow chart

The installation of the ACS550 adjustable speed AC drive follows the outline below. The steps must be carried out in the order shown. At the right of each step are references to the detailed information needed for the correct installation of the drive.

Task	See
PREPARE for installation	Preparing for installation on page 16
↓	
PREPARE the mounting location	Prepare the mounting location on page 20
↓	
REMOVE the front cover	Remove the front cover on page 21
↓	
MOUNT the drive	Mount the drive on page 22
↓	
INSTALL wiring	Wiring overview on page 23 and Check the insulation of the assembly on page 30
↓	
CHECK installation	Check installation on page 35
↓	
REINSTALL the cover	Reinstall the cover on page 36
↓	
START-UP	How to start up the drive on page 37

Preparing for installation

Lifting the drive

Lift the drive only by the metal chassis.

Unpacking the drive

1. Unpack the drive.
2. Check for any damage and notify the shipper immediately if damaged components are found.
3. Check the contents against the order and the shipping label to verify that all parts have been received.



IP2040

Drive identification

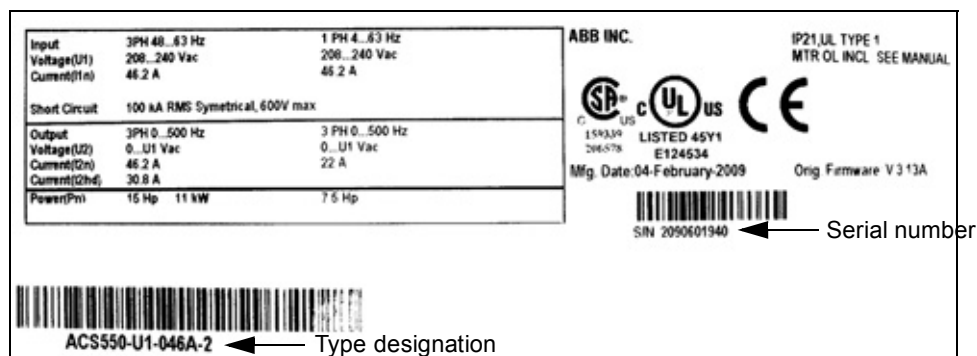
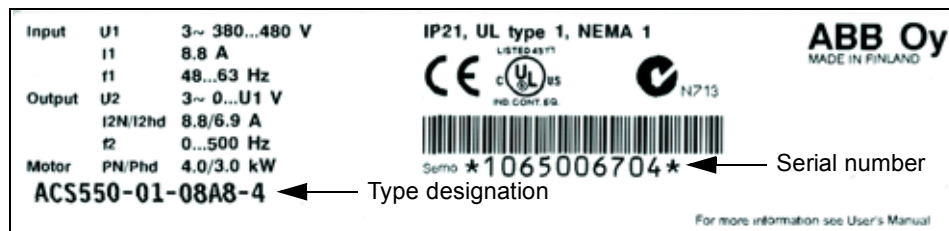
Drive labels

To determine the type of drive you are installing, refer to either:

- serial number label attached on upper part of the choke plate between the mounting holes, or



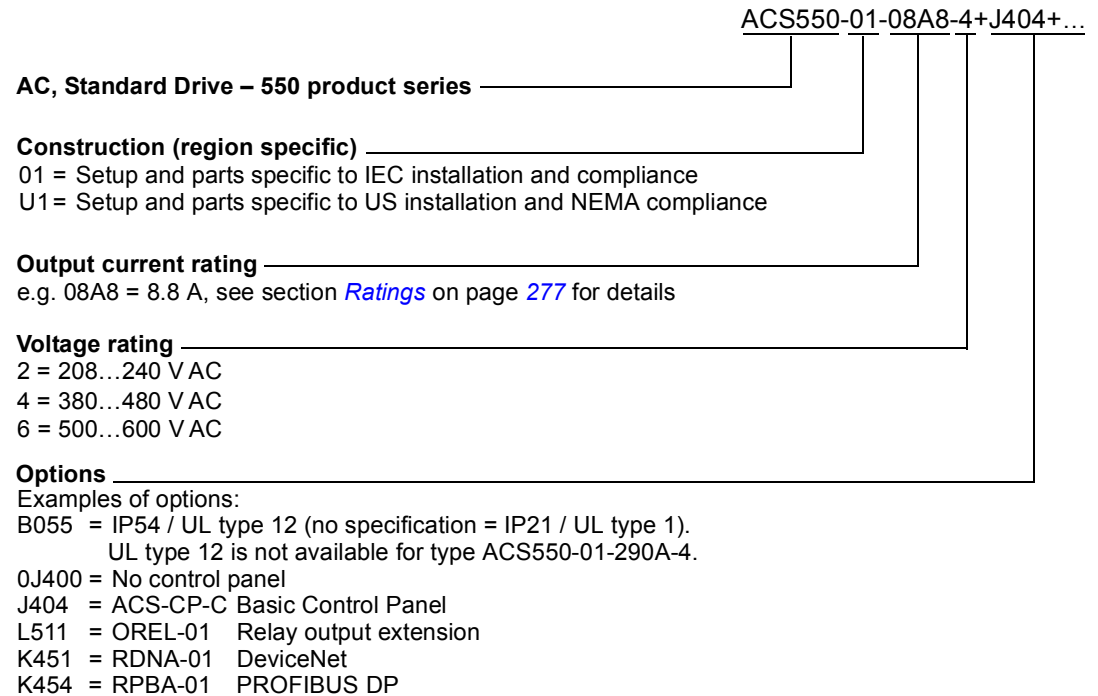
- type designation label attached on the heat sink – on the right side of the drive cover. Two examples of the type designation label are given below.



The labels contain information on the [Type designation](#) (page 17), [Ratings and frame size](#) (page 17), [Serial number](#) (page 17), degree of protection (see also [Degrees of protection](#) on page 306) and valid markings (see also [Markings](#) on page 309).

Type designation

Use the following chart to interpret the type designation found on both the type designation and the serial number label.



Ratings and frame size

The chart in section [Ratings](#) on page 277 lists technical specifications and identifies the drive's frame size – significant, since some instructions in this document vary, depending on the drive's frame size. To read the ratings table, you need the "Output current rating" entry from the type designation. Also, when using the ratings table, note that the table is broken into sections based on the drive's "Voltage rating".

Serial number

The format of the drive serial number shown on the labels is described below.

Serial number is of format CYYWWXXXXX, where

C: Country of manufacture

YY: Year of manufacture

WW: Week of manufacture; 01, 02, 03, ... for week 1, week 2, week 3, ...

XXXXX: Integer starting every week from 00001.

Motor compatibility

The motor, drive and supply power must be compatible:

Motor specification	Verify	Reference
Motor type	3-phase induction motor	–
Nominal current	Motor value is within this range: $0.2 \dots 2.0 \cdot I_{2hd}$ (I_{2hd} = drive heavy duty current)	- Type designation label on drive, entry for Output I_{2hd}, or - Type designation on drive and rating table in chapter Technical data on page 277.
Nominal frequency	10...500 Hz	–
Voltage range	Motor is compatible with the ACS550 voltage range.	208...240 V (for ACS550-X1-XXXX-2) or 380...480 V (for ACS550-X1-XXXX-4) or 500...600 V (for ACS550-U1-XXXX-6)
Insulation	500...600 V drives: Either the motor complies with NEMA MG1 Part 31, or a du/dt filter is used between the motor and drive.	For ACS550-U1-XXXX-6

Tools required

To install the ACS550 you need the following:

- screwdrivers (as appropriate for the mounting hardware used)
- wire stripper
- tape measure
- drill
- for installations involving ACS550-U1, frame sizes R5 or R6 and IP54 / UL type 12 enclosures: punch for creating conduit mounting holes
- for installations involving ACS550-U1, frame size R6: appropriate crimping tool for power cable lugs. See section [Power terminal considerations – R6 frame size](#) on page 287.
- mounting hardware: screws or nuts and bolts, four each. The type of hardware depends on the mounting surface and the frame size. For the dimensions and weights of the frames, see [Dimensions and weights](#) on page 303.

Frame size	Mounting hardware	
R1...R4	M5	#10
R5	M6	1/4 in
R6	M8	5/16 in

Suitable environment and enclosure

Confirm that the site meets the environmental requirements. To prevent damage prior to installation, store and transport the drive according to the environmental requirements specified for storage and transportation. See section [Ambient conditions](#) on page 307.

Confirm that the enclosure is appropriate, based on the site contamination level:

- IP21 / UL type 1 enclosure: The site must be free of airborne dust, corrosive gases or liquids, and conductive contaminants such as dripping water, condensation, carbon dust and metallic particles.
- IP54 / UL type 12 enclosure: This enclosure provides protection from airborne dust and light sprays or splashing water from all directions.
- If, for some reason, an IP21 drive needs to be installed without the conduit box or cover, or an IP54 drive without the conduit plate or hood, see the note in chapter [Technical data](#), page 310.

Suitable mounting location

Confirm that the mounting location meets the following constraints:

- The drive must be mounted vertically on a smooth, solid surface, and in a suitable environment as defined above. For horizontal installation, contact your local ABB representative for more information.
- The minimum space requirements for the drive are the outside dimensions (see section [Outside dimensions](#) on page 304), plus air flow space around the drive (see section [Losses, cooling data and noise](#) on page 301).
- The distance between the motor and the drive is limited by the maximum motor cable length. See section [Motor connection specifications](#) on page 289.
- The mounting site must support the drive's modest weight. See section [Weight](#) on page 306.

Installing the drive



WARNING! Before installing the ACS550, ensure the input power supply to the drive is off.

For flange mounting (mounting the drive in a cooling air duct), see the appropriate *Flange Mounting Instructions*:

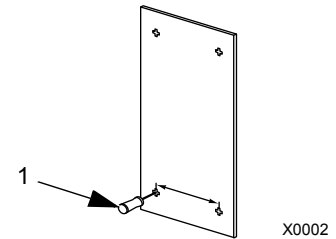
Frame size	IP21 / UL type 1		IP54 / UL type 12	
	Kit	Code (English)	Kit	Code (English)
R1	FMK-A-R1	100000982	FMK-B-R1	100000990
R2	FMK-A-R2	100000984	FMK-B-R2	100000992
R3	FMK-A-R3	100000986	FMK-B-R3	100000994
R4	FMK-A-R4	100000988	FMK-B-R4	100000996
R5	AC8-FLNGMT-R5 ¹	ACS800-PNTG01U-EN	-	-
R6	AC8-FLNGMT-R6 ¹		-	-

1. Not available in ACS550-01 series.

Prepare the mounting location

The ACS550 should only be mounted where all of the requirements defined in section [Preparing for installation](#) on page 16 are met.

1. Mark the position of the mounting holes with the help of the mounting template provided with the drive.
2. Drill the holes.

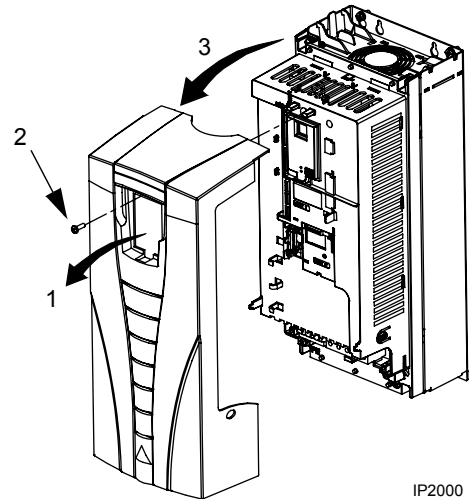


Note: Frame sizes R3 and R4 have four holes along the top. Use only two. If possible, use the two outside holes (to allow room to remove the fan for maintenance).

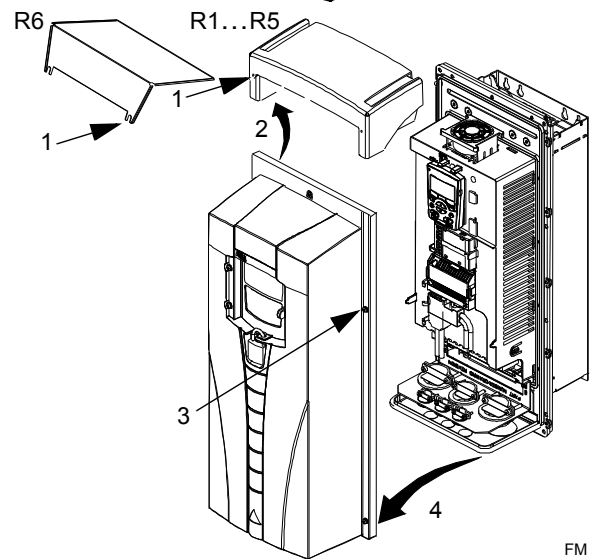
Note: ACS400 drives can be replaced using the original mounting holes. For R1 and R2 frame sizes, the mounting holes are identical. For R3 and R4 frame sizes, the inside mounting holes on the top of ACS550 drives match ACS400 mounts.

Remove the front cover*IP21 / UL type 1*

1. Remove the control panel, if attached.
2. Loosen the captive screw at the top.
3. Pull near the top to remove the cover.

*IP54 / UL type 12*

1. If hood is present: Remove screws (2) holding hood in place.
2. If hood is present: Slide hood up and off of the cover.
3. Loosen the captive screws around the edge of the cover.
4. Remove the cover.



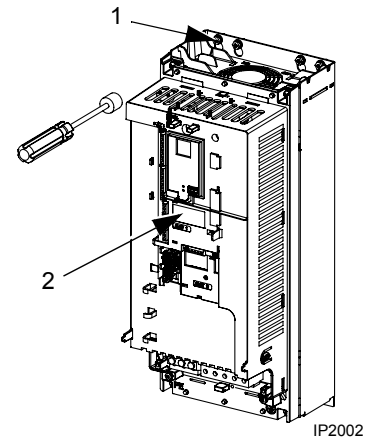
Mount the drive

IP21 / UL type 1

1. Position the ACS550 onto the mounting screws or bolts and securely tighten in all four corners.

Note: Lift the ACS550 by its metal chassis (frame size R6 by the lifting holes on both sides at the top).

2. Non-English speaking locations: Add a warning sticker in the appropriate language over the existing warning on the top of the module.



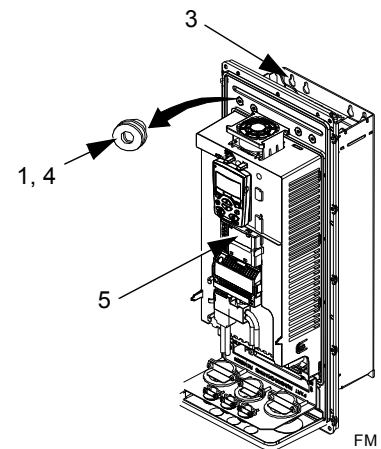
IP54 / UL type 12

For the IP54 / UL type 12 enclosures, rubber plugs are required in the holes provided for access to the drive mounting slots.

1. As required for access, remove the rubber plugs. Push plugs out from the back of the drive.
2. R5 & R6: Align the sheet metal hood (not shown) in front of the drive's top mounting holes. (Attach as part of next step.)
3. Position the ACS550 onto the mounting screws or bolts and securely tighten in all four corners.

Note: Lift the ACS550 by its metal chassis (frame size R6 by the lifting holes on both sides at the top).

4. Reinstall the rubber plugs.
5. Non-English speaking locations: Add a warning sticker in the appropriate language over the existing warning on the top of the module.



Wiring overview

Conduit/Gland kit

Wiring drives with the IP21 / UL type 1 enclosure requires a conduit/gland kit with the following items:

- conduit/gland box
- five (5) cable clamps (ACS550-01 only)
- screws
- cover.

The kit is included with IP21 / UL type 1 enclosures.

Wiring requirements



WARNING! Ensure the motor is compatible for use with the ACS550. The drive must be installed by a competent person in accordance with the considerations defined in section [Preparing for installation](#) on page 16. If in doubt, contact your local ABB representative.

As you install the wiring, observe the following:

- There are four sets of wiring instructions – one set for each combination of drive enclosure type (IP21 / UL type and IP54 / UL type 12) and wiring type (conduit or cable). Be sure to select the appropriate procedure.
- Determine electro-magnetic compliance (EMC) requirements per local codes. See section [Motor cable requirements for CE & C-Tick compliance](#) on page 293. In general:
 - Follow local codes for cable size.
 - Keep these four classes of wiring separated: input power wiring, motor wiring, control/communications wiring and braking unit wiring.
- When installing input power and motor wiring, refer to the following, as appropriate:

Terminal	Description	Specifications and notes
U1, V1, W1 ¹	3-phase power supply input	Input power connections on page 281
PE	Protective Ground	Ground connections on page 285
U2, V2, W2	Power output to motor	Motor connections on page 289

¹ The ACS550 -x1-xxxx-2 (208...240 V series) can be used with a single phase supply, if output current is derated by 50%. For single phase supply voltage, connect power at U1 and W1.

- To locate input power and motor connection terminals, see section [Power connection diagrams](#) on page 25. For specifications on power terminals, see section [Drive's power connection terminals](#) on page 286.
- For corner-grounded TN systems, see section [Corner-grounded TN systems](#) on page 285.
- For IT systems, see section [IT systems](#) on page 286.

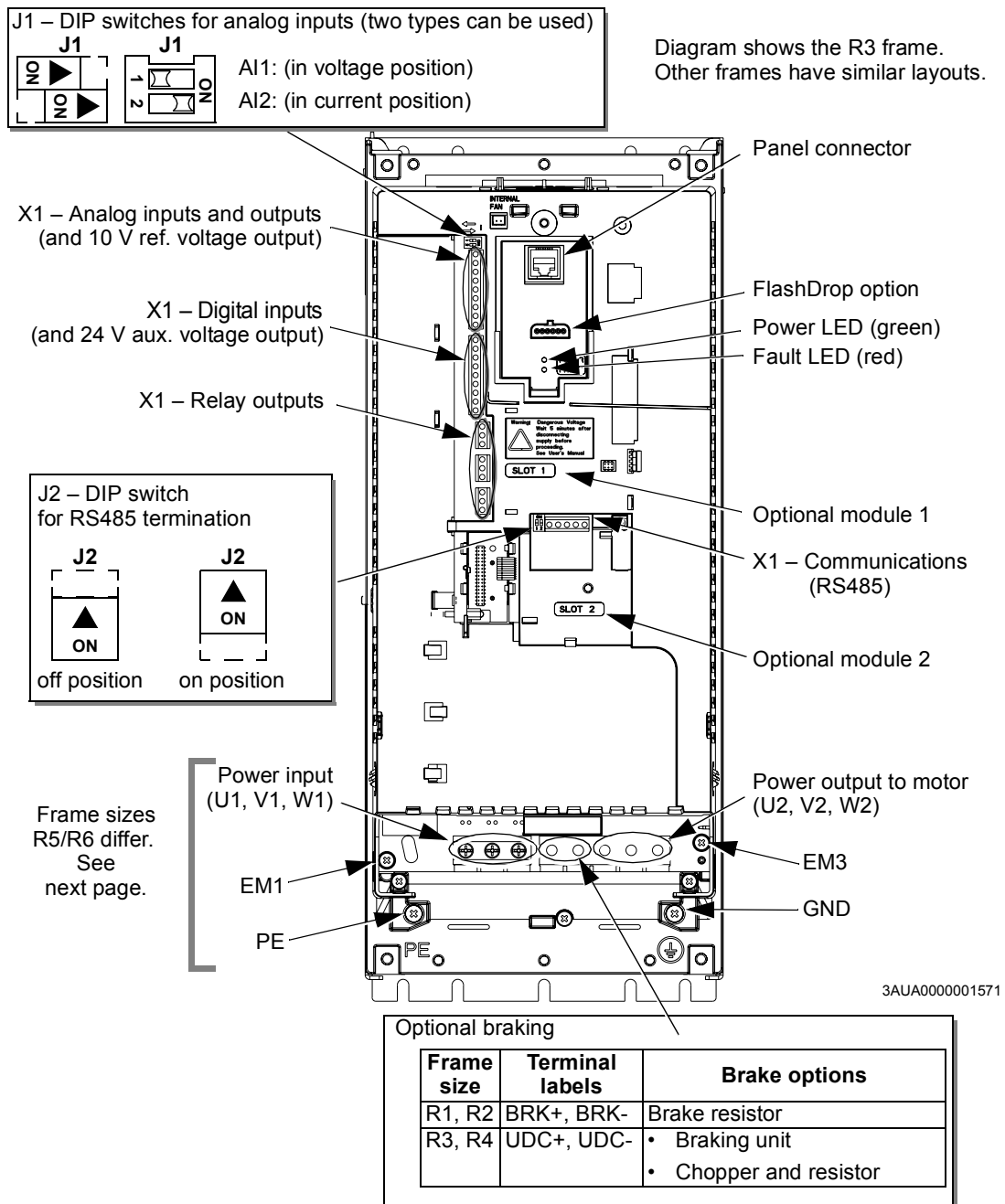
- For frame size R6, see section [Power terminal considerations – R6 frame size](#) on page [287](#) to install the appropriate cable lugs.
- For drives using braking (optional), refer to the following, as appropriate:

Frame size	Terminal	Description	Braking accessory
R1, R2	BRK+, BRK-	Braking resistor	Braking resistor. See section Brake components on page 295 .
R3, R4, R5, R6	UDC+, UDC-	DC bus	Contact your ABB representative to order either: • braking unit or • chopper and resistor

- When installing control wiring, refer to the following chapters or sections, as appropriate:
 - [Control terminals table](#) on page [28](#)
 - [Control connections](#) on page [299](#)
 - [Application macros](#) on page [77](#)
 - [Complete parameter descriptions](#) on page [106](#)
 - [Embedded fieldbus](#) on page [203](#)
 - [Fieldbus adapter](#) on page [237](#).

Power connection diagrams

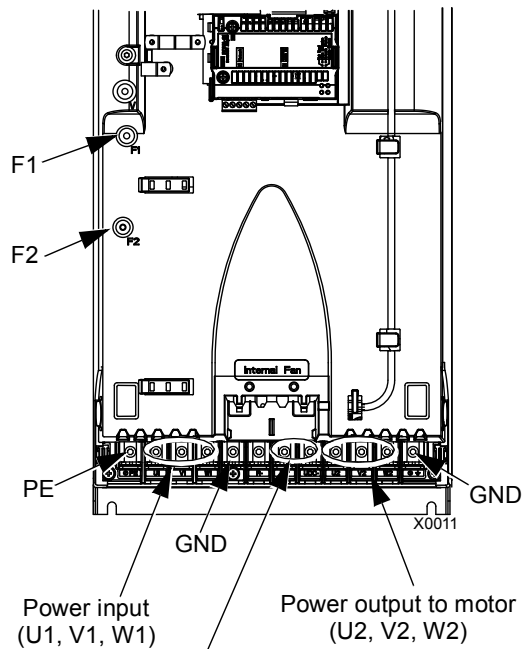
The following diagram shows the terminal layout for frame size R3, which, in general, applies to frame sizes R1...R6, except for the R5/R6 power and ground terminals.



WARNING! To avoid danger, or damage to the drive, on IT systems and corner-grounded TN systems, see section [Disconnecting the internal EMC filter](#) on page 27.

The following diagram shows the power and ground terminal layout for frame sizes R5 and R6end

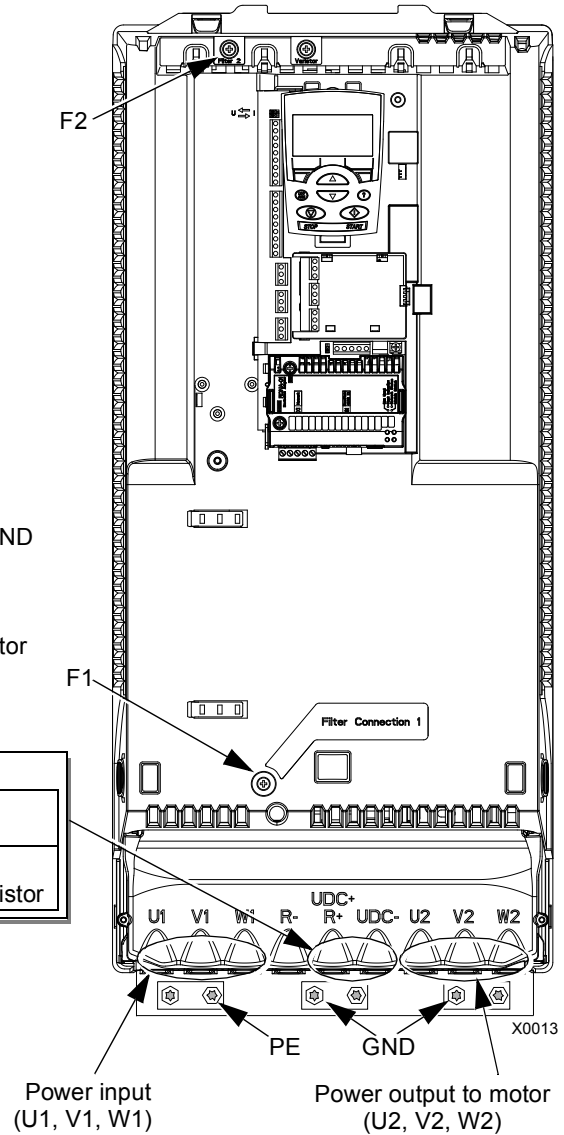
R5



Optional braking

Frame size	Terminal labels	Brake options
R5, R6	UDC+, UDC-	- Braking unit - Chopper and resistor

R6



WARNING! To avoid danger, or damage to the drive, on IT systems and corner-grounded TN systems, see section [Disconnecting the internal EMC filter](#) on page 27.

Disconnecting the internal EMC filter

On certain types of systems, you must disconnect the internal EMC filter, otherwise the system will be connected to ground potential through the EMC filter capacitors, which might cause danger, or damage the drive.

Note: Disconnecting the internal EMC filter increases the conducted emission and reduces the drive EMC compatibility considerably.

The following table shows the installation rules for the EMC filter screws in order to connect or disconnect the filter, depending on the system type and the frame size. For more information on the different system types, see [IT systems](#) on page 286 and [Corner-grounded TN systems](#) on page 285.

The locations of screws EM1 and EM3 are shown in the diagram on page 25. The locations of screws F1 and F2 are shown in the diagram on page 26.

Frame sizes	Screw	Symmetrically grounded TN systems (TN-S systems)	Corner-grounded TN systems	IT systems (ungrounded or high-resistance-grounded [$> 30 \text{ ohm}$])
R1...R3	EM1	x	x	•
	EM3 ¹	x	•	•
R4	EM1	x	x	–
	EM3 ¹	x	–	–
R5...R6	F1	x	x	–
	F2	x	x	–

x = Install the screw. (EMC filter will be connected.)

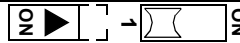
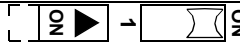
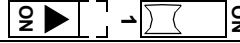
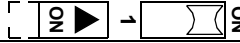
• = Replace the screw with the provided polyamide screw. (EMC filter will be disconnected.)

– = Remove the screw. (EMC filter will be disconnected.)

¹ ACS550-U1 drives are shipped with screw EM3 already removed.

Control terminals table

The following provides information for connecting control wiring at X1 on the drive.

	X1	Hardware description
Analog I/O	1	SCR
	2	AI1
		Analog input channel 1, programmable. Default ² = frequency reference. Resolution 0.1%, accuracy $\pm 1\%$.
		Two different DIP switch types can be used.
		J1: AI1 OFF: 0...10 V ($R_i = 312 \text{ kohm}$) 
		J1: AI1 ON: 0...20 mA ($R_i = 100 \text{ ohm}$) 
	3	AGND
	4	+10 V
	5	AI2
		Analog input channel 2, programmable. Default ² = not used. Resolution 0.1%, accuracy $\pm 1\%$.
Digital inputs ¹		Two different DIP switch types can be used.
		J1: AI2 OFF: 0...10 V ($R_i = 312 \text{ kohm}$) 
		J1: AI2 ON: 0...20 mA ($R_i = 100 \text{ ohm}$) 
	6	AGND
	7	AO1
	8	AO2
	9	AGND
	10	+24V
	11	GND
	12	DCOM
	13	DI1
	14	DI2
	15	DI3
	16	DI4
	17	DI5
	18	DI6

	X1		Hardware description
Relay outputs	19 RO1C		Relay output 1, programmable. Default ² = Ready Maximum: 250 V AC / 30 V DC, 2 A Minimum: 500 mW (12 V, 10 mA)
	20 RO1A		
	21 RO1B		
	22 RO2C		Relay output 2, programmable. Default ² = Running Maximum: 250 V AC / 30 V DC, 2 A Minimum: 500 mW (12 V, 10 mA)
	23 RO2A		
	24 RO2B		
	25 RO3C		Relay output 3, programmable. Default ² = Fault (-1) Maximum: 250 V AC / 30 V DC, 2 A Minimum: 500 mW (12 V, 10 mA)
	26 RO3A		
	27 RO3B		

¹ Digital input impedance 1.5 kohm. Maximum voltage for digital inputs is 30 V.

² Default values depend on the macro used. Values specified are for the default macro. See chapter [Application macros](#) on page 77.

Note: Terminals 3, 6 and 9 are at the same potential.

Note: For safety reasons the fault relay signals a “fault” when the ACS550 is powered down.

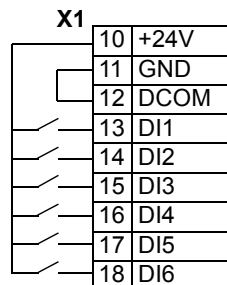


WARNING! All ELV (Extra Low Voltage) circuits connected to the drive must be used within a zone of equipotential bonding, i.e. within a zone where all simultaneously accessible conductive parts are electrically connected to prevent hazardous voltages appearing between them. This is accomplished by a proper factory grounding.

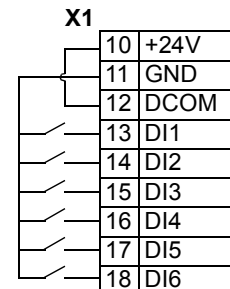
The terminals on the control board as well as on the optional modules attachable to the board fulfil the Protective Extra Low Voltage (PELV) requirements stated in EN 50178, provided that the external circuits connected to the terminals also fulfil the requirements and the installation site is below 2000 m (6562 ft).

You can wire the digital input terminals in either a PNP or NPN configuration.

PNP connection (source)



NPN connection (sink)



Check the insulation of the assembly

Drive

Do not make any voltage tolerance or insulation resistance tests on any part of the drive as testing can damage the drive. Every drive has been tested for insulation between the main circuit and the chassis at the factory. Also, there are voltage-limiting circuits inside the drive which cut down the testing voltage automatically.

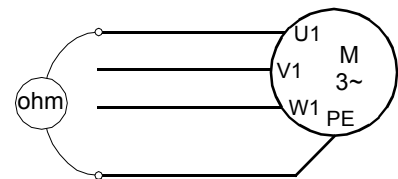
Supply cable

Check the insulation of the supply (input) cable according to local regulations before connecting to the drive.

Motor and motor cable

Check the insulation of the motor and motor cable as follows:

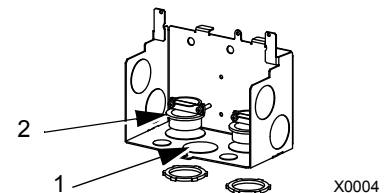
1. Check that the motor cable is connected to the motor, and disconnected from the drive output terminals U2, V2 and W2.
2. Measure the insulation resistance between phase conductors and between each phase conductor and the Protective Earth conductor using a measuring voltage of 1000 V DC. The insulation resistance of an ABB motor must exceed 100 Mohm (reference value at 25 °C or 77 °F). For the insulation resistance of other motors, please consult the manufacturer's instructions. **Note:** Moisture inside the motor casing will reduce the insulation resistance. If moisture is suspected, dry the motor and repeat the measurement.



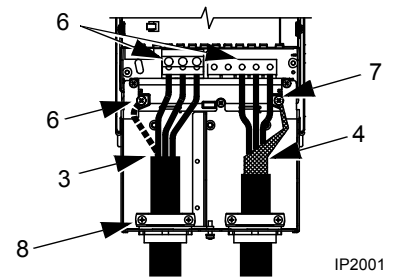
Install the wiring

Wiring IP21 / UL type 1 enclosure with **cables**

1. Open the appropriate knockouts in the conduit/gland box. (See section [Conduit/Gland kit](#) on page 23.)
2. Install the cable clamps for the power/motor cables.



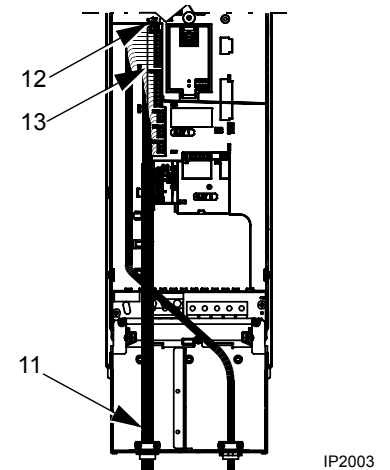
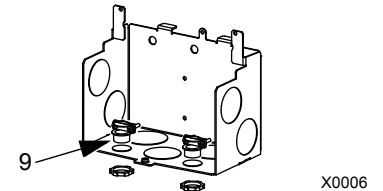
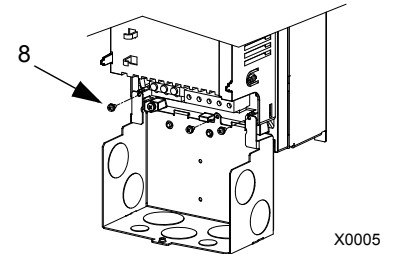
3. On the input power cable, strip the sheathing back far enough to route individual wires.
4. On the motor cable, strip the sheathing back far enough to expose the copper wire shield so that the shield can be twisted into a bundle (pig-tail). Keep the bundle not longer than five times its width to minimize noise radiation.
360° grounding under the clamp is recommended for the motor cable to minimize noise radiation. In this case, remove the sheathing at the cable clamp.
5. Route both cables through the clamps.
6. Strip and connect the power/motor wires and the power ground wire to the drive terminals. See the table on the right for tightening torques.



Frame size	Tightening torque	
	N·m	lb·ft
R1, R2	1.4	1
R3	2.5	1.8
R4	5.6; PE: 2	4; PE 1.5
R5	15	11
R6	40; PE: 8	30; PE: 6

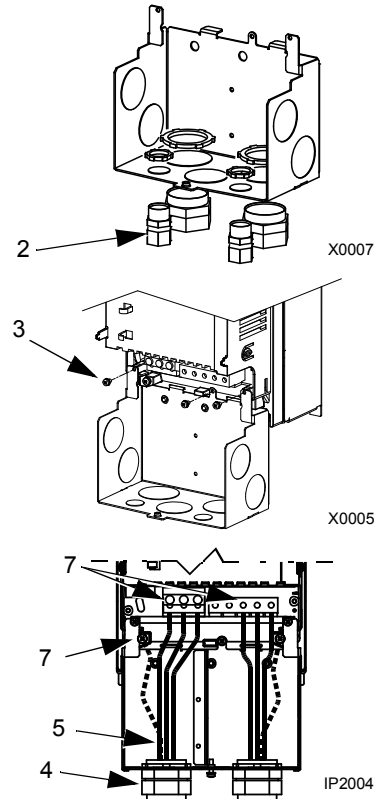
Note: For R6 frame size, refer to section [Power terminal considerations – R6 frame size](#) on page 287.

7. Connect the bundle (pig-tail) created from the motor cable shield to the GND terminal.
8. Install conduit/gland box and tighten the cable clamps.
9. Install the cable clamp(s) for the control cable(s). (Power/motor cables and clamps not shown in the figure.)
10. Strip control cable sheathing and twist the copper shield into a bundle (pig-tail).
11. Route control cable(s) through clamp(s) and tighten clamp(s).
12. Connect the ground shield bundle (pig-tail) for digital and analog I/O cables at X1-1. (Ground only at the drive end.)
13. Strip and connect the individual control wires to the drive terminals. See section [Control terminals table](#) on page 28. Use a tightening torque of 0.4 N·m (0.3 lb·ft).
14. Install the conduit/gland box cover (1 screw).



Wiring IP21 / UL type 1 enclosure with **conduit**

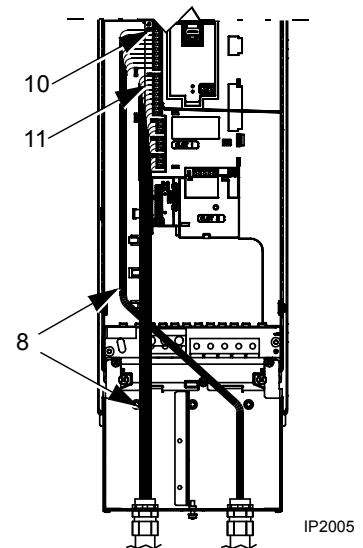
1. Open the appropriate knockouts in the conduit/gland box. (See section [Conduit/Gland kit](#) on page 23.)
2. Install thin-wall conduit clamps (not supplied).
3. Install conduit/gland box.
4. Connect conduit runs to box.
5. Route input power and motor wiring through conduits (must be separate conduit runs).
6. Strip wires.
7. Connect power, motor and ground wires to the drive terminals. See the table on the right for tightening torques.



Note: For R6 frame size, refer to section [Power terminal considerations – R6 frame size](#) on page 287.

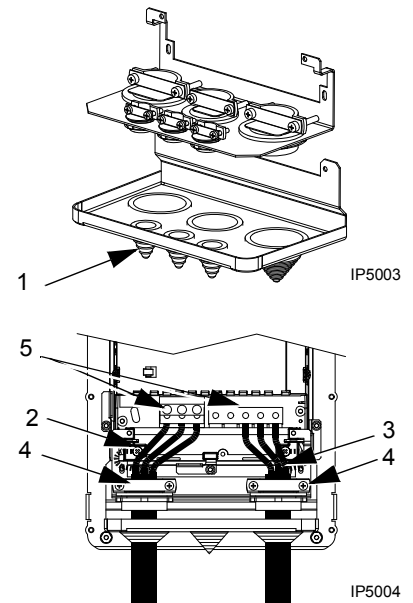
Frame size	Tightening torque	
	N·m	lb·ft
R1, R2	1.4	1
R3	2.5	1.8
R4	5.6; PE: 2	4; PE 1.5
R5	15	11
R6	40; PE: 8	30; PE: 6

8. Route the control cable through the conduit (must be separate from input power and motor conduit runs).
9. Strip the control cable sheathing and twist the copper shield into a bundle (pig-tail).
10. Connect the ground shield bundle (pig-tail) for digital and analog I/O cables at X1-1. (Ground only at the drive end.)
11. Strip and connect the individual control wires to the drive terminals. See section [Control terminals table](#) on page 28. Use a tightening torque of 0.4 N·m (0.3 lb·ft).
12. Install the conduit/gland box cover (1 screw).



Wiring IP54 / UL type 12 enclosure with cables

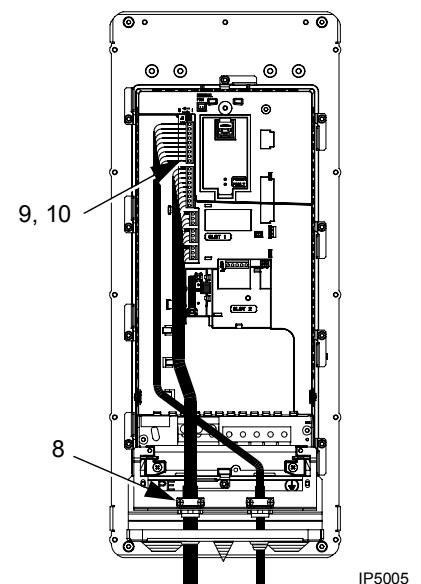
1. Cut the cable seals as needed for the power, motor and control cables. The cable seals are cone-shaped, rubber seals on the bottom of the drive. The conical part of the seals must face downwards when the seals are inserted in the lead-through plate holes.
2. On the input power cable, strip the sheathing back far enough to route individual wires.
3. On the motor cable, strip the sheathing back far enough to expose the copper wire shield so that the shield can be twisted into a bundle (pig-tail). Keep the bundle not longer than five times its width to minimize noise radiation. 360° grounding under the clamp is recommended for the motor cable to minimize noise radiation. In this case, remove the sheathing at the cable clamp.
4. Route both cables through the clamps and tighten the clamps.
5. Strip and connect the power/motor wires and the power ground wire to the drive terminals. See the table on the right for tightening torques.



Frame size	Tightening torque	
	N·m	lb·ft
R1, R2	1.4	1
R3	2.5	1.8
R4	5.6; PE: 2	4; PE 1.5
R5	15	11
R6	40; PE: 8	30; PE: 6

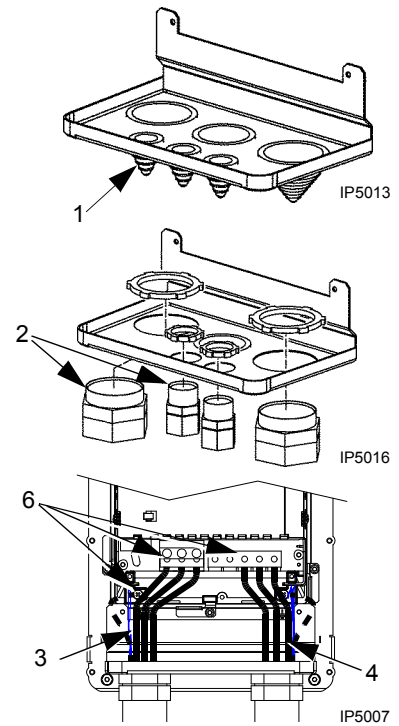
Note: For R6 frame size, refer to section [Power terminal considerations – R6 frame size](#) on page 287.

6. Connect the bundle (pig-tail) created from the motor cable shield to the GND terminal.
7. Strip control cable sheathing and twist the copper shield into a bundle (pig-tail).
8. Route control cable(s) through clamp(s) and tighten clamp(s).
9. Connect the ground shield bundle (pig-tail) for digital and analog I/O cables at X1-1. (Ground only at the drive end.)
10. Strip and connect the individual control wires to the drive terminals. See section [Control terminals table](#) on page 28. Use a tightening torque of 0.4 N·m (0.3 lb·ft).



Wiring **IP54** / UL type 12 enclosure with **conduit**

1. Remove and discard the cable seals where conduit will be installed. (The cable seals are cone-shaped, rubber seals on the bottom of the drive.)
2. For each conduit run, install water tight conduit connectors (not supplied).
3. Route the power wiring through the conduit.
4. Route the motor wiring through the conduit.
5. Strip the wires.
6. Connect the power, motor and ground wires to the drive terminals. See the table on the right for tightening torques.



Note: For R6 frame size, refer to section [Power terminal considerations – R6 frame size](#) on page 287.

Frame size	Tightening torque	
	N·m	lb·ft
R1, R2	1.4	1
R3	2.5	1.8
R4	5.6; PE: 2	4; PE 1.5
R5	15	11
R6	40; PE: 8	30; PE: 6

7. Route the control cable through the conduit.
8. Strip the control cable sheathing and twist the copper shield into a bundle (pig-tail).
9. Connect the ground shield bundle (pig-tail) for digital and analog I/O cables at X1-1. (Ground only at the drive end.)
10. Strip and connect the individual control wires to the drive terminals. See section [Control terminals table](#) on page 28. Use a tightening torque of 0.4 N·m (0.3 lb·ft).

Check installation

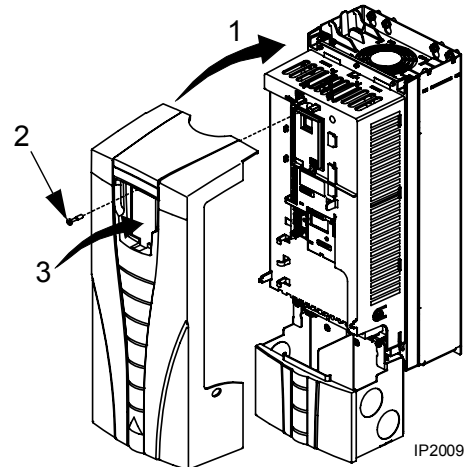
Before applying power, perform the following checks.

✓	Check
	Installation environment conforms to the drive's specifications for ambient conditions.
	The drive is mounted securely.
	Space around the drive meets the drive's specifications for cooling.
	The motor and driven equipment are ready for start.
	For IT systems and corner-grounded TN systems: The internal EMC filter is disconnected (see section Disconnecting the internal EMC filter on page 27).
	The drive is properly grounded.
	The input power (mains) voltage matches the drive nominal input voltage.
	The input power (mains) connections at U1, V1 and W1 are connected and tightened as specified.
	The input power (mains) fuses are installed.
	The motor connections at U2, V2 and W2 are connected and tightened as specified.
	The motor cable is routed away from other cables.
	NO power factor compensation capacitors are in the motor cable.
	The control connections are connected and tightened as specified.
	NO tools or foreign objects (such as drill shavings) are inside the drive.
	NO alternate power source for the motor (such as a bypass connection) is connected – no voltage is applied to the output of the drive.

Reinstall the cover

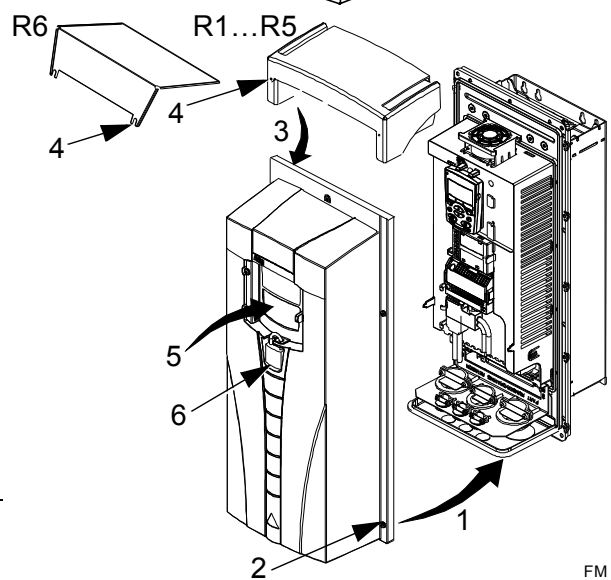
IP21 / UL type 1

1. Align the cover and slide it on.
2. Tighten the captive screw.
3. Reinstall the control panel.
4. Continue with start-up. See chapter [Start-up, control with I/O and ID Run](#) on page 37.



IP54 / UL type 12

1. Align the cover and slide it on.
2. Tighten the captive screws around the edge of the cover.
3. Slide the hood down over the top of the cover. (Only needed for UL type 12 installations.)
4. Install the two screws that attach the hood. (Only needed for UL type 12 installations.)
5. Install the control panel.



Note: The control panel window must be closed to comply with IP54 / UL type 12.

6. Optional: Add a lock (not supplied) to secure the control panel window.
7. Continue with start-up. See chapter [Start-up, control with I/O and ID Run](#) on page 37.

Start-up, control with I/O and ID Run

The chapter instructs how to:

- perform the start-up
- start, stop, change the direction of rotation and adjust the speed of the motor through the I/O interface
- perform an Identification Run for the drive.

Using the control panel to do these tasks is explained briefly in this chapter. For details on how to use the control panel, refer to chapter [Control panels](#) starting on page [47](#).

How to start up the drive

How you start up the drive depends on the control panel you have.

- **If you have an Assistant Control Panel**, you can either run the Start-up Assistant (see section [How to perform the guided start-up](#) on page [42](#)) or perform a limited start-up (see section [How to perform the limited start-up](#) on page [37](#)).

The Start-up Assistant, which is included in the Assistant Control Panel only, guides you through all essential settings to be done. In the limited start-up, the drive gives no guidance; you go through the very basic settings by following the instructions given in the manual.

- **If you have a Basic Control Panel**, follow the instructions given in section [How to perform the limited start-up](#) on page [37](#).

How to perform the limited start-up

For the limited start-up, you can use the Basic Control Panel or the Assistant Control Panel. The instructions below are valid for both control panels, but the displays shown are the Basic Control Panel displays, unless the instruction applies to the Assistant Control Panel only.

Before you start, ensure that you have the motor nameplate data on hand.

SAFETY



The start-up may only be carried out by a qualified electrician.

The safety instructions given in chapter [Safety instructions](#) must be followed during the start-up procedure.



The drive will start up automatically at power up, if the external run command is on.



Check the installation. See the checklist in chapter [Installation](#), page [35](#).

- ☐ Check that the starting of the motor does not cause any danger.
De-couple the driven machine if:
- there is a risk of damage in case of incorrect direction of rotation, or
 - an ID Run needs to be performed during the drive start-up. ID Run is essential only in applications that require the ultimate in motor control accuracy.

POWER-UP

- ☐ Apply input power.
 The Basic Control Panel powers up into the Output mode.
- The Assistant Control Panel asks if you want to run the Start-up Assistant. If you press , the Start-up Assistant is not run, and you can continue with manual start-up in a similar manner as described below for the Basic Control Panel.

REM	0.0 Hz
OUTPUT	FWD

REM  CHOICE	
Do you want to use the start-up assistant?	
Yes	
No	
EXIT	00:00 OK

MANUAL ENTRY OF START-UP DATA (*Group 99: START-UP DATA*)

- ☐ If you have an Assistant Control Panel, select the language (the Basic Control Panel does not support languages). See parameter **9901** for the values of the available language alternatives. You find parameter descriptions in section [Complete parameter descriptions](#) starting on page 106.
- The general parameter setting procedure is described below for the Basic Control Panel. You find more detailed instructions for the Basic Control Panel on page 73. Instructions for the Assistant Control Panel are on page 55.
- The general parameter setting procedure:
1. To go to the Main menu, press  if the bottom line shows OUTPUT; otherwise press  repeatedly until you see MENU at the bottom.
 2. Press keys / until you see "PAR" and press .
 3. Find the appropriate parameter group with keys / and press .
 4. Find the appropriate parameter in the group with keys /.
 5. Press and hold  for about two seconds until the parameter value is shown with **SET** under the value.
 6. Change the value with keys /. The value changes faster while you keep the key pressed down.
 7. Save the parameter value by pressing .

REM	 PAR EDIT
9901	LANGUAGE
	ENGLISH
[0]	
CANCEL	00:00 SAVE

REM	rEF
MENU	FWD

REM	-01-
PAR	FWD

REM	2001
PAR	FWD

REM	2002
PAR	FWD

REM	1500 rpm
PAR	SET FWD

REM	1600 rpm
PAR	SET FWD

REM	2002
PAR	FWD

- ☐ Select the application macro (parameter [9902](#)). The general parameter setting procedure is given above.
The default value 1 (ABB STANDARD) is suitable in most cases.
- ☐ Select the motor control mode (parameter [9904](#)).
1 (VECTOR:SPEED) is suitable in most cases. 2 (VECTOR:TORQ) is suitable for torque control applications. 3 (SCALAR:FREQ) is recommended
 - for multimotor drives when the number of the motors connected to the drive is variable
 - when the nominal current of the motor is less than 20% of the nominal current of the drive
 - when the drive is used for test purposes with no motor connected.
- ☐ Enter the motor data from the motor nameplate:

ABB Motors										CE					
3 ~ motor										M2AA 200 MLA 4					
										IEC 200 M/L 55					
										No					
										Ins.cl. F		IP 55			
V		Hz		kW		r/min		A		cos φ		I _A /I _N		t _E /s	
690 Y		50		30		1475		32.5		0.83					
400 D		50		30		1475		56		0.83					
660 Y		50		30		1470		34		0.83					
380 D		50		30		1470		59		0.83		←		380 V supply voltage	
415 D		50		30		1475		54		0.83					
440 D		60		35		1770		59		0.83					
Cat. no		3GAA 202 001 - ADA													
6312/C3				6210/C3				180 kg							
IEC 34-1															

380 V
supply
voltage

- motor nominal voltage (parameter [9905](#))
- motor nominal current (parameter [9906](#))
Allowed range: $0.2 \dots 2.0 \cdot I_{2hd}$ A
- motor nominal frequency (parameter [9907](#))
- motor nominal speed (parameter [9908](#))
- motor nominal power (parameter [9909](#))

REM	9902
PAR	FWD

REM	9904
PAR	FWD

Note: Set the motor data to exactly the same value as on the motor nameplate. For example, if the motor nominal speed is 1470 rpm on the nameplate, setting the value of parameter [9908](#) MOTOR NOM SPEED to 1500 rpm results in the wrong operation of the drive.

REM	9905
PAR	FWD

REM	9906
PAR	FWD

REM	9907
PAR	FWD

REM	9908
PAR	FWD

REM	9909
PAR	FWD

- Select the motor identification method (parameter [9910](#)).
- The default value 0 (OFF/IDMAGN) using the identification magnetization is suitable for most applications. It is applied in this basic start-up procedure. Note however that this requires that:
- parameter [9904](#) is set to 1 (VECTOR:SPEED) or 2 (VECTOR:TORQ), or
 - parameter [9904](#) is set to 3 (SCALAR:FREQ) and parameter [2101](#) is set to 3 (SCALAR FLYST) or 5 (FLY + BOOST).

If your selection is 0 (OFF/IDMAGN), move to the next step.

Value 1 (ON), which performs a separate ID Run, should be selected if:

- vector control mode is used [parameter [9904](#) = 1 (VECTOR:SPEED) or 2 (VECTOR:TORQ)], and/or
- the operation point is near zero speed, and/or
- operation at torque range above the motor nominal torque over a wide speed range and without any measured speed feedback is required.

If you decide to do the ID Run [value 1 (ON)], continue by following the separate instructions given on page [45](#) in section [How to perform the ID Run](#) and then return to step [DIRECTION OF THE MOTOR ROTATION](#) on page [40](#).

IDENTIFICATION MAGNETIZATION WITH ID RUN SELECTION 0 (OFF/IDMAGN)

- As stated above, the identification magnetization is performed only if:
- parameter [9904](#) is set to 1 (VECTOR:SPEED) or 2 (VECTOR:TORQ), or
 - parameter [9904](#) is set to 3 (SCALAR:FREQ) and parameter [2101](#) is set to 3 (SCALAR FLYST) or 5 (FLY + BOOST).

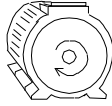
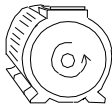
Press key  to switch to local control (LOC shown on the left).

Press  to start the drive. The motor model is now calculated by magnetizing the motor for 10 to 15 s at zero speed (motor not rotating).

DIRECTION OF THE MOTOR ROTATION

- Check the direction of the motor rotation.
- If the drive is in remote control (REM shown on the left), switch to local control by pressing .
 - To go to the Main menu, press  if the bottom line shows OUTPUT; otherwise press  repeatedly until you see MENU at the bottom.
 - Press keys / until you see "rEF" and press .
 - Increase the frequency reference from zero to a small value with key .
 - Press  to start the motor.
 - Check that the actual direction of the motor is the same as indicated on the display (FWD means forward and REV reverse).
 - Press  to stop the motor.

LOC **XXX** Hz
SET FWD

	To change the direction of the motor rotation: • Disconnect input power from the drive, and wait 5 minutes for the intermediate circuit capacitors to discharge. Measure the voltage between each input terminal (U1, V1 and W1) and earth with a multimeter to ensure that the drive is discharged. • Exchange the position of two motor cable phase conductors at the drive output terminals or at the motor connection box. • Verify your work by applying input power and repeating the check as described above.	 forward direction  reverse direction
SPEED LIMITS AND ACCELERATION/DECELERATION TIMES		
☐	Set the minimum speed (parameter 2001).	LOC 2001 PAR FWD
☐	Set the maximum speed (parameter 2002).	LOC 2002 PAR FWD
☐	Set the acceleration time 1 (parameter 2202). Note: Check also acceleration time 2 (parameter 2205) if two acceleration times will be used in the application.	LOC 2202 PAR FWD
☐	Set the deceleration time 1 (parameter 2203). Note: Set also deceleration time 2 (parameter 2206) if two deceleration times will be used in the application.	LOC 2203 PAR FWD
SAVING A USER PARAMETER SET AND FINAL CHECK		
☐	The start-up is now completed. However, it might be useful at this stage to set the parameters required by your application and save the settings as a user parameter set as instructed in section User parameter sets on page 88 .	LOC 9902 PAR FWD
☐	Check that the drive state is OK. Basic Control Panel: Check that there are no faults or alarms shown on the display. If you want to check the LEDs on the front of the drive, switch first to remote control (otherwise a fault is generated) before removing the panel and verifying that the red LED is not lit and the green LED is lit but not blinking. Assistant Control Panel: Check that there are no faults or alarms shown on the display and that the panel LED is green and does not blink.	
The drive is now ready for use.		

How to perform the guided start-up

To be able to perform the guided start-up, you need the Assistant Control Panel.

Before you start, ensure that you have the motor nameplate data on hand.

SAFETY



The start-up may only be carried out by a qualified electrician.

The safety instructions given in chapter [Safety instructions](#) must be followed during the start-up procedure.



The drive will start up automatically at power up, if the external run command is on.

- ☐ Check the installation. See the checklist in chapter [Installation](#), page [35](#).
- ☐ Check that the starting of the motor does not cause any danger.
De-couple the driven machine if:
 - there is a risk of damage in case of incorrect direction of rotation, or
 - an ID Run needs to be performed during the drive start-up. ID Run is essential only in applications that require the ultimate in motor control accuracy.

POWER-UP

- ☐ Apply input power. The control panel first asks if you want to use the Start-up Assistant.
 - Press (when **Yes** is highlighted) to run the Start-up Assistant.
 - Press if you do not want to run the Start-up Assistant.
 - Press key to highlight **NO** and then press if you want to make the panel ask (or not ask) the question about running the Start-up Assistant again the next time you switch on the power to the drive.

REM	CHOICE
Do you want to use the start-up assistant?	
Yes	
NO	
EXIT	00:00 OK

REM	CHOICE
Show start-up assistant on next boot?	
Yes	
NO	
EXIT	00:00 OK

SELECTING THE LANGUAGE

- ☐ If you decided to run the Start-up Assistant, the display then asks you to select the language. Scroll to the desired language with keys / and press to accept. If you press , the Start-up Assistant is stopped.

REM	PAR EDIT
9901 LANGUAGE	
ENGLISH	
[0]	
EXIT	00:00 SAVE

STARTING THE GUIDED SET-UP

- ☐ The Start-up Assistant now guides you through the set-up tasks, starting with the motor set-up. Set the motor data to exactly the same value as on the motor nameplate.
 Scroll to the desired parameter value with keys / and press to accept and continue with the Start-up Assistant.
Note: At any time, if you press , the Start-up Assistant is stopped and the display goes to the Output mode.

REM	PAR EDIT
9905 MOTOR NOM VOLT	
220 V	
EXIT	00:00 SAVE

How to control the drive through the I/O interface

The table below instructs how to operate the drive through the digital and analog inputs when:

- the motor start-up is performed, and
- the default (standard) parameter settings are valid.

Displays of the Basic Control Panel are shown as an example.

PRELIMINARY SETTINGS	
If you need to change the direction of rotation, check that parameter 1003 is set to 3 (REQUEST). Ensure that the control connections are wired according to the connection diagram given for the ABB Standard macro. Ensure that the drive is in remote control. Press key  to switch between remote and local control.	See section ABB Standard macro on page 78. In remote control, the panel display shows text REM.
STARTING AND CONTROLLING THE SPEED OF THE MOTOR	
Start by switching digital input DI1 on. Assistant Control Panel: The arrow starts rotating. It is dotted until the setpoint is reached. Basic Control Panel: Text FWD starts flashing fast and stops after the setpoint is reached Regulate the drive output frequency (motor speed) by adjusting the voltage of analog input AI1.	REM 0.0 Hz OUTPUT FWD REM 50.0 Hz OUTPUT FWD
CHANGING THE DIRECTION OF ROTATION OF THE MOTOR	
Reverse direction: Switch digital input DI2 on. Forward direction: Switch digital input DI2 off.	REM 50.0 Hz OUTPUT REV REM 50.0 Hz OUTPUT FWD
STOPPING THE MOTOR	
Switch digital input DI1 off. The motor stops. Assistant Control Panel: The arrow stops rotating. Basic Control Panel: Text FWD starts flashing slowly.	REM 0.0 Hz OUTPUT FWD

How to perform the ID Run

The drive estimates motor characteristics automatically using identification magnetization when the drive is started for the first time and after any motor parameter (*Group 99: START-UP DATA*) is changed. This is valid when parameter **9910** ID RUN has value 0 (OFF/IDMAGN), and

- parameter **9904** = 1 (VECTOR:SPEED) or 2 (VECTOR:TORQ), or
- parameter **9904** = 3 (SCALAR:FREQ) and parameter **2101** = 3 (SCALAR FLYST) or 5 (FLY + BOOST).

In most applications there is no need to perform a separate ID Run [**9910** ID RUN = 1 (ON)]. The ID Run should be selected if:

- vector control mode is used [parameter **9904** = 1 (VECTOR:SPEED) or 2 (VECTOR:TORQ)], and/or
- the operation point is near zero speed, and/or
- operation at torque range above the motor nominal torque over a wide speed range and without any measured speed feedback is required.

Note: If motor parameters (*Group 99: START-UP DATA*) are changed after the ID Run, it must be repeated.

ID Run procedure

The general parameter setting procedure is not repeated here. For Assistant Control Panel see page **55** and for Basic Control Panel page **73** in chapter *Control panels*.

PRE-CHECK



WARNING! The motor will run at up to approximately 50...80% of the nominal speed during the ID Run. The motor will rotate in the forward direction. **Ensure that it is safe to run the motor before performing the ID Run!**

- ☐ De-couple the motor from the driven equipment.
- ☐ Check that the values of the motor data parameters **9905**...**9909** are equivalent to those on the motor nameplate, as shown in the steps on page **39**.
- ☐ If parameter values (*Group 01: OPERATING DATA* to *Group 98: OPTIONS*) are changed before the ID Run, check that the new settings meet the following conditions:
 - ☐ **2001** MINIMUM SPEED ≤ 0 rpm
 - ☐ **2002** MAXIMUM SPEED $> 80\%$ of the motor rated speed
 - ☐ **2003** MAXIMUM CURRENT $\geq I_{2hd}$
 - ☐ **2017** MAX TORQUE 1 $> 50\%$ or **2018** MAX TORQUE 2 $> 50\%$, depending on which limit is in use according to parameter **2014** MAX TORQUE SEL.
- ☐ Check that the Run Enable signal is on (parameter **1601**).
- ☐ Ensure that the panel is in local control (LOC shown on the left / at the top). Press key  to switch between local and remote control.

ID RUN WITH THE ASSISTANT CONTROL PANEL

- ☐ Change parameter **9910** ID RUN to 1 (ON). Save the new setting by pressing .
 - ☐ If you want to monitor actual values during the ID Run, go to the Output mode by pressing  repeatedly until you get there.
 - ☐ Press  to start the ID Run. The panel keeps switching between the display that was shown when you started the ID Run and the alarm display presented on the right.
In general, it is recommended not to press any control panel keys during the ID Run. However, you can stop the ID Run at any time by pressing .
- After the ID Run is completed, the alarm display is not shown any more.
- If the ID Run fails, the fault display presented on the right is shown.

LOC  PAR EDIT

9910 ID RUN
ON

[1]

CANCEL 00:00 SAVE

LOC  **50.0Hz**

0.0 Hz
0.0 A
0.0 %

DIR 00:00 MENU

LOC  ALARM

ALARM 2019

ID run

00:00

LOC  FAULT

FAULT 11

ID RUN FAIL

00:00

ID RUN WITH THE BASIC CONTROL PANEL

- ☐ Change parameter **9910** ID RUN to 1 (ON). Save the new setting by pressing .
 - ☐ If you want to monitor actual values during the ID Run, go to the Output mode by pressing  repeatedly until you get there.
 - ☐ Press  to start the ID Run. The panel keeps switching between the display that was shown when you started the ID Run and the alarm display presented on the right.
In general, it is recommended not to press any control panel keys during the ID Run. However, you can stop the ID Run at any time by pressing .
- After the ID Run is completed, the alarm display is not shown any more.
- If the ID Run fails, the fault display presented on the right is shown.

LOC **9910**

PAR FWD

LOC **1**

PAR **SET** FWD

LOC **0.0** Hz

OUTPUT FWD

LOC **A2019**

FWD

LOC **F0011**

FWD

Control panels

About control panels

Use a control panel to control the drive, read status data and adjust parameters. The drive works with either of two different control panel types:

- Basic Control Panel – This panel (described in section [Basic Control Panel](#) on page 68) provides basic tools for manual entry of parameter values.
- Assistant Control Panel – This panel (described below) includes pre-programmed assistants to automate the most common parameter setups. The panel provides language support. It is available with different language sets.

Compatibility

The manual is compatible with the following panel versions:

- Basic Control Panel: ACS-CP-C Rev. M or later
- Assistant Control Panel (Area 1): ACS-CP-A Rev. F or later
(new panel series manufactured since 2007 with serial number XYYWWRXXXX, where year YY = 07 or greater and revision R = F, G, E, ...)
- Assistant Control Panel (Asia): ACS-CP-D Rev. Q or later

See page 51 for how to find out the version of your Assistant Control Panel. See parameter 9901 LANGUAGE to see the languages supported by the different Assistant Control Panels.

Assistant Control Panel

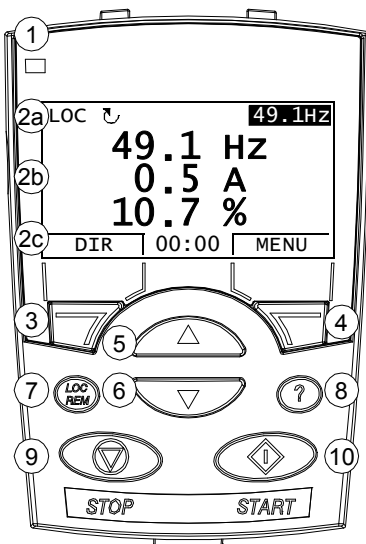
Features

The Assistant Control Panel features:

- alphanumeric control panel with an LCD display
- language selection for the display
- Start-up Assistant to ease drive commissioning
- copy function – parameters can be copied to the control panel memory for later transfer to other drives or for backup of a particular system.
- context sensitive help
- real time clock.

Overview

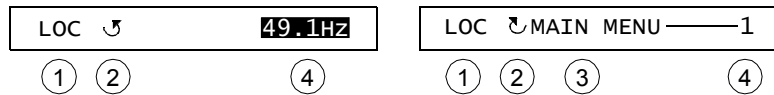
The following table summarizes the key functions and displays on the Assistant Control Panel.



No.	Use
1	Status LED – Green for normal operation. If LED is flashing, or red, see section Diagnostic displays on page 259.
2	LCD display – Divided into three main areas: - Status line – variable, depending on the mode of operation, see section Status line on page 49. - Center – variable; in general, shows signal and parameter values, menus or lists. Shows also faults and alarms. - Bottom line – shows current functions of the two soft keys and, if enabled, the clock display.
3	Soft key 1 – Function depends on the context. The text in the lower left corner of the LCD display indicates the function.
4	Soft key 2 – Function depends on the context. The text in the lower right corner of the LCD display indicates the function.
5	Up – • Scrolls up through a menu or list displayed in the center of the LCD display. • Increments a value if a parameter is selected. • Increments the reference value if the upper right corner is highlighted. Holding the key down changes the value faster.
6	Down – • Scrolls down through a menu or list displayed in the center of the LCD display. • Decrements a value if a parameter is selected. • Decrements the reference value if the upper right corner is highlighted. Holding the key down changes the value faster.
7	LOC/REM – Changes between local and remote control of the drive.
8	Help – Displays context sensitive information when the key is pressed. The information displayed describes the item currently highlighted in the center of the display.
9	STOP – Stops the drive in local control.
10	START – Starts the drive in local control.

Status line

The top line of the LCD display shows the basic status information of the drive.



No.	Field	Alternatives	Significance
1	Control location	LOC	Drive control is local, that is, from the control panel.
		REM	Drive control is remote, such as the drive I/O or fieldbus.
2	State	↶	Forward shaft direction
		↷	Reverse shaft direction
		Rotating arrow	Drive is running at setpoint.
		Dotted rotating arrow	Drive is running but not at setpoint.
		Stationary arrow	Drive is stopped.
		Dotted stationary arrow	Start command is present, but the motor is not running, e.g. because start enable is missing.
3	Panel operation mode		- Name of the current mode - Name of the list or menu shown - Name of the operation state, e.g. PAR EDIT.
4	Reference value or number of the selected item		- Reference value in the Output mode - Number of the highlighted item, e.g mode, parameter group or fault.

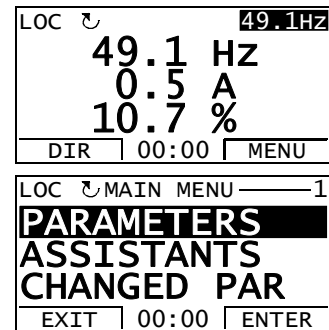
Operation

You operate the control panel with menus and keys. The keys include two context-sensitive soft keys, whose current function is indicated by the text shown in the display above each key.

You select an option, e.g. operation mode or parameter, by scrolling the and arrow keys until the option is highlighted (in reverse video) and then pressing the relevant soft key. With the right soft key you usually enter a mode, accept an option or save the changes. The left soft key is used to cancel the made changes and return to the previous operation level.

The Assistant Control Panel has nine panel modes: Output, Parameters, Assistants, Changed Parameters, Fault Logger, Time and Date, Parameter Backup, I/O Settings and Fault. The operation in the first eight modes is described in this chapter. When a fault or alarm occurs, the panel goes automatically to the Fault mode showing the fault or alarm. You can reset it in the Output or Fault mode (see chapter [Diagnostics](#)).

Initially, the panel is in the Output mode, where you can start, stop, change the direction, switch between local and remote control, modify the reference value and monitor up to three actual values. To do other tasks, go first to the Main menu and select the appropriate mode on the menu. The status line (see section [Status line](#) on page 49) shows the name of the current menu, mode, item or state.



How to do common tasks

The table below lists common tasks, the mode in which you can perform them and the page number where the steps to do the task are described in detail.

Task	Mode	Page
How to get help	Any	51
How to find out the panel version	At power up	51
How to adjust the display contrast	Output	54
How to switch between local and remote control	Any	52
How to start and stop the drive	Any	52
How to change the direction of the motor rotation	Output	53
How to set the speed, frequency or torque reference	Output	54
How to change the value of a parameter	Parameters	55
How to select the monitored signals	Parameters	56
How to do guided tasks (specification of related parameter sets) with assistants	Assistants	57
How to view and edit changed parameters	Changed Parameters	60
How to view faults	Fault Logger	61
How to reset faults and alarms	Output, Fault	265
How to show/hide the clock, change date and time formats, set the clock and enable/disable automatic clock transitions according to the daylight saving changes	Time and Date	62
How to copy parameters from the drive to the control panel	Parameter Backup	65
How to restore parameters from the control panel to the drive	Parameter Backup	65
How to view backup information	Parameter Backup	66
How to edit and change parameter settings related to I/O terminals	I/O Settings	67

How to get help

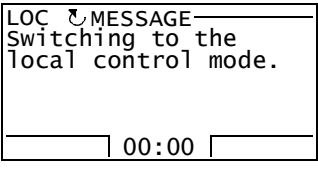
Step	Action	Display
1.	Press  to read the context-sensitive help text for the item that is highlighted. If help text exists for the item, it is shown on the display.	LOC  PAR GROUPS—10 01 OPERATING DATA 03 FB ACTUAL SIGNALS 04 FAULT HISTORY 10 START/STOP/DIR 11 REFERENCE SELECT EXIT 00:00 SEL LOC  HELP— This group defines external sources (EXT1 and EXT2) for commands that enable start, stop and direction changes. EXIT 00:00
2.	If the whole text is not visible, scroll the lines with keys  and  .	LOC  HELP— external sources (EXT1 and EXT2) for commands that enable start, stop and direction changes. EXIT 00:00
3.	After reading the text, return to the previous display by pressing  .	LOC  PAR GROUPS—10 01 OPERATING DATA 03 FB ACTUAL SIGNALS 04 FAULT HISTORY 10 START/STOP/DIR 11 REFERENCE SELECT EXIT 00:00 SEL

How to find out the panel version

Step	Action	Display
1.	If the power is switched on, switch it off.	
2.	Keep key  pressed down while you switch on the power and read the information. The display shows the following panel information: Panel FW: panel firmware version ROM CRC: panel ROM check sum Flash Rev: flash content version Flash content comment. When you release the  key, the panel goes to the Output mode.	PANEL VERSION INFO Panel FW: x.xx ROM CRC: xxxxxxxxxx Flash Rev: x.xx xxxxxxxxxxxxxxxxxxxxxxxx

How to start, stop and switch between local and remote control

You can start, stop and switch between local and remote control in any mode. To be able to start or stop the drive, the drive must be in local control.

Step	Action	Display
1.	- To switch between remote control (REM shown on the status line) and local control (LOC shown on the status line), press . Note: Switching to local control can be disabled with parameter 1606 LOCAL LOCK. The very first time the drive is powered up, it is in remote control (REM) and controlled through the drive I/O terminals. To switch to local control (LOC) and control the drive using the control panel, press . The result depends on how long you press the key: - If you release the key immediately (the display flashes "Switching to the local control mode"), the drive stops. Set the local control reference as instructed on page 54. - If you press the key for about two seconds, the drive continues as before. The drive copies the current remote values for the run/stop status and the reference, and uses them as the initial local control settings. - To stop the drive in local control, press . - To start the drive in local control, press .	 The arrow ( or ) on the status line stops rotating. The arrow ( or ) on the status line starts rotating. It is dotted until the drive reaches the setpoint.

Output mode

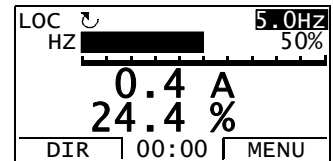
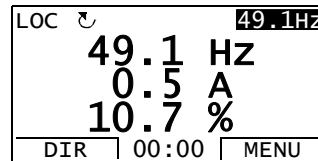
In the Output mode, you can:

- monitor actual values of up to three signals in *Group 01: OPERATING DATA*
- change the direction of the motor rotation
- set the speed, frequency or torque reference
- adjust the display contrast
- start, stop, change the direction and switch between local and remote control.

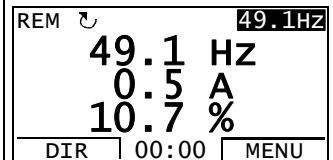
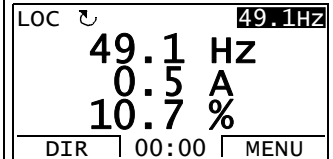
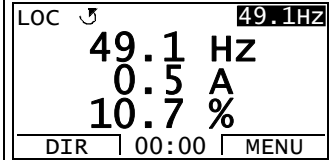
You get to the Output mode by pressing  repeatedly.

The top right corner of the display shows the reference value. The center can be configured to show up to three signal values or bar graphs. If just one or two signals are

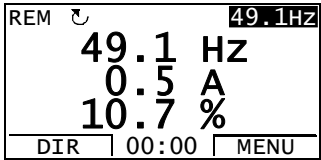
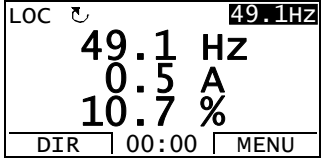
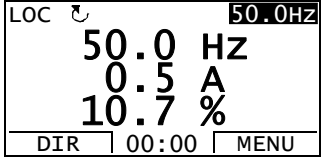
selected for display, the number and name of each displayed signal are shown in addition to the value or bar graph. See page 56 for instructions on selecting and modifying the monitored signals.



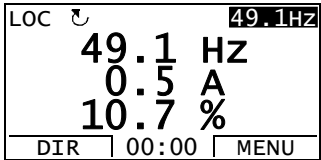
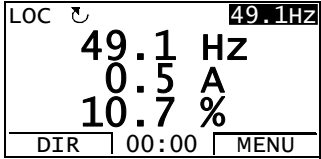
How to change the direction of the motor rotation

Step	Action	Display
1.	If you are not in the Output mode, press  repeatedly until you get there.	
2.	If the drive is in remote control (REM shown on the status line), switch to local control by pressing  . The display briefly shows a message about changing the mode and then returns to the Output mode.	
3.	To change the direction from forward ( shown on the status line) to reverse ( shown on the status line), or vice versa, press  . Note: Parameter 1003 DIRECTION must be set to 3 (REQUEST).	

How to set the speed, frequency or torque reference

Step	Action	Display
1.	If you are not in the Output mode, press  repeatedly until you get there.	
2.	If the drive is in remote control (REM shown on the status line), switch to local control by pressing  . The display briefly shows a message about changing the mode and then returns to the Output mode. Note: With Group 11: REFERENCE SELECT , you can allow the reference modification in remote control.	
3.	- To increase the highlighted reference value shown in the top right corner of the display, press . The value changes immediately. It is stored in the drive permanent memory and restored automatically after power switch-off. - To decrease the value, press .	

How to adjust the display contrast

Step	Action	Display
1.	If you are not in the Output mode, press  repeatedly until you get there.	
2.	- To increase the contrast, press keys  and  simultaneously. - To decrease the contrast, press keys  and  simultaneously.	

Parameters mode

In the Parameters mode, you can:

- view and change parameter values
- start, stop, change the direction and switch between local and remote control.

How to select a parameter and change its value

Step	Action	Display
1.	Go to the Main menu by pressing  if you are in the Output mode, otherwise by pressing  repeatedly until you get to the Main menu.	LOC ↺ MAIN MENU — 1 PARAMETERS ASSISTANTS CHANGED PAR EXIT 00:00 ENTER
2.	Go to the Parameters mode by selecting PARAMETERS on the menu with keys  and  , and pressing  .	LOC ↺ PAR GROUPS — 01 01 OPERATING DATA 03 FB ACTUAL SIGNALS 04 FAULT HISTORY 10 START/STOP/DIR 11 REFERENCE SELECT EXIT 00:00 SEL
3.	Select the appropriate parameter group with keys  and  . Press  .	LOC ↺ PAR GROUPS — 99 99 START-UP DATA 01 OPERATING DATA 03 FB ACTUAL SIGNALS 04 FAULT HISTORY 10 START/STOP/DIR EXIT 00:00 SEL LOC ↺ PARAMETERS — 9901 LANGUAGE ENGLISH 9902 APPLIC MACRO 9904 MOTOR CTRL MODE 9905 MOTOR NOM VOLT EXIT 00:00 EDIT
4.	Select the appropriate parameter with keys  and  . The current value of the parameter is shown below the selected parameter. Press  .	LOC ↺ PARAMETERS — 9901 LANGUAGE 9902 APPLIC MACRO ABB STANDARD 9904 MOTOR CTRL MODE 9905 MOTOR NOM VOLT EXIT 00:00 EDIT LOC ↺ PAR EDIT — 9902 APPLIC MACRO ABB STANDARD [1] CANCEL 00:00 SAVE
5.	Specify a new value for the parameter with keys  and  . Pressing the key once increments or decrements the value. Holding the key down changes the value faster. Pressing the keys simultaneously replaces the displayed value with the default value.	LOC ↺ PAR EDIT — 9902 APPLIC MACRO 3-WIRE [2] CANCEL 00:00 SAVE
6.	• To save the new value, press . • To cancel the new value and keep the original, press .	LOC ↺ PARAMETERS — 9901 LANGUAGE 9902 APPLIC MACRO 3-WIRE 9904 MOTOR CTRL MODE 9905 MOTOR NOM VOLT EXIT 00:00 EDIT

How to select the monitored signals

Step	Action	Display
1.	You can select which signals are monitored in the Output mode and how they are displayed with Group 34: PANEL DISPLAY parameters. See page 55 for detailed instructions on changing parameter values. By default, the display shows three signals. The particular default signals depend on the value of parameter 9902 APPLIC MACRO: For macros whose default value of parameter 9904 MOTOR CTRL MODE is 1 (VECTOR:SPEED), the default for signal 1 is 0102 SPEED, otherwise 0103 OUTPUT FREQ. The defaults for signals 2 and 3 are always 0104 CURRENT and 0105 TORQUE, respectively. To change the default signals, select up to three signals from Group 01: OPERATING DATA to be shown. Signal 1: Change the value of parameter 3401 SIGNAL1 PARAM to the index of the signal parameter in Group 01: OPERATING DATA (= number of the parameter without the leading zero), e.g. 105 means parameter 0105 TORQUE. Value 100 means that no signal is displayed. Repeat for signals 2 (3408 SIGNAL2 PARAM) and 3 (3415 SIGNAL3 PARAM).	LOC ☐ PAR EDIT— 3401 SIGNAL1 PARAM OUTPUT FREQ [103] CANCEL 00:00 SAVE LOC ☐ PAR EDIT— 3408 SIGNAL2 PARAM CURRENT [104] CANCEL 00:00 SAVE LOC ☐ PAR EDIT— 3415 SIGNAL3 PARAM TORQUE [105] CANCEL 00:00 SAVE
2.	Select how you want the signals to be displayed: as a decimal number or a bar graph. For decimal numbers, you can specify the decimal point location, or use the decimal point location and unit of the source signal [setting (9 (DIRECT))]. For details, see parameter 3404. Signal 1: parameter 3404 OUTPUT1 DSP FORM Signal 2: parameter 3411 OUTPUT2 DSP FORM Signal 3: parameter 3418 OUTPUT3 DSP FORM.	LOC ☐ PAR EDIT— 3404 OUTPUT1 DSP FORM DIRECT [9] CANCEL 00:00 SAVE
3.	Select the units to be displayed for the signals. This has no effect if parameter 3404/3411/3418 is set to 9 (DIRECT). For details, see parameter 3405. Signal 1: parameter 3405 OUTPUT1 UNIT Signal 2: parameter 3412 OUTPUT2 UNIT Signal 3: parameter 3419 OUTPUT3 UNIT.	LOC ☐ PAR EDIT— 3405 OUTPUT1 UNIT HZ [3] CANCEL 00:00 SAVE
4.	Select the scalings for the signals by specifying the minimum and maximum display values. This has no effect if parameter 3404/3411/3418 is set to 9 (DIRECT). For details, see parameters 3406 and 3407. Signal 1: parameters 3406 OUTPUT1 MIN and 3407 OUTPUT1 MAX Signal 2: parameters 3413 OUTPUT2 MIN and 3414 OUTPUT2 MAX Signal 3: parameters 3420 OUTPUT3 MIN and 3421 OUTPUT3 MAX.	LOC ☐ PAR EDIT— 3406 OUTPUT1 MIN 0.0 HZ CANCEL 00:00 SAVE LOC ☐ PAR EDIT— 3407 OUTPUT1 MAX 500.0 HZ CANCEL 00:00 SAVE

Assistants mode

When the drive is first powered up, the Start-up Assistant guides you through the setup of the basic parameters. The Start-up Assistant is divided into assistants, each of which guides you through the task of specifying a related parameter set, for example Motor Set-up or PID Control. You can activate the assistants one after the other as the Start-up Assistant suggests, or independently. The tasks of the assistants are listed in the table on page 58.

In the Assistants mode, you can:

- use assistants to guide you through the specification of a set of basic parameters
- start, stop, change the direction and switch between local and remote control.

How to use an assistant

The table below shows the basic operation sequence which leads you through assistants. The Motor Set-up Assistant is used as an example.

Step	Action	Display
1.	Go to the Main menu by pressing  if you are in the Output mode, otherwise by pressing  repeatedly until you get to the Main menu.	LOC ↺ MAIN MENU — 1 PARAMETERS ASSISTANTS CHANGED PAR EXIT 00:00 ENTER
2.	Go to the Assistants mode by selecting ASSISTANTS on the menu with keys  and  , and pressing  .	LOC ↺ ASSISTANTS — 1 Start-up assistant Motor Set-up Application Speed control EXT1 Speed control EXT2 EXIT 00:00 SEL
3.	Select the assistant with keys  and , and press . If you select any other assistant than the Start-up Assistant, it guides you through the task of specification of its parameter set as shown in steps 4. and 5. below. After that you can select another assistant on the Assistants menu or exit the Assistants mode. The Motor Set-up Assistant is used here as an example. If you select the Start-up Assistant, it activates the first assistant, which guides you through the task of specification of its parameter set as shown in steps 4. and 5. below. The Start-up Assistant then asks if you want to continue with the next assistant or skip it – select the appropriate answer with keys  and , and press . If you choose to skip, the Start-up Assistant asks the same question about the next assistant, and so on.	LOC ↺ PAR EDIT — 9905 MOTOR NOM VOLT 220 V EXIT 00:00 SAVE LOC ↺ CHOICE — Do you want to continue with application setup? Continue Skip EXIT 00:00 OK
4.	• To specify a new value, press keys  and . • To ask for information on the requested parameter, press key . Scroll the help text with keys  and . Close the help by pressing .	LOC ↺ PAR EDIT — 9905 MOTOR NOM VOLT 240 V EXIT 00:00 SAVE LOC ↺ HELP — Set as given on the motor nameplate. Voltage value must correspond to motor D/Y connection. EXIT 00:00

Step	Action	Display
5.	- To accept the new value and continue to the setting of the next parameter, press . - To stop the assistant, press .	LOC  PAR EDIT 9906 MOTOR NOM CURR 1.2 A EXIT 00:00 SAVE

The table below lists the tasks of the assistants and the relevant drive parameters. Depending on the selection made in the Application task (parameter **9902** APPLIC MACRO), the Start-up Assistant decides, which consequent tasks it suggests.

Name	Description	Set parameters
Language select	Selecting the language	9901
Motor set-up	Setting the motor data Performing the motor identification. (If the speed limits are not in the allowed range: Setting the limits.)	9904...9909 9910
Application	Selecting the application macro	9902 , parameters associated to the macro
Option modules	Activating the option modules	Group 35: MOTOR TEMP MEAS Group 52: PANEL COMM 9802
Speed control EXT1	Selecting the source for the speed reference (If AI1 is used: Setting analog input AI1 limits, scale, inversion) Setting the reference limits Setting the speed (frequency) limits Setting the acceleration and deceleration times	1103 (1301...1303, 3001) 1104, 1105 2001, 2002, (2007, 2008) 2202, 2203
Speed control EXT2	Selecting the source for the speed reference (If AI1 is used: Setting analog input AI1 limits, scale, inversion) Setting the reference limits	1106 (1301...1303, 3001) 1107, 1108
Torque control	Selecting the source for the torque reference (If AI1 is used: Setting analog input AI1 limits, scale, inversion) Setting the reference limits Setting the torque ramp up and ramp down times	1106 (1301...1303, 3001) 1107, 1108 2401, 2402
PID control	Selecting the source for the process reference (If AI1 is used: Setting analog input AI1 limits, scale, inversion) Setting the reference limits Setting the speed (reference) limits Setting the source and limits for the process actual value	1106 (1301...1303, 3001) 1107, 1108 2001, 2002, (2007, 2008) 4016, 4018, 4019
Start/Stop control	Selecting the source for start and stop signals of the two external control locations, EXT1 and EXT2 Selecting between EXT1 and EXT2 Defining the direction control Defining the start and stop modes Selecting the use of Run Enable signal	1001, 1002 1102 1003 2101...2103 1601
Timed functions	Setting the timed functions Selecting the timed start/stop control for external control locations EXT1 and EXT2 Selecting timed EXT1/EXT2 control Activation of timed constant speed 1	Group 36: TIMED FUNCTIONS 1001, 1002 1102 1201

Name	Description	Set parameters
	Selecting timed function status indicated through relay output RO Selecting timed PID1 parameter set 1/2 control	1401 4027
Protections	Setting the current and torque limits	2003, 2017
Output signals	Selecting the signals indicated through relay output RO Selecting the signals indicated through analog output AO Setting the minimum, maximum, scaling and inversion	Group 14: RELAY OUTPUTS Group 15: ANALOG OUTPUTS

Changed Parameters mode

In the Changed Parameters mode, you can:

- view a list of all parameters that have been changed from the macro default values
- change these parameters
- start, stop, change the direction and switch between local and remote control.

How to view and edit changed parameters

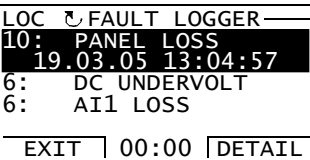
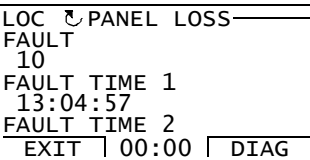
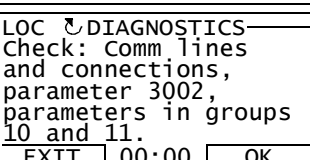
Step	Action	Display
1.	Go to the Main menu by pressing  if you are in the Output mode, otherwise by pressing  repeatedly until you get to the Main menu.	LOC  MAIN MENU — 1 PARAMETERS ASSISTANTS CHANGED PAR EXIT 00:00 ENTER
2.	Go to the Changed Parameters mode by selecting CHANGED PAR on the menu with keys  and  , and pressing  .	LOC  CHANGED PAR — 1202 CONST SPEED 1 10.0 Hz 1203 CONST SPEED 2 1204 CONST SPEED 3 9902 APPLIC MACRO EXIT 00:00 EDIT
3.	Select the changed parameter on the list with keys  and  . The value of the selected parameter is shown below it. Press  to modify the value.	LOC  PAR EDIT — 1202 CONST SPEED 1 10.0 Hz CANCEL 00:00 SAVE
4.	Specify a new value for the parameter with keys  and  . Pressing the key once increments or decrements the value. Holding the key down changes the value faster. Pressing the keys simultaneously replaces the displayed value with the default value.	LOC  PAR EDIT — 1202 CONST SPEED 1 15.0 Hz CANCEL 00:00 SAVE
5.	• To accept the new value, press . If the new value is the default value, the parameter is removed from the list of changed parameters. • To cancel the new value and keep the original, press .	LOC  CHANGED PAR — 1202 CONST SPEED 1 15.0 Hz 1203 CONST SPEED 2 1204 CONST SPEED 3 9902 APPLIC MACRO EXIT 00:00 EDIT

Fault Logger mode

In the Fault Logger mode, you can:

- view the drive fault history of maximum ten faults (after a power off, only the three latest faults are kept in the memory)
- see the details of the three latest faults (after a power off, the details of only the most recent fault is kept in the memory)
- read the help text for the fault
- start, stop, change the direction and switch between local and remote control.

How to view faults

Step	Action	Display
1.	Go to the Main menu by pressing  if you are in the Output mode, otherwise by pressing  repeatedly until you get to the Main menu.	
2.	Go to the Fault Logger mode by selecting FAULT LOGGER on the menu with keys  and  , and pressing  . The display shows the fault log starting with the latest fault. The number on the row is the fault code according to which the causes and corrective actions are listed in chapter Diagnostics .	
3.	To see the details of a fault, select it with keys  and  , and press  .	
4.	To show the help text, press  . Scroll the help text with keys  and  . After reading the help, press  to return to the previous display.	

Time and Date mode

In the Time and Date mode, you can:

- show or hide the clock
- change date and time display formats
- set the date and time
- enable or disable automatic clock transitions according to the daylight saving changes
- start, stop, change the direction and switch between local and remote control.

The Assistant Control Panel contains a battery to ensure the function of the clock when the panel is not powered by the drive.

How to show or hide the clock, change display formats, set the date and time and enable or disable clock transitions due to daylight saving changes

Step	Action	Display
1.	Go to the Main menu by pressing  if you are in the Output mode, otherwise by pressing  repeatedly until you get to the Main menu.	LOC  MAIN MENU —1 PARAMETERS ASSISTANTS CHANGED PAR EXIT 00:00 ENTER
2.	Go to the Time and Date mode by selecting TIME & DATE on the menu with keys  and  , and pressing  .	LOC  TIME & DATE —1 CLOCK VISIBILITY TIME FORMAT DATE FORMAT SET TIME SET DATE EXIT 00:00 SEL
3.	• To show (hide) the clock, select CLOCK VISIBILITY on the menu, press , select Show clock (Hide clock) and press , or, if you want to return to the previous display without making changes, press . • To specify the date format, select DATE FORMAT on the menu, press , and select a suitable format. Press  to save or  to cancel your changes. • To specify the time format, select TIME FORMAT on the menu, press , and select a suitable format. Press  to save or  to cancel your changes. • To set the time, select SET TIME on the menu and press . Specify the hours with keys  and , and press . Then specify the minutes. Press  to save or  to cancel your changes.	LOC  CLOCK VISIB —1 Show clock Hide clock EXIT 00:00 SEL LOC  DATE FORMAT —1 dd.mm.yy mm/dd/yy dd.mm.yyyy mm/dd/yyyy CANCEL 00:00 OK LOC  TIME FORMAT —1 24-hour 12-hour CANCEL 00:00 OK LOC  SET TIME — 15:41 CANCEL 00:00 OK

Step	Action	Display
	- To set the date, select SET DATE on the menu and press . Specify the first part of the date (day or month depending on the selected date format) with keys  and , and press . Repeat for the second part. After specifying the year, press . To cancel your changes, press . - To enable or disable the automatic clock transitions according to the daylight saving changes, select DAYLIGHT SAVING on the menu and press . Pressing  opens the help that shows the beginning and end dates of the period during which daylight saving time is used in each country or area whose daylight saving changes you can select to be followed. - To disable automatic clock transitions according to the daylight saving changes, select Off and press . - To enable automatic clock transitions, select the country or area whose daylight saving changes are followed and press . - To return to the previous display without making changes, press .	LOC  SET DATE— 19.03.05 CANCEL 00:00 OK LOC DAYLIGHT SAV—1 Off EU US Australia1:NSW,Vict.. Australia2:Tasmania.. EXIT 00:00 SEL LOC HELP— EU: On: Mar last Sunday Off: Oct last Sunday US: EXIT 00:00

Parameter Backup mode

The Parameter Backup mode is used to export parameters from one drive to another or to make a backup of the drive parameters. Uploading to the panel stores all drive parameters, including up to two user sets, to the Assistant Control Panel. The full set, partial parameter set (application) and user sets can then be downloaded from the control panel to another drive or the same drive. Uploading and downloading can be performed in local control.

The control panel memory is non-volatile and does not depend on the panel battery.

In the Parameter Backup mode, you can:

- copy all parameters from the drive to the control panel (UPLOAD TO PANEL). This includes all defined user sets of parameters and internal (not adjustable by the user) parameters such as those created by the ID Run.
- view the information about the backup stored to the control panel with UPLOAD TO PANEL (BACKUP INFO). This includes e.g. the type and rating of the drive where the backup was made. It is useful to check this information when you are going to copy the parameters to another drive with DOWNLOAD FULL SET to ensure that the drives match.
- restore the full parameter set from the control panel to the drive (DOWNLOAD FULL SET). This writes all parameters, including the internal non-user-adjustable motor parameters, to the drive. It does not include the user sets of parameters.

Note: Only use this function to restore a drive from a backup or to transfer parameters to systems that are identical to the original system.

- copy a partial parameter set (part of the full set) from the control panel to a drive (DOWNLOAD APPLICATION). The partial set does not include user sets, internal motor parameters, parameters [9905...9909](#), [1605](#), [1607](#), [5201](#), nor any [Group 51: EXT COMM MODULE](#) and [Group 53: EFB PROTOCOL](#) parameters.

The source and target drives and their motor sizes do not need to be the same.

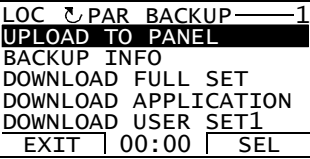
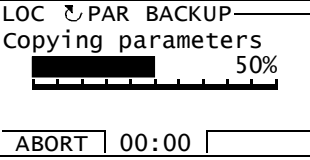
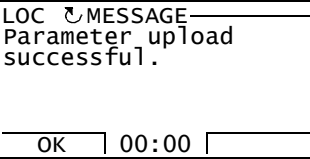
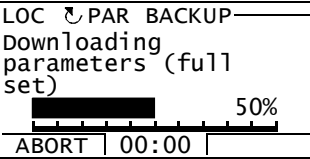
- copy USER S1 parameters from the control panel to the drive (DOWNLOAD USER SET1). A user set includes [Group 99: START-UP DATA](#) parameters and the internal motor parameters.

The function is only shown on the menu when User Set 1 has been first saved using parameter [9902](#) APPLIC MACRO (see section [User parameter sets](#) on page [88](#)) and then uploaded to the control panel with UPLOAD TO PANEL.

- copy USER S2 parameters from the control panel to the drive (DOWNLOAD USER SET2). As DOWNLOAD USER SET1 above.
- start, stop, change the direction and switch between local and remote control.

How to upload and download parameters

For the upload and download functions available, see above. Note that the drive has to be in local control for uploading and downloading.

Step	Action	Display
1.	Go to the Main menu by pressing  if you are in the Output mode, otherwise by pressing  repeatedly until you get to the Main menu. – If REM is shown on the status line, press  to switch to local control.	
2.	Go to the Par Backup mode by selecting PAR BACKUP on the menu with keys  and  , and pressing  .	
3.	- To copy all parameters (including user sets and internal parameters) from the drive to the control panel, select UPLOAD TO PANEL on the Par Backup menu with keys  and , and press . During the transfer, the display shows the transfer status as a percentage of completion. Press  if you want to stop the operation. After the upload is completed, the display shows a message about the completion. Press  to return to the Par Backup menu. - To perform downloads, select the appropriate operation (here DOWNLOAD FULL SET is used as an example) on the Par Backup menu with keys  and , and press . The display shows the transfer status as a percentage of completion. Press  if you want stop the operation. After the download is completed, the display shows a message about the completion. Press  to return to the Par Backup menu.	   

How to view information about the backup

Step	Action	Display
1.	Go to the Main menu by pressing  if you are in the Output mode, otherwise by pressing  repeatedly until you get to the Main menu.	LOC  MAIN MENU — 1 PARAMETERS ASSISTANTS CHANGED PAR EXIT 00:00 ENTER
2.	Go to the Par Backup mode by selecting PAR BACKUP on the menu with keys  and  , and pressing  .	LOC  PAR BACKUP — 1 UPLOAD TO PANEL BACKUP INFO DOWNLOAD FULL SET DOWNLOAD APPLICATION DOWNLOAD USER SET1 EXIT 00:00 SEL
3.	Select BACKUP INFO on the Par Backup menu with keys  and , and press . The display shows the following information about the drive where the backup was made: DRIVE TYPE: type of the drive DRIVE RATING: rating of the drive in format XXXYZ, where XXX: nominal current rating. If present, an "A" indicates a decimal point, e.g. 4A6 means 4.6 A. Y: 2 = 200 V 4 = 400 V 6 = 600 V Z: i = European loading package n = US loading package FIRMWARE: firmware version of the drive. You can scroll the information with keys  and .	LOC  BACKUP INFO — DRIVE TYPE ACS550 3304 DRIVE RATING 4A62i 3301 FIRMWARE EXIT 00:00 LOC  BACKUP INFO — ACS550 3304 DRIVE RATING 4A62i 3301 FIRMWARE 300F hex EXIT 00:00
4.	Press  to return to the Par Backup menu.	LOC  PAR BACKUP — 1 UPLOAD TO PANEL BACKUP INFO DOWNLOAD FULL SET DOWNLOAD APPLICATION DOWNLOAD USER SET1 EXIT 00:00 SEL

I/O Settings mode

In the I/O Settings mode, you can:

- check the parameter settings related to any I/O terminal
- edit the parameter setting. For example, if “1103: REF1” is listed under Ain1 (Analog input 1), that is, parameter **1103** REF1 SELECT has value AI1, you can change its value to e.g. AI2. You cannot, however, set the value of parameter **1106** REF2 SELECT to AI1.
- start, stop, change the direction and switch between local and remote control.

How to edit and change parameter settings related to I/O terminals

Step	Action	Display
1.	Go to the Main menu by pressing  if you are in the Output mode, otherwise by pressing  repeatedly until you get to the Main menu.	LOC  MAIN MENU — 1 PARAMETERS ASSISTANTS CHANGED PAR EXIT 00:00 ENTER
2.	Go the I/O Settings mode by selecting I/O SETTINGS on the menu with keys  and  , and pressing  .	LOC  I/O SETTINGS — 1 DIGITAL INPUTS (DI) ANALOG INPUTS (AI) RELAY OUTPUTS (ROUT) ANALOG OUTPUTS (AOUT) PANEL EXIT 00:00 SEL
3.	Select the I/O group, e.g. DIGITAL INPUTS, with keys  and  , and press  . After a brief pause, the display shows the current settings for the selection.	LOC  I/O SETTINGS — —DI1— 1001: START/STOP (E1) —DI2— — —DI3— EXIT 00:00
4.	Select the setting (line with a parameter number) with keys  and  , and press  .	LOC  PAR EDIT — 1001 EXT1 COMMANDS DI1 [1] CANCEL 00:00 SAVE
5.	Specify a new value for the setting with keys  and  . Pressing the key once increments or decrements the value. Holding the key down changes the value faster. Pressing the keys simultaneously replaces the displayed value with the default value.	LOC  PAR EDIT — 1001 EXT1 COMMANDS DI1, 2 [2] CANCEL 00:00 SAVE
6.	• To save the new value, press . • To cancel the new value and keep the original, press .	LOC  I/O SETTINGS — —DI1— 1001: START/STOP (E1) —DI2— 1001: DIR (E1) —DI3— EXIT 00:00

Basic Control Panel

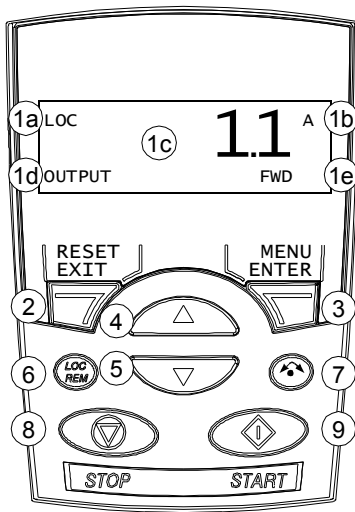
Features

The Basic Control Panel features:

- numeric control panel with an LCD display
- copy function – parameters can be copied to the control panel memory for later transfer to other drives or for backup of a particular system.

Overview

The following table summarizes the key functions and displays on the Basic Control Panel.



No.	Use
1	LCD display – Divided into five areas: - Upper left – Control location: LOC: drive control is local, that is, from the control panel REM: drive control is remote, such as the drive I/O or fieldbus. - Upper right – Unit of the displayed value. - Center – Variable; in general, shows parameter and signal values, menus or lists. Shows also fault and alarm codes. - Lower left and center – Panel operation state: OUTPUT: Output mode PAR: Parameter mode MENU: Main menu FAULT: Fault mode. - Lower right – Indicators: FWD (forward) / REV (reverse): direction of the motor rotation Flashing slowly: stopped Flashing rapidly: running, not at setpoint Steady: running, at setpoint SET: Displayed value can be modified (in the Parameter and Reference modes).
2	RESET/EXIT – Exits to the next higher menu level without saving changed values. Resets faults in the Output and Fault modes.
3	MENU/ENTER – Enters deeper into menu level. In the Parameter mode, saves the displayed value as the new setting.
4	Up – • Scrolls up through a menu or list. • Increases a value if a parameter is selected. • Increases the reference value in the Reference mode. Holding the key down changes the value faster.
5	Down – • Scrolls down through a menu or list. • Decreases a value if a parameter is selected. • Decreases the reference value in the Reference mode. Holding the key down changes the value faster.
6	LOC/REM – Changes between local and remote control of the drive.
7	DIR – Changes the direction of the motor rotation.
8	STOP – Stops the drive in local control.
9	START – Starts the drive in local control.

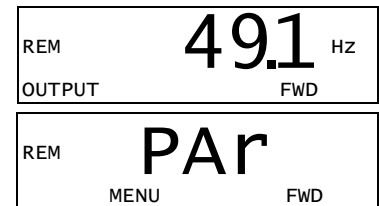
Operation

You operate the control panel with menus and keys. You select an option, e.g. operation mode or parameter, by scrolling the  and  arrow keys until the option is visible in the display and then pressing the  key.

With the  key, you return to the previous operation level without saving the made changes.

The Basic Control Panel has five panel modes: Output, Reference, Parameter, Copy and Fault. The operation in the first four modes is described in this chapter. When a fault or alarm occurs, the panel goes automatically to the Fault mode showing the fault or alarm code. You can reset the fault or alarm in the Output or Fault mode (see chapter [Diagnostics](#)).

After the power is switched on, the panel is in the Output mode, where you can start, stop, change the direction, switch between local and remote control and monitor up to three actual values (one at a time). To do other tasks, go first to the Main menu and select the appropriate mode.



How to do common tasks

The table below lists common tasks, the mode in which you can perform them and the page number where the steps to do the task are described in detail.

Task	Mode	Page
How to switch between local and remote control	Any	70
How to start and stop the drive	Any	70
How to change the direction of the motor rotation	Any	70
How to browse the monitored signals	Output	71
How to set the speed, frequency or torque reference	Reference	72
How to change the value of a parameter	Parameter	73
How to select the monitored signals	Parameter	74
How to reset faults and alarms	Output, Fault	265
How to copy parameters from the drive to the control panel	Copy	76
How to restore parameters from the control panel to the drive	Copy	76

How to start, stop and switch between local and remote control

You can start, stop and switch between local and remote control in any mode. To be able to start or stop the drive, the drive must be in local control.

Step	Action	Display
1.	- To switch between remote control (REM shown on the left) and local control (LOC shown on the left), press . Note: Switching to local control can be disabled with parameter 1606 LOCAL LOCK. - After pressing the key, the display briefly shows message "LoC" or "rE", as appropriate, before returning to the previous display. - The very first time the drive is powered up, it is in remote control (REM) and controlled through the drive I/O terminals. To switch to local control (LOC) and control the drive using the control panel, press . The result depends on how long you press the key: - If you release the key immediately (the display flashes "LoC"), the drive stops. Set the local control reference as instructed on page 72. - If you press the key for about two seconds (release when the display changes from "LoC" to "LoC r"), the drive continues as before. The drive copies the current remote values for the run/stop status and the reference, and uses them as the initial local control settings. - To stop the drive in local control, press . - To start the drive in local control, press .	LOC 49.1 Hz OUTPUT FWD LOC LoC FWD Text FWD or REV on the bottom line starts flashing slowly. Text FWD or REV on the bottom line starts flashing rapidly. It stops flashing when the drive reaches the setpoint.

How to change the direction of the motor rotation

You can change the direction of the motor rotation in any mode.

Step	Action	Display
1.	If the drive is in remote control (REM shown on the left), switch to local control by pressing  . The display briefly shows message "LoC" before returning to the previous display.	LOC 49.1 Hz OUTPUT FWD
2.	To change the direction from forward (FWD shown at the bottom) to reverse (REV shown at the bottom), or vice versa, press . Note: Parameter 1003 DIRECTION must be set to 3 (REQUEST).	LOC 49.1 Hz OUTPUT REV

Output mode

In the Output mode, you can:

- monitor actual values of up to three **Group 01: OPERATING DATA** signals, one signal at a time
- start, stop, change the direction and switch between local and remote control.

You get to the Output mode by pressing  until the display shows text OUTPUT at the bottom.

The display shows the value of one **Group 01: OPERATING DATA** signal. The unit is shown on the right. Page 74 tells how to select up to three signals to be monitored in the Output mode. The table below shows how to view them one at a time.

REM	49.1	Hz
OUTPUT		FWD

How to browse the monitored signals

Step	Action	Display																		
1.	If more than one signals have been selected to be monitored (see page 74), you can browse them in the Output mode. To browse the signals forward, press key  repeatedly. To browse them backward, press key  repeatedly.	<table> <tr> <td>REM</td><td>49.1</td><td>Hz</td></tr> <tr> <td>OUTPUT</td><td></td><td>FWD</td></tr> </table> <table> <tr> <td>REM</td><td>0.5</td><td>A</td></tr> <tr> <td>OUTPUT</td><td></td><td>FWD</td></tr> </table> <table> <tr> <td>REM</td><td>10.7</td><td>%</td></tr> <tr> <td>OUTPUT</td><td></td><td>FWD</td></tr> </table>	REM	49.1	Hz	OUTPUT		FWD	REM	0.5	A	OUTPUT		FWD	REM	10.7	%	OUTPUT		FWD
REM	49.1	Hz																		
OUTPUT		FWD																		
REM	0.5	A																		
OUTPUT		FWD																		
REM	10.7	%																		
OUTPUT		FWD																		

Reference mode

In the Reference mode, you can:

- set the speed, frequency or torque reference
- start, stop, change the direction and switch between local and remote control.

How to set the speed, frequency or torque reference

Step	Action	Display
1.	Go to the Main menu by pressing  if you are in the Output mode, otherwise by pressing  repeatedly until you see MENU at the bottom.	REM PAr MENU FWD
2.	If the drive is in remote control (REM shown on the left), switch to local control by pressing  . The display briefly shows "LoC" before switching to local control. Note: With Group 11: REFERENCE SELECT , you can allow the reference modification in remote control (REM).	LOC PAr MENU FWD
3.	If the panel is not in the Reference mode ("rEF" not visible), press key  or  until you see "rEF" and then press  . Now the display shows the current reference value with SET under the value.	LOC rEF MENU FWD LOC 49.1 Hz SET FWD
4.	• To increase the reference value, press . • To decrease the reference value, press . The value changes immediately when you press the key. It is stored in the drive permanent memory and restored automatically after power switch-off.	LOC 50.0 Hz SET FWD

Parameter mode

In the Parameter mode, you can:

- view and change parameter values
- select and modify the signals shown in the Output mode
- start, stop, change the direction and switch between local and remote control.

How to select a parameter and change its value

Step	Action	Display
1.	Go to the Main menu by pressing  if you are in the Output mode, otherwise by pressing  repeatedly until you see MENU at the bottom.	LOC rEF MENU FWD
2.	If the panel is not in the Parameter mode ("PAR" not visible), press key  or  until you see "PAR" and then press  . The display shows the number of one of the parameter groups.	LOC PAR MENU FWD LOC -01- PAR FWD
3.	Use keys  and  to find the desired parameter group.	LOC -11- PAR FWD
4.	Press  . The display shows one of the parameters in the selected group.	LOC 1101 PAR FWD
5.	Use keys  and  to find the desired parameter.	LOC 1103 PAR FWD
6.	Press and hold  for about two seconds until the display shows the value of the parameter with SET underneath indicating that changing of the value is now possible. Note: When SET is visible, pressing keys  and  simultaneously changes the displayed value to the default value of the parameter.	LOC 1 PAR SET FWD
7.	Use keys  and  to select the parameter value. When you have changed the parameter value, SET starts flashing. • To save the displayed parameter value, press . • To cancel the new value and keep the original, press .	LOC 2 PAR SET FWD LOC 1103 PAR FWD

How to select the monitored signals

Step	Action	Display
1.	You can select which signals are monitored in the Output mode and how they are displayed with Group 34: PANEL DISPLAY parameters. See page 55 for detailed instructions on changing parameter values. By default, you can monitor three signals by browsing (see page 71). The particular default signals depend on the value of parameter 9902 APPLIC MACRO: For macros whose default value of parameter 9904 MOTOR CTRL MODE is 1 (VECTOR:SPEED), the default for signal 1 is 0102 SPEED, otherwise 0103 OUTPUT FREQ. The defaults for signals 2 and 3 are always 0104 CURRENT and 0105 TORQUE, respectively. To change the default signals, select from Group 01: OPERATING DATA up to three signals to be browsed. Signal 1: Change the value of parameter 3401 SIGNAL1 PARAM to the index of the signal parameter in Group 01: OPERATING DATA (= number of the parameter without the leading zero), e.g. 105 means parameter 0105 TORQUE. Value 100 means that no signal is displayed. Repeat for signals 2 (3408 SIGNAL2 PARAM) and 3 (3415 SIGNAL3 PARAM). For example, if 3401 = 0 and 3415 = 0, browsing is disabled and only the signal specified by 3408 appears in the display. If all three parameters are set to 0, i.e. no signals are selected for monitoring, the panel displays text "n.A".	LOC 103 PAR SET FWD LOC 104 PAR SET FWD LOC 105 PAR SET FWD
2.	Specify the decimal point location, or use the decimal point location and unit of the source signal [setting (9 (DIRECT))]. Bar graphs are not available for Basic Operation Panel. For details, see parameter 3404. Signal 1: parameter 3404 OUTPUT1 DSP FORM Signal 2: parameter 3411 OUTPUT2 DSP FORM Signal 3: parameter 3418 OUTPUT3 DSP FORM.	LOC 9 PAR SET FWD
3.	Select the units to be displayed for the signals. This has no effect if parameter 3404/3411/3418 is set to 9 (DIRECT). For details, see parameter 3405. Signal 1: parameter 3405 OUTPUT1 UNIT Signal 2: parameter 3412 OUTPUT2 UNIT Signal 3: parameter 3419 OUTPUT3 UNIT.	LOC 3 PAR SET FWD
4.	Select the scalings for the signals by specifying the minimum and maximum display values. This has no effect if parameter 3404/3411/3418 is set to 9 (DIRECT). For details, see parameters 3406 and 3407. Signal 1: parameters 3406 OUTPUT1 MIN and 3407 OUTPUT1 MAX Signal 2: parameters 3413 OUTPUT2 MIN and 3414 OUTPUT2 MAX Signal 3: parameters 3420 OUTPUT3 MIN and 3421 OUTPUT3 MAX.	LOC 0.0 Hz PAR SET FWD LOC 500.0 Hz PAR SET FWD

Copy mode

The Basic Control Panel can store a full set of drive parameters and up to two user sets of drive parameters to the control panel. The control panel memory is non-volatile.

In the Copy mode, you can:

- copy all parameters from the drive to the control panel (uL – Upload). This includes all defined user sets of parameters and internal (not adjustable by the user) parameters such as those created by the ID Run.
- restore the full parameter set from the control panel to the drive (dL A – Download All). This writes all parameters, including the internal non-user-adjustable motor parameters, to the drive. It does not include the user sets of parameters.

Note: Only use this function to restore a drive, or to transfer parameters to systems that are identical to the original system.

- copy a partial parameter set from the control panel to a drive (dL P – Download Partial). The partial set does not include user sets, internal motor parameters, parameters [9905...9909](#), [1605](#), [1607](#), [5201](#), nor any [Group 51: EXT COMM MODULE](#) and [Group 53: EFB PROTOCOL](#) parameters.

The source and target drives and their motor sizes do not need to be the same.

- copy USER S1 parameters from the control panel to the drive (dL u1 – Download User Set 1). A user set includes [Group 99: START-UP DATA](#) parameters and the internal motor parameters.

The function is only shown on the menu when User Set 1 has been first saved using parameter [9902](#) APPLIC MACRO (see section [User parameter sets](#) on page [88](#)) and then uploaded to panel.

- copy USER S2 parameters from the control panel to the drive (dL u2 – Download User Set 2). As dL u1 – Download User Set 1 above.
- start, stop, change the direction and switch between local and remote control.

How to upload and download parameters

For the upload and download functions available, see above.

Step	Action	Display
1.	Go to the Main menu by pressing  if you are in the Output mode, otherwise by pressing  repeatedly until you see MENU at the bottom.	LOC PAr MENU FWD
2.	If the panel is not in the Copy mode ("CoPY" not visible), press key  or  until you see "CoPY". Press .	LOC CoPY MENU FWD LOC dL u1 MENU FWD
3.	- To upload all parameters (including user sets) from the drive to the control panel, step to "uL" with keys  and . Press . During the transfer, the display shows the transfer status as a percentage of completion. - To perform downloads, step to the appropriate operation (here "dL A", Download All, is used as an example) with keys  and . Press . During the transfer, the display shows the transfer status as a percentage of completion.	LOC uL MENU FWD LOC uL 50 % FWD LOC dL A MENU FWD LOC dL 50 % FWD

Basic Control Panel alarm codes

In addition to the faults and alarms generated by the drive (see chapter [Diagnostics](#)), the Basic Control Panel indicates control panel alarms with a code of form A5xxx. See section [Alarm codes \(Basic Control Panel\)](#) on page 269 for a list of the alarm codes and descriptions.

Application macros

Macros change a group of parameters to new, predefined values. Use macros to minimize the need for manual editing of parameters. Selecting a macro sets all other parameters to their default values, except:

- [Group 99: START-UP DATA](#) parameters (except parameter [9904](#))
- [1602](#) PARAMETER LOCK
- [1607](#) PARAM SAVE
- [3018](#) COMM FAULT FUNC and [3019](#) COMM FAULT TIME
- [9802](#) COMM PROT SEL
- [Group 50: ENCODER](#) ... [Group 53: EFB PROTOCOL](#) parameters
- [Group 29: MAINTENANCE TRIG](#) parameters.

After selecting a macro, you can make additional parameter changes manually with the control panel.

You enable application macros by setting the value for parameter [9902](#) APPLIC MACRO. By default, 1, ABB STANDARD, is the enabled macro.

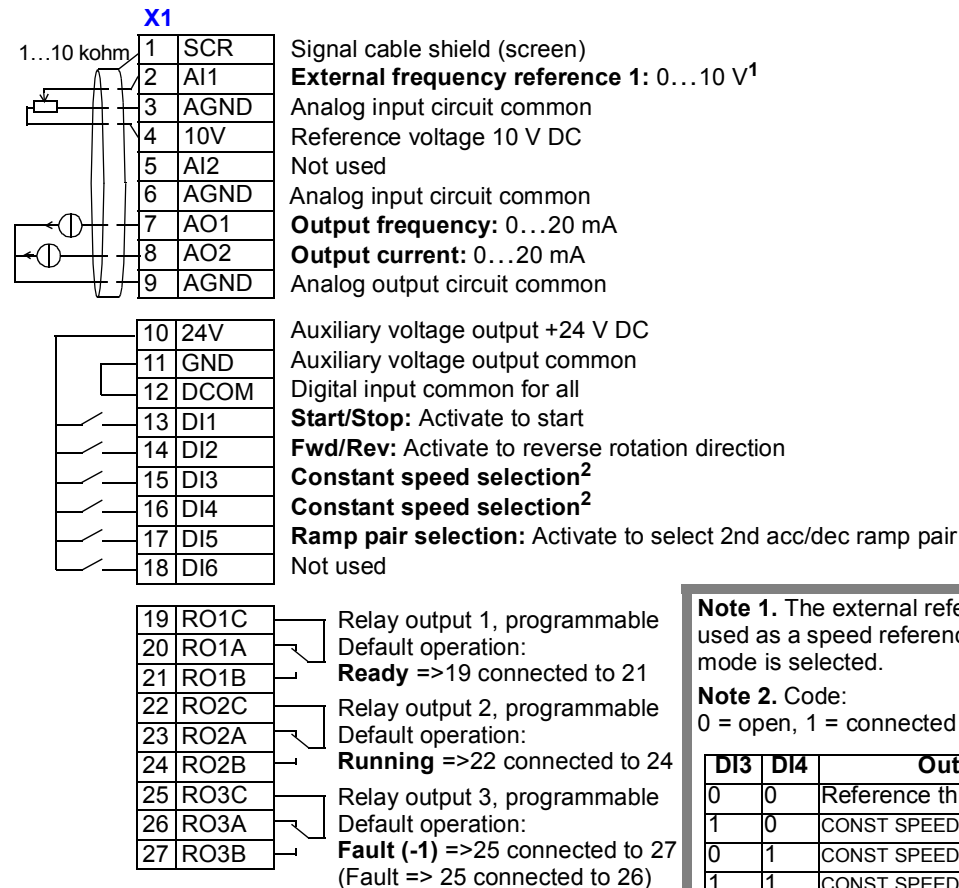
The following sections describe each of the application macros and provide a connection example for each macro.

The last section in this chapter, [Macro default values for parameters](#), lists the parameters that the macros change and the default values established by each macro.

ABB Standard macro

This is the default macro. It provides a general purpose, 2-wire I/O configuration, with three (3) constant speeds. Parameter values are the default values defined in section [Complete parameter list](#) on page 91.

Connection example:



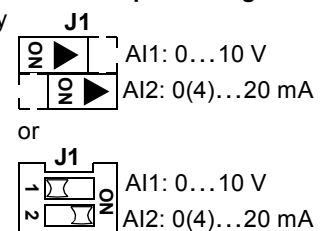
Input signals

- Analog reference (AI1)
- Start, stop and direction (DI1,2)
- Constant speed selection (DI3,4)
- Ramp pair (1 of 2) selection (DI5)

Output signals

- Analog output AO1: Frequency
- Analog output AO2: Current
- Relay output 1: Ready
- Relay output 2: Running
- Relay output 3: Fault (-1)

Jumper setting

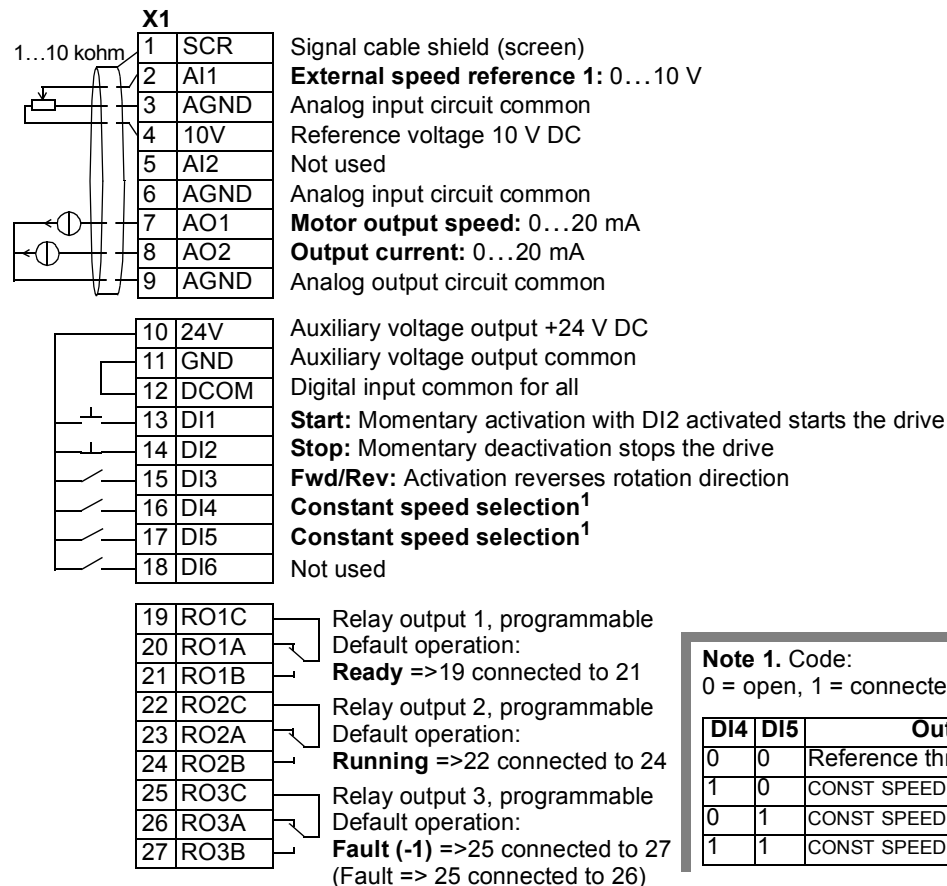


3-wire macro

This macro is used when the drive is controlled using momentary push-buttons. It provides three (3) constant speeds. To enable, set the value of parameter 9902 to 2 (3-WIRE).

Note: When the stop input (DI2) is deactivated (no input), the control panel start/stop buttons are disabled.

Connection example:



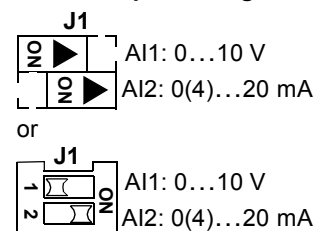
Input signals

- Analog reference (AI1)
- Start, stop and direction (DI1,2,3)
- Constant speed selection (DI4,5)

Output signals

- Analog output AO1: Speed
- Analog output AO2: Current
- Relay output 1: Ready
- Relay output 2: Running
- Relay output 3: Fault (-1)

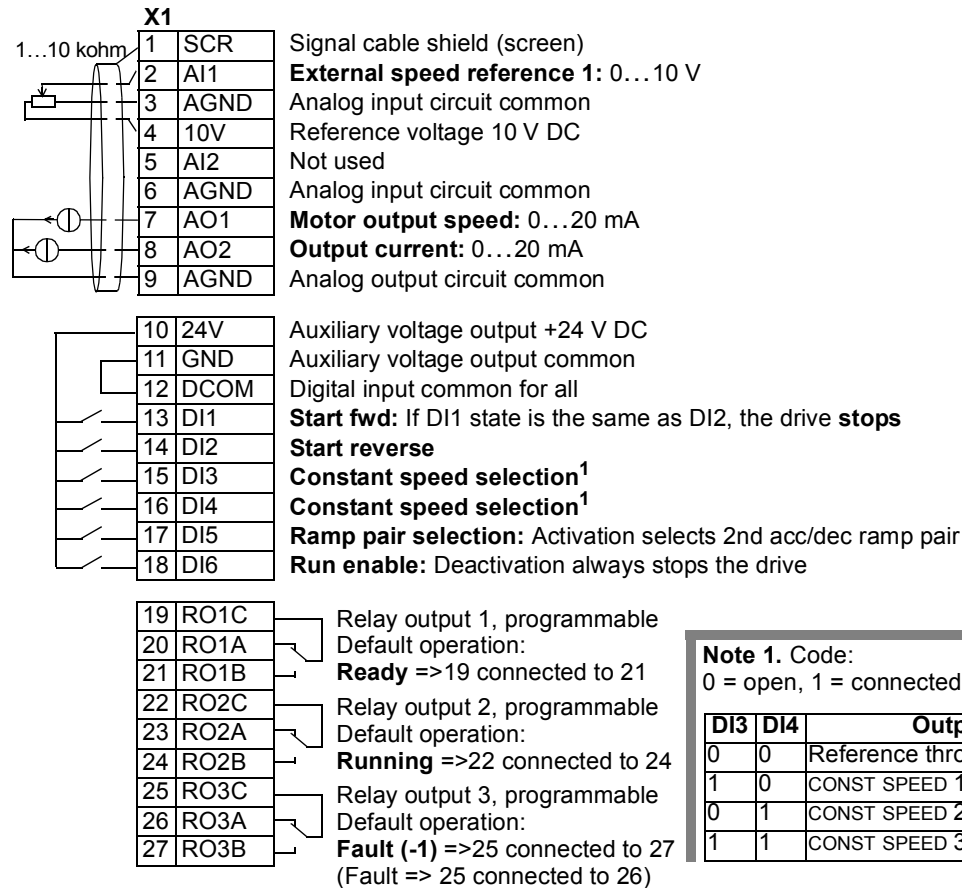
Jumper setting



Alternate macro

This macro provides an I/O configuration adopted to a sequence of DI control signals used when alternating the rotation direction of the motor. To enable, set the value of parameter 9902 to 3 (ALTERNATE).

Connection example:



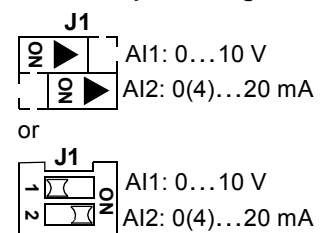
Input signals

- Analog reference (AI1)
- Start, stop and direction (DI1,2)
- Constant speed selection (DI3,4)
- Ramp pair 1/2 selection (DI5)
- Run enable (DI6)

Output signals

- Analog output AO1: Speed
- Analog output AO2: Current
- Relay output 1: Ready
- Relay output 2: Running
- Relay output 3: Fault (-1)

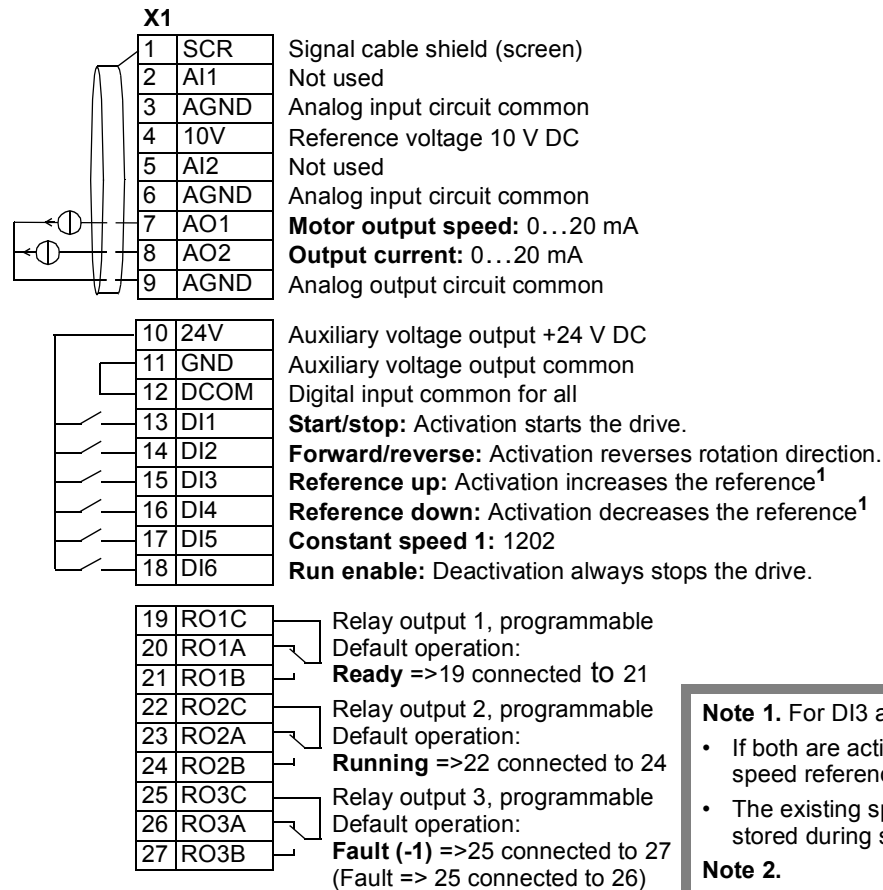
Jumper setting



Motor Potentiometer macro

This macro provides a cost-effective interface for PLCs that vary the speed of the motor using only digital signals. To enable, set the value of parameter 9902 to 4 (MOTOR POT).

Connection example:



Note 1. For DI3 and DI4:

- If both are active or inactive the speed reference is unchanged.
- The existing speed reference is stored during stop or power down.

Note 2.

- Settings of the ramp times with acceleration and deceleration time 2 (parameters 2205 and 2206).

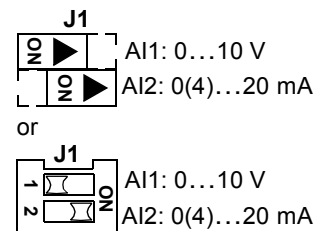
Input signals

- Start, stop and direction (DI1,2)
- Reference up/down (DI3,4)
- Constant speed selection (DI5)
- Run enable (DI6)

Output signals

- Analog output AO1: Speed
- Analog output AO2: Current
- Relay output 1: Ready
- Relay output 2: Running
- Relay output 3: Fault (-1)

Jumper setting

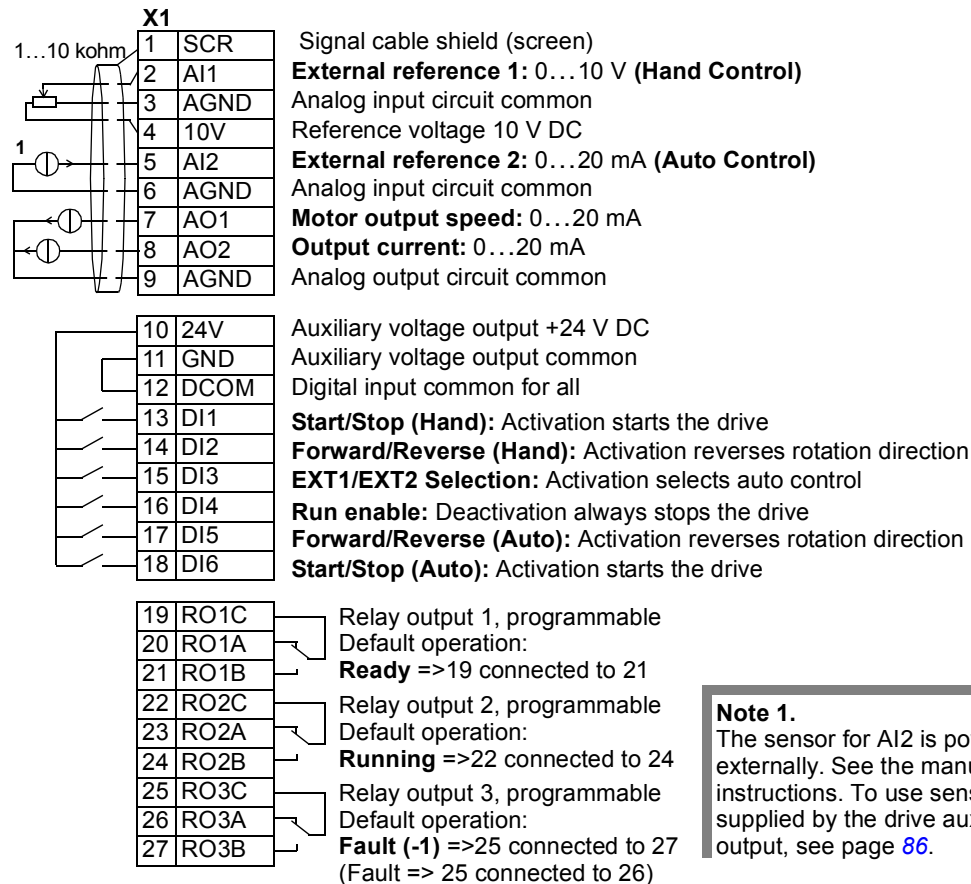


Hand-Auto macro

This macro provides an I/O configuration that is typically used in HVAC applications. To enable, set the value of parameter 9902 to 5 (HAND/AUTO).

Note: Parameter 2108 START INHIBIT must remain in the default setting, 0 (OFF).

Connection example:



Note 1.

The sensor for AI2 is powered externally. See the manufacturer's instructions. To use sensors supplied by the drive aux. voltage output, see page 86.

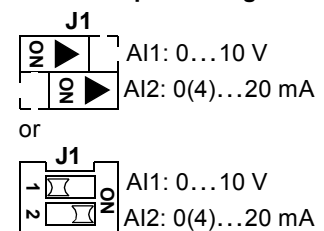
Input signals

- Two analog references (AI1, 2)
- Start/stop – hand/auto (DI1, 6)
- Direction – hand/auto (DI2, 5)
- Control location selection (DI3)
- Run enable (DI4)

Output signals

- Analog output AO1: Speed
- Analog output AO2: Current
- Relay output 1: Ready
- Relay output 2: Running
- Relay output 3: Fault (-1)

Jumper setting

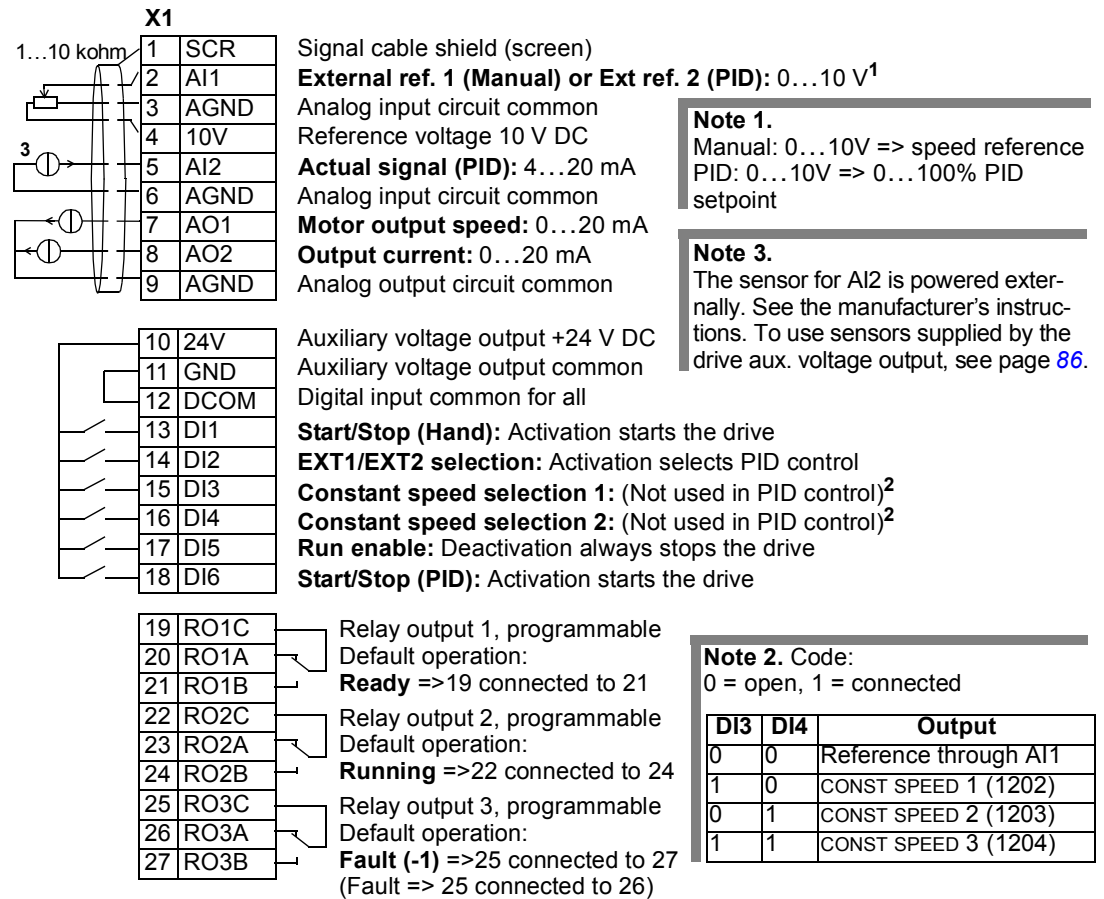


PID Control macro

This macro provides parameter settings for closed-loop control systems such as pressure control, flow control, etc. To enable, set the value of parameter 9902 to 6 (PID CONTROL).

Note: Parameter 2108 START INHIBIT must remain in the default setting, 0 (OFF).

Connection example:



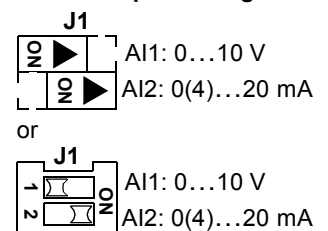
Input signals

- Analog reference (AI1)
- Actual value (AI2)
- Start/stop – hand/PID (DI1, 6)
- EXT1/EXT2 selection (DI2)
- Constant speed selection (DI3, 4)
- Run enable (DI5)

Output signals

- Analog output AO1: Speed
- Analog output AO2: Current
- Relay output 1: Ready
- Relay output 2: Running
- Relay output 3: Fault (-1)

Jumper setting



Note: Use the following switch-on order:

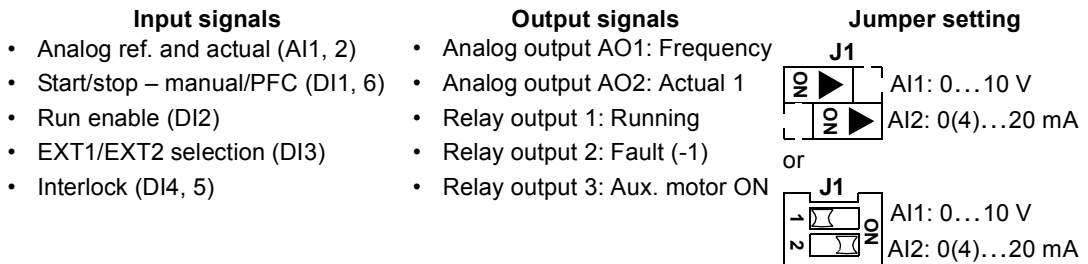
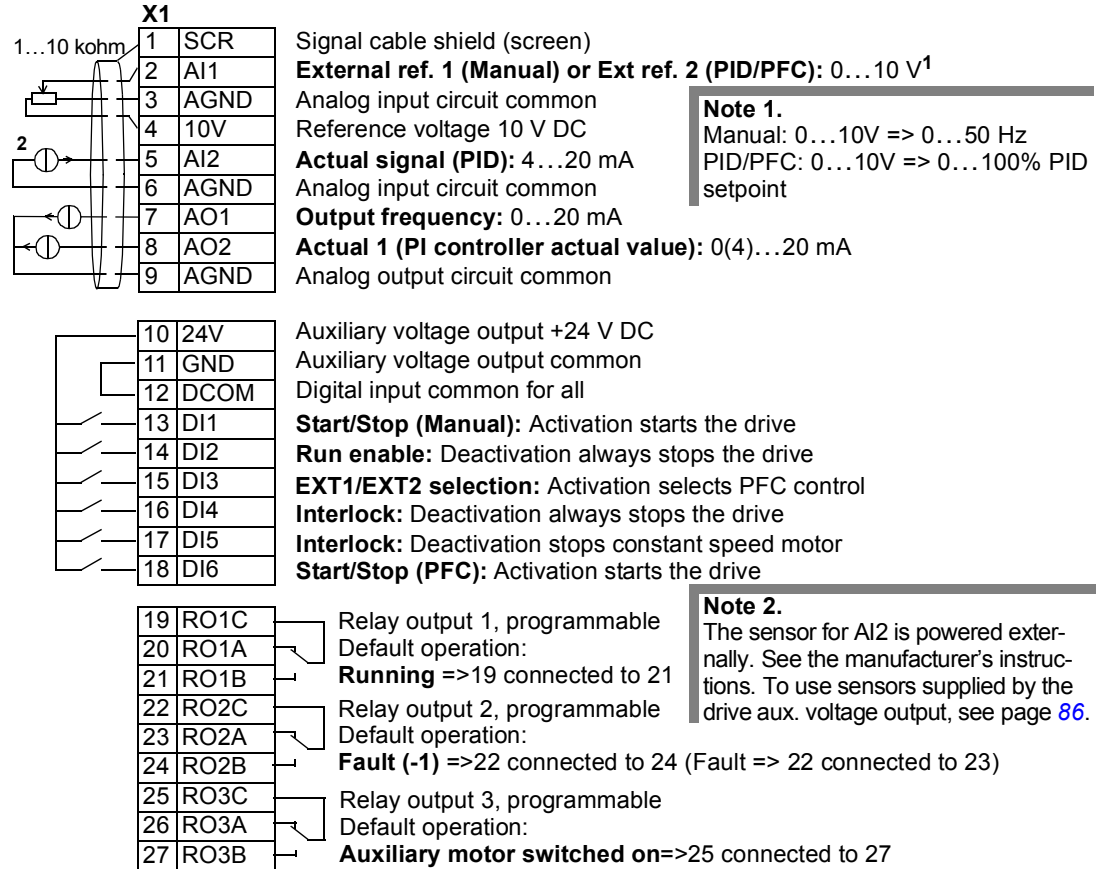
1. EXT1/EXT2
2. Run Enable
3. Start.

PFC macro

This macro provides parameter settings for pump and fan control (PFC) applications. To enable, set the value of parameter 9902 to 7 (PFC CONTROL).

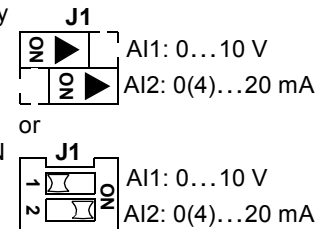
Note: Parameter 2108 START INHIBIT must remain in the default setting, 0 (OFF).

Connection example:



Note: Use the following switch-on order:

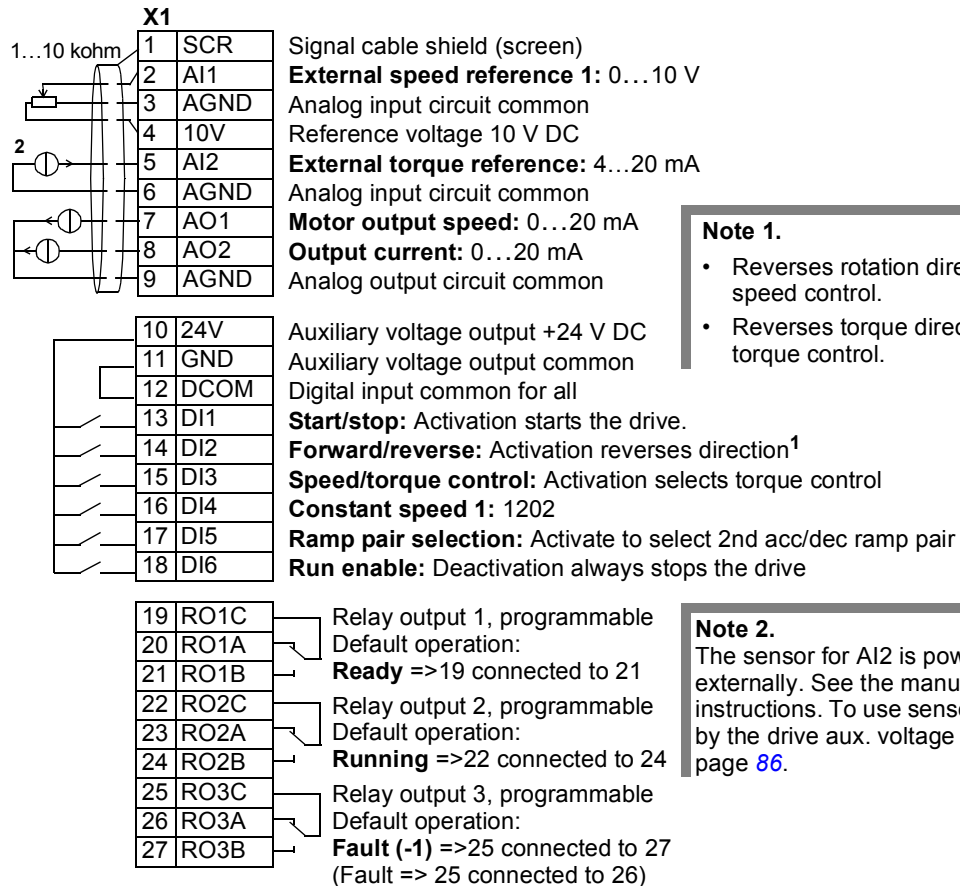
1. EXT1/EXT2
2. Run Enable
3. Start.



Torque Control macro

This macro provides parameter settings for applications that require torque control of the motor. Control can also be switched to speed control. To enable, set the value of parameter 9902 to 8 (TORQUE CTRL).

Connection example:



Note 1.

- Reverses rotation direction in speed control.
- Reverses torque direction in torque control.

Note 2.

The sensor for AI2 is powered externally. See the manufacturer's instructions. To use sensors supplied by the drive aux. voltage output, see page 86.

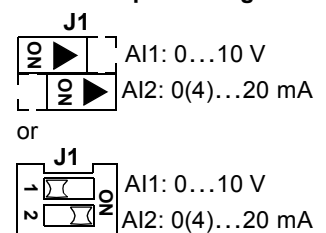
Input signals

- Two analog references (AI1, 2)
- Start/stop and direction (DI1, 2)
- Speed/torque control (DI3)
- Constant speed selection (DI4)
- Ramp pair 1/2 selection (DI5)
- Run enable (DI6)

Output signals

- Analog output AO1: Speed
- Analog output AO2: Current
- Relay output 1: Ready
- Relay output 2: Running
- Relay output 3: Fault (-1)

Jumper setting

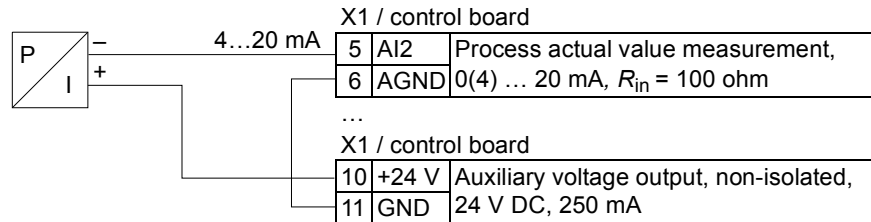


Connection examples of two-wire and three-wire sensors

Many applications use process PI(D) and need a feedback signal from the process. The feedback signal is typically connected to analog input 2 (AI2).

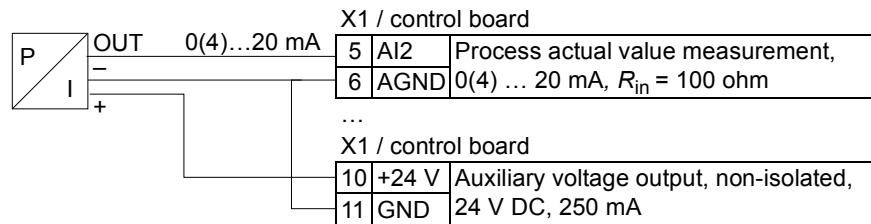
The macro wiring diagrams for each macro earlier in this chapter use an externally powered sensor (connections not shown). The figures below give examples of connections using a two-wire or three-wire sensor/transmitter supplied by the drive auxiliary voltage output.

Two-wire sensor/transmitter



Note: The sensor is supplied through its current output and the drive feeds the supply voltage (+24 V). Thus the output signal must be 4...20 mA, not 0...20 mA

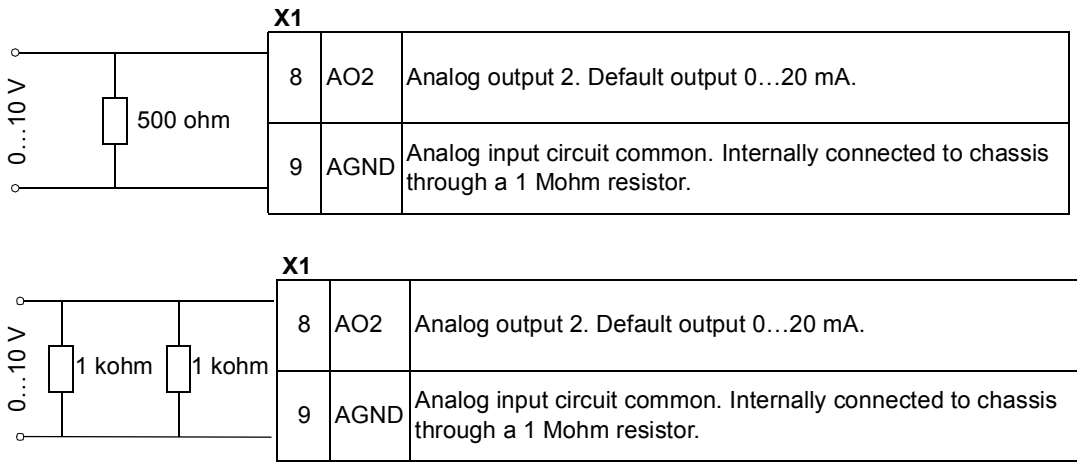
Three-wire sensor/transmitter



Connection for obtaining 0...10 V from analog outputs

To obtain 0...10 V from analog outputs, connect a 500 ohm resistor (or two 1 kohm resistors in parallel) between the analog output and analog output circuit common AGND.

Examples for analog output 2 AO2 are shown in the figure below.



User parameter sets

In addition to the standard application macros, it is possible to save two user parameter sets into the permanent memory and load them at a later time. A user parameter set consists of the user parameter settings, including [Group 99: START-UP DATA](#), and the results of the motor identification. The panel reference is also saved if the user parameter set is saved and loaded in local control. The remote control setting is saved into the user parameter set, but the local control setting is not.

The steps below show how to save and load User Parameter Set 1. The procedure for User Parameter Set 2 is identical, only the parameter [9902](#) values are different.

To save User Parameter Set 1:

- Adjust the parameters. Perform the motor identification if it is needed in the application but it is not done yet.
- Save the parameter settings and the results of the motor identification to the permanent memory by changing parameter [9902](#) to -1 (USER S1 SAVE).
- Press  (Assistant Control Panel) or  (Basic Control Panel).

To load User Parameter Set 1:

- Change parameter [9902](#) to 0 (USER S1 LOAD).
- Press  (Assistant Control Panel) or  (Basic Control Panel) to load.

The user parameter set can also be switched through digital inputs (see parameter [1605](#)).

Note: Loading the user parameter set restores the parameter settings including [Group 99: START-UP DATA](#) and the results of the motor identification. Check that the settings correspond to the motor used.

Hint: The user can for example switch the drive between two motors without having to adjust the motor parameters and to repeat the motor identification every time the motor is changed. The user needs only to adjust the settings and perform the motor identification once for each motor and then to save the data as two user parameter sets. When the motor is changed, only the corresponding user parameter set needs to be loaded, and the drive is ready to operate.

Macro default values for parameters

Parameter default values are listed in section [Complete parameter list](#) on page 91. Changing from the default macro (ABB Standard), that is, editing the value of parameter 9902, changes the parameter default values as defined in the following tables.

Note: There are two sets of values because the defaults are configured for 50 Hz/ IEC compliance (ACS550-01) and 60 Hz/NEMA compliance (ACS550-U1).

ACS550-01

Parameter		ABB Standard	3-wire	Alternate	Motor Potentiometer	Hand-auto	PID Control	PFC Control	Torque Control
9902	APPLIC MACRO	1 = ABB STANDARD	2 = 3-WIRE	3 = ALTERNATE	4 = MOTOR POT	5 = HAND/AUTO	6 = PID CONTROL	7 = PFC CONTROL	8 = TORQUE CTRL
9904	MOTOR CTRL MODE	3 = SCALAR: FREQ	1 = VECTOR: SPEED	1 = VECTOR: SPEED	1 = VECTOR: SPEED	1 = VECTOR: SPEED	1 = VECTOR: SPEED	3 = SCALAR: FREQ	2 = VECTOR: TORQUE
1001	EXT1 COMMANDS	2 = DI1,2	4 = DI1P,2P,3	9 = DI1F,2R	2 = DI1,2	2 = DI1,2	1 = DI1	1 = DI1	2 = DI1,2
1002	EXT2 COMMANDS	0 = NOT SEL	0 = NOT SEL	0 = NOT SEL	0 = NOT SEL	7 = DI6,5	6 = DI6	6 = DI6	2 = DI1,2
1003	DIRECTION	3 = REQUEST	3 = REQUEST	3 = REQUEST	3 = REQUEST	3 = REQUEST	1 = FORWARD	1 = FORWARD	3 = REQUEST
1102	EXT1/EXT2 SEL	0 = EXT1	0 = EXT1	0 = EXT1	0 = EXT1	3 = DI3	2 = DI2	3 = DI3	3 = DI3
1103	REF1 SELECT	1 = AI1	1 = AI1	1 = AI1	12 = DI3U,4D(NC)	1 = AI1	1 = AI1	1 = AI1	1 = AI1
1106	REF2 SELECT	2 = AI2	2 = AI2	2 = AI2	2 = AI2	19 = PID1OUT	19 = PID1OUT	2 = AI2	
1201	CONST SPEED SEL	9 = DI3,4	10 = DI4,5	9 = DI3,4	5 = DI5	0 = NOT SEL	9 = DI3,4	0 = NOT SEL	4 = DI4
1304	MINIMUM AI2	0.0%	0.0%	0.0%	0.0%	20.0%	20.0%	20.0%	20.0%
1401	RELAY OUTPUT 1	1 = READY	1 = READY	1 = READY	1 = READY	1 = READY	1 = READY	2 = RUN	1 = READY
1402	RELAY OUTPUT 2	2 = RUN	2 = RUN	2 = RUN	2 = RUN	2 = RUN	2 = RUN	3 = FAULT(-1)	2 = RUN
1403	RELAY OUTPUT 3	3 = FAULT(-1)	3 = FAULT(-1)	3 = FAULT(-1)	3 = FAULT(-1)	3 = FAULT(-1)	3 = FAULT(-1)	31 = PFC	3 = FAULT(-1)
1501	AO1 CONTENT SEL	103 = 0103 OUTPUT FREQ	102 = 0102 SPEED	102 = 0102 SPEED	102 = 0102 SPEED	102 = 0102 SPEED	102 = 0102 SPEED	103 = 0103 OUTPUT FREQ	102 = 0102 SPEED
1507	AO2 CONTENT SEL	104 = CURRENT	104 = CURRENT	104 = CURRENT	104 = CURRENT	104 = CURRENT	104 = CURRENT	130 = PID 1 FBK	104 = CURRENT
1510	MINIMUM AO2	0.0 mA	0.0 mA	0.0 mA	0.0 mA	0.0 mA	0.0 mA	4.0 mA	0.0 mA
1601	RUN ENABLE	0 = NOT SEL	0 = NOT SEL	6 = DI6	6 = DI6	4 = DI4	5 = DI5	2 = DI2	6 = DI6
2201	ACC/DEC 1/2 SEL	5 = DI5	0 = NOT SEL	5 = DI5	0 = NOT SEL	0 = NOT SEL	0 = NOT SEL	0 = NOT SEL	5 = DI5
3201	SUPERV 1 PARAM	103 = 0103 OUTPUT FREQ	102 = 0102 SPEED	102 = 0102 SPEED	102 = 0102 SPEED	102 = 0102 SPEED	102 = 0102 SPEED	103 = 0103 OUTPUT FREQ	102 = 0102 SPEED
3401	SIGNAL1 PARAM	103 = 0103 OUTPUT FREQ	102 = 0102 SPEED	102 = 0102 SPEED	102 = 0102 SPEED	102 = 0102 SPEED	102 = 0102 SPEED	103 = 0103 OUTPUT FREQ	102 = 0102 SPEED
4001	GAIN	1.0	1.0	1.0	1.0	1.0	1.0	2.5	1.0
4002	INTEGRATION TIME	60.0 s	60.0 s	60.0 s	60.0 s	60.0 s	60.0 s	3.0 s	60.0 s
4101	GAIN	1.0	1.0	1.0	1.0	1.0	1.0	2.5	1.0
4102	INTEGRATION TIME	60.0 s	60.0 s	60.0 s	60.0 s	60.0 s	60.0 s	3.0 s	60.0 s
8123	PFC ENABLE	0 = NOT SEL	0 = NOT SEL	0 = NOT SEL	0 = NOT SEL	0 = NOT SEL	0 = NOT SEL	1 = ACTIVE	0 = NOT SEL

ACS550-U1

	Parameter	ABB Standard	3-wire	Alternate	Motor Potentiometer	Hand-auto	PID Control	PFC Control	Torque Control
9902	APPLIC MACRO	1 = ABB STANDARD	2 = 3-WIRE	3 = ALTERNATE	4 = MOTOR POT	5 = HAND/AUTO	6 = PID CONTROL	7 = PFC CONTROL	8 = TORQUE CTRL
9904	MOTOR CTRL MODE	3 = SCALAR: FREQ	1 = VECTOR: SPEED	1 = VECTOR: SPEED	1 = VECTOR: SPEED	1 = VECTOR: SPEED	1 = VECTOR: SPEED	3 = SCALAR: FREQ	2 = VECTOR: TORQUE
1001	EXT1 COMMANDS	2 = DI1,2	4 = DI1P,2P,3	9 = DI1F,2R	2 = DI1,2	2 = DI1,2	1 = DI1	1 = DI1	2 = DI1,2
1002	EXT2 COMMANDS	0 = NOT SEL	0 = NOT SEL	0 = NOT SEL	0 = NOT SEL	7 = DI6,5	6 = DI6	6 = DI6	2 = DI1,2
1003	DIRECTION	3 = REQUEST	3 = REQUEST	3 = REQUEST	3 = REQUEST	3 = REQUEST	1 = FORWARD	1 = FORWARD	3 = REQUEST
1102	EXT1/EXT2 SEL	0 = EXT1	0 = EXT1	0 = EXT1	0 = EXT1	3 = DI3	2 = DI2	3 = DI3	3 = DI3
1103	REF1 SELECT	1 = AI1	1 = AI1	1 = AI1	12 = DI3U,4D(NC)	1 = AI1	1 = AI1	1 = AI1	1 = AI1
1106	REF2 SELECT	2 = AI2	2 = AI2	2 = AI2	2 = AI2	2 = AI2	19 = PID1OUT	19 = PID1OUT	2 = AI2
1201	CONST SPEED SEL	9 = DI3,4	10 = DI4,5	9 = DI3,4	5 = DI5	0 = NOT SEL	9 = DI3,4	0 = NOT SEL	4 = DI4
1304	MINIMUM AI2	0.0%	0.0%	0.0%	0.0%	20.0%	20.0%	20.0%	20.0%
1401	RELAY OUTPUT 1	1 = READY	1 = READY	1 = READY	1 = READY	1 = READY	1 = READY	2 = RUN	1 = READY
1402	RELAY OUTPUT 2	2 = RUN	2 = RUN	2 = RUN	2 = RUN	2 = RUN	2 = RUN	3 = FAULT(-1)	2 = RUN
1403	RELAY OUTPUT 3	3 = FAULT(-1)	3 = FAULT(-1)	3 = FAULT(-1)	3 = FAULT(-1)	3 = FAULT(-1)	3 = FAULT(-1)	31 = PFC	3 = FAULT(-1)
1501	AO1 CONTENT SEL	103 = 0103 OUTPUT FREQ	102 = 0102 SPEED	102 = 0102 SPEED	102 = 0102 SPEED	102 = 0102 SPEED	102 = 0102 SPEED	103 = 0103 OUTPUT FREQ	102 = 0102 SPEED
1507	AO2 CONTENT SEL	104 = CURRENT	104 = CURRENT	104 = CURRENT	104 = CURRENT	104 = CURRENT	104 = CURRENT	130 = PID 1 FBK	104 = CURRENT
1510	MINIMUM AO2	0.0 mA	0.0 mA	0.0 mA	0.0 mA	0.0 mA	0.0 mA	4.0 mA	0.0 mA
1601	RUN ENABLE	0 = NOT SEL	0 = NOT SEL	6 = DI6	6 = DI6	4 = DI4	5 = DI5	2 = DI2	6 = DI6
2201	ACC/DEC 1/2 SEL	5 = DI5	0 = NOT SEL	5 = DI5	0 = NOT SEL	0 = NOT SEL	0 = NOT SEL	0 = NOT SEL	5 = DI5
3201	SUPERV 1 PARAM	103 = 0103 OUTPUT FREQ	102 = 0102 SPEED	102 = 0102 SPEED	102 = 0102 SPEED	102 = 0102 SPEED	102 = 0102 SPEED	103 = 0103 OUTPUT FREQ	102 = 0102 SPEED
3401	SIGNAL1 PARAM	103 = 0103 OUTPUT FREQ	102 = 0102 SPEED	102 = 0102 SPEED	102 = 0102 SPEED	102 = 0102 SPEED	102 = 0102 SPEED	103 = 0103 OUTPUT FREQ	102 = 0102 SPEED
4001	GAIN	1.0	1.0	1.0	1.0	1.0	1.0	2.5	1.0
4002	INTEGRATION TIME	60.0 s	60.0 s	60.0 s	60.0 s	60.0 s	60.0 s	3.0 s	60.0 s
4101	GAIN	1.0	1.0	1.0	1.0	1.0	1.0	2.5	1.0
4102	INTEGRATION TIME	60.0 s	60.0 s	60.0 s	60.0 s	60.0 s	60.0 s	3.0 s	60.0 s
8123	PFC ENABLE	0 = NOT SEL	0 = NOT SEL	0 = NOT SEL	0 = NOT SEL	0 = NOT SEL	0 = NOT SEL	1 = ACTIVE	0 = NOT SEL

Parameters

Complete parameter list

The following table lists all parameters. Table header abbreviations are:

- S = Parameters can be modified only when the drive is stopped.
- User = Space to enter desired parameter values.

Some values depend on the “construction” as indicated in the table by

“-01:” = Setup and parts specific to IEC installation and compliance or

“-U1:” = Setup and parts specific to US installation and NEMA compliance.

Refer to the type designation on the drive, for example ACS550-01-08A8-4.

Code	Name	Range	Resolution	Default	User	S
Group 99: START-UP DATA						
9901	LANGUAGE	0...16 / 0...3	1	0 (ENGLISH)		
9902	APPLIC MACRO	-3...8, 31	1	1 (ABB STANDARD)		✓
9904	MOTOR CTRL MODE	1 = VECTOR:SPEED, 2 = VECTOR:TORQUE, 3 = SCALAR:FREQ	1	3 (SCALAR:FREQ)		✓
9905	MOTOR NOM VOLT	-01-yyy-2: 115...345 V / -U1-yyy-2: 115...345 V -01-yyy-4: 200...600 V / -U1-yyy-4: 230...690 V -U1-yyy-6: 288...862 V	1 V	-01-yyy-2: 230 V / -U1-yyy-2: 230 V -01-yyy-4: 400 V / -U1-yyy-4: 460 V -U1-yyy-6: 575 V		✓
9906	MOTOR NOM CURR	$0.2 \cdot I_{2hd} \dots 2.0 \cdot I_{2hd}$	0.1 A	$1.0 \cdot I_{2hd}$		✓
9907	MOTOR NOM FREQ	10.0...500.0 Hz	0.1 Hz	-01: 50.0 Hz / -U1: 60.0 Hz		✓
9908	MOTOR NOM SPEED	50...30000 rpm	1 rpm	Size dependent		✓
9909	MOTOR NOM POWER	$0.2 \dots 3.0 \cdot P_{hd}$	-01: 0.1 kW / -U1: 0.1 hp	$1.0 \cdot P_{hd}$		✓
9910	ID RUN	0 = OFF/IDMAGN, 1 = ON	1	0 (OFF/IDMAGN)		✓
9915	MOTOR COSPHI	0 = IDENTIFIED, 0.01...0.97	0.01	0 (IDENTIFIED)		✓
Group 01: OPERATING DATA						
0101	SPEED & DIR	-30000...30000 rpm	1 rpm	-		
0102	SPEED	0...30000 rpm	1 rpm	-		
0103	OUTPUT FREQ	0.0...500.0 Hz	0.1 Hz	-		
0104	CURRENT	$0.0 \dots 2.0 \cdot I_{2hd}$	0.1 A	-		
0105	TORQUE	-200.0...200.0%	0.1%	-		
0106	POWER	$-2.0 \dots 2.0 \cdot P_{hd}$	0.1 kW	-		
0107	DC BUS VOLTAGE	$0 \dots 2.5 \cdot V_{dN}$	1 V	-		
0109	OUTPUT VOLTAGE	$0 \dots 2.0 \cdot V_{dN}$	1 V	-		
0110	DRIVE TEMP	0.0...150.0 °C	0.1 °C	-		
0111	EXTERNAL REF 1	0.0...500.0 Hz / 0...30000 rpm	0.1 Hz / 1 rpm	-		
0112	EXTERNAL REF 2	0.0...100.0% (0.0...600.0% for torque)	0.1%	-		
0113	CTRL LOCATION	0 = LOCAL, 1 = EXT1, 2 = EXT2	1	-		

Code	Name	Range	Resolution	Default	User	S
0114	RUN TIME (R)	0...9999 h	1 h	-		
0115	KWH COUNTER (R)	0...65535 kWh	1 kWh	-		
0116	APPL BLK OUTPUT	0.0...100.0% (0.0...600.0% for torque)	0.1%	-		
0118	DI 1-3 STATUS	000...111 (0...7 decimal)	1	-		
0119	DI 4-6 STATUS	000...111 (0...7 decimal)	1	-		
0120	AI 1	0.0...100.0%	0.1%	-		
0121	AI 2	0.0...100.0%	0.1%	-		
0122	RO 1-3 STATUS	000...111 (0...7 decimal)	1	-		
0123	RO 4-6 STATUS	000...111 (0...7 decimal)	1	-		
0124	AO 1	0.0...20.0 mA	0.1 mA	-		
0125	AO 2	0.0...20.0 mA	0.1 mA	-		
0126	PID 1 OUTPUT	-1000.0...1000.0%	0.1%	-		
0127	PID 2 OUTPUT	-100.0...100.0%	0.1%	-		
0128	PID 1 SETPNT	Unit and scale defined by par. 4006/ 4106 and 4007/4107	-	-		
0129	PID 2 SETPNT	Unit and scale defined by par. 4206 and 4207	-	-		
0130	PID 1 FBK	Unit and scale defined by par. 4006/ 4106 and 4007/4107	-	-		
0131	PID 2 FBK	Unit and scale defined by par. 4206 and 4207	-	-		
0132	PID 1 DEVIATION	Unit and scale defined by par. 4006/ 4106 and 4007/4107	-	-		
0133	PID 2 DEVIATION	Unit and scale defined by par. 4206 and 4207	-	-		
0134	COMM RO WORD	0...65535	1	-		
0135	COMM VALUE 1	-32768...+32767	1	-		
0136	COMM VALUE 2	-32768...+32767	1	-		
0137	PROCESS VAR 1	-	1			
0138	PROCESS VAR 2	-	1			
0139	PROCESS VAR 3	-	1			
0140	RUN TIME	0.00...499.99 kh	0.01 kh	-		
0141	MWH COUNTER	0...65535 MWh	1 MWh	-		
0142	REVOLUTION CNTR	0...65535 Mrev	1 Mrev	-		
0143	DRIVE ON TIME HI	0...65535 days	1 day	-		
0144	DRIVE ON TIME LO	00:00:00...23:59:58	1 = 2 s	-		
0145	MOTOR TEMP	Par. 3501 = 1...3: -10...200 °C Par. 3501 = 4: 0...5000 ohm Par. 3501 = 5...6: 0...1	1	-		
0146	MECH ANGLE	0...32768	1	-		
0147	MECH REVS	-32768 ...+32767	1	-		
0148	Z PLS DETECTED	0 = NOT DETECTED, 1 = DETECTED	1	-		
0150	CB TEMP	-20.0...150.0 °C	1.0 °C	-		
0153	MOT THERM STRESS	0.0...100.0%	0.1%	-		
0158	PID COMM VALUE 1	-32768 ...+32767	1	-		
0159	PID COMM VALUE 2	-32768 ...+32767	1	-		
0174	SAVED KWH	0.0...999.9 kWh	0.1 kWh	-		

Code	Name	Range	Resolution	Default	User	S
0175	SAVED MWH	0...65535 MWh	1 MWh	-		
0176	SAVED AMOUNT 1	0.0...999.9	0.1	-		
0177	SAVED AMOUNT 2	0...65535	1	-		
0178	SAVED CO2	0.0...6553.5 tn	0.1 tn	-		
Group 03: FB ACTUAL SIGNALS						
0301	FB CMD WORD 1	-	-	-		
0302	FB CMD WORD 2	-	-	-		
0303	FB STS WORD 1	-	-	-		
0304	FB STS WORD 2	-	1	-		
0305	FAULT WORD 1	-	1	-		
0306	FAULT WORD 2	-	1	-		
0307	FAULT WORD 3	-	1	-		
0308	ALARM WORD 1	-	1	-		
0309	ALARM WORD 2	-	1	-		
Group 04: FAULT HISTORY						
0401	LAST FAULT	Fault codes (panel displays as text)	1	0		
0402	FAULT TIME 1	Date dd.mm.yy / power-on time in days	1 day	0		
0403	FAULT TIME 2	Time hh.mm.ss	2 s	0		
0404	SPEED AT FLT	-32768...+32767	1 rpm	0		
0405	FREQ AT FLT	-3276.8...+3276.7	0.1 Hz	0		
0406	VOLTAGE AT FLT	0.0...6553.5	0.1 V	0		
0407	CURRENT AT FLT	0.0...6553.5	0.1 A	0		
0408	TORQUE AT FLT	-3276.8...+3276.7	0.1%	0		
0409	STATUS AT FLT	0000...FFFF hex	1	0		
0410	DI 1-3 AT FLT	000...111 (0...7 decimal)	1	0		
0411	DI 4-6 AT FLT	000...111 (0...7 decimal)	1	0		
0412	PREVIOUS FAULT 1	As par. 0401	1	0		
0413	PREVIOUS FAULT 2	As par. 0401	1	0		
Group 10: START/STOP/DIR						
1001	EXT1 COMMANDS	0...14	1	2 (DI1,2)		✓
1002	EXT2 COMMANDS	0...14	1	0 (NOT SEL)		✓
1003	DIRECTION	1 = FORWARD, 2 = REVERSE, 3 = REQUEST	1	3 (REQUEST)		✓
1004	JOGGING SEL	-6...6	1	0 (NOT SEL)		✓
Group 11: REFERENCE SELECT						
1101	KEYPAD REF SEL	1 = REF1(Hz/rpm), 2 = REF2(%)	1	1 [REF1(Hz/rpm)]		
1102	EXT1/EXT2 SEL	-6...12	1	0 (EXT1)		✓
1103	REF1 SELECT	0...17, 20...21	1	1 (AI1)		✓
1104	REF1 MIN	0.0...500.0 Hz / 0...30000 rpm	0.1 Hz / 1 rpm	0.0 Hz / 0 rpm		
1105	REF1 MAX	0.0...500.0 Hz / 0...30000 rpm	0.1 Hz / 1 rpm	-01: 50.0 (52.0) Hz / 1500 rpm -U1: 60.0 (62.0) Hz / 1800 rpm		
1106	REF2 SELECT	0...17, 19...21	1	2 (AI2)		✓
1107	REF2 MIN	0.0...100.0% (0.0...600.0% for torque)	0.1%	0.0%		
1108	REF2 MAX	0.0...100.0% (0.0...600.0% for torque)	0.1%	100.0%		

Code	Name	Range	Resolution	Default	User	S
Group 12: CONSTANT SPEEDS						
1201	CONST SPEED SEL	-14 ...19	1	9 (DI3,4)		✓
1202	CONST SPEED 1	0.0...500.0 Hz / 0...30000 rpm	0.1 Hz / 1 rpm	-01: 5.0 Hz / 300 rpm -U1: 6.0 Hz / 360 rpm		
1203	CONST SPEED 2	0.0...500.0 Hz / 0...30000 rpm	0.1 Hz / 1 rpm	-01: 10.0 Hz / 600 rpm -U1: 12.0 Hz / 720 rpm		
1204	CONST SPEED 3	0.0...500.0 Hz / 0...30000 rpm	0.1 Hz / 1 rpm	-01: 15.0 Hz / 900 rpm -U1: 18.0 Hz / 1080 rpm		
1205	CONST SPEED 4	0.0...500.0 Hz / 0...30000 rpm	0.1 Hz / 1 rpm	-01: 20.0 Hz / 1200 rpm -U1: 24.0 Hz / 1440 rpm		
1206	CONST SPEED 5	0.0...500.0 Hz / 0...30000 rpm	0.1 Hz / 1 rpm	-01: 25.0 Hz / 1500 rpm -U1: 30.0 Hz / 1800 rpm		
1207	CONST SPEED 6	0.0...500.0 Hz / 0...30000 rpm	0.1 Hz / 1 rpm	-01: 40.0 Hz / 2400 rpm -U1: 48.0 Hz / 2880 rpm		
1208	CONST SPEED 7	0.0...500.0 Hz / 0...30000 rpm	0.1 Hz / 1 rpm	-01: 50.0 Hz / 3000 rpm -U1: 60.0 Hz / 3600 rpm		
1209	TIMED MODE SEL	1 = EXT/CS1/2/3, 2 = CS1/2/3/4	1	2 (CS1/2/3/4)		✓
Group 13: ANALOG INPUTS						
1301	MINIMUM AI1	0.0...100.0%	0.1%	0.0%		
1302	MAXIMUM AI1	0.0...100.0%	0.1%	100.0%		
1303	FILTER AI1	0.0...10.0 s	0.1 s	0.1 s		
1304	MINIMUM AI2	0.0...100.0%	0.1%	0.0%		
1305	MAXIMUM AI2	0.0...100.0%	0.1%	100.0%		
1306	FILTER AI2	0.0...10.0 s	0.1 s	0.1 s		
Group 14: RELAY OUTPUTS						
1401	RELAY OUTPUT 1	0...44, 46, 47, 52	1	1 (READY)		
1402	RELAY OUTPUT 2	0...44, 46, 47, 52	1	2 (RUN)		
1403	RELAY OUTPUT 3	0...44, 46, 47, 52	1	3 [FAULT(-1)]		
1404	RO 1 ON DELAY	0.0...3600.0 s	0.1 s	0.0 s		
1405	RO 1 OFF DELAY	0.0...3600.0 s	0.1 s	0.0 s		
1406	RO 2 ON DELAY	0.0...3600.0 s	0.1 s	0.0 s		
1407	RO 2 OFF DELAY	0.0...3600.0 s	0.1 s	0.0 s		
1408	RO 3 ON DELAY	0.0...3600.0 s	0.1 s	0.0 s		
1409	RO 3 OFF DELAY	0.0...3600.0 s	0.1 s	0.0 s		
1410	RELAY OUTPUT 4	0...44, 46, 47, 52	1	0 (NOT SEL)		
1411	RELAY OUTPUT 5	0...44, 46, 47, 52	1	0 (NOT SEL)		
1412	RELAY OUTPUT 6	0...44, 46, 47, 52	1	0 (NOT SEL)		
1413	RO 4 ON DELAY	0.0...3600.0 s	0.1 s	0.0 s		
1414	RO 4 OFF DELAY	0.0...3600.0 s	0.1 s	0.0 s		
1415	RO 5 ON DELAY	0.0...3600.0 s	0.1 s	0.0 s		
1416	RO 5 OFF DELAY	0.0...3600.0 s	0.1 s	0.0 s		
1417	RO 6 ON DELAY	0.0...3600.0 s	0.1 s	0.0 s		
1418	RO 6 OFF DELAY	0.0...3600.0 s	0.1 s	0.0 s		
Group 15: ANALOG OUTPUTS						
1501	AO1 CONTENT SEL	99...178	1	103 (parameter 0103 OUTPUT FREQ)		

Code	Name	Range	Resolution	Default	User	S
1502	AO1 CONTENT MIN	-	-	Depends on the signal selected with par. 1501		
1503	AO1 CONTENT MAX	-	-	Depends on the signal selected with par. 1501		
1504	MINIMUM AO1	0.0...20.0 mA	0.1 mA	0.0 mA		
1505	MAXIMUM AO1	0.0...20.0 mA	0.1 mA	20.0 mA		
1506	FILTER AO1	0.0...10.0 s	0.1 s	0.1 s		
1507	AO2 CONTENT SEL	99...178	1	104 (parameter 0104 CURRENT)		
1508	AO2 CONTENT MIN	-	-	Depends on the signal selected with par. 1507		
1509	AO2 CONTENT MAX	-	-	Depends on the signal selected with par. 1507		
1510	MINIMUM AO2	0.0...20.0 mA	0.1 mA	0.0 mA		
1511	MAXIMUM AO2	0.0...20.0 mA	0.1 mA	20.0 mA		
1512	FILTER AO2	0.0...10.0 s	0.1 s	0.1 s		
Group 16: SYSTEM CONTROLS						
1601	RUN ENABLE	-6...7	1	0 (NOT SEL)		✓
1602	PARAMETER LOCK	0 = LOCKED, 1 = OPEN, 2 = NOT SAVED	1	1 (OPEN)		
1603	PASS CODE	0...65535	1	0		
1604	FAULT RESET SEL	-6...8	1	0 (KEYPAD)		
1605	USER PAR SET CHG	-6...6	1	0 (NOT SEL)		
1606	LOCAL LOCK	-6...8	1	0 (NOT SEL)		
1607	PARAM SAVE	0 = DONE, 1 = SAVE...	1	0 (DONE)		
1608	START ENABLE 1	-6...7	1	0 (NOT SEL)		✓
1609	START ENABLE 2	-6...7	1	0 (NOT SEL)		✓
1610	DISPLAY ALARMS	0 = NO, 1 = YES	1	0 (NO)		
1611	PARAMETER VIEW	0 = DEFAULT, 1 = FLASHDROP	1	0 (DEFAULT)		
1612	FAN CONTROL	0 = AUTO, 1 = ON	1	0 (AUTO)		
1613	FAULT RESET	0 = DEFAULT, 1 = RESET NOW	1	0 (DEFAULT)		
Group 20: LIMITS						
2001	MINIMUM SPEED	-30000...30000 rpm	1 rpm	0 rpm		✓
2002	MAXIMUM SPEED	0...30000 rpm	1 rpm	-01: 1500 rpm / -U1: 1800 rpm		✓
2003	MAX CURRENT	0... $1.8 \cdot I_{2hd}$	0.1 A	$1.8 \cdot I_{2hd}$		✓
2005	OVERVOLT CTRL	0 = DISABLE, 1 = ENABLE	1	1 (ENABLE)		
2006	UNDERVOLT CTRL	0 = DISABLE, 1 = ENABLE(TIME), 2 = ENABLE	1	1 [ENABLE(TIME)]		
2007	MINIMUM FREQ	-500.0...500.0 Hz	0.1 Hz	0.0 Hz		✓
2008	MAXIMUM FREQ	0.0...500.0 Hz	0.1 Hz	-01: 50.0 (52.0) Hz / -U1: 60.0 (62.0) Hz		✓
2013	MIN TORQUE SEL	-6...7	1	0 (MIN TORQUE 1)		
2014	MAX TORQUE SEL	-6...7	1	0 (MAX TORQUE 1)		
2015	MIN TORQUE 1	-600.0...0.0%	0.1%	-300.0%		
2016	MIN TORQUE 2	-600.0...0.0%	0.1%	-300.0%		
2017	MAX TORQUE 1	0.0...600.0%	0.1%	300.0%		
2018	MAX TORQUE 2	0.0...600.0%	0.1%	300.0%		

Code	Name	Range	Resolution	Default	User	S
Group 21: START/STOP						
2101	START FUNCTION	Vector control modes: 1, 2, 8 Scalar control mode: 1...5, 8	1	8 (RAMP)		✓
2102	STOP FUNCTION	1 = COAST, 2 = RAMP	1	1 (COAST)		
2103	DC MAGN TIME	0.00...10.00 s	0.01 s	0.30 s		
2104	DC HOLD CTL	0 = NOT SEL, 1 = DC HOLD, 2 = DC BRAKING	1	0 (NOT SEL)		✓
2105	DC HOLD SPEED	0...360 rpm	1 rpm	5 rpm		
2106	DC CURR REF	0...100%	1%	30%		
2107	DC BRAKE TIME	0.0...250.0 s	0.1 s	0.0 s		
2108	START INHIBIT	0 = OFF, 1 = ON	1	0 (OFF)		
2109	EMERG STOP SEL	-6...6	1	0 (NOT SEL)		
2110	TORQ BOOST CURR	15...300%	1%	100%		
2112	ZERO SPEED DELAY	0.0 = NOT SEL, 0.1...60.0 s	0.1 s	0.0 s (NOT SEL)		
2113	START DELAY	0.00...60.00 s	0.01 s	0.00 s		
Group 22: ACCEL/DECEL						
2201	ACC/DEC 1/2 SEL	-6...7	1	5 (DI5)		
2202	ACCELER TIME 1	0.0...1800.0 s	0.1 s	5.0 s		
2203	DECELER TIME 1	0.0...1800.0 s	0.1 s	5.0 s		
2204	RAMP SHAPE 1	0.0 = LINEAR, 0.1...1000.0 s	0.1 s	0.0 s		
2205	ACCELER TIME 2	0.0...1800.0 s	0.1 s	60.0 s		
2206	DECELER TIME 2	0.0...1800.0 s	0.1 s	60.0 s		
2207	RAMP SHAPE 2	0.0 = LINEAR, 0.1...1000.0 s	0.1 s	0.0 s		
2208	EMERG DEC TIME	0.0...1800.0 s	0.1 s	1.0 s		
2209	RAMP INPUT 0	-6...7	1	0 (NOT SEL)		
Group 23: SPEED CONTROL						
2301	PROP GAIN	0.00...200.00	0.01	5.00		
2302	INTEGRATION TIME	0.00...600.00 s	0.01 s	0.50 s		
2303	DERIVATION TIME	0...10000 ms	1 ms	0 ms		
2304	ACC COMPENSATION	0.00...600.00 s	0.01 s	0.00 s		
2305	AUTOTUNE RUN	0 = OFF, 1 = ON	1	0 (OFF)		
Group 24: TORQUE CONTROL						
2401	TORQ RAMP UP	0.00...120.00 s	0.01 s	0.00 s		
2402	TORQ RAMP DOWN	0.00...120.00 s	0.01 s	0.00 s		
Group 25: CRITICAL SPEEDS						
2501	CRIT SPEED SEL	0 = OFF, 1 = ON	1	0 (OFF)		
2502	CRIT SPEED 1 LO	0.0...500.0 Hz / 0...30000 rpm	0.1 Hz / 1 rpm	0.0 Hz / 0 rpm		
2503	CRIT SPEED 1 HI	0.0...500.0 Hz / 0...30000 rpm	0.1 Hz / 1 rpm	0.0 Hz / 0 rpm		
2504	CRIT SPEED 2 LO	0.0...500.0 Hz / 0...30000 rpm	0.1 Hz / 1 rpm	0.0 Hz / 0 rpm		
2505	CRIT SPEED 2 HI	0.0...500.0 Hz / 0...30000 rpm	0.1 Hz / 1 rpm	0.0 Hz / 0 rpm		
2506	CRIT SPEED 3 LO	0.0...500.0 Hz / 0...30000 rpm	0.1 Hz / 1 rpm	0.0 Hz / 0 rpm		
2507	CRIT SPEED 3 HI	0.0...500.0 Hz / 0...30000 rpm	0.1 Hz / 1 rpm	0.0 Hz / 0 rpm		
Group 26: MOTOR CONTROL						
2601	FLUX OPT ENABLE	0 = OFF, 1 = ON	1	0 (OFF)		
2602	FLUX BRAKING	0 = OFF, 1 = ON	1	0 (OFF)		

Code	Name	Range	Resolution	Default	User	S
2603	IR COMP VOLT	0.0...100.0 V	0.1 V	Size dependent		
2604	IR COMP FREQ	0...100%	1%	80%		
2605	U/F RATIO	1 = LINEAR, 2 = SQUARED	1	1 (LINEAR)		
2606	SWITCHING FREQ	1, 2, 4, 8, 12 kHz	-	4 kHz		
2607	SWITCH FREQ CTRL	0 = OFF, 1 = ON	1	1 (ON)		
2608	SLIP COMP RATIO	0...200%	1%	0%		
2609	NOISE SMOOTHING	0 = DISABLE, 1 = ENABLE	1	0 (DISABLE)		
2619	DC STABILIZER	0 = DISABLE, 1 = ENABLE	1	0 (DISABLE)		
2625	OVERMODULATION	0 = DISABLE, 1 = ENABLE	1	0 (DISABLE)		
Group 29: MAINTENANCE TRIG						
2901	COOLING FAN TRIG	0.0...6553.5 kh, 0.0 disables	0.1 kh	0.0 kh		
2902	COOLING FAN ACT	0.0...6553.5 kh	0.1 kh	0.0 kh		
2903	REVOLUTION TRIG	0...65535 Mrev, 0 disables	1 Mrev	0 Mrev		
2904	REVOLUTION ACT	0...65535 Mrev	1 Mrev	0 Mrev		
2905	RUN TIME TRIG	0.0...6553.5 kh, 0.0 disables	0.1 kh	0.0 kh		
2906	RUN TIME ACT	0.0...6553.5 kh	0.1 kh	0.0 kh		
2907	USER MWh TRIG	0.0...6553.5 MWh, 0.0 disables	0.1 MWh	0.0 MWh		
2908	USER MWh ACT	0.0...6553.5 MWh	0.1 MWh	0.0 MWh		
Group 30: FAULT FUNCTIONS						
3001	AI<MIN FUNCTION	0...3	1	0 (NOT SEL)		
3002	PANEL COMM ERR	1...3	1	1 (FAULT)		
3003	EXTERNAL FAULT 1	-6...6	1	0 (NOT SEL)		
3004	EXTERNAL FAULT 2	-6...6	1	0 (NOT SEL)		
3005	MOT THERM PROT	0 = NOT SEL, 1 = FAULT, 2 = ALARM	1	1 (FAULT)		
3006	MOT THERM TIME	256...9999 s	1 s	500 s		
3007	MOT LOAD CURVE	50...150%	1%	100%		
3008	ZERO SPEED LOAD	25...150%	1%	70%		
3009	BREAK POINT FREQ	1...250 Hz	1 Hz	35 Hz		
3010	STALL FUNCTION	0 = NOT SEL, 1 = FAULT, 2 = ALARM	1	0 (NOT SEL)		
3011	STALL FREQUENCY	0.5...50.0 Hz	0.1 Hz	20.0 Hz		
3012	STALL TIME	10...400 s	1 s	20 s		
3017	EARTH FAULT	0 = DISABLE, 1 = ENABLE	1	1 (ENABLE)		✓
3018	COMM FAULT FUNC	0 = NOT SEL, 1 = FAULT, 2 = CONST SP 7, 3 = LAST SPEED	1	0 (NOT SEL)		
3019	COMM FAULT TIME	0.0...600.0 s	0.1 s	3.0 s		
3021	AI1 FAULT LIMIT	0.0...100.0%	0.1%	0.0%		
3022	AI2 FAULT LIMIT	0.0...100.0%	0.1%	0.0%		
3023	WIRING FAULT	0 = DISABLE, 1 = ENABLE	1	1 (ENABLE)		✓
3024	CB TEMP FAULT	0 = DISABLE, 1 = ENABLE	1	1 (ENABLE)		
3028	EARTH FAULT LVL	1...3	1	-01: 2 (MEDIUM) -U1: 1 (LOW)		
Group 31: AUTOMATIC RESET						
3101	NUMBER OF TRIALS	0...5	1	0		
3102	TRIAL TIME	1.0...600.0 s	0.1 s	30.0 s		
3103	DELAY TIME	0.0...120.0 s	0.1 s	0.0 s		

Code	Name	Range	Resolution	Default	User	S
3104	AR OVERCURRENT	0 = DISABLE, 1 = ENABLE	1	0 (DISABLE)		
3105	AR OVERVOLTAGE	0 = DISABLE, 1 = ENABLE	1	0 (DISABLE)		
3106	AR UNDERVOLTAGE	0 = DISABLE, 1 = ENABLE	1	0 (DISABLE)		
3107	AR AI<MIN	0 = DISABLE, 1 = ENABLE	1	0 (DISABLE)		
3108	AR EXTERNAL FLT	0 = DISABLE, 1 = ENABLE	1	0 (DISABLE)		
Group 32: SUPERVISION						
3201	SUPERV 1 PARAM	100 = NOT SELECTED, 101...178	1	103 (parameter 0103 OUTPUT FREQ)		
3202	SUPERV 1 LIM LO	-	-	Depends on the signal selected with par. 3201		
3203	SUPERV 1 LIM HI	-	-	Depends on the signal selected with par. 3201		
3204	SUPERV 2 PARAM	100 = NOT SELECTED, 101...178	1	104 (parameter 0104 CURRENT)		
3205	SUPERV 2 LIM LO	-	-	Depends on the signal selected with par. 3204		
3206	SUPERV 2 LIM HI	-	-	Depends on the signal selected with par. 3204		
3207	SUPERV 3 PARAM	100 = NOT SELECTED, 101...178	1	105 (parameter 0105 TORQUE)		
3208	SUPERV 3 LIM LO	-	-	Depends on the signal selected with par. 3207		
3209	SUPERV 3 LIM HI	-	-	Depends on the signal selected with par. 3207		
Group 33: INFORMATION						
3301	FIRMWARE	0000...FFFF hex	1	Firmware version		
3302	LOADING PACKAGE	0000...FFFF hex	1	Type dependent		
3303	TEST DATE	yy.ww	0.01	-		
3304	DRIVE RATING	-	-	Type dependent		
3305	PARAMETER TABLE	0000...FFFF hex	1	Type dependent		
Group 34: PANEL DISPLAY						
3401	SIGNAL1 PARAM	100 = NOT SELECTED, 101...178	1	103 (parameter 0103 OUTPUT FREQ)		
3402	SIGNAL1 MIN	-	-	Depends on the signal selected with par. 3401		
3403	SIGNAL1 MAX	-	-	Depends on the signal selected with par. 3401		
3404	OUTPUT1 DSP FORM	0...9	1	9 (DIRECT)		
3405	OUTPUT1 UNIT	0...127	1	Depends on the signal selected with par. 3401		
3406	OUTPUT1 MIN	-	-	Depends on the signal selected with par. 3401		
3407	OUTPUT1 MAX	-	-	Depends on the signal selected with par. 3401		
3408	SIGNAL2 PARAM	100 = NOT SELECTED, 101...178	1	104 (parameter 0104 CURRENT)		
3409	SIGNAL2 MIN	-	-	Depends on the signal selected with par. 3408		
3410	SIGNAL2 MAX	-	-	Depends on the signal selected with par. 3408		

Code	Name	Range	Resolution	Default	User	S
3411	OUTPUT2 DSP FORM	0...9	1	9 (DIRECT)		
3412	OUTPUT2 UNIT	0...127	1	Depends on the signal selected with par. 3408		
3413	OUTPUT2 MIN	-	-	Depends on the signal selected with par. 3408		
3414	OUTPUT2 MAX	-	-	Depends on the signal selected with par. 3408		
3415	SIGNAL3 PARAM	100 = NOT SELECTED, 101...178	1	105 (parameter 0105 TORQUE)		
3416	SIGNAL3 MIN	-	-	Depends on the signal selected with par. 3415		
3417	SIGNAL3 MAX	-	-	Depends on the signal selected with par. 3415		
3418	OUTPUT3 DSP FORM	0...9	1	9 (DIRECT)		
3419	OUTPUT3 UNIT	0...127	1	Depends on the signal selected with par. 3415		
3420	OUTPUT3 MIN	-	-	Depends on the signal selected with par. 3415		
3421	OUTPUT3 MAX	-	-	Depends on the signal selected with par. 3415		
Group 35: MOTOR TEMP MEAS						
3501	SENSOR TYPE	0...6	1	0 (NONE)		
3502	INPUT SELECTION	1...8	1	1 (AI1)		
3503	ALARM LIMIT	Par. 3501 = 1...3: -10...200 °C Par. 3501 = 4: 0...5000 ohm Par. 3501 = 5...6: 0...1	1	110 °C / 1500 ohm / 0		
3504	FAULT LIMIT	Par. 3501 = 1...3: -10...200 °C Par. 3501 = 4: 0...5000 ohm Par. 3501 = 5...6: 0...1	1	130 °C / 4000 ohm / 0		
Group 36: TIMED FUNCTIONS						
3601	TIMERS ENABLE	-6...7	1	0 (NOT SEL)		
3602	START TIME 1	00:00:00...23:59:58	2 s	00:00:00		
3603	STOP TIME 1	00:00:00...23:59:58	2 s	00:00:00		
3604	START DAY 1	1...7	1	1 (MONDAY)		
3605	STOP DAY 1	1...7	1	1 (MONDAY)		
3606	START TIME 2	00:00:00...23:59:58	2 s	00:00:00		
3607	STOP TIME 2	00:00:00...23:59:58	2 s	00:00:00		
3608	START DAY 2	1...7	1	1 (MONDAY)		
3609	STOP DAY 2	1...7	1	1 (MONDAY)		
3610	START TIME 3	00:00:00...23:59:58	2 s	00:00:00		
3611	STOP TIME 3	00:00:00...23:59:58	2 s	00:00:00		
3612	START DAY 3	1...7	1	1 (MONDAY)		
3613	STOP DAY 3	1...7	1	1 (MONDAY)		
3614	START TIME 4	00:00:00...23:59:58	2 s	00:00:00		
3615	STOP TIME 4	00:00:00...23:59:58	2 s	00:00:00		
3616	START DAY 4	1...7	1	1 (MONDAY)		
3617	STOP DAY 4	1...7	1	1 (MONDAY)		
3622	BOOSTER SEL	-6...6	1	0 (NOT SEL)		
3623	BOOSTER TIME	00:00:00...23:59:58	2 s	00:00:00		

Code	Name	Range	Resolution	Default	User	S
3626	TIMED FUNC 1...4 SRC	0...31	1	0 (NOT SEL)		
...						
3629						
Group 37: USER LOAD CURVE						
3701	USER LOAD C MODE	0...3	1	0 (NOT SEL)		
3702	USER LOAD C FUNC	1 = FAULT, 2 = ALARM	1	1 (FAULT)		
3703	USER LOAD C TIME	10...400 s	1 s	20 s		
3704	LOAD FREQ 1	0...500 Hz	1 Hz	5 Hz		
3705	LOAD TORQ LOW 1	0...600%	1%	10%		
3706	LOAD TORQ HIGH 1	0...600%	1%	300%		
3707	LOAD FREQ 2	0...500 Hz	1 Hz	25 Hz		
3708	LOAD TORQ LOW 2	0...600%	1%	15%		
3709	LOAD TORQ HIGH 2	0...600%	1%	300%		
3710	LOAD FREQ 3	0...500 Hz	1 Hz	43 Hz		
3711	LOAD TORQ LOW 3	0...600%	1%	25%		
3712	LOAD TORQ HIGH 3	0...600%	1%	300%		
3713	LOAD FREQ 4	0...500 Hz	1 Hz	50 Hz		
3714	LOAD TORQ LOW 4	0...600%	1%	30%		
3715	LOAD TORQ HIGH 4	0...600%	1%	300%		
3716	LOAD FREQ 5	0...500 Hz	1 Hz	500 Hz		
3717	LOAD TORQ LOW 5	0...600%	1%	30%		
3718	LOAD TORQ HIGH 5	0...600%	1%	300%		
Group 40: PROCESS PID SET 1						
4001	GAIN	0.1...100.0	0.1	1.0		
4002	INTEGRATION TIME	0.0 = NOT SEL, 0.1...3600.0 s	0.1 s	60.0 s		
4003	DERIVATION TIME	0.0...10.0 s	0.1 s	0.0 s		
4004	PID DERIV FILTER	0.0...10.0 s	0.1 s	1.0 s		
4005	ERROR VALUE INV	0 = NO, 1 = YES	1	0 (NO)		
4006	UNITS	0...127	1	4 (%)		
4007	UNIT SCALE	0...4	1	1		
4008	0% VALUE	Unit and scale defined by par. 4006 and 4007	-	0.0		
4009	100% VALUE	Unit and scale defined by par. 4006 and 4007	-	100.0		
4010	SET POINT SEL	0...2, 8...17, 19...20	1	1 (AI1)		✓
4011	INTERNAL SETPNT	Unit and scale defined by par. 4006 and 4007	-	40.0		
4012	SETPOINT MIN	-500.0...500.0%	0.1%	0.0%		
4013	SETPOINT MAX	-500.0...500.0%	0.1%	100.0%		
4014	FBK SEL	1...13	1	1 (ACT1)		
4015	FBK MULTIPLIER	0.000 = NOT SEL, -32.768...32.767	0.001	0.000 (NOT SEL)		
4016	ACT1 INPUT	1...7	1	2 (AI2)		✓
4017	ACT2 INPUT	1...7	1	2 (AI2)		✓
4018	ACT1 MINIMUM	-1000...1000%	1%	0%		
4019	ACT1 MAXIMUM	-1000...1000%	1%	100%		
4020	ACT2 MINIMUM	-1000...1000%	1%	0%		

Code	Name	Range	Resolution	Default	User	S
4021	ACT2 MAXIMUM	-1000...1000%	1%	100%		
4022	SLEEP SELECTION	-6...7	1	0 (NOT SEL)		
4023	PID SLEEP LEVEL	0.0...500.0 Hz / 0...30000 rpm	0.1 Hz / 1 rpm	0.0 Hz / 0 rpm		
4024	PID SLEEP DELAY	0.0...3600.0 s	0.1 s	60.0 s		
4025	WAKE-UP DEV	Unit and scale defined by par. 4006 and 4007	-	0.0		
4026	WAKE-UP DELAY	0.00...60.00 s	0.01 s	0.50 s		
4027	PID 1 PARAM SET	-6...14	1	0 (SET 1)		
Group 41: PROCESS PID SET 2						
4101	GAIN	0.1...100.0	0.1	1.0		
4102	INTEGRATION TIME	0.0 = NOT SEL, 0.1...3600.0 s	0.1 s	60.0 s		
4103	DERIVATION TIME	0.0...10.0 s	0.1 s	0.0 s		
4104	PID DERIV FILTER	0.0...10.0 s	0.1 s	1.0 s		
4105	ERROR VALUE INV	0 = NO, 1 = YES	1	0 (NO)		
4106	UNITS	0...127	1	4 (%)		
4107	UNIT SCALE	0...4	1	1		
4108	0% VALUE	Unit and scale defined by par. 4106 and 4107	-	0.0		
4109	100% VALUE	Unit and scale defined by par. 4106 and 4107	-	100.0		
4110	SET POINT SEL	0...2, 8...17, 19...20	1	1 (AI1)		✓
4111	INTERNAL SETPNT	Unit and scale defined by par. 4106 and 4107	-	40.0		
4112	SETPOINT MIN	-500.0...500.0%	0.1%	0.0%		
4113	SETPOINT MAX	-500.0...500.0%	0.1%	100.0%		
4114	FBK SEL	1...13	1	1 (ACT1)		
4115	FBK MULTIPLIER	0.000 = NOT SEL, -32.768...32.767	0.001	0.000 (NOT SEL)		
4116	ACT1 INPUT	1...7	1	2 (AI2)		✓
4117	ACT2 INPUT	1...7	1	2 (AI2)		✓
4118	ACT1 MINIMUM	-1000...1000%	1%	0%		
4119	ACT1 MAXIMUM	-1000...1000%	1%	100%		
4120	ACT2 MINIMUM	-1000...1000%	1%	0%		
4121	ACT2 MAXIMUM	-1000...1000%	1%	100%		
4122	SLEEP SELECTION	-6...7	1	0 (NOT SEL)		
4123	PID SLEEP LEVEL	0.0...500.0 Hz / 0...30000 rpm	0.1 Hz / 1 rpm	0.0 Hz / 0 rpm		
4124	PID SLEEP DELAY	0.0...3600.0 s	0.1 s	60.0 s		
4125	WAKE-UP DEV	Unit and scale defined by par. 4106 and 4107	-	0.0		
4126	WAKE-UP DELAY	0.00...60.00 s	0.01 s	0.50 s		
Group 42: EXT / TRIM PID						
4201	GAIN	0.1...100.0	0.1	1.0		
4202	INTEGRATION TIME	0.0 = NOT SEL, 0.1...3600.0 s	0.1 s	60.0 s		
4203	DERIVATION TIME	0.0...10.0 s	0.1 s	0.0 s		
4204	PID DERIV FILTER	0.0...10.0 s	0.1 s	1.0 s		
4205	ERROR VALUE INV	0 = NO, 1 = YES	1	0 (NO)		
4206	UNITS	0...127	1	4 (%)		

Code	Name	Range	Resolution	Default	User	S
4207	UNIT SCALE	0...4	1	1		
4208	0% VALUE	Unit and scale defined by par. 4206 and 4207	-	0.0		
4209	100% VALUE	Unit and scale defined by par. 4206 and 4207	-	100.0		
4210	SET POINT SEL	0...2, 8...17, 19...20	1	1 (AI1)		✓
4211	INTERNAL SETPNT	Unit and scale defined by par. 4206 and 4207	-	40.0		
4212	SETPOINT MIN	-500.0...500.0%	0.1%	0.0%		
4213	SETPOINT MAX	-500.0...500.0%	0.1%	100.0%		
4214	FBK SEL	1...13	1	1 (ACT1)		
4215	FBK MULTIPLIER	0.000 = NOT SEL, -32.768...32.767	0.001	0.000 (NOT SEL)		
4216	ACT1 INPUT	1...7	1	2 (AI2)		✓
4217	ACT2 INPUT	1...7	1	2 (AI2)		✓
4218	ACT1 MINIMUM	-1000...1000%	1%	0%		
4219	ACT1 MAXIMUM	-1000...1000%	1%	100%		
4220	ACT2 MINIMUM	-1000...1000%	1%	0%		
4221	ACT2 MAXIMUM	-1000...1000%	1%	100%		
4228	ACTIVATE	-6...12	1	0 (NOT SEL)		
4229	OFFSET	0.0...100.0%	0.1%	0.0%		
4230	TRIM MODE	0 = NOT SEL, 1 = PROPORTIONAL, 3 = DIRECT	1	0 (NOT SEL)		
4231	TRIM SCALE	-100.0...100.0%	0.1%	0.0%		
4232	CORRECTION SRC	1 = PID2REF, 2 = PID2OUTPUT	1	1 (PID2REF)		
Group 45: ENERGY SAVING						
4502	ENERGY PRICE	0.00...655.35	0.01	0.00		
4507	CO2 CONV FACTOR	0.0...10.0 tn/MWh	0.1 tn/MWh	0.5 tn/MWh		
4508	PUMP POWER	0.0...1000.0%	0.1%	100.0%		
4509	ENERGY RESET	0 = DONE, 1 = RESET	1	0 (DONE)		
Group 50: ENCODER						
5001	PULSE NR	50...16384	1	1024		✓
5002	ENCODER ENABLE	0 = DISABLE, 1 = ENABLE	1	0 (DISABLE)		✓
5003	ENCODER FAULT	1 = FAULT, 2 = ALARM	1	1 (FAULT)		✓
5010	Z PLS ENABLE	0 = DISABLE, 1 = ENABLE	1	0 (DISABLE)		✓
5011	POSITION RESET	0 = DISABLE, 1 = ENABLE	1	0 (DISABLE)		
Group 51: EXT COMM MODULE						
5101	FBA TYPE	-	-	0 (NOT DEFINED)		
5102... 5126	FB PAR 2...26	0...65535	1	0		
5127	FBA PAR REFRESH	0 = DONE, 1 = REFRESH	1	0 (DONE)		✓
5128	FILE CPI FW REV	0000...FFFF hex	1	0		
5129	FILE CONFIG ID	0000...FFFF hex	1	0		
5130	FILE CONFIG REV	0000...FFFF hex	1	0		
5131	FBA STATUS	0...6	1	0 (IDLE)		
5132	FBA CPI FW REV	0000...FFFF hex	1	0		
5133	FBA APPL FW REV	0000...FFFF hex	1	0		

Code	Name	Range	Resolution	Default	User	S
Group 52: PANEL COMM						
5201	STATION ID	1...247	1	1		
5202	BAUD RATE	9.6, 19.2, 38.4, 57.6, 115.2 kbits/s	-	9.6 kbits/s		
5203	PARITY	0 = 8 NONE 1, 1 = 8 NONE 2, 2 = 8 EVEN 1, 3 = 8 ODD 1	1	0 (8 NONE 1)		
5204	OK MESSAGES	0...65535	1	-		
5205	PARITY ERRORS	0...65535	1	-		
5206	FRAME ERRORS	0...65535	1	-		
5207	BUFFER OVERRUNS	0...65535	1	-		
5208	CRC ERRORS	0...65535	1	-		
Group 53: EFB PROTOCOL						
5301	EFB PROTOCOL ID	0...0xFFFF	1	0		
5302	EFB STATION ID	0...65535	1	1		✓
5303	EFB BAUD RATE	1.2, 2.4, 4.8, 9.6, 19.2, 38.4, 57.6, 76.8 kbits/s	-	9.6 kbits/s		
5304	EFB PARITY	0 = 8 NONE 1, 1 = 8 NONE 2, 2 = 8 EVEN 1, 3 = 8 ODD 1		0 (8 NONE 1)		
5305	EFB CTRL PROFILE	0 = ABB DRV LIM, 1 = DCU PROFILE, 2 = ABB DRV FULL	1	0 (ABB DRV LIM)		
5306	EFB OK MESSAGES	0...65535	1	0		
5307	EFB CRC ERRORS	0...65535	1	0		
5308	EFB UART ERRORS	0...65535	1	0		
5309	EFB STATUS	0...7	1	0 (IDLE)		
5310	EFB PAR 10	0...65535	1	0		
5311	EFB PAR 11	0...65535	1	0		
5312	EFB PAR 12	0...65535	1	0		
5313	EFB PAR 13	0...65535	1	0		
5314	EFB PAR 14	0...65535	1	0		
5315	EFB PAR 15	0...65535	1	0		
5316	EFB PAR 16	0...65535	1	0		
5317	EFB PAR 17	0...65535	1	0		
5318	EFB PAR 18	0...65535	1	0		
5319	EFB PAR 19	0000...FFFF hex	1	0		
5320	EFB PAR 20	0000...FFFF hex	1	0		
Group 64: LOAD ANALYZER						
6401	PVL SIGNAL	100...178	1	103 (parameter 0103 OUTPUT FREQ)		
6402	PVL FILTER TIME	0.0...120.0 s	0.1 s	0.1 s		
6403	LOGGERS RESET	-6...7	1	0 (NOT SEL)		
6404	AL2 SIGNAL	101...178	1	103 (parameter 0103 OUTPUT FREQ)		
6405	AL2 SIGNAL BASE	-	-	Depends on the signal selected with par. 6404.		
6406	PEAK VALUE	-	-	-		
6407	PEAK TIME 1	Date dd.mm.yy / power-on time in days	1 d	-		
6408	PEAK TIME 2	Time hh.mm.ss	2 s	-		
6409	CURRENT AT PEAK	0.0...6553.5 A	0.1 A	-		

Code	Name	Range	Resolution	Default	User	S
6410	UDC AT PEAK	0...65535 V	1 V	-		
6411	FREQ AT PEAK	0.0...6553.5 Hz	0.1 Hz	-		
6412	TIME OF RESET 1	Date dd.mm.yy / power-on time in days	1 d	-		
6413	TIME OF RESET 2	Time hh.mm.ss	2 s	-		
6414	AL1RANGE0TO10	0.0...100.0%	0.1%	-		
6415	AL1RANGE10TO20	0.0...100.0%	0.1%	-		
6416	AL1RANGE20TO30	0.0...100.0%	0.1%	-		
6417	AL1RANGE30TO40	0.0...100.0%	0.1%	-		
6418	AL1RANGE40TO50	0.0...100.0%	0.1%	-		
6419	AL1RANGE50TO60	0.0...100.0%	0.1%	-		
6420	AL1RANGE60TO70	0.0...100.0%	0.1%	-		
6421	AL1RANGE70TO80	0.0...100.0%	0.1%	-		
6422	AL1RANGE80TO90	0.0...100.0%	0.1%	-		
6423	AL1RANGE90TO	0.0...100.0%	0.1%	-		
6424	AL2RANGE0TO10	0.0...100.0%	0.1%	-		
6425	AL2RANGE10TO20	0.0...100.0%	0.1%	-		
6426	AL2RANGE20TO30	0.0...100.0%	0.1%	-		
6427	AL2RANGE30TO40	0.0...100.0%	0.1%	-		
6428	AL2RANGE40TO50	0.0...100.0%	0.1%	-		
6429	AL2RANGE50TO60	0.0...100.0%	0.1%	-		
6430	AL2RANGE60TO70	0.0...100.0%	0.1%	-		
6431	AL2RANGE70TO80	0.0...100.0%	0.1%	-		
6432	AL2RANGE80TO90	0.0...100.0%	0.1%	-		
6433	AL2RANGE90TO	0.0...100.0%	0.1%	-		
Group 81: PFC CONTROL						
8103	REFERENCE STEP 1	0.0...100.0%	0.1%	0.0%		
8104	REFERENCE STEP 2	0.0...100.0%	0.1%	0.0%		
8105	REFERENCE STEP 3	0.0...100.0%	0.1%	0.0%		
8109	START FREQ 1	0.0...500.0 Hz	0.1 Hz	-01: 50.0 Hz / -U1: 60.0 Hz		
8110	START FREQ 2	0.0...500.0 Hz	0.1 Hz	-01: 50.0 Hz / -U1: 60.0 Hz		
8111	START FREQ 3	0.0...500.0 Hz	0.1 Hz	-01: 50.0 Hz / -U1: 60.0 Hz		
8112	LOW FREQ 1	0.0...500.0 Hz	0.1 Hz	-01: 25.0 Hz / -U1: 30.0 Hz		
8113	LOW FREQ 2	0.0...500.0 Hz	0.1 Hz	-01: 25.0 Hz / -U1: 30.0 Hz		
8114	LOW FREQ 3	0.0...500.0 Hz	0.1 Hz	-01: 25.0 Hz / -U1: 30.0 Hz		
8115	AUX MOT START D	0.0...3600.0 s	0.1 s	5.0 s		
8116	AUX MOT STOP D	0.0...3600.0 s	0.1 s	3.0 s		
8117	NR OF AUX MOT	0...4	1	1		✓
8118	AUTOCHNG INTERV	-0.1 = TEST MODE, 0.0 = NOT SEL, 0.1...336.0 h	0.1 h	0.0 h (NOT SEL)		✓
8119	AUTOCHNG LEVEL	0.0...100.0%	0.1%	50.0%		
8120	INTERLOCKS	0...6	1	4 (DI4)		✓

Code	Name	Range	Resolution	Default	User	S
8121	REG BYPASS CTRL	0 = NO, 1 = YES	1	0 (NO)		
8122	PFC START DELAY	0.00...10.00 s	0.01 s	0.50 s		
8123	PFC ENABLE	0 = NOT SEL, 1 = ACTIVE	1	0 (NOT SEL)		✓
8124	ACC IN AUX STOP	0.0 = NOT SEL, 0.1...1800.0 s	0.1 s	0.0 s (NOT SEL)		
8125	DEC IN AUX START	0.0 = NOT SEL, 0.1...1800.0 s	0.1 s	0.0 s (NOT SEL)		
8126	TMED AUTOCHNG	0...4	1	0 (NOT SEL)		
8127	MOTORS	1...7	1	2		✓
8128	AUX START ORDER	1 = EVEN RUNTIME, 2 = RELAY ORDER	1	1 (EVEN RUNTIME)		✓
Group 98: OPTIONS						
9802	COMM PROT SEL	0 = NOT SEL, 1 = STD MODBUS, 4 = EXT FBA	1	0 (NOT SEL)		✓

Complete parameter descriptions

This section describes the actual signals and parameters for ACS550.

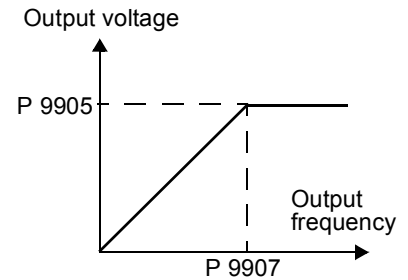
Group 99: START-UP DATA

This group defines special start-up data required to:

- set up the drive
- enter motor information.

Code	Description																								
9901	LANGUAGE Selects the display language. There are two different Assistant Control Panels, each supporting a different language set. (Panel ACS-CP-L supporting languages 0, 2, 11...15 has been integrated into ACS-CP-A.) Assistant Control Panel ACS-CP-A: <table><tr><td>0 = ENGLISH</td><td>1 = ENGLISH (AM)</td><td>2 = DEUTSCH</td><td>3 = ITALIANO</td><td>4 = ESPAÑOL</td></tr><tr><td>5 = PORTUGUES</td><td>6 = NEDERLANDS</td><td>7 = FRANÇAIS</td><td>8 = DANSK</td><td>9 = SUOMI</td></tr><tr><td>10 = SVENSKA</td><td>11 = RUSSKI</td><td>12 = POLSKI</td><td>13 = TÜRKÇE</td><td>14 = CZECH</td></tr><tr><td>15 = MAGYAR</td><td>16 = ELLINIKI</td><td></td><td></td><td></td></tr></table> Assistant Control Panel ACS-CP-D (Asia): <table><tr><td>0 = ENGLISH</td><td>1 = CHINESE</td><td>2 = KOREAN</td><td>3 = JAPANESE</td></tr></table>	0 = ENGLISH	1 = ENGLISH (AM)	2 = DEUTSCH	3 = ITALIANO	4 = ESPAÑOL	5 = PORTUGUES	6 = NEDERLANDS	7 = FRANÇAIS	8 = DANSK	9 = SUOMI	10 = SVENSKA	11 = RUSSKI	12 = POLSKI	13 = TÜRKÇE	14 = CZECH	15 = MAGYAR	16 = ELLINIKI				0 = ENGLISH	1 = CHINESE	2 = KOREAN	3 = JAPANESE
0 = ENGLISH	1 = ENGLISH (AM)	2 = DEUTSCH	3 = ITALIANO	4 = ESPAÑOL																					
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15 = MAGYAR	16 = ELLINIKI																								
0 = ENGLISH	1 = CHINESE	2 = KOREAN	3 = JAPANESE																						
9902	APPLIC MACRO Selects an application macro. Application macros automatically edit parameters to configure the ACS550 for a particular application. <table><tr><td>1 = ABB STANDARD</td><td>2 = 3-WIRE</td><td>3 = ALTERNATE</td><td>4 = MOTOR POT</td><td>5 = HAND/AUTO</td></tr><tr><td>6 = PID CONTROL</td><td>7 = PFC CONTROL</td><td>8 = TORQUE CTRL</td><td>31 = LOAD FD SET</td><td></td></tr><tr><td>0 = USER S1 LOAD</td><td>-1 = USER S1 SAVE</td><td>-2 = USER S2 LOAD</td><td>-3 = USER S2 SAVE</td><td></td></tr></table> 31 = LOAD FD SET – FlashDrop parameter values as defined by the FlashDrop file. Parameter view is selected by parameter 1611 PARAMETER VIEW. FlashDrop is an optional device for fast copying of parameters to unpowered drives. FlashDrop allows easy customization of the parameter list, e.g. selected parameters can be hidden. For more information, see <i>MFDT-01 FlashDrop User's Manual</i> (3AFE68591074 [English]). -1 = USER S1 SAVE, -3 = USER S2 SAVE – With these it is possible to save two different user parameter sets into the drive permanent memory for later use. Each set contains parameter settings, including Group 99: START-UP DATA, and the results of the motor identification run. 0 = USER S1 LOAD, -2 = USER S2 LOAD – With these the user parameter sets can be taken back in use.	1 = ABB STANDARD	2 = 3-WIRE	3 = ALTERNATE	4 = MOTOR POT	5 = HAND/AUTO	6 = PID CONTROL	7 = PFC CONTROL	8 = TORQUE CTRL	31 = LOAD FD SET		0 = USER S1 LOAD	-1 = USER S1 SAVE	-2 = USER S2 LOAD	-3 = USER S2 SAVE										
1 = ABB STANDARD	2 = 3-WIRE	3 = ALTERNATE	4 = MOTOR POT	5 = HAND/AUTO																					
6 = PID CONTROL	7 = PFC CONTROL	8 = TORQUE CTRL	31 = LOAD FD SET																						
0 = USER S1 LOAD	-1 = USER S1 SAVE	-2 = USER S2 LOAD	-3 = USER S2 SAVE																						
9904	MOTOR CTRL MODE Selects the motor control mode. 1 = VECTOR:SPEED – sensorless vector control mode. - Reference 1 is speed reference in rpm. - Reference 2 is speed reference in % (100% is absolute maximum speed, equal to the value of parameter 2002 MAXIMUM SPEED, or 2001 MINIMUM SPEED if the absolute value of the minimum speed is greater than the maximum speed). 2 = VECTOR:TORQ. - Reference 1 is speed reference in rpm. - Reference 2 is torque reference in % (100% is nominal torque.) 3 = SCALAR:FREQ – scalar control mode. - Reference 1 is frequency reference in Hz. - Reference 2 is frequency reference in % (100% is absolute maximum frequency, equal to the value of parameter 2008 MAXIMUM FREQ, or 2007 MINIMUM FREQ if the absolute value of the minimum speed is greater than the maximum speed).																								

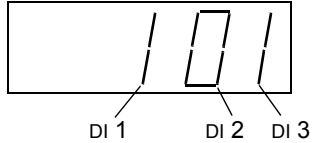
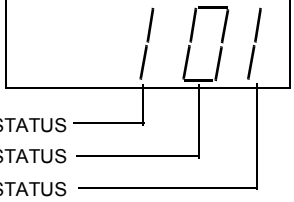
Code	Description
9905	MOTOR NOM VOLT Defines the nominal motor voltage. - Must equal the value on the motor rating plate. - The ACS550 cannot supply the motor with a voltage greater than the input power (mains) voltage.
9906	MOTOR NOM CURR Defines the nominal motor current. - Must equal the value on the motor rating plate. - Range allowed: $0.2 \dots 2.0 \cdot I_{2hd}$ (where I_{2hd} is drive current).
9907	MOTOR NOM FREQ Defines the nominal motor frequency. - Range: 10...500 Hz (typically 50 or 60 Hz) - Sets the frequency at which output voltage equals the MOTOR NOM VOLT. - Field weakening point = Nom Freq · Supply Volt / Mot Nom Volt
9908	MOTOR NOM SPEED Defines the nominal motor speed. Must equal the value on the motor rating plate.
9909	MOTOR NOM POWER Defines the nominal motor power. Must equal the value on the motor rating plate.
9910	ID RUN This parameter controls a self-calibration process called the Motor ID Run. During this process, the drive operates the motor (motor rotating) and makes measurements in order to identify motor characteristics and create a model used for internal calculations. An ID Run is especially effective when: - vector control mode is used [parameter 9904 = 1 (VECTOR:SPEED) or 2 (VECTOR:TORQ)], and/or - operation point is near zero speed, and/or - operation requires a torque range above the motor nominal torque, over a wide speed range, and without any measured speed feedback (i.e. without a pulse encoder). 0 = OFF/IDMAGN – The Motor ID Run process is not run. Identification magnetization is performed, depending on parameter 9904 and 2101 settings. In identification magnetization, the motor model is calculated at first start by magnetizing the motor for 10 to 15 s at zero speed (motor not rotating). The model is recalculated always at start after motor parameter changes. - Parameter 9904 = 1 (VECTOR:SPEED) or 2 (VECTOR:TORQ): Identification magnetization is performed. - Parameter 9904 = 3 (SCALAR:FREQ) and parameter 2101 = 3 (SCALAR FLYST) or 5 (FLY + BOOST): Identification magnetization is performed. - Parameter 9904 = 3 (SCALAR:FREQ) and parameter 2101 has other value than 3 (SCALAR FLYST) or 5 (FLY + BOOST): Identification magnetization is not performed. 1 = ON – Enables the Motor ID Run, during which the motor is rotating, at the next start command. After run completion, this value automatically changes to 0. Note: The motor must be de-coupled from the driven equipment. Note: If motor parameters are changed after ID Run, repeat the ID Run. WARNING! The motor will run at up to approximately 50...80% of the nominal speed during the ID Run. The motor will rotate in the forward direction. Ensure that it is safe to run the motor before performing the ID Run! See also section How to perform the ID Run on page 45.
9915	MOTOR COSPHI Defines the nominal motor cos phi (power factor). The parameter improves performance especially with high efficiency motors. 0 = IDENTIFIED – Drive identifies the cos phi automatically by estimation. 0.01...0.97 – Value entered used as the cos phi.



Group 01: OPERATING DATA

This group contains drive operating data, including actual signals. The drive sets the values for actual signals, based on measurements or calculations. You cannot set these values.

Code	Description
0101	SPEED & DIR The calculated signed speed of the motor (rpm). The absolute value of 0101 SPEED & DIR is the same as the value of 0102 SPEED. - The value of 0101 SPEED & DIR is positive if the motor runs in the forward direction. - The value of 0101 SPEED & DIR is negative if the motor runs in the reverse direction.
0102	SPEED The calculated speed of the motor (rpm). (Parameter 0102 or 0103 is shown by default in the control panel Output mode.)
0103	OUTPUT FREQ The frequency (Hz) applied to the motor. (Parameter 0102 or 0103 is shown by default in the control panel Output mode.)
0104	CURRENT The motor current, as measured by the ACS550. (Shown by default in the control panel Output mode.)
0105	TORQUE Output torque. Calculated value of torque on motor shaft in % of motor nominal torque. (Shown by default in the control panel Output mode.)
0106	POWER The measured motor power in kW.
0107	DC BUS VOLTAGE The DC bus voltage in V DC, as measured by the ACS550.
0109	OUTPUT VOLTAGE The voltage applied to the motor.
0110	DRIVE TEMP The temperature of the drive power transistors in degrees Celsius.
0111	EXTERNAL REF 1 External reference, REF1, in rpm or Hz – units determined by parameter 9904.
0112	EXTERNAL REF 2 External reference, REF2, in %.
0113	CTRL LOCATION Active control location. Alternatives are: 0 = LOCAL 1 = EXT1 2 = EXT2
0114	RUN TIME (R) The drive's accumulated running time in hours (h). Can be reset by pressing UP and DOWN keys simultaneously when the control panel is in the Parameters mode.
0115	KWH COUNTER (R) The drive's accumulated power consumption in kilowatt hours. - The counter value is accumulated till it reaches 65535 after which the counter rolls over and starts again from 0. - Can be reset by pressing UP and DOWN keys simultaneously when the control panel is in the Parameters mode.
0116	APPL BLK OUTPUT Application block output signal. Value is from either: - PFC control, if PFC Control is active, or - Parameter 0112 EXTERNAL REF 2.

Code	Description	
0118	DI 1-3 STATUS Status of the three digital inputs. • Status is displayed as a binary number. • 1 indicates that the input is activated. • 0 indicates that the input is deactivated.	
0119	DI 4-6 STATUS Status of the three digital inputs. • See parameter 0118 DI 1-3 STATUS.	
0120	AI 1 The relative value of analog input 1 in %.	
0121	AI 2 The relative value of analog input 2 in %.	
0122	RO 1-3 STATUS Status of the three relay outputs. • 1 indicates that the relay is energized. • 0 indicates that the relay is de-energized.	
0123	RO 4-6 STATUS Status of the three relay outputs. Available if OREL-01 Relay Output Extension Module is installed. • See parameter 0122.	
0124	AO 1 The analog output 1 value in milliamperes.	
0125	AO 2 The analog output 2 value in milliamperes.	
0126	PID 1 OUTPUT The PID controller 1 output value in %.	
0127	PID 2 OUTPUT The PID controller 2 output value in %.	
0128	PID 1 SETPNT The PID 1 controller setpoint signal. • Units and scale defined by PID parameters.	
0129	PID 2 SETPNT The PID 2 controller setpoint signal. • Units and scale defined by PID parameters.	
0130	PID 1 FBK The PID 1 controller feedback signal. • Units and scale defined by PID parameters.	
0131	PID 2 FBK The PID 2 controller feedback signal. • Units and scale defined by PID parameters.	
0132	PID 1 DEVIATION The difference between the PID 1 controller reference value and actual value. • Units and scale defined by PID parameters.	
0133	PID 2 DEVIATION The difference between the PID 2 controller reference value and actual value. • Units and scale defined by PID parameters.	
0134	COMM RO WORD Free data location that can be written from serial link. • Used for relay output control. • See parameter 1401.	
0135	COMM VALUE 1 Free data location that can be written from serial link.	

Code	Description
0136	COMM VALUE 2 Free data location that can be written from serial link.
0137	PROCESS VAR 1 Process variable 1 • Defined by parameters in Group 34: PANEL DISPLAY .
0138	PROCESS VAR 2 Process variable 2 • Defined by parameters in Group 34: PANEL DISPLAY .
0139	PROCESS VAR 3 Process variable 3 • Defined by parameters in Group 34: PANEL DISPLAY .
0140	RUN TIME The drive's accumulated running time in thousands of hours (kh). • Cannot be reset.
0141	MWH COUNTER The drive's accumulated power consumption in megawatt hours. • The counter value is accumulated till it reaches 65535 after which the counter rolls over and starts again from 0. • Cannot be reset.
0142	REVOLUTION CNTR The motor's accumulated revolutions in millions of revolutions. • Can be reset by pressing UP and DOWN keys simultaneously when the control panel is in the Parameters mode.
0143	DRIVE ON TIME HI The drive's accumulated power-on time in days. • Cannot be reset.
0144	DRIVE ON TIME LO The drive's accumulated power-on time in 2 second ticks (30 ticks = 60 seconds). • Shown in format hh.mm.ss. • Cannot be reset.
0145	MOTOR TEMP Motor temperature in degrees Celsius / PTC resistance in ohms. • Applies only if motor temperature sensor is set up. • See parameter 3501.
0146	MECH ANGLE Defines the motor shaft's angular position to about 0.01° (32,768 divisions for 360°). The position is defined as 0 at power up. During operation the zero position can be set by: • a Z-pulse input, if parameter 5010 Z PLS ENABLE = 1 (ENABLE) • parameter 5011 POSITION RESET, if parameter 5010 Z PLS ENABLE = 2 (DISABLE) • any status change of parameter 5002 ENCODER ENABLE.
0147	MECH REVS A signed integer that counts full revolutions of the motor shaft. The value: • increments when parameter 0146 MECH ANGLE changes from 32767 to 0 • decrements when parameter 0146 MECH ANGLE changes from 0 to 32767.
0148	Z PLS DETECTED Encoder zero pulse detector. When a Z-pulse defines the zero position, the shaft must pass through the zero position to trigger a Z-pulse. Until then, the shaft position is unknown (the drive uses the shaft position at power up as zero). This parameter signals when parameter 0146 MECH ANGLE is valid. The parameter starts at 0 = NOT DETECTED on power-up and changes to 1 = DETECTED only if: • parameter 5010 Z PLS ENABLE = 1 (ENABLE) and • an encoder Z-pulse has been detected.
0150	CB TEMP Temperature of the drive control board in degrees Celsius. Note: Some drives have a control board (OMIO) that does not support this feature. These drives always show the constant value of 25.0 °C.

Code	Description
0153	MOT THERM STRESS Estimated rise of the motor temperature. Value equals to the estimated motor thermal stress as a percentage of the motor temperature trip level.
0158	PID COMM VALUE 1 Data received from fieldbus for PID control (PID1 and PID2).
0159	PID COMM VALUE 2 Data received from fieldbus for PID control (PID1 and PID2).
0174	SAVED KWH Energy saved in kWh compared to the energy used when the pump is connected directly to the supply. See the note on page 180. - The counter value is accumulated till it reaches 999.9 after which the counter rolls over and starts again from 0.0 and the counter value of signal 0175 is incremented by one. Can be reset with parameter 4509 ENERGY RESET (resets all energy calculators at the same time). - See Group 45: ENERGY SAVING.
0175	SAVED MWH Energy saved in MWh compared to the energy used when the pump is connected directly to the supply. See the note on page 180. - The counter value is accumulated till it reaches 65535 after which the counter rolls over and starts again from 0. - Can be reset with parameter 4509 ENERGY RESET (resets all energy calculators at the same time). - See Group 45: ENERGY SAVING.
0176	SAVED AMOUNT 1 Energy saved in local currency (remainder when the total saved energy is divided by 1000). See the note on page 180. - To find out the total saved energy in currency units, add the value of parameter 0177 multiplied by 1000 to the value of parameter 0176. Example: $0176 \text{ SAVED AMOUNT } 1 = 123.4$ $0177 \text{ SAVED AMOUNT } 2 = 5$ $\text{Total saved energy} = 5 \cdot 1000 + 123.4 = 5123.4 \text{ currency units.}$ - The counter value is accumulated till it reaches 999.9 after which the counter rolls over and starts again from 0.0 and the counter value of signal 0177 is incremented by one. - Can be reset with parameter 4509 ENERGY RESET (resets all energy calculators at the same time). - Local energy price is set with parameter 4502 ENERGY PRICE. - See Group 45: ENERGY SAVING.
0177	SAVED AMOUNT 2 Energy saved in local currency in thousand currency units. Eg value 5 means 5000 currency units. See the note on page 180. - The counter value is accumulated till it reaches 65535 (the counter does not roll over). - See parameter 0176 SAVED AMOUNT 1.
0178	SAVED CO2 Reduction on carbon dioxide emissions in tn. See the note on page 180. - The counter value is accumulated till it reaches 6553.5 (the counter does not roll over). - Can be reset with parameter 4509 ENERGY RESET (resets all energy calculators at the same time). - CO2 conversion factor is set with parameter 4507 CO2 CONV FACTOR. - See Group 45: ENERGY SAVING.

Group 03: FB ACTUAL SIGNALS

This group monitors fieldbus communications.

Code	Description		
0301	FB CMD WORD 1 Read-only copy of the Fieldbus Command Word 1. - The fieldbus command is the principal means for controlling the drive from a fieldbus controller. The command consists of two Command Words. Bit-coded instructions in the Command Words switch the drive between states. - To control the drive, using the Command Words, an external location (EXT1 or EXT2) must be active and set to COMM. (See parameters 1001 and 1002.) - The control panel displays the word in hex. For example, all zeros and a 1 in Bit 0 displays as 0001. All zeros and a 1 in Bit 15 displays as 8000.	Bit #	0301, FB CMD WORD 1
		0	STOP
		1	START
		2	REVERSE
		3	LOCAL
		4	RESET
		5	EXT2
		6	RUN_DISABLE
		7	STPMODE_R
		8	STPMODE_EM
		9	STPMODE_C
		10	RAMP_2
		11	RAMP_OUT_0
		12	RAMP_HOLD
		13	RAMP_IN_0
0302	FB CMD WORD 2 Read-only copy of the Fieldbus Command Word 2. See parameter 0301.		0302, FB CMD WORD 2
			FBLOCAL_CTL
			FBLOCAL_REF
0303	FB STS WORD 1 Read-only copy of the Status Word 1. - The drive sends status information to the fieldbus controller. The status consists of two Status Words. - The control panel displays the word in hex. For example, all zeros and a 1 in Bit 0 displays as 0001. All zeros and a 1 in Bit 15 displays as 8000.	Bit #	0303, FB STS WORD 1
		0	READY
		1	ENABLED
		2	STARTED
		3	RUNNING
		4	ZERO_SPEED
		5	ACCELERATE
		6	DECELERATE
		7	AT_SETPOINT
		8	LIMIT
		9	SUPERVISION
		10	REV_REF
		11	REV_ACT
		12	PANEL_LOCAL
		13	FIELDDBUS_LOCAL
0304	FB STS WORD 2 Read-only copy of the Status Word 2. See parameter 0303.		0304, FB STS WORD 2
			ALARM
			NOTICE
0304			DIRLOCK
			LOCALLOCK
			CTL_MODE
			Reserved
			Reserved
			CPY_CTL
			CPY_REF1
			CPY_REF2
			REQ_CTL
			REQ_REF1
			REQ_REF2
			REQ_REF2EXT
			ACK_STARTINH
			ACK_OFF_ILCK

Code	Description				
0305	FAULT WORD 1 Read-only copy of the Fault Word 1. - When a fault is active, the corresponding bit for the active fault is set in the Fault Words. - Each fault has a dedicated bit allocated within Fault Words. - See section Fault listing on page 260 for a description of the faults. - The control panel displays the word in hex. For example, all zeros and a 1 in Bit 0 displays as 0001. All zeros and a 1 in Bit 15 displays as 8000.	Bit #	0305, FAULT WORD 1	0306, FAULT WORD 2	0307, FAULT WORD 3
		0	OVERCURRENT	Obsolete	EFB 1
		1	DC OVERVOLT	THERM FAIL	EFB 2
		2	DEV OVERTEMP	OPEX LINK	EFB 3
		3	SHORT CIRC	OPEX PWR	INCOMPATIBLE SW
		4	Reserved	CURR MEAS	USER LOAD CURVE
		5	DC UNDERVOLT	SUPPLY PHASE	Reserved
		6	AI1 LOSS	ENCODER ERR	Reserved
		7	AI2 LOSS	OVERSPEED	Reserved
		8	MOT OVERTEMP	Reserved	Reserved
		9	PANEL LOSS	DRIVE ID	Reserved
		10	ID RUN FAIL	CONFIG FILE	System error
		11	MOTOR STALL	SERIAL 1 ERR	System error
		12	CB OVERTEMP	EFB CON FILE	System error
		13	EXT FAULT 1	FORCE TRIP	System error
		14	EXT FAULT 2	MOTOR PHASE	System error
		15	EARTH FAULT	OUTP WIRING	Param. setting fault
0306	FAULT WORD 2 Read-only copy of the Fault Word 2. See parameter 0305.				
0307	FAULT WORD 3 Read-only copy of the Fault Word 3. See parameter 0305.				
0308	ALARM WORD 1 - When an alarm is active, the corresponding bit for the active alarm is set in the Alarm Words. - Each alarm has a dedicated bit allocated within Alarm Words. - Bits remain set until the whole alarm word is reset. (Reset by writing zero to the word.) - The control panel displays the word in hex. For example, all zeros and a 1 in Bit 0 displays as 0001. All zeros and a 1 in Bit 15 displays as 8000.	Bit #	0308, ALARM WORD 1	0309, ALARM WORD 2	
		0	OVERCURRENT	Reserved	
		1	OVERVOLTAGE	PID SLEEP	
		2	UNDERVOLTAGE	ID RUN	
		3	DIR LOCK	Reserved	
		4	IO COMM	START ENABLE 1 MISSING	
		5	AI1 LOSS	START ENABLE 2 MISSING	
		6	AI2 LOSS	EMERGENCY STOP	
		7	PANEL LOSS	ENCODER ERROR	
		8	DEVICE OVERTEMP	FIRST START	
		9	MOTOR TEMP	Reserved	
		10	Reserved	USER LOAD CURVE	
		11	MOTOR STALL	START DELAY	
		12	AUTORESET	Reserved	
		13	AUTOCHANGE	Reserved	
		14	PFC I LOCK	Reserved	
		0309	ALARM WORD 2 See parameter 0308.	15	Reserved

Group 04: FAULT HISTORY

This group stores a recent history of the faults reported by the drive.

Code	Description
0401	LAST FAULT 0 – Clear the fault history (on panel = NO RECORD). n – Fault code of the last recorded fault. The fault code is displayed as a name. See section Fault listing on page 260 for the fault codes and names. The fault name shown for this parameter may be shorter than the corresponding name in the fault listing, which shows the names as they are shown in the fault display.
0402	FAULT TIME 1 The day on which the last fault occurred. Either as: • A date – if real time clock is operating. • The number of days after power on – if real time clock is not used, or was not set.
0403	FAULT TIME 2 The time at which the last fault occurred. Either as: • Real time, in format hh:mm:ss – if real time clock is operating. • The time since power on (minus the whole days reported in 0402), in format hh:mm:ss – if real time clock is not used, or was not set. • Format on the Basic Control Panel: The time since power on in 2-second ticks (minus the whole days reported in 0402). 30 ticks = 60 seconds. E.g. Value 514 equals 17 minutes and 8 seconds (= 514/30).
0404	SPEED AT FLT The motor speed (rpm) at the time the last fault occurred.
0405	FREQ AT FLT The frequency (Hz) at the time the last fault occurred.
0406	VOLTAGE AT FLT The DC bus voltage (V) at the time the last fault occurred.
0407	CURRENT AT FLT The motor current (A) at the time the last fault occurred.
0408	TORQUE AT FLT The motor torque (%) at the time the last fault occurred.
0409	STATUS AT FLT The drive status (hex code word) at the time the last fault occurred.
0410	DI 1-3 AT FLT The status of digital inputs 1...3 at the time the last fault occurred.
0411	DI 4-6 AT FLT The status of digital inputs 4...6 at the time the last fault occurred.
0412	PREVIOUS FAULT 1 Fault code of the second last fault. Read-only.
0413	PREVIOUS FAULT 2 Fault code of the third last fault. Read-only.

Group 10: START/STOP/DIR

This group:

- defines external sources (EXT1 and EXT2) for commands that enable start, stop and direction changes
- locks direction or enables direction control.

To select between the two external locations use the next group (parameter 1102).

Code	Description
1001	EXT1 COMMANDS Defines external control location 1 (EXT1) – the configuration of start, stop and direction commands. 0 = NOT SEL – No external start, stop and direction command source. 1 = DI1 – Two-wire Start/Stop. • Start/Stop is through digital input DI1 (DI1 activated = Start; DI1 de-activated = Stop). • Parameter 1003 defines the direction. Selecting 1003 = 3 (REQUEST) is the same as 1003 = 1 (FORWARD). 2 = DI1,2 – Two-wire Start/Stop, Direction. • Start/Stop is through digital input DI1 (DI1 activated = Start; DI1 de-activated = Stop). • Direction control [requires parameter 1003 = 3 (REQUEST)] is through digital input DI2 (DI2 activated = Reverse; de-activated = Forward). 3 = DI1P,2P – Three-wire Start/Stop. • Start/Stop commands are through momentary push-buttons (the P stands for “pulse”). • Start is through a normally open push-button connected to digital input DI1. In order to start the drive, the digital input DI2 must be activated prior to the pulse in DI1. • Connect multiple Start push-buttons in parallel. • Stop is through a normally closed push-button connected to digital input DI2. • Connect multiple Stop push-buttons in series. • Parameter 1003 defines the direction. Selecting 1003 = 3 (REQUEST) is the same as 1003 = 1 (FORWARD). 4 = DI1P,2P,3 – Three-wire Start/Stop, Direction. • Start/Stop commands are through momentary push-buttons, as described for DI1P,2P. • Direction control [requires parameter 1003 = 3 (REQUEST)] is through digital input DI3 (DI3 activated = Reverse; de-activated = Forward). 5 = DI1P,2P,3P – Start Forward, Start Reverse and Stop. • Start and Direction commands are given simultaneously with two separate momentary push-buttons (the P stands for “pulse”). • Start Forward command is through a normally open push-button connected to digital input DI1. In order to start the drive, the digital input DI3 must be activated prior to the pulse in DI1. • Start Reverse command is through a normally open push-button connected to digital input DI2. In order to start the drive, the digital input DI3 must be activated during the pulse in DI2. • Connect multiple Start push-buttons in parallel. • Stop is through a normally closed push-button connected to digital input DI3. • Connect multiple Stop push-buttons in series. • Requires parameter 1003 = 3 (REQUEST). 6 = DI6 – Two-wire Start/Stop. • Start/Stop is through digital input DI6 (DI6 activated = Start; DI6 de-activated = Stop). • Parameter 1003 defines the direction. Selecting 1003 = 3 (REQUEST) is the same as 1003 = 1 (FORWARD). 7 = DI6,5 – Two-wire Start/Stop/Direction. • Start/Stop is through digital input DI6 (DI6 activated = Start; DI6 de-activated = Stop). • Direction control [requires parameter 1003 = 3 (REQUEST)] is through digital input DI5 (DI5 activated = Reverse; de-activated = Forward). 8 = KEYPAD – Control Panel. • Start/Stop and Direction commands are through the control panel when EXT1 is active. • Direction control requires parameter 1003 = 3 (REQUEST). 9 = DI1F,2R – Start/Stop/Direction commands through DI1 and DI2 combinations. • Start forward = DI1 activated and DI2 de-activated. • Start reverse = DI1 de-activated and DI2 activated. • Stop = both DI1 and DI2 activated, or both de-activated. • Requires parameter 1003 = 3 (REQUEST). 10 = COMM – Assigns the fieldbus Command Word as the source for the start/stop and direction commands. • Bits 0,1, 2 of Command Word 1 (parameter 0301) activates the start/stop and direction commands. • See Fieldbus user's manual for detailed instructions.

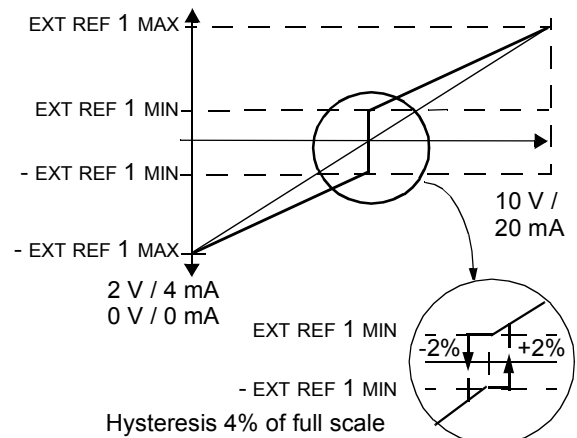
Code	Description
	11 = TIMED FUNC 1. – Assigns Start/Stop control to Timed Function 1 (Timed Function activated = START; Timed Function de-activated = STOP). See Group 36: TIMED FUNCTIONS . 12...14 = TIMED FUNC 2...4 – Assigns Start/Stop control to Timed Function 2...4. See TIMED FUNC 1 above.
1002	EXT2 COMMANDS Defines external control location 2 (EXT2) – the configuration of start, stop and direction commands. • See parameter 1001 EXT1 COMMANDS above.
1003	DIRECTION Defines the control of motor rotation direction. 1 = FORWARD – Rotation is fixed in the forward direction. 2 = REVERSE – Rotation is fixed in the reverse direction. 3 = REQUEST – Rotation direction can be changed on command.
1004	JOGGING SEL Defines the signal that activates the jogging function. Jogging uses Constant Speed 7 (parameter 1208) for speed reference and ramp pair 2 (parameters 2205 and 2206) for accelerating and decelerating. When the jogging activation signal is lost, the drive uses ramp stop to decelerate to zero speed, even if coast stop is used in normal operation (parameter 2102). The jogging status can be parameterized to relay outputs (parameter 1401). The jogging status is also seen in DCU Profile status bit 21. 0 = NOT SEL – Disables the jogging function. 1 = DI1 – Activates/de-activates jogging based on the state of DI1 (DI1 activated = jogging active; DI1 de-activated = jogging inactive). 2...6 = DI2...DI6 – Activates jogging based on the state of the selected digital input. See DI1 above. -1 = DI1(INV) – Activates jogging based on the state of DI1 (DI1 activated = jogging inactive; DI1 de-activated = jogging active). -2...-6 = DI2(INV)...DI6(INV) – Activates jogging based on the state of the selected digital input. See DI1(INV) above.

Group 11: REFERENCE SELECT

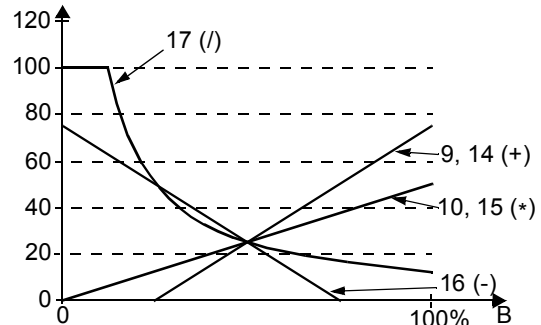
This group defines:

- how the drive selects between command sources
- characteristics and sources for REF1 and REF2.

Code	Description
1101	KEYPAD REF SEL Selects the reference controlled in local control mode. 1 = REF1(Hz/rpm) – Reference type depends on parameter 9904 MOTOR CTRL MODE. • Speed reference (rpm) if 9904 = 1 (VECTOR:SPEED) or 2 (VECTOR:TORQ). • Frequency reference (Hz) if 9904 = 3 (SCALAR:FREQ). 2 = REF2(%)
1102	EXT1/EXT2 SEL Defines the source for selecting between the two external control locations EXT1 or EXT2. Thus, defines the source for Start/Stop/Direction commands and reference signals. 0 = EXT1 – Selects external control location 1 (EXT1). • See parameter 1001 EXT1 COMMANDS for EXT1's Start/Stop/Dir definitions. • See parameter 1103 REF1 SELECT for EXT1's reference definitions. 1 = DI1 – Assigns control to EXT1 or EXT2 based on the state of DI1 (DI1 activated = EXT2; DI1 de-activated = EXT1). 2...6 = DI2...DI6 – Assigns control to EXT1 or EXT2 based on the state of the selected digital input. See DI1 above. 7 = EXT2 – Selects external control location 2 (EXT2). • See parameter 1002 EXT2 COMMANDS for EXT2's Start/Stop/Dir definitions. • See parameter 1106 REF2 SELECT for EXT2's reference definitions. 8 = COMM – Assigns control of the drive via external control location EXT1 or EXT2 based on the fieldbus control word. • Bit 5 of the Command Word 1 (parameter 0301) defines the active external control location (EXT1 or EXT2). • See Fieldbus user's manual for detailed instructions. 9 = TIMED FUNC 1 – Assigns control to EXT1 or EXT2 based on the state of the Timed Function (Timed Function activated = EXT2; Timed Function de-activated = EXT1). See Group 36: TIMED FUNCTIONS. 10...12 = TIMED FUNC 2...4 – Assigns control to EXT1 or EXT2 based on the state of the Timed Function. See TIMED FUNC 1 above. -1 = DI1(INV) – Assigns control to EXT1 or EXT2 based on the state of DI1 (DI1 activated = EXT1; DI1 de-activated = EXT2). -2...-6 = DI2(INV)...DI6(INV) – Assigns control to EXT1 or EXT2 based on the state of the selected digital input. See DI1(INV) above.
1103	REF1 SELECT Selects the signal source for external reference REF1. 0 = KEYPAD – Defines the control panel as the reference source. 1 = AI1 – Defines analog input 1 (AI1) as the reference source. 2 = AI2 – Defines analog input 2 (AI2) as the reference source. 3 = AI1/JOYST – Defines analog input 1 (AI1), configured for joystick operation, as the reference source. • The minimum input signal runs the drive at the maximum reference in the reverse direction. Define the minimum using parameter 1104. • The maximum input signal runs the drive at maximum reference in the forward direction. Define the maximum using parameter 1105. • Requires parameter 1003 = 3 (REQUEST). ⚠ WARNING! Because the low end of the reference range commands full reverse operation, do not use 0 V as the lower end of the reference range. Doing so means that if the control signal is lost (which is a 0 V input) the result is full reverse operation. Instead, use the following set-up so that loss of the analog input triggers a fault, stopping the drive: • Set parameter 1301 MINIMUM AI1 (1304 MINIMUM AI2) at 20% (2 V or 4 mA). • Set parameter 3021 AI1 FAULT LIMIT to a value 5% or higher. • Set parameter 3001 AI<MIN FUNCTION to 1 (FAULT). 4 = AI2/JOYST – Defines analog input 2 (AI2), configured for joystick operation, as the reference source. • See above (AI1/JOYST) description.



Code	Description										
	5 = DI3U,4D(R) – Defines digital inputs as the speed reference source (motor potentiometer control). - Digital input DI3 increases the speed (the U stands for “up”). - Digital input DI4 decreases the speed (the D stands for “down”). - A Stop command resets the reference to zero (the R stands for “reset”). - Parameter 2205 ACCELER TIME 2 controls the reference signal's rate of change. 6 = DI3U,4D – Same as above (DI3U,4D(R)), except: - A Stop command does not reset the reference to zero. The reference is stored. - When the drive restarts, the motor ramps up (at the selected acceleration rate) to the stored reference. 7 = DI5U,6D – Same as above (DI3U,4D), except that DI5 and DI6 are the digital inputs used. 8 = COMM – Defines the fieldbus as the reference source. 9 = COMM+AI1 – Defines a fieldbus and analog input 1 (AI1) combination as the reference source. See Analog input reference correction below. 10 = COMM*AI1 – Defines a fieldbus and analog input 1 (AI1) combination as the reference source. See Analog input reference correction below. 11 = DI3U,4D(RNC) – Same as DI3U,4D(R) above, except that: - Changing the control source (EXT1 to EXT2, EXT2 to EXT1, LOC to REM) does not copy the reference. 12 = DI3U,4D(NC) – Same as DI3U,4D above, except that: - Changing the control source (EXT1 to EXT2, EXT2 to EXT1, LOC to REM) does not copy the reference. - Stop command resets reference to zero. 13 = DI5U,6D(NC) – Same as DI5U,6D above, except that: - Changing the control source (EXT1 to EXT2, EXT2 to EXT1, LOC to REM) does not copy the reference. 14 = AI1+AI2 – Defines an analog input 1 (AI1) and analog input 2 (AI2) combination as the reference source. See Analog input reference correction below. 15 = AI1*AI2 – Defines an analog input 1 (AI1) and analog input 2 (AI2) combination as the reference source. See Analog input reference correction below. 16 = AI1-AI2 – Defines an analog input 1 (AI1) and analog input 2 (AI2) combination as the reference source. See Analog input reference correction below. 17 = AI1/AI2 – Defines an analog input 1 (AI1) and analog input 2 (AI2) combination as the reference source. See Analog input reference correction below. 20 = KEYPAD(RNC) – Defines the control panel as the reference source. - A Stop command resets the reference to zero (the R stands for reset.). - Changing the control source (EXT1 to EXT2, EXT2 to EXT1) does not copy the reference. 21 = KEYPAD(NC) – Defines the control panel as the reference source. - A Stop command does not reset the reference to zero. The reference is stored. - Changing the control source (EXT1 to EXT2, EXT2 to EXT1) does not copy the reference.										
	Analog input reference correction Parameter values 9, 10 and 14...17 use the formula in the following table. <table border="1"> <thead> <tr> <th>Value setting</th><th>Calculation of the AI reference</th></tr> </thead> <tbody> <tr> <td>C + B</td><td>C value + (B value - 50% of reference value)</td></tr> <tr> <td>C * B</td><td>C value · (B value / 50% of reference value)</td></tr> <tr> <td>C - B</td><td>(C value + 50% of reference value) - B value</td></tr> <tr> <td>C / B</td><td>(C value · 50% of reference value) / B value</td></tr> </tbody> </table> Where: - C = Main reference value (= COMM for values 9, 10 and = AI1 for values 14...17). - B = Correcting reference (= AI1 for values 9, 10 and = AI2 for values 14...17). Example: The figure shows the reference source curves for value settings 9, 10 and 14...17, where: - C = 25%. - P 4012 SETPOINT MIN = 0. - P 4013 SETPOINT MAX = 0. - B varies along the horizontal axis.	Value setting	Calculation of the AI reference	C + B	C value + (B value - 50% of reference value)	C * B	C value · (B value / 50% of reference value)	C - B	(C value + 50% of reference value) - B value	C / B	(C value · 50% of reference value) / B value
Value setting	Calculation of the AI reference										
C + B	C value + (B value - 50% of reference value)										
C * B	C value · (B value / 50% of reference value)										
C - B	(C value + 50% of reference value) - B value										
C / B	(C value · 50% of reference value) / B value										



Code	Description
1104	REF1 MIN Sets the minimum for external reference 1. - The minimum analog input signal (as a percent of the full signal in volts or amperes) corresponds to REF1 MIN in Hz/rpm. - Parameter 1301 MINIMUM AI1 or 1304 MINIMUM AI2 sets the minimum analog input signal. - These parameters (reference and analog min. and max. settings) provide scale and offset adjustment for the reference.
1105	REF1 MAX Sets the maximum for external reference 1. - The maximum analog input signal (as a percent of full the signal in volts or amperes) corresponds to REF1 MAX in Hz/rpm. - Parameter 1302 MAXIMUM AI1 or 1305 MAXIMUM AI2 sets the maximum analog input signal.
1106	REF2 SELECT Selects the signal source for external reference REF2. 0...17 – Same as for parameter 1103 REF1 SELECT. 19 = PID1OUT – The reference is taken from the PID1 output. See Group 40: PROCESS PID SET 1 and Group 41: PROCESS PID SET 2 . 20...21 – Same as for parameter 1103 REF1 SELECT.
1107	REF2 MIN Sets the minimum for external reference 2. - The minimum analog input signal (in volts or amperes) corresponds to REF2 MIN in %. - Parameter 1301 MINIMUM AI1 or 1304 MINIMUM AI2 sets the minimum analog input signal. - This parameter sets the minimum frequency reference. - The value is a percentage of the: - maximum frequency or speed - maximum process reference - nominal torque.
1108	REF2 MAX Sets the maximum for external reference 2. - The maximum analog input signal (in volts or amperes) corresponds to REF2 MAX in %. - Parameter 1302 MAXIMUM AI1 or 1305 MAXIMUM AI2 sets the maximum analog input signal. - This parameter sets the maximum frequency reference. - The value is a percentage of the: - maximum frequency or speed - maximum process reference - nominal torque.

Group 12: CONSTANT SPEEDS

This group defines a set of constant speeds. In general:

- You can program up to 7 constant speeds, ranging from 0...500 Hz or 0...30000 rpm.
- Values must be positive (No negative speed values for constant speeds).
- Constant speed selections are ignored if:
 - the torque control is active, or
 - the process PID reference is followed, or
 - the drive is in local control mode, or
 - PFC (Pump-Fan Control) is active.

Note: Parameter 1208 CONST SPEED 7 acts also as a so-called fault speed which may be activated if the control signal is lost. For example, see parameters 3001 AI<MIN FUNCTION, 3002 PANEL COMM ERR and 3018 COMM FAULT FUNC.

Code

Description

1201

CONST SPEED SEL

Defines the digital inputs used to select Constant Speeds. See general comments in introduction.

0 = NOT SEL – Disables the constant speed function.

1 = DI1 – Selects Constant Speed 1 with digital input DI1.

- Digital input activated = Constant Speed 1 activated.

2...6 = DI2...DI6 – Selects Constant Speed 1 with digital input DI2...DI6. See above.

7 = DI1,2 – Selects one of three Constant Speeds (1...3) using DI1 and DI2.

- Uses two digital inputs, as defined below (0 = DI de-activated, 1 = DI activated):

DI1	DI2	Function
0	0	No constant speed
1	0	Constant speed 1 (1202)
0	1	Constant speed 2 (1203)
1	1	Constant speed 3 (1204)

- Can be set up as a so-called fault speed, which is activated if the control signal is lost. Refer to parameter 3001 AI<MIN function and parameter 3002 PANEL COMM ERR.

8 = DI2,3 – Selects one of three Constant Speeds (1...3) using DI2 and DI3.

- See above (DI1,2) for code.

9 = DI3,4 – Selects one of three Constant Speeds (1...3) using DI3 and DI4.

- See above (DI1,2) for code.

10 = DI4,5 – Selects one of three Constant Speeds (1...3) using DI4 and DI5.

- See above (DI1,2) for code.

11 = DI5,6 – Selects one of three Constant Speeds (1...3) using DI5 and DI6.

- See above (DI1,2) for code.

12 = DI1,2,3 – Selects one of seven Constant Speeds (1...7) using DI1, DI2 and DI3.

- Uses three digital inputs, as defined below (0 = DI de-activated, 1 = DI activated):

DI1	DI2	DI3	Function
0	0	0	No constant speed
1	0	0	Constant speed 1 (1202)
0	1	0	Constant speed 2 (1203)
1	1	0	Constant speed 3 (1204)
0	0	1	Constant speed 4 (1205)
1	0	1	Constant speed 5 (1206)
0	1	1	Constant speed 6 (1207)
1	1	1	Constant speed 7 (1208)

Code	Description																																																			
	13 = DI3,4,5 – Selects one of seven Constant Speeds (1...7) using DI3, DI4 and DI5. • See above (DI1,2,3) for code. 14 = DI4,5,6 – Selects one of seven Constant Speeds (1...7) using DI4, DI5 and DI6. • See above (DI1,2,3) for code. 15...18 = TIMED FUNC 1...4 – Selects Constant Speed 1, Constant Speed 2 or the external reference, depending on the state of the Timed Function (1...4) and constant speed mode. See parameter 1209 TIMED MODE SEL and Group 36: TIMED FUNCTIONS. 19 = TIMED FUN1&2 – Selects a constant speed or the external reference, depending on the state of Timed Functions 1 & 2 and constant speed mode. See parameter 1209 TIMED MODE SEL and Group 36: TIMED FUNCTIONS. -1 = DI1(INV) – Selects Constant Speed 1 with digital input DI1. • Inverse operation: Digital input de-activated = Constant Speed 1 activated. -2...-6 = DI2(INV)...DI6(INV) – Selects Constant Speed 1 with digital input. See above. -7 = DI1,2(INV) – Selects one of three Constant Speeds (1...3) using DI1 and DI2. • Inverse operation uses two digital inputs, as defined below (0 = DI de-activated, 1 = DI activated): <table><tr><th>DI1</th><th>DI2</th><th>Function</th></tr><tr><td>1</td><td>1</td><td>No constant speed</td></tr><tr><td>0</td><td>1</td><td>Constant speed 1 (1202)</td></tr><tr><td>1</td><td>0</td><td>Constant speed 2 (1203)</td></tr><tr><td>0</td><td>0</td><td>Constant speed 3 (1204)</td></tr></table> -8 = DI2,3(INV) – Selects one of three Constant Speeds (1...3) using DI2 and DI3. • See above (DI1,2(INV)) for code. -9 = DI3,4(INV) – Selects one of three Constant Speeds (1...3) using DI3 and DI4. • See above (DI1,2(INV)) for code. -10 = DI4,5(INV) – Selects one of three Constant Speeds (1...3) using DI4 and DI5. • See above (DI1,2(INV)) for code. -11 = DI5,6(INV) – Selects one of three Constant Speeds (1...3) using DI5 and DI6. • See above (DI1,2(INV)) for code. -12 = DI1,2,3(INV) – Selects one of seven Constant Speeds (1...7) using DI1, DI2 and DI3. • Inverse operation uses three digital inputs, as defined below (0 = DI de-activated, 1 = DI activated): <table><tr><th>DI1</th><th>DI2</th><th>DI3</th><th>Function</th></tr><tr><td>1</td><td>1</td><td>1</td><td>No constant speed</td></tr><tr><td>0</td><td>1</td><td>1</td><td>Constant speed 1 (1202)</td></tr><tr><td>1</td><td>0</td><td>1</td><td>Constant speed 2 (1203)</td></tr><tr><td>0</td><td>0</td><td>1</td><td>Constant speed 3 (1204)</td></tr><tr><td>1</td><td>1</td><td>0</td><td>Constant speed 4 (1205)</td></tr><tr><td>0</td><td>1</td><td>0</td><td>Constant speed 5 (1206)</td></tr><tr><td>1</td><td>0</td><td>0</td><td>Constant speed 6 (1207)</td></tr><tr><td>0</td><td>0</td><td>0</td><td>Constant speed 7 (1208)</td></tr></table> -13 = DI3,4,5(INV) – Selects one of seven Constant Speeds (1...7) using DI3, DI4 and DI5. • See above (DI1,2,3(INV)) for code. -14 = DI4,5,6(INV) – Selects one of seven Constant Speeds (1...7) using DI4, DI5 and DI6. • See above (DI1,2,3(INV)) for code.	DI1	DI2	Function	1	1	No constant speed	0	1	Constant speed 1 (1202)	1	0	Constant speed 2 (1203)	0	0	Constant speed 3 (1204)	DI1	DI2	DI3	Function	1	1	1	No constant speed	0	1	1	Constant speed 1 (1202)	1	0	1	Constant speed 2 (1203)	0	0	1	Constant speed 3 (1204)	1	1	0	Constant speed 4 (1205)	0	1	0	Constant speed 5 (1206)	1	0	0	Constant speed 6 (1207)	0	0	0	Constant speed 7 (1208)
DI1	DI2	Function																																																		
1	1	No constant speed																																																		
0	1	Constant speed 1 (1202)																																																		
1	0	Constant speed 2 (1203)																																																		
0	0	Constant speed 3 (1204)																																																		
DI1	DI2	DI3	Function																																																	
1	1	1	No constant speed																																																	
0	1	1	Constant speed 1 (1202)																																																	
1	0	1	Constant speed 2 (1203)																																																	
0	0	1	Constant speed 3 (1204)																																																	
1	1	0	Constant speed 4 (1205)																																																	
0	1	0	Constant speed 5 (1206)																																																	
1	0	0	Constant speed 6 (1207)																																																	
0	0	0	Constant speed 7 (1208)																																																	
1202	CONST SPEED 1 Sets value for Constant Speed 1. • The range and units depend on parameter 9904 MOTOR CTRL MODE. • Range: 0...30000 rpm when 9904 = 1 (VECTOR:SPEED) or 2 (VECTOR:TORQ). • Range: 0...500 Hz when 9904 = 3 (SCALAR:FREQ).																																																			
1203	CONST SPEED 2...CONST SPEED 7 Each sets a value for a Constant Speed. See CONST SPEED 1 above.																																																			
1208	Constant Speed 7 is used also as jogging speed. See parameter 1004 JOGGING SEL.																																																			

Code

Description

1209

TIMED MODE SEL

Defines timed function activated constant speed mode. Timed function can be used to change between the external reference and constant speeds when parameter 1201 CONST SPEED SEL = 15...18 (TIMED FUNC 1...4) or 19 (TIMED FUN1&2).

1 = EXT/CS1/2/3

- If parameter 1201 = 15...18 (TIMED FUNC 1...4), selects an external speed when this timed function (1...4) is not active and selects Constant speed 1 when it is active.

TIMED FUNCTION 1...4	Function
0	External reference
1	Constant speed 1 (1202)

- If parameter 1201 = 19 (TIMED FUN1&2), selects an external speed when neither timed function is active, selects Constant speed 1 when only Timed function 1 is active, selects Constant speed 2 when only Timed function 2 is active and selects Constant speed 3 when both Timed functions 1 and 2 are active.

TIMED FUNCTION 1	TIMED FUNCTION 2	Function
0	0	External reference
1	0	Constant speed 1 (1202)
0	1	Constant speed 2 (1203)
1	1	Constant speed 3 (1204)

2 = CS1/2/3/4

- If parameter 1201 = 15...18 (TIMED FUNC 1...4), selects Constant speed 1 when this timed function (1...4) is not active and selects Constant speed 2 when it is active.

TIMED FUNCTION 1...4	Function
0	Constant speed 1 (1202)
1	Constant speed 2 (1203)

- If parameter 1201 = 19 (TIMED FUN1&2), selects Constant speed 1 when neither timed function is active, selects Constant speed 2 when only Timed function 1 is active, selects Constant speed 3 when only Timed function 2 is active and selects Constant speed 4 when both Timed functions 1 and 2 are active.

TIMED FUNCTION 1	TIMED FUNCTION 2	Function
0	0	Constant speed 1 (1202)
1	0	Constant speed 2 (1203)
0	1	Constant speed 3 (1204)
1	1	Constant speed 4 (1205)

Group 13: ANALOG INPUTS

This group defines the limits and the filtering for analog inputs.

Code	Description
1301	MINIMUM AI1 Defines the minimum value of the analog input. - Define value as a percent of the full analog signal range. See example below. - The minimum analog input signal corresponds to 1104 REF1 MIN or 1107 REF2 MIN. - MINIMUM AI cannot be greater than MAXIMUM AI. - These parameters (reference and analog min. and max. settings) provide scale and offset adjustment for the reference. - See the figure at parameter 1104. Example: To set the minimum analog input value to 4 mA: - Configure the analog input for 0...20 mA current signal. - Calculate the minimum (4 mA) as a percent of full range (20 mA) = $4 \text{ mA} / 20 \text{ mA} \cdot 100\% = 20\%$
1302	MAXIMUM AI1 Defines the maximum value of the analog input. - Define value as a percent of the full analog signal range. - The maximum analog input signal corresponds to 1105 REF1 MAX or 1108 REF2 MAX. - See the figure at parameter 1104.
1303	FILTER AI1 Defines the filter time constant for analog input 1 (AI1). The filtered signal reaches 63% of a step change within the time specified.
1304	MINIMUM AI2 Defines the minimum value of the analog input. See MINIMUM AI1 above.
1305	MAXIMUM AI2 Defines the maximum value of the analog input. See MAXIMUM AI1 above.
1306	FILTER AI2 Defines the filter time constant for analog input 2 (AI2). See FILTER AI1 above.

Group 14: RELAY OUTPUTS

This group defines the condition that activates each of the relay outputs. Relay outputs 4...6 are only available if OREL-01 Relay Output Extension Module is installed.

Code	Description
1401	RELAY OUTPUT 1 Defines the event or condition that activates relay 1 – what relay output 1 means. 0 = NOT SEL – Relay is not used and is de-energized. 1 = READY – Energize relay when drive is ready to function. Requires: • Run enable signal present. • No faults exist. • Supply voltage is within range. • Emergency Stop command is not on. 2 = RUN – Energize relay when the drive is running. 3 = FAULT(-1) – Energize relay when power is applied. De-energizes when a fault occurs. 4 = FAULT – Energize relay when a fault is active. 5 = ALARM – Energize relay when an alarm is active. 6 = REVERSED – Energize relay when motor rotates in reverse direction. 7 = STARTED – Energize relay when drive receives a start command (even if Run Enable signal is not present). De-energized relay when drive receives a stop command or a fault occurs. 8 = SUPRV1 OVER – Energize relay when first supervised parameter (3201) exceeds the limit (3203). • See Group 32: SUPERVISION starting on page 153. 9 = SUPRV1 UNDER – Energize relay when first supervised parameter (3201) drops below the limit (3202). • See Group 32: SUPERVISION starting on page 153. 10 = SUPRV2 OVER – Energize relay when second supervised parameter (3204) exceeds the limit (3206). • See Group 32: SUPERVISION starting on page 153. 11 = SUPRV2 UNDER – Energize relay when second supervised parameter (3204) drops below the limit (3205). • See Group 32: SUPERVISION starting on page 153. 12 = SUPRV3 OVER – Energize relay when third supervised parameter (3207) exceeds the limit (3209). • See Group 32: SUPERVISION starting on page 153. 13 = SUPRV3 UNDER – Energize relay when third supervised parameter (3207) drops below the limit (3208). • See Group 32: SUPERVISION starting on page 153. 14 = AT SET POINT – Energize relay when the output frequency is equal to the reference frequency. 15 = FAULT(RST) – Energize relay when the drive is in a fault condition and will reset after the programmed auto-reset delay. • See parameter 3103 DELAY TIME. 16 = FLT/ALARM – Energize relay when fault or alarm occurs. 17 = EXT CTRL – Energize relay when external control is selected. 18 = REF 2 SEL – Energize relay when EXT2 is selected. 19 = CONST FREQ – Energize relay when a constant speed is selected. 20 = REF LOSS – Energize relay when reference or active control place is lost. 21 = OVERCURRENT – Energize relay when an overcurrent alarm or fault occurs. 22 = OVERVOLTAGE – Energize relay when an overvoltage alarm or fault occurs. 23 = DRIVE TEMP – Energize relay when a drive or control board overtemperature alarm or fault occurs. 24 = UNDERVOLTAGE – Energize relay when an undervoltage alarm or fault occurs. 25 = AI1 LOSS – Energize relay when AI1 signal is lost. 26 = AI2 LOSS – Energize relay when AI2 signal is lost. 27 = MOTOR TEMP – Energize relay when a motor overtemperature alarm or fault occurs. 28 = STALL – Energize relay when a stall alarm or fault exists. 30 = PID SLEEP – Energize relay when the PID sleep function is active. 31 = PFC – Use relay to start/stop motor in PFC control (See Group 81: PFC CONTROL). • Use this option only when PFC control is used. • Selection activated / deactivated when drive is not running. 32 = AUTOCHANGE – Energize relay when PFC autochange operation is performed. • Use this option only when PFC control is used. 33 = FLUX READY – Energize relay when the motor is magnetized and able to supply nominal torque (motor has reached nominal magnetizing). 34 = USER MACRO 2 – Energize relay when User Parameter Set 2 is active.

Code	Description																																																																																																																																
	35 = COMM – Energize relay based on input from fieldbus communication. - Fieldbus writes binary code in parameter 0134 that can energize relay 1...relay 6 according to the following: <table><tr><th>Par. 0134</th><th>Binary</th><th>RO6</th><th>RO5</th><th>RO4</th><th>RO3</th><th>RO2</th><th>RO1</th></tr><tr><td>0</td><td>000000</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr><tr><td>1</td><td>000001</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td></tr><tr><td>2</td><td>000010</td><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td><td>0</td></tr><tr><td>3</td><td>000011</td><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td><td>1</td></tr><tr><td>4</td><td>000100</td><td>0</td><td>0</td><td>0</td><td>1</td><td>0</td><td>0</td></tr><tr><td>5...62</td><td>...</td><td>...</td><td>...</td><td>...</td><td>...</td><td>...</td><td>...</td></tr><tr><td>63</td><td>111111</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td></tr></table> 0 = De-energize relay, 1 = Energize relay. 36 = COMM(-1) – Energize relay based on input from fieldbus communication. - Fieldbus writes binary code in parameter 0134 that can energize relay 1...relay 6 according to the following: <table><tr><th>Par. 0134</th><th>Binary</th><th>RO6</th><th>RO5</th><th>RO4</th><th>RO3</th><th>RO2</th><th>RO1</th></tr><tr><td>0</td><td>000000</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td></tr><tr><td>1</td><td>000001</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>0</td></tr><tr><td>2</td><td>000010</td><td>1</td><td>1</td><td>1</td><td>1</td><td>0</td><td>1</td></tr><tr><td>3</td><td>000011</td><td>1</td><td>1</td><td>1</td><td>1</td><td>0</td><td>0</td></tr><tr><td>4</td><td>000100</td><td>1</td><td>1</td><td>1</td><td>0</td><td>1</td><td>1</td></tr><tr><td>5...62</td><td>...</td><td>...</td><td>...</td><td>...</td><td>...</td><td>...</td><td>...</td></tr><tr><td>63</td><td>111111</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr></table> 0 = De-energize relay, 1 = Energize relay. 37 = TIMED FUNC 1 – Energize relay when Timed Function 1 is active. See Group 36: TIMED FUNCTIONS. 38...40 = TIMED FUNC 2...4 – Energize relay when Timed Function 2...4 is active. See TIMED FUNC 1 above. 41 = MNT TRIG FAN – Energize relay when cooling fan counter is triggered. See Group 29: MAINTENANCE TRIG. 42 = MNT TRIG REV – Energize relay when revolutions counter is triggered. See Group 29: MAINTENANCE TRIG. 43 = MNT TRIG RUN – Energize relay when run time counter is triggered. See Group 29: MAINTENANCE TRIG. 44 = MNT TRIG MWH – Energize relay when MWh counter is triggered. See Group 29: MAINTENANCE TRIG. 46 = START DELAY – Energize relay when a start delay is active. 47 = USER LOAD C – Energize relay when a user load curve fault or alarm occurs. 52 = JOG ACTIVE – Energize relay when the jogging function is active.	Par. 0134	Binary	RO6	RO5	RO4	RO3	RO2	RO1	0	000000	0	0	0	0	0	0	1	000001	0	0	0	0	0	1	2	000010	0	0	0	0	1	0	3	000011	0	0	0	0	1	1	4	000100	0	0	0	1	0	0	5...62	...	...	...	...	...	...	...	63	111111	1	1	1	1	1	1	Par. 0134	Binary	RO6	RO5	RO4	RO3	RO2	RO1	0	000000	1	1	1	1	1	1	1	000001	1	1	1	1	1	0	2	000010	1	1	1	1	0	1	3	000011	1	1	1	1	0	0	4	000100	1	1	1	0	1	1	5...62	...	...	...	...	...	...	...	63	111111	0	0	0	0	0	0
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1402	RELAY OUTPUT 2 Defines the event or condition that activates relay 2 – what relay output 2 means. See 1401 RELAY OUTPUT 1.																																																																																																																																
1403	RELAY OUTPUT 3 Defines the event or condition that activates relay 3 – what relay output 3 means. See 1401 RELAY OUTPUT 1.																																																																																																																																
1404	RO 1 ON DELAY Defines the switch-on delay for relay 1. On / off delays are ignored when relay output 1401 is set to PFC.																																																																																																																																
1405	RO 1 OFF DELAY Defines the switch-off delay for relay 1. On / off delays are ignored when relay output 1401 is set to PFC.																																																																																																																																
1406	RO 2 ON DELAY Defines the switch-on delay for relay 2. See RO 1 ON DELAY.																																																																																																																																
1407	RO 2 OFF DELAY Defines the switch-off delay for relay 2. See RO 1 OFF DELAY.																																																																																																																																
1408	RO 3 ON DELAY Defines the switch-on delay for relay 3. See RO 1 ON DELAY.																																																																																																																																

Code	Description
1409	RO 3 OFF DELAY Switch-off delay for relay 3. • See RO 1 OFF DELAY.
1410	RELAY OUTPUT 4...6 Defines the event or condition that activates relay 4...6 – what relay output 4...6 means. Available if OREL-01 Relay Output Extension Module is installed. • See 1401 RELAY OUTPUT 1.
1412	
1413	RO 4 ON DELAY Defines the switch-on delay for relay 4. • See RO 1 ON DELAY.
1414	RO 4 OFF DELAY Defines the switch-off delay for relay 4. • See RO 1 OFF DELAY.
1415	RO 5 ON DELAY Defines the switch-on delay for relay 5. • See RO 1 ON DELAY.
1416	RO 5 OFF DELAY Defines the switch-off delay for relay 5. • See RO 1 OFF DELAY.
1417	RO 6 ON DELAY Defines the switch-on delay for relay 6. • See RO 1 ON DELAY.
1418	RO 6 OFF DELAY Defines the switch-off delay for relay 6. • See RO 1 OFF DELAY.

Group 15: ANALOG OUTPUTS

This group defines the drive's analog (current signal) outputs. The drive's analog outputs can be:

- any parameter in [Group 01: OPERATING DATA](#)
- limited to programmable minimum and maximum values of output current
- scaled (and/or inverted) by defining the minimum and maximum values of the source parameter (or content). Defining an maximum value (parameter 1503 or 1509) that is less than the content minimum value (parameter 1502 or 1508) results in an inverted output.
- filtered.

Code	Description	
1501	AO1 CONTENT SEL Defines the content for analog output AO1. 99 = EXCITE PTC – Provides a current source for sensor type PTC. Output = 1.6 mA. See Group 35: MOTOR TEMP MEAS. 100 = EXCITE PT100 – Provides a current source for sensor type PT100. Output = 9.1 mA. See Group 35: MOTOR TEMP MEAS. 101...178 – Output corresponds to a parameter in Group 01: OPERATING DATA . • Parameter defined by value (value 102 = parameter 0102)	
1502	AO1 CONTENT MIN Sets the minimum content value. • Content is the parameter selected by parameter 1501. • Minimum value refers to the minimum content value that will be converted to an analog output. • These parameters (content and current min. and max. settings) provide scale and offset adjustment for the output. See the figure.	
1503	AO1 CONTENT MAX Sets the maximum content value • Content is the parameter selected by parameter 1501. • Maximum value refers to the maximum content value that will be converted to an analog output.	
1504	MINIMUM AO1 Sets the minimum output current.	
1505	MAXIMUM AO1 Sets the maximum output current.	
1506	FILTER AO1 Defines the filter time constant for AO1. • The filtered signal reaches 63% of a step change within the time specified. • See the figure in parameter 1303.	
1507	AO2 CONTENT SEL Defines the content for analog output AO2. See AO1 CONTENT SEL above.	
1508	AO2 CONTENT MIN Sets the minimum content value. See AO1 CONTENT MIN above.	
1509	AO2 CONTENT MAX Sets the maximum content value. See AO1 CONTENT MAX above.	
1510	MINIMUM AO2 Sets the minimum output current. See MINIMUM AO1 above.	

Code	Description
1511	MAXIMUM AO2 Sets the maximum output current. See MAXIMUM AO1 above.
1512	FILTER AO2 Defines the filter time constant for AO2. See FILTER AO1 above.

Group 16: SYSTEM CONTROLS

This group defines a variety of system level locks, resets and enables.

Code	Description
1601	RUN ENABLE Selects the source of the run enable signal. 0 = NOT SEL – Allows the drive to start without an external run enable signal. 1 = DI1 – Defines digital input DI1 as the run enable signal. - This digital input must be activated for run enable. - If the voltage drops and de-activates this digital input, the drive will coast to stop and not start until the run enable signal resumes. 2...6 = DI2...DI6 – Defines digital input DI2...DI6 as the run enable signal. - See DI1 above. 7 = COMM – Assigns the fieldbus Command Word as the source for the run enable signal. - Bit 6 of the Command Word 1 (parameter 0301) activates the run disable signal. - See fieldbus user's manual for detailed instructions. -1 = DI1(INV) – Defines an inverted digital input DI1 as the run enable signal. - This digital input must be de-activated for run enable. - If this digital input activates, the drive will coast to stop and not start until the run enable signal resumes. -2...-6 = DI2(INV)...DI6(INV) – Defines an inverted digital input DI2...DI6 as the run enable signal. - See DI1(INV) above.
1602	PARAMETER LOCK Determines if the control panel can change parameter values. - This lock does not limit parameter changes made by macros. - This lock does not limit parameter changes written by fieldbus inputs. - This parameter value can be changed only if the correct pass code is entered. See parameter 1603 PASS CODE. 0 = LOCKED – You cannot use the control panel to change parameter values. - The lock can be opened by entering the valid pass code to parameter 1603. 1 = OPEN – You can use the control panel to change parameter values. 2 = NOT SAVED – You can use the control panel to change parameter values, but they are not stored in permanent memory. - Set parameter 1607 PARAM SAVE to 1 (SAVE) to store changed parameter values to memory.
1603	PASS CODE Entering the correct pass code allows you to change the parameter lock. - See parameter 1602 above. - The code 358 allows you to change the value of the parameter 1602 once. - This entry reverts back to 0 automatically.
1604	FAULT RESET SEL Selects the source for the fault reset signal. The signal resets the drive after a fault trip if the cause of the fault no longer exists. 0 = KEYPAD – Defines the control panel as the only fault reset source. - Fault reset is always possible with control panel. 1 = DI1 – Defines digital input DI1 as a fault reset source. - Activating the digital input resets the drive. 2...6 = DI2...DI6 – Defines digital input DI2...DI6 as a fault reset source. - See DI1 above. 7 = START/STOP – Defines the Stop command as a fault reset source. - Do not use this option when fieldbus communication provides the start, stop and direction commands. 8 = COMM – Defines the fieldbus as a fault reset source. - The Command Word is supplied through fieldbus communication. - The bit 4 of the Command Word 1 (parameter 0301) resets the drive. -1 = DI1(INV) – Defines an inverted digital input DI1 as a fault reset source. - De-activating the digital input resets the drive. -2...-6 = DI2(INV)...DI6(INV) – Defines an inverted digital input DI2...DI6 as a fault reset source. - See DI1(INV) above.

Code	Description
1605	USER PAR SET CHG Defines control for changing the user parameter set. • See parameter 9902 APPLIC MACRO. • The drive must be stopped to change User Parameter Sets. • During a change, the drive will not start. Note: Always save the User Parameter Set after changing any parameter settings, or performing a motor identification. • Whenever the power is cycled, or parameter 9902 APPLIC MACRO is changed, the drive loads the last settings saved. Any unsaved changes to a user parameter set are lost. Note: The value of this parameter (1605) is not included in the User Parameter Sets, and it does not change if User Parameter Sets change. Note: You can use a relay output to supervise the selection of User Parameter Set 2. • See parameter 1401. 0 = NOT SEL – Defines the control panel (using parameter 9902) as the only control for changing User Parameter Sets. 1 = DI1 – Defines digital input DI1 as a control for changing User Parameter Sets. • The drive loads User Parameter Set 1 on the falling edge of the digital input. • The drive loads User Parameter Set 2 on the rising edge of the digital input. • The User Parameter Set changes only when the drive is stopped. 2...6 = DI2...DI6 – Defines digital input DI2...DI6 as a control for changing User Parameter Sets. • See DI1 above. -1 = DI1(INV) – Defines an inverted digital input DI1 as a control for changing User Parameter Sets. • The drive loads User Parameter Set 1 on the rising edge of the digital input. • The drive loads User Parameter Set 2 on the falling edge of the digital input. • The User Parameter Set changes only when the drive is stopped. -2...-6 = DI2(INV)...DI6(INV) – Defines an inverted digital input DI2...DI6 as a control for changing User Parameter Sets. • See DI1(INV) above.
1606	LOCAL LOCK Defines control for the use of the LOC mode. The LOC mode allows drive control from the control panel. • When LOCAL LOCK is active, the control panel cannot change to LOC mode. 0 = NOT SEL – Disables the lock. The control panel can select LOC and control the drive. 1 = DI1 – Defines digital input DI1 as the control for setting the local lock. • Activating the digital input locks out local control. • De-activating the digital input enable the LOC selection. 2...6 = DI2...DI6 – Defines digital input DI2...DI6 as the control for setting the local lock. • See DI1 above. 7 = ON – Sets the lock. The control panel cannot select LOC and cannot control the drive. 8 = COMM – Defines bit 14 of the Command Word 1 as the control for setting the local lock. • The Command Word is supplied through fieldbus communication. • The Command Word is 0301. -1 = DI1(INV) – Defines an inverted digital input DI1 as the control for setting the local lock. • De-activating the digital input locks out local control. • Activating the digital input enable the LOC selection. -2...-6 = DI2(INV)...DI6(INV) – Defines an inverted digital input DI2...DI6 as the control for setting the local lock. • See DI1(INV) above.
1607	PARAM SAVE Saves all altered parameters to permanent memory. • Parameters altered through a fieldbus are not automatically saved to permanent memory. To save, you must use this parameter. • If 1602 PARAMETER LOCK = 2 (NOT SAVED), parameters altered from the control panel are not saved. To save, you must use this parameter. • If 1602 PARAMETER LOCK = 1 (OPEN), parameters altered from the control panel are stored immediately to permanent memory. 0 = DONE – Value changes automatically when all parameters are saved. 1 = SAVE... – Saves altered parameters to permanent memory.

Code	Description
1608	START ENABLE 1 Selects the source of the start enable 1 signal. Note: Start enable functionality differs from the run enable functionality. 0 = NOT SEL – Allows the drive to start without an external start enable signal. 1 = DI1 – Defines digital input DI1 as the start enable 1 signal. - This digital input must be activated for start enable 1 signal. - If the voltage drops and de-activates this digital input, the drive will coast to stop and show alarm 2021 on the panel display. The drive will not start until start enable 1 signal resumes. 2...6 = DI2...DI6 – Defines digital input DI2...DI6 as the start enable 1 signal. - See DI1 above. 7 = COMM – Assigns the fieldbus Command Word as the source for the start enable 1 signal. - Bit 2 of the Command word 2 (parameter 0302) activates the start disable 1 signal. - See fieldbus user's manual for detailed instructions. -1 = DI1(INV) – Defines an inverted digital input DI1 as the start enable 1 signal. -2...-6 = DI2 (INV)...DI6(INV) – Defines an inverted digital input DI2...DI6 as the start enable 1 signal. - See DI1 (INV) above. The diagram illustrates the timing sequence for the START ENABLE 1 signal. It shows the relationship between several signals and states over time: Drive started: The initial state where the drive begins operation. START/STOP COMMAND (Group 10): A digital signal that transitions from low to high to initiate the start sequence. START ENABLE SIGNAL (Parameters 1608 & 1609): A digital signal that must be active (high) for the drive to start. Relay de-energized: The state of the relay before the start sequence begins. Relay energized: The state of the relay after the start sequence begins. STARTED RELAY STATUS (Group 14): A digital signal that transitions from low to high when the relay is energized. Damper closed: The initial state of the damper. Damper opening time: The time interval from the start of the damper opening process to the point where the damper is fully open. Damper open: The state of the damper after the opening time has elapsed. Damper closing time: The time interval from the start of the damper closing process to the point where the damper is fully closed. DAMPER STATUS: A digital signal that transitions from low to high when the damper is open and back to low when it is closed. RUN ENABLE SIGNAL from the damper end switch when the damper is fully opened. (Parameter 1601): A digital signal that transitions from low to high when the damper is fully open. Acceleration time (Par 2202): The time interval from the start of the acceleration process to the point where the drive reaches its maximum speed. Drive coasts to stop: The state of the drive after the acceleration time has elapsed. MOTOR STATUS: A digital signal that transitions from low to high when the drive is running and back to low when it is stopped.

Code	Description
1609	START ENABLE 2 Selects the source of the start enable 2 signal. Note: Start enable functionality differs from the run enable functionality. 0 = NOT SEL – Allows the drive to start without an external start enable signal. 1 = DI1 – Defines digital input DI1 as the start enable 2 signal. - This digital input must be activated for start enable 2 signal. - If the voltage drops and de-activates this digital input, the drive will coast to stop and show alarm 2022 on the panel display. The drive will not start until start enable 2 signal resumes. 2...6 = DI2...DI6 – Defines digital input DI2...DI6 as the start enable 2 signal. - See DI1 above. 7 = COMM – Assigns the fieldbus Command Word as the source for the start enable 2 signal. Bit 3 of the Command word 2 (parameter 0302) activates the start enable 2 signal. - See fieldbus user's manual for detailed instructions. -1 = DI1(INV) – Defines an inverted digital input DI1 as the start enable 2 signal. -2...-6 = DI2(INV)...DI6(INV) – Defines an inverted digital input DI2...DI6 as the start enable 2 signal. - See DI1 (INV) above.
1610	DISPLAY ALARMS Controls the visibility of the following alarms: 2001, Overcurrent alarm 2002, Overvoltage alarm 2003, Undervoltage alarm 2009, Device overtemperature alarm. For more information, see section Alarm listing on page 267. 0 = NO – The above alarms are suppressed. 1 = YES – All of the above alarms are enabled.
1611	PARAMETER VIEW Selects the parameter view, i.e. which parameters are shown. Note: This parameter is visible only when it is activated by the optional FlashDrop device. FlashDrop is designed for fast copying of parameters to unpowered drives. It allows easy customization of the parameter list, e.g. selected parameters can be hidden. For more information, see <i>MFDT-01 FlashDrop User's Manual</i> (3AFE68591074 [English]). FlashDrop parameter values are activated by setting parameter 9902 to 31 (LOAD FD SET). 0 = DEFAULT – Complete long and short parameter lists are shown. 1 = FLASHDROP – FlashDrop parameter list is shown. Does not include short parameter list. Parameters that are hidden by the FlashDrop device are not visible.
1612	FAN CONTROL Selects drive cooling fan control. Can be used to mitigate DC voltage fluctuations. 0 = AUTO – Fan is controlled automatically (default). 1 = ON – Fan is always forced on.
1613	FAULT RESET Allows to reset faults with a parameter. Can be used to reset faults from remote monitoring systems that have access to drive parameters. 0 = DEFAULT – Fault is not reset (default) 1 = RESET NOW – Resets fault.

Group 20: LIMITS

This group defines minimum and maximum limits to follow in driving the motor – speed, frequency, current, torque, etc.

Code	Description	
2001	MINIMUM SPEED Defines the minimum speed (rpm) allowed. • A positive (or zero) minimum speed value defines two ranges, one positive and one negative. • A negative minimum speed value defines one speed range. • See the figure.	
2002	MAXIMUM SPEED Defines the maximum speed (rpm) allowed.	
2003	MAX CURRENT Defines the maximum output current (A) supplied by the drive to the motor.	
2005	OVERVOLT CTRL Sets the DC overvoltage controller on or off. • Fast braking of a high inertia load causes the DC bus voltage to rise to the overvoltage control limit. To prevent the DC voltage from exceeding the trip limit, the overvoltage controller automatically decreases the braking torque by increasing output frequency. 0 = DISABLE – Disables controller. 1 = ENABLE – Enables controller Note: If a braking chopper or a braking resistor is connected to the drive, this parameter value must be set to 0 (DISABLE) to ensure proper operation of the chopper.	
2006	UNDERVOLT CTRL Sets the DC undervoltage controller on or off. When on: • If the DC bus voltage drops due to loss of input power, the undervoltage controller decreases the motor speed in order to keep the DC bus voltage above the lower limit. • When the motor speed decreases, the inertia of the load causes regeneration back into the drive, keeping the DC bus charged and preventing an undervoltage trip. • The DC undervoltage controller increases power loss ride-through on systems with a high inertia, such as a centrifuge or a fan. 0 = DISABLE – Disables controller. 1 = ENABLE(TIME) – Enables controller with 500 ms time limit for operation. 2 = ENABLE – Enables controller without maximum time limit for operation.	

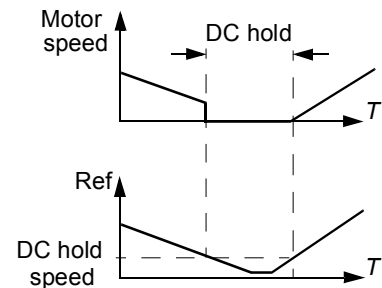
Code	Description	
2007	MINIMUM FREQ Defines the minimum limit for the drive output frequency. • A positive or zero minimum frequency value defines two ranges, one positive and one negative. • A negative minimum frequency value defines one speed range. See the figure. Note: Keep $\text{MINIMUM FREQ} \leq \text{MAXIMUM FREQ}$.	
2008	MAXIMUM FREQ Defines the maximum limit for the drive output frequency.	
2013	MIN TORQUE SEL Defines control of the selection between two minimum torque limits (2015 MIN TORQUE 1 and 2016 MIN TORQUE 2). 0 = MIN TORQUE 1 – Selects 2015 MIN TORQUE 1 as the minimum limit used. 1 = DI1 – Defines digital input DI1 as the control for selecting the minimum limit used. • Activating the digital input selects MIN TORQUE 2 value. • De-activating the digital input selects MIN TORQUE 1 value. 2...6 = DI2...DI6 – Defines digital input DI2...DI6 as the control for selecting the minimum limit used. • See DI1 above. 7 = COMM – Defines bit 15 of the Command Word 1 as the control for selecting the minimum limit used. • The Command Word is supplied through fieldbus communication. • The Command Word is parameter 0301. -1 = DI1(INV) – Defines an inverted digital input DI1 as the control for selecting the minimum limit used. • Activating the digital input selects MIN TORQUE 1 value. • De-activating the digital input selects MIN TORQUE 2 value. -2...-6 = DI2(INV)...DI6(INV) – Defines an inverted digital input DI2...DI6 as the control for selecting the minimum limit used. • See DI1(INV) above.	
2014	MAX TORQUE SEL Defines control of the selection between two maximum torque limits (2017 MAX TORQUE 1 and 2018 MAX TORQUE 2). 0 = MAX TORQUE 1 – Selects 2017 MAX TORQUE 1 as the maximum limit used. 1 = DI1 – Defines digital input DI1 as the control for selecting the maximum limit used. • Activating the digital input selects MAX TORQUE 2 value. • De-activating the digital input selects MAX TORQUE 1 value. 2...6 = DI2...DI6 – Defines digital input DI2...DI6 as the control for selecting the maximum limit used. • See DI1 above. 7 = COMM – Defines bit 15 of the Command Word 1 as the control for selecting the maximum limit used. • The Command Word is supplied through fieldbus communication. • The Command Word is parameter 0301. -1 = DI1(INV) – Defines an inverted digital input di1 as the control for selecting the maximum limit used. • Activating the digital input selects MAX TORQUE 1 value. • De-activating the digital input selects MAX TORQUE 2 value. -2...-6 = DI2(INV)...DI6(INV) – Defines an inverted digital input DI2...DI6 as the control for selecting the maximum limit used. • See DI1(INV) above.	
2015	MIN TORQUE 1 Sets the first minimum limit for torque (%). Value is a percent of the motor nominal torque.	
2016	MIN TORQUE 2 Sets the second minimum limit for torque (%). Value is a percent of the motor nominal torque.	

Code	Description
2017	MAX TORQUE 1 Sets the first maximum limit for torque (%). Value is a percent of the motor nominal torque.
2018	MAX TORQUE 2 Sets the second maximum limit for torque (%). Value is a percent of the motor nominal torque.

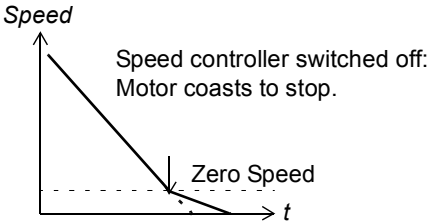
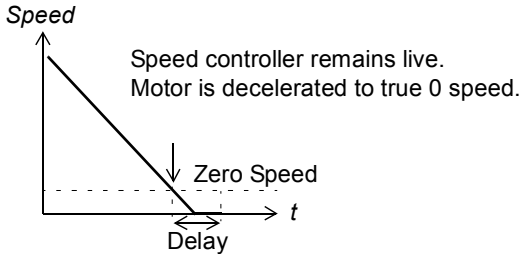
Group 21: START/STOP

This group defines how the motor starts and stops. The ACS550 supports several start and stop modes.

Code	Description
2101	START FUNCTION Selects the motor start method. The valid options depend on the value of parameter 9904 MOTOR CTRL MODE. 1 = AUTO – Selects the automatic start mode. - Vector control modes: Optimal start in most cases. The drive automatically selects the correct output frequency to start a rotating motor. - SCALAR:FREQ mode: Immediate start from zero frequency. Identical to selection 8 = RAMP. 2 = DC MAGN – Selects the DC Magnetizing start mode. Note: The DC Magnetizing start mode cannot start a rotating motor. Note: The drive starts when the set pre-magnetizing time (parameter 2103 DC MAGN TIME) has passed, even if motor magnetization is not complete. - Vector control modes: Magnetizes the motor within the time determined by the parameter 2103 DC MAGN TIME using DC current. The normal control is released exactly after the magnetizing time. This selection guarantees the highest possible break-away torque. - SCALAR:FREQ mode: Magnetizes the motor within the time determined by the parameter 2103 DC MAGN TIME using DC current. The normal control is released exactly after the magnetizing time. 3 = SCALAR FLYST – Selects the flying start mode. - Vector control modes: Not applicable. - SCALAR:FREQ mode: The drive automatically selects the correct output frequency to start a rotating motor – useful if the motor is already rotating and if the drive will start smoothly at the current frequency. - Cannot be used in multimotor systems. 4 = TORQ BOOST – Selects the automatic torque boost mode (SCALAR:FREQ mode only). - May be necessary in drives with high starting torque. - Torque boost is only applied at start, ending when output frequency exceeds 20 Hz or when output frequency is equal to reference. - In the beginning the motor magnetizes within the time determined by the parameter 2103 DC MAGN TIME using DC current. - See parameter 2110 TORQ BOOST CURR. 5 = FLY + BOOST – Selects both the flying start and the torque boost mode (SCALAR:FREQ mode only). - Flying start routine is performed first and the motor is magnetized. If the speed is found to be zero, the torque boost is done. 8 = RAMP – Immediate start from zero frequency.
2102	STOP FUNCTION Selects the motor stop method. 1 = COAST – Selects cutting off the motor power as the stop method. The motor coasts to stop. 2 = RAMP – Selects using a deceleration ramp. Deceleration ramp is defined by 2203 DECELER TIME 1 or 2206 DECELER TIME 2 (whichever is active).
2103	DC MAGN TIME Defines the pre-magnetizing time for the DC Magnetizing start mode. - Use parameter 2101 to select the start mode. - After the start command, the drive pre-magnetizes the motor for the time defined here and then starts the motor. - Set the pre-magnetizing time just long enough to allow full motor magnetization. Too long a time heats the motor excessively.
2104	DC HOLD CTL Selects whether DC current is used for braking or DC Hold. 0 = NOT SEL – Disables the DC current operation. 1 = DC HOLD – Enables the DC Hold function. See the diagram. - Requires parameter 9904 MOTOR CTRL MODE = 1 (VECTOR:SPEED) - Stops generating sinusoidal current and injects DC into the motor when both the reference and the motor speed drop below the value of parameter 2105. - When the reference rises above the level of parameter 2105 the drive resumes normal operation. 2 = DC BRAKING – Enables the DC Injection Braking after modulation has stopped. - If parameter 2102 STOP FUNCTION is 1 (COAST), braking is applied after start is removed. - If parameter 2102 STOP FUNCTION is 2 (RAMP), braking is applied after ramp.



Code	Description
2105	DC HOLD SPEED Sets the speed for DC Hold. Requires that parameter 2104 DC HOLD CTL = 1 (DC HOLD).
2106	DC CURR REF Defines the DC current control reference as a percentage of parameter 9906 MOTOR NOM CURR.
2107	DC BRAKE TIME Defines the DC brake time after modulation has stopped, if parameter 2104 is 2 (DC BRAKING).
2108	START INHIBIT Sets the Start inhibit function on or off. If the drive is not actively started and running, the Start inhibit function ignores a pending start command in any of the following situations and a new start command is required: • A fault is reset. • Run Enable (parameter 1601) activates while start command is active. • Mode changes from local to remote. • Control switches from EXT1 to EXT2. • Control switches from EXT2 to EXT1. 0 = OFF – Disables the Start inhibit function. 1 = ON – Enables the Start inhibit function.
2109	EMERG STOP SEL Defines control of the Emergency stop command. When activated: • Emergency stop decelerates the motor using the emergency stop ramp (parameter 2208 EMERG DEC TIME). • Requires an external stop command and removal of the emergency stop command before drive can restart. 0 = NOT SEL – Disables the Emergency stop function through digital inputs. 1 = DI1 – Defines digital input DI1 as the control for Emergency stop command. • Activating the digital input issues an Emergency stop command. • De-activating the digital input removes the Emergency stop command. 2...6 = DI2...DI6 – Defines digital input DI2...DI6 as the control for Emergency stop command. • See DI1 above. -1 = DI1(INV) – Defines an inverted digital input DI1 as the control for Emergency stop command. • De-activating the digital input issues an Emergency stop command. • Activating the digital input removes the Emergency stop command. -2...-6 = DI2(INV)...DI6(INV) – Defines an inverted digital input DI2...DI6 as the control for Emergency stop command. • See DI1(INV) above.
2110	TORQ BOOST CURR Sets the maximum supplied current during torque boost. • See parameter 2101 START FUNCTION.

Code	Description
2112	ZERO SPEED DELAY Defines the delay for the Zero Speed Delay function. If parameter value is set to zero, the Zero Speed Delay function is disabled. The function is useful in applications where a smooth and quick restarting is essential. During the delay the drive knows accurately the rotor position. No Zero Speed Delay  With Zero Speed Delay  Zero speed delay can be used e.g. with jogging function or mechanical brake. No Zero Speed Delay The drive receives a stop command and decelerates along a ramp. When the motor actual speed falls below an internal limit (called Zero Speed), the speed controller is switched off. The drive modulation is stopped and the motor coasts to standstill. With Zero Speed Delay The drive receives a stop command and decelerates along a ramp. When the motor actual speed falls below an internal limit (called Zero Speed), the zero speed delay function activates. During the delay the functions keeps the speed controller live: The drive modulates, motor is magnetized and drive is ready for a quick restart. Note: Parameter 2102 STOP FUNCTION must be 2 = RAMP for zero speed delay to operate. 0.0 = NOT SEL – Disables the Zero Speed Delay function.
2113	START DELAY Defines the Start delay. After the conditions for start have been fulfilled, the drive waits until the delay has elapsed and then starts the motor. Start delay can be used with all start modes. • If START DELAY = zero, the delay is disabled. • During the Start delay, alarm 2028 START DELAY is shown.

Group 22: ACCEL/DECEL

This group defines ramps that control the rate of acceleration and deceleration. You define these ramps as a pair, one for acceleration and one for deceleration. You can define two pairs of ramps and use a digital input to select one or the other pair.

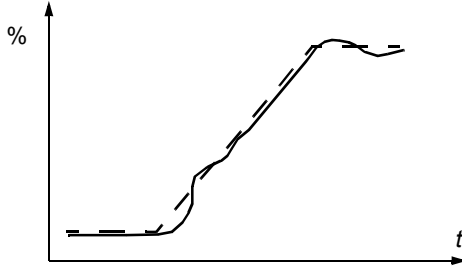
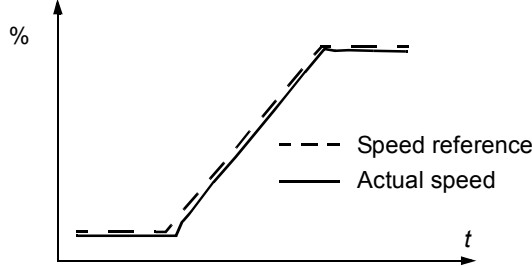
Code	Description	
2201	ACC/DEC 1/2 SEL Defines control for selection of acceleration/deceleration ramps. - Ramps are defined in pairs, one each for acceleration and deceleration. - See below for the ramp definition parameters. 0 = NOT SEL – Disables selection, the first ramp pair is used. 1 = DI1 – Defines digital input DI1 as the control for ramp pair selection. - Activating the digital input selects ramp pair 2. - De-activating the digital input selects ramp pair 1. 2...6 = DI2...DI6 – Defines digital input DI2...DI6 as the control for ramp pair selection. - See DI1 above. 7 = COMM – Defines bit 10 of the Command Word 1 as the control for ramp pair selection. - The Command Word is supplied through fieldbus communication. - The Command Word is parameter 0301. -1 = DI1(INV) – Defines an inverted digital input DI1 as the control for ramp pair selection. - De-activating the digital input selects ramp pair 2 - Activating the digital input selects ramp pair 1. -2...-6 = DI2(INV)...DI6(INV) – Defines an inverted digital input DI2...DI6 as the control for ramp pair selection. - See DI1(INV) above.	
2202	ACCELER TIME 1 Sets the acceleration time for zero to maximum frequency for ramp pair 1. See A in the figure. - Actual acceleration time also depends on 2204 RAMP SHAPE 1. - See 2008 MAXIMUM FREQ.	A = 2202 ACCELER TIME 1 B = 2204 RAMP SHAPE 1
2203	DECELER TIME 1 Sets the deceleration time for maximum frequency to zero for ramp pair 1. - Actual deceleration time also depends on 2204 RAMP SHAPE 1. - See 2008 MAXIMUM FREQ.	
2204	RAMP SHAPE 1 Selects the shape of the acceleration/deceleration ramp for ramp pair 1. See B in the figure. - Shape is defined as a ramp, unless additional time is specified here to reach the maximum frequency. A longer time provides a softer transition at each end of the slope. The shape becomes an s-curve. - Rule of thumb: 1/5 is a suitable relation between the ramp shape time and the acceleration ramp time. 0.0 = LINEAR – Specifies linear acceleration/deceleration ramps for ramp pair 1. 0.1...1000.0 = S-CURVE – Specifies s-curve acceleration/deceleration ramps for ramp pair 1.	
2205	ACCELER TIME 2 Sets the acceleration time for zero to maximum frequency for ramp pair 2. - See 2202 ACCELER TIME 1. - Used also as jogging acceleration time. See 1004 JOGGING SEL.	
2206	DECELER TIME 2 Sets the deceleration time for maximum frequency to zero for ramp pair 2. - See 2203 DECELER TIME 1. - Used also as jogging deceleration time. See 1004 JOGGING SEL.	
2207	RAMP SHAPE 2 Selects the shape of the acceleration/deceleration ramp for ramp pair 2. See 2204 RAMP SHAPE 1.	

Code	Description
2208	EMERG DEC TIME Sets the deceleration time for maximum frequency to zero for an emergency. • See parameter 2109 EMERG STOP SEL. • Ramp is linear.
2209	RAMP INPUT 0 Defines control for forcing the speed to 0 with the currently used deceleration ramp (see parameters 2203 DECELER TIME 1 and 2206 DECELER TIME 2). 0 = NOT SEL – Not selected. 1 = DI1 – Defines digital input DI1 as the control for forcing the speed to 0. • Activating the digital input forces the speed to zero, after which the speed will stay at 0. • De-activating the digital input: speed control resumes normal operation. 2...6 = DI2...DI6 – Defines digital input DI2...DI6 as the control for forcing the speed to 0. • See DI1 above. 7 = COMM – Defines bit 13 of the Command Word 1 as the control for forcing the speed to 0. • The Command Word is supplied through fieldbus communication. • The Command Word is parameter 0301. -1 = DI1(INV) – Defines inverted digital input DI1 as the control for forcing the speed to 0. • De-activating the digital input forces the speed to 0. • Activating the digital input: speed control resumes normal operation. -2...-6 = DI2(INV)...DI6(INV) – Defines an inverted digital input DI2...DI6 as the control for forcing the speed to 0. • See DI1(INV) above.

Group 23: SPEED CONTROL

This group defines variables used for speed control operation.

Code	Description
2301	PROP GAIN Sets the relative gain for the speed controller. • Larger values may cause speed oscillation. • The figure shows the speed controller output after an error step (error remains constant). Note: You can use parameter 2305 AUTOTUNE RUN to automatically set the proportional gain. Controller output = $K_p \cdot e$ Gain = $K_p = 1$ T_i = Integration time = 0 T_D = Derivation time = 0
2302	INTEGRATION TIME Sets the integration time for the speed controller. • The integration time defines the rate at which the controller output changes for a constant error value. • Shorter integration times correct continuous errors faster. • Control becomes unstable if the integration time is too short. • The figure shows the speed controller output after an error step (error remains constant). Note: You can use parameter 2305 AUTOTUNE RUN to automatically set the integration time. Gain = $K_p = 1$ T_i = Integration time > 0 T_D = Derivation time = 0
2303	DERIVATION TIME Sets the derivation time for the speed controller. • Derivative action makes the control more responsive to error value changes. • The longer the derivation time, the more the speed controller output is boosted during the change. • If the derivation time is set to zero, the controller works as a PI controller, otherwise as a PID controller. The figure below shows the speed controller output after an error step when the error remains constant. Gain = $K_p = 1$ T_i = Integration time > 0 T_D = Derivation time > 0 T_s = Sample time period = 2 ms Δe = Error value change between two samples Controller output Error value e = Error value

Code	Description
2304	ACC COMPENSATION Sets the derivation time for acceleration compensation. - Adding a derivative of the reference to the output of the speed controller compensates for inertia during acceleration. 2303 DERIVATION TIME describes the principle of derivative action. - Rule of thumb: Set this parameter between 50 and 100% of the sum of the mechanical time constants for the motor and the driven machine. - The figure shows the speed responses when a high inertia load is accelerated along a ramp. * No acceleration compensation  Acceleration compensation  *Note: You can use parameter 2305 AUTOTUNE RUN to automatically set acceleration compensation.
2305	AUTOTUNE RUN Starts automatic tuning of the speed controller. 0 = OFF – Disables the Autotune creation process. (Does not disable the operation of Autotune settings.) 1 = ON – Activates speed controller autotuning. Automatically reverts to OFF. Procedure: Note: The motor load must be connected. - Run the motor at a constant speed of 20 to 40% of the rated speed. - Change the autotuning parameter 2305 to ON. The drive: - Accelerates the motor. - Calculates values for proportional gain, integration time and acceleration compensation. - Changes parameters 2301, 2302 and 2304 to these values. - Resets 2305 to OFF.

Group 24: TORQUE CONTROL

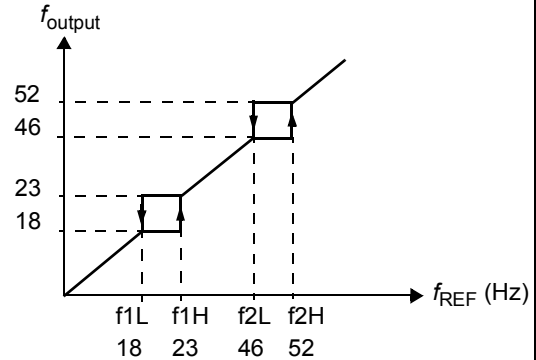
This group defines variables used for torque control operation.

Code	Description
2401	TORQ RAMP UP Defines the torque reference ramp up time – The minimum time for the reference to increase from zero to the nominal motor torque.
2402	TORQ RAMP DOWN Defines the torque reference ramp down time – The minimum time for the reference to decrease from the nominal motor torque to zero.

Group 25: CRITICAL SPEEDS

This group defines up to three critical speeds or ranges of speeds that are to be avoided due, for example, to mechanical resonance problems at certain speeds.

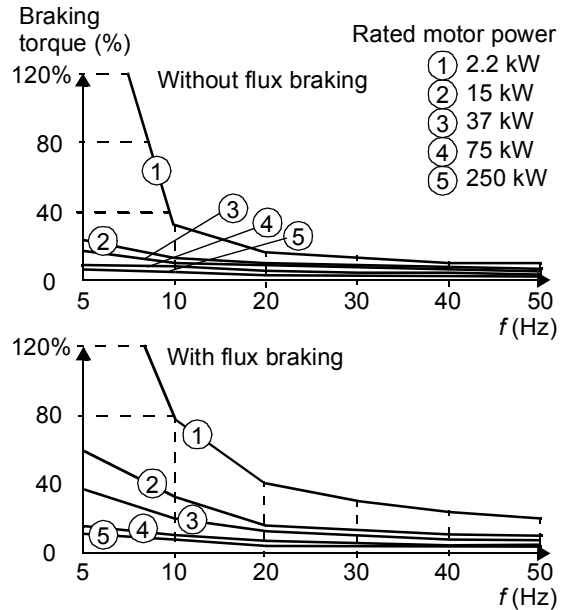
Code	Description
2501	CRIT SPEED SEL Sets the critical speeds function on or off. The critical speed function avoids specific speed ranges. 0 = OFF – Disables the critical speeds function. 1 = ON – Enables the critical speeds function. Example: To avoid speeds at which a fan system vibrates badly: • Determine problem speed ranges. Assume they are found to be: 18...23 Hz and 46...52 Hz. • Set 2501 CRIT SPEED SEL = 1. • Set 2502 CRIT SPEED 1 LO = 18 Hz. • Set 2503 CRIT SPEED 1 HI = 23 Hz. • Set 2504 CRIT SPEED 2 LO = 46 Hz. • Set 2505 CRIT SPEED 2 HI = 52 Hz.
2502	CRIT SPEED 1 LO Sets the minimum limit for critical speed range 1. • The value must be less than or equal to 2503 CRIT SPEED 1 HI. • Units are rpm, unless 9904 MOTOR CTRL MODE = 3 (SCALAR:FREQ), then units are Hz.
2503	CRIT SPEED 1 HI Sets the maximum limit for critical speed range 1. • The value must be greater than or equal to 2502 CRIT SPEED 1 LO. • Units are rpm, unless 9904 MOTOR CTRL MODE = 3 (SCALAR:FREQ), then units are Hz.
2504	CRIT SPEED 2 LO Sets the minimum limit for critical speed range 2. • See parameter 2502.
2505	CRIT SPEED 2 HI Sets the maximum limit for critical speed range 2. • See parameter 2503.
2506	CRIT SPEED 3 LO Sets the minimum limit for critical speed range 3. • See parameter 2502.
2507	CRIT SPEED 3 HI Sets the maximum limit for critical speed range 3. • See parameter 2503.



Group 26: MOTOR CONTROL

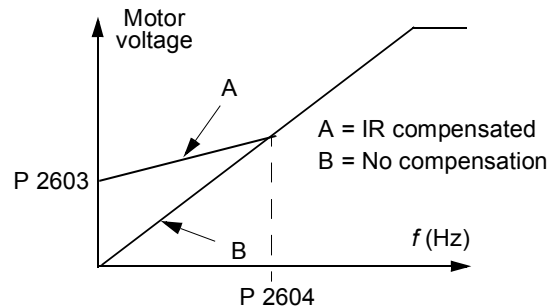
This group defines variables used for motor control.

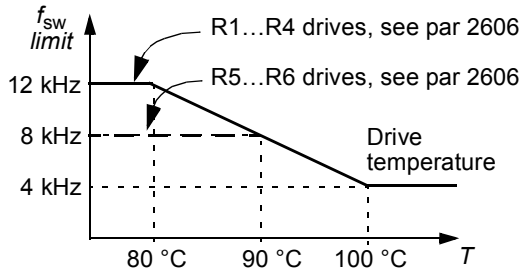
Code	Description																			
2601	FLUX OPT ENABLE Changes the magnitude of the flux depending on the actual load. Flux Optimization can reduce the total energy consumption and noise, and it should be enabled for drives that usually operate below nominal load. 0 = OFF – Disables the feature. 1 = ON – Enables the feature.																			
2602	FLUX BRAKING Provides faster deceleration by raising the level of magnetization in the motor when needed, instead of limiting the deceleration ramp. By increasing the flux in the motor, the energy of the mechanical system is changed to thermal energy in the motor. Requires parameter 9904 MOTOR CTRL MODE = 1 (VECTOR:SPEED) OR 2 (VECTOR:TORQ). 0 = OFF – Disables the feature. 1 = ON – Enables the feature.	Braking torque (%) Rated motor power ① 2.2 kW ② 15 kW ③ 37 kW ④ 75 kW ⑤ 250 kW Without flux braking With flux braking																		
2603	IR COMP VOLT Sets the IR compensation voltage used for 0 Hz. - Requires parameter 9904 MOTOR CTRL MODE = 3 (SCALAR:FREQ). - Keep IR compensation as low as possible to prevent overheating. - Typical IR compensation values are: <table border="1"><thead><tr><th colspan="6">380...480 V drives</th></tr><tr><th>P_N (kW)</th><th>3</th><th>7.5</th><th>15</th><th>37</th><th>132</th></tr></thead><tbody><tr><td>IR comp (V)</td><td>18</td><td>15</td><td>12</td><td>8</td><td>3</td></tr></tbody></table>	380...480 V drives						P_N (kW)	3	7.5	15	37	132	IR comp (V)	18	15	12	8	3	IR compensation When enabled, IR compensation provides an extra voltage boost to the motor at low speeds. Use IR compensation, for example, in applications that require a high breakaway torque.
380...480 V drives																				
P_N (kW)	3	7.5	15	37	132															
IR comp (V)	18	15	12	8	3															
2604	IR COMP FREQ Sets the frequency at which IR compensation is 0 V (in % of motor frequency).																			
2605	U/f RATIO Selects the form for the U/f (voltage to frequency) ratio below field weakening point. 1 = LINEAR – Preferred for constant torque applications. 2 = SQUARED – Preferred for centrifugal pump and fan applications. (SQUARED is more silent for most operating frequencies.)																			



IR compensation

- When enabled, IR compensation provides an extra voltage boost to the motor at low speeds. Use IR compensation, for example, in applications that require a high breakaway torque.



Code	Description												
2606	SWITCHING FREQ Sets the switching frequency for the drive. Also see parameter 2607 SWITCH FREQ CTRL and section Switching frequency derating on page 280. - Higher switching frequencies mean less noise. - In multimotor systems, do not change the switching frequency from the default value. 12 kHz switching frequency is available in scalar control mode, that is when parameter 9904 MOTOR CTRL MODE = 3 (SCALAR:FREQ). - See the availability of switching frequencies for different drive types in the table below. <table><tr><th></th><th>1, 2, 4 and 8 kHz</th><th>12 kHz</th></tr><tr><td>208...240 V</td><td>All types</td><td>Frame sizes R1...R4 in scalar control mode</td></tr><tr><td>380...480 V</td><td>All types</td><td>Frame sizes R1...R4 (except ACS550-01-097A-4) in scalar control mode</td></tr><tr><td>500...600 V</td><td>All types</td><td>Frame sizes R2...R4 in scalar control mode</td></tr></table>		1, 2, 4 and 8 kHz	12 kHz	208...240 V	All types	Frame sizes R1...R4 in scalar control mode	380...480 V	All types	Frame sizes R1...R4 (except ACS550-01-097A-4) in scalar control mode	500...600 V	All types	Frame sizes R2...R4 in scalar control mode
	1, 2, 4 and 8 kHz	12 kHz											
208...240 V	All types	Frame sizes R1...R4 in scalar control mode											
380...480 V	All types	Frame sizes R1...R4 (except ACS550-01-097A-4) in scalar control mode											
500...600 V	All types	Frame sizes R2...R4 in scalar control mode											
2607	SWITCH FREQ CTRL The switching frequency may be reduced if the ACS550 internal temperature rises above a limit. See the figure. This function allows the highest possible switching frequency to be used based on operating conditions. Higher switching frequency results in lower acoustic noise. In multimotor systems, do not disable (set OFF) the function. 0 = OFF – The function is disabled. 1 = ON – The switching frequency is limited according to the figure.												
2608	SLIP COMP RATIO Sets gain for slip compensation (in %). - A squirrel-cage motor slips under load. Increasing the frequency as the motor torque increases compensates for the slip. - Requires parameter 9904 MOTOR CTRL MODE = 3 (SCALAR:FREQ). 0 – No slip compensation. 1...200 – Increasing slip compensation. 100% means full slip compensation.												
2609	NOISE SMOOTHING This parameter introduces a random component to the switching frequency. Noise smoothing distributes the acoustic motor noise over a range of frequencies instead of a single tonal frequency resulting in lower peak noise intensity. The random component has an average of 0 Hz. It is added to the switching frequency set by parameter 2606 SWITCHING FREQ. This parameter has no effect if parameter 2606 = 12 kHz. 0 = DISABLE 1 = ENABLE.												
2619	DC STABILIZER Enables or disables the DC voltage stabilizer. The DC stabilizer is used in scalar control mode to prevent possible voltage oscillations in the drive DC bus caused by motor load or weak supply network. In case of voltage variation the drive tunes the frequency reference to stabilize the DC bus voltage and therefore the load torque oscillation. 0 = DISABLE – Disables DC stabilizer. 1 = ENABLE – Enables DC stabilizer.												
2625	OVERMODULATION Enables or disables overmodulation. Disabling overmodulation can help in some applications in field weakening area. 0 = DISABLE – Disables overmodulation. 1 = ENABLE – Enables overmodulation.												

Group 29: MAINTENANCE TRIG

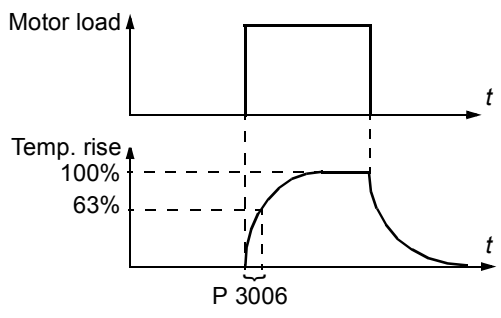
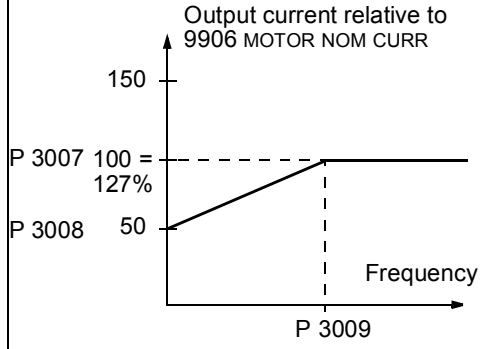
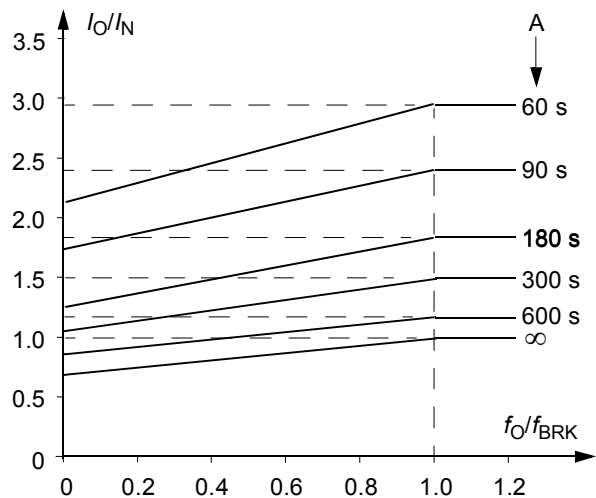
This group contains usage levels and trigger points. When usage reaches the set trigger point, a notice displayed on the control panel signals that maintenance is due.

Code	Description
2901	COOLING FAN TRIG Sets the trigger point for the drive's cooling fan counter. Value is compared to parameter 2902 value. 0.0 – Disables the trigger.
2902	COOLING FAN ACT Defines the actual value of the drive's cooling fan counter. - When parameter 2901 has been set to a non-zero value, the counter starts. - When the actual value of the counter exceeds the value defined by parameter 2901, a maintenance notice is displayed on the panel. 0.0 – Resets the parameter.
2903	REVOLUTION TRIG Sets the trigger point for the motor's accumulated revolutions counter. Value is compared to parameter 2904 value. 0 – Disables the trigger.
2904	REVOLUTION ACT Defines the actual value of the motor's accumulated revolutions counter. - When parameter 2903 has been set to a non-zero value, the counter starts. - When the actual value of the counter exceeds the value defined by parameter 2903, a maintenance notice is displayed on the panel. 0 – Resets the parameter.
2905	RUN TIME TRIG Sets the trigger point for the drive's run time counter. Value is compared to parameter 2906 value. 0.0 – Disables the trigger.
2906	RUN TIME ACT Defines the actual value of the drive's run time counter. - When parameter 2905 has been set to a non-zero value, the counter starts. - When the actual value of the counter exceeds the value defined by parameter 2905, a maintenance notice is displayed on the panel. 0.0 – Resets the parameter.
2907	USER MWh TRIG Sets the trigger point for the drive's accumulated power consumption (in megawatt hours) counter. Value is compared to parameter 2908 value. 0.0 – Disables the trigger.
2908	USER MWh ACT Defines the actual value of the drive's accumulated power consumption (in megawatt hours) counter. - When parameter 2907 has been set to a non-zero value, the counter starts. - When the actual value of the counter exceeds the value defined by parameter 2907, a maintenance notice is displayed on the panel. 0.0 – Resets the parameter.

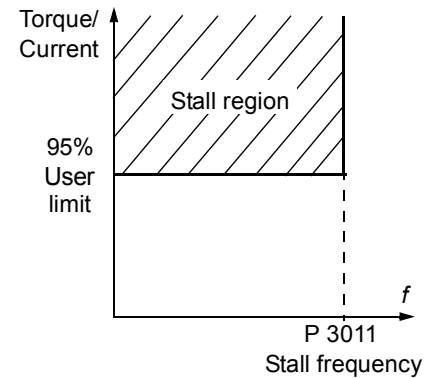
Group 30: FAULT FUNCTIONS

This group defines situations that the drive should recognize as potential faults and defines how the drive should respond if the fault is detected.

Code	Description
3001	AI<MIN FUNCTION Defines the drive response if the analog input (AI) signal drops below the fault limits and AI is used • as the active reference source (Group 11: REFERENCE SELECT) • as the Process or External PID controllers' feedback or setpoint source (Group 40: PROCESS PID SET 1, Group 41: PROCESS PID SET 2 or Group 42: EXT / TRIM PID) and the corresponding PID controller is active. 3021 AI1 FAULT LIMIT and 3022 AI2 FAULT LIMIT set the fault limits. 0 = NOT SEL – No response. 1 = FAULT – Displays a fault (7, AI1 LOSS or 8, AI2 LOSS) and the drive coasts to stop. 2 = CONST SP 7 – Displays an alarm (2006, AI1 LOSS or 2007, AI2 LOSS) and sets speed using 1208 CONST SPEED 7. 3 = LAST SPEED – Displays an alarm (2006, AI1 LOSS or 2007, AI2 LOSS) and sets speed using the last operating level. This value is the average speed over the last 10 seconds.  WARNING! If you select CONST SP 7 or LAST SPEED, make sure that continued operation is safe when the analog input signal is lost.
3002	PANEL COMM ERR Defines the drive response to a control panel communication error. 1 = FAULT – Displays a fault (10, PANEL LOSS) and the drive coasts to stop. 2 = CONST SP 7 – Displays an alarm (2008, PANEL LOSS) and sets speed using 1208 CONST SPEED 7. 3 = LAST SPEED – Displays an alarm (2008, PANEL LOSS) and sets speed using the last operating level. This value is the average speed over the last 10 seconds. Note: When either of the two external control locations are active, and start, stop and/or direction are through the control panel – 1001 EXT1 COMMANDS / 1002 EXT2 COMMANDS = 8 (KEYPAD) – the drive follows speed/frequency reference according to the configuration of the external control locations, instead of the value of the last speed or parameter 1208 CONST SPEED 7.  WARNING! If you select CONST SP 7 or LAST SPEED, make sure that continued operation is safe when the control panel communication is lost.
3003	EXTERNAL FAULT 1 Defines the External Fault 1 signal input and the drive response to an external fault. 0 = NOT SEL – External fault signal is not used. 1 = DI1 – Defines digital input DI1 as the external fault input. • Activating the digital input indicates a fault. The drive displays a fault (14, EXT FAULT 1) and the drive coasts to stop. 2...6 = DI2...DI6 – Defines digital input DI2...DI6 as the external fault input. • See DI1 above. -1 = DI1(INV) – Defines an inverted digital input DI1 as the external fault input. • De-activating the digital input indicates a fault. The drive displays a fault (14, EXT FAULT 1) and the drive coasts to stop. -2...-6 = DI2(INV)...DI6(INV) – Defines an inverted digital input DI2...DI6 as the external fault input. • See DI1(INV) above.
3004	EXTERNAL FAULT 2 Defines the External Fault 2 signal input and the drive response to an external fault. • See parameter 3003 above.
3005	MOT THERM PROT Defines the drive response to motor overheating. 0 = NOT SEL – No response and/or motor thermal protection not set up. 1 = FAULT – When the calculated motor temperature exceeds 90 °C, displays an alarm (2010, MOTOR TEMP). When the calculated motor temperature exceeds 110 °C, displays a fault (9, MOT OVERTEMP) and the drive coasts to stop. 2 = ALARM – When the calculated motor temperature exceeds 90 °C, displays an alarm (2010, MOTOR TEMP).

Code	Description	
3006	MOT THERM TIME Sets the motor thermal time constant for the motor temperature model. - This is the time required for the motor to reach 63% of the final temperature with steady load. - For thermal protection according to UL requirements for NEMA class motors, use the rule of thumb: MOTOR THERM TIME equals 35 times t_6, where t_6 (in seconds) is specified by the motor manufacturer as the time that the motor can safely operate at six times its rated current. - The thermal time for a Class 10 trip curve is 350 s, for a Class 20 trip curve 700 s, and for a Class 30 trip curve 1050 s.	
3007	MOT LOAD CURVE Sets the maximum allowable operating load of the motor. - With the default value 100%, motor overload protection is functioning when the constant current exceeds 127% of the parameter 9906 MOTOR NOM CURR value. - The default overloadability is at the same level as what motor manufacturers typically allow below 30 °C (86 °F) ambient temperature and below 1000 m (3300 ft) altitude. When the ambient temperature exceeds 30 °C (86 °F) or the installation altitude is over 1000 m (3300 ft), decrease the parameter 3007 value according to the motor manufacturer's recommendation. Example: If the constant protection level needs to be 115% of the motor nominal current, set parameter 3007 value to 91% ($= 115/127 \cdot 100\%$).	
3008	ZERO SPEED LOAD Sets the maximum allowable current at zero speed. Value is relative to 9906 MOTOR NOM CURR.	
3009	BREAK POINT FREQ Sets the break point frequency for the motor load curve.	
Example: Thermal protection trip times when parameters 3006 MOT THERM TIME, 3007 MOT LOAD CURVE and 3008 ZERO SPEED LOAD have default values.  I_O = Output current I_N = Nominal motor current f_O = Output frequency f_{BRK} = Break point frequency A = Trip time		

Code	Description
3010	STALL FUNCTION This parameter defines the operation of the Stall function. This protection is active if the drive operates in the stall region (see the figure) for the time defined by 3012 STALL TIME. The "User Limit" is defined in Group 20: LIMITS by 2017 MAX TORQUE 1, 2018 MAX TORQUE 2, or the limit on the COMM input. 0 = NOT SEL – Stall protection is not used. 1 = FAULT – When the drive operates in the stall region for the time set by 3012 STALL TIME: - The drive coasts to stop. - A fault indication is displayed. 2 = ALARM – When the drive operates in the stall region for the time set by 3012 STALL TIME: - An alarm indication is displayed. - The alarm disappears when the drive is out of the stall region for half the time set by parameter 3012 STALL TIME.
3011	STALL FREQUENCY This parameter sets the frequency value for the Stall function. Refer to the figure.
3012	STALL TIME This parameter sets the time value for the Stall function.
3017	EARTH FAULT Defines the drive response if the drive detects a ground fault in the motor or motor cables. The drive monitors for ground faults while the drive is running, and while the drive is not running. See also parameter 3023 WIRING FAULT and 3028 EARTH FAULT LVL. Note: Disabling earth fault (ground fault) may void the warranty. 0 = DISABLE – No drive response to ground faults. 1 = ENABLE – Ground faults display fault 16 (EARTH FAULT), and (if running) the drive coasts to stop.
3018	COMM FAULT FUNC Defines the drive response if the fieldbus communication is lost. 0 = NOT SEL – No response. 1 = FAULT – Displays a fault (28, SERIAL 1 ERR) and the drive coasts to stop. 2 = CONST SP 7 – Displays an alarm (2005, I/O COMM) and sets speed using 1208 CONST SPEED 7. This "alarm speed" remains active until the fieldbus writes a new reference value. 3 = LAST SPEED – Displays an alarm (2005, I/O COMM) and sets speed using the last operating level. This value is the average speed over the last 10 seconds. This "alarm speed" remains active until the fieldbus writes a new reference value. WARNING! If you select CONST SP 7, or LAST SPEED, make sure that continued operation is safe when fieldbus communication is lost.
3019	COMM FAULT TIME Sets the communication fault time used with 3018 COMM FAULT FUNC. Brief interruptions in the fieldbus communication are not treated as faults if they are less than the COMM FAULT TIME value.
3021	AI1 FAULT LIMIT Sets a fault level for analog input 1. See 3001 AI<MIN FUNCTION.
3022	AI2 FAULT LIMIT Sets a fault level for analog input 2. See 3001 AI<MIN FUNCTION.

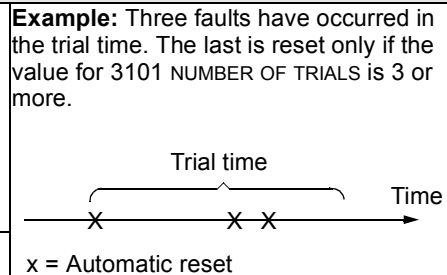


Code	Description
3023	WIRING FAULT Defines the drive response to cross wiring faults and to ground faults detected when the drive is NOT running. When the drive is not running it monitors for: • Improper connections of input power to the drive output (the drive can display fault 35, OUTPUT WIRING if improper connections are detected). • Ground faults (the drive can display fault 16, EARTH FAULT if a ground fault is detected). Also, see parameter 3017 EARTH FAULT. Note: Disabling wiring fault (ground fault) may void the warranty. 0 = DISABLE – No drive response to either of the above monitoring results. 1 = ENABLE – The drive displays faults when this monitoring detects problems.
3024	CB TEMP FAULT Defines the drive response to control board overheating. Not for drives with an OMIO control board. 0 = DISABLE – No response. 1 = ENABLE – Displays fault 37 (CB OVERTEMP) and the drive coasts to stop.
3028	EARTH FAULT LVL Defines detection level for earth fault. See Correcting faults , fault 16, EARTH FAULT. Note: Parameter 3017 EARTH FAULT has to be enabled. 1 = LOW – Low level leakage current, high sensitivity. The drive trips to low ground (earth) leakage current (default in the USA software version). 2 = MEDIUM – Medium sensitivity to ground (earth) fault current (default in the European software version). 3 = HIGH – High level leakage current, low sensitivity. The drive trips to higher ground (earth) leakage current.

Group 31: AUTOMATIC RESET

This group defines conditions for automatic resets. An automatic reset occurs after a particular fault is detected. The drive holds for a set delay time, then automatically restarts. You can limit the number of resets in a specified time period and set up automatic resets for a variety of faults.

Code	Description
3101	NUMBER OF TRIALS Sets the number of allowed automatic resets within a trial period defined by 3102 TRIAL TIME. - If the number of automatic resets exceeds this limit (within the trial time), the drive prevents additional automatic resets and remains stopped. - Starting then requires a successful reset performed from the control panel or from a source selected by 1604 FAULT RESET SEL.
3102	TRIAL TIME Sets the time period used for counting and limiting the number of resets. See 3101 NUMBER OF TRIALS.
3103	DELAY TIME Sets the delay time between a fault detection and attempted drive restart. If DELAY TIME = zero, the drive resets immediately.
3104	AR OVERCURRENT Sets the automatic reset for the overcurrent function on or off. 0 = DISABLE – Disables automatic reset. 1 = ENABLE – Enables automatic reset. Automatically resets the fault (OVERCURRENT) after the delay set by 3103 DELAY TIME, and the drive resumes normal operation.
3105	AR OVERVOLTAGE Sets the automatic reset for the overvoltage function on or off. 0 = DISABLE – Disables automatic reset. 1 = ENABLE – Enables automatic reset. Automatically resets the fault (DC OVERVOLT) after the delay set by 3103 DELAY TIME, and the drive resumes normal operation.
3106	AR UNDERVOLTAGE Sets the automatic reset for the undervoltage function on or off. 0 = DISABLE – Disables automatic reset. 1 = ENABLE – Enables automatic reset. Automatically resets the fault (DC UNDERVOLT) after the delay set by 3103 DELAY TIME, and the drive resumes normal operation.
3107	AR AI<MIN Sets the automatic reset for the analog input less than minimum value function on or off. 0 = DISABLE – Disables automatic reset. 1 = ENABLE – Enables automatic reset. Automatically resets the fault (AI<MIN) after the delay set by 3103 DELAY TIME, and the drive resumes normal operation.  WARNING! When the analog input signal is restored, the drive may restart, even after a long stop. Make sure that automatic, long delayed starts will not cause physical injury and/or damage equipment.
3108	AR EXTERNAL FLT Sets the automatic reset for external faults function on or off. 0 = DISABLE – Disables automatic reset. 1 = ENABLE – Enables automatic reset. Automatically resets the fault (EXT FAULT 1 or EXT FAULT 2) after the delay set by 3103 DELAY TIME, and the drive resumes normal operation.



Group 32: SUPERVISION

This group defines supervision for up to three signals from *Group 01: OPERATING DATA*. Supervision monitors a specified parameter and energizes a relay output if the parameter passes a defined limit. Use *Group 14: RELAY OUTPUTS* to define the relay and whether the relay activates when the signal is too low or too high.

Code	Description	
3201	SUPERV 1 PARAM Selects the first supervised parameter. - Must be a parameter number from <i>Group 01: OPERATING DATA</i>. 100 = NOT SELECTED – No parameter selected. 101...178 – Selects parameter 0101...0178. - If the supervised parameter passes a limit, a relay output is energized. - The supervision limits are defined in this group. - The relay outputs are defined in <i>Group 14: RELAY OUTPUTS</i> (definition also specifies which supervision limit is monitored). LO ≤ HI Operating data supervision using relay outputs, when $LO \leq HI$. - Case A = Parameter 1401 RELAY OUTPUT 1 (or 1402 RELAY OUTPUT 2, etc.) value is SUPRV1 OVER or SUPRV2 OVER. Use for monitoring when/if the supervised signal exceeds a given limit. The relay remains active until the supervised value drops below the low limit. - Case B = Parameter 1401 RELAY OUTPUT 1 (or 1402 RELAY OUTPUT 2, etc.) value is SUPRV1 UNDER or SUPRV2 UNDER. Use for monitoring when/if the supervised signal falls below a given limit. The relay remains active until the supervised value rises above the high limit. LO > HI Operating data supervision using relay outputs, when $LO > HI$. The lowest limit (HI 3203) is active initially and remains active until the supervised parameter goes above the highest limit (LO 3202), making that limit the active limit. That limit remains active until the supervised parameter goes below the lowest limit (HI 3203), making that limit active. - Case A = Parameter 1401 RELAY OUTPUT 1 (or 1402 RELAY OUTPUT 2, etc.) value is SUPRV1 OVER or SUPRV2 OVER. Initially the relay is de-energized. It is energized whenever the supervised parameter goes above the active limit. - Case B = Parameter 1401 RELAY OUTPUT 1 (or 1402 RELAY OUTPUT 2, etc.) value is SUPRV1 UNDER or SUPRV2 UNDER. Initially the relay is energized. It is de-energized whenever the supervised parameter goes below the active limit.	LO ≤ HI Note: Case $LO \leq HI$ represents a normal hysteresis. Value of supervised parameter Case A Energized (1) Case B Energized (1) LO > HI Note: Case $LO > HI$ represents a special hysteresis with two separate supervision limits. Value of supervised parameter Case A Energized (1) Case B Energized (1)
3202	SUPERV 1 LIM LO Sets the low limit for the first supervised parameter. See 3201 SUPERV 1 PARAM above.	
3203	SUPERV 1 LIM HI Sets the high limit for the first supervised parameter. See 3201 SUPERV 1 PARAM above.	
3204	SUPERV 2 PARAM Selects the second supervised parameter. See 3201 SUPERV 1 PARAM above.	
3205	SUPERV 2 LIM LO Sets the low limit for the second supervised parameter. See 3204 SUPERV 2 PARAM above.	
3206	SUPERV 2 LIM HI Sets the high limit for the second supervised parameter. See 3204 SUPERV 2 PARAM above.	

Code	Description
3207	SUPERV 3 PARAM Selects the third supervised parameter. See 3201 SUPERV 1 PARAM above.
3208	SUPERV 3 LIM LO Sets the low limit for the third supervised parameter. See 3207 SUPERV 3 PARAM above.
3209	SUPERV 3 LIM HI Sets the high limit for the third supervised parameter. See 3207 SUPERV 3 PARAM above.

Group 33: INFORMATION

This group provides access to information about the drive's current programs: versions and test date.

Code	Description
3301	FIRMWARE Contains the version of the drive's firmware.
3302	LOADING PACKAGE Contains the version of the loading package.
3303	TEST DATE Contains the test date (yy.ww).
3304	DRIVE RATING Indicates the drive's current and voltage rating. The format is XXXY, where: • XXX = The nominal current rating of the drive in amperes. If present, an "A" indicates a decimal point in the rating for the current. For example XXX = 8A8 indicates a nominal current rating of 8.8 A. • Y = The voltage rating of the drive, where Y = : • 2 indicates a 208...240 V rating. • 4 indicates a 380...480 V rating. • 6 indicates a 500...600 V rating.
3305	PARAMETER TABLE Contains the version of the parameter table used in the drive.

Group 34: PANEL DISPLAY

This group defines the content for control panel display (middle area), when the control panel is in the Output mode.

Code	Description																												
3401	SIGNAL1 PARAM Selects the first parameter (by number) displayed on the control panel. - Definitions in this group define display content when the control panel is in the control mode. - Any parameter number in <i>Group 01: OPERATING DATA</i> can be selected. - Using the following parameters, the display value can be scaled, converted to convenient units and/or displayed as a bar graph. - The figure identifies selections made by parameters in this group. - If just one or two parameters are selected for display, that is just one or two of the values of parameters 3401 SIGNAL1 PARAM, 3408 SIGNAL2 PARAM and 3415 SIGNAL3 PARAM are other than 100 (NOT SELECTED), the number and name of each displayed parameter are shown in addition to the value. 100 = NOT SELECTED – First parameter not displayed. 101...178 – Displays parameter 0101...0178. If parameter does not exist, the display shows “n.a.”.	P 3404 P 3405 LOC ↺ 49.1 Hz P 3401 (=137) → 49.1 Hz P 3408 (=138) → 0.5 A P 3415 (=139) → 10.7 % DIR 00:00 MENU LOC ↺ 5.0Hz P 3404 → 0.4 A 24.4 % DIR 00:00 MENU																											
3402	SIGNAL1 MIN Defines the minimum expected value for the first display parameter. Use parameters 3402, 3403, 3406 and 3407, for example to convert a <i>Group 01: OPERATING DATA</i> parameter, such as 0102 SPEED (in rpm) to the speed of a conveyor driven by the motor (in ft/min). For such a conversion, the source values in the figure are the min. and max. motor speed, and the display values are the corresponding min. and max. conveyor speed. Use parameter 3405 to select the proper units for the display. Note: Selecting units does not convert values. Parameter is not effective if parameter 3404 OUTPUT1 DSP FORM = 9 (DIRECT).	Display value P 3407 P 3406 P3402 P 3403 Source value																											
3403	SIGNAL1 MAX Defines the maximum expected value for the first display parameter. Note: Parameter is not effective if parameter 3404 OUTPUT1 DSP FORM = 9 (DIRECT).																												
3404	OUTPUT1 DSP FORM Defines the decimal point location for the first display parameter. 0...7 – Defines the decimal point location. - Enter the number of digits desired to the right of the decimal point. - See the table for an example using pi (3.14159). 8 = BAR METER – Specifies a bar meter display. 9 = DIRECT – Decimal point location and units of measure are identical to the source signal. See <i>Group 01: OPERATING DATA</i> parameter listing in section <i>Complete parameter list</i> on page 91 for resolution (which indicates the decimal point location) and the units of measure.	<table><tr><th>3404 value</th><th>Display</th><th>Range</th></tr><tr><td>0</td><td>± 3</td><td rowspan="4">-32768...+32767 (Signed)</td></tr><tr><td>1</td><td>± 3.1</td></tr><tr><td>2</td><td>± 3.14</td></tr><tr><td>3</td><td>± 3.142</td></tr><tr><td>4</td><td>3</td><td rowspan="4">0...65535 (Unsigned)</td></tr><tr><td>5</td><td>3.1</td></tr><tr><td>6</td><td>3.14</td></tr><tr><td>7</td><td>3.142</td></tr><tr><td>8</td><td colspan="2">Bar meter displayed.</td></tr><tr><td>9</td><td colspan="2">Decimal point location and units as for the source signal.</td></tr></table>	3404 value	Display	Range	0	± 3	-32768...+32767 (Signed)	1	± 3.1	2	± 3.14	3	± 3.142	4	3	0...65535 (Unsigned)	5	3.1	6	3.14	7	3.142	8	Bar meter displayed.		9	Decimal point location and units as for the source signal.	
3404 value	Display	Range																											
0	± 3	-32768...+32767 (Signed)																											
1	± 3.1																												
2	± 3.14																												
3	± 3.142																												
4	3	0...65535 (Unsigned)																											
5	3.1																												
6	3.14																												
7	3.142																												
8	Bar meter displayed.																												
9	Decimal point location and units as for the source signal.																												

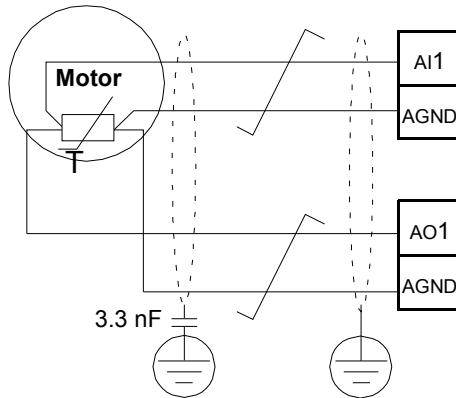
Code	Description
3405	OUTPUT1 UNIT Selects the units used with the first display parameter. Note: Parameter is not effective if parameter 3404 OUTPUT1 DSP FORM = 9 (DIRECT). 0 = NO UNIT 9 = °C 18 = MWh 27 = ft 36 = l/s 45 = Pa 54 = lb/m 63 = Mrev 1 = A 10 = lb ft 19 = m/s 28 = MGD 37 = l/min 46 = GPS 55 = lb/h 64 = d 2 = V 11 = mA 20 = m ³ /h 29 = inHg 38 = l/h 47 = gal/s 56 = FPS 65 = inWC 3 = Hz 12 = mV 21 = dm ³ /s 30 = FPM 39 = m ³ /s 48 = gal/m 57 = ft/s 66 = m/min 4 = % 13 = kW 22 = bar 31 = kb/s 40 = m ³ /m 49 = gal/h 58 = inH ₂ O 67 = Nm 5 = s 14 = W 23 = kPa 32 = kHz 41 = kg/s 50 = ft ³ /s 59 = in wg 68 = Km ³ /h 6 = h 15 = kWh 24 = GPM 33 = ohm 42 = kg/m 51 = ft ³ /m 60 = ft wg 7 = rpm 16 = °F 25 = PSI 34 = ppm 43 = kg/h 52 = ft ³ /h 61 = lbsi 8 = kh 17 = hp 26 = CFM 35 = pps 44 = mbar 53 = lb/s 62 = ms The following units are useful for the bar display. 117 = %ref 119 = %dev 121 = % SP 123 = Iout 125 = Fout 127 = Vdc 118 = %act 120 = % LD 122 = %FBK 124 = Vout 126 = Tout
3406	OUTPUT1 MIN Sets the minimum value displayed for the first display parameter. Note: Parameter is not effective if parameter 3404 OUTPUT1 DSP FORM = 9 (DIRECT).
3407	OUTPUT1 MAX Sets the maximum value displayed for the first display parameter. Note: Parameter is not effective if parameter 3404 OUTPUT1 DSP FORM = 9 (DIRECT).
3408	SIGNAL2 PARAM Selects the second parameter (by number) displayed on the control panel. See parameter 3401.
3409	SIGNAL2 MIN Defines the minimum expected value for the second display parameter. See parameter 3402.
3410	SIGNAL2 MAX Defines the maximum expected value for the second display parameter. See parameter 3403.
3411	OUTPUT2 DSP FORM Defines the decimal point location for the second display parameter. See parameter 3404.
3412	OUTPUT2 UNIT Selects the units used with the second display parameter. See parameter 3405.
3413	OUTPUT2 MIN Sets the minimum value displayed for the second display parameter. See parameter 3406.
3414	OUTPUT2 MAX Sets the maximum value displayed for the second display parameter. See parameter 3407.
3415	SIGNAL3 PARAM Selects the third parameter (by number) displayed on the control panel. See parameter 3401.
3416	SIGNAL3 MIN Defines the minimum expected value for the third display parameter. See parameter 3402.
3417	SIGNAL3 MAX Defines the maximum expected value for the third display parameter. See parameter 3403.
3418	OUTPUT3 DSP FORM Defines the decimal point location for the third display parameter. See parameter 3404.
3419	OUTPUT3 UNIT Selects the units used with the third display parameter. See parameter 3405.
3420	OUTPUT3 MIN Sets the minimum value displayed for the third display parameter. See parameter 3406.

Code	Description
3421	OUTPUT3 MAX Sets the maximum value displayed for the third display parameter. See parameter 3407.

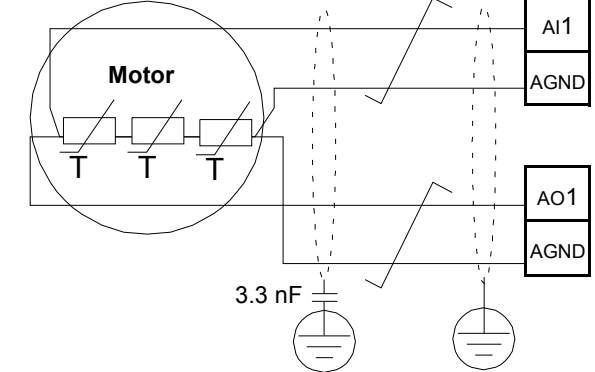
Group 35: MOTOR TEMP MEAS

This group defines the detection and reporting for a particular potential fault – motor overheating, as detected by a temperature sensor. Typical connections are shown below.

One sensor



Three sensors



WARNING! IEC 60664 requires double or reinforced insulation between live parts and the surface of accessible parts of electrical equipment which are either non-conductive or conductive but not connected to the protective earth.

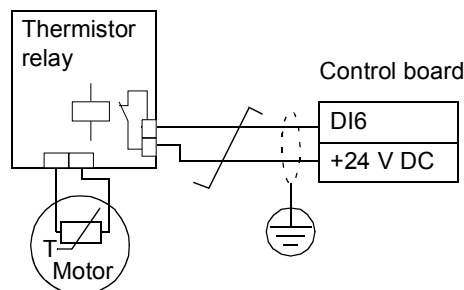
To fulfil this requirement, connect a thermistor (and other similar components) to the drive's control terminals using any of these alternatives:

- Separate the thermistor from live parts of the motor with double reinforced insulation.
- Protect all circuits connected to the drive's digital and analog inputs. Protect against contact, and insulate from other low voltage circuits with basic insulation (rated for the same voltage level as the drive's main circuit).
- Use an external thermistor relay. The relay insulation must be rated for the same voltage level as the drive's main circuit.

The figure below shows thermistor relay and PTC sensor connections using a digital input. At the motor end, the cable shield should be earthed through, eg a 3.3 nF capacitor. If this is not possible, leave the shield unconnected.

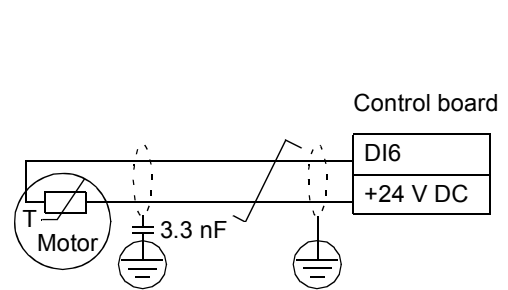
Thermistor relay

3501 SENSOR TYPE = 5 (THERM(0)) or 6 (THERM(1))



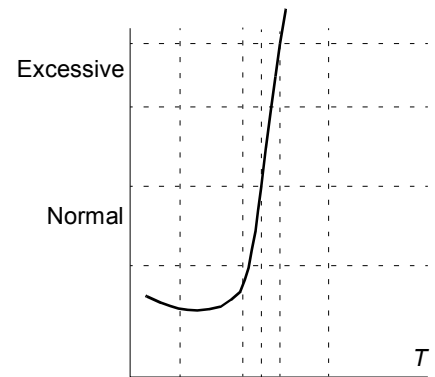
PTC sensor

3501 SENSOR TYPE = 5 (THERM(0))



For other faults, or for anticipating motor overheating using a model, see [Group 30: FAULT FUNCTIONS](#).

Code	Description												
3501	SENSOR TYPE Identifies the type of the motor temperature sensor used, PT100 (°C), PTC (ohm) or thermistor. See parameters 1501 AO1 CONTENT SEL and 1507 AO2 CONTENT SEL. 0 = NONE 1 = 1 x PT100 – Sensor configuration uses one PT100 sensor. - Analog output AO1 or AO2 feeds constant current through the sensor. - The sensor resistance increases as the motor temperature rises, as does the voltage over the sensor. - The temperature measurement function reads the voltage through analog input Ai1 or Ai2 and converts it to degrees Celsius. 2 = 2 x PT100 – Sensor configuration uses two PT100 sensors. - Operation is the same as for above 1 x PT100. 3 = 3 x PT100 – Sensor configuration uses three PT100 sensors. - Operation is the same as for above 1 x PT100. 4 = PTC – Sensor configuration uses one PTC. - The analog output feeds a constant current through the sensor. - The resistance of the sensor increases sharply as the motor temperature rises over the PTC reference temperature (T_{ref}), as does the voltage over the resistor. The temperature measurement function reads the voltage through analog input Ai1 and converts it into ohms. - The table below and the graph show typical PTC sensor resistance as a function of the motor operating temperature. <table border="1"> <thead> <tr> <th>Temperature</th><th>Resistance</th></tr> </thead> <tbody> <tr> <td>Normal</td><td>< 1.5 kohm</td></tr> <tr> <td>Excessive</td><td>> 4 kohm</td></tr> </tbody> </table> 5 = THERM(0) – Sensor configuration uses a thermistor. - Motor thermal protection is activated through a digital input. Connect either a PTC sensor or a normally closed thermistor relay to a digital input. - When the digital input is '0', the motor is overheated. - See the connection figure on page 159. - The table below and the graph show the resistance requirements for a PTC sensor connected between 24 V and a digital input as a function of the motor operating temperature. <table border="1"> <thead> <tr> <th>Temperature</th><th>Resistance</th></tr> </thead> <tbody> <tr> <td>Normal</td><td>< 3 kohm</td></tr> <tr> <td>Excessive</td><td>> 28 kohm</td></tr> </tbody> </table> 6 = THERM(1) – Sensor configuration uses a thermistor. - Motor thermal protection is activated through a digital input. Connect a normally open thermistor relay to a digital input. - When the digital input is '1', the motor is overheated. - See the connection figure on page 159.	Temperature	Resistance	Normal	< 1.5 kohm	Excessive	> 4 kohm	Temperature	Resistance	Normal	< 3 kohm	Excessive	> 28 kohm
Temperature	Resistance												
Normal	< 1.5 kohm												
Excessive	> 4 kohm												
Temperature	Resistance												
Normal	< 3 kohm												
Excessive	> 28 kohm												
3502	INPUT SELECTION Defines the input used for the temperature sensor. 1 = Ai1 – PT100 and PTC. 2 = Ai2 – PT100 and PTC. 3...8 = DI1...DI6 – Thermistor and PTC												
3503	ALARM LIMIT Defines the alarm limit for motor temperature measurement. At motor temperatures above this limit, the drive displays an alarm (2010, MOTOR TEMP) For thermistors or PTC connected to a digital input: 0 – de-activated 1 – activated												



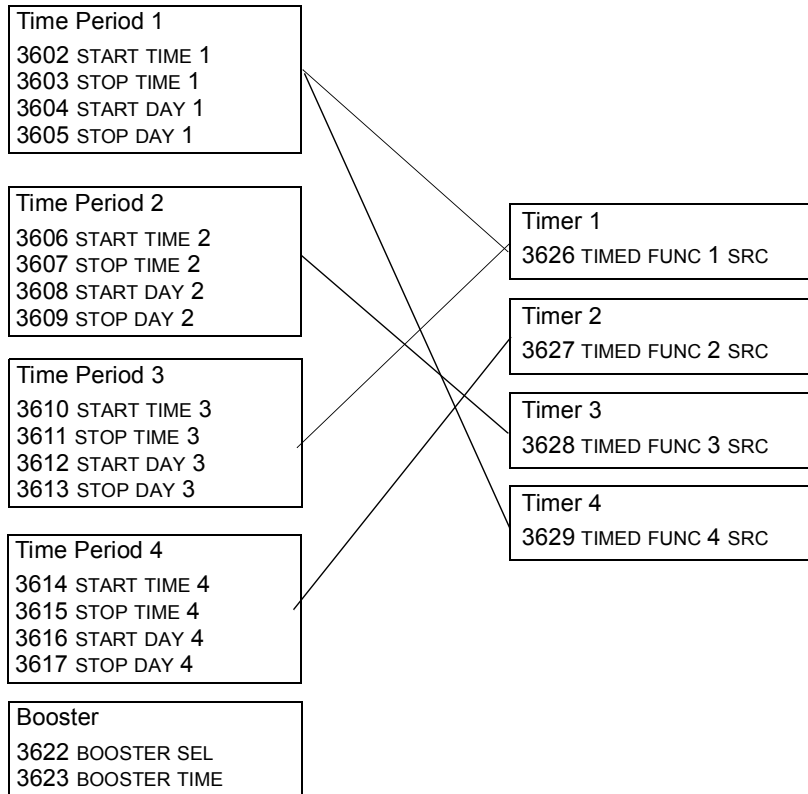
Code	Description
3504	FAULT LIMIT Defines the fault limit for motor temperature measurement. • At motor temperatures above this limit, the drive displays a fault (9, MOT OVERTEMP) and stops the drive. For thermistors or PTC connected to a digital input: 0 – de-activated 1 – activated

Group 36: TIMED FUNCTIONS

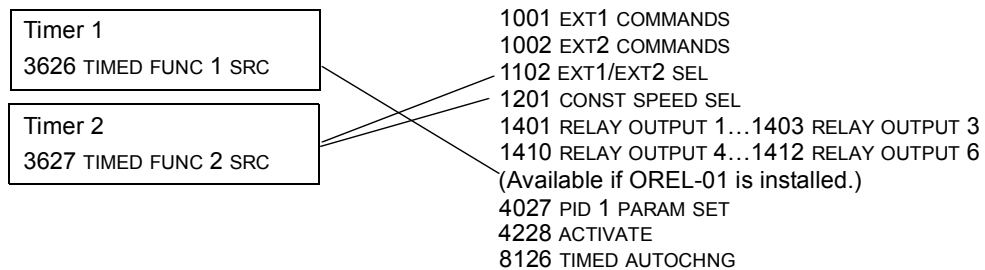
This group defines the timed functions. The timed functions include:

- four daily start and stop times
- four weekly start, stop and boost times
- four timers for collecting selected periods together.

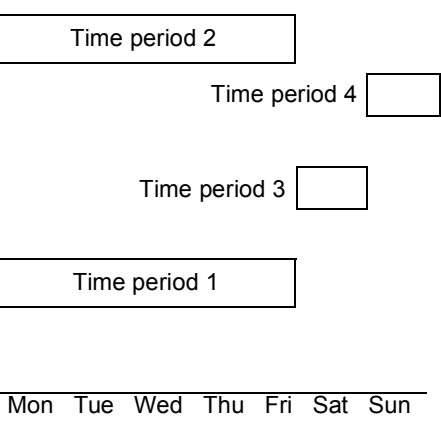
A timer can be connected to multiple time periods and a time period can be in multiple timers.

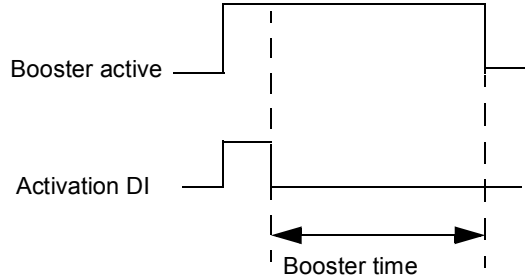


A parameter can be connected to only one timer.



You can use the Timed functions assistant for easy configuring. For more information on the assistants, see section [Assistants mode](#) on page 57.

Code	Description
3601	TIMERS ENABLE Selects the source for the timer enable signal. 0 = NOT SEL – Timed functions are disabled. 1 = DI1 – Defines digital input DI1 as the timed function enable signal. • The digital input must be activated to enable the timed function. 2...6 = DI2...DI6 – Defines digital input DI2...DI6 as the timed function enable signal. 7 = ACTIVE – Timed functions are enabled. -1 = DI1(INV) – Defines an inverted digital input DI1 as the timed function enable signal. • This digital input must be de-activated to enable the timed function. • -2...-6 = DI2(INV)...DI6(INV) – Defines an inverted digital input DI2...DI6 as the timed function enable signal.
3602	START TIME 1 Defines the daily start time. 20:30:00 • The time can be changed in steps of 2 seconds. • If parameter value is 07:00:00, the timer is activated at 7 a.m. • The figure shows multiple timers on different weekdays. 17:00:00 15:00:00 13:00:00 12:00:00 10:30:00 09:00:00 00:00:00 
3603	STOP TIME 1 Defines the daily stop time. • The time can be changed in steps of 2 seconds. • If the parameter value is 09:00:00, the timer is deactivated at 9 a.m.
3604	START DAY 1 Defines the weekly start day. 1 = MONDAY...7 = SUNDAY • If parameter value is 1, timer 1 weekly is active from Monday midnight (00:00:00).
3605	STOP DAY 1 Defines weekly stop day. 1 = MONDAY...7 = SUNDAY • If parameter value is 5, timer 1 weekly is deactivated on Friday midnight (23:59:58).
3606	START TIME 2 Defines timer2 daily start time. • See parameter 3602.
3607	STOP TIME 2 Defines timer 2 daily stop time. • See parameter 3603.
3608	START DAY 2 Defines timer 2 weekly start day. • See parameter 3604.
3609	STOP DAY 2 Defines timer 2 weekly stop day. • See parameter 3605.
3610	START TIME 3 Defines timer 3 daily start time. • See parameter 3602.
3611	STOP TIME 3 Defines timer 3 daily stop time. • See parameter 3603.

Code	Description
3612	START DAY 3 Defines timer 3 weekly start day. • See parameter 3604.
3613	STOP DAY 3 Defines timer 3 weekly stop day. • See parameter 3605.
3614	START TIME 4 Defines timer 4 daily start time. • See parameter 3602.
3615	STOP TIME 4 Defines timer 4 daily stop time. • See parameter 3603.
3616	START DAY 4 Defines timer 4 weekly start day. • See parameter 3604.
3617	STOP DAY 4 Defines timer 4 weekly stop day. • See parameter 3605.
3622	BOOSTER SEL Selects the source for the booster signal. 0 = NOT SEL – Booster signal is disabled. 1 = DI1 – Defines DI1 as the booster signal. 2...6 = DI2...DI6 – Defines DI2...DI6 as the booster signal. -1 = DI1(INV) – Defines an inverted digital input DI1 as the booster signal. -2...-6 = DI2(INV)...DI6(INV) – Defines an inverted digital input DI2...DI6 as the booster signal.
3623	BOOSTER TIME Defines the booster ON time. Time is started when booster sel signal is released. If parameter value is 01:30:00, booster is active for 1 hour and 30 minutes after activation DI is released. 
3626	TIMED FUNC 1 SRC Defines the time periods used by the timer. 0 = NOT SEL – No time periods have been selected. 1 = T1 – Time Period 1 selected in the timer. 2 = T2 – Time Period 2 selected in the timer. 3 = T1+T2 – Time Periods 1 and 2 selected in the timer. 4 = T3 – Time Period 3 selected in the timer. 5 = T1+T3 – Time Periods 1 and 3 selected in the timer. 6 = T2+T3 – Time Periods 2 and 3 selected in the timer. 7 = T1+T2+T3 – Time Periods 1, 2 and 3 selected in the timer. 8 = T4 – Time Period 4 selected in the timer. 9 = T1+T4 – Time Periods 1 and 4 selected in the timer. 10 = T2+T4 – Time Periods 2 and 4 selected in the timer. 11 = T1+T2+T4 – Time Periods 1, 2 and 4 selected in the timer. 12 = T3+T4 – Time Periods 3 and 4 selected in the timer. 13 = T1+T3+T4 – Time Periods 1, 3 and 4 selected in the timer. 14 = T2+T3+T4 – Time Periods 2, 3 and 4 selected in the timer. 15 = T1+T2+T3+T4 – Time Periods 1, 2, 3 and 4 selected in the timer. 16 = BOOSTER – Booster selected in the timer. 17 = T1+B – Booster and Time Period 1 selected in the timer. 18 = T2+B – Booster and Time Period 2 selected in the timer. 19 = T1+T2+B – Booster and Time Periods 1 and 2 selected in the timer. 20 = T3+B – Booster and Time Period 3 selected in the timer.

Code	Description
	21 = $T1+T3+B$ – Booster and Time Periods 1 and 3 selected in the timer. 22 = $T2+T3+B$ – Booster and Time Periods 2 and 3 selected in the timer. 23 = $T1+T2+T3+B$ – Booster and Time Periods 1, 2 and 3 selected in the timer. 24 = $T4+B$ – Booster and Time Period 4 selected in the timer. 25 = $T1+T4+B$ – Booster and Time Periods 1 and 4 selected in the timer. 26 = $T2+T4+B$ – Booster and Time Periods 2 and 4 selected in the timer. 27 = $T1+T2+T4+B$ – Booster and Time Periods 1, 2 and 4 selected in the timer. 28 = $T3+T4+B$ – Booster and Time Periods 3 and 4 selected in the timer. 29 = $T1+T3+T4+B$ – Booster and Time Periods 1, 3 and 4 selected in the timer. 30 = $T2+T3+T4+B$ – Booster and Time Periods 2, 3 and 4 selected in the timer. 31 = $T1+2+3+4+B$ – Booster and Time Periods 1, 2, 3 and 4 selected in the timer.
3627	TIMED FUNC 2 SRC • See parameter 3626.
3628	TIMED FUNC 3 SRC • See parameter 3626.
3629	TIMED FUNC 4 SRC • See parameter 3626.

Group 37: USER LOAD CURVE

This group defines supervision of user adjustable load curves (motor torque as a function of frequency). The curve is defined by five points.

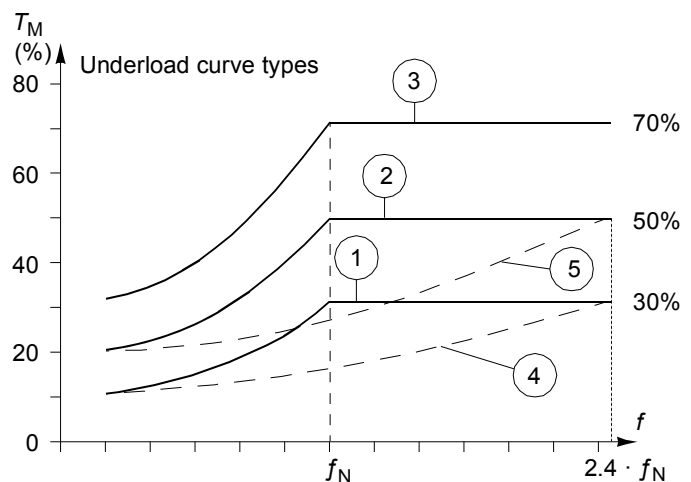
Code	Description
3701	USER LOAD C MODE Supervision mode for the user adjustable load curves. This functionality replaces the former underload supervision in Group 30: FAULT FUNCTIONS. To emulate it, see section Correspondence with the obsolete underload supervision on page 167. 0 = NOT SEL – Supervision is not active. 1 = UNDERLOAD – Supervision for the torque dropping below the underload curve. 2 = OVERLOAD – Supervision for the torque exceeding the overload curve. 3 = BOTH – Supervision for the torque dropping below the underload curve or exceeding the overload curve.
	The graph illustrates the motor torque supervision zones. The vertical axis represents Motor torque (%) and the horizontal axis represents Output frequency (Hz). Two curves are defined by five points each: P3705, P3708, P3711, P3712, and P3715 for the underload curve; and P3706, P3709, P3712, P3715, and P3718 for the overload curve. The area between the curves is labeled 'Allowed operating area'. The area below the underload curve is shaded and labeled 'Underload area'. The area above the overload curve is shaded and labeled 'Overload area'. The points P3704, P3707, P3710, P3713, and P3716 are marked on the frequency axis, corresponding to the points on the curves.
3702	USER LOAD C FUNC Action wanted during load supervision. 1 = FAULT – A fault is generated when the condition defined by 3701 USER LOAD C MODE has been valid longer than the time set by 3703 USER LOAD C TIME. 2 = ALARM – An alarm is generated when the condition defined by 3701 USER LOAD C MODE has been valid longer than half of the time defined by 3703 USER LOAD C TIME.
3703	USER LOAD C TIME Defines the time limit for generating a fault. Half of this time is used as the limit for generating an alarm.
3704	LOAD FREQ 1 Defines the frequency value of the first load curve definition point. Must be smaller than 3707 LOAD FREQ 2.
3705	LOAD TORQ LOW 1 Defines the torque value of the first underload curve definition point. Must be smaller than 3706 LOAD TORQ HIGH 1.
3706	LOAD TORQ HIGH 1 Defines the torque value of the first overload curve definition point.
3707	LOAD FREQ 2 Defines the frequency value of the second load curve definition point. Must be smaller than 3710 LOAD FREQ 3.
3708	LOAD TORQ LOW 2 Defines the torque value of the second underload curve definition point. Must be smaller than 3709 LOAD TORQ HIGH 2.
3709	LOAD TORQ HIGH 2 Defines the torque value of the second overload curve definition point.
3710	LOAD FREQ 3 Defines the frequency value of the third load curve definition point. Must be smaller than 3713 LOAD FREQ 4.
3711	LOAD TORQ LOW 3 Defines the torque value of the third underload curve definition point. Must be smaller than 3712 LOAD TORQ HIGH 3.
3712	LOAD TORQ HIGH 3 Defines the torque value of the third overload curve definition point.

Code	Description
3713	LOAD FREQ 4 Defines the frequency value of the fourth load curve definition point. • Must be smaller than 3716 LOAD FREQ 5
3714	LOAD TORQ LOW 4 Defines the torque value of the fourth underload curve definition point. • Must be smaller than 3715 LOAD TORQ HIGH 4.
3715	LOAD TORQ HIGH 4 Defines the torque value of the fourth overload curve definition point.
3716	LOAD FREQ 5 Defines the frequency value of fifth load curve definition point.
3717	LOAD TORQ LOW 5 Defines the torque value of the fifth underload curve definition point. • Must be smaller than 3718 LOAD TORQ HIGH 5.
3718	LOAD TORQ HIGH 5 Defines the torque value of the fifth overload curve definition point.

Correspondence with the obsolete underload supervision

The now obsolete parameter 3015 UNDERLOAD CURVE provided five selectable curves shown in the figure. The parameter characteristics were as described below.

- If the load drops below the set curve for longer than the time set by parameter 3014 UNDERLOAD TIME (obsolete), the underload protection is activated.
- Curves 1...3 reach maximum at the motor rated frequency set by parameter 9907 MOTOR NOM FREQ.
- T_M = nominal torque of the motor.
- f_N = nominal frequency of the motor.



If you want to emulate the behavior of an old underload curve with parameters as in the shaded columns, set the new parameters as in the white columns in the two tables below:

Underload supervision with parameters 3013...3015 (obsolete)	Obsolete parameters		New parameters		
	3013 UNDERLOAD FUNCTION	3014 UNDERLOAD TIME	3701 USER LOAD C MODE	3702 USER LOAD C FUNC	3703 USER LOAD C TIME
No underload functionality	0	-	0	-	-
Underload curve, fault generated	1	t	1	1	t
Underload curve, alarm generated	2	t	1	2	2 · t

Obs. par.	New parameters														
3015 UNDER LOAD CURVE	3704 LOAD FREQ 1 (Hz)		3705 LOAD TORQ LOW 1 (%)	3707 LOAD FREQ 2 (Hz)		3708 LOAD TORQ LOW 2 (%)	3710 LOAD FREQ 3 (Hz)		3711 LOAD TORQ LOW 3 (%)	3713 LOAD FREQ 4 (Hz)		3714 LOAD TORQ LOW 4 (%)	3716 LOAD FREQ 5 (Hz)		3717 LOAD TORQ LOW 5 (%)
	EU	US		EU	US		EU	US		EU	US		EU	US	
1	5	6	10	32	38	17	41	50	23	50	60	30	500	500	30
2	5	6	20	31	37	30	42	50	40	50	60	50	500	500	50
3	5	6	30	31	37	43	42	50	57	50	60	70	500	500	70
4	5	6	10	73	88	17	98	117	23	120	144	30	500	500	30
5	5	6	20	71	86	30	99	119	40	120	144	50	500	500	50

Group 40: PROCESS PID SET 1

This group defines a set of parameters used with the Process PID (PID1) controller.

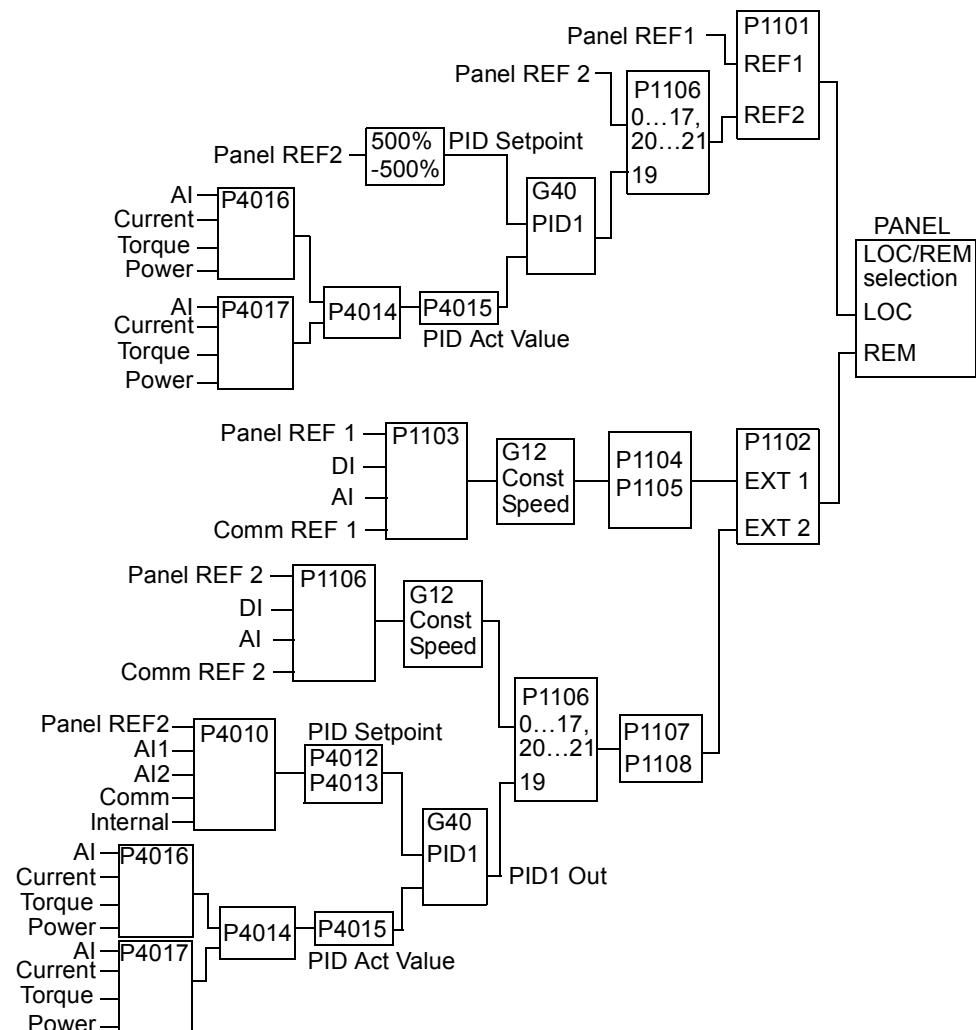
Typically only parameters in this group are needed.

PID controller – Basic set-up

In PID control mode, the drive compares a reference signal (setpoint) to an actual signal (feedback) and automatically adjusts the speed of the drive to match the two signals. The difference between the two signals is the error value.

Typically PID control mode is used, when the speed of a motor needs to be controlled based on pressure, flow or temperature. In most cases – when there is only 1 transducer signal wired to the ACS550 – only parameter group 40 is needed.

The following is a schematic of setpoint/feedback signal flow using parameter group 40.



Note: In order to activate and use the PID controller, parameter 1106 must be set to value 19.

PID controller – Advanced

The ACS550 has two separate PID controllers:

- Process PID (PID1) and
- External PID (PID2)

Process PID (PID1) has 2 separate sets of parameters:

- Process PID (PID1) SET1, defined in [Group 40: PROCESS PID SET 1](#) and
- Process PID (PID1) SET2, defined in [Group 41: PROCESS PID SET 2](#)

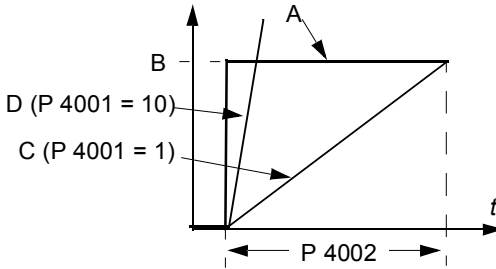
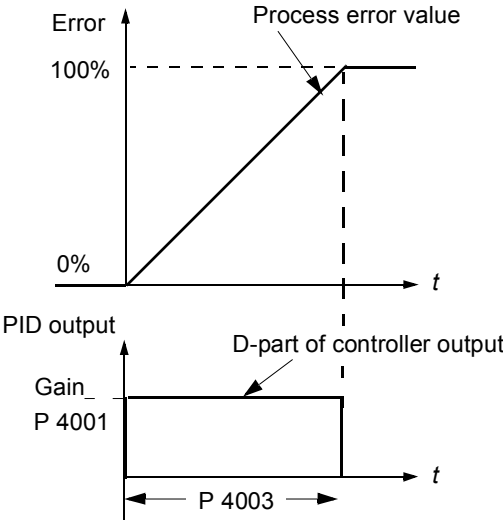
You can select between the two different sets by using parameter 4027.

Typically two different PID controller sets are used when the load of the motor changes considerably from one situation to another.

You can use External PID (PID2), defined in [Group 42: EXT / TRIM PID](#), in two different ways:

- Instead of using additional PID controller hardware, you can set outputs of the ACS550 to control a field instrument like a damper or a valve. In this case, set parameter 4230 to value 0. (0 is the default value.)
- You can use External PID (PID2) to trim or fine-tune the speed of the ACS550.

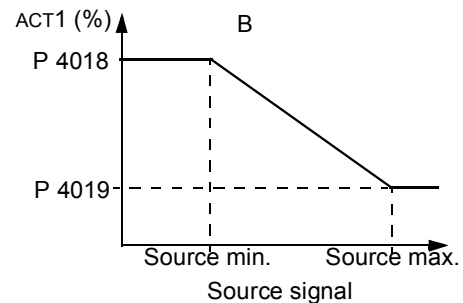
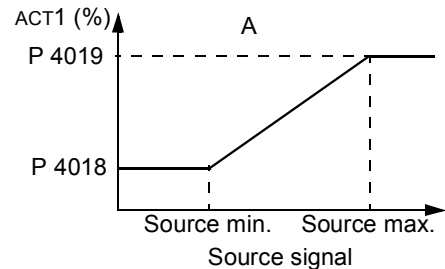
Code	Description
4001	GAIN Defines the PID controller's gain. • The setting range is 0.1... 100. • At 0.1, the PID controller output changes one-tenth as much as the error value. • At 100, the PID controller output changes one hundred times as much as the error value. Use the proportional gain and integration time values to adjust the responsiveness of the system. • A low value for proportional gain and a high value for integral time ensures stable operation, but provides sluggish response. If the proportional gain value is too large or the integral time too short, the system can become unstable. Procedure: • Initially, set: • 4001 GAIN = 0.1. • 4002 INTEGRATION TIME = 20 seconds. • Start the system and see if it reaches the setpoint quickly while maintaining stable operation. If not, increase GAIN (4001) until the actual signal (or drive speed) oscillates constantly. It may be necessary to start and stop the drive to induce this oscillation. • Reduce GAIN (4001) until the oscillation stops. • Set GAIN (4001) to 0.4 to 0.6 times the above value. • Decrease the INTEGRATION TIME (4002) until the feedback signal (or drive speed) oscillates constantly. It may be necessary to start and stop the drive to induce this oscillation. • Increase INTEGRATION TIME (4002) until the oscillation stops. • Set INTEGRATION TIME (4002) to 1.15 to 1.5 times the above value. • If the feedback signal contains high frequency noise, increase the value of parameter 1303 FILTER AI1 or 1306 FILTER AI2 until the noise is filtered from the signal.

Code	Description																		
4002	INTEGRATION TIME Defines the PID controller's integration time. Integration time is, by definition, the time required to increase the output by the error value: - Error value is constant and 100%. - Gain = 1. - Integration time of 1 second denotes that a 100% change is achieved in 1 second. 0.0 = NOT SEL – Disables integration (I-part of controller). 0.1...3600.0 – Integration time (seconds). - See 4001 for adjustment procedure.  A = Error B = Error value step C = Controller output with Gain = 1 D = Controller output with Gain = 10																		
4003	DERIVATION TIME Defines the PID controller's derivation time. - You can add the derivative of the error to the PID controller output. The derivative is the error value's rate of change. For example, if the process error value changes linearly, the derivative is a constant added to the PID controller output. - The error-derivative is filtered with a 1-pole filter. The time constant of the filter is defined by parameter 4004 PID DERIV FILTER. 0.0...10.0 – Derivation time (seconds).  Error 100% 0% t Process error value PID output Gain_ P 4001 D-part of controller output P 4003																		
4004	PID DERIV FILTER Defines the filter time constant for the error-derivative part of the PID controller output. - Before being added to the PID controller output, the error-derivative is filtered with a 1-pole filter. - Increasing the filter time smooths the error-derivative, reducing noise. 0.0...10.0 – Filter time constant (seconds).																		
4005	ERROR VALUE INV Selects either a normal or inverted relationship between the feedback signal and the drive speed. 0 = NO – Normal, a decrease in feedback signal increases drive speed. Error = Ref - Fbk 1 = YES – Inverted, a decrease in feedback signal decreases drive speed. Error = Fbk - Ref																		
4006	UNITS Selects the unit for the PID controller actual values. (PID1 parameters 0128, 0130 and 0132). See parameter 3405 for list of available units.																		
4007	UNIT SCALE Defines the decimal point location in PID controller actual values. - Enter the decimal point location counting in from the right end of the entry. - See the table for an example using pi (3.14159). <table><tr><th>4007 value</th><th>Entry</th><th>Display</th></tr><tr><td>0</td><td>00003</td><td>3</td></tr><tr><td>1</td><td>00031</td><td>3.1</td></tr><tr><td>2</td><td>00314</td><td>3.14</td></tr><tr><td>3</td><td>03142</td><td>3.142</td></tr><tr><td>4</td><td>31416</td><td>3.1416</td></tr></table>	4007 value	Entry	Display	0	00003	3	1	00031	3.1	2	00314	3.14	3	03142	3.142	4	31416	3.1416
4007 value	Entry	Display																	
0	00003	3																	
1	00031	3.1																	
2	00314	3.14																	
3	03142	3.142																	
4	31416	3.1416																	

Code	Description	
4008	0% VALUE Defines (together with the next parameter) the scaling applied to the PID controller's actual values (PID1 parameters 0128, 0130 and 0132). Units and scale are defined by parameters 4006 and 4007.	
4009	100% VALUE Defines (together with the previous parameter) the scaling applied to the PID controller's actual values. Units and scale are defined by parameters 4006 and 4007.	
4010	SET POINT SEL Defines the reference signal source for the PID controller. - Parameter has no significance when the PID regulator is by-passed (see 8121 REG BYPASS CTRL). 0 = KEYPAD – Control panel provides reference. 1 = AI1 – Analog input 1 provides reference. 2 = AI2 – Analog input 2 provides reference. 8 = COMM – Fieldbus provides reference. 9 = COMM+AI1 – Defines a fieldbus and analog input 1 (AI1) combination as the reference source. See Analog input reference correction below. 10 = COMM*AI1 – Defines a fieldbus and analog input 1 (AI1) combination as the reference source. See Analog input reference correction below. 11 = DI3U,4D(RNC) – Digital inputs, acting as a motor potentiometer control, provide reference. - DI3 increases the speed (the U stands for “up”) - DI4 decreases the reference (the D stands for “down”). - Parameter 2205 ACCELER TIME 2 controls the reference signal's rate of change. - R = Stop command resets the reference to zero. - NC = Reference value is not copied. 12 = DI3U,4D(NC) – Same as DI3U,4D(RNC) above, except: - Stop command does not reset reference to zero. At restart the motor ramps up, at the selected acceleration rate, to the stored reference. 13 = DI5U,6D(NC) – Same as DI3U,4D(NC) above, except: - Uses digital inputs DI5 and DI6. 14 = AI1+AI2 – Defines an analog input 1 (AI1) and analog input 2 (AI2) combination as the reference source. See Analog input reference correction below. 15 = AI1*AI2 – Defines an analog input 1 (AI1) and analog input 2 (AI2) combination as the reference source. See Analog input reference correction below. 16 = AI1-AI2 – Defines an analog input 1 (AI1) and analog input 2 (AI2) combination as the reference source. See Analog input reference correction below. 17 = AI1/AI2 – Defines an analog input 1 (AI1) and analog input 2 (AI2) combination as the reference source. See Analog input reference correction below. 19 = INTERNAL – A constant value set using parameter 4011 provides reference. 20 = PID2OUT – Defines PID controller 2 output (parameter 0127 PID 2 OUTPUT) as the reference source.	

Code	Description										
	Analog input reference correction Parameter values 9, 10 and 14...17 use the formula in the following table. <table border="1"> <thead> <tr> <th>Value setting</th><th>Calculation of the AI reference</th></tr> </thead> <tbody> <tr> <td>C + B</td><td>C value + (B value - 50% of reference value)</td></tr> <tr> <td>C * B</td><td>C value * (B value / 50% of reference value)</td></tr> <tr> <td>C - B</td><td>(C value + 50% of reference value) - B value</td></tr> <tr> <td>C / B</td><td>(C value * 50% of reference value) / B value</td></tr> </tbody> </table> Where: - C = Main reference value (= COMM for values 9, 10 and = AI1 for values 14...17) - B = Correcting reference (= AI1 for values 9, 10 and = AI2 for values 14...17). Example: The figure shows the reference source curves for value settings 9, 10 and 14...17, where: - C = 25%. - P 4012 SETPOINT MIN = 0. - P 4013 SETPOINT MAX = 0. - B varies along the horizontal axis.	Value setting	Calculation of the AI reference	C + B	C value + (B value - 50% of reference value)	C * B	C value * (B value / 50% of reference value)	C - B	(C value + 50% of reference value) - B value	C / B	(C value * 50% of reference value) / B value
Value setting	Calculation of the AI reference										
C + B	C value + (B value - 50% of reference value)										
C * B	C value * (B value / 50% of reference value)										
C - B	(C value + 50% of reference value) - B value										
C / B	(C value * 50% of reference value) / B value										
4011	INTERNAL SETPNT Sets a constant value used for the process reference. Units and scale are defined by parameters 4006 and 4007.										
4012	SETPOINT MIN Sets the minimum value for the reference signal source. See parameter 4010.										
4013	SETPOINT MAX Sets the maximum value for the reference signal source. See parameter 4010.										
4014	FBK SEL Defines the PID controller feedback (actual signal). - You can define a combination of two actual values (ACT1 and ACT2) as the feedback signal. - Use parameter 4016 to define the source for actual value 1 (ACT1). - Use parameter 4017 to define the source for actual value 2 (ACT2). 1 = ACT1 – Actual value 1 (ACT1) provides the feedback signal. 2 = ACT1-ACT2 – ACT1 minus ACT2 provides the feedback signal. 3 = ACT1+ACT2 – ACT1 plus ACT2 provides the feedback signal. 4 = ACT1*ACT2 – ACT1 times ACT2 provides the feedback signal. 5 = ACT1/ACT2 – ACT1 divided by ACT2 provides the feedback signal. 6 = MIN(ACT1,2) – The smaller of ACT1 or ACT2 provides the feedback signal. 7 = MAX(ACT1,2) – The greater of ACT1 or ACT2 provides the feedback signal. 8 = sqrt(ACT1-2) – Square root of the value for ACT1 minus ACT2 provides the feedback signal. 9 = sqA1+sqA2 – Square root of ACT1 plus the square root of ACT2 provides the feedback signal. 10 = sqrt(ACT1) – Square root of ACT1 provides the feedback signal. 11 = COMM FBK 1 – Signal 0158 PID COMM VALUE 1 provides the feedback signal. 12 = COMM FBK 2 – Signal 0159 PID COMM VALUE 2 provides the feedback signal. 13 = AVE(ACT1,2) – The average of ACT1 and ACT2 provides the feedback signal.										
4015	FBK MULTIPLIER Defines an extra multiplier for the PID feedback value FBK defined by parameter 4014. Used mainly in applications where the flow is calculated from the pressure difference. 0.000 = NOT SEL – The parameter has no effect (1.000 used as the multiplier). -32.768...32.767 – Multiplier applied to the signal defined by parameter 4014 FBK SEL. Example: FBK = Multiplier × $\sqrt{A1 - A2}$										

Code	Description																								
4016	ACT1 INPUT Defines the source for actual value 1 (ACT1). See also parameter 4018 ACT1 MINIMUM. 1 = AI1 – Uses analog input 1 for ACT1. 2 = AI2 – Uses analog input 2 for ACT1. 3 = CURRENT – Uses current for ACT1. 4 = TORQUE – Uses torque for ACT1. 5 = POWER – Uses power for ACT1. 6 = COMM ACT 1 – Uses value of signal 0158 PID COMM VALUE 1 for ACT1. 7 = COMM ACT 2 – Uses value of signal 0159 PID COMM VALUE 2 for ACT1.																								
4017	ACT2 INPUT Defines the source for actual value 2 (ACT2). See also parameter 4020 ACT2 MINIMUM. 1 = AI1 – Uses analog input 1 for ACT2. 2 = AI2 – Uses analog input 2 for ACT2. 3 = CURRENT – Uses current for ACT2. 4 = TORQUE – Uses torque for ACT2. 5 = POWER – Uses power for ACT2. 6 = COMM ACT 1 – Uses value of signal 0158 PID COMM VALUE 1 for ACT2. 7 = COMM ACT 2 – Uses value of signal 0159 PID COMM VALUE 2 for ACT2.																								
4018	ACT1 MINIMUM Sets the minimum value for ACT1. • Scales the source signal used as the actual value ACT1 (defined by parameter 4016 ACT1 INPUT). For parameter 4016 values 6 (COMM ACT 1) and 7 (COMM ACT 2) scaling is not done. <table><tr><th>Par 4016</th><th>Source</th><th>Source min.</th><th>Source max.</th></tr><tr><td>1</td><td>Analog input 1</td><td>1301 MINIMUM AI1</td><td>1302 MAXIMUM AI1</td></tr><tr><td>2</td><td>Analog input 2</td><td>1304 MINIMUM AI2</td><td>1305 MAXIMUM AI2</td></tr><tr><td>3</td><td>Current</td><td>0</td><td>2 · nominal current</td></tr><tr><td>4</td><td>Torque</td><td>-2 · nominal torque</td><td>2 · nominal torque</td></tr><tr><td>5</td><td>Power</td><td>-2 · nominal power</td><td>2 · nominal power</td></tr></table> • See the figure: A= Normal; B = Inversion (ACT1 MINIMUM > ACT1 MAXIMUM)	Par 4016	Source	Source min.	Source max.	1	Analog input 1	1301 MINIMUM AI1	1302 MAXIMUM AI1	2	Analog input 2	1304 MINIMUM AI2	1305 MAXIMUM AI2	3	Current	0	2 · nominal current	4	Torque	-2 · nominal torque	2 · nominal torque	5	Power	-2 · nominal power	2 · nominal power
Par 4016	Source	Source min.	Source max.																						
1	Analog input 1	1301 MINIMUM AI1	1302 MAXIMUM AI1																						
2	Analog input 2	1304 MINIMUM AI2	1305 MAXIMUM AI2																						
3	Current	0	2 · nominal current																						
4	Torque	-2 · nominal torque	2 · nominal torque																						
5	Power	-2 · nominal power	2 · nominal power																						
4019	ACT1 MAXIMUM Sets the maximum value for ACT1. • See 4018 ACT1 MINIMUM.																								
4020	ACT2 MINIMUM Sets the minimum value for ACT2. • See 4018 ACT1 MINIMUM.																								
4021	ACT2 MAXIMUM Sets the maximum value for ACT2. • See 4018 ACT1 MINIMUM.																								
4022	SLEEP SELECTION Defines the control for the PID sleep function. 0 = NOT SEL– Disables the PID sleep control function. 1 = DI1 – Defines digital input DI1 as the control for the PID sleep function. • Activating the digital input activates the sleep function. • De-activating the digital input restores PID control. 2...6 = DI2...DI6 – Defines digital input DI2...DI6 as the control for the PID sleep function. • See DI1 above. 7 = INTERNAL – Defines the output rpm/frequency, process reference and process actual value as the control for the PID sleep function. Refer to parameters 4025 WAKE-UP DEV and 4023 PID SLEEP LEVEL. -1 = DI1(INV) – Defines an inverted digital input DI1 as the control for the PID sleep function. • De-activating the digital input activates the sleep function. • Activating the digital input restores PID control. -2...-6 = DI2(INV)...DI6(INV) – Defines an inverted digital input DI2...DI6 as the control for the PID sleep function. • See DI1(INV) above.																								



Code	Description	
4023	PID SLEEP LEVEL Sets the motor speed / frequency that enables the PID sleep function – a motor speed / frequency below this level, for at least the time period 4024 PID SLEEP DELAY enables the PID sleep function (stopping the drive). - Requires 4022 = 7 (INTERNAL). - See the figure: A = PID output level; B = PID process feedback.	
4024	PID SLEEP DELAY Sets the time delay for the PID sleep function – a motor speed / frequency below 4023 PID SLEEP LEVEL for at least this time period enables the PID sleep function (stopping the drive). See 4023 PID SLEEP LEVEL above.	
4025	WAKE-UP DEV Defines the wake-up deviation – a deviation from the setpoint greater than this value, for at least the time period 4026 WAKE-UP DELAY, re-starts the PID controller. - Parameters 4006 and 4007 define the units and scale. - Parameter 4005 = 0, Wake-up level = Setpoint - Wake-up deviation. - Parameter 4005 = 1, Wake-up level = Setpoint + Wake-up deviation. - Wake-up level can be above or below setpoint. See the figures: - C = Wake-up level when parameter 4005 = 1 - D = Wake-up level when parameter 4005 = 0 - E = Feedback is above wake-up level and lasts longer than 4026 WAKE-UP DELAY – PID function wakes up. - F = Feedback is below wake-up level and lasts longer than 4026 WAKE-UP DELAY – PID function wakes up.	
4026	WAKE-UP DELAY Defines the wake-up delay – a deviation from the setpoint greater than 4025 WAKE-UP DEV, for at least this time period, re-starts the PID controller.	

Code	Description
4027	PID 1 PARAM SET Process PID (PID1) has two separate sets of parameters, PID set 1 and PID set 2. • PID set 1 uses parameters 4001...4026. • PID set 2 uses parameters 4101...4126. PID 1 PARAM SET defines which set is selected. 0 = SET 1 – PID Set 1 (parameters 4001...4026) is active. 1 = DI1 – Defines digital input DI1 as the control for PID Set selection. • Activating the digital input selects PID Set 2. • De-activating the digital input selects PID Set 1. 2...6 = DI2...DI6 – Defines digital input DI2...DI6 as the control for PID Set selection. • See DI1 above. 7 = SET 2 – PID Set 2 (parameters 4101...4126) is active. 8...11 = TIMED FUNC 1...4 – Defines the Timed function as the control for the PID Set selection (Timed function de-activated = PID Set 1; Timed function activated = PID Set 2) • See Group 36: TIMED FUNCTIONS. 12 = 2-ZONE MIN – The drive calculates the difference between setpoint 1 and feedback 1 as well as setpoint 2 and feedback 2. The drive will control the zone (and select the set) that has a larger difference. • A positive difference (a setpoint higher than the feedback) is always larger than a negative difference. This keeps feedback values at or above the setpoint. • Controller does not react to the situation of feedback above setpoint if another zone's feedback is closer to its setpoint. 13 = 2-ZONE MAX – The drive calculates the difference between setpoint 1 and feedback 1 as well as setpoint 2 and feedback 2. The drive will control the zone (and select the set) that has a smaller difference. • A negative difference (a setpoint lower than the feedback) is always smaller than a positive difference. This keeps feedback values at or below the setpoint. • Controller does not react to the situation of feedback below setpoint if another zone's feedback is closer to its setpoint. 14 = 2-ZONE AVE – The drive calculates the difference between setpoint 1 and feedback 1 as well as setpoint 2 and feedback 2. In addition, it calculates the average of the deviations and uses it to control zone 1. Therefore one feedback is kept above its setpoint and another is kept as much below its setpoint. -1 = DI1(INV) – Defines an inverted digital input DI1 as the control for PID Set selection. • Activating the digital input selects PID Set 1. • De-activating the digital input selects PID Set 2. -2...-6 = DI2(INV)...DI6(INV) – Defines an inverted digital input DI2...DI6 as the control for PID Set selection. • See DI1(INV) above.

Group 41: PROCESS PID SET 2

Parameters of this group belong to PID parameter set 2. The operation of parameters 4101...4126 is analogous with set 1 parameters 4001...4026.

PID parameter set 2 can be selected by parameter 4027 PID 1 PARAM SET.

Code	Description
4101 ... 4126	See 4001 ...4026

Group 42: EXT / TRIM PID

This group defines the parameters used for the second PID controller (PID2), which is used for the External / Trimming PID.

The operation of parameters 4201...4221 is analogous with Process PID set 1 (PID1) parameters 4001...4021.

Code	Description
4201 ... 4221	See 4001 ...4021
4228	ACTIVATE Defines the source for enabling the external PID function. - Requires 4230 TRIM MODE = 0 (NOT SEL). 0 = NOT SEL – Disables external PID control. 1 = DI1 – Defines digital input DI1 as the control for enabling external PID control. - Activating the digital input enables external PID control. - De-activating the digital input disables external PID control. 2...6 = DI2...DI6 – Defines digital input DI2...DI6 as the control for enabling external PID control. - See DI1 above. 7 = DRIVE RUN – Defines the start command as the control for enabling external PID control. - Activating the start command (drive is running) enables external PID control. 8 = ON – Defines the power-on as the control for enabling external PID control. - Activating power to the drive enables external PID control. 9...12 = TIMED FUNC 1...4 – Defines the Timed function as the control for enabling external PID control (Timed function active enables external PID control). - See Group 36: TIMED FUNCTIONS. -1 = DI1(INV) – Defines an inverted digital input DI1 as the control for enabling external PID control. - Activating the digital input disables external PID control. - De-activating the digital input enables external PID control. -2...-6 = DI2(INV)...DI6(INV) – Defines an inverted digital input DI2...DI6 as the control for enabling external PID control. - See DI1(INV) above.
4229	OFFSET Defines the offset for the PID output. - When PID is activated, output starts from this value. - When PID is deactivated, output resets to this value. - Parameter is active when 4230 TRIM MODE = 0 (trim mode is not active).
4230	TRIM MODE Selects the type of trim, if any. Using the trim it is possible to combine a corrective factor to the drive reference. 0 = NOT SEL – Disables the trim function. 1 = PROPORTIONAL – Adds a trim factor that is proportional to the rpm/Hz reference. 2 = DIRECT – Adds a trim factor based on the control loop's maximum limit.
4231	TRIM SCALE Defines the multiplier (as a percent, plus or minus) used in the trim mode.

Code	Description
4232	CORRECTION SRC Defines the trimming reference for the correction source. 1 = PID2REF – Uses appropriate REF MAX (SWITCH A OR B): • 1105 REF1 MAX when REF1 is active (A). • 1108 REF2 MAX when REF2 is active (B). 2 = PID2OUTPUT – Uses the absolute maximum speed or frequency (Switch C): • 2002 MAXIMUM SPEED if 9904 MOTOR CTRL MODE = 1 (VECTOR:SPEED) or 2 (VECTOR:TORQ). • 2008 MAXIMUM FREQ if 9904 MOTOR CTRL MODE = 3 (SCALAR:FREQ).

Group 45: ENERGY SAVING

This group defines the setup of calculation and optimization of energy savings.

Note: The values of saved energy parameters 0174 SAVED KWH, 0175 SAVED MWH, 0176 SAVED AMOUNT 1, 0177 SAVED AMOUNT 2 and 0178 SAVED CO2 are derived from subtracting the drive's energy consumed from the direct-on-line (DOL) consumption calculated on the basis of parameter 4508 PUMP POWER. As such, the accuracy of the values is dependent on the accuracy of the power estimate entered in that parameter.

Code	Description
4502	ENERGY PRICE Price of energy per kWh. • Used for reference when energy savings are calculated. • See parameters 0174 SAVED KWH, 0175 SAVED MWH, 0176 SAVED AMOUNT 1, 0177 SAVED AMOUNT 2 and 0178 SAVED CO2 (reduction on carbon dioxide emissions in tn).
4507	CO2 CONV FACTOR Conversion factor for converting energy into CO2 emissions (kg/kWh or tn/MWh). Used for multiplying the saved energy in MWh to calculate the value of parameter 0178 SAVED CO2 (reduction on carbon dioxide emissions in tn).
4508	PUMP POWER Pump power (as a percentage of the nominal motor power) when connected directly to supply (DOL). • Used for reference when energy savings are calculated. • See parameters 0174 SAVED KWH, 0175 SAVED MWH, 0176 SAVED AMOUNT 1, 0177 SAVED AMOUNT 2 and 0178 SAVED CO2. • It is possible to use this parameter as the reference power also for other applications than pumps. The reference power can also be some other constant power than a motor connected directly online.
4509	ENERGY RESET Resets energy calculators 0174 SAVED KWH, 0175 SAVED MWH, 0176 SAVED AMOUNT 1, 0177 SAVED AMOUNT 2 and 0178 SAVED CO2.

Group 50: ENCODER

This group defines the setup for encoder use:

- Sets the number of encoder pulses per shaft revolution.
- Enables the encoder operation.
- Defines how mechanical angle and revolution data is reset.

See also *User's Manual for Pulse Encoder Interface Module OTAC-01* (3AUA0000001938 [English]).

Code	Description
5001	PULSE NR Sets the number of pulses provided by an optional encoder for each full motor shaft revolution (ppr).
5002	ENCODER ENABLE Enables/disables an optional encoder. 0 = DISABLE – Drive uses speed feedback derived from the internal motor model (applies for any setting of parameter 9904 MOTOR CTRL MODE). 1 = ENABLE – Drive uses feedback from an optional encoder. This function requires the Pulse Encoder Interface Module (OTAC-01) and an encoder. Operation depends on the setting of parameter 9904 MOTOR CTRL MODE: • 9904 = 1 (VECTOR:SPEED): The encoder provides improved speed feedback and improved low speed torque accuracy. • 9904 = 2 (VECTOR:TORQ): The encoder provides improved speed feedback and improved low speed torque accuracy. • 9904 = 3 (SCALAR:SPEED): The encoder provides speed feedback. (This is not closed loop speed regulation. However, using parameter 2608 SLIP COMP RATIO and an encoder improves steady state speed accuracy.)
5003	ENCODER FAULT Defines the drive operation if a failure is detected in communication between the encoder and the encoder interface module, or between the module and the drive. 1 = FAULT – The drive generates fault ENCODER ERR, and the motor coasts to a stop. 2 = ALARM – The drive generates alarm ENCODER ERR and operates as if parameter 5002 ENCODER ENABLE = 0 (DISABLE), that is, speed feedback is derived from the internal motor model.
5010	Z PLS ENABLE Enables/disables the use of an encoder's Z-pulse to define the motor shaft's zero position. When enabled, a Z-pulse input resets parameter 0146 MECH ANGLE to zero to define the shaft's zero position. This function requires an encoder that provides Z-pulse signals. 0 = DISABLE – Z-pulse input is not present or ignored if present. 1 = ENABLE – A Z-pulse input resets parameter 0146 MECH ANGLE to zero.
5011	POSITION RESET Resets the encoder's position feedback. This parameter is self-clearing. 0 = DISABLE – Inactive. 1 = ENABLE – Resets the encoder position feedback. Parameters reset depends on the state of parameter 5010 Z PLS ENABLE: • 5010 = 0 (DISABLE) – Reset applies to parameters 0147 MECH REVS and 0146 MECH ANGLE. • 5010 = 1 (ENABLE) – Reset applies only to parameter 0147 MECH REVS.

Group 51: EXT COMM MODULE

This group defines set-up variables for a fieldbus adapter (FBA) communication module. For more information on these parameters, refer to the user's manual supplied with the FBA module.

Code	Description
5101	FBA TYPE Displays the type of the connected fieldbus adapter module. 0 = NOT DEFINED – Module not found, or not properly connected, or parameter 9802 is not set to 4 (EXT FBA). 1 = PROFIBUS-DP 21 = LONWORKS 32 = CANopen 37 = DEVICENET 101 = CONTROLNET 128 = ETHERNET 132 = PROFINET 135 = EtherCAT 136 = EPL – Ethernet POWERLINK
5102 ... 5126	FB PAR 2...FB PAR 26 Refer to communication module documentation for more information on these parameters.
5127	FBA PAR REFRESH Validates any changed fieldbus parameter settings. 0 = DONE – Refreshing done. 1 = REFRESH – Refreshing. • After refreshing, the value reverts automatically to DONE.
5128	FILE CPI FW REV Displays the CPI firmware revision of the drive's fieldbus adapter configuration file. Format is xyz where: • x = major revision number • y = minor revision number • z = correction number Example: 107 = revision 1.07
5129	FILE CONFIG ID Displays the revision of the drive's fieldbus adapter module's configuration file identification. • File configuration information is drive application program-dependent.
5130	FILE CONFIG REV Contains the revision of the drive's fieldbus adapter module configuration file. Example: 1 = revision 1
5131	FBA STATUS Contains the status of the adapter module. 0 = IDLE – Adapter not configured. 1 = EXECUT INIT – Adapter is initializing. 2 = TIME OUT – A timeout has occurred in the communication between the adapter and the drive. 3 = CONFIG ERROR – Adapter configuration error. • The revision code of the adapter's CPI firmware revision is older than required CPI firmware version defined in the drive's configuration file (parameter 5132 < 5128). 4 = OFF-LINE – Adapter is off-line. 5 = ON-LINE – Adapter is on-line. 6 = RESET – Adapter is performing a hardware reset.
5132	FBA CPI FW REV Contains the revision of the module's CPI program. Format is xyz where: • x = major revision number • y = minor revision number • z = correction number Example: 107 = revision 1.07
5133	FBA APPL FW REV Contains the revision of the module's application program. Format is xyz (see parameter 5132).

Group 52: PANEL COMM

This group defines the communication settings for the control panel port on the drive. Normally, when using the supplied control panel, there is no need to change settings in this group.

In this group, parameter modifications take effect on the next power-up.

Code	Description
5201	STATION ID Defines the address of the drive. - Two units with the same address are not allowed on-line. - Range: 1...247
5202	BAUD RATE Defines the communication speed of the drive in kbits per second (kb/s). 9.6 kb/s 19.2 kb/s 38.4 kb/s 57.6 kb/s 115.2 kb/s
5203	PARITY Sets the character format to be used with the panel communication. 0 = 8 NONE 1 – 8 data bits, no parity, one stop bit. 1 = 8 NONE 2 – 8 data bits, no parity, two stop bits. 2 = 8 EVEN 1 – 8 data bits, even parity, one stop bit. 3 = 8 ODD 1 – 8 data bits, odd parity, one stop bit.
5204	OK MESSAGES Contains a count of valid Modbus messages received by the drive. During normal operation, this counter is increasing constantly.
5205	PARITY ERRORS Contains a count of the characters with a parity error that is received from the bus. For high counts, check: - Parity settings of devices connected on the bus – they must not differ. - Ambient electro-magnetic noise levels – high noise levels generate errors.
5206	FRAME ERRORS Contains a count of the characters with a framing error that the bus receives. For high counts, check: - Communication speed settings of devices connected on the bus – they must not differ. - Ambient electro-magnetic noise levels – high noise levels generate errors.
5207	BUFFER OVERRUNS Contains a count of the characters received that cannot be placed in the buffer. - Longest possible message length for the drive is 128 bytes. - Received messages exceeding 128 bytes overflow the buffer. The excess characters are counted.
5208	CRC ERRORS Contains a count of the messages with a CRC error that the drive receives. For high counts, check: - Ambient electro-magnetic noise levels – high noise levels generate errors. - CRC calculations for possible errors.

Group 53: EFB PROTOCOL

This group defines set-up variables used for an embedded fieldbus (EFB) communication protocol. The standard EFB protocol in the ACS550 is Modbus. See chapter [Embedded fieldbus](#) page 203.

Code	Description
5301	EFB PROTOCOL ID Contains the identification and program revision of the protocol. • Format: XXYY, where xx = protocol ID, and YY = program revision.
5302	EFB STATION ID Defines the node address of the RS485 link. • The node address on each unit must be unique.
5303	EFB BAUD RATE Defines the communication speed of the RS485 link in kbits per second (kb/s). 1.2 kb/s 2.4 kb/s 4.8 kb/s 9.6 kb/s 19.2 kb/s 38.4 kb/s 57.6 kb/s 76.8 kb/s
5304	EFB PARITY Defines the data length, parity and stop bits to be used with the RS485 link communication. • The same settings must be used in all on-line stations. 0 = 8 NONE 1 – 8 data bits, no parity, one stop bit. 1 = 8 NONE 2 – 8 data bits, no parity, two stop bits. 2 = 8 EVEN 1 – 8 data bits, even parity, one stop bit. 3 = 8 ODD 1 – 8 data bits, odd parity, one stop bit.
5305	EFB CTRL PROFILE Selects the communication profile used by the EFB protocol. 0 = ABB DRV LIM – Operation of Control/Status Words conforms to ABB Drives Profile, as used in ACS400. 1 = DCU PROFILE – Operation of Control/Status Words conforms to 32-bit DCU Profile. 2 = ABB DRV FULL – Operation of Control/Status Words conforms to ABB Drives Profile, as used in ACS600/800.
5306	EFB OK MESSAGES Contains a count of valid messages received by the drive. • During normal operation, this counter is increasing constantly.
5307	EFB CRC ERRORS Contains a count of the messages with a CRC error received by the drive. For high counts, check: • Ambient electro-magnetic noise levels – high noise levels generate errors. • CRC calculations for possible errors.
5308	EFB UART ERRORS Contains a count of the messages with a character error received by the drive.
5309	EFB STATUS Contains the status of the EFB protocol. 0 = IDLE – EFB protocol is configured, but not receiving any messages. 1 = EXECUT INIT – EFB protocol is initializing. 2 = TIME OUT – A timeout has occurred in the communication between the network master and the EFB protocol. 3 = CONFIG ERROR – EFB protocol has a configuration error. 4 = OFF-LINE – EFB protocol is receiving messages that are NOT addressed to this drive. 5 = ON-LINE – EFB protocol is receiving messages that are addressed to this drive. 6 = RESET – EFB protocol is performing a hardware reset. 7 = LISTEN ONLY – EFB protocol is in listen-only mode.
5310	EFB PAR 10 Specifies the parameter mapped to Modbus Register 40005.

Code	Description
5311	EFB PAR 11 Specifies the parameter mapped to Modbus Register 40006.
5312	EFB PAR 12 Specifies the parameter mapped to Modbus Register 40007.
5313	EFB PAR 13 Specifies the parameter mapped to Modbus Register 40008.
5314	EFB PAR 14 Specifies the parameter mapped to Modbus Register 40009.
5315	EFB PAR 15 Specifies the parameter mapped to Modbus Register 40010.
5316	EFB PAR 16 Specifies the parameter mapped to Modbus Register 40011.
5317	EFB PAR 17 Specifies the parameter mapped to Modbus Register 40012.
5318	EFB PAR 18 For Modbus: Sets additional delay in milliseconds before the ACS550 begins transmitting response to the master request.
5319	EFB PAR 19 ABB Drives profile (ABB DRV LIM or ABB DRV FULL) Control Word. Read only copy of the Fieldbus Control Word.
5320	EFB PAR 20 ABB Drives profile (ABB DRV LIM or ABB DRV FULL) Status Word. Read only copy of the Fieldbus Status Word.

Group 64: LOAD ANALYZER

This group defines the load analyzer, which can be used for analyzing the customer's process and sizing the drive and the motor.

The peak value is logged at 2 ms level, and the distribution loggers are updated on 0.2 s (200 ms) time level. Three different values can be logged.

1. Amplitude logger 1: The measured current is logged continuously. The distribution as a percentage of the nominal current I_{2N} is shown in ten classes.
2. Peak value logger: One signal in group 1 can be logged for the peak (maximum) value. The peak value of the signal, peak time (time when the peak value was detected) as well the frequency, current and DC voltage at the peak time are shown.
3. Amplitude logger 2: One signal in group 1 can be logged for amplitude distribution. The base value (100% value) can be set by the user.

The first logger cannot be reset. The other two loggers can be reset by a user-defined method. They are also reset if either of the signals or the peak value filter time is changed.

Code	Description
6401	PVL SIGNAL Defines (by number) the signal logged for the peak value. - Any parameter number in Group 01: OPERATING DATA can be selected. Eg 102 = parameter 0102 SPEED. 100 = NOT SELECTED – No signal (parameter) logged for the peak value. 101...178 – Logs parameter 0101...0178.
6402	PVL FILTER TIME Defines the filter time for peak value logging. 0.0...120.0 – Filter time (seconds).
6403	LOGGERS RESET Defines the source for the reset of peak value logger and amplitude logger 2. 0 = NOT SEL – No reset selected. 1 = DI1 – Reset loggers on the rising edge of digital input DI1. 2...6 = DI2...DI6 – Reset loggers on the rising edge of digital input DI2...DI6. 7 = RESET – Reset loggers. Parameter is set to NOT SEL. -1 = DI1(INV) – Reset loggers on the falling edge of digital input DI1. -2...-6 = DI2(INV) ...DI6(INV) – Reset loggers on the falling edge of digital input DI2...DI6.
6404	AL2 SIGNAL Defines the signal logged for amplitude logger 2. - Any parameter number in Group 01: OPERATING DATA can be selected. Eg 102 = parameter 0102 SPEED. 100 = NOT SELECTED – No signal (parameter) logged for amplitude distribution (amplitude logger 2). 101...178 – Logs parameter 0101...0178.
6405	AL2 SIGNAL BASE Defines the base value from which the percentage distribution is calculated. Representation and default value depends on the signal selected with parameter 6404 AL2 SIGNAL.
6406	PEAK VALUE Detected peak value of the signal selected with parameter 6401 PVL SIGNAL.
6407	PEAK TIME 1 Date of the peak value detection. Format: Date if the real time clock is operating (dd.mm.yy). / The number of days elapsed after the power-on if the real time clock is not used, or was not set (xx d).
6408	PEAK TIME 2 Time of the peak value detection. Format: hours:minutes:seconds.

Code	Description
6409	CURRENT AT PEAK Current at the moment of the peak value (amperes).
6410	UDC AT PEAK DC voltage at the moment of the peak value (volts).
6411	FREQ AT PEAK Output frequency at the moment of the peak value (herzes).
6412	TIME OF RESET 1 Last reset date of the peak logger and amplitude logger 2. • Format: Date if the real time clock is operating (dd.mm.yy). / The number of days elapsed after the power-on if the real time clock is not used, or was not set (xx d).
6413	TIME OF RESET 2 Last reset time of the peak logger and amplitude logger 2. • Format: hours:minutes:seconds.
6414	AL1RANGE0TO10 Amplitude logger 1 (current in percent of nominal current I_{2N}) 0...10% distribution.
6415	AL1RANGE10TO20 Amplitude logger 1 (current in percent of nominal current I_{2N}) 10...20% distribution.
6416	AL1RANGE20TO30 Amplitude logger 1 (current in percent of nominal current I_{2N}) 20...30% distribution.
6417	AL1RANGE30TO40 Amplitude logger 1 (current in percent of nominal current I_{2N}) 30...40% distribution.
6418	AL1RANGE40TO50 Amplitude logger 1 (current in percent of nominal current I_{2N}) 40...50% distribution.
6419	AL1RANGE50TO60 Amplitude logger 1 (current in percent of nominal current I_{2N}) 50...60% distribution.
6420	AL1RANGE60TO70 Amplitude logger 1 (current in percent of nominal current I_{2N}) 60...70% distribution.
6421	AL1RANGE70TO80 Amplitude logger 1 (current in percent of nominal current I_{2N}) 70...80% distribution.
6422	AL1RANGE80TO90 Amplitude logger 1 (current in percent of nominal current I_{2N}) 80...90% distribution.
6423	AL1RANGE90TO Amplitude logger 1 (current in percent of nominal current I_{2N}) over 90% distribution.
6424	AL2RANGE0TO10 Amplitude logger 2 (signal selection with parameter 6404) 0...10% distribution.
6425	AL2RANGE10TO20 Amplitude logger 2 (signal selection with parameter 6404) 10...20% distribution.
6426	AL2RANGE20TO30 Amplitude logger 2 (signal selection with parameter 6404) 20...30% distribution.
6427	AL2RANGE30TO40 Amplitude logger 2 (signal selection with parameter 6404) 30...40% distribution.
6428	AL2RANGE40TO50 Amplitude logger 2 (signal selection with parameter 6404) 40...50% distribution.
6429	AL2RANGE50TO60 Amplitude logger 2 (signal selection with parameter 6404) 50...60% distribution.
6430	AL2RANGE60TO70 Amplitude logger 2 (signal selection with parameter 6404) 60...70% distribution.
6431	AL2RANGE70TO80 Amplitude logger 2 (signal selection with parameter 6404) 70...80% distribution.

Code	Description
6432	AL2RANGE80TO90 Amplitude logger 2 (signal selection with parameter 6404) 80...90% distribution.
6433	AL2RANGE90TO Amplitude logger 2 (signal selection with parameter 6404) over 90% distribution.

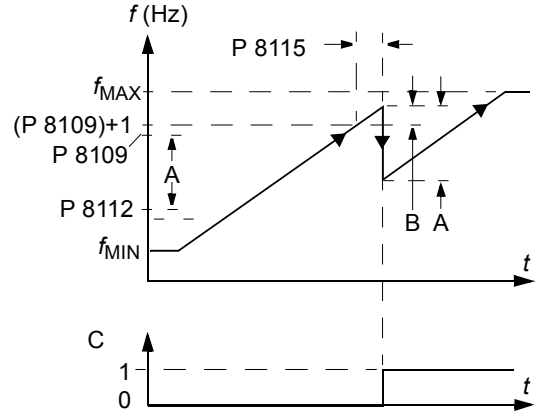
Group 81: PFC CONTROL

This group defines a Pump-Fan Control (PFC) mode of operation. The major features of PFC control are:

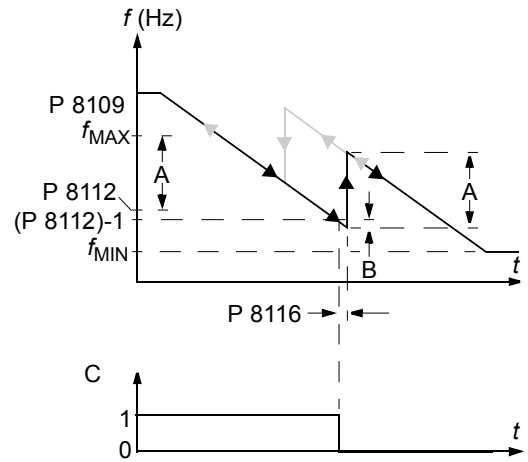
- The ACS550 controls the motor of pump no. 1, varying the motor speed to control the pump capacity. This motor is the speed regulated motor.
- Direct line connections power the motor of pump no. 2 and pump no.3, etc. The ACS550 switches pump no. 2 (and then pump no. 3, etc.) on and off as needed. These motors are auxiliary motors.
- The ACS550 PID control uses two signals: a process reference and an actual value feedback. The PID controller adjusts the speed (frequency) of the first pump such that the actual value follows the process reference.
- When demand (defined by the process reference) exceeds the first motor's capacity (user defined as a frequency limit), the PFC control automatically starts an auxiliary pump. The PFC also reduces the speed of the first pump to account for the auxiliary pump's addition to total output. Then, as before, the PID controller adjusts the speed (frequency) of the first pump such that the actual value follows the process reference. If demand continues to increase, PFC adds additional auxiliary pumps, using the same process.
- When demand drops, such that the first pump speed falls below a minimum limit (user defined by a frequency limit), the PFC control automatically stops an auxiliary pump. The PFC also increases the speed of the first pump to account for the auxiliary pump's missing output.
- An Interlock function (when enabled) identifies off-line (out of service) motors, and the PFC control skips to the next available motor in the sequence.
- An Autochange function (when enabled and with the appropriate switchgear) equalizes duty time between the pump motors. Autochange periodically increments the position of each motor in the rotation – the speed regulated motor becomes the last auxiliary motor, the first auxiliary motor becomes the speed regulated motor, etc.

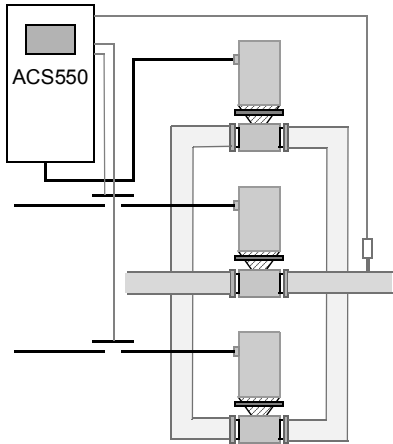
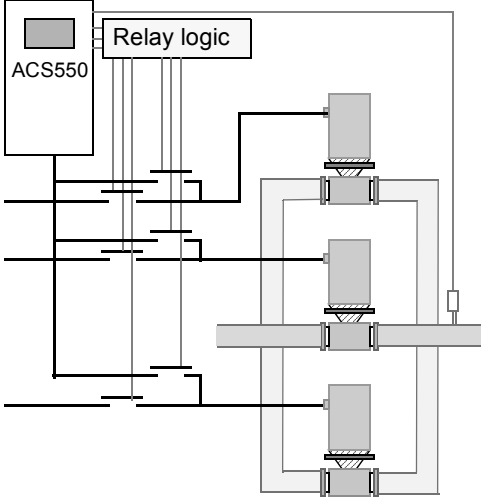
Code	Description
8103	REFERENCE STEP 1 Sets a percentage value that is added to the process reference. • Applies only when <u>at least one</u> auxiliary (constant speed) motor is running. • Default value is 0%. Example: An ACS550 operates three parallel pumps that maintain water pressure in a pipe. • 4011 INTERNAL SETPNT sets a constant pressure reference that controls the pressure in the pipe. • The speed regulated pump operates alone at low water consumption levels. • As water consumption increases, first one constant speed pump operates, then, the second. • As flow increases, the pressure at the output end of the pipe drops relative to the pressure measured at the input end. As auxiliary motors step in to increase the flow, the adjustments below correct the reference to more closely match the output pressure. • When the first auxiliary pump operates, increase the reference with parameter 8103 REFERENCE STEP 1. • When two auxiliary pumps operate, increase the reference with parameter 8103 REFERENCE STEP 1 + parameter 8104 REFERENCE STEP 2. • When three auxiliary pumps operate, increase the reference with parameter 8103 REFERENCE STEP 1 + parameter 8104 REFERENCE STEP 2 + parameter 8105 REFERENCE STEP 3.

Code	Description
8104	REFERENCE STEP 2 Sets a percentage value that is added to the process reference. • Applies only when <u>at least two</u> auxiliary (constant speed) motors are running. • See parameter 8103 REFERENCE STEP 1.
8105	REFERENCE STEP 3 Sets a percentage value that is added to the process reference. • Applies only when <u>at least three</u> auxiliary (constant speed) motors are running. • See parameter 8103 REFERENCE STEP 1.
8109	START FREQ 1 Sets the frequency limit used to start the first auxiliary motor. The first auxiliary motor starts if: • No auxiliary motors are running. • ACS550 output frequency exceeds the limit: $8109 + 1$ Hz. • Output frequency stays above a relaxed limit ($8109 - 1$ Hz) for at least the time: 8115 AUX MOT START D. After the first auxiliary motor starts: • Output frequency decreases by the value = $(8109 \text{ START FREQ } 1) - (8112 \text{ LOW FREQ } 1)$. • In effect, the output of the speed regulated motor drops to compensate for the input from the auxiliary motor. See the figure, where: • A = $(8109 \text{ START FREQ } 1) - (8112 \text{ LOW FREQ } 1)$ • B = Output frequency increase during the start delay. • C = Diagram showing auxiliary motor's run status as frequency increases (1 = On). Note: 8109 START FREQ 1 value must be between: • 8112 LOW FREQ 1 • $(2008 \text{ MAXIMUM FREQ}) - 1$.
8110	START FREQ 2 Sets the frequency limit used to start the second auxiliary motor. • See 8109 START FREQ 1 for a complete description of the operation. The second auxiliary motor starts if: • One auxiliary motor is running. • ACS550 output frequency exceeds the limit: $8110 + 1$. • Output frequency stays above the relaxed limit ($8110 - 1$ Hz) for at least the time: 8115 AUX MOT START D.
8111	START FREQ 3 Sets the frequency limit used to start the third auxiliary motor. • See 8109 START FREQ 1 for a complete description of the operation. The third auxiliary motor starts if: • Two auxiliary motors are running. • ACS550 output frequency exceeds the limit: $8111 + 1$ Hz. • Output frequency stays above the relaxed limit ($8111 - 1$ Hz) for at least the time: 8115 AUX MOT START D.

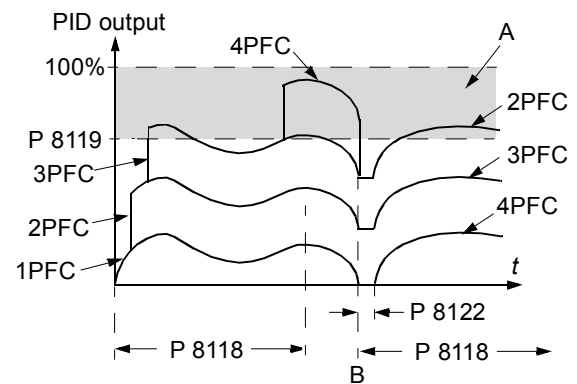


Code	Description
8112	LOW FREQ 1 Sets the frequency limit used to stop the first auxiliary motor. The first auxiliary motor stops if: - Only one (the first) auxiliary motor is running. - ACS550 output frequency drops below the limit: 8112 - 1. - Output frequency stays below the relaxed limit (8112 + 1 Hz) for at least the time: 8116 AUX MOT STOP D. After the first auxiliary motor stops: - Output frequency increases by the value = (8109 START FREQ 1) - (8112 LOW FREQ 1). - In effect, the output of the speed regulated motor increases to compensate for the loss of the auxiliary motor. See the figure, where: - A = (8109 START FREQ 1) - (8112 LOW FREQ 1) - B = Output frequency decrease during the stop delay. - C = Diagram showing auxiliary motor's run status as frequency decreases (1 = On). - Grey path = Shows hysteresis – if time is reversed, the path backwards is not the same. For details on the path for starting, see the diagram at 8109 START FREQ 1. Note: 8112 LOW FREQ 1 value must be between: (2007 MINIMUM FREQ) + 1. 8109 START FREQ 1
8113	LOW FREQ 2 Sets the frequency limit used to stop the second auxiliary motor. - See 8112 LOW FREQ 1 for a complete description of the operation. The second auxiliary motor stops if: - Two auxiliary motors are running. - ACS550 output frequency drops below the limit: 8113 - 1. - Output frequency stays below the relaxed limit (8113 + 1 Hz) for at least the time: 8116 AUX MOT STOP D.
8114	LOW FREQ 3 Sets the frequency limit used to stop the third auxiliary motor. - See 8112 LOW FREQ 1 for a complete description of the operation. The third auxiliary motor stops if: - Three auxiliary motors are running. - ACS550 output frequency drops below the limit: 8114 - 1. - Output frequency stays below the relaxed limit (8114 + 1 Hz) for at least the time: 8116 AUX MOT STOP D.
8115	AUX MOT START D Sets the Start Delay for the auxiliary motors. - The output frequency must remain above the start frequency limit (parameter 8109, 8110, or 8111) for this time period before the auxiliary motor starts. - See 8109 START FREQ 1 for a complete description of the operation.
8116	AUX MOT STOP D Sets the Stop Delay for the auxiliary motors. - The output frequency must remain below the low frequency limit (parameter 8112, 8113, or 8114) for this time period before the auxiliary motor stops. - See 8112 LOW FREQ 1 for a complete description of the operation.

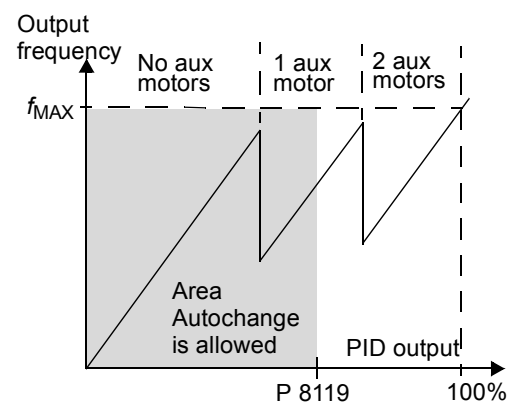


Code	Description
8117	NR OF AUX MOT Sets the number of auxiliary motors. • Each auxiliary motor requires a relay output, which the drive uses to send start/stop signals. • The Autochange function, if used, requires an additional relay output for the speed regulated motor. • The following describes the set-up of the required relay outputs. Relay outputs As noted above, each auxiliary motor requires a relay output, which the drive uses to send start/stop signals. The following describes how the drive keeps track of motors and relays. • The ACS550 provides relay outputs RO1...RO3. • An external digital output module (OREL-01) can be added to provide relay outputs RO4...RO6. • Parameters 1401...1403 and 1410...1412 define, respectively, how relays RO1...RO6 are used – the parameter value 31 PFC defines the relay as used for PFC. • The ACS550 assigns auxiliary motors to relays in ascending order. If the Autochange function is disabled, the first auxiliary motor is the one connected to the first relay with a parameter setting = 31 PFC, and so on. If the Autochange function is used, the assignments rotate. Initially, the speed regulated motor is the one connected to the first relay with a parameter setting = 31 PFC, the first auxiliary motor is the one connected to the second relay with a parameter setting = 31 PFC, and so on.  Standard PFC mode  PFC with Autochange mode • The fourth auxiliary motor uses the same reference step, low frequency and start frequency values as the third auxiliary motor.

Code	Description
8119	AUTOCHNG LEVEL Sets an upper limit, as a percent of output capacity, for the autochange logic. When the output from the PID/PFC control block exceeds this limit, autochange is prevented. For example, use this parameter to deny autochange when the Pump-Fan system is operating near maximum capacity. Autochange overview The purpose of the autochange operation is to equalize duty time between multiple motors used in a system. At each autochange operation: • A different motor takes a turn connected to the ACS550 output – the speed regulated motor. • The starting order of the other motors rotates. The Autochange function requires: • External switchgear for changing the drive's output power connections. • Parameter 8120 INTERLOCKS = value > 0. Autochange is performed when: • The running time since the previous autochange reaches the time set by 8118 AUTOCHNG INTERV. • The PFC input is below the level set by this parameter, 8119 AUTOCHNG LEVEL. Note: The ACS550 always coasts to stop when autochange is performed. In an autochange, the Autochange function does all of the following (see the figure): • Initiates a change when the running time, since the last autochange, reaches 8118 AUTOCHNG INTERV, and PFC input is below limit 8119 AUTOCHNG LEVEL. • Stops the speed regulated motor. • Switches off the contactor of the speed regulated motor. • Increments the starting order counter, to change the starting order for the motors. • Identifies the next motor in line to be the speed regulated motor. • Switches off the above motor's contactor, if the motor was running. Any other running motors are not interrupted. • Switches on the contactor of the new speed regulated motor. The autochange switchgear connects this motor to the ACS550 power output. • Delays motor start for the time 8122 PFC START DELAY. • Starts the speed regulated motor. • Identifies the next constant speed motor in the rotation. • Switches the above motor on, but only if the new speed regulated motor had been running (as a constant speed motor) – This step keeps an equal number of motors running before and after autochange. • Continues with normal PFC operation. Starting order counter The operation of the starting-order counter: • The relay output parameter definitions (1401...1403 and 1410...1412) establish the initial motor sequence. (The lowest parameter number with a value 31 (PFC) identifies the relay connected to 1PFC, the first motor, and so on.) • Initially, 1PFC = speed regulated motor, 2PFC = 1st auxiliary motor, etc. • The first autochange shifts the sequence to: 2PFC = speed regulated motor, 3PFC = 1st auxiliary motor, ..., 1PFC = last auxiliary motor. • The next autochange shifts the sequence again, and so on. • If the autochange cannot start a needed motor because all inactive motors are interlocked, the drive displays an alarm (2015, PFC I LOCK). • When ACS550 power supply is switched off, the counter preserves the current Autochange rotation positions in permanent memory. When power is restored, the Autochange rotation starts at the position stored in memory. • If the PFC relay configuration is changed (or if the PFC enable value is changed), the rotation is reset. (See the first bullet above.)



A = Area above 8119 AUTOCHNG LEVEL – autochange not allowed.
 B = Autochange occurs.
 1PFC, etc. = PID output associated with each motor.

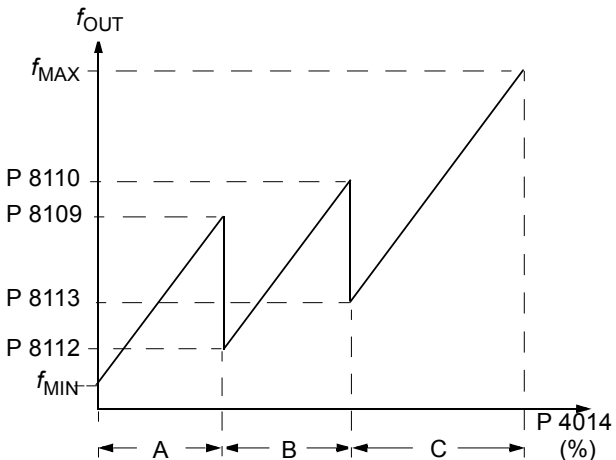
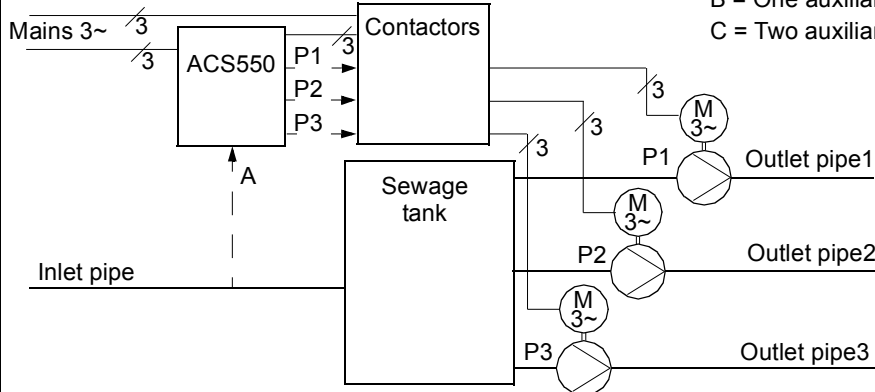


Code	Description																								
8120	INTERLOCKS Defines operation of the Interlock function. When the Interlock function is enabled: • An interlock is active when its command signal is absent. • An interlock is inactive when its command signal is present. • The ACS550 will not start if a start command occurs when the speed regulated motor's interlock is active – the control panel displays an alarm (2015, PFC I LOCK). Wire each Interlock circuit as follows: • Wire a contact of the motor's On/Off switch to the Interlock circuit – the drive's PFC logic can then recognize that the motor is switched off and start the next available motor. • Wire a contact of the motor thermal relay (or other protective device in the motor circuit) to the Interlock input – the drive's PFC logic can then recognize that a motor fault is activated and stop the motor. 0 = NOT SEL – Disables the Interlock function. All digital inputs are available for other purposes. • Requires 8118 AUTOCHNG INTERV = 0.0 (The Autochange function must be disabled if Interlock function is disabled.) 1 = DI1 – Enables the Interlock function and assigns a digital input (starting with DI1) to the interlock signal for each PFC relay. These assignments are defined in the following table and depend on: • the number of PFC relays [number of parameters 1401...1403 and 1410...1412 with value = 31 (PFC)] • the Autochange function status (disabled if 8118 AUTOCHNG INTERV = 0.0, and otherwise enabled). <table><tr><th>No. PFC relays</th><th>Autochange disabled (P 8118)</th><th>Autochange enabled (P 8118)</th></tr><tr><td>0</td><td>DI1: Speed Reg Motor DI2...DI6: Free</td><td>Not allowed</td></tr><tr><td>1</td><td>DI1: Speed Reg Motor DI2: First PFC Relay DI3...DI6: Free</td><td>DI1: First PFC Relay DI2...DI6: Free</td></tr><tr><td>2</td><td>DI1: Speed Reg Motor DI2: First PFC Relay DI3: Second PFC Relay DI4...DI6: Free</td><td>DI1: First PFC Relay DI2: Second PFC Relay DI3...DI6: Free</td></tr><tr><td>3</td><td>DI1: Speed Reg Motor DI2: First PFC Relay DI3: Second PFC Relay DI4: Third PFC Relay DI5...DI6: Free</td><td>DI1: First PFC Relay DI2: Second PFC Relay DI3: Third PFC Relay DI4...DI6: Free</td></tr><tr><td>4</td><td>DI1: Speed Reg Motor DI2: First PFC Relay DI3: Second PFC Relay DI4: Third PFC Relay DI5: Fourth PFC Relay DI6: Free</td><td>DI1: First PFC Relay DI2: Second PFC Relay DI3: Third PFC Relay DI4: Fourth PFC Relay DI5...DI6: Free</td></tr><tr><td>5</td><td>DI1: Speed Reg Motor DI2: First PFC Relay DI3: Second PFC Relay DI4: Third PFC Relay DI5: Fourth PFC Relay DI6: Fifth PFC Relay</td><td>DI1: First PFC Relay DI2: Second PFC Relay DI3: Third PFC Relay DI4: Fourth PFC Relay DI5: Fifth PFC Relay DI6: Free</td></tr><tr><td>6</td><td>Not allowed</td><td>DI1: First PFC Relay DI2: Second PFC Relay DI3: Third PFC Relay DI4: Fourth PFC Relay DI5: Fifth PFC Relay DI6: Sixth PFC Relay</td></tr></table>	No. PFC relays	Autochange disabled (P 8118)	Autochange enabled (P 8118)	0	DI1: Speed Reg Motor DI2...DI6: Free	Not allowed	1	DI1: Speed Reg Motor DI2: First PFC Relay DI3...DI6: Free	DI1: First PFC Relay DI2...DI6: Free	2	DI1: Speed Reg Motor DI2: First PFC Relay DI3: Second PFC Relay DI4...DI6: Free	DI1: First PFC Relay DI2: Second PFC Relay DI3...DI6: Free	3	DI1: Speed Reg Motor DI2: First PFC Relay DI3: Second PFC Relay DI4: Third PFC Relay DI5...DI6: Free	DI1: First PFC Relay DI2: Second PFC Relay DI3: Third PFC Relay DI4...DI6: Free	4	DI1: Speed Reg Motor DI2: First PFC Relay DI3: Second PFC Relay DI4: Third PFC Relay DI5: Fourth PFC Relay DI6: Free	DI1: First PFC Relay DI2: Second PFC Relay DI3: Third PFC Relay DI4: Fourth PFC Relay DI5...DI6: Free	5	DI1: Speed Reg Motor DI2: First PFC Relay DI3: Second PFC Relay DI4: Third PFC Relay DI5: Fourth PFC Relay DI6: Fifth PFC Relay	DI1: First PFC Relay DI2: Second PFC Relay DI3: Third PFC Relay DI4: Fourth PFC Relay DI5: Fifth PFC Relay DI6: Free	6	Not allowed	DI1: First PFC Relay DI2: Second PFC Relay DI3: Third PFC Relay DI4: Fourth PFC Relay DI5: Fifth PFC Relay DI6: Sixth PFC Relay
No. PFC relays	Autochange disabled (P 8118)	Autochange enabled (P 8118)																							
0	DI1: Speed Reg Motor DI2...DI6: Free	Not allowed																							
1	DI1: Speed Reg Motor DI2: First PFC Relay DI3...DI6: Free	DI1: First PFC Relay DI2...DI6: Free																							
2	DI1: Speed Reg Motor DI2: First PFC Relay DI3: Second PFC Relay DI4...DI6: Free	DI1: First PFC Relay DI2: Second PFC Relay DI3...DI6: Free																							
3	DI1: Speed Reg Motor DI2: First PFC Relay DI3: Second PFC Relay DI4: Third PFC Relay DI5...DI6: Free	DI1: First PFC Relay DI2: Second PFC Relay DI3: Third PFC Relay DI4...DI6: Free																							
4	DI1: Speed Reg Motor DI2: First PFC Relay DI3: Second PFC Relay DI4: Third PFC Relay DI5: Fourth PFC Relay DI6: Free	DI1: First PFC Relay DI2: Second PFC Relay DI3: Third PFC Relay DI4: Fourth PFC Relay DI5...DI6: Free																							
5	DI1: Speed Reg Motor DI2: First PFC Relay DI3: Second PFC Relay DI4: Third PFC Relay DI5: Fourth PFC Relay DI6: Fifth PFC Relay	DI1: First PFC Relay DI2: Second PFC Relay DI3: Third PFC Relay DI4: Fourth PFC Relay DI5: Fifth PFC Relay DI6: Free																							
6	Not allowed	DI1: First PFC Relay DI2: Second PFC Relay DI3: Third PFC Relay DI4: Fourth PFC Relay DI5: Fifth PFC Relay DI6: Sixth PFC Relay																							

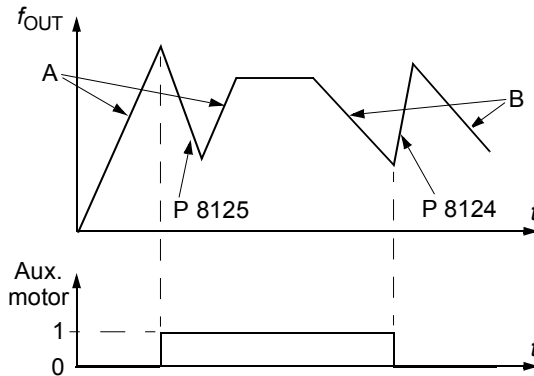
Code	Description																								
2	DI2 – Enables the Interlock function and assigns a digital input (starting with DI2) to the interlock signal for each PFC relay. These assignments are defined in the following table and depend on: - the number of PFC relays [number of parameters 1401...1403 and 1410...1412 with value = 31 (PFC)] - the Autochange function status (disabled if 8118 AUTOCHNG INTERV = 0.0, and otherwise enabled). <table><tr><th>No. PFC relays</th><th>Autochange disabled (P 8118)</th><th>Autochange enabled (P 8118)</th></tr><tr><td>0</td><td>DI1: Free DI2: Speed Reg Motor DI3...DI6: Free</td><td>Not allowed</td></tr><tr><td>1</td><td>DI1: Free DI2: Speed Reg Motor DI3: First PFC Relay DI4...DI6: Free</td><td>DI1: Free DI2: First PFC Relay DI3...DI6: Free</td></tr><tr><td>2</td><td>DI1: Free DI2: Speed Reg Motor DI3: First PFC Relay DI4: Second PFC Relay DI5...DI6: Free</td><td>DI1: Free DI2: First PFC Relay DI3: Second PFC Relay DI4...DI6: Free</td></tr><tr><td>3</td><td>DI1: Free DI2: Speed Reg Motor DI3: First PFC Relay DI4: Second PFC Relay DI5: Third PFC Relay DI6: Free</td><td>DI1: Free DI2: First PFC Relay DI3: Second PFC Relay DI4: Third PFC Relay DI5...DI6: Free</td></tr><tr><td>4</td><td>DI1: Free DI2: Speed Reg Motor DI3: First PFC Relay DI4: Second PFC Relay DI5: Third PFC Relay DI6: Fourth PFC Relay</td><td>DI1: Free DI2: First PFC Relay DI3: Second PFC Relay DI4: Third PFC Relay DI5: Fourth PFC Relay DI6: Free</td></tr><tr><td>5</td><td>Not allowed</td><td>DI1: Free DI2: First PFC Relay DI3: Second PFC Relay DI4: Third PFC Relay DI5: Fourth PFC Relay DI6: Fifth PFC Relay</td></tr><tr><td>6</td><td>Not allowed</td><td>Not allowed</td></tr></table>	No. PFC relays	Autochange disabled (P 8118)	Autochange enabled (P 8118)	0	DI1: Free DI2: Speed Reg Motor DI3...DI6: Free	Not allowed	1	DI1: Free DI2: Speed Reg Motor DI3: First PFC Relay DI4...DI6: Free	DI1: Free DI2: First PFC Relay DI3...DI6: Free	2	DI1: Free DI2: Speed Reg Motor DI3: First PFC Relay DI4: Second PFC Relay DI5...DI6: Free	DI1: Free DI2: First PFC Relay DI3: Second PFC Relay DI4...DI6: Free	3	DI1: Free DI2: Speed Reg Motor DI3: First PFC Relay DI4: Second PFC Relay DI5: Third PFC Relay DI6: Free	DI1: Free DI2: First PFC Relay DI3: Second PFC Relay DI4: Third PFC Relay DI5...DI6: Free	4	DI1: Free DI2: Speed Reg Motor DI3: First PFC Relay DI4: Second PFC Relay DI5: Third PFC Relay DI6: Fourth PFC Relay	DI1: Free DI2: First PFC Relay DI3: Second PFC Relay DI4: Third PFC Relay DI5: Fourth PFC Relay DI6: Free	5	Not allowed	DI1: Free DI2: First PFC Relay DI3: Second PFC Relay DI4: Third PFC Relay DI5: Fourth PFC Relay DI6: Fifth PFC Relay	6	Not allowed	Not allowed
No. PFC relays	Autochange disabled (P 8118)	Autochange enabled (P 8118)																							
0	DI1: Free DI2: Speed Reg Motor DI3...DI6: Free	Not allowed																							
1	DI1: Free DI2: Speed Reg Motor DI3: First PFC Relay DI4...DI6: Free	DI1: Free DI2: First PFC Relay DI3...DI6: Free																							
2	DI1: Free DI2: Speed Reg Motor DI3: First PFC Relay DI4: Second PFC Relay DI5...DI6: Free	DI1: Free DI2: First PFC Relay DI3: Second PFC Relay DI4...DI6: Free																							
3	DI1: Free DI2: Speed Reg Motor DI3: First PFC Relay DI4: Second PFC Relay DI5: Third PFC Relay DI6: Free	DI1: Free DI2: First PFC Relay DI3: Second PFC Relay DI4: Third PFC Relay DI5...DI6: Free																							
4	DI1: Free DI2: Speed Reg Motor DI3: First PFC Relay DI4: Second PFC Relay DI5: Third PFC Relay DI6: Fourth PFC Relay	DI1: Free DI2: First PFC Relay DI3: Second PFC Relay DI4: Third PFC Relay DI5: Fourth PFC Relay DI6: Free																							
5	Not allowed	DI1: Free DI2: First PFC Relay DI3: Second PFC Relay DI4: Third PFC Relay DI5: Fourth PFC Relay DI6: Fifth PFC Relay																							
6	Not allowed	Not allowed																							

Code	Description																																							
	3 = DI3 – Enables the Interlocks function and assigns a digital input (starting with DI3) to the interlock signal for each PFC relay. These assignments are defined in the following table and depend on: • the number of PFC relays [number of parameters 1401...1403 and 1410...1412 with value = 31 (PFC)] • the Autochange function status (disabled if 8118 AUTOCHNG INTERV = 0.0, and otherwise enabled). <table><tr><th>No. PFC relays</th><th>Autochange disabled (P 8118)</th><th>Autochange enabled (P 8118)</th></tr><tr><td>0</td><td>DI1...DI2: Free DI3: Speed Reg Motor DI4...DI6: Free</td><td>Not allowed</td></tr><tr><td>1</td><td>DI1...DI2: Free DI3: Speed Reg Motor DI4: First PFC Relay DI5...DI6: Free</td><td>DI1...DI2: Free DI3: First PFC Relay DI4...DI6: Free</td></tr><tr><td>2</td><td>DI1...DI2: Free DI3: Speed Reg Motor DI4: First PFC Relay DI5: Second PFC Relay DI6: Free</td><td>DI1...DI2: Free DI3: First PFC Relay DI4: Second PFC Relay DI5...DI6: Free</td></tr><tr><td>3</td><td>DI1...DI2: Free DI3: Speed Reg Motor DI4: First PFC Relay DI5: Second PFC Relay DI6: Third PFC Relay</td><td>DI1...DI2: Free DI3: First PFC Relay DI4: Second PFC Relay DI5: Third PFC Relay DI6: Free</td></tr><tr><td>4</td><td>Not allowed</td><td>DI1...DI2: Free DI3: First PFC Relay DI4: Second PFC Relay DI5: Third PFC Relay DI6: Fourth PFC Relay</td></tr><tr><td>5...6</td><td>Not allowed</td><td>Not allowed</td></tr></table> 4 = DI4 – Enables the Interlock function and assigns a digital input (starting with DI4) to the interlock signal for each PFC relay. These assignments are defined in the following table and depend on: • the number of PFC relays [number of parameters 1401...1403 and 1410...1412 with value = 31 (PFC)] • the Autochange function status (disabled if 8118 AUTOCHNG INTERV = 0.0, and otherwise enabled). <table><tr><th>No. PFC relays</th><th>Autochange disabled (P 8118)</th><th>Autochange enabled (P 8118)</th></tr><tr><td>0</td><td>DI1...DI3: Free DI4: Speed Reg Motor DI5...DI6: Free</td><td>Not allowed</td></tr><tr><td>1</td><td>DI1...DI3: Free DI4: Speed Reg Motor DI5: First PFC Relay DI6: Free</td><td>DI1...DI3: Free DI4: First PFC Relay DI5...DI6: Free</td></tr><tr><td>2</td><td>DI1...DI3: Free DI4: Speed Reg Motor DI5: First PFC Relay DI6: Second PFC Relay</td><td>DI1...DI3: Free DI4: First PFC Relay DI5: Second PFC Relay DI6: Free</td></tr><tr><td>3</td><td>Not allowed</td><td>DI1...DI3: Free DI4: First PFC Relay DI5: Second PFC Relay DI6: Third PFC Relay</td></tr><tr><td>4...6</td><td>Not allowed</td><td>Not allowed</td></tr></table>	No. PFC relays	Autochange disabled (P 8118)	Autochange enabled (P 8118)	0	DI1...DI2: Free DI3: Speed Reg Motor DI4...DI6: Free	Not allowed	1	DI1...DI2: Free DI3: Speed Reg Motor DI4: First PFC Relay DI5...DI6: Free	DI1...DI2: Free DI3: First PFC Relay DI4...DI6: Free	2	DI1...DI2: Free DI3: Speed Reg Motor DI4: First PFC Relay DI5: Second PFC Relay DI6: Free	DI1...DI2: Free DI3: First PFC Relay DI4: Second PFC Relay DI5...DI6: Free	3	DI1...DI2: Free DI3: Speed Reg Motor DI4: First PFC Relay DI5: Second PFC Relay DI6: Third PFC Relay	DI1...DI2: Free DI3: First PFC Relay DI4: Second PFC Relay DI5: Third PFC Relay DI6: Free	4	Not allowed	DI1...DI2: Free DI3: First PFC Relay DI4: Second PFC Relay DI5: Third PFC Relay DI6: Fourth PFC Relay	5...6	Not allowed	Not allowed	No. PFC relays	Autochange disabled (P 8118)	Autochange enabled (P 8118)	0	DI1...DI3: Free DI4: Speed Reg Motor DI5...DI6: Free	Not allowed	1	DI1...DI3: Free DI4: Speed Reg Motor DI5: First PFC Relay DI6: Free	DI1...DI3: Free DI4: First PFC Relay DI5...DI6: Free	2	DI1...DI3: Free DI4: Speed Reg Motor DI5: First PFC Relay DI6: Second PFC Relay	DI1...DI3: Free DI4: First PFC Relay DI5: Second PFC Relay DI6: Free	3	Not allowed	DI1...DI3: Free DI4: First PFC Relay DI5: Second PFC Relay DI6: Third PFC Relay	4...6	Not allowed	Not allowed
No. PFC relays	Autochange disabled (P 8118)	Autochange enabled (P 8118)																																						
0	DI1...DI2: Free DI3: Speed Reg Motor DI4...DI6: Free	Not allowed																																						
1	DI1...DI2: Free DI3: Speed Reg Motor DI4: First PFC Relay DI5...DI6: Free	DI1...DI2: Free DI3: First PFC Relay DI4...DI6: Free																																						
2	DI1...DI2: Free DI3: Speed Reg Motor DI4: First PFC Relay DI5: Second PFC Relay DI6: Free	DI1...DI2: Free DI3: First PFC Relay DI4: Second PFC Relay DI5...DI6: Free																																						
3	DI1...DI2: Free DI3: Speed Reg Motor DI4: First PFC Relay DI5: Second PFC Relay DI6: Third PFC Relay	DI1...DI2: Free DI3: First PFC Relay DI4: Second PFC Relay DI5: Third PFC Relay DI6: Free																																						
4	Not allowed	DI1...DI2: Free DI3: First PFC Relay DI4: Second PFC Relay DI5: Third PFC Relay DI6: Fourth PFC Relay																																						
5...6	Not allowed	Not allowed																																						
No. PFC relays	Autochange disabled (P 8118)	Autochange enabled (P 8118)																																						
0	DI1...DI3: Free DI4: Speed Reg Motor DI5...DI6: Free	Not allowed																																						
1	DI1...DI3: Free DI4: Speed Reg Motor DI5: First PFC Relay DI6: Free	DI1...DI3: Free DI4: First PFC Relay DI5...DI6: Free																																						
2	DI1...DI3: Free DI4: Speed Reg Motor DI5: First PFC Relay DI6: Second PFC Relay	DI1...DI3: Free DI4: First PFC Relay DI5: Second PFC Relay DI6: Free																																						
3	Not allowed	DI1...DI3: Free DI4: First PFC Relay DI5: Second PFC Relay DI6: Third PFC Relay																																						
4...6	Not allowed	Not allowed																																						

Code	Description																											
	5 = DI5 – Enables the Interlock function and assigns a digital input (starting with DI5) to the interlock signal for each PFC relay. These assignments are defined in the following table and depend on: • the number of PFC relays [number of parameters 1401...1403 and 1410...1412 with value = 31 (PFC)] • the Autochange function status (disabled if 8118 AUTOCHNG INTERV = 0.0, and otherwise enabled). <table><tr><th>No. PFC relays</th><th>Autochange disabled (P 8118)</th><th>Autochange enabled (P 8118)</th></tr><tr><td>0</td><td>DI1...DI4: Free DI5: Speed Reg Motor DI6: Free</td><td>Not allowed</td></tr><tr><td>1</td><td>DI1...DI4: Free DI5: Speed Reg Motor DI6: First PFC Relay</td><td>DI1...DI4: Free DI5: First PFC Relay DI6: Free</td></tr><tr><td>2</td><td>Not allowed</td><td>DI1...DI4: Free DI5: First PFC Relay DI6: Second PFC Relay</td></tr><tr><td>3...6</td><td>Not allowed</td><td>Not allowed</td></tr></table> 6 = DI6 – Enables the Interlock function and assigns digital input DI6 to the interlock signal for the speed regulated motor. • Requires 8118 AUTOCHNG INTERV = 0.0. <table><tr><th>No. PFC relays</th><th>Autochange disabled</th><th>Autochange enabled</th></tr><tr><td>0</td><td>DI1...DI5: Free DI6: Speed Reg Motor</td><td>Not allowed</td></tr><tr><td>1</td><td>Not allowed</td><td>DI1...DI5: Free DI6: First PFC Relay</td></tr><tr><td>2...6</td><td>Not allowed</td><td>Not allowed</td></tr></table>	No. PFC relays	Autochange disabled (P 8118)	Autochange enabled (P 8118)	0	DI1...DI4: Free DI5: Speed Reg Motor DI6: Free	Not allowed	1	DI1...DI4: Free DI5: Speed Reg Motor DI6: First PFC Relay	DI1...DI4: Free DI5: First PFC Relay DI6: Free	2	Not allowed	DI1...DI4: Free DI5: First PFC Relay DI6: Second PFC Relay	3...6	Not allowed	Not allowed	No. PFC relays	Autochange disabled	Autochange enabled	0	DI1...DI5: Free DI6: Speed Reg Motor	Not allowed	1	Not allowed	DI1...DI5: Free DI6: First PFC Relay	2...6	Not allowed	Not allowed
No. PFC relays	Autochange disabled (P 8118)	Autochange enabled (P 8118)																										
0	DI1...DI4: Free DI5: Speed Reg Motor DI6: Free	Not allowed																										
1	DI1...DI4: Free DI5: Speed Reg Motor DI6: First PFC Relay	DI1...DI4: Free DI5: First PFC Relay DI6: Free																										
2	Not allowed	DI1...DI4: Free DI5: First PFC Relay DI6: Second PFC Relay																										
3...6	Not allowed	Not allowed																										
No. PFC relays	Autochange disabled	Autochange enabled																										
0	DI1...DI5: Free DI6: Speed Reg Motor	Not allowed																										
1	Not allowed	DI1...DI5: Free DI6: First PFC Relay																										
2...6	Not allowed	Not allowed																										

Code	Description
8121	REG BYPASS CTRL Selects Regulator by-pass control. When enabled, Regulator by-pass control provides a simple control mechanism without a PID regulator. - Use Regulator by-pass control only in special applications. 0 = NO – Disables Regulator by-pass control. The drive uses the normal PFC reference: 1106 REF2 SELECT. 1 = YES – Enables Regulator by-pass control. - The process PID regulator is bypassed. Actual value of PID is used as the PFC reference (input). Normally EXT REF2 is used as the PFC reference. - The drive uses the feedback signal defined by 4014 FBK SEL (or 4114) for the PFC frequency reference. - The figure shows the relation between the control signal 4014 FBK SEL (OR 4114) and the speed regulated motor's frequency in a three-motor system. Example: In the diagram below, the pumping station's outlet flow is controlled by the measured inlet flow (A).  A = No auxiliary motors running B = One auxiliary motor running C = Two auxiliary motors running 
8122	PFC START DELAY Sets the start delay for speed regulated motors in the system. Using the delay, the drive works as follows: - Switches on the contactor of the speed regulated motor – connecting the motor to the ACS550 power output. - Delays motor start for the time 8122 PFC START DELAY. - Starts the speed regulated motor. - Starts auxiliary motors. See parameter 8115 for delay. WARNING! Motors equipped with star-delta starters require a PFC Start Delay. - After the ACS550 relay output switches a motor on, the star-delta starter must switch to the star-connection and then back to the delta-connection before the drive applies power. - So, the PFC Start Delay must be longer than the time setting of the star-delta starter.
8123	PFC ENABLE Selects PFC control. When enabled, PFC control: - Switches in, or out, auxiliary constant speed motors as output demand increases or decreases. Parameters 8109 START FREQ 1 to 8114 LOW FREQ 3 define the switch points in terms of the drive output frequency. - Adjusts the speed regulated motor output down, as auxiliary motors are added, and adjusts the speed regulated motor output up, as auxiliary motors are taken off line. - Provides Interlock functions, if enabled. - Requires 9904 MOTOR CTRL MODE = 3 (SCALAR:FREQ). 0 = NOT SEL – Disables PFC control. 1 = ACTIVE – Enables PFC control.

Code	Description
8124	ACC IN AUX STOP Sets the PFC acceleration time for a zero-to-maximum frequency ramp. This PFC acceleration ramp: • Applies to the speed regulated motor, when an auxiliary motor is switched off. • Replaces the acceleration ramp defined in Group 22: ACCEL/DECEL. • Applies only until the output of the regulated motor increases by an amount equal to the output of the switched off auxiliary motor. Then the acceleration ramp defined in Group 22: ACCEL/DECEL applies. 0 = NOT SEL. 0.1...1800 – Activates this function using the value entered as the acceleration time.
8125	DEC IN AUX START Sets the PFC deceleration time for a maximum-to-zero frequency ramp. This PFC deceleration ramp: • Applies to the speed regulated motor, when an auxiliary motor is switched on. • Replaces the deceleration ramp defined in Group 22: ACCEL/DECEL. • Applies only until the output of the regulated motor decreases by an amount equal to the output of the auxiliary motor. Then the deceleration ramp defined in Group 22: ACCEL/DECEL applies. 0 = NOT SEL. 0.1...1800 – Activates this function using the value entered as the deceleration time.
8126	TIMED AUTOCHNG Sets the autochange using a Timed function. See parameter 8119 AUTOCHNG LEVEL. 0 = NOT SEL. 1 = TIMED FUNC 1 – Enables autochange when Timed function 1 is active. 2...4 = TIMED FUNC 2...4 – Enables autochange when Timed function 2...4 is active.
8127	MOTORS Sets the actual number of PFC controlled motors (maximum 7 motors, 1 speed regulated, 3 connected direct-on-line and 3 spare motors). • This value includes also the speed regulated motor. • This value must be compatible with the number of relays allocated to PFC if the Autochange function is used. • If Autochange function is not used, the speed regulated motor does not need to have a relay output allocated to PFC but it needs to be included in this value.
8128	AUX START ORDER Sets the start order of the auxiliary motors. 1 = EVEN RUNTIME – Time sharing is active. Evens out the cumulative run time of the auxiliary motors. The start order depends on the run time: The auxiliary motor whose cumulative run time is shortest is started first, then the motor whose cumulative run time is the second shortest etc. When the demand drops, the first motor to be stopped is the one whose cumulative run time is longest. 2 = RELAY ORDER – The start order is fixed to be the order of the relays.



- A = speed regulated motor accelerating using [Group 22: ACCEL/DECEL](#) parameters (2202 or 2205).
- B = speed regulated motor decelerating using [Group 22: ACCEL/DECEL](#) parameters (2203 or 2206).
- At aux. motor start, speed regulated motor decelerates using 8125 DEC IN AUX START.
- At aux. motor stop, speed regulated motor accelerates using 8124 ACC IN AUX STOP.

Group 98: OPTIONS

This group configures for options, in particular, enabling serial communication with the drive.

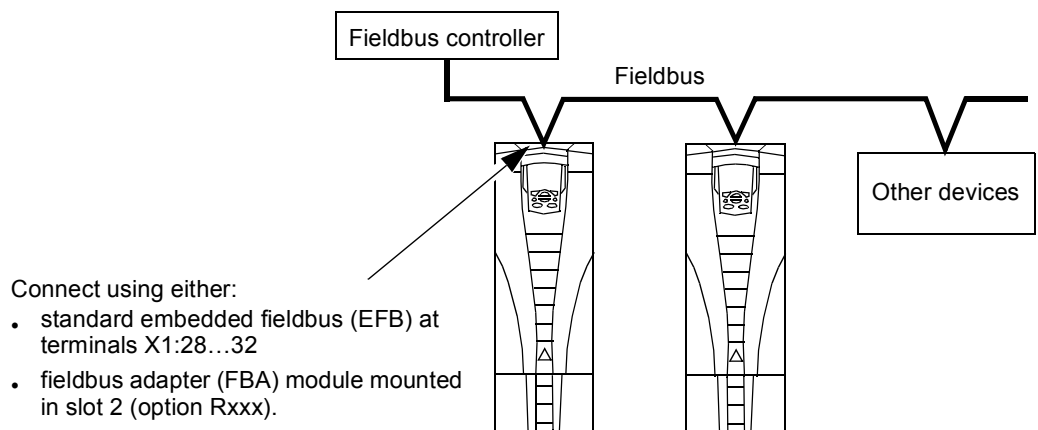
Code	Description
9802	COMM PROT SEL Selects the communication protocol. 0 = NOT SEL – No communication protocol selected. 1 = STD MODBUS – The drive communicates with Modbus via the RS485 channel (X1-communications, terminal). • See also Group 53: EFB PROTOCOL. 4 = EXT FBA – The drive communicates via a fieldbus adapter module in option slot 2 of the drive. • See also Group 51: EXT COMM MODULE.

Embedded fieldbus

Overview

The ACS550 can be set up to accept control from an external system using standard serial communication protocols. When using serial communication, the ACS550 can either:

- receive all of its control information from the fieldbus, or
- be controlled from some combination of fieldbus control and other available control locations, such as digital or analog inputs and the control panel.



Two basic serial communications configurations are available:

- embedded fieldbus (EFB) – Using the RS485 interface at terminals X1:28...32 on the control board, a control system can communicate with the drive using the Modbus® protocol. (For protocol and profile descriptions, see sections [Modbus protocol technical data](#) and [ABB control profiles technical data](#) later in this chapter.)
- fieldbus adapter (FBA) – See chapter [Fieldbus adapter](#) on page 237.

Control interface

In general, the basic control interface between Modbus and the drive consists of:

- Output words
 - Control Word
 - Reference1
 - Reference2
- Input words
 - Status Word
 - Actual value 1
 - Actual value 2

- Actual value 3
- Actual value 4
- Actual value 5
- Actual value 6
- Actual value 7
- Actual value 8

The content of these words is defined by profiles. For details on the profiles used, see section [ABB control profiles technical data](#) on page 224.

Note: The words “output” and “input” are used as seen from the fieldbus controller point of view. For example an output describes data flow from the fieldbus controller to the drive and appears as an input from the drive point of view.

Planning

Network planning should address the following questions:

- What types and quantities of devices must be connected to the network?
- What control information must be sent down to the drives?
- What feedback information must be sent from the drives to the controlling system?

Mechanical and electrical installation – EFB

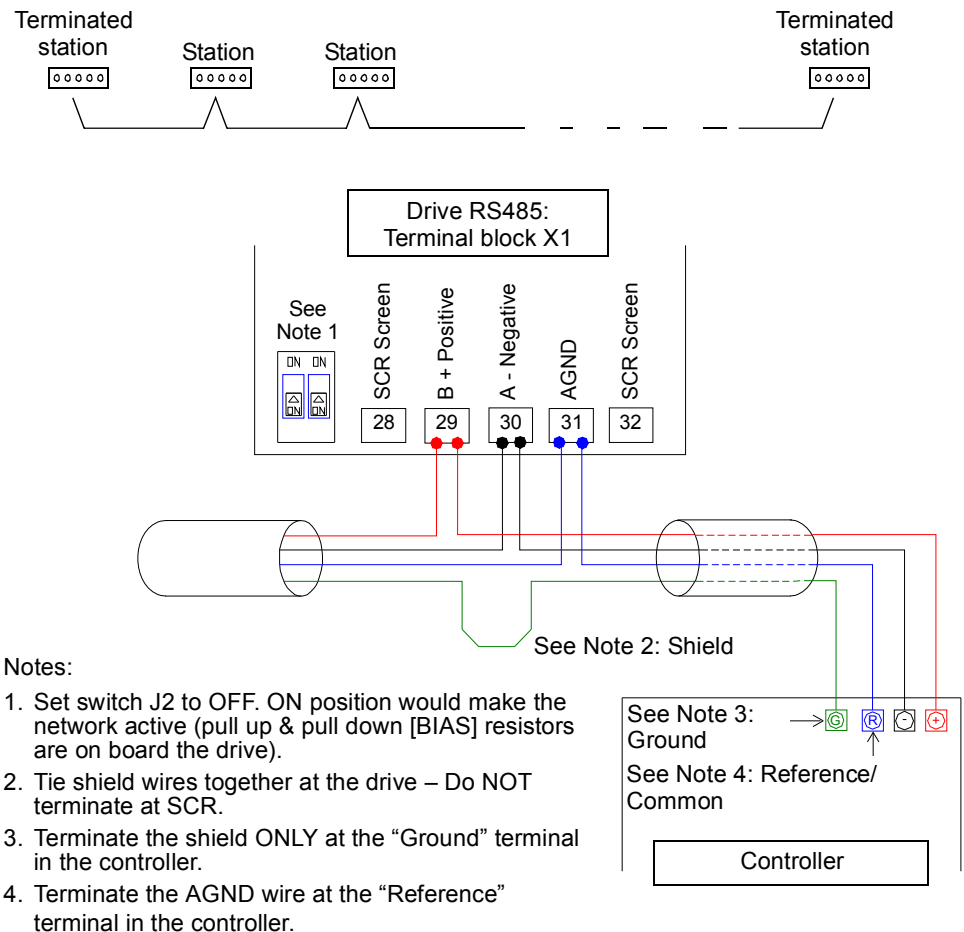


WARNING! Connections should be made only while the drive is disconnected from the power source.

Drive terminals 28...32 are for RS485 communications.

- Use Belden 9842 or equivalent. Belden 9842 is a dual twisted, shielded pair cable with a wave impedance of 120 ohm.
- Use one of these twisted shielded pairs for the RS485 link. Use this pair to connect all A (-) terminals together and all B (+) terminals together.
- Use one of the wires in the other pair for the logical ground (terminal 31), leaving one wire unused.
- Do not directly ground the RS485 network at any point. Ground all devices on the network using their corresponding earthing terminals.
- As always, the grounding wires should not form any closed loops, and all the devices should be earthed to a common ground.
- Connect the RS485 link in a daisy-chained bus, without dropout lines.

- To reduce noise on the network, terminate the RS485 network using 120 Ω resistors at both ends of the network. Use the DIP switch to connect or disconnect the termination resistors. See the following diagram.



- For configuration information see the following sections:
 - [Communication set-up – EFB](#) on page 205
 - [Activate drive control functions – EFB](#) on page 207
 - The appropriate EFB protocol specific technical data. For example, [Modbus protocol technical data](#) on page 215.

Communication set-up – EFB

Serial communication selection

To activate the serial communication, set parameter 9802 COMM PROT SEL = 1 (STD MODBUS).

Note: If you cannot see the desired selection on the panel, your drive does not have that protocol software in the application memory.

Serial communication configuration

Setting 9802 automatically sets the appropriate default values in parameters that define the communication process. These parameters and descriptions are defined below. In particular, note that the station Id may require adjustment.

Code	Description	Protocol reference
		Modbus
5301	EFB PROTOCOL ID Contains the identification and program revision of the protocol.	Do not edit. Any non-zero value entered for parameter 9802 COMM PROT SEL, sets this parameter automatically. The format is: XXYY, where XX = protocol ID, and YY = program revision.
5302	EFB STATION ID Defines the node address of the RS485 link. Note: For a new address to take affect, the drive power must be cycled or 5302 must first be set to 0 before selecting a new address. Leaving 5302 = 0 places the RS485 channel in reset, disabling communication.	Set each drive on the network with a unique value for this parameter. When this protocol is selected, the default value for this parameter is: 1
5303	EFB BAUD RATE Defines the communication speed of the RS485 link in kbits per second (kbits/s). 1.2 kb/s 19.2 kb/s 2.4 kb/s 38.4 kb/s 4.8 kb/s 57.6 kb/s 9.6 kb/s 76.8 kb/s	When this protocol is selected, the default value for this parameter is: 9.6
5304	EFB PARITY Defines the data length, parity and stop bits to be used with the RS485 communication. • The same settings must be used in all on-line stations. 0 = 8 NONE 1 – 8 data bits, no parity, one stop bit. 1 = 8 NONE 2 – 8 data bits, no parity, two stop bits. 2 = 8 EVEN 1 – 8 data bits, even parity, one stop bit. 3 = 8 ODD 1 – 8 data bits, odd parity, one stop bit.	When this protocol is selected, the default value for this parameter is: 1
5305	EFB CTRL PROFILE Selects the communication profile used by the EFB protocol. 0 = ABB DRV LIM – Operation of Control/Status Words conforms to ABB Drives Profile, as used in ACS400. 1 = DCU PROFILE – Operation of Control/Status Words conforms to 32-bit DCU Profile. 2 = ABB DRV FULL – Operation of Control/Status Words conforms to ABB Drives Profile, as used in ACS600/800.	When this protocol is selected, the default value for this parameter is: 0

Note: After any changes to the communication settings, the protocol must be reactivated by either cycling the drive power, or by clearing and then restoring the station Id (5302).

Activate drive control functions – EFB

Controlling the drive

Fieldbus control of various drive functions requires configuration to:

- tell the drive to accept fieldbus control of the function
- define as a fieldbus input, any drive data required for control
- define as a fieldbus output, any control data required by the drive.

The following sections describe, at a general level, the configuration required for each control function. For the protocol-specific details, see the document supplied with the FBA module.

Start/Stop Direction control

Using the fieldbus for start/stop/direction control of the drive requires:

- drive parameter values set as defined below
- fieldbus controller supplied command(s) in the appropriate location. (The location is defined by the Protocol Reference, which is protocol dependent.)

Drive parameter		Value	Description	Modbus ¹ protocol reference	
				ABB DRV	DCU PROFILE
1001	EXT1 COMMANDS	10 (COMM)	Start/Stop by fieldbus with Ext1 selected.	40001 bits 0...3	40031 bits 0, 1
1002	EXT2 COMMANDS	10 (COMM)	Start/Stop by fieldbus with Ext2 selected.	40001 bits 0...3	40031 bits 0, 1
1003	DIRECTION	3 (REQUEST)	Direction by fieldbus.	4002/4003 ²	40031 bit 3

¹ For Modbus, the protocol reference can depend on the profile used, hence two columns in these tables. One column refers to the ABB Drives profile, selected when parameter 5305 = 0 (ABB DRV LIM) or 5305 = 2 (ABB DRV FULL). The other column refers to the DCU profile selected when parameter 5305 = 1 (DCU PROFILE). See section [ABB control profiles technical data](#) on page 224.

² The reference provides direction control – a negative reference provides reverse rotation.

Input reference select

Using the fieldbus to provide input references to the drive requires:

- drive parameter values set as defined below
- fieldbus controller supplied reference word(s) in the appropriate location. (The location is defined by the Protocol Reference, which is protocol dependent.)

Drive parameter		Value	Description	Modbus protocol reference	
				ABB DRV	DCU PROFILE
1102	EXT1/EXT2 SEL	8 (COMM)	Reference set selection by fieldbus.	40001 bit 11	40031 bit 5
1103	REF1 SELECT	8 (COMM)	Input reference 1 by fieldbus.	40002	
1106	REF2 SELECT	8 (COMM)	Input reference 2 by fieldbus.	40003	

Reference Scaling

Where required, REFERENCES can be scaled. See the following, as appropriate:

- Modbus Register [40002](#) in section [Modbus protocol technical data](#) on page [215](#)
- [Reference scaling](#) in section [ABB control profiles technical data](#) on page [224](#).

Miscellaneous drive control

Using the fieldbus for miscellaneous drive control requires:

- drive parameter values set as defined below
- fieldbus controller supplied command(s) in the appropriate location. (The location is defined by the Protocol Reference, which is protocol dependent.)

Drive parameter		Value	Description	Modbus protocol reference	
				ABB DRV	DCU PROFILE
1601	RUN ENABLE	7 (COMM)	Run enable by fieldbus.	40001 bit 3	40031 bit 6 (inverted)
1604	FAULT RESET SEL	8 (COMM)	Fault reset by fieldbus.	40001 bit 7	40031 bit 4
1606	LOCAL LOCK	8 (COMM)	Source for local lock selection is the fieldbus.	Does not apply	40031 bit 14
1607	PARAM SAVE	1 (SAVE)	Saves altered parameters to memory (then value returns to 0).	41607	
1608	START ENABLE 1	7 (COMM)	Source for start enable 1 is the fieldbus Command word.	Does not apply.	40032 bit 2
1609	START ENABLE 2	7 (COMM)	Source for start enable 2 is the fieldbus Command word.		40032 bit 3
2013	MIN TORQUE SEL	7 (COMM)	Source for minimum torque selection is the fieldbus.		40031 bit 15
2014	MAX TORQUE SEL	7 (COMM)	Source for maximum torque selection is the fieldbus.		
2201	ACC/DEC 1/2 SEL	7 (COMM)	Source for ramp pair selection is the fieldbus.		40031 bit 10

Relay output control

Using the fieldbus for relay output control requires:

- drive parameter values set as defined below
- fieldbus controller supplied, binary coded, relay command(s) in the appropriate location. (The location is defined by the Protocol Reference, which is protocol dependent.)

Drive parameter		Value	Description	Modbus protocol reference	
				ABB DRV	DCU PROFILE
1401	RELAY OUTPUT 1	35 (COMM)	Relay Output 1 controlled by fieldbus.	40134 bit 0 or 00033	
1402	RELAY OUTPUT 2	35 (COMM)	Relay Output 2 controlled by fieldbus.	40134 bit 1 or 00034	
1403	RELAY OUTPUT 3	35 (COMM)	Relay Output 3 controlled by fieldbus.	40134 bit 2 or 00035	
1410 ¹	RELAY OUTPUT 4	35 (COMM)	Relay Output 4 controlled by fieldbus.	40134 bit 3 or 00036	
1411 ¹	RELAY OUTPUT 5	35 (COMM)	Relay Output 5 controlled by fieldbus.	40134 bit 4 or 00037	
1412 ¹	RELAY OUTPUT 6	35 (COMM)	Relay Output 6 controlled by fieldbus.	40134 bit 5 or 00038	

¹ More than 3 relays requires the addition of a relay extension module.

Note: Relay status feedback occurs without configuration as defined below.

Drive parameter		Description	Modbus protocol reference	
			ABB DRV	DCU PROFILE
0122	RO 1-3 STATUS	Relay 1...3 status.	40122	
0123	RO 4-6 STATUS	Relay 4...6 status.	40123	

Analog output control

Using the fieldbus for analog output control (e.g. PID setpoint) requires:

- drive parameter values set as defined below
- fieldbus controller supplied analog value(s) in the appropriate location. (The location is defined by the Protocol Reference, which is protocol dependent.)

Drive parameter		Value	Description	Modbus protocol reference	
				ABB DRV	DCU PROFILE
1501	AO1 CONTENT SEL	135 (COMM VALUE 1)	Analog Output 1 controlled by writing to parameter 0135.	—	
0135	COMM VALUE 1	—		40135	
1507	AO2 CONTENT SEL	136 (COMM VALUE 2)	Analog Output 2 controlled by writing to parameter 0136.	—	
0136	COMM VALUE 2	—		40136	

PID control setpoint source

Using the following settings to select the fieldbus as the setpoint source for PID loops:

Drive parameter		Value	Description	Modbus protocol reference	
				ABB DRV	DCU PROFILE
4010	SET POINT SEL (Set 1)	8 (COMM VALUE 1) 9 (COMM+AI1) 10 (COMM*AI1)	Setpoint is input reference 2 (+/-/* AI1)	40003	
4110	SET POINT SEL (Set 2)				
4210	SET POINT SEL (Ext/Trim)				

Communication fault

When using fieldbus control, specify the drive's action if serial communication is lost.

Drive parameter		Value	Description
3018	COMM FAULT FUNC	0 (NOT SEL) 1 (FAULT) 2 (CONST SP7) 3 (LAST SPEED)	Set for appropriate drive response.
3019	COMM FAULT TIME	Set time delay before acting on a communication loss.	

Feedback from the drive – EFB

Pre-defined feedback

Inputs to the controller (drive outputs) have pre-defined meanings established by the protocol. This feedback does not require drive configuration. The following table lists a sample of feedback data. For a complete listing, see input word/point/object listings in the technical data for the appropriate protocol starting on page [215](#).

Drive parameter		Modbus protocol reference	
		ABB DRV	DCU PROFILE
0102	SPEED	40102	
0103	OUTPUT FREQ	40103	
0104	CURRENT	40104	
0105	TORQUE	40105	
0106	POWER	40106	
0107	DC BUS VOLTAGE	40107	
0109	OUTPUT VOLTAGE	40109	
0301	FB CMD WORD1 – bit 0 (STOP)	40301 bit 0	
0301	FB CMD WORD1 1 – bit 2 (REV)	40301 bit 2	
0118	DI 1-3 STATUS – bit 0 (DI3)	40118	

Note: With Modbus, any parameter can be accessed using the format: “4” followed by the parameter number.

Actual value scaling

The scaling of actual values can be protocol dependent. In general, for Actual Values, scale the feedback integer using the parameter's resolution. (See section [Complete parameter list](#) on page [91](#) for parameter resolutions.) For example:

Feedback integer	Parameter resolution	(Feedback integer) · (Parameter resolution) = Scaled value
1	0.1 mA	$1 \cdot 0.1 \text{ mA} = 0.1 \text{ mA}$
10	0.1%	$10 \cdot 0.1\% = 1\%$

Where parameters are in percent, the [Complete parameter descriptions](#) section specifies what parameter corresponds to 100%. In such cases, to convert from percent to engineering units, multiply by the value of the parameter that defines 100% and divide by 100%.

For example:

Feedback integer	Parameter resolution	Value of the parameter that defines 100%	(Feedback integer) · (Parameter resolution) · (Value of 100% ref.) / 100% = Scaled value
10	0.1%	1500 rpm ¹	$10 \cdot 0.1\% \cdot 1500 \text{ RPM} / 100\% = 15 \text{ rpm}$
100	0.1%	500 Hz ²	$100 \cdot 0.1\% \cdot 500 \text{ Hz} / 100\% = 50 \text{ Hz}$

¹ Assuming, for the sake of this example, that the Actual Value uses parameter 9908 MOT NOM SPEED as the 100% reference and that 9908 = 1500 rpm.

² Assuming, for the sake of this example, that the Actual Value uses parameter 9907 MOT NOM FREQ as the 100% reference and that 9907 = 500 Hz.

Diagnostics – EFB

Fault queue for drive diagnostics

For general ACS550 diagnostics information, see chapter [Diagnostics](#) on page 259. The three most recent ACS550 faults are reported to the fieldbus as defined below.

Drive parameter		Modbus protocol reference	
		ABB DRV	DCU PROFILE
0401	LAST FAULT	40401	
0412	PREVIOUS FAULT 1	40412	
0413	PREVIOUS FAULT 2	40413	

Serial communication diagnostics

Network problems can be caused by multiple sources. Some of these sources are:

- loose connections
- incorrect wiring (including swapped wires)
- bad grounding
- duplicate station numbers
- incorrect setup of drives or other devices on the network.

The major diagnostic features for fault tracing on an EFB network include [Group 53: EFB PROTOCOL](#) parameters 5306...5309. Section [Complete parameter descriptions](#) on page 106 describes these parameters in detail.

Diagnostic situations

The sub-sections below describe various diagnostic situations – the problem symptoms and corrective actions.

Normal operation

During normal network operation, 5306...5309 parameter values act as follows at each drive:

- 5306 EFB OK MESSAGES advances (advances for each message properly received and addressed to this drive).
- 5307 EFB CRC ERRORS does not advance at all (advances when an invalid message CRC is received).
- 5308 EFB UART ERRORS does not advance at all (advances when character format errors are detected, such as parity or framing errors).
- 5309 EFB STATUS value varies depending on network traffic.

Loss of communication

The ACS550 behavior, if communication is lost, was configured earlier in section [Communication fault](#) on page 210. The parameters are 3018 COMM FAULT FUNC and 3019 COMM FAULT TIME. Section [Complete parameter descriptions](#) on page 106 describes these parameters in detail.

No master station on line

If no master station is on line: Neither the EFB OK MESSAGES nor the errors (5307 EFB CRC ERRORS and 5308 EFB UART ERRORS) increase on any of the stations.

To correct:

- Check that a network master is connected and properly programmed on the network.
- Verify that the cable is connected and that it is not cut or short circuited.

Duplicate stations

If two or more stations have duplicate numbers:

- Two or more drives cannot be addressed.
- Every time there is a read or write to one particular station, the value for 5307 EFB CRC ERRORS or 5308 EFB UART ERRORS advances.

To correct: Verify the station numbers of all stations. Change conflicting station numbers.

Swapped wires

If the communication wires are swapped (terminal A on one drive is connected to terminal B on another):

- The value of 5306 EFB OK MESSAGES does not advance.
- The values of 5307 EFB CRC ERRORS and 5308 EFB UART ERRORS are advancing.

To correct: Check that the RS-485 lines are not swapped.

Fault 28 – Serial 1 Err

If the drive's control panel shows fault code 28, SERIAL 1 ERR, check for either of the following:

- The master system is down. To correct, resolve problem with master system.
- The communication connection is bad. To correct, check communication connection at the drive.
- The time-out selection for the drive is too short for the given installation. The master is not polling the drive within the specified time-out delay. To correct, increase the time set by parameter 3019 COMM FAULT TIME.

Faults 31...33 – EFB1...EFB3

The three EFB fault codes listed for the drive in chapter [Diagnostics](#) on page [259](#) (fault codes 31...33) are not used.

Intermittent off-line occurrences

The problems described above are the most common problems encountered with ACS550 serial communication. Intermittent problems might also be caused by:

- marginally loose connections
- wear on wires caused by equipment vibrations
- insufficient grounding and shielding on both the devices and on the communication cables.

Modbus protocol technical data

Overview

The Modbus® protocol was introduced by Modicon, Inc. for use in control environments featuring Modicon programmable controllers. Due to its ease of use and implementation, this common PLC language was quickly adopted as a de-facto standard for integration of a wide variety of master controllers and slave devices.

Modbus is a serial, asynchronous protocol. Transactions are half-duplex, featuring a single Master controlling one or more Slaves. While RS232 can be used for point-to-point communication between a single Master and a single Slave, a more common implementation features a multi-drop RS485 network with a single Master controlling multiple Slaves. The ACS550 features RS485 for its Modbus physical interface.

RTU

The Modbus specification defines two distinct transmission modes: ASCII and RTU. The ACS550 supports RTU only.

Feature summary

The following Modbus function codes are supported by the ACS550.

Function	Code (Hex)	Description
Read Coil Status	0x01	Read discrete output status. For the ACS550, the individual bits of the control word are mapped to Coils 1...16. Relay outputs are mapped sequentially beginning with Coil 33 (e.g. RO1=Coil 33).
Read Discrete Input Status	0x02	Read discrete inputs status. For the ACS550, the individual bits of the status word are mapped to Inputs 1...16 or 1...32, depending on the active profile. Terminal inputs are mapped sequentially beginning with Input 33 (e.g. DI1=Input 33).
Read Multiple Holding Registers	0x03	Read multiple holding registers. For the ACS550, the entire parameter set is mapped as holding registers, as well as command, status and reference values.
Read Multiple Input Registers	0x04	Read multiple input registers. For the ACS550, the 2 analog input channels are mapped as input registers 1 & 2.
Force Single Coil	0x05	Write a single discrete output. For the ACS550, the individual bits of the control word are mapped to Coils 1...16. Relay outputs are mapped sequentially beginning with Coil 33 (e.g. RO1=Coil 33).
Write Single Holding Register	0x06	Write single holding register. For the ACS550, the entire parameter set is mapped as holding registers, as well as command, status and reference values.
Diagnostics	0x08	Perform Modbus diagnostics. Subcodes for Query (0x00), Restart (0x01) & Listen Only (0x04) are supported.
Force Multiple Coils	0x0F	Write multiple discrete outputs. For the ACS550, the individual bits of the control word are mapped to Coils 1...16. Relay outputs are mapped sequentially beginning with Coil 33 (e.g. RO1=Coil 33).
Write Multiple Holding Registers	0x10	Write multiple holding registers. For the ACS550, the entire parameter set is mapped as holding registers, as well as command, status and reference values.
Read/Write Multiple Holding Registers	0x17	This function combines functions 0x03 and 0x10 into a single command.

Mapping summary

The following table summarizes the mapping between the ACS550 (parameters and I/O) and Modbus reference space. For details, see [Modbus addressing](#) below.

ACS550	Modbus reference	Supported function codes
- Control Bits - Relay Outputs	Coils(0xxxx)	01 – Read Coil Status 05 – Force Single Coil 15 – Force Multiple Coils
- Status Bits - Discrete Inputs	Discrete Inputs(1xxxx)	02 – Read Input Status
Analog Inputs	Input Registers(3xxxxx)	04 – Read Input Registers
- Parameters - Control/Status Words - References	Holding Registers(4xxxx)	03 – Read 4X Registers 06 – Preset Single 4X Register 16 – Preset Multiple 4X Registers 23 – Read/Write 4X Registers

Communication profiles

When communicating by Modbus, the ACS550 supports multiple profiles for control and status information. Parameter 5305 EFB CTRL PROFILE selects the profile used.

- ABB DRV LIM – The primary (and default) profile is the ABB DRV LIM profile. This implementation of the ABB Drives profile standardizes the control interface with ACS400 drives. The ABB Drives profile is based on the PROFIBUS interface. It is discussed in detail in the following sections.
- DCU PROFILE – The DCU PROFILE profile extends the control and status interface to 32 bits. It is the internal interface between the main drive application and the embedded fieldbus environment.
- ABB DRV FULL – ABB DRV FULL is the implementation of the ABB Drives profile that standardizes the control interface with ACS600 and ACS800 drives. This implementation supports two control word bits not supported by the ABB DRV LIM implementation.

Modbus addressing

With Modbus, each function code implies access to a specific Modbus reference set. Thus, the leading digit is not included in the address field of a Modbus message.

Note: The ACS550 supports the zero-based addressing of the Modbus specification. Holding register 40002 is addressed as 0001 in a Modbus message. Similarly, coil 33 is addressed as 0032 in a Modbus message.

Refer again to the [Mapping summary](#) above. The following sections describe, in detail, the mapping to each Modbus reference set.

0xxxx Mapping – Modbus coils. The drive maps the following information to the 0xxxx Modbus set called Modbus Coils:

- bit-wise map of the CONTROL WORD (selected using parameter 5305 EFB CTRL PROFILE). The first 32 coils are reserved for this purpose.

- relay output states, numbered sequentially beginning with coil 00033.

The following table summarizes the 0xxxx reference set:

Modbus ref.	Internal location (all profiles)	ABB DRV LIM (5305 = 0)	DCU PROFILE (5305 = 1)	ABB DRV FULL (5305 = 2)
00001	CONTROL WORD – Bit 0	OFF1 ¹	STOP	OFF1 ¹
00002	CONTROL WORD – Bit 1	OFF2 ¹	START	OFF2 ¹
00003	CONTROL WORD – Bit 2	OFF3 ¹	REVERSE	OFF3 ¹
00004	CONTROL WORD – Bit 3	START	LOCAL	START
00005	CONTROL WORD – Bit 4	N/A	RESET	RAMP_OUT_ZERO ¹
00006	CONTROL WORD – Bit 5	RAMP_HOLD ¹	EXT2	RAMP_HOLD ¹
00007	CONTROL WORD – Bit 6	RAMP_IN_ZERO ¹	RUN_DISABLE	RAMP_IN_ZERO ¹
00008	CONTROL WORD – Bit 7	RESET	STPMODE_R	RESET
00009	CONTROL WORD – Bit 8	N/A	STPMODE_EM	N/A
00010	CONTROL WORD – Bit 9	N/A	STPMODE_C	N/A
00011	CONTROL WORD – Bit 10	N/A	RAMP_2	REMOTE_CMD ¹
00012	CONTROL WORD – Bit 11	EXT2	RAMP_OUT_0	EXT2
00013	CONTROL WORD – Bit 12	N/A	RAMP_HOLD	N/A
00014	CONTROL WORD – Bit 13	N/A	RAMP_IN_0	N/A
00015	CONTROL WORD – Bit 14	N/A	REQ_LOCALLOCK	N/A
00016	CONTROL WORD – Bit 15	N/A	TORQLIM2	N/A
00017	CONTROL WORD – Bit 16	Does not apply	FBLOCAL_CTL	Does not apply
00018	CONTROL WORD – Bit 17		FBLOCAL_REF	
00019	CONTROL WORD – Bit 18		START_DISABLE1	
00020	CONTROL WORD – Bit 19		START_DISABLE2	
00021... 00032	Reserved	Reserved	Reserved	Reserved
00033	RELAY OUTPUT 1	Relay Output 1	Relay Output 1	Relay Output 1
00034	RELAY OUTPUT 2	Relay Output 2	Relay Output 2	Relay Output 2
00035	RELAY OUTPUT 3	Relay Output 3	Relay Output 3	Relay Output 3
00036	RELAY OUTPUT 4	Relay Output 4	Relay Output 4	Relay Output 4
00037	RELAY OUTPUT 5	Relay Output 5	Relay Output 5	Relay Output 5
00038	RELAY OUTPUT 6	Relay Output 6	Relay Output 6	Relay Output 6

¹ = Active low

For the 0xxxx registers:

- Status is always readable.
- Forcing is allowed by user configuration of the drive for fieldbus control.
- Additional relay outputs are added sequentially.

The ACS550 supports the following Modbus function codes for coils:

Function code	Description
01	Read coil status
05	Force single coil
15 (0x0F Hex)	Force multiple coils

1xxxx Mapping – Modbus discrete inputs. The drive maps the following information to the 1xxxx Modbus set called Modbus Discrete Inputs:

- bit-wise map of the STATUS WORD (selected using parameter 5305 EFB CTRL PROFILE). The first 32 inputs are reserved for this purpose.
- discrete hardware inputs, numbered sequentially beginning with input 33.

The following table summarizes the 1xxxx reference set:

Modbus ref.	Internal location (all profiles)	ABB DRV (5305 = 0 OR 2)	DCU PROFILE (5305 = 1)
10001	STATUS WORD – Bit 0	RDY_ON	READY
10002	STATUS WORD – Bit 1	RDY_RUN	ENABLED
10003	STATUS WORD – Bit 2	RDY_REF	STARTED
10004	STATUS WORD – Bit 3	TRIPPED	RUNNING
10005	STATUS WORD – Bit 4	OFF_2_STA ¹	ZERO_SPEED
10006	STATUS WORD – Bit 5	OFF_3_STA ¹	ACCELERATE
10007	STATUS WORD – Bit 6	SWC_ON_INHIB	DECELERATE
10008	STATUS WORD – Bit 7	ALARM	AT_SETPOINT
10009	STATUS WORD – Bit 8	AT_SETPOINT	LIMIT
10010	STATUS WORD – Bit 9	REMOTE	SUPERVISION
10011	STATUS WORD – Bit 10	ABOVE_LIMIT	REV_REF
10012	STATUS WORD – Bit 11	EXT2	REV_ACT
10013	STATUS WORD – Bit 12	RUN_ENABLE	PANEL_LOCAL
10014	STATUS WORD – Bit 13	N/A	FIELD BUS_LOCAL
10015	STATUS WORD – Bit 14	N/A	EXT2_ACT
10016	STATUS WORD – Bit 15	N/A	FAULT
10017	STATUS WORD – Bit 16	Reserved	ALARM
10018	STATUS WORD – Bit 17	Reserved	REQ_MAINT
10019	STATUS WORD – Bit 18	Reserved	DIRLOCK
10020	STATUS WORD – Bit 19	Reserved	LOCALLOCK
10021	STATUS WORD – Bit 20	Reserved	CTL_MODE
10022	STATUS WORD – Bit 21	Reserved	Reserved
10023	STATUS WORD – Bit 22	Reserved	Reserved
10024	STATUS WORD – Bit 23	Reserved	Reserved
10025	STATUS WORD – Bit 24	Reserved	Reserved
10026	STATUS WORD – Bit 25	Reserved	Reserved
10027	STATUS WORD – Bit 26	Reserved	REQ_CTL

Modbus ref.	Internal location (all profiles)	ABB DRV (5305 = 0 OR 2)	DCU PROFILE (5305 = 1)
10028	STATUS WORD – Bit 27	Reserved	REQ_REF1
10029	STATUS WORD – Bit 28	Reserved	REQ_REF2
10030	STATUS WORD – Bit 29	Reserved	REQ_REF2EXT
10031	STATUS WORD – Bit 30	Reserved	ACK_STARTINH
10032	STATUS WORD – Bit 31	Reserved	ACK_OFF_ILCK
10033	DI1	DI1	DI1
10034	DI2	DI2	DI2
10035	DI3	DI3	DI3
10036	DI4	DI4	DI4
10037	DI5	DI5	DI5
10038	DI6	DI6	DI6

¹ = Active low

For the 1xxxx registers:

- Additional discrete inputs are added sequentially.

The ACS550 supports the following Modbus function codes for discrete inputs:

Function code	Description
02	Read input status

3xxxx Mapping – Modbus inputs. The drive maps the following information to the 3xxxx Modbus addresses called Modbus input registers:

- any user defined analog inputs.

The following table summarizes the input registers:

Modbus reference	ACS550 all profiles	Remarks
30001	AI1	This register shall report the level of Analog Input 1 (0...100%).
30002	AI2	This register shall report the level of Analog Input 2 (0...100%).

The ACS550 supports the following Modbus function codes for 3xxxx registers:

Function code	Description
04	Read 3xxxx input status

4xxxx Register mapping. The drive maps its parameters and other data to the 4xxxx holding registers as follows:

- 40001...40099 map to drive control and actual values. These registers are described in the table below.
- 40101...49999 map to drive parameters 0101...9999. Register addresses that do not correspond to drive parameters are invalid. If there is an attempt to read or write outside the parameter addresses, the Modbus interface returns an exception code to the controller.

The following table summarizes the 4xxxx drive control registers 40001...40099 (for 4xxxx registers above 40099, see the drive parameter list, e.g. 40102 is parameter 0102):

Modbus register		Access	Remarks
40001	CONTROL WORD	R/W	Maps directly to the profile's CONTROL WORD. Supported only if 5305 = 0 or 2 (ABB Drives profile). Parameter 5319 holds a copy in hex format. If 5305 = 1 (DCU profile selected), the register remains empty.
40002	Reference 1	R/W	Range = 0...+20000 (scaled to 0...1105 REF1 MAX), or -20000...0 (scaled to 1105 REF1 MAX...0).
40003	Reference 2	R/W	Range = 0...+10000 (scaled to 0...1108 REF2 MAX), or -10000...0 (scaled to 1108 REF2 MAX...0).
40004	STATUS WORD	R	Maps directly to the profile's STATUS WORD. Supported only if 5305 = 0 or 2 (ABB Drives profile). Parameter 5320 holds a copy in hex format. If 5305 = 1 (DCU profile selected), the register remains empty.
40005	Actual 1 (select using 5310)	R	By default, stores a copy of 0103 OUTPUT FREQ. Use parameter 5310 to select a different actual value for this register.
40006	Actual 2 (select using 5311)	R	By default, stores a copy of 0104 CURRENT. Use parameter 5311 to select a different actual value for this register.
40007	Actual 3 (select using 5312)	R	By default, stores nothing. Use parameter 5312 to select an actual value for this register.
40008	Actual 4 (select using 5313)	R	By default, stores nothing. Use parameter 5313 to select an actual value for this register.
40009	Actual 5 (select using 5314)	R	By default, stores nothing. Use parameter 5314 to select an actual value for this register.
40010	Actual 6 (select using 5315)	R	By default, stores nothing. Use parameter 5315 to select an actual value for this register.
40011	Actual 7 (select using 5316)	R	By default, stores nothing. Use parameter 5316 to select an actual value for this register.
40012	Actual 8 (select using 5317)	R	By default, stores nothing. Use parameter 5317 to select an actual value for this register.
40031	ACS550 CONTROL WORD LSW	R/W	Maps directly to the Least Significant Word of the DCU profile's CONTROL WORD. Supported only if 5305 = 1. See parameter 0301.
40032	ACS550 CONTROL WORD MSW	R	Maps directly to the Most Significant Word of the DCU profile's CONTROL WORD. Supported only if 5305 = 1. See parameter 0302.
40033	ACS550 STATUS WORD LSW	R	Maps directly to the Least Significant Word of the DCU profile's STATUS WORD. Supported only if 5305 = 1. See parameter 0303.
40034	ACS550 STATUS WORD MSW	R	Maps directly to the Most Significant Word of the DCU profile's STATUS WORD. Supported only if 5305 = 1. See parameter 0304.
40045	REFERENCE 1 LSW	R/W	The least significant word of reference 1. Supported only by the DCU profile i.e. when 5305 ECB CTRL PROFILE setting is DCU profile.

Modbus register		Access	Remarks
40046	REFERENCE 1 MSW	R/W	The most significant word of reference 1. Supported only by the DCU profile i.e. when 5305 ECB CTRL PROFILE setting is DCU profile.
40047	REFERENCE 2 LSW	R/W	The least significant word of reference 2. Supported only by the DCU profile i.e. when 5305 ECB CTRL PROFILE setting is DCU profile.
40048	REFERENCE 2 MSW	R/W	The most significant word of reference 2. Supported only by DCU profile i.e. when 5305 ECB CTRL PROFILE setting is DCU profile.

For the Modbus protocol, drive parameters in [Group 53: EFB PROTOCOL](#) report the parameter mapping to 4xxxx Registers.

Code	Description
5310	EFB PAR 10 Specifies the parameter mapped to Modbus register 40005.
5311	EFB PAR 11 Specifies the parameter mapped to Modbus register 40006.
5312	EFB PAR 12 Specifies the parameter mapped to Modbus register 40007.
5313	EFB PAR 13 Specifies the parameter mapped to Modbus register 40008.
5314	EFB PAR 14 Specifies the parameter mapped to Modbus register 40009.
5315	EFB PAR 15 Specifies the parameter mapped to Modbus register 40010.
5316	EFB PAR 16 Specifies the parameter mapped to Modbus register 40011.
5317	EFB PAR 17 Specifies the parameter mapped to Modbus register 40012.
5318	EFB PAR 18 Sets additional delay in milliseconds before the ACS550 begins transmitting response to the master request.
5319	EFB PAR 19 Holds a copy (in hex) of the CONTROL WORD, Modbus register 40001.
5320	EFB PAR 20 Holds a copy (in hex) of the STATUS WORD, Modbus register 40004.

Except where restricted by the drive, all parameters are available for both reading and writing. The parameter writes are verified for the correct value and for a valid register addresses.

Note: Parameter writes through standard Modbus are always volatile i.e. modified values are not automatically stored to permanent memory. Use parameter 1607 PARAM SAVE to save all altered values.

The ACS550 supports the following Modbus function codes for 4xxxx registers:

Function code	Description
03	Read holding 4xxxx registers
06	Preset single 4xxxx register
16 (0x10 Hex)	Preset multiple 4xxxx registers
23 (0x17 Hex)	Read/write 4xxxx registers

Actual values

The contents of the register addresses 40005...40012 are ACTUAL VALUES and are:

- specified using parameters 5310...5317
- Read-only values containing information on the operation of the drive
- 16-bit words containing a sign bit and a 15-bit integer
- when negative values, written as the two's complement of the corresponding positive value
- scaled as described earlier in section [Actual value scaling](#) on page 211.

Exception codes

Exception codes are serial communication responses from the drive. The ACS550 supports the standard Modbus exception codes defined below.

Exception code	Name	Meaning
01	ILLEGAL FUNCTION	Unsupported Command
02	ILLEGAL DATA ADDRESS	The data address received in the query is not allowable. It is not a defined parameter/group.
03	ILLEGAL DATA VALUE	A value contained in the query data field is not an allowable value for the ACS550, because it is one of the following: • Outside min. or max. limits. • Parameter is read-only. • Message is too long. • Parameter write not allowed when start is active. • Parameter write not allowed when factory macro is selected.

ABB control profiles technical data

Overview

ABB Drives profile

The ABB Drives profile provides a standard profile that can be used on multiple protocols, including Modbus and the protocols available on the FBA module. Two implementations of the ABB Drives profile are available:

- ABB DRV FULL – This implementation standardizes the control interface with ACS600 and ACS800 drives.
- ABB DRV LIM – This implementation standardizes the control interface with ACS400 drives. This implementation does not support two control word bits supported by ABB DRV FULL.

Except as noted, the following “ABB Drives Profile” descriptions apply to both implementations.

DCU profile

The DCU profile extends the control and status interface to 32 bits. It is the internal interface between the main drive application and the embedded fieldbus environment.

Control Word

The CONTROL WORD is the principal means for controlling the drive from a fieldbus system. The fieldbus master station sends the CONTROL WORD to the drive. The drive switches between states according to the bit-coded instructions in the CONTROL WORD. Using the CONTROL WORD requires that:

- The drive is in remote (REM) control.
- The serial communication channel is defined as the source for controlling commands (set using parameters such as 1001 EXT1 COMMANDS, 1002 EXT2 COMMANDS and 1102 EXT1/EXT2 SEL).
- The serial communication channel used is configured to use an ABB control profile. For example, to use the control profile ABB DRV FULL requires both parameter 9802 COMM PROT SEL = 1 (STD MODBUS) and parameter 5305 EFB CTRL PROFILE = 2 (ABB DRV FULL).

ABB Drives profile

The following table and the state diagram later in this sub-section describe the CONTROL WORD content for the ABB Drives profile.

ABB Drives profile CONTROL WORD (See parameter 5319)				
Bit	Name	Value	Commanded state	Comments
0	OFF1 CONTROL	1	READY TO OPERATE	Enter READY TO OPERATE
		0	EMERGENCY OFF	Drive ramps to stop according to currently active deceleration ramp (2203 or 2205) Normal command sequence: • Enter OFF1 ACTIVE • Proceed to READY TO SWITCH ON, unless other interlocks (OFF2, OFF3) are active.
1	OFF2 CONTROL	1	OPERATING	Continue operation (OFF2 inactive)
		0	EMERGENCY OFF	Drive coasts to stop. Normal command sequence: • Enter OFF2 ACTIVE • Proceed to SWITCHON INHIBITED
2	OFF3 CONTROL	1	OPERATING	Continue operation (OFF3 inactive)
		0	EMERGENCY STOP	Drive stops within time specified by parameter 2208. Normal command sequence: • Enter OFF3 ACTIVE • Proceed to SWITCH ON INHIBITED  WARNING! Be sure motor and driven equipment can be stopped using this mode.
3	INHIBIT OPERATION	1	OPERATION ENABLED	Enter OPERATION ENABLED (Note the Run enable signal must be active. See 1601. If 1601 is set to COMM, this bit also activates the Run Enable signal.)
		0	OPERATION INHIBITED	Inhibit operation. Enter OPERATION INHIBITED
4	Unused (ABB DRV LIM)			
	RAMP_OUT_ZERO (ABB DRV FULL)	1	NORMAL OPERATION	Enter RAMP FUNCTION GENERATOR: ACCELERATION ENABLED
		0	RFG OUT ZERO	Force ramp function generator output to Zero. Drive ramps to stop (current and DC voltage limits in force).
5	RAMP_HOLD	1	RFG OUT ENABLED	Enable ramp function. Enter RAMP FUNCTION GENERATOR: ACCELERATOR ENABLED
		0	RFG OUT HOLD	Halt ramping (Ramp Function Generator output held)
6	RAMP_IN_ZERO	1	RFG INPUT ENABLED	Normal operation. Enter OPERATING
		0	RFG INPUT ZERO	Force Ramp Function Generator input to zero.

ABB Drives profile CONTROL WORD (See parameter 5319)				
Bit	Name	Value	Commanded state	Comments
7	RESET	0=>1	RESET	Fault reset if an active fault exists (Enter SWITCH-ON INHIBITED). Effective if 1604 = COMM.
		0	OPERATING	Continue normal operation
8...9	Unused			
10	Unused (ABB DRV LIM)			
	REMOTE_CMD (ABB DRV FULL)	1		Fieldbus control enabled.
		0		- CW ≠ 0 or Ref ≠ 0: Retain last CW and Ref. - CW = 0 and Ref = 0: Fieldbus control enabled. - Ref and deceleration/acceleration ramp are locked.
11	EXT CTRL LOC	1	EXT2 SELECT	Select external control location 2 (EXT2). Effective if 1102 = COMM.
		0	EXT1 SELECT	Select external control location 1 (EXT1). Effective if 1102 = COMM.
12...15	Unused			

DCU Profile

The following tables describe the CONTROL WORD content for the DCU profile.

DCU profile CONTROL WORD (See parameter 0301)				
Bit	Name	Value	Command/Req.	Comments
0	STOP	1	Stop	Stops according to either the stop mode parameter or the stop mode requests (bits 7 and 8).
		0	(no op)	
1	START	1	Start	Simultaneous STOP and START commands result in a stop command.
		0	(no op)	
2	REVERSE	1	Reverse direction	This bit XOR'd with the sign of the reference defines direction.
		0	Forward direction	
3	LOCAL	1	Local mode	When the fieldbus sets this bit, it steals control and the drive moves to fieldbus local control mode.
		0	External mode	
4	RESET	-> 1	Reset	Edge sensitive.
		other	(no op)	
5	EXT2	1	Switch to EXT2	
		0	Switch to EXT1	
6	RUN_DISABLE	1	Run disable	Inverted run enable.
		0	Run enable on	
7	STPMODE_R	1	Normal ramp stop mode	
		0	(no op)	

DCU profile CONTROL WORD (See parameter 0301)				
Bit	Name	Value	Command/Req.	Comments
8	STPMODE_EM	1	Emergency ramp stop mode	
		0	(no op)	
9	STPMODE_C	1	Coast stop mode	
		0	(no op)	
10	RAMP_2	1	Ramp pair 2	
		0	Ramp pair 1	
11	RAMP_OUT_0	1	Ramp output to 0	
		0	(no op)	
12	RAMP_HOLD	1	Ramp freeze	
		0	(no op)	
13	RAMP_IN_0	1	Ramp input to 0	
		0	(no op)	
14	RREQ_LOCALL OC	1	Local mode lock	In lock, drive will not switch to local mode.
		0	(no op)	
15	TORQLIM2	1	Torque limit pair 2	
		0	Torque limit pair 1	

DCU profile CONTROL WORD (See parameter 0302)				
Bit	Name	Value	Function	Comments
16...26	Reserved			
27	REF_CONST	1	Constant speed ref.	These bits are only for supervision purposes.
		0	(no op)	
28	REF_AVE	1	Average speed ref.	
		0	(no op)	
29	LINK_ON	1	Master is detected in link	
		0	Link is down	
30	REQ_STARTINH	1	Start inhibit request is pending	
		0	Start inhibit request is OFF	
31	OFF_INTERLOCK	1	Panel OFF button pressed	For the control panel (or PC tool) this is the OFF button interlock.
		0	(no op)	

Status Word

The contents of the STATUS WORD is status information, sent by the drive to the master station.

ABB Drives profile

The following table and the state diagram later in this sub-section describe the STATUS WORD content for the ABB Drives profile.

ABB Drives profile (EFB) STATUS WORD (See parameter 5320)			
Bit	Name	Value	Description (Correspond to states/boxes in the state diagram)
0	RDY_ON	1	READY TO SWITCH ON
		0	NOT READY TO SWITCH ON
1	RDY_RUN	1	READY TO OPERATE
		0	OFF1 ACTIVE
2	RDY_REF	1	OPERATION ENABLED
		0	OPERATION INHIBITED
3	TRIPPED	0...1	FAULT
		0	No fault
4	OFF_2_STA	1	OFF2 INACTIVE
		0	OFF2 ACTIVE
5	OFF_3_STA	1	OFF3 INACTIVE
		0	OFF3 ACTIVE
6	SWC_ON_INHIB	1	SWITCH-ON INHIBIT ACTIVE
		0	SWITCH-ON INHIBIT NOT ACTIVE
7	ALARM	1	Alarm (See section Alarm listing on page 267 for details on alarms.)
		0	No alarm
8	AT_SETPOINT	1	OPERATING. Actual value equals (within tolerance limits) the reference value.
		0	Actual value is outside tolerance limits (not equal to reference value).
9	REMOTE	1	Drive control location: REMOTE (EXT1 or EXT2)
		0	Drive control location: LOCAL
10	ABOVE_LIMIT	1	Supervised parameter's value $\geq$ supervision high limit. Bit remains "1" until supervised parameter's value < supervision low limit. See Group 32: SUPERVISION .
		0	Supervised parameter's value < supervision low limit. Bit remains "0" until supervised parameter's value > supervision high limit. See Group 32: SUPERVISION .
11	EXT CTRL LOC	1	External control location 2 (EXT2) selected
		0	External control location 1 (EXT1) selected
12	EXT RUN ENABLE	1	External Run Enable signal received
		0	No External Run Enable signal received
13... 15	Unused		

DCU profile

The following tables describe the STATUS WORD content for the DCU profile.

DCU profile STATUS WORD (See parameter 0303)			
Bit	Name	Value	Status
0	READY	1	Drive is ready to receive start command.
		0	Drive is not ready.
1	ENABLED	1	External run enable signal received.
		0	No external run enable signal received.
2	STARTED	1	Drive has received start command.
		0	Drive has not received start command.
3	RUNNING	1	Drive is modulating.
		0	Drive is not modulating.
4	ZERO_SPEED	1	Drive is at zero speed.
		0	Drive has not reached zero speed.
5	ACCELERATE	1	Drive is accelerating.
		0	Drive is not accelerating.
6	DECELERATE	1	Drive is decelerating.
		0	Drive is not decelerating.
7	AT_SETPOINT	1	Drive is at setpoint.
		0	Drive has not reached setpoint.
8	LIMIT	1	Operation is limited by Group 20: LIMITS settings.
		0	Operation is within Group 20: LIMITS settings.
9	SUPERVISION	1	A supervised parameter (Group 32: SUPERVISION) is outside its limits.
		0	All supervised parameters are within limits.
10	REV_REF	1	Drive reference is in reverse direction.
		0	Drive reference is in forward direction.
11	REV_ACT	1	Drive is running in reverse direction.
		0	Drive is running in forward direction.
12	PANEL_LOCAL	1	Control is in control panel (or PC tool) local mode.
		0	Control is not in control panel local mode.
13	FIELDBUS_LOCAL	1	Control is in fieldbus local mode (steals control panel local).
		0	Control is not in fieldbus local mode.
14	EXT2_ACT	1	Control is in EXT2 mode.
		0	Control is in EXT1 mode.
15	FAULT	1	Drive is in a fault state.
		0	Drive is not in a fault state.

DCU profile STATUS WORD (See parameter 0304)			
Bit	Name	Value	Status
16	ALARM	1	An alarm is on.
		0	No alarms are on.
17	REQ_MAINT	1	A maintenance request is pending.
		0	No maintenance request is pending.
18	DIRLOCK	1	Direction lock is ON. (Direction change is locked out.)
		0	Direction lock is OFF.
19	LOCALLOCK	1	Local mode lock is ON. (Local mode is locked out.)
		0	Local mode lock is OFF.
20	CTL_MODE	1	Drive is in vector control mode.
		0	Drive is in scalar control mode.
21...25	Reserved		
26	REQ_CTL	1	Copy the control word
		0	(no op)
27	REQ_REF1	1	Reference 1 requested in this channel.
		0	Reference 1 is not requested in this channel.
28	REQ_REF2	1	Reference 2 requested in this channel.
		0	Reference 2 is not requested in this channel.
29	REQ_REF2EXT	1	External PID reference 2 requested in this channel.
		0	External PID reference 2 is not requested in this channel.
30	ACK_STARTINH	1	A start inhibit from this channel is granted.
		0	A start inhibit from this channel is not granted.
31	ACK_OFF_ILCK	1	Start inhibit due to OFF button
		0	Normal operation

State diagram

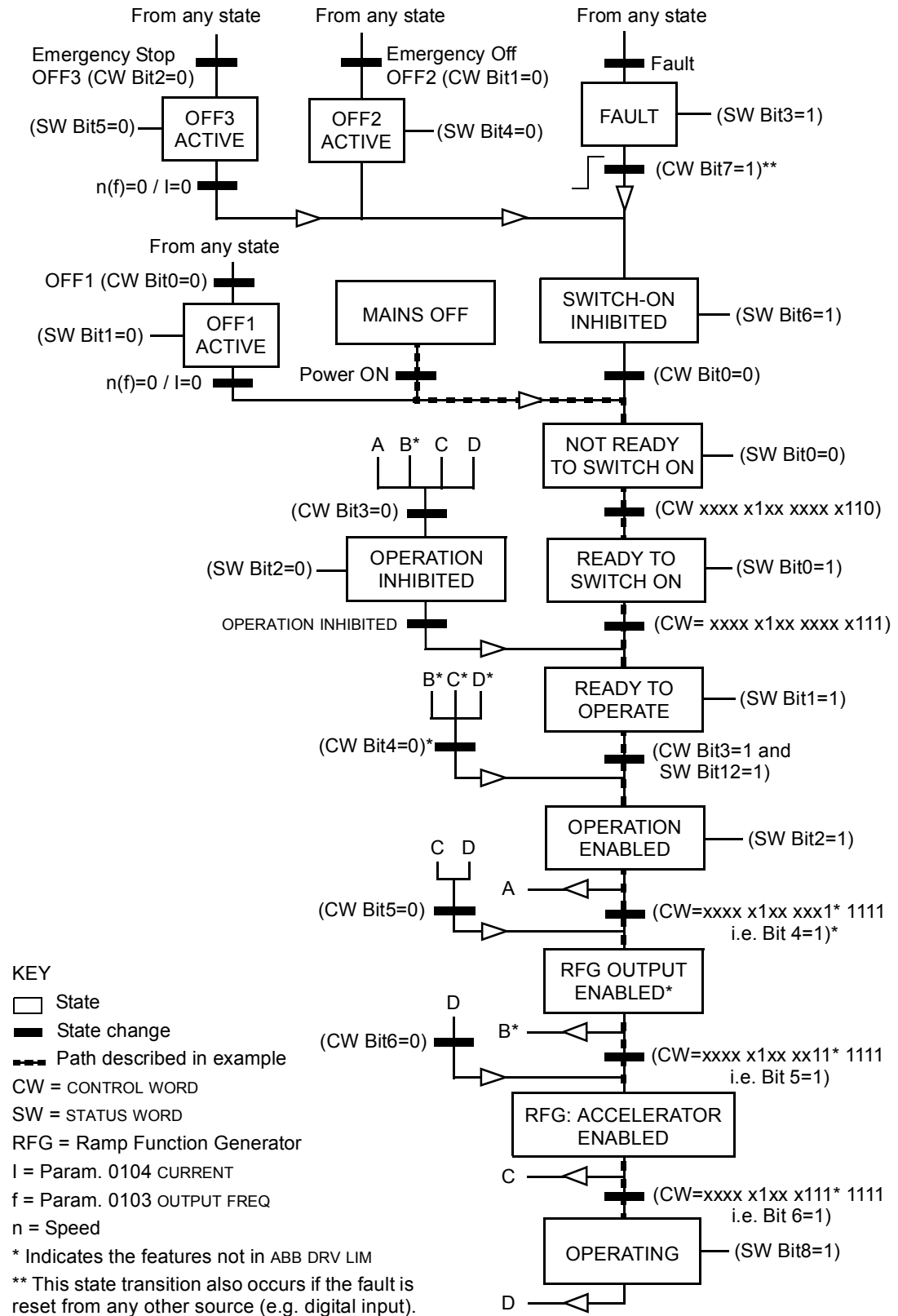
ABB Drives profile

To illustrate the operation of the state diagram, the following example (ABB DRV LIM implementation of the ABB Drives profile) uses the control word to start the drive:

- First, the requirements for using the CONTROL WORD must be met. See above.
- When the power is first connected, the state of the drive is not ready to switch on. See dotted lined path (---) in the state diagram below.
- Use the CONTROL WORD to step through the state machine states until the OPERATING state is reached, meaning that the drive is running and follows the given reference. See the table below.

Step	CONTROL WORD Value	Description
1	CW = 0000 0000 0000 0110 bit 15 bit 0	This CW value changes the drive state to READY TO SWITCH ON.
2		Wait at least 100 ms before proceeding.
3	CW = 0000 0000 0000 0111	This CW value changes the drive state to READY TO OPERATE.
4	CW = 0000 0000 0000 1111	This CW value changes the drive state to OPERATION ENABLED. The drive starts, but will not accelerate.
5	CW = 0000 0000 0010 1111	This CW value releases the ramp function generator (RFG) output and changes the drive state to RFG: ACCELERATOR ENABLED.
6	CW = 0000 0000 0110 1111	This CW value releases the ramp function generator (RFG) output and changes the drive state to OPERATING. The drive accelerates to the given reference and follows the reference.

The state diagram below describes the start-stop function of CONTROL WORD (CW) and STATUS WORD (SW) bits for the ABB Drives profile.



Reference scaling

Fieldbus references REF1 and REF2 are scaled as shown in the following tables.

Fieldbus scaling for ABB Drives profile

Reference	Range	Reference type	Scaling	Remarks
REF1	-32767 ... +32767	Speed or frequency	-20000 = -(par. 1105) 0 = 0 +20000 = (par. 1105) (20000 corresponds to 100%)	Final reference limited by 1104/1105. Actual motor speed limited by 2001/2002 (speed) or 2007/2008 (frequency).
REF2	-32767 ... +32767	Speed or frequency	-10000 = -(par. 1108) 0 = 0 +10000 = (par. 1108) (10000 corresponds to 100%)	Final reference limited by 1107/1108. Actual motor speed limited by 2001/2002 (speed) or 2007/2008 (frequency).
		Torque	-10000 = -(par. 1108) 0 = 0 +10000 = (par. 1108) (10000 corresponds to 100%)	Final reference limited by 2015/2017 (torque1) or 2016/2018 (torque2).
		PID Reference	-10000 = -(par. 1108) 0 = 0 +10000 = (par. 1108) (10000 corresponds to 100%)	Final reference limited by 4012/4013 (PID set1) or 4112/4113 (PID set2).

Note: The setting of parameter 1104 REF1 MIN and 1107 REF2 MIN has no effect on the scaling of references.

Fieldbus scaling for DCU profile

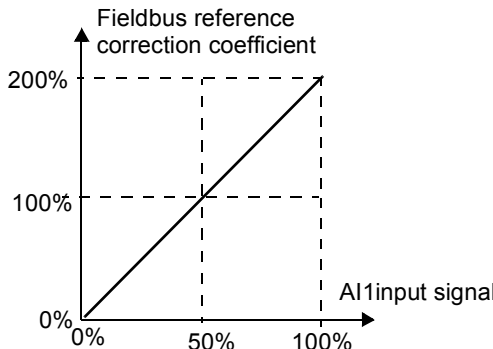
Reference	Range	Reference type	Scaling	Remarks
REF1	-214783648 ... +214783647	Speed or frequency	1000 = 1 rpm / 1 Hz	Final reference limited by 1104/1105. Actual motor speed limited by 2001/2002 (speed) or 2007/2008 (frequency).
REF2	-214783648 ... +214783647	Speed or frequency	1000 = 1%	Final reference limited by 1107/1108. Actual motor speed limited by 2001/2002 (speed) or 2007/2008 (frequency).
		Torque	1000 = 1%	Final reference limited by 2015/2017 (torque1) or 2016/2018 (torque2).
		PID Reference	1000 = 1%	Final reference limited by 4012/4013 (PID set1) or 4112/4113 (PID set2).

Note: The setting of parameter 1104 REF1 MIN and 1107 REF2 MIN has no effect on the scaling of references.

Scaling examples

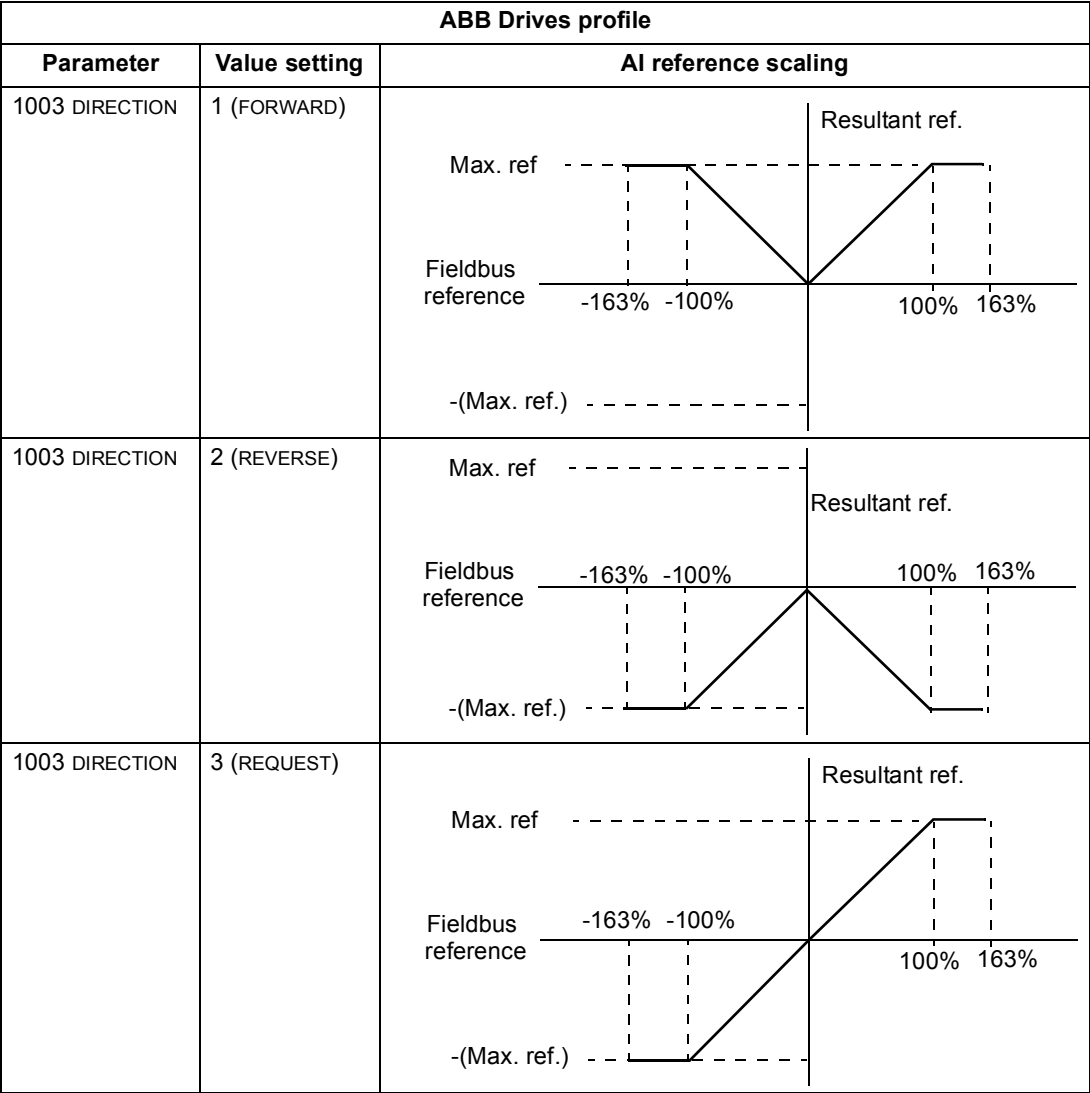
When parameter 1103 REF1 SELECT or 1106 REF2 SELECT is set to COMM+AI1 or COMM*AI1, the reference is scaled as follows:

ABB Drives and DCU profiles		
Reference	Value setting	AI reference scaling
REF1	COMM+AI1	$\text{COMM (\%)} + (\text{AI (\%)} - 0.5 \cdot \text{REF1 MAX (\%)})$
REF1	COMM*AI1	$\text{COMM (\%)} \cdot (\text{AI (\%)} / 0.5 \cdot \text{REF1 MAX (\%)})$
REF2	COMM+AI1	$\text{COMM (\%)} + (\text{AI (\%)} - 0.5 \cdot \text{REF2 MAX (\%)})$

ABB Drives and DCU profiles		
Reference	Value setting	AI reference scaling
REF2	COMM*AI1	$\text{COMM (\%)} \cdot (\text{AI (\%)} / 0.5 \cdot \text{REF2 MAX (\%)})$ 

Reference handling

Use [Group 10: START/STOP/DIR](#) parameters to configure for control of rotation direction for each control location (EXT1 and EXT2). The following diagrams illustrate how group 10 parameters and the sign of the fieldbus reference interact to produce REFERENCE values (REF1 and REF2). Note, fieldbus references are bipolar, that is they can be positive or negative.

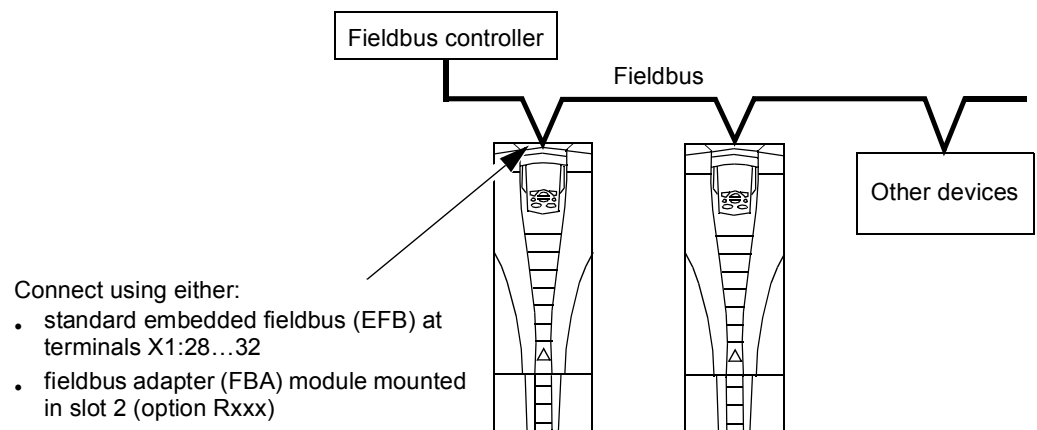


Fieldbus adapter

Overview

The ACS550 can be set up to accept control from an external system using standard serial communication protocols. When using serial communication, the ACS550 can either:

- receive all of its control information from the fieldbus, or
- be controlled from some combination of fieldbus control and other available control locations, such as digital or analog inputs and the control panel.



Two basic serial communications configurations are available:

- embedded fieldbus (EFB) – See chapter [Embedded fieldbus](#) on page 203.
- fieldbus adapter (FBA) – With one of the optional FBA modules in the drive's expansion slot 2, the drive can communicate to a control system using one of the following protocols:
 - PROFIBUS DP
 - Ethernet (Modbus/TCP, EtherNet/IP, EtherCAT, PROFINET IO, POWERLINK)
 - CANopen
 - DeviceNet
 - ControlNet.

The ACS550 detects automatically which communication protocol is used by the plug-in fieldbus adapter. The default settings for each protocol assume that the profile used is the protocol's industry-standard drive profile (e.g. PROFIdrive for PROFIBUS, AC/DC Drive for DeviceNet). All of the FBA protocols can also be configured for the ABB Drives profile.

Configuration details depend on the protocol and profile used. These details are provided in a user's manual supplied with the FBA module.

Details for the ABB Drives profile (which apply for all protocols) are provided in section [ABB Drives profile technical data](#) on page 248.

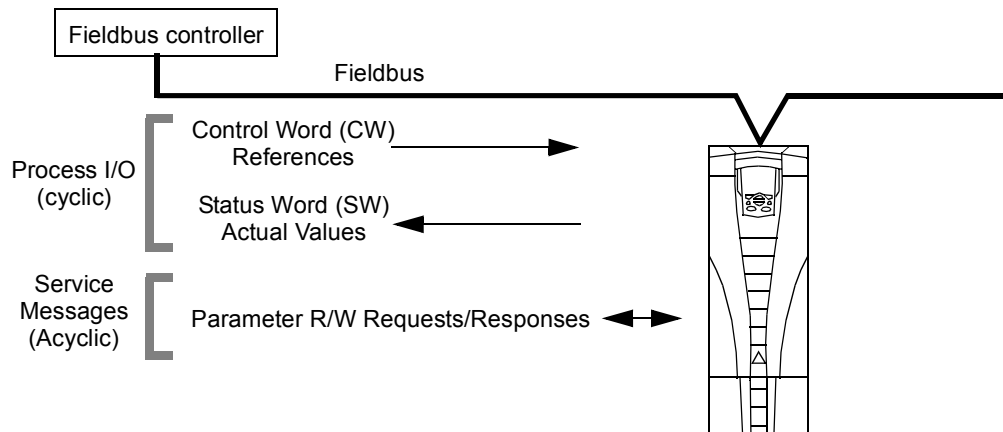
Control interface

In general, the basic control interface between the fieldbus system and the drive consists of:

- Output Words:
 - CONTROL WORD
 - REFERENCE (speed or frequency)
 - Others: The drive supports a maximum of 15 output words. Protocols limits may further restrict the total.
- Input Words:
 - STATUS WORD
 - Actual Value (speed or frequency)
 - Others: The drive supports a maximum of 15 input words. Protocols limits may further restrict the total.

Note: The words “output” and “input” are used as seen from the fieldbus controller point of view. For example an output describes data flow from the fieldbus controller to the drive and appears as an input from the drive point of view.

The meanings of the controller interface words are not restricted by the ACS550. However, the profile used may set particular meanings.



Control Word

The CONTROL WORD is the principal means for controlling the drive from a fieldbus system. The fieldbus controller sends the CONTROL WORD to the drive. The drive switches between states according to the bit-coded instructions in the CONTROL WORD. Using the CONTROL WORD requires that:

- The drive is in remote (REM) control.
- The serial communication channel is defined as the source for controlling commands from EXT1 (set using parameters 1001 EXT1 COMMANDS and 1102 EXT1/EXT2 SEL).
- The external plug-in fieldbus adapter is activated:

- Parameter 9802 COMM PROT SEL = 4 (EXT FBA).
- The external plug-in fieldbus adapter is configured to use the drive profile mode or drive profile objects.

The content of the CONTROL WORD depends on the protocol/profile used. See the user's manual provided with the FBA module and/or section [ABB Drives profile technical data](#) on page 248.

Status Word

The STATUS WORD is a 16-bit word containing status information, sent by the drive to the fieldbus controller. The content of the STATUS WORD depends on the protocol/profile used. See the user's manual provided with the FBA module and/or section [ABB Drives profile technical data](#) on page 248.

Reference

The contents of each REFERENCE word:

- can be used, as speed or frequency reference
- is a 16-bit word comprised of a sign bit and a 15-bit integer
- Negative references (indicating reversed rotation direction) are indicated by the two's complement of the corresponding positive reference value.

The use of a second reference (REF2) is supported only when a protocol is configured for the ABB Drives profile.

Reference scaling is fieldbus type specific. See the user's manual provided with the FBA module and/or the following sections as appropriate:

- [Reference scaling](#) on page 252 ([ABB Drives profile technical data](#))
- [Reference scaling](#) on page 256 ([Generic profile technical data](#)).

Actual Values

Actual Values are 16-bit words containing information on selected operations of the drive. Drive Actual Values (for example, [Group 10: START/STOP/DIR](#) parameters) can be mapped to Input Words using [Group 51: EXT COMM MODULE](#) parameters (protocol-dependent, but typically parameters 5104...5126).

Planning

Network planning should address the following questions:

- What types and quantities of devices must be connected to the network?
- What control information must be sent down to the drives?
- What feedback information must be sent from the drives to the controlling system?

Mechanical and electrical installation – FBA



WARNING! Connections should be made only while the drive is disconnected from the power source.

Overview

The FBA (fieldbus adapter) is a plug-in module that fits in the drive's expansion slot 2. The module is held in place with plastic retaining clips and two screws. The screws also ground the shield for the module cable and connect the module GND signals to the drive control board.

On installation of the module, electrical connection to the drive is automatically established through the 34-pin connector.

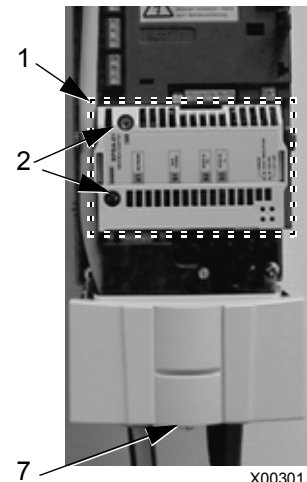
Mounting procedure

Note: Install the input power and motor cables first.

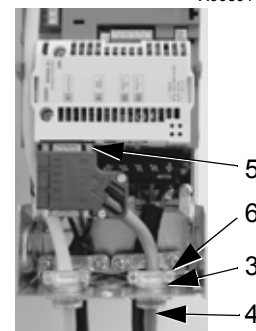
1. Insert the module carefully into the drive expansion slot 2 until the retaining clips lock the module into position.
2. Fasten the two screws (included) to the stand-offs.

Note: Correct installation of the screws is essential for fulfilling the EMC requirements and for proper operation of the module.

3. Open the appropriate knockout in the conduit box and install the cable clamp for the network cable.
4. Route the network cable through the cable clamp.
5. Connect the network cable to the module's network connector.
6. Tighten the cable clamp.
7. Install the conduit box cover (1 screw).
8. For configuration information see the following:
 - section [Communication set-up – FBA](#) on page 241
 - section [Activate drive control functions – FBA](#) on page 241
 - The protocol specific documentation provided with the module.



X00301



X00302

Communication set-up – FBA

Serial communication selection

To activate the serial communication, use parameter 9802 COMM PROT SEL. Set 9802 = 4 (EXT FBA).

Serial communication configuration

Setting 9802, together with mounting a particular FBA module, automatically sets the appropriate default values in parameters that define the communication process. These parameters and descriptions are defined in the user's manual supplied with the FBA module.

- Parameter 5101 is automatically configured.
- Parameters 5102...5126 are protocol-dependent and define, for example, the profile used and additional I/O words. These parameters are referred to as the fieldbus configuration parameters. See the user's manual provided with the FBA module for details on the fieldbus configuration parameters.
- Parameter 5127 forces the validation of changes to parameters 5102...5126. If parameter 5127 is not used, changes to parameters 5102...5126 take affect only after the drive power is cycled.
- Parameters 5128...5133 provide data about the FBA module currently installed (e.g. component versions and status).

See [Group 51: EXT COMM MODULE](#) for parameter descriptions.

Activate drive control functions – FBA

Fieldbus control of various drive functions requires configuration to:

- tell the drive to accept fieldbus control of the function
- define as a fieldbus input, any drive data required for control
- define as a fieldbus output, any control data required by the drive.

The following sections describe, at a general level, the configuration required for each control function. The last column in each table below is deliberately blank. See the user's manual supplied with the FBA module for the appropriate entry.

Start/Stop Direction control

Using the fieldbus for start/stop/direction control of the drive requires:

- drive parameter values set as defined below
- fieldbus controller supplied command(s) in the appropriate location. (The location is defined by the Protocol Reference, which is protocol dependent.)

Drive parameter		Value	Description	Protocol reference
1001	EXT1 COMMANDS	10 (COMM)	Start/Stop controlled by fieldbus with Ext1 selected.	

Drive parameter		Value	Description	Protocol reference
1002	EXT2 COMMANDS	10 (COMM)	Start/Stop by controlled fieldbus with Ext2 selected.	
1003	DIRECTION	3 (REQUEST)	Direction controlled by fieldbus.	

Input reference select

Using the fieldbus to provide input reference to the drive requires:

- drive parameter value set as defined below
- fieldbus controller supplied reference word(s) in the appropriate location. (The location is defined by the Protocol Reference, which is protocol dependent.)

Drive parameter		Value	Description	Protocol reference
1102	EXT1/EXT2 SEL	8 (COMM)	Ref. selected by fieldbus. (Required only if 2 references used.)	
1103	REF1 SELECT	8 (COMM) 9 (COMM+AI1) 10 (COMM*AI1)	Input reference 1 supplied by fieldbus.	
1106	REF2 SELECT	8 (COMM) 9 (COMM+AI) 10 (COMM*AI)	Input reference 2 supplied by fieldbus. (Required only if 2 references used.)	

Note: Multiple references are supported only when using the ABB Drives profile.

Scaling

Where required, REFERENCES can be scaled. See the following sections, as appropriate:

- [Reference scaling](#) on page 252 (*ABB Drives profile technical data*)
- [Reference scaling](#) on page 256 (*Generic profile technical data*).

System control

Using the fieldbus for miscellaneous drive control requires:

- drive parameter values set as defined below
- fieldbus controller command(s) in the appropriate location. (The location is defined by the Protocol Reference, which is protocol dependent.)

Drive parameter		Value	Description	Protocol reference
1601	RUN ENABLE	7 (COMM)	Run enable by fieldbus.	
1604	FAULT RESET SEL	8 (COMM)	Fault reset by fieldbus.	
1607	PARAM SAVE	1 (SAVE)	Saves altered parameters to memory (then value returns to 0).	

Relay output control

Using the fieldbus for relay output control requires:

- drive parameter values set as defined below
- fieldbus controller supplied, binary coded, relay command(s) in the appropriate location. (The location is defined by the Protocol Reference, which is protocol dependent.)

Drive parameter		Value	Description	Protocol reference
1401	RELAY OUTPUT 1	35 (COMM)	Relay Output 1 controlled by fieldbus.	
1402	RELAY OUTPUT 2	36 (COMM(-1))	Relay Output 2 controlled by fieldbus.	
1403	RELAY OUTPUT 3		Relay Output 3 controlled by fieldbus.	
1410 ¹	RELAY OUTPUT 4		Relay Output 4 controlled by fieldbus.	
1411 ¹	RELAY OUTPUT 5		Relay Output 5 controlled by fieldbus.	
1412 ¹	RELAY OUTPUT 6		Relay Output 6 controlled by fieldbus.	

¹ More than 3 relays requires the addition of a relay extension module.

Note: Relay status feedback occurs without configuration as defined below.

Drive parameter		Value	Protocol reference
0122	RO 1-3 STATUS	Relay 1...3 status.	
0123	RO 4-6 STATUS	Relay 4...6 status.	

Analog output control

Using the fieldbus for analog output control (e.g. PID setpoint) requires:

- drive parameter values set as defined below
- fieldbus controller supplied analog value(s) in the appropriate location. (The location is defined by the Protocol Reference, which is protocol dependent.)

Drive parameter		Value	Description	Protocol reference
1501	AO1 CONTENT SEL	135 (COMM VALUE 1)	Analog Output 1 controlled by writing to parameter 0135.	–
0135	COMM VALUE 1	–		
1502 ... 1505	AO1 CONTENT MIN ... MAXIMUM AO1	Set appropriate values.	Used for scaling	–
1506	FILTER AO1		Filter time constant for AO1.	–
1507	AO2 CONTENT SEL	136 (COMM VALUE 2)	Analog Output 2 controlled by writing to parameter 0136.	–
0136	COMM VALUE 2	–		
1508 ... 1511	AO2 CONTENT MIN ... MAXIMUM AO2	Set appropriate values.	Used for scaling	–
1512	FILTER AO2		Filter time constant for AO2.	–

PID Control setpoint source

Using the following settings to select the fieldbus as the setpoint source for PID loops:

Drive parameter		Value	Setting	Protocol reference
4010	SET POINT SEL (Set 1)	8 (COMM VALUE 1)	Setpoint is input reference 2 (+/-/* AI1)	
4110	SET POINT SEL (Set 2)	9 (COMM+AI1)		
4210	SET POINT SEL (Ext/Trim)	10 (COMM*AI1)		

Communication fault

When using fieldbus control, specify the drive's action if serial communication is lost.

Drive parameter		Value	Description
3018	COMM FAULT FUNC	0 (NOT SEL) 1 (FAULT) 2 (CONST SP7) 3 (LAST SPEED)	Set for appropriate drive response.
3019	COMM FAULT TIME	Set time delay before acting on a communication loss.	

Feedback from the drive – FBA

Inputs to the controller (drive outputs) have pre-defined meanings established by the protocol. This feedback does not require drive configuration. The following table lists a sample of feedback data. For a complete listing, see all parameters listed in section [Complete parameter descriptions](#) on page 106.

Drive parameter		Protocol reference
0102	SPEED	
0103	OUTPUT FREQ	
0104	CURRENT	
0105	TORQUE	
0106	POWER	
0107	DC BUS VOLTAGE	
0109	OUTPUT VOLTAGE	
0301	FB CMD WORD 1 – bit 0 (STOP)	
0301	FB CMD WORD 1 – bit 2 (REV)	
0118	DI 1-3 STATUS – bit 0 (DI3)	

Scaling

To scale the drive parameter values see the following sections, as appropriate:

- [Actual Value scaling](#) on page 255 ([ABB Drives profile technical data](#))
- [Actual Value scaling](#) on page 257 ([Generic profile technical data](#)).

Diagnostics – FBA

Fault handling

The ACS550 provides fault information as follows:

- The control panel display shows a fault code and text. See chapter [Diagnostics](#) on page [259](#) for a complete description.
- Parameters 0401 LAST FAULT, 0412 PREVIOUS FAULT1 and 0413 PREVIOUS FAULT2 store the most recent faults.
- For fieldbus access, the drive reports faults as a hexadecimal value, assigned and coded according to the DRIVECOM specification. See the table below. Not all profiles support requesting fault codes using this specification. For profiles that support this specification, the profile documentation defines the proper fault request process.

Drive fault code		Fieldbus fault code (DRIVECOM specification)
1	OVERCURRENT	2310h
2	DC OVERVOLT	3210h
3	DEV OVERTEMP	4210h
4	SHORT CIRC	2340h
5	Reserved	FF6Bh
6	DC UNDERVOLT	3220h
7	AI1 LOSS	8110h
8	AI2 LOSS	8110h
9	MOT OVERTEMP	4310h
10	PANEL LOSS	5300h
11	ID RUN FAIL	FF84h
12	MOTOR STALL	7121h
14	EXT FAULT 1	9000h
15	EXT FAULT 2	9001h
16	EARTH FAULT	2330h
17	Obsolete	FF6Ah
18	THERM FAIL	5210h
19	OPEX LINK	7500h
20	OPEX PWR	5414h
21	CURR MEAS	2211h
22	SUPPLY PHASE	3130h
23	ENCODER ERR	7301h
24	OVERSPEED	7310h
25	Reserved	FF80h
26	DRIVE ID	5400h

Drive fault code		Fieldbus fault code (DRIVECOM specification)
27	CONFIG FILE	630Fh
28	SERIAL 1 ERR	7510h
29	EFB CON FILE	6306h
30	FORCE TRIP	FF90h
31	EFB 1	FF92h
32	EFB 2	FF93h
33	EFB 3	FF94h
34	MOTOR PHASE	FF56h
35	OUTP WIRING	FF95h
36	INCOMPATIBLE SW	630Fh
37	CB OVERTEMP	4110h
38	USER LOAD CURVE	FF6Bh
101	SERF CORRUPT	FF55h
102	Reserved	FF55h
103	SERF MACRO	FF55h
104	Reserved	FF55h
105	Reserved	FF55h
201	DSP T1 OVERLOAD	6100h
202	DSP T2 OVERLOAD	6100h
203	DSP T3 OVERLOAD	6100h
204	DSP STACK ERROR	6100h
205	Reserved (obsolete)	5000h
206	CB ID ERROR	5000h
207	EFB LOAD ERROR	6100h
1000	PAR HZRPM	6320h
1001	PAR PFC REF NEG	6320h
1002	Reserved (obsolete)	6320h
1003	PAR AI SCALE	6320h
1004	PAR AO SCALE	6320h
1005	PAR PCU 2	6320h
1006	PAR EXT RO	6320h
1007	PAR FIELDBUS MISSING	6320h
1008	PAR PFC MODE	6320h
1009	PAR PCU 1	6320h
1012	PAR PFC IO 1	6320h
1013	PAR PFC IO 2	6320h
1014	PAR PFC IO 3	6320h
1016	PAR USER LOAD C	6320h

Serial communication diagnostics

Besides the drive fault codes, the FBA module has diagnostic tools. Refer to the user's manual supplied with the FBA module.

ABB Drives profile technical data

Overview

The ABB Drives profile provides a standard profile that can be used on multiple protocols, including protocols available on the FBA module. This section describes the ABB Drives profile implemented for FBA modules.

Control Word

As described earlier in section [Control interface](#) on page 238, the CONTROL WORD is the principal means for controlling the drive from a fieldbus system.

The following table and the state diagram later in this sub-section describe the CONTROL WORD content for the ABB Drives profile.

ABB Drives profile (FBA) CONTROL WORD				
Bit	Name	Value	Commanded state	Comments
0	OFF1 CONTROL	1	READY TO OPERATE	Enter READY TO OPERATE
		0	EMERGENCY OFF	Drive ramps to stop according to currently active deceleration ramp (2203 or 2205) Normal command sequence: • Enter OFF1 ACTIVE • Proceed to READY TO SWITCH ON, unless other interlocks (OFF2, OFF3) are active.
1	OFF2 CONTROL	1	OPERATING	Continue operation (OFF2 inactive)
		0	EMERGENCY OFF	Drive coasts to stop. Normal command sequence: • Enter OFF2 ACTIVE • Proceed to SWITCHON INHIBITED
2	OFF3 CONTROL	1	OPERATING	Continue operation (OFF3 inactive)
		0	EMERGENCY STOP	Drive stops within in time specified by parameter 2208. Normal command sequence: • Enter OFF3 ACTIVE • Proceed to SWITCH ON INHIBITED  WARNING! Be sure motor and driven equipment can be stopped using this mode.
3	INHIBIT OPERATION	1	OPERATION ENABLED	Enter OPERATION ENABLED (Note the Run enable signal must be active. See 1601. If 1601 is set to COMM, this bit also activates the Run Enable signal.)
		0	OPERATION INHIBITED	Inhibit operation. Enter OPERATION INHIBITED
4	RAMP_OUT_ ZERO	1	NORMAL OPERATION	Enter RAMP FUNCTION GENERATOR: ACCELERATION ENABLED
		0	RFG OUT ZERO	Force ramp function generator output to Zero. Drive ramps to stop (current and DC voltage limits in force).

ABB Drives profile (FBA) CONTROL WORD				
Bit	Name	Value	Commanded state	Comments
5	RAMP_HOLD	1	RFG OUT ENABLED	Enable ramp function. Enter RAMP FUNCTION GENERATOR: ACCELERATOR ENABLED
		0	RFG OUT HOLD	Halt ramping (Ramp Function Generator output held)
6	RAMP_IN_ZERO	1	RFG INPUT ENABLED	Normal operation. Enter OPERATING
		0	RFG INPUT ZERO	Force Ramp Function Generator input to zero.
7	RESET	0=>1	RESET	Fault reset if an active fault exists (Enter SWITCH-ON INHIBITED). Effective if 1604 = COMM.
		0	OPERATING	Continue normal operation
8...9	Unused			
10	REMOTE_CMD	1		Fieldbus control enabled
		0		- CW ≠ 0 or Ref ≠ 0: Retain last CW and Ref. - CW = 0 and Ref = 0: Fieldbus control enabled. - Ref and deceleration/acceleration ramp are locked.
11	EXT CTRL LOC	1	EXT2 SELECT	Select external control location 2 (EXT2). Effective if 1102 = COMM.
		0	EXT1 SELECT	Select external control location 1 (EXT1). Effective if 1102 = COMM.
12...15	Unused			

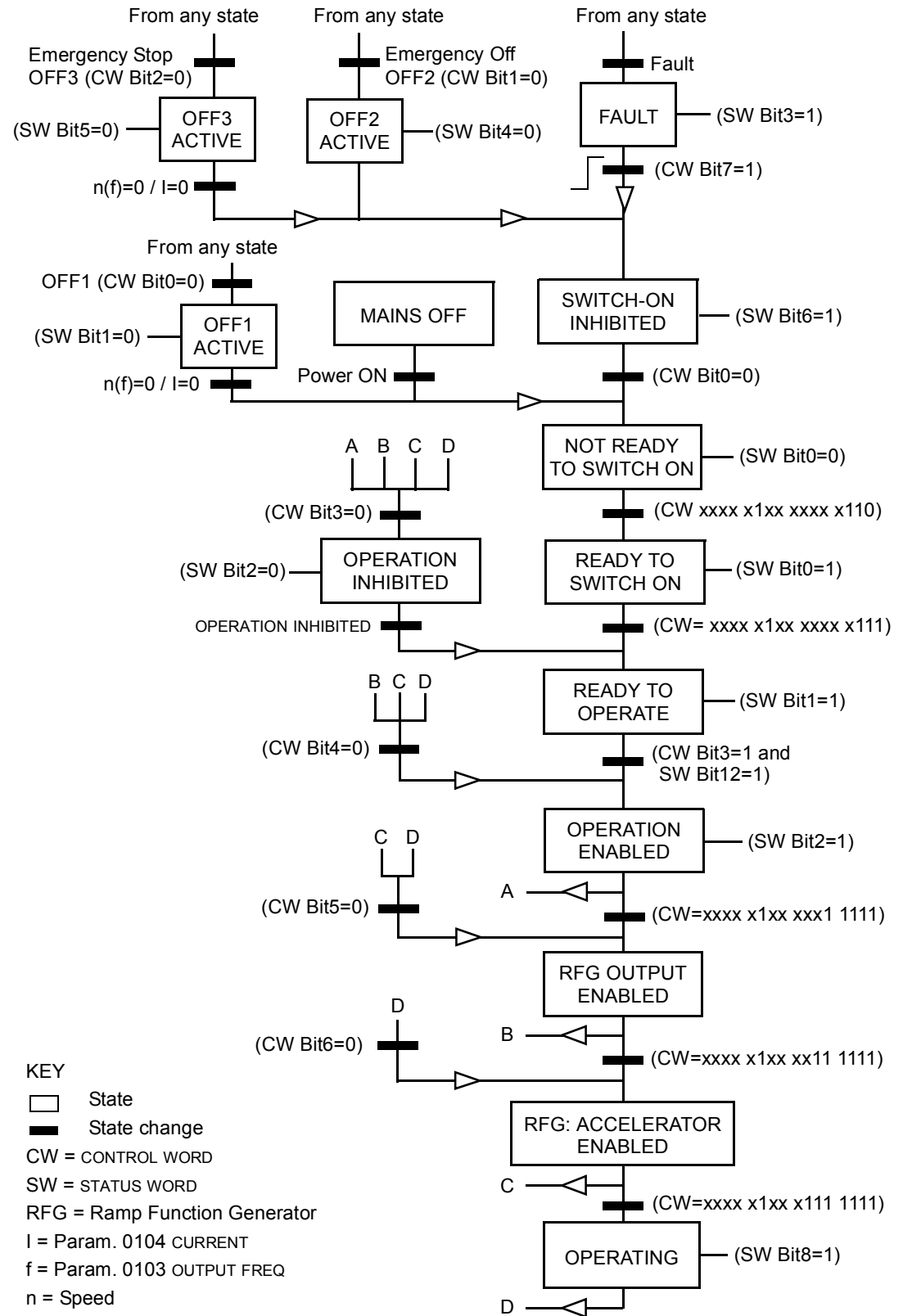
Status Word

As described earlier in section [Control interface](#) on page 238, the contents of the STATUS WORD is status information, sent by the drive to the master station. The following table and the state diagram later in this sub-section describe the status word content.

ABB Drives profile (FBA) STATUS WORD			
Bit	Name	Value	Description (Correspond to states/boxes in the state diagram)
0	RDY_ON	1	READY TO SWITCH ON
		0	NOT READY TO SWITCH ON
1	RDY_RUN	1	READY TO OPERATE
		0	OFF1 ACTIVE
2	RDY_REF	1	OPERATION ENABLED
		0	OPERATION INHIBITED
3	TRIPPED	0...1	FAULT
		0	No fault

ABB Drives profile (FBA) STATUS WORD			
Bit	Name	Value	Description (Correspond to states/boxes in the state diagram)
4	OFF_2_STA	1	OFF2 inactive
		0	OFF2 ACTIVE
5	OFF_3_STA	1	OFF3 inactive
		0	OFF3 ACTIVE
6	SWC_ON_INHIB	1	SWITCH-ON INHIBIT ACTIVE
		0	SWITCH-ON INHIBIT NOT ACTIVE
7	ALARM	1	Alarm (See section Alarm listing on page 267 for details on alarms.)
		0	No alarm
8	AT_SETPOINT	1	OPERATING. Actual value equals (within tolerance limits) the reference value.
		0	Actual value is outside tolerance limits (not equal to reference value).
9	REMOTE	1	Drive control location: REMOTE (EXT1 or EXT2)
		0	Drive control location: LOCAL
10	ABOVE_LIMIT	1	Supervised parameter's value $\geq$ supervision high limit. Bit remains "1" until supervised parameter's value < supervision low limit. See Group 32: SUPERVISION .
		0	Supervised parameter's value < supervision low limit. Bit remains "0" until supervised parameter's value > supervision high limit. See Group 32: SUPERVISION .
11	EXT CTRL LOC	1	External control location 2 (EXT2) selected
		0	External control location 1 (EXT1) selected
12	EXT RUN ENABLE	1	External Run Enable signal received
		0	No External Run Enable signal received
13... 15	Unused		

The state diagram below describes the start-stop function of CONTROL WORD (CW) and STATUS WORD (SW) bits.



Reference

As described earlier in section [Control interface](#) on page 238, the REFERENCE word is a speed or frequency reference.

Reference scaling

The following table describes REFERENCE scaling for the ABB Drives profile.

ABB Drives Profile (FBA)				
Reference	Range	Reference type	Scaling	Remarks
REF1	-32767... +32767	Speed or frequency	-20000 = -(par. 1105) 0 = 0 +20000 = (par. 1105) (20000 corresponds to 100%)	Final reference limited by 1104/1105. Actual motor speed limited by 2001/2002 (speed) or 2007/2008 (frequency).
REF2	-32767... +32767	Speed or frequency	-10000 = -(par. 1108) 0 = 0 +10000 = (par. 1108) (10000 corresponds to 100%)	Final reference limited by 1107/1108. Actual motor speed limited by 2001/2002 (speed) or 2007/2008 (frequency).
		Torque	-10000 = -(par. 1108) 0 = 0 +10000 = (par. 1108) (10000 corresponds to 100%)	Final reference limited by 2015/2017 (torque1) or 2016/2018 (torque2).
		PID Reference	-10000 = -(par. 1108) 0 = 0 +10000 = (par. 1108) (10000 corresponds to 100%)	Final reference limited by 4012/4013 (PID set1) or 4112/4113 (PID set2).

Note: The setting of parameter 1104 REF1 MIN and 1107 REF2 MIN has no effect on the scaling of references.

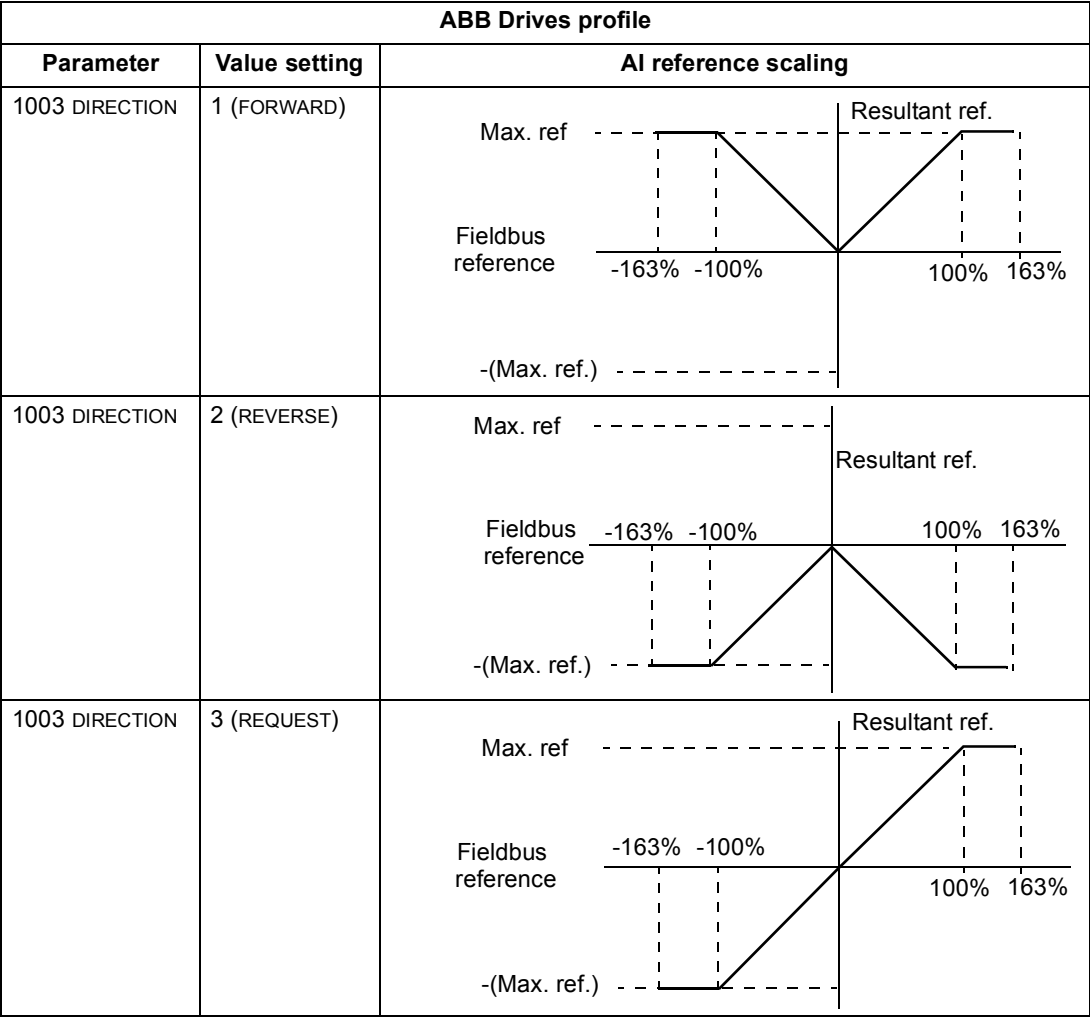
When parameter 1103 REF1 SELECT or 1106 REF2 SELECT is set to COMM+AI1 or COMM*AI1, the reference is scaled as follows:

ABB Drives profile (FBA)		
Reference	Value setting	AI reference scaling
REF1	COMM+AI1	$\text{COMM (\%)} + (\text{AI (\%)} - 0.5 \cdot \text{REF1 MAX (\%)})$ Fieldbus reference correction coefficient (100 + 0.5 · (Par. 1105))% 100% (100 - 0.5 · (par. 1105))% 0% 50% 100% AI1 input signal

ABB Drives profile (FBA)		
Reference	Value setting	AI reference scaling
REF1	COMM*AI1	$\text{COMM (\%)} \cdot (\text{AI (\%)} / 0.5 \cdot \text{REF1 MAX (\%)})$ (100 - 0.5 · (par. 1105))%
REF2	COMM+AI1	$\text{COMM (\%)} + (\text{AI (\%)} - 0.5 \cdot \text{REF2 MAX (\%)})$ (100 + 0.5 · (Par. 1108))% (100 - 0.5 · (par. 1108))%
REF2	COMM*AI1	$\text{COMM (\%)} \cdot (\text{AI (\%)} / 0.5 \cdot \text{REF2 MAX (\%)})$

Reference handling

Use [Group 10: START/STOP/DIR](#) parameters to configure for control of rotation direction for each control location (EXT1 and EXT2). The following diagrams illustrate how group 10 parameters and the sign of the fieldbus reference interact to produce REFERENCE values (REF1 and REF2). Note, fieldbus references are bipolar, that is they can be positive or negative.



Actual Value

As described earlier in section [Control interface](#) on page 238, Actual Values are words containing drive values.

Actual Value scaling

The scaling of the integers sent to the fieldbus as Actual Values depends on the resolution of the selected drive parameter. Except as noted for ACT1 and ACT2 below, scale the feedback integer using the resolution listed for the parameter in section [Complete parameter list](#) on page 91. For example:

Feedback integer	Parameter resolution	Scaled Value
1	0.1 mA	$1 \cdot 0.1 \text{ mA} = 0.1 \text{ mA}$
10	0.1%	$10 \cdot 0.1\% = 1\%$

Data words 5 and 6 are scaled as follows:

ABB Drives profile		
	Contents	Scaling
ACT1	ACTUAL SPEED	-20000 ... +20000 = -(par. 1105) ... +(par. 1105)
ACT2	TORQUE	-10000 ... +10000 = -100% ... +100%

Virtual addresses of the drive control

The virtual address area of the drive control is allocated as follows:

1	Control Word
2	Reference 1 (REF1)
3	Reference 2 (REF2)
4	Status Word
5	Actual Value 1 (ACT1)
6	Actual Value 2 (ACT2)

Generic profile technical data

Overview

The generic profile aims to fulfill the industry-standard drive profile for each protocol (e.g. PROFIdrive for PROFIBUS, AC/DC Drive for DeviceNet).

Control Word

As described earlier in section [Control interface](#) on page 238, the CONTROL WORD is the principal means for controlling the drive from a fieldbus system. For specific CONTROL WORD content, see the user's manual provided with the FBA module.

Status Word

As described earlier in section [Control interface](#) on page 238, the contents of the STATUS WORD is status information, sent by the drive to the master station. For specific STATUS WORD content, see the user's manual provided with the FBA module.

Reference

As described earlier in section [Control interface](#) on page 238, the REFERENCE word is a speed or frequency reference.

Note: REF2 is not supported by the Generic Drive profiles.

Reference scaling

REFERENCE scaling is fieldbus type specific. However, at the drive, the meaning of a 100% REFERENCE value is fixed as described in the table below. For a detailed description on the range and scaling of the REFERENCE, see the user's manual supplied with the FBA module.

Generic profile				
Reference	Range	Reference type	Scaling	Remarks
REF	Fieldbus specific	Speed	-100% = -(par. 9908) 0 = 0 +100 = (par. 9908)	Final reference limited by 1104/1105. Actual motor speed limited by 2001/2002 (speed).
		Frequency	-100% = -(par. 9907) 0 = 0 +100 = (par. 9907)	Final reference limited by 1104/1105. Actual motor speed limited by 2007/2008 (frequency).

Actual Values

As described earlier in section [Control interface](#) on page 238, Actual Values are words containing drive values.

Actual Value scaling

For Actual Values, scale the feedback integer using the parameter's resolution. (See section [Complete parameter list](#) on page 91 for parameter resolutions.) For example:

Feedback integer	Parameter resolution	(Feedback integer) · (Parameter resolution) = Scaled Value
1	0.1 mA	$1 \cdot 0.1 \text{ mA} = 0.1 \text{ mA}$
10	0.1%	$10 \cdot 0.1\% = 1\%$

Where parameters are in percent, the [Complete parameter list](#) section specifies what parameter corresponds to 100%. In such cases, to convert from percent to engineering units, multiply by the value of the parameter that defines 100% and divide by 100%. For example:

Feedback integer	Parameter resolution	Value of the parameter that defines 100%	(Feedback integer) · (Parameter resolution) · (Value of 100% ref.) / 100% = Scaled Value
10	0.1%	1500 rpm ¹	$10 \cdot 0.1\% \cdot 1500 \text{ RPM} / 100\% = 15 \text{ rpm}$
100	0.1%	500 Hz ²	$100 \cdot 0.1\% \cdot 500 \text{ Hz} / 100\% = 50 \text{ Hz}$

¹ Assuming, for the sake of this example, that the Actual Value uses parameter 9908 MOT NOM SPEED as the 100% reference and that 9908 = 1500 rpm.

² Assuming, for the sake of this example, that the Actual Value uses parameter 9907 MOT NOM FREQ as the 100% reference and that 9907 = 500 Hz.

Actual Value mapping

See the user's manual supplied with the FBA module.

Diagnostics



WARNING! Do not attempt any measurement, parts replacement or other service procedure not described in this manual. Such action will void the warranty, may endanger correct operation and increase downtime and expense.



WARNING! All electrical installation and maintenance work described in this chapter should only be undertaken by qualified service personnel. The safety instructions in chapter [Safety instructions](#) on page 5 must be followed.

Diagnostic displays

The drive detects error situations and reports them using:

- the green and red LED on the body of the drive
- the status LED on the control panel (if an Assistant Control Panel is attached to the drive)
- the control panel display (if a control panel is attached to the drive)
- the Fault Word and Alarm Word parameter bits (parameters 0305 to 0309). See [Group 03: FB ACTUAL SIGNALS](#) on page 112 for the bit definitions.

The form of the display depends on the severity of the error. You can specify the severity for many errors by directing the drive to:

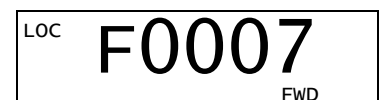
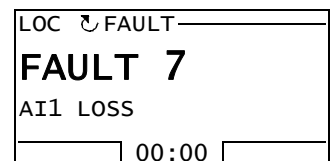
- ignore the error situation
- report the situation as an alarm
- report the situation as a fault.

Red – Faults

The drive signals that it has detected a severe error, or fault, by:

- enabling the red LED on the drive (LED is either steady on or blinking)
- showing the steady red status LED on the control panel (if attached to the drive)
- setting an appropriate bit in a Fault Word parameter (0305 to 0307)
- overriding the control panel display with the display of a fault code in the Fault mode (figures on the right)
- stopping the motor (if it was on).

The fault code on the control panel display is temporary. Pressing any of the following keys removes the fault message: MENU, ENTER, UP, or DOWN key.



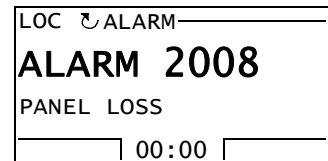
The message reappears after a few seconds if the control panel is not touched and the fault is still active.

Flashing green – Alarms

For less severe errors, called alarms, the diagnostic display is advisory. For these situations, the drive is simply reporting that it had detected something “unusual.” In these situations, the drive:

- flashes the green LED on the drive (does not apply to alarms that arise from control panel operation errors)
- flashes the green LED on the control panel (if attached to the drive)
- sets an appropriate bit in an Alarm Word parameter (0308 or 0309). See [Group 03: FB ACTUAL SIGNALS](#) on page 112 for the bit definitions
- overrides the control panel display with the display of an alarm code and/or name in the Fault mode (figures on the right).

Alarm messages disappear from the control panel display after a few seconds. The message returns periodically as long as the alarm condition exists.



Correcting faults

The recommended corrective action for faults is:

- Use the table in section [Fault listing](#) below to find and address the root cause of the problem.
- Reset the drive. See section [Fault resetting](#) on page 265.

Fault listing

The following table lists the faults by code number and describes each. The fault name is the long form shown in the Fault mode of the Assistant Control Panel when the fault occurs. The fault names shown (for Assistant Control Panel only) in the Fault Logger mode (see page 61) and the fault names for parameter 0401 LAST FAULT may be shorter.

Fault code	Fault name in panel	Description and recommended corrective action
1	OVERCURRENT	Output current is excessive. Check for and correct: • Excessive motor load. • Insufficient acceleration time (parameters 2202 ACCELER TIME 1 and 2205 ACCELER TIME 2). • Faulty motor, motor cables or connections.

Fault code	Fault name in panel	Description and recommended corrective action
2	DC OVERVOLT	Intermediate circuit DC voltage is excessive. Check for and correct: • Static or transient overvoltages in the input power supply. • Insufficient deceleration time (parameters 2203 DECELER TIME 1 and 2206 DECELER TIME 2). • Undersized brake chopper (if present). • Verify that overvoltage controller is ON (using parameter 2005).
3	DEV OVERTEMP	Drive heatsink is overheated. Temperature is at or above limit. R1...R4: 115 °C (239 °F) R5, R6: 125 °C (257 °F) Check for and correct: • Fan failure. • Obstructions in the air flow. • Dirt or dust coating on the heat sink. • Excessive ambient temperature. • Excessive motor load.
4	SHORT CIRC	Fault current. Check for and correct: • A short-circuit in the motor cable(s) or motor. • Supply disturbances.
5	RESERVED	Not used.
6	DC UNDERVOLT	Intermediate circuit DC voltage is not sufficient. Check for and correct: • Missing phase in the input power supply. • Blown fuse. • Undervoltage on mains.
7	AI1 LOSS	Analog input 1 loss. Analog input value is less than AI1 FAULT LIMIT (3021). Check for and correct: • Source and connection for analog input. • Parameter settings for AI1 FAULT LIMIT (3021) and 3001 AI<MIN FUNCTION.
8	AI2 LOSS	Analog input 2 loss. Analog input value is less than AI2 FAULT LIMIT (3022). Check for and correct: • Source and connection for analog input. • Parameter settings for AI2 FAULT LIMIT (3022) and 3001 AI<MIN FUNCTION.
9	MOT OVERTEMP	Motor is too hot, based on either the drive's estimate or on temperature feedback. • Check for overloaded motor. • Adjust the parameters used for the estimate (3005...3009). • Check the temperature sensors and Group 35: MOTOR TEMP MEAS parameters.
10	PANEL LOSS	Panel communication is lost and either: • Drive is in local control mode (the control panel displays LOC), or • Drive is in remote control mode (REM) and is parameterized to accept start/stop, direction or reference from the control panel. To correct check: • Communication lines and connections. • Parameter 3002 PANEL COMM ERR. • Parameters in Group 10: START/STOP/DIR and Group 11: REFERENCE SELECT (if drive operation is REM).

Fault code	Fault name in panel	Description and recommended corrective action
11	ID RUN FAIL	The Motor ID Run was not completed successfully. Check for and correct: • Motor connections. • Motor parameters 9905...9909.
12	MOTOR STALL	Motor or process stall. Motor is operating in the stall region. Check for and correct: • Excessive load. • Insufficient motor power. • Parameters 3010...3012.
13	RESERVED	Not used.
14	EXT FAULT 1	Digital input defined to report first external fault is active. See parameter 3003 EXTERNAL FAULT 1.
15	EXT FAULT 2	Digital input defined to report second external fault is active. See parameter 3004 EXTERNAL FAULT 2.
16	EARTH FAULT	Possible ground fault detected in the motor or motor cables. The drive monitors for ground faults while the drive is running and while the drive is not running. Detection is more sensitive when the drive is not running and can produce false positives. Possible corrections: • Check for/correct faults in the input wiring. • Verify that motor cable does not exceed maximum specified length. • Decrease the detection level for earth fault with parameter 3028 EARTH FAULT LVL. • A delta grounded input power supply and motor cables with high capacitance may result in erroneous error reports during non-running tests. To disable response to fault monitoring when the drive is not running, use parameter 3023 WIRING FAULT. To disable response to all ground fault monitoring, use parameter 3017 EARTH FAULT. Note: Disabling earth fault (ground fault) may void the warranty.
17	OBSOLETE	Not used.
18	THERM FAIL	Internal fault. The thermistor measuring the internal temperature of the drive is open or shorted. Contact your local ABB representative.
19	OPEX LINK	Internal fault. A communication-related problem has been detected on the fiber optic link between the control and OINT boards. Contact your local ABB representative.
20	OPEX PWR	Internal fault. Exceptionally low voltage detected on the OINT power supply. Contact your local ABB representative.
21	CURR MEAS	Internal fault. Current measurement is out of range. Contact your local ABB representative.
22	SUPPLY PHASE	Ripple voltage in the DC link is too high. Check for and correct: • Missing mains phase. • Blown fuse.

Fault code	Fault name in panel	Description and recommended corrective action
23	ENCODER ERR	The drive is not detecting a valid encoder signal. Check for and correct: - Encoder presence and proper connection (reverse wired = channel A connected to terminal of channel B or vice versa, loose connection or short circuit). - Voltage logic levels are outside of the specified range. - A working and properly connected Pulse Encoder Interface Module, OTAC-01. - Wrong value entered in parameter 5001 PULSE NR. A wrong value will only be detected if the error is such that the calculated slip is greater than 4 times the rated slip of the motor. - Encoder is not being used, but parameter 5002 ENCODER ENABLE = 1 (ENABLE).
24	OVERSPEED	Motor speed is greater than 120% of the larger (in magnitude) of 2001 MINIMUM SPEED or 2002 MAXIMUM SPEED. Check for and correct: - Parameter settings for 2001 and 2002. - Adequacy of motor braking torque. - Applicability of torque control. - Brake chopper and resistor.
25	RESERVED	Not used.
26	DRIVE ID	Internal fault. Configuration Block Drive ID is not valid. Contact your local ABB representative.
27	CONFIG FILE	Internal configuration file has an error. Contact your local ABB representative.
28	SERIAL 1 ERR	Fieldbus communication has timed out. Check for and correct: - Fault setup (3018 COMM FAULT FUNC and 3019 COMM FAULT TIME). - Communication settings (Group 51: EXT COMM MODULE or Group 53: EFB PROTOCOL as appropriate). - Poor connections and/or noise on line.
29	EFB CON FILE	Error in reading the configuration file for the embedded fieldbus.
30	FORCE TRIP	Fault trip forced by the fieldbus. See the fieldbus User's Manual.
31	EFB 1	Fault code reserved for the embedded fieldbus (EFB) protocol application. The meaning is protocol dependent.
32	EFB 2	
33	EFB 3	
34	MOTOR PHASE	Fault in the motor circuit. One of the motor phases is lost. Check for and correct: - Motor fault. - Motor cable fault. - Thermal relay fault (if used). - Internal fault.
35	OUTP WIRING	Incorrect input power and motor cable connection (i.e., input power cable is connected to drive motor connection). The fault can be erroneously declared if the drive is faulty or the input power is a delta grounded system and the motor cable capacitance is large. This fault can be disabled by using parameter 3023 WIRING FAULT. Check input power connections. Check grounding.

Fault code	Fault name in panel	Description and recommended corrective action
36	INCOMPATIBLE SW	The drive cannot use the software. - Internal fault. - The loaded software is not compatible with the drive. - Call support representative.
37	CB OVERTEMP	Drive control board is overheated. The fault trip limit is 88 °C. Check for and correct: - Excessive ambient temperature. - Fan failure. - Obstructions in the air flow. Not for drives with an OMIO control board.
38	USER LOAD CURVE	Condition defined by parameter 3701 USER LOAD C MODE has been valid longer than the time defined by 3703 USER LOAD C TIME.
101...199	SYSTEM ERROR	Error internal to the drive. Contact your local ABB representative and report the error number.
201...299	SYSTEM ERROR	Error in the system. Contact your local ABB representative and report the error number.
-	UNKNOWN DRIVE TYPE: ACS550 SUPPORTED DRIVES: X	Wrong type of panel, i.e. panel that supports drive X but not the ACS550, has been connected to the ACS550.

Faults that indicate conflicts in the parameter settings are listed below.

Fault code	Fault name in panel	Description and recommended corrective action
1000	PAR HZRPM	Parameter values are inconsistent. Check for any of the following: 2001 MINIMUM SPEED > 2002 MAXIMUM SPEED. 2007 MINIMUM FREQ > 2008 MAXIMUM FREQ. 2001 MINIMUM SPEED / 9908 MOTOR NOM SPEED is outside proper range (> 50). 2002 MAXIMUM SPEED / 9908 MOTOR NOM SPEED is outside proper range (> 50). 2007 MINIMUM FREQ / 9907 MOTOR NOM FREQ is outside proper range (> 50). 2008 MAXIMUM FREQ / 9907 MOTOR NOM FREQ is outside proper range (> 50).
1001	PAR PFC REF NEG	Parameter values are inconsistent. Check for the following: 2007 MINIMUM FREQ is negative, when 8123 PFC ENABLE is active.
1002	RESERVED	Not used.
1003	PAR AI SCALE	Parameter values are inconsistent. Check for any of the following: 1301 MINIMUM AI1 > 1302 MAXIMUM AI1. 1304 MINIMUM AI2 > 1305 MAXIMUM AI2.
1004	PAR AO SCALE	Parameter values are inconsistent. Check for any of the following: 1504 MINIMUM AO1 > 1505 MAXIMUM AO1. 1510 MINIMUM AO2 > 1511 MAXIMUM AO2.

Fault code	Fault name in panel	Description and recommended corrective action
1005	PAR PCU 2	Parameter values for power control are inconsistent: Improper motor nominal kVA or motor nominal power. Check for the following: $1.1 \leq (9906 \text{ MOTOR NOM CURR} \cdot 9905 \text{ MOTOR NOM VOLT} \cdot 1.73 / P_N) \leq 3.0$ where: $P_N = 1000 \cdot 9909 \text{ MOTOR NOM POWER}$ (if units are kW) or $P_N = 746 \cdot 9909 \text{ MOTOR NOM POWER}$ (if units are hp, e.g. in US)
1006	PAR EXT RO	Parameter values are inconsistent. Check for the following: - Extension relay module not connected and 1410...1412 RELAY OUTPUTS 4...6 have non-zero values.
1007	PAR FIELD BUS MISSING	Parameter values are inconsistent. Check for and correct: A parameter is set for fieldbus control (e.g. 1001 EXT1 COMMANDS = 10 (COMM)), but 9802 COMM PROT SEL = 0.
1008	PAR PFC MODE	Parameter values are inconsistent – 9904 MOTOR CTRL MODE must be = 3 (SCALAR:FREQ), when 8123 PFC ENABLE is activated.
1009	PAR PCU 1	Parameter values for power control are inconsistent: Improper motor nominal frequency or speed. Check for both of the following: $1 \leq (60 \cdot 9907 \text{ MOTOR NOM FREQ} / 9908 \text{ MOTOR NOM SPEED}) \leq 16$ $0.8 \leq 9908 \text{ MOTOR NOM SPEED} / (120 \cdot 9907 \text{ MOTOR NOM FREQ} / \text{Motor Poles}) \leq 0.992$
1010/ 1011	RESERVED	Not used.
1012	PAR PFC IO 1	IO configuration is not complete – not enough relays are parameterized to PFC. Or, a conflict exists between Group 14: RELAY OUTPUTS , parameter 8117 NR OF AUX MOT and parameter 8118 AUTOCHNG INTERV.
1013	PAR PFC IO 2	IO configuration is not complete – the actual number of PFC motors (parameter 8127, MOTORS) does not match the PFC motors in Group 14: RELAY OUTPUTS and parameter 8118 AUTOCHNG INTERV.
1014	PAR PFC IO 3	IO configuration is not complete – the drive is unable to allocate a digital input (interlock) for each PFC motor (parameters 8120 INTERLOCKS and 8127 MOTORS).
1015	RESERVED	Not used.
1016	PAR USER LOAD C	Parameter values for the user load curve are inconsistent. Check that the following conditions are met: $3704 \text{ LOAD FREQ } 1 \leq 3707 \text{ LOAD FREQ } 2 \leq 3710 \text{ LOAD FREQ } 3 \leq 3713 \text{ LOAD FREQ } 4 \leq 3716 \text{ LOAD FREQ } 5$. $3705 \text{ LOAD TORQ LOW } 1 \leq 3706 \text{ LOAD TORQ HIGH } 1$. $3708 \text{ LOAD TORQ LOW } 2 \leq 3709 \text{ LOAD TORQ HIGH } 2$. $3711 \text{ LOAD TORQ LOW } 3 \leq 3712 \text{ LOAD TORQ HIGH } 3$. $3714 \text{ LOAD TORQ LOW } 4 \leq 3715 \text{ LOAD TORQ HIGH } 4$. $3717 \text{ LOAD TORQ LOW } 5 \leq 3718 \text{ LOAD TORQ HIGH } 5$.

Fault resetting

The ACS550 can be configured to automatically reset certain faults. Refer to parameter [Group 31: AUTOMATIC RESET](#).



WARNING! If an external source for start command is selected and it is active, the ACS550 may start immediately after fault reset.

Flashing red LED

To reset the drive for faults indicated by a flashing red LED:

- Turn the power off for 5 minutes.

Red LED

To reset the drive for faults indicated by a red LED (on, not flashing), correct the problem and do one of the following:

- Press RESET from the control panel.
- Turn the power off for 5 minutes.

Depending on the value of 1604 FAULT RESET SEL, the following could also be used to reset the drive:

- digital input
- serial communication.

When the fault has been corrected, the motor can be started.

History

For reference, the last three fault codes are stored into parameters 0401, 0412, 0413. For the most recent fault (identified by parameter 0401), the drive stores additional data (in parameters 0402...0411) to aid in troubleshooting a problem. For example, parameter 0404 stores the motor speed at the time of the fault.

The Assistant Control Panel provides additional information about the fault history. See section [Fault Logger mode](#) on page 61 for more information.

To clear the fault history (all of the [Group 04: FAULT HISTORY](#) parameters):

1. Using the control panel in the Parameters mode, select parameter 0401.
2. Press EDIT (or ENTER on the Basic Control Panel).
3. Press UP and DOWN at the same time.
4. Press SAVE.

Correcting alarms

The recommended corrective action for alarms is:

- Determine if the alarm requires any corrective action (action is not always required).
- Use the table in section [Alarm listing](#) below to find and address the root cause of the problem.

Alarm listing

The following table lists the alarms by code number and describes each.

Alarm code	Display	Description
2001	OVERCURRENT	Current limiting controller is active. Check for and correct: - Excessive motor load. - Insufficient acceleration time (parameters 2202 ACCELER TIME 1 and 2205 ACCELER TIME 2). - Faulty motor, motor cables or connections.
2002	OVERVOLTAGE	Overvoltage controller is active. Check for and correct: - Static or transient overvoltages in the input power supply. - Insufficient deceleration time (parameters 2203 DECELER TIME 1 and 2206 DECELER TIME 2).
2003	UNDERVOLTAGE	Undervoltage controller is active. Check for and correct: Undervoltage on mains.
2004	DIR LOCK	The change in direction being attempted is not allowed. Either: - Do not attempt to change the direction of motor rotation, or - Change parameter 1003 DIRECTION to allow direction change (if reverse operation is safe).
2005	IO COMM	Fieldbus communication has timed out. Check for and correct: - Fault setup (3018 COMM FAULT FUNC and 3019 COMM FAULT TIME). - Communication settings (Group 51: EXT COMM MODULE or Group 53: EFB PROTOCOL as appropriate). - Poor connections and/or noise on line.
2006	AI1 LOSS	Analog input 1 is lost, or value is less than the minimum setting. Check: - Input source and connections. - Parameter that sets the minimum (3021). - Parameter that sets the alarm/fault operation (3001),
2007	AI2 LOSS	Analog input 2 is lost, or value is less than the minimum setting. Check: - Input source and connections. - Parameter that sets the minimum (3022). - Parameter that sets the alarm/fault operation (3001).
2008	PANEL LOSS	Panel communication is lost and either: - Drive is in local control mode (the control panel displays LOC), or - Drive is in remote control mode (REM) and is parameterized to accept start/stop, direction or reference from the control panel. To correct check: - Communication lines and connections. - Parameter 3002 PANEL COMM ERR. - Parameters in Group 10: START/STOP/DIR and Group 11: REFERENCE SELECT (if drive operation is REM).

Alarm code	Display	Description
2009	DEVICE OVERTEMP	Drive heatsink is hot. This alarm warns that a DEVICE OVERTEMP fault may be near. R1...R4: 100 °C (212 °F) R5, R6: 110 °C (230 °F) Check for and correct: • Fan failure. • Obstructions in the air flow. • Dirt or dust coating on the heat sink. • Excessive ambient temperature. • Excessive motor load.
2010	MOTOR TEMP	Motor is hot, based on either the drive's estimate or on temperature feedback. This alarm warns that a MOT OVERTEMP fault trip may be near. Check: • Check for overloaded motor. • Adjust the parameters used for the estimate (3005...3009). • Check the temperature sensors and Group 35: MOTOR TEMP MEAS.
2011	RESERVED	Not used.
2012	MOTOR STALL	Motor is operating in the stall region. This alarm warns that a MOTOR STALL fault trip may be near.
2013 (Note 1)	AUTORESET	This alarm warns that the drive is about to perform an automatic fault reset, which may start the motor. • To control automatic reset, use Group 31: AUTOMATIC RESET.
2014 (Note 1)	AUTOCHANGE	This alarm warns that the PFC autochange function is active. • To control PFC, use Group 81: PFC CONTROL and the PFC macro on page 84.
2015	PFC I LOCK	This alarm warns that the PFC interlocks are active, which means that the drive cannot start the following: • Any motor (when Autochange is used). • The speed regulated motor (when Autochange is not used).
2016/ 2017	RESERVED	Not used.
2018 (Note 1)	PID SLEEP	This alarm warns that the PID sleep function is active, which means that the motor could accelerate when the PID sleep function ends. • To control PID sleep, use parameters 4022...4026 or 4122...4126.
2019	ID RUN	Performing ID Run.
2020	RESERVED	Not used.
2021	START ENABLE 1 MISSING	This alarm warns that the Start Enable 1 signal is missing. • To control Start Enable 1 function, use parameter 1608. To correct, check: • Digital input configuration. • Communication settings.
2022	START ENABLE 2 MISSING	This alarm warns that the Start Enable 2 signal is missing. • To control Start Enable 2 function, use parameter 1609. To correct, check: • Digital input configuration. • Communication settings.

Alarm code	Display	Description
2023	EMERGENCY STOP	Emergency stop activated.
2024	ENCODER ERROR	The drive is not detecting a valid encoder signal. Check for and correct: - Encoder presence and proper connection (reverse wired, loose connection or short circuit). - Voltage logic levels are outside of the specified range. - A working and properly connected Pulse Encoder Interface Module, OTAC-01. - Wrong value entered in parameter 5001 PULSE NR. A wrong value will only be detected if the error is such that the calculated slip is greater than 4 times the rated slip of the motor. - Encoder is not being used, but parameter 5002 ENCODER ENABLE = 1 (ENABLE).
2025	FIRST START	Signals that a the drive is performing a First Start evaluation of motor characteristics. This is normal the first time the motor is run after motor parameters are entered or changed. See parameter 9910 ID RUN for a description of motor models.
2026	RESERVED	Not used.
2027	USER LOAD CURVE	This alarm warns that the condition defined by parameter 3701 USER LOAD C MODE has been valid longer than half of the time defined by 3703 USER LOAD C TIME.
2028	START DELAY	Shown during the Start delay. See parameter 2113 START DELAY.

Note 1. Even when the relay output is configured to indicate alarm conditions (e.g. parameter 1401 RELAY OUTPUT 1 = 5 (ALARM) or 16 (FLT/ALARM)), this alarm is not indicated by a relay output.

Alarm codes (Basic Control Panel)

The Basic Control Panel indicates control panel alarms with a code, A5xxx. The following table lists the alarm codes and descriptions.

Code	Description
5001	Drive is not responding.
5002	The communication profile is incompatible with the drive.
5010	The panel's parameter backup file is corrupted.
5011	Drive is controlled from another source.
5012	Rotation direction is locked.
5013	Button is disabled, because start is inhibited.
5014	Button is disabled, because drive is faulted.
5015	Button is disabled, because local mode lock is on.
5018	Parameter default value can't be found.
5019	Writing a non-zero value is prohibited (can only write a zero value).
5020	Group or parameter does not exist or parameter value is inconsistent.
5021	Group or parameter is hidden.
5022	Group or parameter is write protected.
5023	Modification is not allowed while the drive is running.

Code	Description
5024	Drive is busy, try again.
5025	Write is not allowed while upload or download is in progress.
5026	Value is at or below low limit.
5027	Value is at or above high limit.
5028	Value is invalid – doesn't match any values in the discrete values list.
5029	Memory is not ready, try again.
5030	Request is invalid.
5031	Drive is not ready, e.g due to low DC voltage.
5032	Parameter error was detected.
5040	Selected parameter set can't be found in the current parameter backup.
5041	Parameter backup doesn't fit into memory.
5042	Selected parameter set can't be found in the current parameter backup.
5043	No start inhibit was granted.
5044	Parameter backup versions do not match.
5050	Parameter upload was aborted.
5051	File error was detected.
5052	Parameter upload attempt has failed.
5060	Parameter download was aborted.
5062	Parameter download attempt has failed.
5070	Panel backup memory write error was detected.
5071	Panel backup memory read error was detected.
5080	Operation is not allowed, because the drive is not in local mode.
5081	Operation is not allowed, because a fault is active.
5083	Operation is not allowed, because parameter lock is not open.
5084	Operation is not allowed, because drive is busy, try again.
5085	Download is not allowed, because drive types are incompatible.
5086	Download is not allowed, because drive models are incompatible.
5087	Download is not allowed, because parameter sets do not match.
5088	Operation failed, because a drive memory error was detected.
5089	Download failed, because a CRC error was detected.
5090	Download failed, because a data processing error was detected.
5091	Operation failed, because a parameter error was detected.
5092	Download failed, because parameter sets do not match.

Maintenance



WARNING! Read chapter [Safety instructions](#) on page 5 before performing any maintenance on the equipment. Ignoring the safety instructions can cause injury or death.

Maintenance intervals

If installed in an appropriate environment, the drive requires very little maintenance. This table lists the routine maintenance intervals recommended by ABB.

Maintenance	Interval	Instruction
Heatsink temperature check and cleaning	Depends on the dustiness of the environment (every 6...12 months)	See Heatsink on page 271.
Main cooling fan replacement	Every six years	See Main fan replacement on page 272.
Internal enclosure cooling fan replacement (IP54 / UL type 12 drives)	Every three years.	See Internal enclosure fan replacement on 274.
Capacitor reforming	Every year when stored	See Reforming on page 275.
Capacitor replacement (frame sizes R5 and R6)	Every nine years	See Replacement on page 275.
Replace battery in the Assistant Control Panel	Every ten years	See Battery on page 275.

Consult your local ABB representative for more details on the maintenance. On the Internet, go to www.abb.com/drives and select *Service – Maintenance*.

Heatsink

The heatsink fins accumulate dust from the cooling air. Since a dusty heatsink is less efficient at cooling the drive, overtemperature faults become more likely. In a “normal” environment (not dusty, not clean) check the heatsink annually, in a dusty environment check more often.

Clean the heatsink as follows (when necessary):

1. Remove power from the drive.
2. Remove the cooling fan (see section [Main fan replacement](#) on page 272).
3. Blow clean compressed air (not humid) from bottom to top and simultaneously use a vacuum cleaner at the air outlet to trap the dust.

Note: If there is a risk of the dust entering adjoining equipment, perform the cleaning in another room.

4. Reinstall the cooling fan.
5. Restore power.

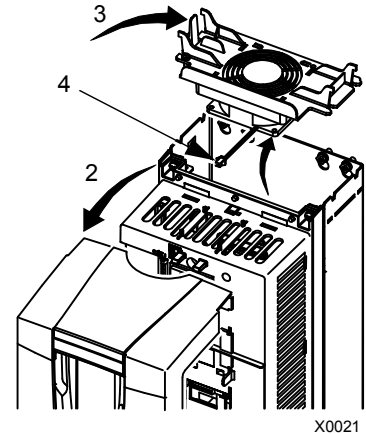
Main fan replacement

Fan failure can be predicted by the increasing noise from fan bearings and the gradual rise in the heatsink temperature in spite of heatsink cleaning. If the drive is operated in a critical part of a process, fan replacement is recommended once these symptoms start appearing. Replacement fans are available from ABB. Do not use other than ABB specified spare parts.

Frame sizes R1...R4

To replace the fan:

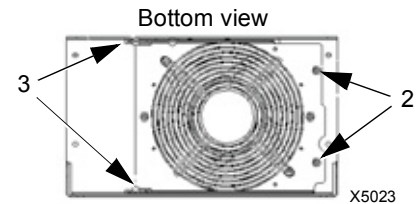
1. Remove power from the drive.
2. Remove drive cover.
3. For frame size:
 - R1, R2: Press together the retaining clips on the fan cover sides, and lift.
 - R3, R4: Press in on the lever located on the left side of the fan mount, and rotate the fan up and out.
4. Disconnect the fan cable.
5. Reinstall the fan in reverse order.
6. Restore power.



Frame size R5

To replace the fan:

1. Remove power from drive.
2. Remove the screws attaching the fan.
3. Remove the fan: Swing the fan out on its hinges.
4. Disconnect the fan cable.
5. Reinstall the fan in reverse order.
6. Restore power.

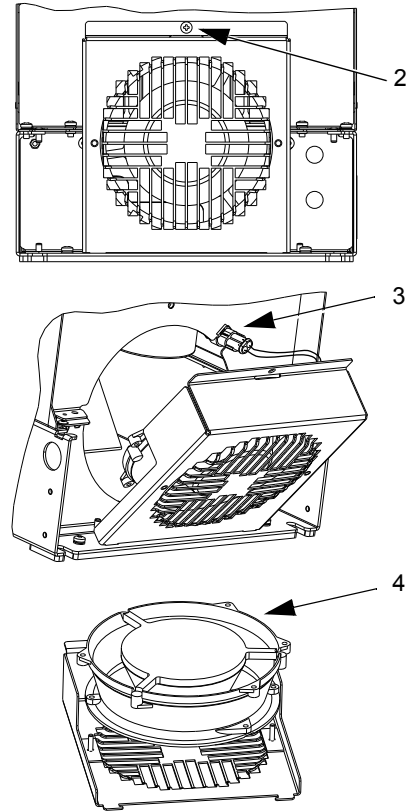


Arrows in the fan show the directions of the rotation and air flow.

Frame size R6

To replace the fan:

1. Remove power from the drive.
2. Remove the screw attaching the fan casing and let the casing lean down against the limiters.
3. Slide out the cable connector and disconnect it.
4. Take off the casing and replace the fan onto the casing's pins.
5. Reinstall the casing in reverse order.
6. Restore power.



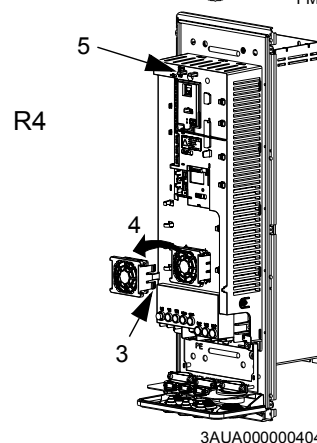
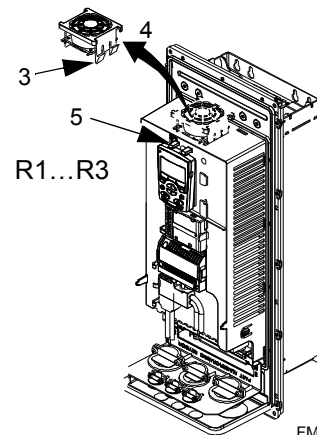
Internal enclosure fan replacement

IP54 / UL type 12 enclosures have an additional internal fan to circulate air inside the enclosure.

Frame sizes R1...R4

To replace the internal enclosure fan in frame sizes R1 to R3 (located at the top of the drive) and R4 (located in front of the drive):

1. Remove power from the drive.
2. Remove the front cover.
3. The housing that holds the fan in place has barbed retaining clips at each corner. Press all four clips toward the center to release the barbs.
4. When the clips/barbs are free, pull the housing up to remove from the drive.
5. Disconnect the fan cable.
6. Install the fan in reverse order, noting that:
 - The fan air flow is up (refer to the arrow on fan).
 - The fan wire harness is toward the front.
 - The notched housing barb is located in the right-rear corner.
 - The fan cable connects just forward of the fan at the top of the drive.



Frame sizes R5 and R6

To replace the internal enclosure fan in frame sizes R5 or R6:

1. Remove power from the drive.
2. Remove the front cover.
3. Lift the fan out and disconnect the cable.
4. Install the fan in reverse order.
5. Restore power.

Capacitors

Reforming

The drive DC link capacitors need to be reformed (re-aged) if the drive has been non-operational for more than one year. Without reforming, capacitors may be damaged when the drive starts to operate. It is therefore recommended to reform the capacitors once a year. See section [Serial number](#) on page 17 for how to check the date of manufacture from the serial number shown on the drive labels.

For information on reforming the capacitors, refer to *Guide for Capacitor Reforming in ACS50, ACS55, ACS150, ACS310, ACS350, ACS355, ACS550, ACH550 and R1-R4 OINT-/SINTboards* (3AFE68735190 [English]), available on the Internet (go to www.abb.com and enter the code in the Search field).

Replacement

The drive intermediate circuit employs several electrolytic capacitors. Capacitor life can be prolonged by lowering the ambient temperature.

It is not possible to predict a capacitor failure. Capacitor failure is usually followed by a input power fuse failure or a fault trip. Contact ABB if capacitor failure is suspected. Replacements for frame size R5 and R6 are available from ABB. Do not use other than ABB specified spare parts.

Control panel

Cleaning

Use a soft damp cloth to clean the control panel. Avoid harsh cleaners which could scratch the display window.

Battery

A battery is only used in Assistant Control Panels that have the clock function available and enabled. The battery keeps the clock operating in memory during power interruptions.

To remove the battery, use a coin to rotate the battery holder on the back of the control panel. Replace the battery with type CR2032.

Note: The battery is NOT required for any control panel or drive function, except the clock.

Technical data

Ratings

By type designation, the table below provides ratings for the ACS550 adjustable speed AC drive, including:

- IEC ratings
- NEMA ratings (shaded columns)
- frame size.

Ratings, 208...240 V drives

Abbreviated column headers are described in section [Symbols](#) on page 279.

Type	Normal use			Heavy-duty use			Frame size
ACS550-x1-see below	I_{2N} A	P_N kW	P_N hp	I_{2hd} A	P_{hd} kW	P_{hd} hp	
Three-phase supply voltage, 208...240 V							
-04A6-2	4.6	0.75	1	3.5	0.55	0.75	R1
-06A6-2	6.6	1.1	1.5	4.6	0.75	1	R1
-07A5-2	7.5	1.5	2	6.6	1.1	1.5	R1
-012A-2	11.8	2.2	3	7.5	1.5	2	R1
-017A-2	16.7	4	5	11.8	2.2	3	R1
-024A-2	24.2	5.5	7.5	16.7	4	5	R2
-031A-2	30.8	7.5	10	24.2	5.5	7.5	R2
-046A-2	46.2	11	15	30.8	7.5	10	R3
-059A-2	59.4	15	20	46.2	11	15	R3
-075A-2	74.8	18.5	25	59.4	15	20	R4
-088A-2	88.0	22	30	74.8	18.5	25	R4
-114A-2	114	30	40	88.0	22	30	R4
-143A-2	143	37	50	114	30	40	R6
-178A-2	178	45	60	150	37	50	R6
-221A-2	221	55	75	178	45	60	R6
-248A-2	248	75	100	192	55	75	R6

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Ratings, 380...480 V drives

Abbreviated column headers are described in section [Symbols](#) on page 279.

Type	Normal use			Heavy-duty use			Frame size
ACS550-x1-see below	I _{2N} A	P _N kW	P _N hp	I _{2hd} A	P _{hd} kW	P _{hd} hp	
Three-phase supply voltage, 380...480 V							
-03A3-4	3.3	1.1	1.5	2.4	0.75	1	R1
-04A1-4	4.1	1.5	2	3.3	1.1	1.5	R1
-05A4-4	5.4	2.2	Note 1	4.1	1.5	Note 1	R1
-06A9-4	6.9	3	3	5.4	2.2	3	R1
-08A8-4	8.8	4	5	6.9	3	3	R1
-012A-4	11.9	5.5	7.5	8.8	4	5	R1
-015A-4	15.4	7.5	10	11.9	5.5	7.5	R2
-023A-4	23	11	15	15.4	7.5	10	R2
-031A-4	31	15	20	23	11	15	R3
-038A-4	38	18.5	25	31	15	20	R3
-045A-4	45	22	30	38	18.5	25	R3
-059A-4	59	30	40	44	22	30	R4
-072A-4	72	37	50	59	30	40	R4
-078A-4	77	Note 2	60	72	Note 2	50	R4
-087A-4	87	45	Note 1	72	37	Note 1	R4
-097A-4	97	Note 2	75	77	Note 2	60	R4
-125A-4	125	55	Note 1	87	45	Note 1	R5
-125A-4	125	Note 2	100	96	Note 2	75	R5
-157A-4	157	75	125	124	55	100	R6
-180A-4	180	90	150	156	75	125	R6
-195A-4	205	110	Note 1	162	90	Note 1	R6
-246A-4	246	132	200	192	110	150	R6
-290A-4	290	160	Note 1	246	132	200	R6

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1. Not available in ACS550-U1 series.
2. Not available in ACS550-01 series.

Ratings, 500...600 V drives

Abbreviated column headers are described in section [Symbols](#) on page 279.

Type	Normal use			Heavy-duty use			Frame size
ACS550-U1- see below	I_{2N} A	P_N kW	P_N hp	I_{2hd} A	P_{hd} kW	P_{hd} hp	
Three-phase supply voltage, 500...600 V (Note 1)							
-02A7-6	2.7	1.5	2	2.4	1.1	1.5	R2
-03A9-6	3.9	2.2	3	2.7	1.5	2	R2
-06A1-6	6.1	4	5	3.9	2.2	3	R2
-09A0-6	9.0	5.5	7.5	6.1	4	5	R2
-011A-6	11	7.5	10	9.0	5.5	7.5	R2
-017A-6	17	11	15	11	7.5	10	R2
-022A-6	22	15	20	17	11	15	R3
-027A-6	27	18.5	25	22	15	20	R3
-032A-6	32	22	30	27	18.5	25	R4
-041A-6	41	30	40	32	22	30	R4
-052A-6	52	37	50	41	30	40	R4
-062A-6	62	45	60	52	37	50	R4
-077A-6	77	55	75	62	45	60	R6
-099A-6	99	75	100	77	55	75	R6
-125A-6	125	90	125	99	75	100	R6
-144A-6	144	110	150	125	90	125	R6

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1. Not available in ACS550-01 series.

Symbols

Typical ratings:

Normal use (10% overload capability)

I_{2N} continuous rms current. 10% overload is allowed for one minute in ten minutes.

P_N typical motor power in normal use. The kilowatt power ratings apply to most IEC, 4-pole motors. The horsepower ratings apply to most 4-pole NEMA motors.

Heavy-duty use (50% overload capability)

I_{2hd} continuous rms current. 50% overload is allowed for one minute in ten minutes.

P_{hd} typical motor power in heavy duty use. The kilowatt power ratings apply to most IEC, 4-pole motors. The horsepower ratings apply to most 4-pole NEMA motors.

Sizing

The current ratings are the same regardless of the supply voltage within one voltage range. To achieve the rated motor power given in the table, the rated current of the drive must be higher than or equal to the rated motor current. Also note that:

- the ratings apply for ambient temperature of 40 °C (104 °F)
- the maximum allowed motor shaft power is limited to $1.5 \cdot P_{hd}$. If the limit is exceeded, motor torque and current are automatically restricted. The function protects the input bridge of the drive against overload.

In multimotor systems, the output current of the drive must be equal to or greater than the calculated sum of the input currents of all motors.

Derating

The load capacity (current and power) decreases for certain situations, as defined below. In such situations, where full motor power is required, oversize the drive so that the derated value provides sufficient capacity.

For example, if your application requires 15.4 A of motor current and a 8 kHz switching frequency, calculate the appropriate drive size requirement as follows:

The minimum size required = $15.4 \text{ A} / 0.80 = 19.25 \text{ A}$

Where: 0.80 is the derating for 8 kHz switching frequency (see section [Switching frequency derating](#) on page 280).

Referring to I_{2N} in the ratings tables (starting from page 277), the following drives exceed the I_{2N} requirement of 19.25 A: ACS550-x1-023A-4, or ACS550-x1-024A-2.

Temperature derating

In the temperature range +40 °C...50 °C (+104 °F...122 °F), the rated output current is decreased 1% for every 1 °C (1.8 °F) above +40 °C (+104 °F). Calculate the output current by multiplying the current given in the rating table by the derating factor.

Example If the ambient temperature is 50 °C (+122 °F), the derating factor is $100\% - 1\%/^{\circ}\text{C} \cdot 10^{\circ}\text{C} = 90\%$ or 0.90.

The output current is then $0.90 \cdot I_{2N}$ or $0.90 \cdot I_{2hd}$.

Altitude derating

In altitudes 1000...4000 m (3300...13,200 ft) above sea level, the derating is 1% for every 100 m (330 ft). If the installation site is higher than 2000 m (6600 ft) above sea level, contact your local ABB representative for further information.

Single phase supply derating

For 208...240 V series drives, a single phase supply can be used. In that case, the derating is 50%.

Switching frequency derating

When using the 8 kHz switching frequency (parameter 2606),

- derate all rated currents and powers (including drive's overload currents) to 80%.

When using the 12 kHz switching frequency (parameter 2606),

- derate all rated currents and powers (including drive's overload currents) to 65% (to 50% for 600 V, R4 frame sizes, that is for ACS550-U1-032A-6 ... ACS550-U1-062A-6),
- derate ambient temperature maximum to 30 °C (86 °F).
- Note: The continuous maximum current is limited to I_{2hd} .

Note: Setting parameter 2607 SWITCH FREQ CTRL = 1 (ON) allows the drive to reduce the switching frequency if/when the drive's internal temperature exceeds 80 °C (with 12 kHz switching frequency) or 90 °C (with 8 kHz switching frequency). See the parameter description for 2607 for details.

Input power connections



WARNING! Do not operate the drive outside the nominal input line voltage range. Overvoltage can result in permanent damage to the drive.

Input power specifications

Input power (mains) connection specifications	
Voltage (U_1)	208/220/230/240 V AC 3-phase (or 1-phase) -15%...+10% for ACS550-x1-xxxx-2. 380/400/415/440/460/480 V AC 3-phase -15%...+10% for ACS550-x1-xxxx-4. 500/525/575/600 V AC 3-phase -15%...+10% for ACS550-U1-xxxx-6.
Prospective short-circuit current (IEC 629)	Maximum allowed prospective short-circuit current in the supply is 100 kA providing that the input power cable of the drive is protected with appropriate fuses. US: 100 000 AIC.
Frequency	48...63 Hz
Imbalance	Max. $\pm 3\%$ of nominal phase to phase input voltage
Fundamental power factor ($\cos \phi_1$)	0.98 (at nominal load)
Cable temperature rating	90 °C (194 °F) rating minimum

Disconnecting device for isolation

Install a hand-operated input disconnecting device (disconnecting means) between the AC power source and the drive. The disconnecting device must be of a type that can be locked to the open position for installation and maintenance work.

- **Europe:** To meet the European Union Directives, according to standard EN 60204-1, Safety of Machinery, the disconnecting device must be one of the following types:
 - a switch-disconnector of utilization category AC-23B (EN 60947-3)
 - a disconnector having an auxiliary contact that in all cases causes switching devices to break the load circuit before the opening of the main contacts of the disconnector (EN 60947-3)
 - a circuit breaker suitable for isolation in accordance with EN 60947-2.
- **Other regions:** The disconnecting device must conform to the applicable safety regulations.

Fuses

Branch circuit protection must be provided by the end user and sized per national and local electric codes. The following tables provide fuse recommendations for short circuit protection on the drive's input power.

The rated fuse currents given in the tables are the maximums for the mentioned fuse types. If smaller fuse ratings are used, check that the fuse rms current rating is larger than the input current.

Check that the operating time of the fuse is below 0.5 seconds. The operating time depends on the fuse type, the supply network impedance as well as the cross-sectional area, material and length of the supply cable. In case the 0.5 seconds operating time is exceeded with the gG or T fuses, ultra rapid (aR) fuses will in most cases reduce the operating time to an acceptable level.

Fuses, 208...240 V drives

ACS550-x1- see below	Input current A	Input power (mains) fuses		
		IEC 60269 gG (A)	UL Class T (A)	Bussmann type
-04A6-2	4.6	10	10	JJS-10
-06A6-2	6.6			
-07A5-2	7.5			
-012A-2	11.8	16	15	JJS-15
-017A-2	16.7	25	25	JJS-25
-024A-2	24.2		30	JJS-30
-031A-2	30.8	40	40	JJS-40
-046A-2	46.2	63	60	JJS-60
-059A-2	59.4		80	JJS-80
-075A-2	74.8	80	100	JJS-100
-088A-2	88.0	100	110	JJS-110
-114A-2	114	125	150	JJS-150
-143A-2	143	200	200	JJS-200
-178A-2	178	250	250	JJS-250
-221A-2	221	315	300	JJS-300
-248A-2	248		350	JJS-350

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Fuses, 380...480 V drives

ACS550-x1- see below	Input current A	Input power (mains) fuses		
		IEC 60269 gG (A)	UL Class T (A)	Bussmann type
-03A3-4	3.3	10	10	JJS-10
-04A1-4	4.1			
-05A4-4	5.4			
-06A9-4	6.9			
-08A8-4	8.8	16	15	JJS-15
-012A-4	11.9		20	JJS-20
-015A-4	15.4			
-023A-4	23	25	30	JJS-30
-031A-4	31	35	40	JJS-40
-038A-4	38	50	50	JJS-50
-045A-4	45		60	JJS-60
-059A-4	59	63	80	JJS-80
-072A-4	72	80	90	JJS-90
-078A-4	77		100	JJS-100

ACS550-x1- see below	Input current A	Input power (mains) fuses		
		IEC 60269 gG (A)	UL Class T (A)	Bussmann type
-087A-4	87	125	125	JJS-125
-097A-4	97			
-125A-4	125	160	175	JJS-175
-157A-4	157	200	200	JJS-200
-180A-4	180	250	250	JJS-250
-195A-4	205			
-246A-4	246	315	350	JJS-350
-290A-4	290			

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Fuses, 500...600 V drives

ACS550-U1- see below	Input current A	Input power (mains) fuses		
		IEC 60269 gG (A)	UL Class T (A)	Bussmann type
-02A7-6	2.7	10	10	JJS-10
-03A9-6	3.9			
-06A1-6	6.1			
-09A0-6	9.0	16	15	JJS-15
-011A-6	11			
-017A-6	17	25	25	JJS-25
-022A-6	22			
-027A-6	27	35	40	JJS-40
-032A-6	32			
-041A-6	41	50	50	JJS-50
-052A-6	52	60	60	JJS-60
-062A-6	62	80	80	JJS-80
-077A-6	77		100	JJS-100
-099A-6	99	125	150	JJS-150
-125A-6	125	160	175	JJS-175
-144A-6	144	200	200	JJS-200

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Emergency stop devices

The overall design of the installation must include emergency stop devices and any other safety equipment that may be needed. Pressing STOP on the drive's control panel does NOT:

- generate an emergency stop of the motor
- separate the drive from dangerous potential.

Input power cables/wiring

Input wiring can be any of:

- a four conductor cable (three phases and ground/protective earth). Shielding is not required.
- four insulated conductors routed through conduit.

Size wiring according to local safety regulations, appropriate input voltage and the drive's load current.

Note: The conductor must be less than the maximum limit defined by the terminal size. Check the maximum wire size according to the table in section [Drive's power connection terminals](#) on page 286.

The table below lists copper and aluminium cable types for different load currents. These recommendations apply only for the conditions listed at the top of the table.

IEC				NEC		
Based on: • EN 60204-1 and IEC 60364-5-2 • PVC insulation • 30 °C (86 °F) ambient temperature • 70 °C (158 °F) surface temperature • cables with concentric copper shield • not more than nine cables laid on cable ladder side by side.				Based on: • NEC Table 310-16 for copper wires • 90 °C (194 °F) wire insulation • 40 °C (104 °F) ambient temperature • not more than three current-carrying conductors in raceway or cable, or earth (directly buried) • copper cables with concentric copper shield.		
Max. load current A	Cu cable mm ²		Max. load current A	Al cable mm ²	Max. load current A	Cu wire size AWG/kcmil
14	3×1.5				22.8	14
20	3×2.5				27.3	12
27	3×4				36.4	10
34	3×6				50.1	8
47	3×10				68.3	6
62	3×16		61	3×25	86.5	4
79	3×25		75	3×35	100	3
98	3×35		91	3×50	118	2
119	3×50		117	3×70	137	1
153	3×70		143	3×95	155	1/0
186	3×95		165	3×120	178	2/0
215	3×120		191	3×150	205	3/0
249	3×150		218	3×185	237	4/0
284	3×185		257	3×240	264	250 MCM or 2 × 1
330	3×240		274	3× (3×50)	291	300 MCM or 2 × 1/0
			285	2× (3×95)	319	350 MCM or 2 × 2/0

Ground connections

For personnel safety, proper operation and reduction of electromagnetic emission/pick-up, the drive and the motor must be grounded at the installation site.

- Conductors must be adequately sized as required by safety regulations.
- Power cable shields must be connected to the drive PE terminal in order to meet safety regulations.
- Power cable shields are suitable for use as equipment grounding conductors only when the shield conductors are adequately sized as required by safety regulations.
- In multiple drive installations, do not connect drive terminals in series.

Corner-grounded TN systems

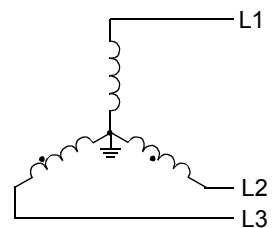


WARNING! Do not attempt to install or remove the EMC filter screws EM1, EM3, F1 or F2 while power is applied to the drive's input terminals.

Corner-grounded TN systems are defined in the following table. In such systems, disconnect the internal ground connection through the EMC filter capacitors (do this also if the grounding configuration of the system is unknown), see section [Disconnecting the internal EMC filter](#) on page 27.

Corner-grounded TN systems – EMC filter must be disconnected			
Grounded at the corner of the delta		Grounded at the mid point of a delta leg	
Single phase, grounded at an end point		Three phase "Variac" without solidly grounded neutral	

The EMC filter capacitors make an internal ground connection that reduces electro-magnetic emission. Where EMC (electro-magnetic compatibility) is a concern, and the system is symmetrically grounded, the EMC filter may be connected. For reference, the diagram on the right illustrates a symmetrically grounded TN system (TN-S system).



IT systems



WARNING! Do not attempt to install or remove the EMC filter screws EM1, EM3, F1 or F2 while power is applied to the drive's input terminals.

For IT systems (an ungrounded power system or a high-resistance-grounded [over 30 ohm] power system):

- Disconnect the ground connection to the internal EMC filter, see section [Disconnecting the internal EMC filter](#) on page 27.
- Where EMC requirements exist, check for excessive emission propagated to neighboring low voltage networks. In some cases, the natural suppression in transformers and cables is sufficient. If in doubt, use a supply transformer with static screening between the primary and secondary windings.
- Do NOT install an external RFI/EMC filter. Using an EMC filter grounds the input power through the filter capacitors, which could be dangerous and could damage the drive.

Drive's power connection terminals

The following table provides specifications for the drive's power connection terminals.

Note: See the recommended cable sizes for different load currents in section [Input power cables/wiring](#) on page 284.

Frame size	U1, V1, W1 U2, V2, W2 BRK±, UDC± terminals						Earthing PE terminal			
	Minimum wire size		Maximum wire size		Tightening torque		Maximum wire size		Tightening torque	
	mm ²	AWG	mm ²	AWG	N·m	lb·ft	mm ²	AWG	N·m	lb·ft
R1	0.75	18	10	8	1.4	1	10	8	1.4	1
R2	0.75	18	10	8	1.4	1	10	8	1.4	1
R3	2.5	14	25	3	2.5	1.8	16	6	1.8	1.3
R4	6	10	50	1/0	5.6	4	25	3	2	1.5
R5	6	10	70	2/0	15	11	70	2/0	15	11
R6	95 ¹	3/0 ¹	240	350 MCM	40	30	95	3/0	8	6

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¹ See section [Power terminal considerations – R6 frame size](#) on page 287.

Power terminal considerations – R6 frame size

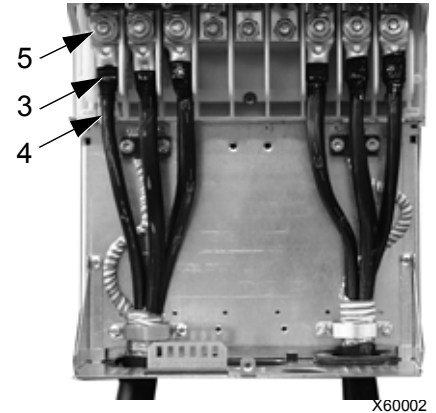


WARNING! For R6 power terminals, if screw-on terminal lugs are supplied, they can only be used for wire sizes that are 95 mm² (3/0 AWG) or larger. Smaller wires will loosen and may damage the drive. They require crimp-on ring lugs as described below.

Crimp-on ring lugs

On the R6 frame size, if screw-on terminal lugs are supplied but the cable size used is less than 95 mm² (3/0 AWG), or if no screw-on terminal lugs are supplied at all, use crimp-on ring lugs according to the following procedure.

1. Select appropriate ring lugs from the following table.
2. Remove the screw-on terminal lugs, if supplied.
3. Attach the ring lugs to the drive end of the cables.
4. Isolate the ends of the ring lugs with insulating tape or shrink tubing.
5. Attach the ring lugs to the drive.



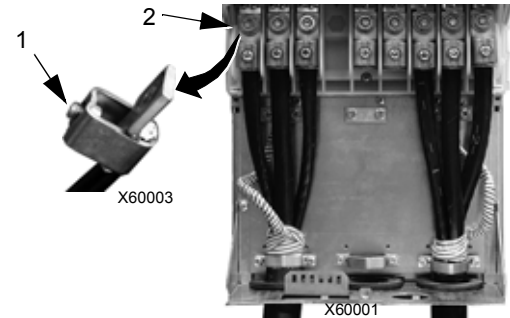
Wire size		Manufacturer	Ring lug	Crimping tool	No. of crimps
mm ²	kcmil/ AWG				
16	6	Burndy	YAV6C-L2	MY29-3	1
		IlSCO	CCL-6-38	ILC-10	2
25	4	Burndy	YA4C-L4BOX	MY29-3	1
		IlSCO	CCL-4-38	MT-25	1
35	2	Burndy	YA2C-L4BOX	MY29-3	2
		IlSCO	CRC-2	IDT-12	1
		IlSCO	CCL-2-38	MT-25	1
50	1	Burndy	YA1C-L4BOX	MY29-3	2
		IlSCO	CRA-1-38	IDT-12	1
		IlSCO	CCL-1-38	MT-25	1
		Thomas & Betts	54148	TBM-8	3
55	1/0	Burndy	YA25-L4BOX	MY29-3	2
		IlSCO	CRB-0	IDT-12	1
		IlSCO	CCL-1/0-38	MT-25	1
		Thomas & Betts	54109	TBM-8	3

Wire size		Manufacturer	Ring lug	Crimping tool	No. of crimps
mm ²	kcmil/ AWG				
70	2/0	Burndy	YAL26T38	MY29-3	2
		IlSCO	CRA-2/0	IDT-12	1
		IlSCO	CCL-2/0-38	MT-25	1
		Thomas & Betts	54110	TBM-8	3
95	3/0	Burndy	YAL27T38	MY29-3	2
		IlSCO	CRA-3/0	IDT-12	1
		IlSCO	CCL-3/0-38	MT-25	1
		Thomas & Betts	54111	TBM-8	3
95	3/0	Burndy	YA28R4	MY29-3	2
		IlSCO	CRA-4/0	IDT-12	1
		IlSCO	CCL-4/0-38	MT-25	2
		Thomas & Betts	54112	TBM-8	4

Screw-on terminal lugs

Use the following procedure to attach cables if screw-on terminal lugs are supplied and the cable size is 95 mm² (3/0 AWG) or larger.

1. Attach the supplied screw-on lugs to the drive end of the cables.
2. Attach screw-on lugs to the drive.



Motor connections



WARNING! Never connect line power to the drive output terminals: U2, V2 or W2. Line voltage applied to the output can result in permanent damage to the drive. If frequent bypassing is required, use mechanically interlocked switches or contactors.



WARNING! Do not connect any motor with a nominal voltage less than one half of the drive's nominal input voltage.



WARNING! Disconnect the drive before conducting any voltage tolerance (Hi-Pot) test or insulation resistance (Megger) test on the motor or motor cables. Do not conduct these tests on the drive.

Motor connection specifications

Motor connection specifications														
Voltage (U_2)	0... U_1 , 3-phase symmetrical, $U_{\max}$ at the field weakening point													
Frequency	0...500 Hz													
Frequency resolution	0.01 Hz													
Current	See section Ratings on page 277.													
Field weakening point	10...500 Hz													
Switching frequency	Selectable. See the availability in the table below.													
		<table><tr><th></th><th>1, 2, 4 and 8 kHz</th><th>12 kHz</th></tr><tr><td>208...240 V</td><td>All types</td><td>Frame sizes R1...R4 in scalar control mode</td></tr><tr><td>380...480 V</td><td>All types</td><td>Frame sizes R1...R4 (except ACS550-01-097A-4) in scalar control mode</td></tr><tr><td>500...600 V</td><td>All types</td><td>Frame sizes R2...R4 in scalar control mode</td></tr></table>		1, 2, 4 and 8 kHz	12 kHz	208...240 V	All types	Frame sizes R1...R4 in scalar control mode	380...480 V	All types	Frame sizes R1...R4 (except ACS550-01-097A-4) in scalar control mode	500...600 V	All types	Frame sizes R2...R4 in scalar control mode
		1, 2, 4 and 8 kHz	12 kHz											
	208...240 V	All types	Frame sizes R1...R4 in scalar control mode											
	380...480 V	All types	Frame sizes R1...R4 (except ACS550-01-097A-4) in scalar control mode											
500...600 V	All types	Frame sizes R2...R4 in scalar control mode												
Cable temperature rating	90 °C (194 °F) rating minimum.													
Maximum motor cable length	See section Motor cable lengths on page 289.													

Motor cable lengths

Maximum motor cable lengths for 400 V and 600 V drives are given in the sections below.

In multimotor systems, the calculated sum of all motor cable lengths must not exceed the maximum motor cable length given in the appropriate table below.

Motor cable length for 400 V drives

The table below shows the maximum motor cable lengths for 400 V drives with different switching frequencies. Examples for using the table are also given.

Maximum cable length for 400 V drives																		
Frame size	EMC limits												Operational limits					
	Second environment (category C3 ¹)						First environment (category C2 ¹)						Basic unit				With du/dt filters	
	1 kHz		4 kHz		8 kHz		1 kHz		4 kHz		8 kHz		1/4 kHz		8/12 kHz			
	m	ft	m	ft	m	ft	m	ft	m	ft	m	ft	m	ft	m	ft	m	ft
	R1	300	980	300	980	300	980	300	980	300	980	300	980	100	330	100	330	150
R2	300	980	300	980	300	980	300	980	100	330	30	98	200	660	100	330	250	820
R3	300	980	300	980	300	980	300	980	75	245	75	245	200	660	100	330	250	820
R4	300	980	300	980	300	980	300	980	75	245	75	245	200	660	100	330	300	980
R5	100	330	100	330	100	330	100	330	100	330	100	330	300	980	150 ²	490 ²	300	980
R6	100	330	100	330	3	3	100	330	100	330	3	3	300	980	150 ²	490 ²	300	980

¹ See the new terms in section [IEC/EN 61800-3:2004 Definitions](#) on page [311](#).

² 12 kHz switching frequency is not available.

³ Not tested.

Sine filters further extend the cable lengths.

Under heading “Operational limits”, the “Basic unit” columns define the cable lengths with which the basic drive unit works without problems within the drive specification, without installing any further options. Column “With du/dt filters” defines the cable lengths when an external du/dt filter is used.

The columns under heading “EMC limits” show the maximum cable lengths with which the units have been tested for EMC emissions. The factory guarantees that these cable lengths meet the EMC standard requirements.

If external sine filters are installed, longer cable lengths can be used. With sine filters the limiting factors are the voltage drop of the cable, which has to be taken into account in engineering, as well as the EMC limits (where applicable).

The default switching frequency is 4 kHz.



WARNING! Using a motor cable longer than specified in the table above may cause permanent damage to the drive.

Examples for using the table:

Requirements	Checking and conclusions
R1 frame size, 8 kHz fsw, Category C2, 150 m (490 ft) cable	Check operational limits for R1 and 8 kHz -> for a 150 m (490 ft) cable a du/dt filter is needed. Check EMC limits -> EMC requirements for Category C2 are met with a 150 m (490 ft) cable.

Requirements	Checking and conclusions
R3 frame size, 4 kHz fsw, Category C3, 300 m (980 ft) cable	Check operational limits for R3 and 4 kHz -> a 300 m (980 ft) cable cannot be used even with a du/dt filter. A sine filter must be used and the voltage drop of the cable must be taken into account in the installation. Check EMC limits -> EMC requirements for Category C3 are met with a 300 m (980 ft) cable.
R5 frame size, 8 kHz fsw, Category C3, 150 m (490 ft) cable	Check operational limits for R5 and 8 kHz -> for a 150 m (490 ft) cable the basic unit is sufficient. Check EMC limits -> EMC requirements for Category C3 cannot be met with a 300 m (980 ft) cable. The installation configuration is not possible. An EMC plan is recommended to overcome the situation.
R6 frame size, 4 kHz fsw, EMC limits not applicable, 150 m (490 ft) cable	Check operational limits for R6 and 4 kHz -> for a 150 m (490 ft) cable the basic unit is sufficient. EMC limits do not need to be checked as there are no EMC requirements.

Motor cable length for 600 V drives

The table below shows the maximum motor cable lengths for 600 V drives with different switching frequencies. As the 600 V drives are not CE approved, cable lengths for EMC limits are not given.

Maximum cable length for 600 V drives				
Frame size	Operational limits			
	1/4 kHz		8/12 kHz	
	m	ft	m	ft
R2	100	330	100	330
R3...R4	200	660	100	330
R6	300	980	150 ²	490 ²

² 12 kHz switching frequency is not available.



WARNING! Using a motor cable longer than specified in the table above may cause permanent damage to the drive.

Motor thermal protection

According to regulations, the motor must be protected against thermal overload and the current must be switched off when overload is detected. The drive includes a motor thermal protection function that protects the motor and switches off the current when necessary. Depending on a drive parameter value (see parameter 3501 SENSOR TYPE), the function either monitors a calculated temperature value (based on a motor thermal model, see parameters 3005 MOT THERM PROT ... 3009 BREAK POINT FREQ) or an actual temperature indication given by motor temperature sensors (see [Group 35: MOTOR TEMP MEAS](#)). The user can tune the thermal model further by feeding in additional motor and load data.

The most common temperature sensors are:

- motor sizes IEC180...225: thermal switch (e.g. Klixon)
- motor sizes IEC200...250 and larger: PTC or PT100.

Ground fault protection

ACS550 internal fault logic detects ground faults in the drive, motor, or motor cable. This fault logic:

- is NOT a personal safety or fire protection feature
- can be disabled using parameter 3017 EARTH FAULT

Note: Disabling earth fault (ground fault) may void the warranty.

- could be tripped by leakage currents (input power to ground) associated with long high capacitance motor cables.

Grounding and routing

Motor cable shielding

Motor cables require shielding using conduit, armored cable or shielded cable.

- Conduit – When using conduit:
 - Bridge joints with a ground conductor bonded to the conduit on each side of the joint.
 - Bond conduit run to the drive enclosure.
 - Use a separate conduit run for motor cables (also separate input power and control cables).
 - Use a separate conduit run for each drive.
- Armored cable – When using armored cable:
 - Use six-conductor (3 phases and 3 grounds), type MC continuous corrugated aluminium armor cable with symmetrical grounds.
 - Armored motor cable can share a cable tray with input power cables, but not with control cables.
- Shielded cable – For shielded cable details, see section [Motor cable requirements for CE & C-Tick compliance](#) on page 293.

Grounding

See section [Ground connections](#) on page 285.

For CE compliant installations and installations where EMC emissions must be minimized, see section [Effective motor cable shields](#) on page 294.

Drive's motor connection terminals

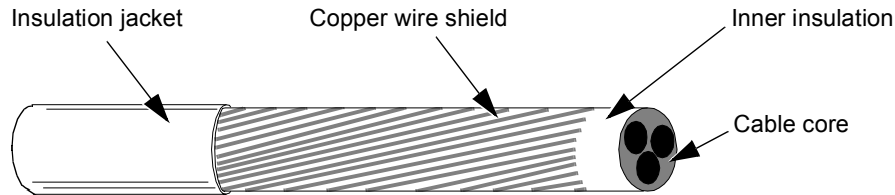
The drive's motor and input power terminals have the same specifications. See section [Drive's power connection terminals](#) on page 286.

Motor cable requirements for CE & C-Tick compliance

The requirements in this section apply for CE or C-Tick compliance.

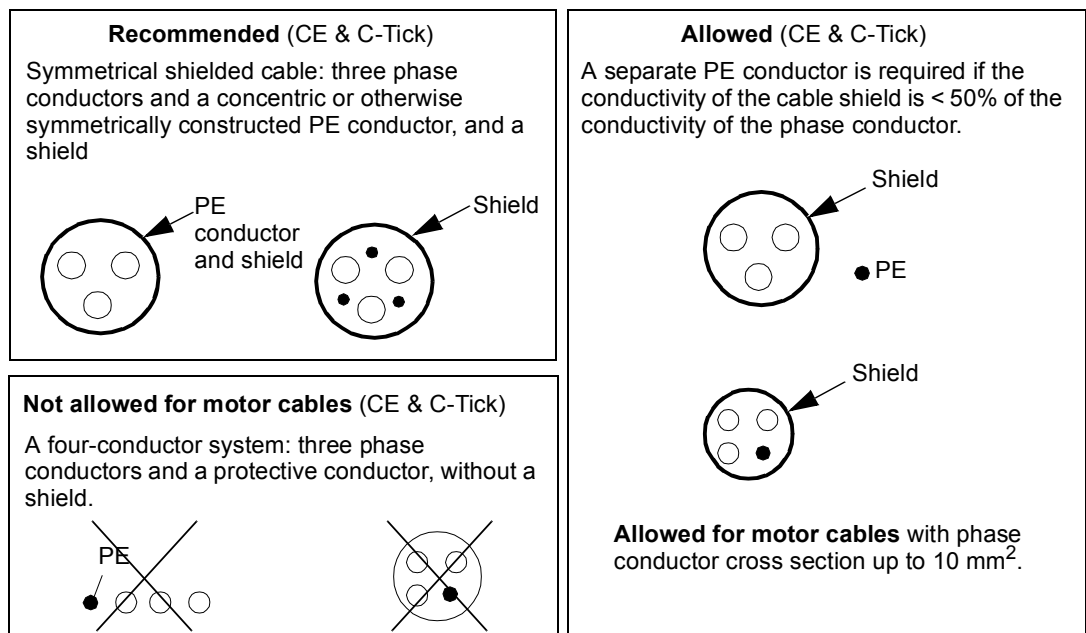
Minimum requirement (CE & C-Tick)

The motor cable must be a symmetrical three conductor cable with a concentric PE conductor or a four conductor cable with a concentric shield, however, a symmetrical constructed PE conductor is always recommended. The following figure shows the minimum requirement for the motor cable shield (for example, MCMK, Draka NK Cables).



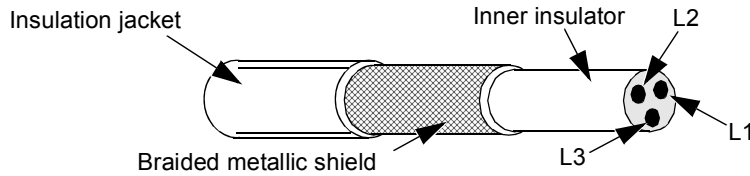
Recommendation for conductor layout

The following figure compares conductor layout features in motor cables.



Effective motor cable shields

The general rule for cable shield effectiveness is: the better and tighter the cable's shield, the lower the radiated emission level. The following figure shows an example of an effective construction (for example Ölflex-Servo-FD 780 CP, Lappkabel or MCCMK, NK Cables).



EN 61800-3 compliant motor cables

The most efficient EMC filtering can be achieved by following these rules:

- Motor cables must have an effective shield as described in section [Effective motor cable shields](#) on page 294.
- Motor cable shield wires must be twisted together into a bundle (pig-tail) – the bundle length must be less than five times its width – and connected to the terminal marked $\perp$ (at the bottom right-hand corner of the drive).
- At the motor end, the motor cable shield must be earthed 360 degrees with an EMC cable gland, or the shield wires must be twisted together into a bundle (pig-tail) not longer than five times its width and connected to the PE terminal of the motor.
- See section [Motor cable length for 400 V drives](#), columns “[EMC limits](#)” on page 290 to check the maximum motor cable lengths and the need for filters for 400 V drives for IEC/EN 61800-3 compliance.



WARNING! Do not use RFI/EMC filters on IT systems.

Brake components

Availability

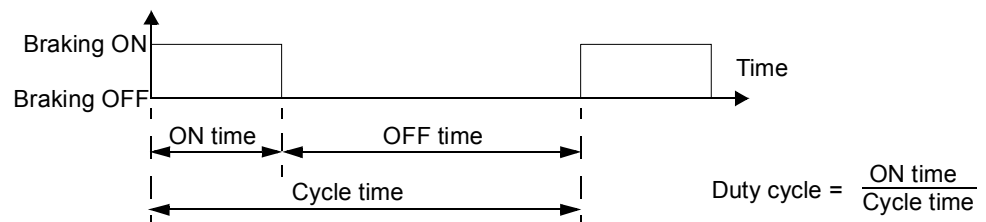
Braking availability for ACS550 drives, by frame size is:

- R1 and R2 – a built-in brake chopper is standard equipment. Add appropriate resistor, as determined using the following section. Resistors are available from ABB.
- R3...R6 – does not include an internal brake chopper. Connect a chopper and a resistor, or a brake unit to the DC link terminals on the drive. Contact your ABB representative for appropriate parts.

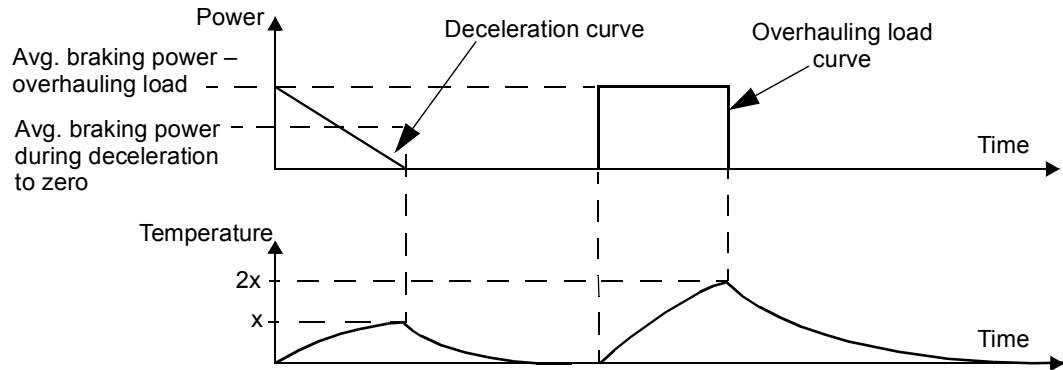
Selecting the braking resistors (frame sizes R1 and R2)

Braking resistor must meet three requirements:

- Resistance must be always higher than the minimum value R_{MIN} defined for the drive type in the following tables. Never use resistance below this value.
- Resistance must be low enough to be able to produce the desired braking torque. To achieve the maximum braking torque (the larger of 150% of heavy duty or 110% of nominal duty), the resistance must not exceed R_{MAX} . If maximum braking torque is not necessary, resistor values can exceed R_{MAX} .
- The resistor power rating must be high enough to dissipate the braking power. This requirement involves many factors:
 - the maximum continuous power rating for the resistor(s)
 - the rate at which the resistor changes temperature (resistor thermal time constant)
 - maximum braking time ON – If the regeneration (braking) power is larger than the resistor rated power, there is a limit to the ON time, or the resistor overheats before the OFF period begins.
 - minimum braking time OFF – If the regeneration (braking) power is larger than the resistor rated power, the OFF time must be large enough for the resistor to cool between ON periods.



- the peak braking power requirement
- type of braking (deceleration to zero vs. overhauling load) – During deceleration to zero, the generated power steadily decreases, averaging half of the peak power. For an overhauling load, the braking is countering an external force (gravity for example) and the braking power is constant. The total heat generated from an overhauling load is double the heat generated from deceleration to zero speed (for the same peak torque and ON time).



The many variables in the last requirement above are most easily dealt with using the following tables.

- First, determine your maximum braking time ON (ON_{MAX}), minimum braking time OFF (OFF_{MIN}) and load type (deceleration or overhauling load).
- Calculate duty cycle:

$$\text{Duty cycle} = \frac{ON_{MAX}}{(ON_{MAX} + OFF_{MIN})} \cdot 100\%$$

- In the appropriate table, find the column that best matches your data:
 - $ON_{MAX} \leq$ column specification and
 - Duty cycle $\leq$ column specification
- Find the row that matches your drive.
- The minimum power rating for deceleration to zero is the value in the selected row/column.
- For overhauling loads, double the rating in the selected row/column, or use the "Continuous ON" column.

208...240 V drives

Type ACS550-01/U1- see below	Resistance		Resistor ¹ minimum continuous power rating				
			Deceleration-to-zero rating				P_{rcont} Continuous ON > 60 s ON > 25% Duty
	R_{MAX}	R_{MIN}	P_{r3} ≤ 3 s ON ≥ 27 s OFF $\leq 10\%$ Duty	P_{r10} ≤ 10 s ON ≥ 50 s OFF $\leq 17\%$ Duty	P_{r30} ≤ 30 s ON ≥ 180 s OFF $\leq 14\%$ Duty	P_{r60} ≤ 60 s ON ≥ 180 s OFF $\leq 25\%$ Duty	
	ohm	ohm	W	W	W	W	W
Three-phase supply voltage, 208...240 V							
-04A6-2	234	80	45	80	120	200	1100
-06A6-2	160	80	65	120	175	280	1500
-07A5-2	117	44	85	160	235	390	2200
-012A-2	80	44	125	235	345	570	3000
-017A-2	48	44	210	390	575	950	4000
-024A-2	32	30	315	590	860	1425	5500
-031A-2	23	22	430	800	1175	1940	7500

¹ Resistor time constant specification must be ≥ 85 seconds.

380...480 V drives

Type ACS550-01/U1- see below	Resistance		Resistor ¹ minimum continuous power rating				
			Deceleration-to-zero rating				P_{rcont} Continuous ON > 60 s ON > 25% Duty
	R_{MAX}	R_{MIN}	P_{r3} ≤ 3 s ON ≥ 27 s OFF $\leq 10\%$ Duty	P_{r10} ≤ 10 s ON ≥ 50 s OFF $\leq 17\%$ Duty	P_{r30} ≤ 30 s ON ≥ 180 s OFF $\leq 14\%$ Duty	P_{r60} ≤ 60 s ON ≥ 180 s OFF $\leq 25\%$ Duty	
	ohm	ohm	W	W	W	W	W
Three-phase supply voltage, 380...480 V							
-03A3-4	641	120	65	120	175	285	1100
-04A1-4	470	120	90	160	235	390	1500
-05A4-4	320	120	125	235	345	570	2200
-06A9-4	235	80	170	320	470	775	3000
-08A8-4	192	80	210	400	575	950	4000
-012A-4	128	80	315	590	860	1425	5500
-015A-4	94	63	425	800	1175	1950	7500
-023A-4	64	63	625	1175	1725	2850	11000

¹ Resistor time constant specification must be ≥ 85 seconds.

500...600 V drives

Type ACS550-U1- see below	Resistance		Resistor ¹ minimum continuous power rating				
			Deceleration-to-zero rating				P_{rcont} Continuous ON > 60 s ON > 25% Duty
	R_{MAX}	R_{MIN}	P_{r3} ≤ 3 s ON ≥ 27 s OFF $\leq 10\%$ Duty	P_{r10} ≤ 10 s ON ≥ 50 s OFF $\leq 17\%$ Duty	P_{r30} ≤ 30 s ON ≥ 180 s OFF $\leq 14\%$ Duty	P_{r60} ≤ 60 s ON ≥ 180 s OFF $\leq 25\%$ Duty	
	ohm	ohm	W	W	W	W	W
Three-phase supply voltage, 500...600 V							
-02A7-6	548	80	93	175	257	425	1462
-03A9-6	373	80	137	257	377	624	2144
-06A1-6	224	80	228	429	629	1040	3573
-09A0-6	149	80	342	643	943	1560	5359
-011A-6	110	60	467	877	1286	2127	7308
-017A-6	75	60	685	1286	1886	3119	10718

¹ Resistor time constant specification must be ≥ 85 seconds.



WARNING! Never use a brake resistor with a resistance below the minimum value specified for the particular drive. The drive and the internal chopper are not able to handle the overcurrent caused by the low resistance.

Symbols

R_{MIN} – Minimum allowed resistance of the braking resistor.

R_{MAX} – Maximum resistance allowed if maximum braking torque is necessary.

P_{rx} – Duty-cycle based resistor power rating in deceleration braking, where “x” is ON_{MAX} time.

Installing and wiring resistors

All resistors must be installed outside the drive module in a place where they can dissipate heat.



WARNING! The surface temperature of the resistor is very high, and air flowing from the resistor is very hot. Materials near the brake resistor must be non-flammable. Provide protection from accidental contact with the resistor.

To ensure that the input fuses protect the resistor cable, use resistor cables with the same rating as used for the power input to the drive.

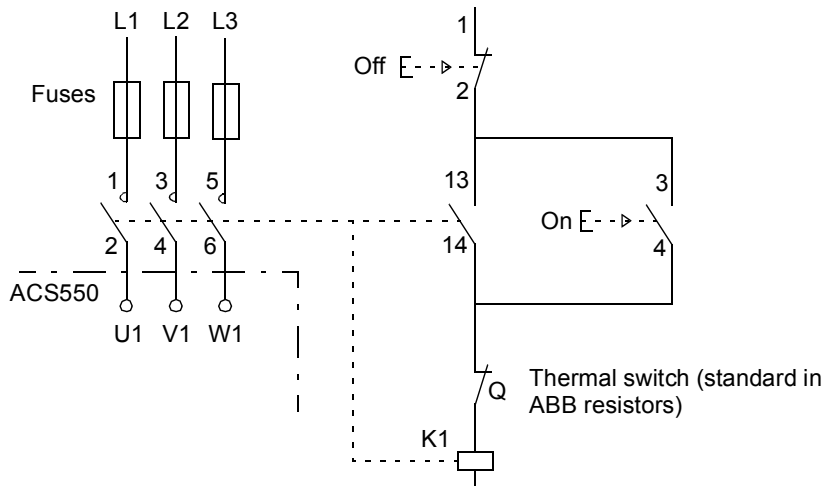
The maximum length of the resistor cable(s) is 10 m (33 ft). See section [Power connection diagrams](#) on page 25 for the resistor cable connection points.

Mandatory circuit protection

The following setup is essential for safety – it interrupts the main supply in fault situations involving chopper shorts:

- Equip the drive with a main contactor.
- Wire the contactor so that it opens if the resistor thermal switch opens (an overheated resistor opens the contactor).

Below is a simple wiring diagram example.



Parameter set-up

To enable dynamic braking, switch off the drive's overvoltage control [Set parameter 2005 = 0 (DISABLE)].

Control connections

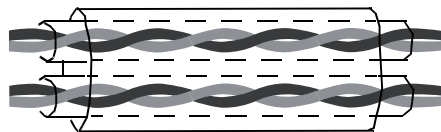
Control connection specifications

Control connection specifications	
Analog inputs and outputs	See section Control terminals table on page 28.
Digital inputs	Digital input impedance 1.5 kohm. Maximum voltage for digital inputs is 30 V.
Relays (digital outputs)	- Max. contact voltage: 30 V DC, 250 V AC - Max. contact current / power: 6 A, 30 V DC; 1500 VA, 250 V AC - Max. continuous current: 2 A rms ($\cos \varphi = 1$), 1 A rms ($\cos \varphi = 0.4$) - Minimum load: 500 mW (12 V, 10 mA) - Contact material: Silver-nickel (AgN) - Isolation between relay digital outputs, test voltage: 2.5 kV rms, 1 minute
Cable specifications	See section Control terminals table on page 28.

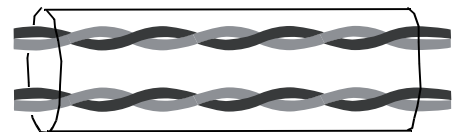
Control cables

General recommendations

Use multi-core cables with a braided copper wire shield, temperature rated at 60 °C (140 °F) or above:



Double shielded
Example: JAMAK by Draka NK Cables



Single shielded
Example: NOMAK by Draka NK Cables

For digital and analog I/O cables, twist the shield together into a bundle (pig-tail) not longer than five times its width and connect it to terminal X1-1 at the drive end. Leave the other end of the cable shield unconnected.

For connecting the shield wires of the RS485 cable, see the instructions (and notes) in section [Mechanical and electrical installation – EFB](#) on page 204.

Route control cables to minimize radiation to the cable:

- Route as far away as possible from the input power and motor cables (at least 20 cm [8 in]).
- Where control cables must cross power cables, make sure they are at an angle as near 90° as possible.
- Stay at least 20 cm (8 in) from the sides of the drive.

Use care in mixing signal types on the same cable:

- Do not mix relay-controlled signals using more than 30 V and other control signals in the same cable.
- Run relay-controlled signals as twisted pairs (especially if voltage > 48 V). Relay-controlled signals using less than 48 V can be run in the same cables as digital input signals.

Note: Never mix 24 V DC and 115/230 V AC signals in the same cable.

Analog cables

Recommendations for analog signal runs:

- Use double shielded, twisted pair cable.
- Use one individually shielded pair for each signal.
- Do not use a common return for different analog signals.

Digital cables

Recommendation for digital signal runs: A double shielded cable is the best alternative, but single-shielded, twisted, multi-pair cable is also usable.

Control panel cable

If the control panel is connected to the drive with a cable, use only Category 5 Patch ethernet cable. The maximum length that is tested to meet EMC specifications is 3 m (9.8 ft). Longer cables are susceptible to electromagnetic noise and must be user-tested to verify that EMC requirements are met. Where long runs are required (especially for runs longer than about 12 m [40 ft]), use a RS232/RS485 converter at each end and run RS485 cable.

Drive's control connection terminals

The following table provides specifications for the drive's control terminals

Frame size	Control			
	Maximum wire size ¹		Tightening torque	
	mm ²	AWG	N·m	lb·ft
All	1.5	16	0.4	0.3

¹ Values given for solid wires.
For stranded wires, the maximum size is 1 mm².

Efficiency

Approximately 98% at nominal power level.

Losses, cooling data and noise

Cooling specifications	
Method	Internal fan, flow direction from bottom to top.
Requirement	Free space above and below the ACS550 drive: 200 mm (8 in). Free space is not required on the drive's sides – ACS550 drives can be mounted side-by-side.

Air flow, 208...240 V drives

The following table lists the requirements for the cooling air flow data for 208...240 V drives at full load in all ambient conditions listed in [Ambient conditions](#) on page 307.

Drive		Heat dissipation		Air flow		Noise
ACS550-x1-	Frame size	W	BTU/hr	m ³ /h	ft ³ /min	dB
-04A6-2	R1	55	189	44	26	52
-06A6-2	R1	73	249	44	26	52
-07A5-2	R1	81	276	44	26	52
-012A-2	R1	118	404	44	26	52
-017A-2	R1	161	551	44	26	52
-024A-2	R2	227	776	88	52	66
-031A-2	R2	285	973	88	52	66
-046A-2	R3	420	1434	134	79	67
-059A-2	R3	536	1829	134	79	67
-075A-2	R4	671	2290	280	165	75
-088A-2	R4	786	2685	280	165	75
-114A-2	R4	1014	3463	280	165	75
-143A-2	R6	1268	4431	405	238	77
-178A-2	R6	1575	5379	405	238	77
-221A-2	R6	1952	6666	405	238	77
-248A-2	R6	2189	7474	405	238	77

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Air flow, 380...480 V drives

The following table lists the requirements for the cooling air flow data for 380...480 V drives at full load in all ambient conditions listed in [Ambient conditions](#) on page 307.

Drive		Heat dissipation		Air flow		Noise
ACS550-x1-	Frame size	W	BTU/hr	m ³ /h	ft ³ /min	dB
-03A3-4	R1	40	137	44	26	52
-04A1-4	R1	52	178	44	26	52
-05A4-4	R1	73	249	44	26	52
-06A9-4	R1	97	331	44	26	52
-08A8-4	R1	127	434	44	26	52
-012A-4	R1	172	587	44	26	52

Drive		Heat dissipation		Air flow		Noise
ACS550-x1-	Frame size	W	BTU/hr	m ³ /h	ft ³ /min	dB
-015A-4	R2	232	792	88	52	66
-023A-4	R2	337	1151	88	52	66
-031A-4	R3	457	1561	134	79	67
-038A-4	R3	562	1919	134	79	67
-045A-4	R3	667	2278	134	79	67
-059A-4	R4	907	3098	280	165	75
-072A-4	R4	1120	3825	280	165	75
-078A-4	R4	1295	4423	250	147	75
-087A-4	R4	1440	4918	280	165	75
-097A-4	R4	1440	4918	280	165	75
-125A-4	R5	1940	6625	350	205	75
-157A-4	R6	2310	7889	405	238	77
-180A-4	R6	2810	9597	405	238	77
-195A-4	R6	3050	10416	405	238	77
-246A-4	R6	3260	11134	405	238	77
-290A-4	R6	3850	13125	405	238	77

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Air flow, 500...600 V drives

The following table lists the requirements for the cooling air flow data for 500...600 V drives at full load in all ambient conditions listed in [Ambient conditions](#) on page 307.

Drive		Heat dissipation		Air flow		Noise
ACS550-U1-	Frame size	W	BTU/hr	m ³ /h	ft ³ /min	dB
-02A7-6	R2	52	178	88	52	66
-03A9-6	R2	73	249	88	52	66
-06A1-6	R2	127	434	88	52	66
-09A0-6	R2	172	587	88	52	66
-011A-6	R2	232	792	88	52	66
-017A-6	R2	337	1151	88	52	66
-022A-6	R3	457	1561	134	79	67
-027A-6	R3	562	1919	134	79	67
-032A-6	R4	667	2278	280	165	75
-041A-6	R4	907	3098	280	165	75
-052A-6	R4	1117	3815	280	165	75
-062A-6	R4	1357	4634	280	165	75
-077A-6	R6	2310	7889	405	238	77
-099A-6	R6	2310	7889	405	238	77
-125A-6	R6	2310	7889	405	238	77

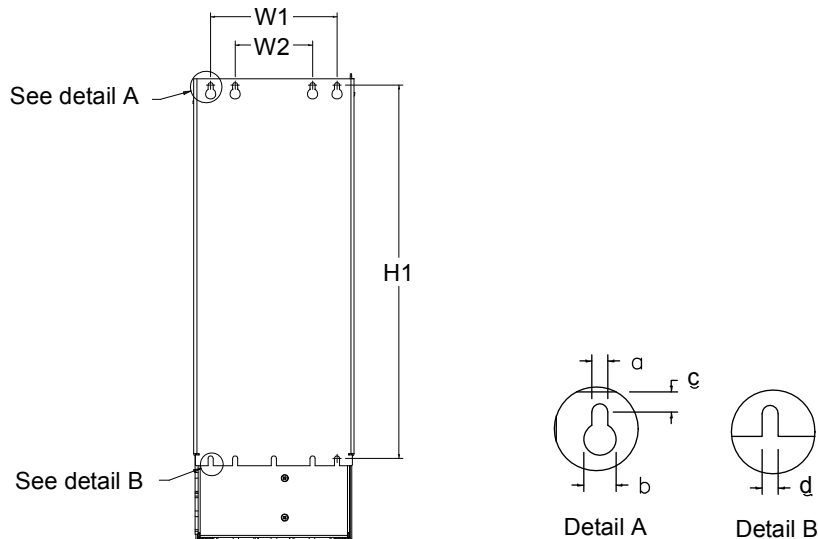
Drive		Heat dissipation		Air flow		Noise
ACS550-U1-	Frame size	W	BTU/hr	m ³ /h	ft ³ /min	dB
-144A-6	R6	2310	7889	405	238	77

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Dimensions and weights

The dimensions and mass for the ACS550 depend on the frame size and enclosure type. If unsure of the frame size, first, find the “Type” designation on the drive labels (see sections [The labels contain information on the Type designation \(page 17\)](#), [Ratings and frame size \(page 17\)](#), [Serial number \(page 17\)](#), [degree of protection \(see also Degrees of protection on page 306\)](#) and [valid markings \(see also Markings on page 309\)](#) on page 17 and [Drive labels](#) on page 16). Then look up that type designation in the rating tables (see chapter [Technical data](#), page 277), to determine the frame size.

Mounting dimensions



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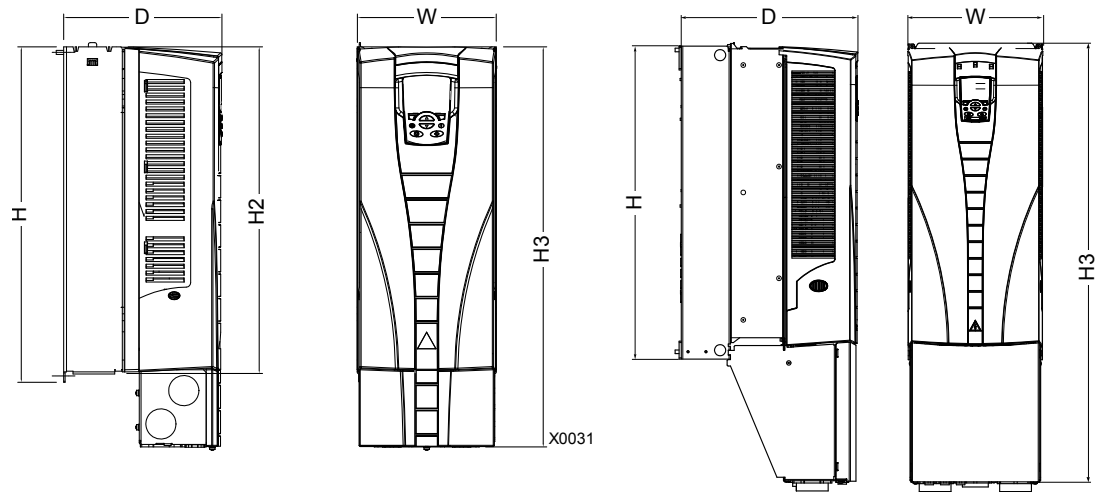
IP21 / UL type 1 and IP54 / UL type 12 – Dimensions for each frame size												
Ref.	R1		R2		R3		R4		R5		R6	
	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in
W1 ¹	98.0	3.9	98.0	3.9	160	6.3	160	6.3	238	9.4	263	10.4
W2 ¹	--	--	--	--	98.0	3.9	98.0	3.9	--	--	--	--
H1 ¹	318	12.5	418	16.4	473	18.6	578	22.8	588	23.2	675	26.6
a	5.5	0.2	5.5	0.2	6.5	0.25	6.5	0.25	6.5	0.25	9.0	0.35
b	10.0	0.4	10.0	0.4	13.0	0.5	13.0	0.5	14.0	0.55	18.0	0.71
c	5.5	0.2	5.5	0.2	8.0	0.3	8.0	0.3	8.5	0.3	8.5	0.3
d	5.5	0.2	5.5	0.2	6.5	0.25	6.5	0.25	6.5	0.25	9.0	0.35

¹ Center to center dimension.

Outside dimensions

Drives with IP21 / UL type 1 enclosures

Types ACS550-x1-221A-2,
ACS550-x1-246A-4, ACS550-x1-248A-2,
and ACS550-01-290A-4, frame size R6



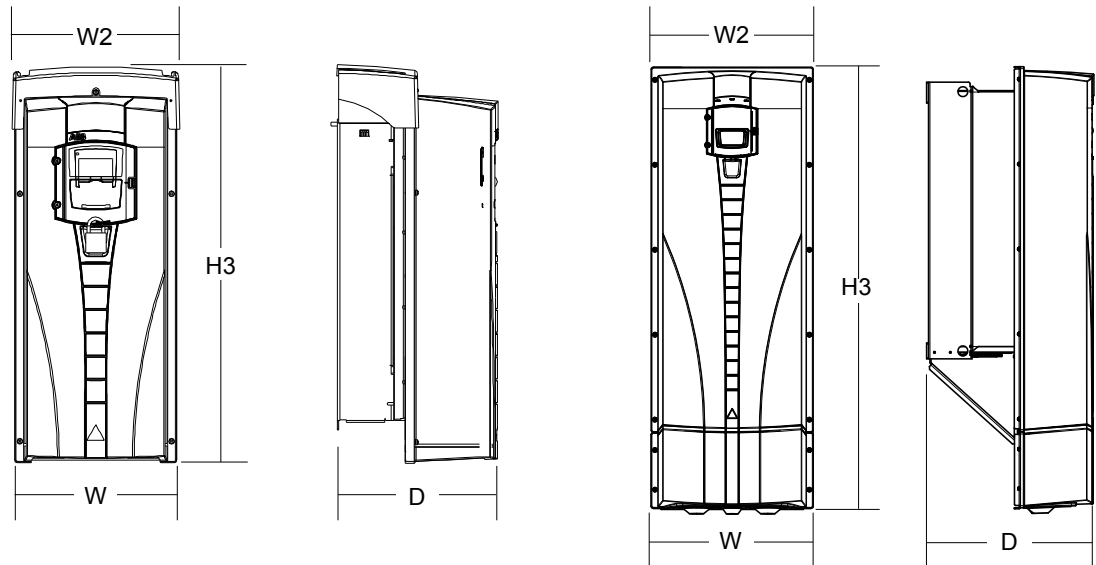
IP21 / UL type 1 – dimensions for each frame size												
Ref.	R1		R2		R3		R4		R5		R6	
	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in
W	125	4.9	125	4.9	203	8.0	203	8.0	265	10.4	302	11.9
H	330	13.0	430	16.9	490	19.3	596	23.5	602	23.7	700	27.6
H2	315	12.4	415	16.3	478	18.8	583	23.0	578	22.8	698	27.5
H3	369	14.5	469	18.5	583	23.0	689	27.1	736	29.0	888 ¹	35.0 ¹
D	212	8.3	222	8.7	231	9.1	262	10.3	286	11.3	400	15.8

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1. ACS550-x1-221A-2, ACS550-x1-246A-4, ACS550-x1-248A-2 and ACS550-x1-290A-4: 981 mm / 38.6 in.

Drives with IP54 / UL type 12 enclosures

Type ACS550-01-290A-4, IP54
(UL type 12 not available), frame size R6



IP54 / UL type 12 – Dimensions for each frame size												
Ref.	R1		R2		R3		R4		R5		R6 ²	
	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in
W	213	8.4	213	8.4	257	10.1	257	10.1	369	14.5	410	16.1
W2	222	8.8	222	8.8	267	10.5	267	10.5	369	14.5	410	16.1
H3	461	18.2	561	22.1	629	24.8	760	29.9	775	30.5	924 ¹	36.4 ¹
D	234	9.2	245	9.7	254	10.0	284	11.2	309	12.2	423	16.7

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1. ACS550-01-290A-4: 1119 mm / 44.1 in.

2. UL type 12 not available for ACS550-01-290A-4.

Weight

The following table lists typical maximum weights for each frame size. Variations within each frame size (due to components associated with voltage/current ratings and options) are minor.

Enclosure	Weight											
	R1		R2		R3		R4		R5		R6	
	kg	lb	kg	lb	kg	lb	kg	lb	kg	lb	kg	lb
IP21 / UL type 1	6.5	14.3	9.0	19.8	16	35	24	53	34	75	69 ¹	152 ¹
IP54 / UL type 12	8.0	17.6	11.0	24.3	17.0	37.5	26.0	57.3	42.0	93.0	86.0 ²	190 ²

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1. ACS550-x1-221A-2, IP21 / UL type 1: 70 kg / 154 lb
ACS550-x1-246A-4, IP21 / UL type 1: 70 kg / 154 lb,
ACS550-x1-248A-2, IP21 / UL type 1, 80 kg / 176 lb.
ACS550-01-290A-4, IP21 / UL type 1: 80 kg / 176 lb.
2. ACS550-x1-246A-4, IP54 / UL type 12: 80 kg / 176 lb
ACS550-01-290A-4, IP54: 90 kg / 198 lb (UL type 12 not available).

Degrees of protection

Available enclosures:

- IP21 / UL type 1 enclosure. The site must be free of airborne dust, corrosive gases or liquids, and conductive contaminants such as condensation, carbon dust and metallic particles.
- IP54 / UL type 12 enclosure. This enclosure provides protection from airborne dust and light sprays or splashing water from all directions.

Note: UL type 12 enclosure is not available for type ACS550-01-290A-4.

Compared to the IP21 / UL type 1 enclosure, the IP54 / UL type 12 enclosure has:

- the same internal plastic shell as the IP21 enclosure
- a different outer plastic cover
- an additional internal fan to improve cooling
- larger dimensions
- the same rating (does not require a derating).

Ambient conditions

The following table lists the ACS550 environmental requirements.

Ambient environment requirements		
	Installation site	Storage and transportation in the protective package
Altitude	0...1000 m (0...3 300 ft) 1000...2000 m (3 300...6 600 ft) if P_N and I_{2N} derated 1% every 100 m above 1000 m (300 ft above 3 300 ft)	
Ambient temperature	- Min. -15 °C (5 °F) – no frost allowed - Max. (fsw = 1 or 4) 40 °C (104 °F); 50 °C (122 °F) if P_N and I_{2N} derated to 90% - Max. (fsw = 8) 40 °C (104 °F) if P_N and I_{2N} derated to 80% - Max. (fsw = 12) 30 °C (86 °F) if P_N and I_{2N} derated to 65% (to 50% for 600 V, R4 frame sizes, that is for ACS550-U1-032A-6 ... ACS550-U1-062A-6)	-40...70 °C (-40...158 °F)
Relative humidity	5...95%, no condensation allowed	
Contamination levels (IEC 60721-3-3)	- No conductive dust allowed. - The ACS550 should be installed in clean air according to enclosure classification. - Cooling air must be clean, free from corrosive materials and free from electrically conductive dust. - Chemical gases: Class 3C2 - Solid particles: Class 3S2	Storage - No conductive dust allowed. - Chemical gases: Class 1C2 - Solid particles: Class 1S2 Transportation - No conductive dust allowed. - Chemical gases: Class 2C2 - Solid particles: Class 2S2

The following table lists the standard stress testing that the ACS550 passes.

Stress tests		
	Without shipping package	Inside shipping package
Sinusoidal vibration	Mechanical conditions: In accordance with IEC 60721-3-3, Class 3M4 2...9 Hz 3.0 mm (0.12 in) 9...200 Hz 10 m/s² (33 ft/s²)	In accordance with ISTA 1A and 1B specifications.
Shock	Not allowed	In accordance with IEC 68-2-29: max. 100 m/s ² (330 ft/s ²), 11ms
Free fall	Not allowed	76 cm (30 in), frame size R1 61cm (24 in), frame size R2 46 cm (18 in), frame size R3 31 cm (12 in), frame size R4 25 cm (10 in), frame size R5 15 cm (6 in), frame size R6

Materials

Material specifications	
Drive enclosure	• PC/ABS 2.5 mm, color NCS 1502-Y or NCS 7000-N • Hot-dip zinc coated steel sheet 1.5...2 mm, thickness of coating 20 micrometers. If the surface is painted, the total thickness of the coating (zinc and paint) is 80...100 micrometers. • Cast aluminium AlSi • Extruded aluminium AlSi
Package	Corrugated board, expanded polystyrene, plywood, raw wood (heat dried). Package wrap consists of one or more of the following: PE-LD plastic wrap, PP or steel bands.
Disposal	The drive contains raw materials that should be recycled to preserve energy and natural resources. The package materials are environmentally compatible and recyclable. All metal parts can be recycled. The plastic parts can either be recycled or burned under controlled circumstances, according to local regulations. Most recyclable parts are marked with recycling marks. If recycling is not feasible, all parts excluding electrolytic capacitors and printed circuit boards can be landfilled. The DC capacitors contain electrolyte and, if the drive is not provided with the RoHS marking, the printed circuit boards contain lead, both of which are classified as hazardous waste within the EU. They must be removed and handled according to local regulations. For further information on environmental aspects and more detailed recycling instructions, contact your local ABB representative.

Applicable standards

Drive compliance with the following standards is identified by the standard “marks” on the type designation label. The following standards are applicable to the drive:

Mark	Applicable standards	
	EN 50178:1997	Electronic equipment for use in power installations
	IEC/EN 60204-1:2005	Safety of machinery. Electrical equipment of machines. Part 1: General requirements. <i>Provisions for compliance:</i> The final assembler of the machine is responsible for installing: • an emergency-stop device • a supply disconnecting device.
	IEC/EN 60529:1989 + A1:1999 + A2:2013	Degrees of protection provided by enclosures (IP code)
	IEC 60664-1:2002	Insulation coordination for equipment within low-voltage systems. Part 1: Principles, requirements and tests
	IEC/EN 61800-5-1:2007	Adjustable speed electrical power drive systems. Part 5-1: Safety requirements. Electrical, thermal and energy
	IEC/EN 61800-3:2004 +A1:2012	Adjustable speed electrical power drive systems. Part 3: EMC requirements and specific test methods
	IEC/EN 61000-3-12:2011	Electromagnetic compatibility (EMC). Part 3-12: Limits - Limits for harmonic currents produced by equipment connected to public low-voltage systems with input current > 16 A and = 75 A per phase
	IEC/EN 61800-3:2004 +A1:2012	Adjustable speed electrical power drive systems. Part 3: EMC requirements and specific test methods
	UL 508C	UL Standard for Safety, Power Conversion Equipment, third edition
	C22.2 No. 14	CSA Standard for Industrial Control Equipment (for ACS550-U1 drives only)

Markings

CE marking

 A CE mark is attached to the drive to verify that the drive follows the provisions of the European Low Voltage, EMC and RoHS Directives

Note: The 600 V ACS550-U1 drives are not CE approved.

Compliance with the European Low Voltage Directive

The compliance with the European Low Voltage Directive has been verified according to standards IEC/EN 60204-1:2005 and EN 50178:1997.

Compliance with the European EMC Directive

The Directive defines the requirements for immunity and emissions of electrical equipment used within the European Union. The EMC product standard IEC/EN 61800-3:2004 +A1:2012 covers requirements stated for drives.

Compliance with IEC/EN 61800-3:2004 +A1:2012

See page [311](#).

C-Tick marking



The drive carries C-Tick marking.

C-Tick marking is required in Australia and New Zealand. A C-Tick mark is attached to the drive to verify compliance with the relevant standard (IEC 61800-3:2004) – Adjustable speed electrical power drive systems – Part 3: EMC product standard including specific test methods), mandated by the Trans-Tasman Electromagnetic Compatibility Scheme.

The Trans-Tasman Electromagnetic Compatibility Scheme (EMCS) was introduced by the Australian Communication Authority (ACA) and the Radio Spectrum Management Group (RSM) of the New Zealand Ministry of Economic Development (NZMED) in November 2001. The aim of the scheme is to protect the radio frequency spectrum by introducing technical limits for emission from electrical/ electronic products.

Compliance with IEC/EN 61800-3:004

See page [311](#).

UL/CSA markings



An UL mark is attached to ACS550 drives to verify that the drive follows the provisions of UL 508C.



A CSA mark is attached to ACS550-**U1** type drives to verify that the drive follows the provisions of C22.2 NO. 14.

The ACS550 is suitable for use in a circuit capable of delivering not more than 100 kA RMS symmetrical amperes, 600 V maximum. The ampere rating is based on tests done according to UL 508.

Branch circuit protection must be provided in accordance with local codes.

The ACS550 has an electronic motor protection feature that complies with the requirements of UL 508C and, for ACS550-U1, C22.2 No. 14. When this feature is selected and properly adjusted, additional overload protection is not required unless more than one motor is connected to the drive or unless additional protection is required by applicable safety regulations. See parameters 3005 (MOT THERM PROT) and 3006 (MOT THERM RATE).

The drives are to be used in a controlled environment. See section [Ambient conditions](#) on page [307](#) for specific limits.

Note: For open type enclosures, i.e. drives without the conduit box and/or cover for IP21 / UL type 1 drives, or without the conduit plate and/or hood for IP54 / UL type 12 drives, the drive must be mounted inside an enclosure in accordance with National Electric Code and local electrical codes.

Brake choppers, when applied with appropriately sized brake resistors, will allow the drive to dissipate regenerative energy (normally associated with quickly decelerating a motor). Frame sizes R1 and R2 have a built-in brake chopper as standard

equipment. For frame sizes R3...R6, contact your local ABB representative for appropriate parts. See section [Brake components](#) on page 295.

EAC marking



The drive has EAC certification. EAC marking is required in Russia, Belarus and Kazakhstan.

IEC/EN 61800-3:2004 Definitions

EMC stands for **E**lectromagnetic **C**ompatibility. It is the ability of electrical/electronic equipment to operate without problems within an electromagnetic environment. Likewise, the equipment must not disturb or interfere with any other product or system within its locality.

First environment includes establishments connected to a low-voltage network which supplies buildings used for domestic purposes.

Second environment includes establishments connected to a network not directly supplying domestic premises.

Drive of category C2: drive of rated voltage less than 1000 V and intended to be installed and commissioned only by a professional when used in the first environment.

Note: A professional is a person or organization having necessary skills in installing and/or commissioning power drive systems, including their EMC aspects.

Category C2 has the same EMC emission limits as the earlier class first environment restricted distribution. EMC standard IEC/EN 61800-3 does not any more restrict the distribution of the drive, but the using, installation and commissioning are defined.

Drive of category C3: drive of rated voltage less than 1000 V, intended for use in the second environment and not intended for use in the first environment.

Category C3 has the same EMC emission limits as the earlier class second environment unrestricted distribution.

Compliance with the IEC/EN 61800-3:2004 +A1:2012

The immunity performance of the drive complies with the demands of IEC/EN 61800-3, category C2 (see page 311 for IEC/EN 61800-3 definitions). The emission limits of IEC/EN 61800-3 comply with the provisions described below.

First environment (drives of category C2)

1. The internal EMC filter is connected.
2. The motor and control cables are selected as specified in this manual.
3. The drive is installed according to the instructions given in this manual.
4. The motor cable length does not exceed the allowed maximum length specified in section [Motor cable length for 400 V drives](#) on page 290 for the frame size and switching frequency in use.

WARNING! In a domestic environment, this product may cause radio interference, in which case supplementary mitigation measures may be required.

Second environment (drives of category C3)

1. The internal EMC filter is connected.
2. The motor and control cables are selected as specified in this manual.
3. The drive is installed according to the instructions given in this manual.
4. The motor cable length does not exceed the allowed maximum length specified in section [Motor cable length for 400 V drives](#) on page 290 for the frame size and switching frequency in use.

WARNING! A drive of category C3 is not intended to be used on a low-voltage public network which supplies domestic premises. Radio frequency interference is expected if the drive is used on such a network.

Note: It is not allowed to install a drive with the internal EMC filter connected on IT (ungrounded) systems. The supply network becomes connected to ground potential through the EMC filter capacitors, which may cause danger or damage the drive.

Note: It is not allowed to install a drive with the internal EMC filter connected to a corner grounded TN system as this would damage the drive.

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Further information

Product and service inquiries

Address any inquiries about the product to your local ABB representative, quoting the type designation and serial number of the unit in question. A listing of ABB sales, support and service contacts can be found by navigating to www.abb.com/searchchannels.

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For information on ABB product training, navigate to www.abb.com/drives and select *Training courses*.

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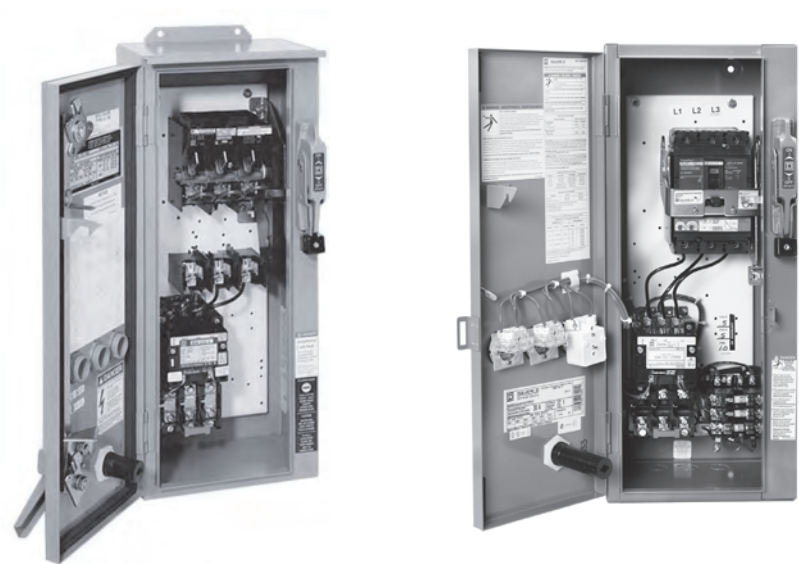


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Combination Starters

NEMA Style

Catalog
8538CT9701R08/17
2017
Class 8538/8539, 8738/8739



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Non-Reversing Combination Starters, NEMA Style

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 come standard with melting alloy overload relays. Bimetallic and solid-state overload relays are available as options (see pages 45–46).

Type 2 Coordination

Square D brand 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 controller components—the contactor, the overload relay, and the motor branch circuit protective device (fuses or circuit breaker)—will be suitable for further use following a short-circuit fault (even though contact welding is recognized but can be easily broken). This allows for replacement of components during normal scheduled maintenance.

Square D starters and specified fuses have been tested by UL and CSA (at 100,000 A fault current) for operation at 600 Vac. Class 8538 Type S combination starters, NEMA Size 0–5, with fusible disconnect switches have tested to Type 2 performance criteria.

Class 8538 Disconnect Switch Type

Class 8538 combination starters can be furnished with either a fusible or non-fusible disconnect switch. Class 8538 combination starters are available in NEMA Size 0–6.

The design of the fusible disconnect switch combination starter uses 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 device can be furnished with Class R fuse clips, increasing the short-circuit rating to 100,000 A.

Size 0–2 non-fusible combination starters can be converted to a fusible type. See catalog 9999CT9701 for fuse block kits and fuse kits.

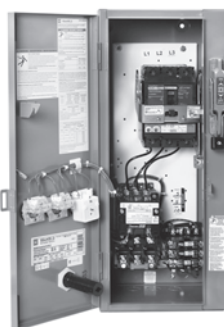
Class 8539 Electronic Motor Circuit Protector (MCP) or Thermal-Magnetic Circuit Breaker Type

Class 8539 combination starters can be furnished with either an electronic motor circuit protector (MCP) or a thermal-magnetic circuit breaker. Class 8539 combination starters are available in NEMA Size 0–7.

The circuit breakers in Class 8539 combination starters can be furnished with a factory installed auxiliary switch for remote indication of an open/tripped or closed circuit breaker. For one auxiliary switch, specify **Form Y74**. For two auxiliary switches, specify **Form Y75**. The switches are furnished with normally open and normally closed circuits with a common connection. Contacts must be used on the same polarity and are rated 15 A at 240 Vac.

An alarm switch can be factory installed only—specify **Form Y742**. The alarm switch is used to actuate bell alarms and warning lights. It operates only when the circuit breaker is tripped. The alarm switch consists of a normally open single-pole, single-throw switch. The contacts are rated 4 A at 240 Vac.

Circuit breaker combination starters have short-circuit interrupting ratings up to 100,000 A. See page 39 for details.



Combination Starters

Class 8538, 8539—Non-Reversing—General Information

Enclosures—Class 8538 and 8539 combination starters are available in the following enclosures:

- NEMA 1 General Purpose
- NEMA 4 & 4X Watertight and Dusttight Stainless Steel
- NEMA 4X Watertight, Dusttight, and Corrosion Resistant Glass-Polyester
- NEMA 12/3R Dusttight and Driptight for Industrial Use

These enclosures have three holes (30.5 mm) as standard for installation of Class 9001 Type K push buttons, pilot lights, and other cover-mounted control units.

The NEMA 4 & 4X stainless steel enclosures (Sizes 0–5) have a brushed finish. Sizes 6–7 are painted sheet-steel enclosures and are rated NEMA 4 only. Hubs come standard on NEMA 4X enclosures.

NEMA 12 enclosures can be field modified for outdoor applications. Specify **Form G26** for NEMA 3R (no additional charge). See page 19 for additional information.

Oversize Enclosures—Class 8538 disconnect switch type and Class 8539 electronic motor circuit protector (MCP), Sizes 0–2, are also available in NEMA 1, 4 & 4X, and 12/3R oversize enclosures. The oversize enclosures provide additional panel space for customer installation of control transformers, fuse blocks, terminal blocks, relays, and other auxiliary equipment.

Coil Voltages—AC coils are available for application at 50–60 Hz. The coils for NEMA Size 00–5 devices are designed to operate satisfactorily on line voltages of 85–110% of rated voltage. NEMA Size 6–7 contactors come with a DC coil operated by a solid-state rectifier circuit, which is powered by an AC source and designed to operate satisfactorily on line voltages of 90–110% of rated voltage.

NOTE: A voltage code is required when ordering combination starters. Polyphase combination starters with 24 Vac or 120 Vac coil voltages come wired for **separate control**.

Auxiliary Contacts—Additional auxiliary contacts can be added to Type S starters. Refer to page 37 for the maximum number of auxiliary units and the 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 units are available as field modifications. See catalog 9999CT9701. For factory modifications (Forms), see page 42.

Overload Protection

Type S magnetic starters are used for full-voltage starting and stopping of AC squirrel cage motors. Motor overload protection for three-phase starter applications can be provided through one of four options, as follows:

Solid-State Overload Relay Protection (Motor Logic™ SSOLR)—These ambient insensitive overload relays are available on Sizes 00–6 and standard on Size 7. They provide phase loss and phase unbalance protection. To order, add Form **H30** (for selectable trip class 10 or 20 protection). For more information about Motor Logic SSOLRs, see page 45 and catalog 9065CT9701. (Product catalog number example: 8536SCO3V06**H30**)

Adapted Bimetallic Overload Relay (NEMA Sizes 00–1)—The adapted bimetallic motor starter consists of a specially designed adapter. It attaches with bus bars to the Type S NEMA contactor and holds the IEC-style bimetallic overload relay (type LRD or LR3D). This starter configuration can be ordered by adding Form **E** (adapter only) to the standard catalog number. The LRD or LR3D bimetallic overload relay must be purchased separately, based on the motor FLA, and installed in the field in order to operate the starter. For more information—including how to order the adapted bimetallic overload relay as a factory installed option—see page 45 and catalog 9065CT9701. (Product catalog number example: 8536SCO3V06**E**)

TeSys™ T Motor Management System (NEMA Sizes 1–6)—The flexible TeSys T system integrates seamlessly into your automation system through five major communication protocols. The TeSys T system can predict what will happen in the process, as it accurately monitors current, voltage, and power over a wide range. This option is available for control voltages of 24 Vac or 100–240 Vac. For additional information about the TeSys T Motor Management System, see page 46 and catalog 9065CT9701.

NOTE: The full catalog number contains a four-character Form number (for example, 8536SCO3V06**H616**).

Melting Alloy Thermal Overload Relays—Melting alloy type thermal overload blocks are installed as part of the starter, and thermal elements must be selected and installed separately in order to operate the starter. For a three-phase motor, three thermal units must be ordered using the tables in catalog 9065CT9701. The catalog number includes no Form number (for example, 8536SCO3V06).

Combination Starters

Class 8538—Fusible Disconnect Switch Type

Fusible, 3-Pole Polyphase—600 Vac Maximum, 50–60 Hz

For Class J fuse clip, use Form Y1072 (no additional charge).

Table 1: Class 8538 Fusible Full Voltage Type (Class H and K Fuse Clips), with Motor Logic SSOLR (replace ●●● with the voltage code)



Motor Voltage (Starter Voltage)	Ratings			Enclosure				
	Max. Hp Poly-phase	NEMA Size	Fuse Clip Size (A)	NEMA 1 General Purpose	NEMA 4 & 4X Watertight and Dusttight Stainless Steel (304) (Sizes 0-5) ^[1]	NEMA 4X Watertight, Dusttight, and Corrosion Resistant Polyester	NEMA 12/3R Industrial Use Dusttight and Driptight ^[2]	
				Type ^[3]	Type ^[3]	Type ^[3]	With External Reset	Without External Reset
200 (208)	3	0	30	SBG12●●●H30 ^[4]	SBW12●●●H30 ^[4]	SBW22●●●H30 ^[4]	SBA22●●●H30 ^[4]	SBA12●●●H30 ^[4]
	5	1	30	SCG12●●●H30 ^[4]	SCW12●●●H30 ^[4]	SCW22●●●H30 ^[4]	SCA22●●●H30 ^[4]	SCA12●●●H30 ^[4]
	7.5		60	SCG13●●●H30 ^[4]	SCW13●●●H30 ^[4]	SCW23●●●H30 ^[4]	SCA23●●●H30 ^[4]	SCA13●●●H30 ^[4]
	10	2	60	SDG12●●●H30	SDW12●●●H30	SDW22●●●H30 ^[4]	SDA22●●●H30	SDA12●●●H30
	20	3	100	SEG15●●●H30	SEW15●●●H30	SEW25●●●H30	SEA25●●●H30	SEA15●●●H30
	25		200	SEG12●●●H30	SEW12●●●H30	—	SEA22●●●H30	SEA12●●●H30
	40	4	200	SFG15●●●H30	SFW15●●●H30	—	SFA25●●●H30	SFA15●●●H30
	75	5	400	SGG15●●●H30	SGW15●●●H30	—	SGA25●●●H30	SGA15●●●H30
230 (240)	150	6	600	SHG13●●●H30	SHW13●●●H30	—	SHA23●●●H30	SHA13●●●H30
	3	0	30	SBG12●●●H30 ^[4]	SBW12●●●H30 ^[4]	SBW22●●●H30 ^[4]	SBA22●●●H30 ^[4]	SBA12●●●H30 ^[4]
	5	1	30	SCG12●●●H30 ^[4]	SCW12●●●H30 ^[4]	SCW22●●●H30 ^[4]	SCA22●●●H30 ^[4]	SCA12●●●H30 ^[4]
	7.5		60	SCG13●●●H30 ^[4]	SCW13●●●H30 ^[4]	SCW23●●●H30 ^[4]	SCA23●●●H30 ^[4]	SCA13●●●H30 ^[4]
	10	2	60	SDG12●●●H30 ^[4]	SDW12●●●H30	SDW22●●●H30 ^[4]	SDA22●●●H30	SDA12●●●H30
	25	3	100	SEG15●●●H30	SEW15●●●H30	SEW25●●●H30	SEA25●●●H30	SEA15●●●H30
	30		200	SEG12●●●H30	SEW12●●●H30	—	SEA22●●●H30	SEA12●●●H30
	50	4	200	SFG15●●●H30	SFW15●●●H30	—	SFA25●●●H30	SFA15●●●H30
460 (480)	100	5	400	SGG15●●●H30	SGW15●●●H30	—	SGA25●●●H30	SGA15●●●H30
	200	6	600	SHG13●●●H30	SHW13●●●H30	—	SHA23●●●H30	SHA13●●●H30
	5	0	30	SBG13●●●H30 ^[4]	SBW13●●●H30 ^[4]	SBW23●●●H30 ^[4]	SBA23●●●H30 ^[4]	SBA13●●●H30 ^[4]
	10	1	30	SCG14●●●H30 ^[4]	SCW14●●●H30 ^[4]	SCW24●●●H30 ^[4]	SCA24●●●H30 ^[4]	SCA14●●●H30 ^[4]
	15	2	30	SDG16●●●H30 ^[4]	SDW16●●●H30 ^[4]	SDW26●●●H30 ^[4]	SDA26●●●H30 ^[4]	SDA16●●●H30 ^[4]
	25		60	SDG14●●●H30	SDW14●●●H30	SDW24●●●H30	SDA24●●●H30	SDA14●●●H30
	50	3	100	SEG13●●●H30	SEW13●●●H30	SEW23●●●H30	SEA23●●●H30	SEA13●●●H30
	100	4	200	SFG13●●●H30	SFW13●●●H30	—	SFA23●●●H30	SFA13●●●H30
575 (600)	200	5	400	SGG13●●●H30	SGW13●●●H30	—	SGA23●●●H30	SGA13●●●H30
	400	6	600	SHG12●●●H30	SHW12●●●H30	—	SHA22●●●H30	SHA12●●●H30
	5	0	30	SBG13●●●H30 ^[4]	SBW13●●●H30 ^[4]	SBW23●●●H30 ^[4]	SBA23●●●H30 ^[4]	SBA13●●●H30 ^[4]
	10	1	30	SCG14●●●H30 ^[4]	SCW14●●●H30 ^[4]	SCW24●●●H30 ^[4]	SCA24●●●H30 ^[4]	SCA14●●●H30 ^[4]
	15	2	30	SDG16●●●H30 ^[4]	SDW16●●●H30 ^[4]	SDW26●●●H30 ^[4]	SDA26●●●H30 ^[4]	SDA16●●●H30 ^[4]
	25		60	SDG14●●●H30	SDW14●●●H30	SDW24●●●H30	SDA24●●●H30	SDA14●●●H30
	50	3	100	SEG13●●●H30	SEW13●●●H30	SEW23●●●H30	SEA23●●●H30	SEA13●●●H30
	100	4	200	SFG13●●●H30	SFW13●●●H30	—	SFA23●●●H30	SFA13●●●H30
	200	5	400	SGG13●●●H30	SGW13●●●H30	—	SGA23●●●H30	SGA13●●●H30
	400	6	600	SHG12●●●H30	SHW12●●●H30	—	SHA22●●●H30	SHA12●●●H30



File E152395
CCN NKJH7



File LR584
Class 3211 04

Note:
Some units are not
CSA certified.
Consult the factory.

^[1] Size 6 starter enclosures are NEMA 4 painted sheet steel.

^[2] NEMA 12/3R enclosures can be field modified for outdoor non-corrosive and non-service entrance rated applications. See page 19 for more information.

^[3] Replace the three bullets (●●●) in the catalog number with the coil voltage code. Refer to the standard coil voltage codes shown in Table 5 on page 8.

^[4] **Form H30**, with the possibility of a fourth character to select a lower FLA range (for example, **H308**). See page 45.

NOTE: Some control transformers may require the use of oversize enclosures. Refer to Table 71 on page 44 for control transformer selection.

Combination Starters Class 8538—Fusible Disconnect Switch Type

Table 2: Class 8538 Fusible Disconnect Switch Type (Class H Fuse Clips), Single Phase ^[1], with Melting Alloy Overload Relay (see Thermal Unit Selection)

Motor Voltage	Ratings					Enclosure				
	Max. Hp	Coil Voltage	NEMA Size	Poles	Fuse Clip Size (A)	NEMA 1 General Purpose	NEMA 4 & 4X Watertight and Dusttight Stainless Steel (304)	NEMA 4X Watertight, Dusttight, and Corrosion Resistant Polyester	NEMA 12/3R ^[2] Industrial Use Dusttight and Driptight	
						Type	Type	Type	With External Reset	Without External Reset
120	1	120	0	2	30	SBG62V02	SBW62V02	SBW65V02	SBA65V02	SBA62V02
	2		1		30	SCG62V02	SCW62V02	SCW65V02	SCA65V02	SCA62V02
	3		2		60	SDG62V02	SDW62V02	SDW65V02	SDA65V02	SDA62V02
240	2	240	0	2	30	SBG62V03	SBW62V03	SBW65V03	SBA65V03	SBA62V03
	3		1		30	SCG62V03	SCW62V03	SCW65V03	SCA65V03	SCA62V03
	7.5		2		60	SDG62V03	SDW62V03	SDW65V03	SDA65V03	SDA62V03

^[1] Single-phase units require one thermal unit. They are not available with solid-state overload relays (Form H**).
Not included in the Laser™ Delivery program.

^[2] NEMA 12 enclosures can be field modified for outdoor non-corrosive and non-service entrance rated applications. See page 19 for more information.

Non-Fusible, 3-Pole Polyphase—600 Vac Maximum, 50–60 Hz

Table 3: Class 8538 Non-Fusible Full Voltage Type, Non-Reversing, with Motor Logic SSOLR (replace ... with the voltage code)

Ratings			Enclosure				
Motor Voltage (Starter Voltage)	Max. Hp Polyphase	NEMA Size	NEMA 1 General Purpose	NEMA 4 & 4X Watertight and Dusttight Stainless Steel (304) (Sizes 0–5) ^[1]	NEMA 4X Watertight, Dusttight, and Corrosion Resistant Polyester	NEMA 12/3R ^[2] Industrial Use Dusttight and Driptight	
			Type ^[3]	Type ^[3]	Type ^[3]	With External Reset	Without External Reset
200 (208)	3	0	SBG11...H30 ^[4]	SBW11...H30 ^[4]	SBW21...H30 ^[4]	SBA21...H30 ^[4]	SBA11...H30 ^[4]
	7.5	1	SCG11...H30 ^[4]	SCW11...H30 ^[4]	SCW21...H30 ^[4]	SCA21...H30 ^[4]	SCA11...H30 ^[4]
	10	2	SDG11...H30	SDW11...H30	SDW21...H30	SDA21...H30	SDA11...H30
	25	3	SEG11...H30	SEW11...H30	SEW21...H30	SEA21...H30	SEA11...H30
	40	4	SFG11...H30	SFW11...H30	—	SFA21...H30	SFA11...H30
	75	5	SGG11...H30	SGW11...H30	—	SGA21...H30	SGA11...H30
	150	6	SHG11...H30	SHW11...H30	—	SHA21...H30	SHA11...H30
230 (240)	3	0	SBG11...H30 ^[4]	SBW11...H30 ^[4]	SBW21...H30 ^[4]	SBA21...H30 ^[4]	SBA11...H30 ^[4]
	7.5	1	SCG11...H30 ^[4]	SCW11...H30 ^[4]	SCW21...H30 ^[4]	SCA21...H30 ^[4]	SCA11...H30 ^[4]
	15	2	SDG11...H30	SDW11...H30	SDW21...H30	SDA21...H30	SDA11...H30
	30	3	SEG11...H30	SEW11...H30	SEW21...H30	SEA21...H30	SEA11...H30
	50	4	SFG11...H30	SFW11...H30	—	SFA21...H30	SFA11...H30
	100	5	SGG11...H30	SGW11...H30	—	SGA21...H30	SGA11...H30
	200	6	SHG11...H30	SHW11...H30	—	SHA21...H30	SHA11...H30
460 (480)	5	0	SBG11...H30 ^[4]	SBW11...H30 ^[4]	SBW21...H30 ^[4]	SBA21...H30 ^[4]	SBA11...H30 ^[4]
	10	1	SCG11...H30 ^[4]	SCW11...H30 ^[4]	SCW21...H30 ^[4]	SCA21...H30 ^[4]	SCA11...H30 ^[4]
	25	2	SDG11...H30	SDW11...H30	SDW21...H30	SDA21...H30	SDA11...H30
	50	3	SEG11...H30	SEW11...H30	SEW21...H30	SEA21...H30	SEA11...H30
	100	4	SFG11...H30	SFW11...H30	—	SFA21...H30	SFA11...H30
	200	5	SGG11...H30	SGW11...H30	—	SGA21...H30	SGA11...H30
	400	6	SHG11...H30	SHW11...H30	—	SHA21...H30	SHA11...H30
575 (600)	5	0	SBG11...H30 ^[4]	SBW11...H30 ^[4]	SBW21...H30 ^[4]	SBA21...H30 ^[4]	SBA11...H30 ^[4]
	10	1	SCG11...H30 ^[4]	SCW11...H30 ^[4]	SCW21...H30 ^[4]	SCA21...H30 ^[4]	SCA11...H30 ^[4]
	25	2	SDG11...H30	SDW11...H30	SDW21...H30	SDA21...H30	SDA11...H30
	50	3	SEG11...H30	SEW11...H30	SEW21...H30	SEA21...H30	SEA11...H30
	100	4	SFG11...H30	SFW11...H30	—	SFA21...H30	SFA11...H30
	200	5	SGG11...H30	SGW11...H30	—	SGA21...H30	SGA11...H30
	400	6	SHG11...H30	SHW11...H30	—	SHA21...H30	SHA11...H30

^[1] Size 6 starter enclosures are NEMA 4 painted sheet steel.

^[2] NEMA 12/3R enclosures can be field modified for outdoor non-corrosive and non-service entrance rated applications. See page 19 for more information.

^[3] Replace the three bullets (•••) in the catalog number with the coil voltage code. Refer to the standard coil voltage codes shown in Table 5 on page 8.

^[4] **Form H30**, with the possibility of a fourth character to select a lower FLA range (for example, **H308**). See page 45.

Combination Starters

Class 8538—Fusible Disconnect Switch Type

Table 4: Class 8538 Non-Fusible Disconnect Switch Type, Single Phase ^[1], with Melting Alloy Overload Relay (see Thermal Unit Selection)

Motor Voltage	Ratings				Enclosure				
	Max. Hp	Coil Voltage	NEMA Size	Poles	NEMA 1 General Purpose	NEMA 4 & 4X Watertight and Dusttight Stainless Steel (304)	NEMA 4X Watertight, Dusttight, and Corrosion Resistant Polyester	NEMA 12/3R ^[2] Industrial Use Dusttight and Driptight	
					Type	Type	Type	With External Reset	Without External Reset
120	1	120	0	2	SBG61V02	SBW61V02	SBW64V02	SBA64V02	SBA61V02
	2		1		SCG61V02	SCW61V02	SCW64V02	SCA64V02	SCA61V02
	3		2		SDG61V02	SDW61V02	SDW64V02	SDA64V02	SDA61V02
240	2	240	0	2	SBG61V03	SBW61V03	SBW64V03	SBA64V03	SBA61V03
	3		1		SCG61V03	SCW61V03	SCW64V03	SCA64V03	SCA61V03
	7.5		2		SDG61V03	SDW61V03	SDW64V03	SDA64V03	SDA61V03

^[1] Single-phase units require one thermal unit. They are not available with solid-state overload relays (Form H**).
Not included in the Laser™ Delivery program.

^[2] NEMA 12 enclosures can be field modified for outdoor non-corrosive and non-service entrance rated applications. See page 19 for more information.

NOTE: Some control transformers may require the use of oversize enclosures. Refer to Table 71 on page 44 for control transformer selection.

Table 5: Coil Voltage Codes

Voltage		Code
60 Hz	50 Hz	
24 ^[1]	—	V01
120 ^[1]	110	V02
208	—	V08
240	220	V03
277 ^[1]	—	V04
480	440	V06
600	550	V07
Specify	Specify	V99

^[1] **Form S** (no charge) must be included with these voltage codes where a separate source of voltage is used for the control coil (for example, order as 8538SCG11V02H30S).

Note that **24 V** coils are **not** available on Sizes 4–7.

NOTE: For voltage codes used with control transformers, see Table 71 on page 44.

Combination Starters

Class 8538—Fusible Disconnect Switch Type with Class R Fuse Clips

Class R Fuse Clips, 3-Pole Polyphase—600 Vac Maximum, 50–60 Hz

Table 6: Class 8538 Fusible (with Class R Fuse Clips) Full Voltage Type, Non-Reversing, with Motor Logic SSOLR (100,000 AIC Rated) (replace ●●● with the voltage code)

Motor Voltage (Starter Voltage)	Ratings			Enclosure				
	Max. Hp Polyphase	NEMA Size	Fuse Clip Size (A)	NEMA 1 General Purpose	NEMA 4 & 4X Watertight and Dusttight Stainless Steel (304) (Sizes 0–5) [1]	NEMA 4 & 4X Watertight, Dusttight, and Corrosion Resistant Polyester	NEMA 12/3R Industrial Use Dusttight and Driptight [2]	
				Type [3]	Type [3]	Type [3]	With External Reset	Without External Reset
200 (208)	3	0	30	SBG32●●●H30[4]	SBW32●●●H30[4]	SBW42●●●H30[4]	SBA42●●●H30[4]	SBA32●●●H30[4]
	5	1	30	SCG32●●●H30[4]	SCW32●●●H30[4]	SCW42●●●H30[4]	SCA42●●●H30[4]	SCA32●●●H30[4]
	7.5	1	60	SCG33●●●H30[4]	SCW33●●●H30[4]	SCW43●●●H30[4]	SCA43●●●H30[4]	SCA33●●●H30[4]
	10	2	60	SDG32●●●H30	SDW32●●●H30[4]	SDW42●●●H30[4]	SDA42●●●H30[4]	SDA32●●●H30[4]
	20	3	100	SEG35●●●H30	SEW35●●●H30	SEW45●●●H30	SEA45●●●H30	SEA35●●●H30
	25	3	200	SEG32●●●H30	SEW32●●●H30	—	SEA42●●●H30	SEA32●●●H30
	40	4	200	SFG35●●●H30	SFW35●●●H30	—	SFA45●●●H30	SFA35●●●H30
	75	5	400	SGG35●●●H30	SGW35●●●H30	—	SGA45●●●H30	SGA35●●●H30
230 (240)	150	6	600	SHG33●●●H30	SHW33●●●H30	—	SHA43●●●H30	SHA33●●●H30
	3	0	30	SBG32●●●H30[4]	SBW32●●●H30[4]	SBW42●●●H30[4]	SBA42●●●H30[4]	SBA32●●●H30[4]
	5	1	30	SCG32●●●H30[4]	SCW32●●●H30[4]	SCW42●●●H30[4]	SCA42●●●H30[4]	SCA32●●●H30[4]
	7.5	1	60	SCG33●●●H30[4]	SCW33●●●H30[4]	SCW43●●●H30[4]	SCA43●●●H30[4]	SCA33●●●H30[4]
	10	2	60	SDG32●●●H30	SDW32●●●H30	SDW42●●●H30	SDA42●●●H30	SDA32●●●H30
	25	3	100	SEG35●●●H30	SEW35●●●H30	SEW45●●●H30	SEA45●●●H30	SEA35●●●H30
	30	3	200	SEG32●●●H30	SEW32●●●H30	—	SEA42●●●H30	SEA32●●●H30
	50	4	200	SFG35●●●H30	SFW35●●●H30	—	SFA45●●●H30	SFA35●●●H30
460 (480)	100	5	400	SGG35●●●H30	SGW35●●●H30	—	SGA45●●●H30	SGA35●●●H30
	200	6	600	SHG33●●●H30	SHW33●●●H30	—	SHA43●●●H30	SHA33●●●H30
	5	0	30	SBG33●●●H30[4]	SBW33●●●H30[4]	SBW43●●●H30[4]	SBA43●●●H30[4]	SBA33●●●H30[4]
	10	1	30	SCG34●●●H30[4]	SCW34●●●H30[4]	SCW44●●●H30[4]	SCA44●●●H30[4]	SCA34●●●H30[4]
	15	2	30	SDG36●●●H30[4]	SDW36●●●H30[4]	SDW46●●●H30[4]	SDA46●●●H30[4]	SDA36●●●H30[4]
	25	2	60	SDG34●●●H30	SDW34●●●H30	SDW44●●●H30	SDA44●●●H30	SDA34●●●H30
	50	3	100	SEG33●●●H30	SEW33●●●H30	SEW43●●●H30	SEA43●●●H30	SEA33●●●H30
	100	4	200	SFG33●●●H30	SFW33●●●H30	—	SFA43●●●H30	SFA33●●●H30
575 (600)	200	5	400	SGG33●●●H30	SGW33●●●H30	—	SGA43●●●H30	SGA33●●●H30
	400	6	600	SHG32●●●H30	SHW32●●●H30	—	SHA42●●●H30	SHA32●●●H30
	5	0	30	SBG33●●●H30[4]	SBW33●●●H30[4]	SBW43●●●H30[4]	SBA43●●●H30[4]	SBA33●●●H30[4]
	10	1	30	SCG34●●●H30[4]	SCW34●●●H30[4]	SCW44●●●H30[4]	SCA44●●●H30[4]	SCA34●●●H30[4]
	15	2	30	SDG36●●●H30[4]	SDW36●●●H30[4]	SDW46●●●H30[4]	SDA46●●●H30[4]	SDA36●●●H30[4]
	25	2	60	SDG34●●●H30	SDW34●●●H30	SDW44●●●H30	SDA44●●●H30	SDA34●●●H30
	50	3	100	SEG33●●●H30	SEW33●●●H30	SEW43●●●H30	SEA43●●●H30	SEA33●●●H30
	100	4	200	SFG33●●●H30	SFW33●●●H30	—	SFA43●●●H30	SFA33●●●H30

[1] Size 6 starter enclosures are NEMA 4 painted sheet steel.

[2] NEMA 12/3R enclosures can be field modified for outdoor non-corrosive and non-service entrance rated applications. See page 19 for more information.

[3] Replace the three bullets (●●●) in the catalog number with the coil voltage code. Refer to the standard coil voltage codes shown in Table 8 on page 10.

[4] Form H30, with the possibility of a fourth character to select a lower FLA range (for example, H308). See page 45.

Combination Starters

Class 8538—Fusible Disconnect Switch Type with Class R Fuse Clips

Table 7: Class 8538 Fusible Disconnect Switch Type (Class R Fuses), Single Phase ^[1], with Melting Alloy Overload Relay

Motor Voltage	Ratings					Enclosure				
	Max. Hp	Coil Voltage	NEMA Size	Poles	Fuse Clip Size (A)	NEMA 1 General Purpose	NEMA 4 & 4X Watertight and Dusttight Stainless Steel	NEMA 4X Watertight, Dusttight, and Corrosion Resistant Polyester	NEMA 12/3R Industrial Dusttight and Driptight With External Reset	NEMA 12/3R Industrial Dusttight and Driptight Without External Reset
						Type	Type	Type	Type	Type
120	1	120	0	2	30	SBG63V02	SBW63V02	SBW66V02	SBA66V02	SBA63V02
	2		1		30	SCG63V02	SCW63V02	SCW66V02	SCA66V02	SCA63V02
	3		2		60	SDG63V02	SDW63V02	SDW66V02	SDA66V02	SDA63V02
240	2	240	0	2	30	SBG63V03	SBW63V03	SBW66V03	SBA66V03	SBA63V03
	3		1		30	SCG63V03	SCW63V03	SCW66V03	SCA66V03	SCA63V03
	7.5		2		60	SDG63V03	SDW63V03	SDW66V03	SDA66V03	SDA63V03

^[1] Single-phase units require one thermal unit. They are not available with solid-state overload relays (Form H**). Not included in the Laser™ Delivery program.

NOTE: Some control transformers may require the use of oversize enclosures. See Table 71 on page 44 for control transformer selection.

Table 8: Coil Voltage Codes

Voltage		Code
60 Hz	50 Hz	
24 ^[1]	—	V01
120 ^[1]	110	V02
208	—	V08
240	220	V03
277 ^[1]	—	V04
480	440	V06
600	550	V07
Specify	Specify	V99

^[1] **Form S** (no charge) must be included with these voltage codes where a separate source of voltage is used for the control coil (for example, order as 8538SCG32V02H30S). Note that **24 V** coils are **not** available on Sizes 4–7.

NOTE: For voltage codes used with control transformers, see Table 71 on page 44.

Combination Starters

Class 8538—Disconnect Switch Type in Oversize Enclosure, NEMA Size 0–2

Oversize Enclosures, 3-Pole Polyphase—600 Vac Maximum, 50–60 Hz

Table 9: Class 8538 with Oversize Enclosures (replace ●●● with the voltage code)

Motor Voltage (Starter Voltage)	Ratings			Enclosure			
	Max. Hp Polyphase	NEMA Size	Fuse Clip Size (A)	NEMA 1 General Purpose	NEMA 4 & 4X Watertight and Dusttight, Stainless Steel (304)	NEMA 12/3R ^[5] , Industrial Use, Dusttight and Driptight	
				Type ^[3]	Type ^[3]	With External Reset	Without External Reset
Type ^[3]							
Class 8538 Non-Fusible Disconnect Switch Type—NEMA Size 0–2 ^{[1], [2]}							
200 (208)	3	0	N/A	SBG11S8●●●H30 ^[4]	SBW11S8●●●H30 ^[4]	SBA21S8●●●H30 ^[4]	SBA11S8●●●H30 ^[4]
	7.5	1	N/A	SCG11S8●●●H30 ^[4]	SCW11S8●●●H30 ^[4]	SCA21S8●●●H30 ^[4]	SCA11S8●●●H30 ^[4]
	10	2	N/A	SDG11S8●●●H30	SDW11S8●●●H30	SDA21S8●●●H30	SDA11S8●●●H30
230 (240)	3	0	N/A	SBG11S8●●●H30 ^[4]	SBW11S8●●●H30 ^[4]	SBA21S8●●●H30 ^[4]	SBA11S8●●●H30 ^[4]
	7.5	1	N/A	SCG11S8●●●H30 ^[4]	SCW11S8●●●H30 ^[4]	SCA21S8●●●H30 ^[4]	SCA11S8●●●H30 ^[4]
	15	2	N/A	SDG11S8●●●H30	SDW11S8●●●H30	SDA21S8●●●H30	SDA11S8●●●H30
460 (480)	5	0	N/A	SBG11S8●●●H30 ^[4]	SBW11S8●●●H30 ^[4]	SBA21S8●●●H30 ^[4]	SBA11S8●●●H30 ^[4]
	10	1	N/A	SCG11S8●●●H30 ^[4]	SCW11S8●●●H30 ^[4]	SCA21S8●●●H30 ^[4]	SCA11S8●●●H30 ^[4]
	25	2	N/A	SDG11S8●●●H30	SDW11S8●●●H30	SDA21S8●●●H30	SDA11S8●●●H30
575 (600)	5	0	N/A	SBG11S8●●●H30 ^[4]	SBW11S8●●●H30 ^[4]	SBA21S8●●●H30 ^[4]	SBA11S8●●●H30 ^[4]
	10	1	N/A	SCG11S8●●●H30 ^[4]	SCW11S8●●●H30 ^[4]	SCA21S8●●●H30 ^[4]	SCA11S8●●●H30 ^[4]
	25	2	N/A	SDG11S8●●●H30	SDW11S8●●●H30	SDA21S8●●●H30	SDA11S8●●●H30
Class 8538 Fusible Disconnect Switch Type—NEMA Size 0–2 ^{[1], [2]}							
200 (208)	3	0	30	SBG12S8●●●H30 ^[4]	SBW12S8●●●H30 ^[4]	SBA22S8●●●H30 ^[4]	SBA12S8●●●H30 ^[4]
	5	1	30	SCG12S8●●●H30 ^[4]	SCW12S8●●●H30 ^[4]	SCA22S8●●●H30 ^[4]	SCA12S8●●●H30 ^[4]
	7.5	1	60	SCG13S8●●●H30 ^[4]	SCW13S8●●●H30 ^[4]	SCA23S8●●●H30 ^[4]	SCA13S8●●●H30 ^[4]
	10	2	60	SDG12S8●●●H30	SDW12S8●●●H30	SDA22S8●●●H30	SDA12S8●●●H30
230 (240)	3	0	30	SBG12S8●●●H30 ^[4]	SBW12S8●●●H30 ^[4]	SBA22S8●●●H30 ^[4]	SBA12S8●●●H30 ^[4]
	5	1	30	SCG12S8●●●H30 ^[4]	SCW12S8●●●H30 ^[4]	SCA22S8●●●H30 ^[4]	SCA12S8●●●H30 ^[4]
	7.5	1	60	SCG13S8●●●H30 ^[4]	SCW13S8●●●H30 ^[4]	SCA23S8●●●H30 ^[4]	SCA13S8●●●H30 ^[4]
	15	2	60	SDG12S8●●●H30	SDW12S8●●●H30	SDA22S8●●●H30	SDA12S8●●●H30
460 (480)	5	0	30	SBG13S8●●●H30 ^[4]	SBW13S8●●●H30 ^[4]	SBA23S8●●●H30 ^[4]	SBA13S8●●●H30 ^[4]
	10	1	30	SCG14S8●●●H30 ^[4]	SCW14S8●●●H30 ^[4]	SCA24S8●●●H30 ^[4]	SCA14S8●●●H30 ^[4]
	15	2	30	SDG16S8●●●H30 ^[4]	SDW16S8●●●H30 ^[4]	SDA26S8●●●H30 ^[4]	SDA16S8●●●H30 ^[4]
	25	2	60	SDG14S8●●●H30	SDW14S8●●●H30	SDA24S8●●●H30	SDA14S8●●●H30
575 (600)	5	0	30	SBG13S8●●●H30 ^[4]	SBW13S8●●●H30 ^[4]	SBA23S8●●●H30 ^[4]	SBA13S8●●●H30 ^[4]
	10	1	30	SCG14S8●●●H30 ^[4]	SCW14S8●●●H30 ^[4]	SCA24S8●●●H30 ^[4]	SCA14S8●●●H30 ^[4]
	15	2	30	SDG16S8●●●H30 ^[4]	SDW16S8●●●H30 ^[4]	SDA26S8●●●H30 ^[4]	SDA16S8●●●H30 ^[4]
	25	2	60	SDG14S8●●●H30	SDW14S8●●●H30	SDA24S8●●●H30	SDA14S8●●●H30
Class 8538 Fusible Disconnect Switch Type with Class R Fuse Clips—NEMA Size 0–2 ^{[1], [2]}							
200 (208)	3	0	30	SBG32S8●●●H30 ^[4]	SBW32S8●●●H30 ^[4]	SBA42S8●●●H30 ^[4]	SBA32S8●●●H30 ^[4]
	5	1	30	SCG32S8●●●H30 ^[4]	SCW32S8●●●H30 ^[4]	SCA42S8●●●H30 ^[4]	SCA32S8●●●H30 ^[4]
	7.5	1	60	SCG33S8●●●H30 ^[4]	SCW33S8●●●H30 ^[4]	SCA43S8●●●H30 ^[4]	SCA33S8●●●H30 ^[4]
	10	2	60	SDG32S8●●●H30	SDW32S8●●●H30	SDA42S8●●●H30	SDA32S8●●●H30
230 (240)	3	0	30	SBG32S8●●●H30 ^[4]	SBW32S8●●●H30 ^[4]	SBA42S8●●●H30 ^[4]	SBA32S8●●●H30 ^[4]
	5	1	30	SCG32S8●●●H30 ^[4]	SCW32S8●●●H30	SCA42S8●●●H30	SCA32S8●●●H30
	7.5	1	60	SCG33S8●●●H30	SCW33S8●●●H30 ^[4]	SCA43S8●●●H30 ^[4]	SCA33S8●●●H30 ^[4]
	15	2	60	SDG32S8●●●H30	SDW32S8●●●H30	SDA42S8●●●H30	SDA32S8●●●H30
460 (480)	5	0	30	SBG33S8●●●H30 ^[4]	SBW33S8●●●H30 ^[4]	SBA43S8●●●H30 ^[4]	SBA33S8●●●H30 ^[4]
	10	1	30	SCG34S8●●●H30 ^[4]	SCW34S8●●●H30 ^[4]	SCA44S8●●●H30 ^[4]	SCA34S8●●●H30 ^[4]
	15	2	30	SDG36S8●●●H30 ^[4]	SDW36S8●●●H30 ^[4]	SDA46S8●●●H30 ^[4]	SDA36S8●●●H30 ^[4]
	25	2	60	SDG34S8●●●H30	SDW34S8●●●H30	SDA44S8●●●H30	SDA34S8●●●H30
575 (600)	5	0	30	SBG33S8●●●H30 ^[4]	SBW33S8●●●H30 ^[4]	SBA43S8●●●H30 ^[4]	SBA33S8●●●H30 ^[4]
	10	1	30	SCG34S8●●●H30 ^[4]	SCW34S8●●●H30 ^[4]	SCA44S8●●●H30 ^[4]	SCA34S8●●●H30 ^[4]
	15	2	30	SDG36S8●●●H30 ^[4]	SDW36S8●●●H30 ^[4]	SDA46S8●●●H30 ^[4]	SDA36S8●●●H30 ^[4]
	25	2	60	SDG34S8●●●H30	SDW34S8●●●H30	SDA44S8●●●H30	SDA34S8●●●H30

^[1] For Size 3–5 starters in oversize NEMA 1, 4, or 12 enclosures, contact the factory for pricing and TAG number.

^[2] Not included in the Laser™ Delivery program.

^[3] Replace the three bullets (●●●) in the catalog number with the coil voltage code. Refer to the standard coil voltage codes shown in Table 10 on page 12.

^[4] **Form H30**, with the possibility of a fourth character to select a lower FLA range (for example, **H308**). See page 45.

^[5] NEMA 12/3R enclosures can be field modified for outdoor non-corrosive and non-service entrance rated applications. See page 19 for more information.

NOTE: Some control transformers may require the use of oversize enclosures. Refer to Table 71 on page 44 for control transformer selection.

Combination Starters
Class 8538—Disconnect Switch Type in Oversize Enclosure, NEMA Size 0–2

Table 10: Coil Voltage Codes

Voltage		Code
60 Hz	50 Hz	
24 ^[1]	—	V01
120 ^[1]	110	V02
208	—	V08
240	220	V03
277 ^[1]	—	V04
480	440	V06
600	550	V07
Specify	Specify	V99

^[1] **Form S** (no charge) must be included with these voltage codes where a separate source of voltage is used for the control coil (for example, order as 8538SCG11S8V02H30S). Note that **24 V** coils are **not** available on Sizes 4–7.

NOTE: For voltage codes used with control transformers, see Table 71 on page 44.

Combination Starters

Class 8539—Electronic Motor Circuit Protector (MCP)

Electronic MCP, 3-Pole Polyphase—600 Vac Maximum, 50–60 Hz

Table 11: Class 8539 Full Voltage Type, Non-Reversing, 200–240 V, with Motor Logic SSOLR (replace ●●● with the voltage code)

Motor Voltage (Starter Voltage)	Ratings			Enclosure				
	Hp Range Polyphase	NEMA Size	Circuit Breaker [1]	NEMA 1 General Purpose	NEMA 4 & 4X Watertight and Dusttight Stainless Steel (304) (Sizes 0–5) [2]	NEMA 4 & 4X Watertight, Dusttight, and Corrosion Resistant Polyester	NEMA 12/3R Industrial Use Dusttight and Driptight [3]	
				Type[4]	Type[4]	Type[4]	With External Reset	Without External Reset
200 (208)	0.25–3	0	HLL36030M71	SBG43●●●H30[5]	SBW43●●●H30[5]	SBW53●●●H30[5]	SBA53●●●H30[5]	SBA43●●●H30[5]
	0.25–5	1	HLL36030M71	SCG44●●●H30[5]	SCW44●●●H30[5]	SCW54●●●H30[5]	SCA54●●●H30[5]	SCA44●●●H30[5]
	7.5		HLL36050M72	SCG45●●●H30[5]	SCW45●●●H30[5]	SCW55●●●H30[5]	SCA55●●●H30[5]	SCA45●●●H30[5]
	1.5–5	2	HLL36030M71	SDG42●●●H30[5]	SDW42●●●H30[5]	SDW52●●●H30[5]	SDA52●●●H30[5]	SDA42●●●H30[5]
	7.5–10		HLL36050M72	SDG43●●●H30	SDW43●●●H30	SDW53●●●H30	SDA53●●●H30	SDA43●●●H30
	15–25	3	HLL36100M73	SEG42●●●H30	SEW42●●●H30	SEW52●●●H30	SEA52●●●H30	SEA42●●●H30
	30–40	4	JLL36250M75	SFG44●●●H30	SFW44●●●H30	SFW54●●●H30	SFA54●●●H30	SFA44●●●H30
	50–60	5	JLL36250M75	SGG44●●●H30	SGW44●●●H30	—	SGA54●●●H30	SGA44●●●H30
	75		LJL36400M36	SGG45●●●H30	SGW45●●●H30	—	SGA55●●●H30	SGA45●●●H30
	100	6	LJL36400M36	SHG43●●●H30	SHW43●●●H30	—	SHA53●●●H30	SHA43●●●H30
	125–150		LJL36600M42	SHG45●●●H30	SHW45●●●H30	—	SHA55●●●H30	SHA45●●●H30
230 (240)	0.25–3	0	HLL36030M71	SBG43●●●H30[5]	SBW43●●●H30[5]	SBW53●●●H30[5]	SBA53●●●H30[5]	SBA43●●●H30[5]
	0.25–7.5	1	HLL36030M71	SCG44●●●H30[5]	SCW44●●●H30[5]	SCW54●●●H30[5]	SCA54●●●H30[5]	SCA44●●●H30[5]
	1.5–7.5	2	HLL36030M71	SDG42●●●H30[5]	SDW42●●●H30[5]	SDW52●●●H30[5]	SDA52●●●H30[5]	SDA42●●●H30[5]
	10		HLL36050M72	SDG43●●●H30	SDW43●●●H30	SDW53●●●H30	SDA53●●●H30	SDA43●●●H30
	15		HLL36100M73	SDG44●●●H30	SDW44●●●H30	SDW54●●●H30	SDA54●●●H30	SDA44●●●H30
	15–30	3	HLL36100M73	SEG42●●●H30	SEW42●●●H30	SEW52●●●H30	SEA52●●●H30	SEA42●●●H30
	40–50	4	JLL36250M75	SFG44●●●H30	SFW44●●●H30	SFW54●●●H30	SFA54●●●H30	SFA44●●●H30
	60	5	JLL36250M75	SGG44●●●H30	SGW44●●●H30	—	SGA54●●●H30	SGA44●●●H30
	75–100		LJL36400M36	SGG46●●●H30	SGW45●●●H30	—	SGA55●●●H30	SGA45●●●H30
	125–150	6	LJL36600M42	SHG45●●●H30	SHW45●●●H30	—	SHA55●●●H30	SHA45●●●H30
	200		PLL34080M68	SHG46●●●H30	SHW46●●●H30	—	SHA56●●●H30	SHA46●●●H30
	250–300	7	PLL36100M69	SJA43●●●H30	SJW43●●●H30	—	SJA53●●●H30	—

[1] See Digest Section 7 for the circuit breaker adjustment range.

[2] Size 6 and 7 enclosures are NEMA 4 sheet steel.

[3] NEMA 12/3R enclosures can be field modified for outdoor non-corrosive and non-service entrance rated applications. See page 19 for more information.

[4] Replace the three bullets (●●●) in the catalog number with the coil voltage code. Refer to the standard coil voltage codes shown in Table 12.

[5] **Form H30**, with the possibility of a fourth character to select a lower FLA range (for example, **H308**). See page 45.

NOTE: Some control transformers may require the use of oversize enclosures. Refer to Table 71 on page 44 for control transformer selection.

Standard unit



File E152395
CCN NKJH, NKJH7

Table 12: Coil Voltage Codes

Voltage		Code
60 Hz	50 Hz	
24 ^[1]	—	V01
120 ^[1]	110	V02
208	—	V08
240	220	V03
277 ^[1]	—	V04
480	440	V06
600	550	V07
Specify	Specify	V99

[1] **Form S** (no charge) must be included with these voltage codes where a separate source of voltage is used for the control coil (for example, 8539SCG41V02S). Note that **24 V** coils are **not** available on Sizes 4–7.

NOTE: For voltage codes used with control transformers, see Table 71 on page 44.

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Combination Starters

Class 8539—Electronic Motor Circuit Protector (MCP)

Electronic MCP, 3-Pole Polyphase—600 Vac Maximum, 50–60 Hz

Table 13: Class 8539 Full Voltage Type, Non-Reversing, 460–600 V, with Motor Logic SSOLR (replace ●●● with the voltage code)

Motor Voltage (Starter Voltage)	Ratings			Enclosure				
	Hp Range Polyphase	NEMA Size	Circuit Breaker [1]	NEMA 1 General Purpose	NEMA 4 & 4X Watertight and Dusttight Stainless Steel (304) (Sizes 0–5)[2]	NEMA 4 & 4X Watertight, Dusttight, and Corrosion Resistant Polyester	NEMA 12/3R [3] Industrial Use Dusttight and Driptight	
				Type [4]	Type [4]	Type [4]	With External Reset	Without External Reset
460 (480)	0.25–5	0	HLL36030M71	SBG43●●●H30 [5]	SBW43●●●H30 [5]	SBW53●●●H30 [5]	SBA53●●●H30 [5]	SBA43●●●H30 [5]
	0.25–10	1	HLL36030M71	SCG44●●●H30 [5]	SCW44●●●H30 [5]	SCW54●●●H30 [5]	SCA54●●●H30 [5]	SCA44●●●H30 [5]
	5–15	2	HLL36030M71	SDG42●●●H30 [5]	SDW42●●●H30 [5]	SDW52●●●H30 [5]	SDA52●●●H30 [5]	SDA42●●●H30 [5]
	20–25		HLL36050M72	SDG43●●●H30	SDW43●●●H30	SDW53●●●H30	SDA53●●●H30	SDA43●●●H30
	20–25	3	HLL36050M72	SEG41●●●H30	SEW41●●●H30	SEW51●●●H30	SEA51●●●H30	SEA41●●●H30
	30–50		HLL36100M73	SEG42●●●H30	SEW42●●●H30	SEW52●●●H30	SEA52●●●H30	SEA42●●●H30
	60–100	4	JLL36250M75	SFG44●●●H30	SFW44●●●H30	SFW54●●●H30	SFA54●●●H30	SFA44●●●H30
	125		JLL36250M75	SGG44●●●H30	SGW44●●●H30	—	SGA54●●●H30	SGA44●●●H30
	150–200	5	LJL36400M36	SGG45●●●H30	SGW45●●●H30	—	SGA55●●●H30	SGA45●●●H30
	250–350		LJL36600M42	SHG45●●●H30	SHW45●●●H30	—	SHA55●●●H30	SHA45●●●H30
	400	6	PLL34080M68	SHG46●●●H30	SHW46●●●H30	—	SHA56●●●H30	SHA46●●●H30
	500		PLL36080M68	SJA42●●●H30	SJW42●●●H30	—	SJA52●●●H30	—
	600	7	PLL36100M69	SJA43●●●H30	SJW43●●●H30	—	SJA53●●●H30	—
	0.25–5	0	HLL36030M71	SBG43●●●H30 [5]	SBW43●●●H30 [5]	SBW53●●●H30 [5]	SBA53●●●H30 [5]	SBA43●●●H30 [5]
575 (600)	0.25–10	1	HLL36030M71	SCG44●●●H30 [5]	SCW44●●●H30 [5]	SCW54●●●H30 [5]	SCA54●●●H30 [5]	SCA44●●●H30 [5]
	5–20	2	HLL36030M71	SDG42●●●H30 [5]	SDW42●●●H30 [5]	SDW52●●●H30 [5]	SDA52●●●H30 [5]	SDA42●●●H30 [5]
	25		HLL36050M72	SDG43●●●H30	SDW43●●●H30	SDW53●●●H30	SDA53●●●H30	SDA43●●●H30
	25–30	3	HLL36050M72	SEG41●●●H30	SEW41●●●H30	SEW51●●●H30	SEA51●●●H30	SEA41●●●H30
	40–50		HLL36100M73	SEG42●●●H30	SEW42●●●H30	SEW52●●●H30	SEA52●●●H30	SEA42●●●H30
	60–100	4	JLL36250M75	SFG44●●●H30	SFW44●●●H30	SFW54●●●H30	SFA54●●●H30	SFA44●●●H30
	125–150		JLL36250M75	SGG44●●●H30	SGW44●●●H30	—	SGA54●●●H30	SGA44●●●H30
	200	5	LJL36400M36	SGG45●●●H30	SGW45●●●H30	—	SGA55●●●H30	SGA45●●●H30
	250		LJL36400M36	SHG43●●●H30	SHW43●●●H30	—	SHA53●●●H30	SHA43●●●H30
	300–400	6	LJL36600M42	SHG45●●●H30	SHW45●●●H30	—	SHA55●●●H30	SHA45●●●H30
	500–600	7	PLL34100M69	SJG41●●●H30	SJW41●●●H30	—	SJA51●●●H30	—

[1] See Digest Section 7 for the circuit breaker adjustment range.

[2] Size 6 and 7 enclosures are NEMA 4 only, painted sheet steel.

[3] NEMA 12/3R enclosures can be field modified for outdoor non-corrosive and non-service entrance rated applications. See page 19 for more information.

[4] Replace the three bullets (●●●) in the catalog number with the coil voltage code. Refer to the standard coil voltage codes shown in Table 14.

[5] **Form H30**, with the possibility of a fourth character to select a lower FLA range (for example, **H308**). See page 45.

NOTE: Some control transformers may require the use of oversize enclosures. Refer to Table 71 on page 44 for control transformer selection.

Table 14: Coil Voltage Codes

Voltage		Code
60 Hz	50 Hz	
24 [1]	—	V01
120 [1]	110	V02
208	—	V08
240	220	V03
277 [1]	—	V04
480	440	V06
600	550	V07
Specify	Specify	V99

[1] **Form S** (no charge) must be included with these voltage codes where a separate source of voltage is used for the control coil (for example, order as 8539SCG41V02S). Note that **24 V** coils are **not** available on Sizes 4–7.

NOTE: For voltage codes used with control transformers, see Table 71 on page 44.

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Combination Starters

Class 8539—Electronic Motor Circuit Protector (MCP) in Oversize Enclosure, NEMA Size 0–2

Electronic MCP, Oversize, 3-Pole Polyphase—600 Vac Maximum, 50–60 Hz

NOTE: Some control transformers may require the use of oversize enclosures. Refer to Table 71 on page 44 for control transformer selection.

Table 15: Class 8539 Electronic Motor Circuit Protectors (MCP) in Oversize Enclosure, NEMA Size 0–2 [1]
Full Voltage Type, Non-Reversing with Motor Logic SSOLR (replace ●●● with the voltage code)

Motor Voltage (Starter Voltage)	Ratings			Enclosure			
	Hp Range Polyphase	NEMA Size	Circuit Breaker [2]	NEMA 1 General Purpose	NEMA 4 & 4X Watertight and Dusttight Stainless Steel (304)	NEMA 12/3R Industrial Use Dusttight and Driptight [3]	
				Type[4]	Type[4]	With External Reset Type[4]	Without External Reset Type[4]
200 (208)	0.25–3	0	HLL36030M71	SBG43S8●●●H30[5]	SBW43S8●●●H30[5]	SBA53S8●●●H30[5]	SBA43S8●●●H30[5]
	0.25–5 7.5	1	HLL36030M71 HLL36050M72	SCG44S8●●●H30[5] SCG45S8●●●H30[5]	SCW44S8●●●H30[5] SCW45S8●●●H30[5]	SCA54S8●●●H30[5] SCA55S8●●●H30[5]	SCA44S8●●●H30[5] SCA45S8●●●H30[5]
	1.5–5 7.5–10	2	HLL36030M71 HLL36050M72	SDG42S8●●●H30[5] SDG43S8●●●H30	SDW42S8●●●H30[5] SDW43S8●●●H30	SDA52S8●●●H30[5] SDA53S8●●●H30	SDA42S8●●●H30[5] SDA43S8●●●H30
	0.25–3	0	HLL36030M71	SBG43S8●●●H30[5]	SBW43S8●●●H30[5]	SBA53S8●●●H30[5]	SBA43S8●●●H30[5]
230 (240)	0.25–7.5	1	HLL36030M71	SCG44S8●●●H30[5]	SCW44S8●●●H30[5]	SCA54S8●●●H30[5]	SCA44S8●●●H30[5]
	1.5–7.5 10 15	2	HLL36030M71 HLL36050M72 HLL36100M73	SDG42S8●●●H30[5] SDG43S8●●●H30 SDG44S8●●●H30	SDW42S8●●●H30[5] SDW43S8●●●H30 SDW44S8●●●H30	SDA52S8●●●H30[5] SDA53S8●●●H30 SDA54S8●●●H30	SDA42S8●●●H30[5] SDA43S8●●●H30 SDA44S8●●●H30
	0.25–5	0	HLL36030M71	SBG43S8●●●H30[5]	SBW43S8●●●H30[5]	SBA53S8●●●H30[5]	SBA43S8●●●H30[5]
	0.25–10	1	HLL36030M71	SCG44S8●●●H30[5]	SCW44S8●●●H30[5]	SCA54S8●●●H30[5]	SCA44S8●●●H30[5]
460 (480)	5–15 20–25	2	HLL36030M71 HLL36050M72	SDG42S8●●●H30[5] SDG43S8●●●H30	SDW42S8●●●H30[5] SDW43S8●●●H30	SDA52S8●●●H30[5] SDA53S8●●●H30	SDA42S8●●●H30[5] SDA43S8●●●H30
	0.25–5	0	HLL36060M71	SBG43S8●●●H30[5]	SBW43S8●●●H30[5]	SBA53S8●●●H30[5]	SBA43S8●●●H30[5]
	0.25–10	1	HLL36030M71	SCG44S8●●●H30[5]	SCW44S8●●●H30[5]	SCA54S8●●●H30[5]	SCA44S8●●●H30[5]
	5–20 25	2	HLL36030M71 HLL36050M72	SDG42S8●●●H30[5] SDG43S8●●●H30	SDW42S8●●●H30[5] SDW43S8●●●H30	SDA52S8●●●H30[5] SDA53S8●●●H30	SDA42S8●●●H30[5] SDA43S8●●●H30

[1] Not included in the Laser™ Delivery program.

[2] See Digest Section 7 for the circuit breaker adjustment range.

[3] NEMA 12/3R enclosures can be field modified for outdoor non-corrosive and non-service entrance rated applications. See page 19 for more information.

[4] Replace the three bullets (●●●) in the catalog number with the coil voltage code. Refer to the standard coil voltage codes shown in Table 16.

[5] Form H30, with the possibility of a fourth character to select a lower FLA range (for example, H308). See page 45.

Table 16: Coil Voltage Codes

Voltage		Code
60 Hz	50 Hz	
24 [1]	—	V01
120 [1]	110	V02
208	—	V08
240	220	V03
277 [1]	—	V04
480	440	V06
600	550	V07
Specify	Specify	V99

[1] **Form S** (no charge) must be included with these voltage codes where a separate source of voltage is used for the control coil (for example, order as 8539SCG41S8V02S). Note that **24 V** coils are **not** available on Sizes 4–7.

NOTE: For voltage codes used with control transformers, see Table 71 on page 44.

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Combination Starters

Class 8539—Thermal-Magnetic Circuit Breaker

Thermal-Magnetic, 3-Pole Polyphase—600 Vac Maximum, 50–60 Hz

Table 17: Class 8539 Full Voltage, Thermal-Magnetic Circuit Breaker Type, Non-Reversing, with Motor Logic SSOLR (replace ●●● with the voltage code)

Motor Voltage (Starter Voltage)	Ratings				NEMA 1 General Purpose	Enclosure			
	Max. Hp Poly-phase	NEMA Size	Circuit Breaker			NEMA 4 & 4X Watertight and Dusttight Stainless Steel (304) (Sizes 0–5) ^[1]	NEMA 4 & 4X Watertight, Dusttight and Corrosion Resistant Polyester	NEMA 12/3R ^[2] Dusttight and Driptight Industrial Use	
			Type	Rating (A)				Type ^[3]	Type ^[3]
200 (208)	2	0	HLL36015	15	SBG1●●●H30 ^[4]	SBW1●●●H30 ^[4]	SBW11●●●H30 ^[4]	SBA11●●●H30 ^[4]	SBA1●●●H30 ^[4]
	3		HLL36020	20	SBG3●●●H30 ^[4]	SBW3●●●H30 ^[4]	SBW13●●●H30 ^[4]	SBA13●●●H30 ^[4]	SBA3●●●H30 ^[4]
	5	1	HLL36035	35	SCG5●●●H30 ^[4]	SCW5●●●H30 ^[4]	SCW15●●●H30 ^[4]	SCA15●●●H30 ^[4]	SCA5●●●H30 ^[4]
	7.5		HLL36050	50	SCG2●●●H30 ^[4]	SCW2●●●H30 ^[4]	SCW12●●●H30 ^[4]	SCA12●●●H30 ^[4]	SCA2●●●H30 ^[4]
	10	2	HLL36060	60	SDG1●●●H30	SDW1●●●H30	SDW11●●●H30	SDA11●●●H30	SDA1●●●H30
	15		HLL36100	100	SEG3●●●H30	SEW3●●●H30	SEW13●●●H30	SEA13●●●H30	SEA3●●●H30
	20	3	HLL36125	125	SEG1●●●H30	SEW1●●●H30	SEW11●●●H30	SEA11●●●H30	SEA1●●●H30
	25		HLL36150	150	SEG5●●●H30	SEW5●●●H30	SEW15●●●H30	SEA15●●●H30	SEA5●●●H30
	30	4	JLL36200	200	SFG3●●●H30	SFW3●●●H30	SFW13●●●H30	SFA13●●●H30	SFA3●●●H30
	40		JLL36250	250	SFG4●●●H30	SFW4●●●H30	SFW14●●●H30	SFA14●●●H30	SFA4●●●H30
	50	5	JLL36250	250	SGG6●●●H30	SGW6●●●H30	—	SGA16●●●H30	SGA6●●●H30
	60–75		LLL36400U33X	400	SGG4●●●H30	SGW4●●●H30	—	SGA14●●●H30	SGA4●●●H30
	100–125	6	LLL36600U33X	600	SHG4●●●H30	SHW4●●●H30	—	SHA14●●●H30	SHA4●●●H30
	150		MJL36800	800	SHG5●●●H30	SHW5●●●H30	—	SHA15●●●H30	SHA5●●●H30
230 (240)	2	0	HLL36015	15	SBG1●●●H30 ^[4]	SBW1●●●H30 ^[4]	SBW11●●●H30 ^[4]	SBA11●●●H30 ^[4]	SBA1●●●H30 ^[4]
	3		HLL36020	20	SBG3●●●H30 ^[4]	SBW3●●●H30 ^[4]	SBW13●●●H30 ^[4]	SBA13●●●H30 ^[4]	SBA3●●●H30 ^[4]
	5	1	HLL36035	35	SCG5●●●H30 ^[4]	SCW5●●●H30 ^[4]	SCW15●●●H30 ^[4]	SCA15●●●H30 ^[4]	SCA1●●●H30 ^[4]
	7.5		HLL36045	45	SCG6●●●H30 ^[4]	SCW6●●●H30 ^[4]	SCW16●●●H30 ^[4]	SCA16●●●H30 ^[4]	SCA6●●●H30 ^[4]
	10	2	HLL36060	60	SDG1●●●H30	SDW1●●●H30	SDW11●●●H30	SDA11●●●H30	SDA1●●●H30
	15		HLL36090	90	SDG7●●●H30	SDW7●●●H30	SDW17●●●H30	SDA17●●●H30	SDA7●●●H30
	20	3	HLL36100	100	SEG3●●●H30	SEW3●●●H30	SEW13●●●H30	SEA13●●●H30	SEA3●●●H30
	25–30		HLL36150	150	SEG5●●●H30	SEW5●●●H30	SEW15●●●H30	SEA15●●●H30	SEA5●●●H30
	40	4	JLL36225	225	SFG1●●●H30	SFW1●●●H30	SFW11●●●H30	SFA11●●●H30	SFA1●●●H30
	50		JLL36250	250	SFG4●●●H30	SFW4●●●H30	SFW14●●●H30	SFA14●●●H30	SFA4●●●H30
	60	5	JLL36250	250	SGG6●●●H30	SGW6●●●H30	—	SGA16●●●H30	SGA6●●●H30
	75		LLL36400U33X	400	SGG4●●●H30	SGW4●●●H30	—	SGA14●●●H30	SGA4●●●H30
	100	6	LLL36600U33X	600	SGG2●●●H30	SGW2●●●H30	—	SGA12●●●H30	SGA2●●●H30
	125		LLL36600U33X	600	SHG4●●●H30	SHW4●●●H30	—	SHA14●●●H30	SHA4●●●H30
150–200	7	MJL36800	800	SHG5●●●H30	SHW5●●●H30	—	SHA15●●●H30	SHA5●●●H30	
250–300		PKL36100	1200	SJG3●●●H30	SJW3●●●H30	—	SJA13●●●H30	—	

[1] Size 6 and 7 enclosures are NEMA 4 only, painted sheet steel.

[2] NEMA 12/3R enclosures can be field modified for outdoor non-corrosive and non-service entrance rated applications. See page 19 for more information.

[3] Replace the three bullets (●●●) in the catalog number with the coil voltage code. Refer to the standard coil voltage codes listed in Table 18.

[4] **Form H30**, with the possibility of a fourth character to select a lower FLA range (for example, **H308**). See page 45.

Table 18: Coil Voltage Codes

Voltage		Code
60 Hz	50 Hz	
24 ^[1]	—	V01
120 ^[1]	110	V02
208	—	V08
240	220	V03
277 ^[1]	—	V04
480	440	V06
600	550	V07
Specify	Specify	V99

NOTE: For voltage codes used with control transformers, see Table 71 on page 44.

[1] **Form S** (no charge) must be included with these voltage codes where a separate source of voltage is used for the control coil (for example, order as 8539SCG5V02S). Note that **24 V** coils are **not** available on Sizes 4–7.

NOTE: Some control transformers may require the use of oversize enclosures. Refer to Table 71 on page 44 for control transformer selection.

Dimensions Page 18
 Factory Modifications (Forms) Page 42
 Type S Accessories (Class 9999) Catalog 9999CT9701R10/07

Combination Starters

Class 8539—Thermal-Magnetic Circuit Breaker

Thermal-Magnetic, 3-Pole Polyphase—600 Vac Maximum, 50–60 Hz

Table 19: Class 8539 Line Voltage, Thermal-Magnetic Circuit Breaker Type, Non-Reversing, with Motor Logic SSOLR (replace ●●● with the voltage code)

Motor Voltage (Starter Voltage)	Ratings				Enclosure				
	Max. Hp Poly-phase	NEMA Size	Circuit Breaker		NEMA 1 General Purpose	NEMA 4 & 4X Watertight and Dusttight Stainless Steel (304) (Sizes 0–5) ^[1]	NEMA 4 & 4X Watertight, Dusttight and Corrosion Resistant Polyester	NEMA 12/3R Industrial Use Dusttight and Driptight ^[2]	
			Type	Rating (A)				With External Reset	Without External Reset
					Type ^[3]	Type ^[3]	Type ^[3]	Type ^[3]	Type ^[3]
460 (480)	5	0	HLL36015	15	SBG1●●●H30 ^[4]	SBW1●●●H30 ^[4]	SBW11●●●H30 ^[4]	SBA11●●●H30 ^[4]	SBA1●●●H30 ^[4]
	7.5	1	HLL36025	25	SCG3●●●H30 ^[4]	SCW3●●●H30 ^[4]	SCW13●●●H30 ^[4]	SCA13●●●H30 ^[4]	SCA3●●●H30 ^[4]
	10		HLL36030	30	SCG7●●●H30 ^[4]	SCW7●●●H30 ^[4]	SCW17●●●H30 ^[4]	SCA17●●●H30 ^[4]	SCA7●●●H30 ^[4]
	15	2	HLL36045	45	SDG3●●●H30	SDW3●●●H30	SDW13●●●H30	SDA13●●●H30	SDA3●●●H30
	20		HLL36060	60	SDG1●●●H30	SDW1●●●H30	SDW11●●●H30	SDA11●●●H30	SDA1●●●H30
	25		HLL36070	70	SDG5●●●H30	SDW5●●●H30	SDW15●●●H30	SDA15●●●H30	SDA5●●●H30
	30	3	HLL36080	80	SEG7●●●H30	SEW7●●●H30	SEW17●●●H30	SEA17●●●H30	SEA7●●●H30
	40		HLL36100	100	SEG3●●●H30	SEW3●●●H30	SEW13●●●H30	SEA13●●●H30	SEA3●●●H30
	50		HLL36150	150	SEG5●●●H30	SEW5●●●H30	SEW15●●●H30	SEA15●●●H30	SEA5●●●H30
	60	4	JLL36150	150	SFG5●●●H30	SFW5●●●H30	SFW15●●●H30	SFA15●●●H30	SFA5●●●H30
	75		JLL36200	200	SFG3●●●H30	SFW3●●●H30	SFW13●●●H30	SFA13●●●H30	SFA3●●●H30
	100		JLL36250	250	SFG4●●●H30	SFW4●●●H30	SFW14●●●H30	SFA14●●●H30	SFA4●●●H30
	125–150	5	LLL36400U33X	400	SGG4●●●H30	SGW4●●●H30	—	SGA14●●●H30	SGA4●●●H30
	200		LLL36600U33X	600	SGG2●●●H30	SGW2●●●H30	—	SGA12●●●H30	SGA2●●●H30
250	6	LLL36600U33X	600	SHG4●●●H30	SHW4●●●H30	—	SHA14●●●H30	SHA4●●●H30	
300–400		MJL36800	800	SHG5●●●H30	SHW5●●●H30	—	SHA15●●●H30	SHA5●●●H30	
500–600	7	PLL36120	1200	SJG3●●●H30	SJW3●●●H30	—	SJA13●●●H30	—	
575 (600)	5	0	HLL36015	15	SBG1●●●H30 ^[4]	SBW1●●●H30 ^[4]	SBW11●●●H30 ^[4]	SBA11●●●H30 ^[4]	SBA1●●●H30 ^[4]
	7.5	1	HLL36020	20	SCG8●●●H30 ^[4]	SCW8●●●H30 ^[4]	SCW18●●●H30 ^[4]	SCA18●●●H30 ^[4]	SCA8●●●H30 ^[4]
	10		HLL36025	25	SCG3●●●H30 ^[4]	SCW3●●●H30 ^[4]	SCW13●●●H30 ^[4]	SCA13●●●H30 ^[4]	SCA3●●●H30 ^[4]
	15	2	HLL36035	35	SDG8●●●H30	SDW8●●●H30	SDW18●●●H30	SDA18●●●H30	SDA8●●●H30
	20		HLL36045	45	SDG3●●●H30	SDW3●●●H30	SDW13●●●H30	SDA13●●●H30	SDA3●●●H30
	25		HLL36060	60	SDG1●●●H30	SDW1●●●H30	SDW11●●●H30	SDA11●●●H30	SDA1●●●H30
	30	3	HLL36070	70	SEG4●●●H30	SEW4●●●H30	SEW14●●●H30	SEA14●●●H30	SEA4●●●H30
	40		HLL36090	90	SEG6●●●H30	SEW6●●●H30	SEW16●●●H30	SEA16●●●H30	SEA6●●●H30
	50		HLL36100	100	SEG3●●●H30	SEW3●●●H30	SEW13●●●H30	SEA13●●●H30	SEA3●●●H30
	60–75	4	JLL36150	150	SFG5●●●H30	SFW5●●●H30	SFW15●●●H30	SFA15●●●H30	SFA5●●●H30
	100		JLL36250	250	SFG4●●●H30	SFW4●●●H30	SFW14●●●H30	SFA14●●●H30	SFA4●●●H30
	125–150	5	JLL36250	250	SGG6●●●H30	SGW6●●●H30	—	SGA16●●●H30	SGA6●●●H30
	200		LLL36400U33X	400	SGG4●●●H30	SGW4●●●H30	—	SGA14●●●H30	SGA4●●●H30
	250–350	6	LLL36600U33X	600	SHG4●●●H30	SHW4●●●H30	—	SHA14●●●H30	SHA4●●●H30
400	MJL36800		800	SHG5●●●H30	SHW5●●●H30	—	SHA15●●●H30	SHA5●●●H30	
500–600	7	PKL36100	1200	SJG2●●●H30	SJW2●●●H30	—	SJA12●●●H30	—	

^[1] Size 6 and 7 enclosures are NEMA 4 only, painted sheet steel.

^[2] NEMA 12/3R enclosures can be field modified for outdoor non-corrosive and non-service entrance rated applications. See page 19 for more information.

^[3] Replace the three bullets (●●●) in the catalog number with the coil voltage code. Refer to the standard coil voltage codes listed in Table 18 on page 16.

^[4] **Form H30**, with the possibility of a fourth character to select a lower FLA range (for example, **H30B**). See page 45.

Table 20: Single-Phase^[1] Thermal-Magnetic Circuit Breaker Type, Class 8539

Ratings							Enclosure				
Motor Voltage	Max. Hp	Coil Voltage	NEMA Size	Poles	Circuit Breaker		NEMA 1 General Purpose	NEMA 4 & 4X Watertight and Dusttight Stainless Steel (304) (Sizes 0–2)	NEMA 4 & 4X Watertight, Dusttight and Corrosion Resistant Polyester	NEMA 12/3R ^[2] Dusttight and Driptight Industrial Use	
					Type	Rating (A)				With External Reset	Without External Reset
					Type	Rating (A)	Type	Type	Type	Type	
120	1	120	0	2	HLL26030	30	SBG72V02	SBW72V02	SBW75V02	SBA75V02	SBA72V02
	2		1		HLL26050	50	SCG72V02	SCW72V02	SCW75V02	SCA75V02	SCA72V02
	3		2		HLL26080	80	SDG71V02	SDW71V02	SDW74V02	SDA74V02	SDA71V02
240	2	240	0	2	HLL26025	25	SBG71V03	SBW71V03	SBW74V03	SBA74V03	SBA71V03
	3		1		HLL26035	35	SCG71V03	SCW71V03	SCW74V03	SCA74V03	SCA71V03
	7.5		2		HLL26080	80	SDG71V03	SDW71V03	SDW74V03	SDA74V03	SDA71V03

NOTE: Some control transformers may require the use of oversize enclosures. Refer to Table 71 on page 44 for control transformer selection.

^[1] Single phase units require one thermal unit and are not available with solid-state overload relays (Form Hxx).

Not included in the Laser™ Delivery program.

^[2] NEMA 12/3R enclosures can be field modified for outdoor non-corrosive and non-service entrance rated applications. See page 19 for more information.

Combination Starters
Class 8538, 8539—Approximate Dimensions, Shipping Weights

Dimensions for Non-Reversing Combination Starters

NEMA 1 Enclosures

NOTE: The dimensions in Tables 21 and 22 include space for Form **FF4T** (standard control transformer). An oversize enclosure may be required for Form **FF4T11** (100 VA additional capacity) and Form **FF4T12** (200 VA additional capacity). See Table 57 on page 38 for replacement transformer selection.

Table 21: Sizes 0–2, NEMA 1 Enclosure—See Figure 1

NEMA Size	Class	Type	Dimensions, in.																	Top & Bottom		Sides Y	Wt. (lb)
			A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	W	X			
0–1	8538	SBG, SCG	9.5	22.5	8.34	6.38	20.5	14.66	1.81	1.69	3	2.31	1.06	3.25	2.19	1.25	0.88	—	0.5–0.75	0.5–0.75	0.5	38	
	8539	SBG, SCG	9.5	22.5	9.84	6.38	20.5	14.66	1.81	1.69	3	2.31	1.06	3.25	2.19	1.25	0.88	—	0.5–0.75	0.5–0.75	0.5	38	
2	8538, 8539	SDG	10.5	26	9.59	7.38	24	16.91	2.13	2	4	2.31	1.06	3.25	2.19	1.25	0.88	—	1–1.25	0.5–0.75	0.5	54	

Table 22: Sizes 3–6, NEMA 1 Enclosure—See Figure 2

NEMA Size	Type	Class	Dimensions, in.																Top & Bottom		Sides	Wt. (lb)
			A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	W	X	Y	
3 ^[1]	8538, 8539	SEG	15.25	42	10.59	9.25	3	22.72	41	0.5	—	2.83	3.53	5	2.69	5.38	1.28	0.91	1–1.25 2–2.5	0.5–0.75	0.5	102
4	8538	SFG	16	52.5	10.53	10	3	23.66	51.5	0.5	—	2.83	3.53	5	2.69	5.38	1.28	0.91	2.5	0.5–0.75	0.5	163
	8539	SFG	16	52.5	10.53	10	3	23.66	51.5	0.5	—	2.83	3.53	5	2.69	5.38	1.28	0.91	2.5	0.5–0.75	0.5	163
5	8538	SGG	20	78	15.5	12	4	29.41	77	0.5	—	3.52	4.61	9.25	3.19	—	—	—	0.5– 0.75 ^[2]	3	—	450
	8539	SGG	20	66	13.72	12	4	29.41	65	0.5	—	3.52	4.61	5	3.19	—	—	—	0.5–0.75	3	—	420
6 ^[3]	8538, 8539	SHG	36	90	21.03	—	—	41.38	—	—	—	—	—	5	—	—	—	—	—	—	—	—

[1] For Class 8538 Size 3 devices with 200 A fuse clips, use the dimensions for Class 8538 Size 4 devices.

[2] Left side only.

[3] Size 6 enclosures are floor mounting.

Figure 1: NEMA 1 Enclosure
Sizes 0–2

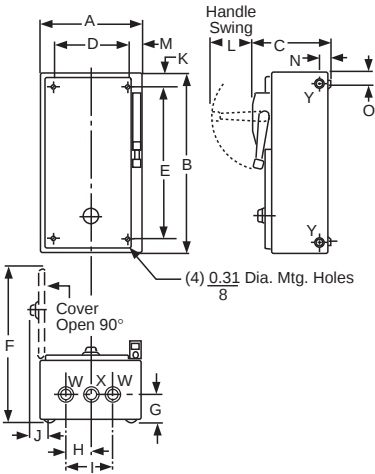
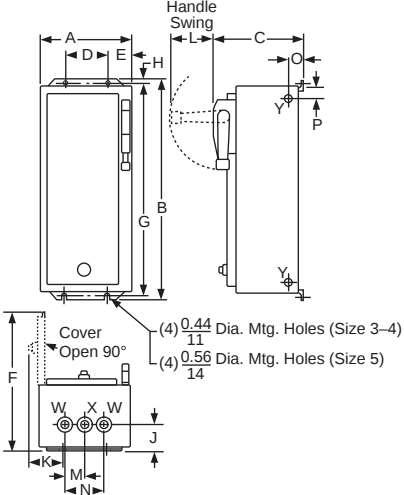


Figure 2: NEMA 1 Enclosure
Sizes 3–6



Combination Starters

Class 8538, 8539—Approximate Dimensions, Shipping Weights

NEMA 12/3R Enclosures

Modifying NEMA 12 for Outdoor Applications (not for use in salt air or corrosive environments)

Field Modifications for NEMA 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 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.

Table 23: NEMA 12/3R Enclosure (see Figure 3)
Dimensions include space for control circuit transformers.

NEMA Size	Class	Type	Dimensions, in.										Wt. (lb)
			A	B	C	D	E	F	G	H	I	J	
0-1	8538	SBA SCA	9.5	8.34	24	3.25	2.5	4.5	23.5	0.59	4.44	14.31	40
	8539	SBA SCA	9.5	9.84	24	3.25	2.5	4.5	23.5	0.59	4.44	14.31	40
2	8538, 8539	SDA	10.5	9.59	27.75	3.25	2.5	5.5	27	0.38	4.13	16.56	55
3 ^[1]	8538, 8539	SEA	15.25	10.59	42	5	3	9.25	41	0.5	5.06	22.31	111
4	8538	SFA	16	10.53	52.5	5	3	10	51.5	0.5	4.19	22.97	170
	8539	SFA	16	10.53	52.5	5	3	10	51.5	0.5	5.19	22.97	170
5	8538	SGA	20	13.72	78	9.25	4	12	77	0.5	7.78	29.41	—
	8539	SGA	20	13.72	66	5	4	12	65	0.5	7.78	27.41	440
6 ^[2]	8538, 8539	SHA	36	17	90	5	—	—	—	—	—	47.38	—

^[1] For Class 8538 Size 3 devices with 200 A fuse clips, use the dimensions for Class 8538 Size 4 devices.

^[2] Size 6 enclosures are floor mounting.

Oversize Enclosures

Table 24: NEMA 1, 4, 4X Stainless, and 12 Oversize Enclosures—See Figure 4

NEMA Size	NEMA Enclosure	Dimensions, in.					
		Wide	High	Deep	Handle	Mounting	
0-2	1	15	28.75	9.59	3.25	11.63	26.25
	4	15	30.03	9.59	3.25	10	29.75
	12	15	31	10.97	3.25	9	30.25

Figure 3: NEMA 12/3R Enclosure

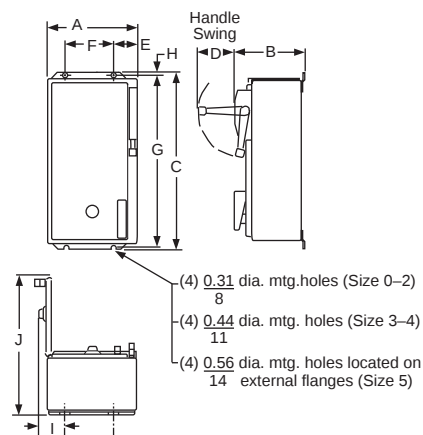
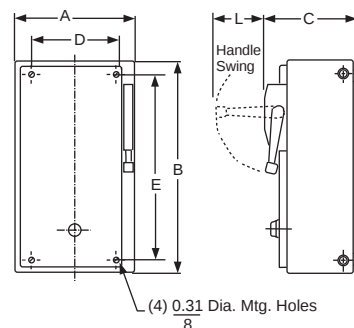


Figure 4: Class 8538 and 8539 In Oversize Enclosures—NEMA 1, 4 & 4X Stainless, 12/3R



Combination Starters

Class 8538, 8539—Approximate Dimensions, Shipping Weights

NEMA 4, 4X Enclosures (for oversize enclosures, see page 19)

Figure 5:
NEMA 4X
Polyester Enclosure

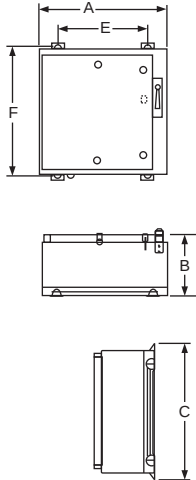


Table 25: NEMA 4X Polyester Enclosure (see Figure 5)

NEMA Size	Class	Type	Dimensions, in. [1]				
			A	B	C	E	F
0-1	8538	SBW	13.72	11.4	26.94	6.25	25.75
0-1	8539	SCW					
		SDW					
0-2	8738, 8739	SBW	25.25	11.4	27.00	17.88	25.75
2	8538, 8539	SCW					
		SDW					
3-4	8538, 8738 8539, 8739	SEW SFW [2]	26.31	11.4	33.50	18.50	32.25

[1] Dimensions include space for Form **FF4T** (standard control transformer) and Form **FF4T10** (50 VA additional capacity). An oversize enclosure may be required for other control transformers.

[2] 8539 Size 4 only.

Table 26: Information on Hubs

Hubs are furnished with each NEMA 4X combination starter as shown in this table. Note that hubs are only installed in stainless steel enclosures; they are not installed in polyester enclosures.

NEMA Size	Hub Size, Quantity = 1	Hub Size, Quantity = 2
0-1	0.75 in.	1.00 in.
2	0.75 in.	1.50 in.
3-4	0.75 in.	2.50 in.

Table 27: NEMA 4 and 4X Stainless Steel Enclosure (see Figure 6)

NEMA Size	Class	Type	Dimensions, in. [1]												Bottom W (Hub)	Top & Bottom X (Hub)	Wt. (lb)
			A	B	C	D	E	F	G	H	I	J	K	L			
0-1	8538	SBW	9.5	8.34	24.06	3.25	2.5	4.5	23.5	0.59	3.03	1.31	2.31	14.28	0.75	1	40
	8539	SCW	9.5	9.84	24.06	3.25	2.5	4.5	23.5	0.59	3.03	1.31	2.31	14.28	0.75	1	40
2	8538, 8539	SDW	10.5	9.59	27.75	3.25	2.5	5.5	27	0.59	3	2	2.63	16.53	0.75	1.5	55
3 [2]	8538, 8539	SEW	15.25	10.59	42	5	3.19	10.25	40.5	0.59	3	2.56	3.19	22.19	0.75	2.5	111
4	8538	SFW	16	10.53	52.5	5	3.56	11	51	0.59	3	2.56	3.19	22.47	0.75	2.5	158
	8539	SFW	16	10.53	52.5	3.25	2.5	11	51	0.59	3	2.56	3.19	22.47	0.75	2.5	120
5	8538	SGW	20	13.72	78	9.25	4	12	77	0.56	4.5	3	3.5	29.41	0.75	3.5	—
	8539	SGW	20	13.72	66	5	4	12	65	0.56	4.5	3	3.5	29.41	0.75	3.5	440
6 [3]	8538, 8539	SHW	36	17	90	—	—	—	—	—	—	—	—	47.88	—	—	—

[1] Dimensions include space for Form **FF4T** (standard control transformer). An oversize enclosure may be required for Form **FF4T11** (100 VA additional capacity) and Form **FF4T12** (200 VA additional capacity).

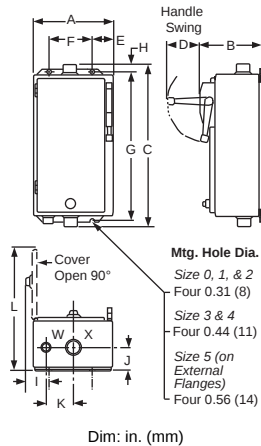
[2] For Class 8538 Size 3 devices with 200 A fuse clips, use the dimensions for Class 8538 Size 4 devices.

[3] Size 6 enclosures are floor mounting.

Table 28: Conduit Sizes, Locations A, B, C, and D

NEMA Size	Standard
0-1	1.25
2	1.5
3-4	2.5
5	4

Figure 6:
NEMA 4 & 4X
Stainless Steel Enclosure



Dim: in. (mm)

Combination Starters Class 8538, 8539—Panel Layout

Panel Layout Drawings

Table 29: Standard Enclosures—NEMA1, 4 & 4X Stainless, and 12/3R

This table identifies open panel space on standard NEMA 1, 4 & 4X stainless steel, and 12/3R combination starters. Space and mounting holes are provided in all combination starters for the field addition of a control transformer—see Table 71 on page 44 for control transformer selection.

Class	NEMA Size	Dimensions, in.								
		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				6.5	8.5					—
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 ^[1]	17.3	59.0	13.5	25.0	0	10.8	6.5	20.5	—
8539				JLL: 6.8 LLL: 9.0	JLL: 23.0 LLL: 24.5					—
8538	6	32.0	82.0	32.0	40.0	0	13.0	19.0	35.0	—
8539				LLL: 9.0 MJL: 12.5	LLL: 25.5 MJL: 40.5					—

^[1] Size 5 combination starter does not contain a full-size panel. No usable panel space is available.

Figure 7: Class 8538—Standard

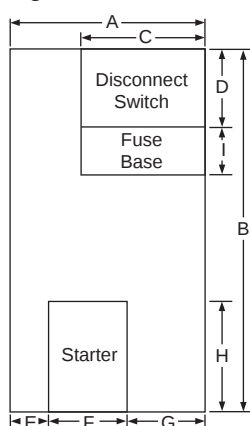
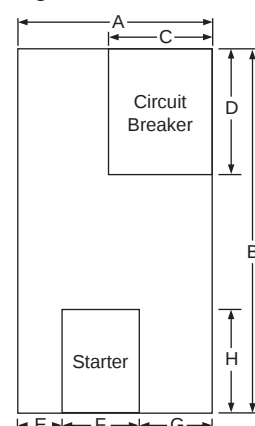


Figure 8: Class 8539—Standard



Oversize Enclosures—NEMA 1, 4 & 4X Stainless, and 12

Combination starters in oversize enclosures provide additional panel space for field addition of control relays, timing relays, terminal blocks, or other auxiliary equipment. Disconnect switch devices offer more than 130 in² of available panel space, and circuit breaker devices more than 180 in².

Figure 9: Class 8538—Oversize

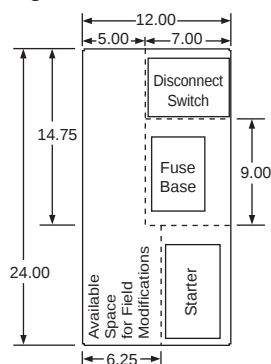
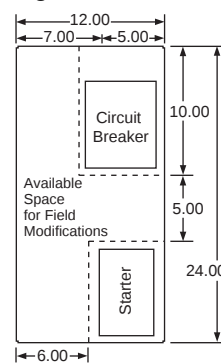


Figure 10: Class 8539—Oversize



Reversing Combination Starters, NEMA Style

General Information—Reversing Combination Starters

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 are CSA certified. Class 8738 and 8739 reversing combination starters are designed to operate at 600 Vac, 50–60 Hz. Type S reversing combination starters come standard with melting alloy overload relays. Bimetallic and solid-state overload relays are available as options (see pages 45–46).

Enclosures—Class 8738 and 8739 reversing combination starters are available in the following enclosures:

- NEMA 1 General Purpose
- NEMA 4 & 4X Watertight and Dusttight
- NEMA 4X Watertight, Dusttight, and Corrosion Resistant Glass-Polyester
- NEMA 12/3R Dusttight and Driptight for Industrial Use

The NEMA 4 & 4X stainless steel enclosures (Sizes 0–5) have a brushed finish. Sizes 6–7 are sheet-steel enclosures and are rated NEMA 4 only.

The NEMA 4X glass-polyester enclosed devices are UL Listed. Hubs are furnished as standard on NEMA 4X enclosures.

NEMA 12/3R enclosures can be field modified for outdoor applications. Specify **Form G26** for NEMA 3R (no additional charge). See page 19 for details.

Coil Voltages—AC coils are available for application at 50/60 Hz. NEMA Sizes 00–5 are furnished with coils designed to operate satisfactorily on line voltages of 85–110% of rated voltage.

NEMA Size 6–7 contactors are furnished with a DC coil operated by a solid-state rectifier circuit, which is powered by an AC source.

NOTE: A voltage code is required when ordering combination starters. Polyphase combination starters with 24 Vac or 120 Vac coil voltages come wired for **separate control**.

Auxiliary Contacts—Additional auxiliary contacts may be added to Type S starters. See page 37 for the maximum number of auxiliary units and the 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 units are available for field modifications. For factory modifications (Forms), see page 42. For field modification kits, see catalog 9999CT9701.

Overload Protection

Type S magnetic starters are used for full-voltage starting and stopping of AC squirrel cage motors. Motor overload protection for three-phase starter applications can be provided through one of four options, as follows:

Solid-State Overload Relay Protection (Motor Logic™ SSOLR)—These ambient insensitive overload relays are available on Sizes 00–6 and standard on Size 7. They provide phase loss and phase unbalance protection. To order, add Form **H30** (for selectable trip class 10 or 20 protection). For more information about Motor Logic SSOLRs, see page 45 and catalog 9065CT9701. (Product catalog number example: 8536SCO3V06**H30**)

Adapted Bimetallic Overload Relay (NEMA Sizes 00–1)—The adapted bimetallic motor starter includes a specially designed adapter. It attaches with bus bars to the Type S NEMA contactor and holds the IEC-style bimetallic overload relay (type LRD or LR3D). This starter configuration can be ordered by adding Form **E** (adapter only) to the standard catalog number. The LRD or LR3D bimetallic overload relay must be purchased separately, based on the motor FLA, and installed in the field in order to operate the starter. For more information—including how to order the adapted bimetallic overload relay as a factory installed option—see page 45 and catalog 9065CT9701. (Product catalog number example: 8536SCO3V06**E**)

TeSys T Motor Management System (NEMA Sizes 1–6)—The flexible TeSys T system integrates seamlessly into your automation system through five major communication protocols. The TeSys T system can predict what will happen in the process, as it accurately monitors current, voltage, and power over a wide range. This option is available for control voltages of 24 Vac or 100–240 Vac. For additional information about the TeSys T Motor Management System, see page 46 and catalog 9065CT9701. NOTE: The full catalog number contains a four-character Form number (for example, 8536SCO3V06**H616**).

Melting Alloy Thermal Overload Relays—Melting alloy style thermal overload blocks are installed as part of the starter, and thermal elements must be selected and installed separately in order to operate the starter. For a three-phase motor, three thermal units must be ordered using the tables in catalog 9065CT9701. The catalog number includes no Form number (for example, 8536SCO3V06).

Combination Starters

Class 8738—Reversing, Fusible Disconnect Switch Type

Fusible, 3-Pole Polyphase—600 Vac Maximum, 50–60 Hz

Table 30: Class 8738 Reversing Full-Voltage Type, Fusible (with Class H and K Fuse Clips), with Motor Logic SSOLR (replace ●●● with the voltage code)

Motor Voltage (Starter Voltage)	Ratings			Enclosure				
	Max. Hp Polyphase	NEMA Size	Fuse Clip Size (A)	NEMA 1 General Purpose	NEMA 4 & 4X Watertight and Dusttight Stainless Steel (304)	NEMA 4X Watertight, Dusttight, and Corrosion Resistant Polyester	NEMA 12/3R Industrial Use Dusttight and Driptight ^[1]	
				Type ^[2]	Type ^[2]	Type ^[2]	With External Reset	Without External Reset
200 (208)	3	0	30	SBG12●●●H30 ^[3]	SBW12●●●H30 ^[3]	SBW22●●●H30 ^[3]	SBA22●●●H30 ^[3]	SBA12●●●H30 ^[3]
	5	1	30	SCG12●●●H30 ^[3]	SCW12●●●H30 ^[3]	SCW22●●●H30 ^[3]	SCA22●●●H30 ^[3]	SCA12●●●H30 ^[3]
	7.5		60	SCG13●●●H30 ^[3]	SCW13●●●H30 ^[3]	SCW23●●●H30 ^[3]	SCA23●●●H30 ^[3]	SCA13●●●H30 ^[3]
	10	2	60	SDG12●●●H30	SDW12●●●H30	SDW22●●●H30	SDA22●●●H30	SDA12●●●H30
	20	3	100	SEG15●●●H30	SEW15●●●H30	—	SEA25●●●H30	SEA15●●●H30
	40	4	200	SFG15●●●H30	SFW15●●●H30	—	SFA25●●●H30	SFA15●●●H30
	75	5	400	SGG15●●●H30	SGW15●●●H30	—	SGA25●●●H30	SGA15●●●H30
230 (240)	3	0	30	SBG12●●●H30 ^[3]	SBW12●●●H30 ^[3]	SBW22●●●H30 ^[3]	SBA22●●●H30 ^[3]	SBA12●●●H30 ^[3]
	5	1	30	SCG12●●●H30 ^[3]	SCW12●●●H30 ^[3]	SCW22●●●H30 ^[3]	SCA22●●●H30 ^[3]	SCA12●●●H30 ^[3]
	7.5		60	SCG13●●●H30 ^[3]	SCW13●●●H30 ^[3]	SCW23●●●H30 ^[3]	SCA23●●●H30 ^[3]	SCA13●●●H30 ^[3]
	15	2	60	SDG12●●●H30	SDW12●●●H30	SDW22●●●H30	SDA22●●●H30	SDA12●●●H30
	25	3	100	SEG15●●●H30	SEW15●●●H30	—	SEA25●●●H30	SEA15●●●H30
	50	4	200	SFG15●●●H30	SFW15●●●H30	—	SFA25●●●H30	SFA15●●●H30
	100	5	400	SGG15●●●H30	SGW15●●●H30	—	SGA25●●●H30	SGA15●●●H30
460 (480)	5	0	30	SBG13●●●H30 ^[3]	SBW13●●●H30 ^[3]	SBW23●●●H30 ^[3]	SBA23●●●H30 ^[3]	SBA13●●●H30 ^[3]
	10	1	30	SCG14●●●H30 ^[3]	SCW14●●●H30 ^[3]	SCW24●●●H30 ^[3]	SCA24●●●H30 ^[3]	SCA14●●●H30 ^[3]
	15	2	30	SDG16●●●H30 ^[3]	SDW16●●●H30 ^[3]	SDW26●●●H30 ^[3]	SDA26●●●H30 ^[3]	SDA16●●●H30 ^[3]
	25		60	SDG14●●●H30	SDW14●●●H30	SDW24●●●H30	SDA24●●●H30	SDA14●●●H30
	50	3	100	SEG13●●●H30	SEW13●●●H30	—	SEA23●●●H30	SEA13●●●H30
	100	4	200	SFG13●●●H30	SFW13●●●H30	—	SFA23●●●H30	SFA13●●●H30
	200	5	400	SGG13●●●H30	SGW13●●●H30	—	SGA23●●●H30	SGA13●●●H30
575 (600)	5	0	30	SBG13●●●H30 ^[3]	SBW13●●●H30 ^[3]	SBW23●●●H30 ^[3]	SBA23●●●H30 ^[3]	SBA13●●●H30 ^[3]
	10	1	30	SCG14●●●H30 ^[3]	SCW14●●●H30 ^[3]	SCW24●●●H30 ^[3]	SCA24●●●H30 ^[3]	SCA14●●●H30 ^[3]
	15	2	30	SDG16●●●H30 ^[3]	SDW16●●●H30 ^[3]	SDW26●●●H30 ^[3]	SDA26●●●H30 ^[3]	SDA16●●●H30 ^[3]
	25		60	SDG14●●●H30	SDW14●●●H30	SDW24●●●H30	SDA24●●●H30	SDA14●●●H30
	50	3	100	SEG13●●●H30	SEW13●●●H30	—	SEA23●●●H30	SEA13●●●H30
	100	4	200	SFG13●●●H30	SFW13●●●H30	—	SFA23●●●H30	SFA13●●●H30
	200	5	400	SGG13●●●H30	SGW13●●●H30	—	SGA23●●●H30	SGA13●●●H30

^[1] NEMA 12/3R enclosures can be field modified for outdoor non-corrosive and non-service entrance rated applications. See page 19 for more information.

^[2] Replace the three bullets (●●●) in the catalog number with the coil voltage code. Refer to the standard coil voltage codes shown in Table 31.

^[3] Form H30, with the possibility of a fourth character to select a lower FLA range (for example, H308). See page 45.

Table 31: Coil Voltage Codes

Voltage		Code
60 Hz	50 Hz	
24 ^[1]	—	V01
120 ^[1]	110	V02
208	—	V08
240	220	V03
277 ^[1]	—	V04
480	440	V06
600	550	V07
Specify	Specify	V99

Standard unit



File E152395
CCN, NKJH, KNKJH7



File LR584
Class 3211 04

Note that some units are not CSA certified. Consult the factory.

^[1] These voltage codes must include **Form S** (no charge) for separate control (for example, order as 8738SCG13V02S). Note that **24 V** coils are **not** available on Sizes 4–7.

NOTE: For voltage codes used with control transformers, see Table 71 on page 44.

Combination Starters

Class 8738—Reversing, Non-Fusible Disconnect Switch Type

Non-Fusible, 3-Pole Polyphase—600 Vac Maximum, 50–60 Hz

Table 32: Class 8738 Non-Fusible Disconnect Switch Type—Full-Voltage, Reversing, with Motor Logic SSOLR

Motor Voltage (Starter Voltage)	Ratings			Enclosure				
	Max. Hp Polyphase	NEMA Size	Fuse Clip Size (A)	NEMA 1 General Purpose	NEMA 4 & 4X Watertight and Dusttight Stainless Steel (304)	NEMA 4X Watertight, Dusttight and Corrosion Resistant Polyester	NEMA 12/3R ^[1] Industrial Use Dusttight and Driptight	
				Type ^[2]	Type ^[2]	Type ^[2]	With External Reset	Without External Reset
200 (208)	3	0	None	SBG11●●●H30 ^[3]	SBW11●●●H30 ^[3]	SBW21●●●H30 ^[3]	SBA21●●●H30 ^[3]	SBA11●●●H30 ^[3]
	7.5	1	None	SCG11●●●H30 ^[3]	SCW11●●●H30 ^[3]	SCW21●●●H30 ^[3]	SCA21●●●H30 ^[3]	SCA11●●●H30 ^[3]
	10	2	None	SDG11●●●H30	SDW11●●●H30	SDW21●●●H30	SDA21●●●H30	SDA11●●●H30
	25	3	None	SEG11●●●H30	SEW11●●●H30	—	SEA21●●●H30	SEA11●●●H30
	40	4	None	SFG11●●●H30	SFW11●●●H30	—	SFA21●●●H30	SFA11●●●H30
230 (240)	75	5	None	SGG11●●●H30	SGW11●●●H30	—	SGA21●●●H30	SGA11●●●H30
	3	0	None	SBG11●●●H30 ^[3]	SBW11●●●H30 ^[3]	SBW21●●●H30 ^[3]	SBA21●●●H30 ^[3]	SBA11●●●H30 ^[3]
	7.5	1	None	SCG11●●●H30 ^[3]	SCW11●●●H30 ^[3]	SCW21●●●H30 ^[3]	SCA21●●●H30 ^[3]	SCA11●●●H30 ^[3]
	15	2	None	SDG11●●●H30	SDW11●●●H30	SDW21●●●H30	SDA21●●●H30	SDA11●●●H30
	30	3	None	SEG11●●●H30	SEW11●●●H30	—	SEA21●●●H30	SEA11●●●H30
460 (480)	50	4	None	SFG11●●●H30	SFW11●●●H30	—	SFA21●●●H30	SFA11●●●H30
	100	5	None	SGG11●●●H30	SGW11●●●H30	—	SGA21●●●H30	SGA11●●●H30
	5	0	None	SBG11●●●H30 ^[3]	SBW11●●●H30 ^[3]	SBW21●●●H30 ^[3]	SBA21●●●H30 ^[3]	SBA11●●●H3 ^[3]
	10	1	None	SCG11●●●H30 ^[3]	SCW11●●●H30 ^[3]	SCW21●●●H30 ^[3]	SCA21●●●H30 ^[3]	SCA11●●●H30 ^[3]
	25	2	None	SDG11●●●H30	SDW11●●●H30	SDW21●●●H30	SDA21●●●H30	SDA11●●●H30
575 (600)	50	3	None	SEG11●●●H30	SEW11●●●H30	—	SEA21●●●H30	SEA11●●●H30
	100	4	None	SFG11●●●H30	SFW11●●●H30	—	SFA21●●●H30	SFA11●●●H30
	200	5	None	SGG11●●●H30	SGW11●●●H30	—	SGA21●●●H30	SGA11●●●H30
	5	0	None	SBG11●●●H30 ^[3]	SBW11●●●H30 ^[3]	SBW21●●●H30 ^[3]	SBA21●●●H30 ^[3]	SBA11●●●H30 ^[3]
	10	1	None	SCG11●●●H30 ^[3]	SCW11●●●H30 ^[3]	SCW21●●●H30 ^[3]	SCA21●●●H30 ^[3]	SCA11●●●H30 ^[3]

^[1] NEMA 12/3R enclosures can be field modified for outdoor non-corrosive and non-service entrance rated applications. See page 19 for more information.

^[2] Replace the three bullets (●●●) in the catalog number with the coil voltage code. Refer to the standard coil voltage codes shown in Table 35 on page 28.

^[3] Form H30, with the possibility of a fourth character to select a lower FLA range (for example, H308). See page 45.

Combination Starters

Class 8738—Reversing, Disconnect Switch Type, Fusible, with Class R Fuse Clips

Class R Fuse Clips, 3-Pole Polyphase—600 Vac Maximum, 50–60 Hz

Table 33: Class 8738 Disconnect Switch Type, Fusible, with Class R Fuse Clips—100,000 AIC Rating (replace ●●● with the voltage code)

Motor Voltage (Starter Voltage)	Ratings			Enclosure				
	Max. Hp Polyphase	NEMA Size	Fuse Clip Size (A)	NEMA 1 General Purpose	NEMA 4 & 4X Watertight and Dusttight Stainless Steel (304)	NEMA 4X Watertight, Dusttight, and Corrosion Resistant Polyester	NEMA 12/3R ^[1] Industrial Use Dusttight and Driptight	
				Type ^[2]	Type ^[2]	Type ^[2]	With External Reset	Without External Reset
200 (208)	3	0	30	SBG32●●●H30 ^[3]	SBW32●●●H30 ^[3]	SBW42●●●H30 ^[3]	SBA42●●●H30 ^[3]	SBA32●●●H30 ^[3]
	5	1	30	SCG32●●●H30 ^[3]	SCW32●●●H30 ^[3]	SCW42●●●H30 ^[3]	SCA42●●●H30 ^[3]	SCA32●●●H30 ^[3]
	7.5		60	SCG33●●●H30 ^[3]	SCW33●●●H30 ^[3]	SCW43●●●H30 ^[3]	SCA43●●●H30 ^[3]	SCA33●●●H30 ^[3]
	10	2	60	SDG32●●●H30	SDW32●●●H30	SDW42●●●H30	SDA42●●●H30	SDA32●●●H30
	20	3	100	SEG35●●●H30	SEW35●●●H30	—	SEA45●●●H30	SEA35●●●H30
	40	4	200	SFG35●●●H30	SFW35●●●H30	—	SFA45●●●H30	SFA35●●●H30
	75	5	400	SGG35●●●H30	SGW35●●●H30	—	SGA45●●●H30	SGA35●●●H30
230 (240)	3	0	30	SBG32●●●H30 ^[3]	SBW32●●●H30 ^[3]	SBW42●●●H30 ^[3]	SBA42●●●H30 ^[3]	SBA32●●●H30 ^[3]
	5	1	30	SCG32●●●H30 ^[3]	SCW32●●●H30 ^[3]	SCW42●●●H30 ^[3]	SCA42●●●H30 ^[3]	SCA32●●●H30 ^[3]
	7.5		60	SCG33●●●H30 ^[3]	SCW33●●●H30 ^[3]	SCW43●●●H30 ^[3]	SCA43●●●H30 ^[3]	SCA33●●●H30 ^[3]
	15	2	60	SDG32●●●H30	SDW32●●●H30	SDW42●●●H30	SDA42●●●H30	SDA32●●●H30
	25	3	100	SEG35●●●H30	SEW35●●●H30	—	SEA45●●●H30	SEA35●●●H30
	50	4	200	SFG35●●●H30	SFW35●●●H30	—	SFA45●●●H30	SFA35●●●H30
	100	5	400	SGG35●●●H30	SGW35●●●H30	—	SGA45●●●H30	SGA35●●●H30
460 (480)	5	0	30	SBG33●●●H30 ^[3]	SBW33●●●H30 ^[3]	SBW43●●●H30 ^[3]	SBA43●●●H30 ^[3]	SBA33●●●H30 ^[3]
	10	1	30	SCG34●●●H30 ^[3]	SCW34●●●H30 ^[3]	SCW44●●●H30 ^[3]	SCA44●●●H30 ^[3]	SCA34●●●H30 ^[3]
	15	2	30	SDG36●●●H30 ^[3]	SDW36●●●H30 ^[3]	SDW46●●●H30 ^[3]	SDA46●●●H30 ^[3]	SDA36●●●H30 ^[3]
	25		60	SDG34●●●H30	SDW34●●●H30	SDW44●●●H30	SDA44●●●H30	SDA34●●●H30
	50	3	100	SEG33●●●H30	SEW33●●●H30	—	SEA43●●●H30	SEA33●●●H30
	100	4	200	SFG33●●●H30	SFW33●●●H30	—	SFA43●●●H30	SFA33●●●H30
	200	5	400	SGG33●●●H30	SGW33●●●H30	—	SGA43●●●H30	SGA33●●●H30
575 (600)	5	0	30	SBG33●●●H30 ^[3]	SBW33●●●H30 ^[3]	SBW43●●●H30 ^[3]	SBA43●●●H30 ^[3]	SBA33●●●H30 ^[3]
	10	1	30	SCG34●●●H30 ^[3]	SCW34●●●H30 ^[3]	SCW44●●●H30 ^[3]	SCA44●●●H30 ^[3]	SCA34●●●H30 ^[3]
	15	2	30	SDG36●●●H30 ^[3]	SDW36●●●H30 ^[3]	SDW46●●●H30 ^[3]	SDA46●●●H30 ^[3]	SDA36●●●H30 ^[3]
	25		60	SDG34●●●H30	SDW34●●●H30	SDW44●●●H30	SDA44●●●H30	SDA34●●●H30
	50	3	100	SEG33●●●H30	SEW33●●●H30	—	SEA43●●●H30	SEA33●●●H30
	100	4	200	SFG33●●●H30	SFW33●●●H30	—	SFA43●●●H30	SFA33●●●H30
	200	5	400	SGG33●●●H30	SGW33●●●H30	—	SGA43●●●H30	SGA33●●●H30

^[1] NEMA 12/3R enclosures can be field modified for outdoor non-corrosive and non-service entrance rated applications. See page 19 for more information.

^[2] Replace the three bullets (●●●) in the catalog number with the coil voltage code. Refer to the standard coil voltage codes shown in Table 35 on page 28.

^[3] Form H30, with the possibility of a fourth character to select a lower FLA range (for example, H308). See page 45.

Combination Starters

Class 8739—Reversing, Electronic Motor Circuit Protector (MCP) Circuit Breaker

Electronic MCP, 3-Pole Polyphase—600 Vac Maximum, 50–60 Hz

Table 34: Class 8739 Electronic MCP, Full-Voltage Type, Reversing with Motor Logic SSOLR (replace ●●● with the voltage code)

Motor Voltage (Starter Voltage)	Ratings			Enclosure				
	NEMA Size	Hp Range Polyphase	Circuit Breaker (See Digest Section 7 for Adjustment Range)	NEMA 1 General Purpose	NEMA 4 & 4X Watertight and Dusttight Stainless Steel (304) (Sizes 0-5) ^[1]	NEMA 4X Watertight, Dusttight and Corrosion Resistant Polyester	NEMA 12/3R ^[2] Industrial Use Dusttight and Driptight	
				Type ^[3]	Type ^[3]	Type ^[3]	With External Reset	Without External Reset
200 (208)	0	0.25–3	HLL36030M71	SBG43●●●H30 ^[4]	SBW43●●●H30 ^[4]	SBW53●●●H30 ^[4]	SBA53●●●H30 ^[4]	SBA43●●●H30 ^[4]
	1	0.25–5	HLL36030M71	SCG44●●●H30 ^[4]	SCW44●●●H30 ^[4]	SCW54●●●H30 ^[4]	SCA54●●●H30 ^[4]	SCA44●●●H30 ^[4]
		7.5	HLL36050M72	SCG45●●●H30 ^[4]	SCW45●●●H30 ^[4]	SCW55●●●H30 ^[4]	SCA55●●●H30 ^[4]	SCA45●●●H30 ^[4]
	2	1.5–5	HLL36030M71	SDG42●●●H30 ^[4]	SDW42●●●H30 ^[4]	SDW52●●●H30 ^[4]	SDA52●●●H30 ^[4]	SDA42●●●H30 ^[4]
		7.5–10	HLL36050M72	SDG43●●●H30	SDW43●●●H30	SDW53●●●H30	SDA53●●●H30	SDA43●●●H30
	3	15–25	HLL36100M73	SEG42●●●H30	SEW42●●●H30	SEW52●●●H30	SEA52●●●H30	SEA42●●●H30
	4	30–40	JLL36250M75	SFG44●●●H30	SFW44●●●H30	SFW54●●●H30	SFA54●●●H30	SFA44●●●H30
	5	50–60	JLL36250M75	SGG44●●●H30	SGW44●●●H30	—	SGA54●●●H30	SGA44●●●H30
		75	LJL36400M36	SGG45●●●H30	SGW45●●●H30	—	SGA55●●●H30	SGA45●●●H30
	6	100	LJL36400M36	SHG43●●●H30	SHW43●●●H30	—	SHA53●●●H30	SHA43●●●H30
		125–150	LJL36600M42	SHG45●●●H30	SHW45●●●H30	—	SHA55●●●H30	SHA45●●●H30
230 (240)	0	0.25–3	HLL36030M71	SBG43●●●H30 ^[4]	SBW43●●●H30 ^[4]	SBW53●●●H30 ^[4]	SBA53●●●H30 ^[4]	SBA43●●●H30 ^[4]
	1	0.25–7.5	HLL36030M71	SCG44●●●H30 ^[4]	SCW44●●●H30 ^[4]	SCW54●●●H30 ^[4]	SCA54●●●H30 ^[4]	SCA44●●●H30 ^[4]
	2	1.5–7.5	HLL36030M71	SDG42●●●H30 ^[4]	SDW42●●●H30 ^[4]	SDW52●●●H30 ^[4]	SDA52●●●H30 ^[4]	SDA42●●●H30 ^[4]
		10	HLL36050M72	SDG43●●●H30	SDW43●●●H30	SDW53●●●H30	SDA53●●●H30	SDA43●●●H30
	3	15	HLL36100M73	SDG44●●●H30	SDW44●●●H30	SDW54●●●H30	SDA54●●●H30	SDA44●●●H30
		15–30	HLL36100M73	SEG42●●●H30	SEW42●●●H30	SEW52●●●H30	SEA52●●●H30	SEA42●●●H30
	4	40–50	JLL36250M75	SFG44●●●H30	SFW44●●●H30	SFW54●●●H30	SFA54●●●H30	SFA44●●●H30
	5	60	JLL36250M75	SGG44●●●H30	SGW44●●●H30	—	SGA54●●●H30	SGA44●●●H30
		75–100	LJL36400M36	SGG45●●●H30	SGW45●●●H30	—	SGA55●●●H30	SGA45●●●H30
	6	125–150	LJL36600M42	SHG45●●●H30	SHW45●●●H30	—	SHA55●●●H30	SHA45●●●H30
		200	PLL34080M68	SHG46●●●H30	SHW46●●●H30	—	SHA56●●●H30	SHA46●●●H30
460 (480)	0	0.25–5	HLL36030M71	SBG43●●●H30 ^[4]	SBW43●●●H30 ^[4]	SBW53●●●H30 ^[4]	SBA53●●●H30 ^[4]	SBA43●●●H30 ^[4]
	1	0.25–10	HLL36030M71	SCG44●●●H30 ^[4]	SCW44●●●H30 ^[4]	SCW54●●●H30 ^[4]	SCA54●●●H30 ^[4]	SCA44●●●H30 ^[4]
	2	5–15	HLL36030M71	SDG42●●●H30 ^[4]	SDW42●●●H30 ^[4]	SDW52●●●H30 ^[4]	SDA52●●●H30 ^[4]	SDA42●●●H30 ^[4]
		20–25	HLL36050M72	SDG43●●●H30	SDW43●●●H30	SDW53●●●H30	SDA53●●●H30	SDA43●●●H30
	3	20–25	HLL36050M72	SEG41●●●H30	SEW41●●●H30	SEW51●●●H30	SEA51●●●H30	SEA41●●●H30
		30–50	HLL36100M73	SEG42●●●H30	SEW42●●●H30	SEW52●●●H30	SEA52●●●H30	SEA42●●●H30
	4	60–100	JLL36250M75	SFG44●●●H30	SFW44●●●H30	SFW54●●●H30	SFA54●●●H30	SFA44●●●H30
	5	125	JLL36250M75	SGG44●●●H30	SGW44●●●H30	—	SGA54●●●H30	SGA44●●●H30
		150–200	LJL36400M36	SGG45●●●H30	SGW45●●●H30	—	SGA55●●●H30	SGA45●●●H30
	6	250–350	LJL36600M42	SHG45●●●H30	SHW45●●●H30	—	SHA55●●●H30	SHA45●●●H30
		400	PLL34080M68	SHG46●●●H30	SHW46●●●H30	—	SHA56●●●H30	SHA46●●●H30
575 (600)	0	0.25–5	HLL36030M71	SBG43●●●H30 ^[4]	SBW43●●●H30 ^[4]	SBW53●●●H30 ^[4]	SBA53●●●H30 ^[4]	SBA43●●●H30 ^[4]
	1	0.25–10	HLL36030M71	SCG44●●●H30 ^[4]	SCW44●●●H30 ^[4]	SCW54●●●H30 ^[4]	SCA54●●●H30 ^[4]	SCA44●●●H30 ^[4]
	2	5–20	HLL36030M71	SDG42●●●H30 ^[4]	SDW42●●●H30 ^[4]	SDW52●●●H30 ^[4]	SDA52●●●H30 ^[4]	SDA42●●●H30 ^[4]
		25	HLL36050M72	SDG43●●●H30	SDW43●●●H30	SDW53●●●H30	SDA53●●●H30	SDA43●●●H30
	3	25–30	HLL36050M72	SEG41●●●H30	SEW41●●●H30	SEW51●●●H30	SEA51●●●H30	SEA41●●●H30
		40–50	HLL36100M73	SEG42●●●H30	SEW42●●●H30	SEW52●●●H30	SEA52●●●H30	SEA42●●●H30
	4	60–100	JLL36250M75	SFG44●●●H30	SFW44●●●H30	SFW54●●●H30	SFA54●●●H30	SFA44●●●H30
	5	125–150	JLL36250M75	SGG44●●●H30	SGW44●●●H30	—	SGA54●●●H30	SGA44●●●H30
		200	LJL36400M36	SGG45●●●H30	SGW45●●●H30	—	SGA55●●●H30	SGA45●●●H30
	6	250	LJL36400M36	SHG43●●●H30	SHW43●●●H30	—	SHA53●●●H30	SHA43●●●H30
		300–400	LJL36600M42	SHG45●●●H30	SHW45●●●H30	—	SHA55●●●H30	SHA45●●●H30

^[1] Size 6 starter enclosures are NEMA 4 painted sheet steel.

^[2] NEMA 12/3R enclosures can be field modified for outdoor non-corrosive and non-service entrance rated applications. See page 19 for more information.

^[3] Replace the three bullets (●●●) in the catalog number with the coil voltage code. Refer to the standard coil voltage codes shown in Table 35 on page 28.

^[4] Form H30, with the possibility of a fourth character to select a lower FLA range (for example, H308). See page 45.

Combination Starters
Class 8739—Reversing, Electronic Motor Circuit Protector (MCP) Circuit Breaker

Table 35: Coil Voltage Codes

Voltage		Code
60 Hz	50 Hz	
24 ^[1]	—	V01
120 ^[1]	110	V02
208	—	V08
240	220	V03
277 ^[1]	—	V04
480	440	V06
600	550	V07
Specify	Specify	V99

^[1] **Form S** (no charge) must be included with these voltage codes where a separate source of voltage is used for the control coil (for example, order as 8739SCG41V02**S**).
Note that **24 V** coils are **not** available on Sizes 4–7.

NOTE: For voltage codes used with control transformers, see Table 71 on page 44.

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Type S Accessories (Class 9999)	Catalog 9999CT9701R10/07

Combination Starters

Class 8739—Reversing, Thermal-Magnetic Circuit Breaker

Thermal-Magnetic, 3-Pole Polyphase—600 Vac Maximum, 50–60 Hz

Table 36: Class 8739 Thermal-Magnetic, Full-Voltage Type, Reversing, 200–240 V, with Motor Logic SSOLR (replace ●●● with the voltage code)

Motor Voltage (Starter Voltage)	Ratings				Enclosure				
	Max. Hp Polyphase	NEMA Size	Circuit Breaker		NEMA 1 General Purpose	NEMA 4 & 4X Watertight and Dusttight Stainless Steel (304) (Sizes 0-5) ^[1]	NEMA 4X Watertight, Dusttight and Corrosion Resistant Polyester	NEMA 12/3R ^[2] Industrial Use Dusttight and Driptight	
			Type	Rating (A)	Type ^[3]	Type ^[3]	Type ^[3]	With External Reset	Without External Reset
200 (208)	2	0	HLL36015	15	SBG1●●●H30 ^[4]	SBW1●●●H30 ^[4]	SBW11●●●H30 ^[4]	SBA11●●●H30 ^[4]	SBA1●●●H30 ^[4]
	3		HLL36020	20	SBG3●●●H30 ^[4]	SBW3●●●H30 ^[4]	SBW13●●●H30 ^[4]	SBA13●●●H30 ^[4]	SBA3●●●H30 ^[4]
	5	1	HLL36035	35	SCG5●●●H30 ^[4]	SCW5●●●H30 ^[4]	SCW15●●●H30 ^[4]	SCA15●●●H30 ^[4]	SCA5●●●H30 ^[4]
	7.5		HLL36050	50	SCG2●●●H30 ^[4]	SCW2●●●H30 ^[4]	SCW12●●●H30 ^[4]	SCA12●●●H30 ^[4]	SCA2●●●H30 ^[4]
	10	2	HLL36060	60	SDG1●●●H30	SDW1●●●H30	SDW11●●●H30	SDA11●●●H30	SDA1●●●H30
	15	3	HLL36100	100	SEG3●●●H30	SEW3●●●H30	SEW13●●●H30	SEA13●●●H30	SEA3●●●H30
	20		HLL36125	125	SEG1●●●H30	SEW1●●●H30	SEW11●●●H30	SEA11●●●H30	SEA1●●●H30
	25		HLL36150	150	SEG5●●●H30	SEW5●●●H30	SEW15●●●H30	SEA15●●●H30	SEA5●●●H30
	30	4	JLL36200	200	SFG3●●●H30	SFW3●●●H30	SFW13●●●H30	SFA13●●●H30	SFA3●●●H30
	40		JLL36250	250	SFG4●●●H30	SFW4●●●H30	SFW14●●●H30	SFA14●●●H30	SFA4●●●H30
230 (240)	50	5	JLL36250	250	SGG6●●●H30	SGW6●●●H30	—	SGA16●●●H30	SGA6●●●H30
	60–75		LLL36400U33X	400	SGG4●●●H30	SGW4●●●H30	—	SGA14●●●H30	SGA4●●●H30
	100–125	6	LLL36600U33X	600	SHG4●●●H30	SHW4●●●H30	—	SHA14●●●H30	SHA4●●●H30
	150		MJL36800	800	SHG5●●●H30	SHW5●●●H30	—	SHA15●●●H30	SHA5●●●H30
	2	0	HLL36015	15	SBG1●●●H30 ^[4]	SBW1●●●H30 ^[4]	SBW11●●●H30 ^[4]	SBA11●●●H30 ^[4]	SBA1●●●H30 ^[4]
	3		HLL36020	20	SBG3●●●H30 ^[4]	SBW3●●●H30 ^[4]	SBW13●●●H30 ^[4]	SBA13●●●H30 ^[4]	SBA3●●●H30 ^[4]
	5	1	HLL36035	35	SCG5●●●H30 ^[4]	SCW5●●●H30 ^[4]	SCW15●●●H30 ^[4]	SCA15●●●H30 ^[4]	SCA5●●●H30 ^[4]
	7.5		HLL36045	45	SCG6●●●H30 ^[4]	SCW6●●●H30 ^[4]	SCW16●●●H30 ^[4]	SCA16●●●H30 ^[4]	SCA6●●●H30 ^[4]
	10	2	HLL36060	60	SDG1●●●H30	SDW1●●●H30	SDW11●●●H30	SDA11●●●H30	SDA1●●●H30
	15		HLL36090	90	SDG7●●●H30	SDW7●●●H30	SDW17●●●H30	SDA17●●●H30	SDA7●●●H30
230 (240)	20	3	HLL36100	100	SEG3●●●H30	SEW3●●●H30	SEW13●●●H30	SEA13●●●H30	SEA3●●●H30
	25–30		HLL36150	150	SEG5●●●H30	SEW5●●●H30	SEW15●●●H30	SEA15●●●H30	SEA5●●●H30
	40	4	JLL36225	225	SFG1●●●H30	SFW1●●●H30	SFW11●●●H30	SFA11●●●H30	SFA1●●●H30
	50		JLL36250	250	SFG4●●●H30	SFW4●●●H30	SFW14●●●H30	SFA14●●●H30	SFA4●●●H30
	60	5	JLL36250	250	SGG6●●●H30	SGW6●●●H30	—	SGA16●●●H30	SGA6●●●H30
	75		LLL36400U33X	400	SGG4●●●H30	SGW4●●●H30	—	SGA14●●●H30	SGA4●●●H30
	100		LLL36600U33X	600	SGG2●●●H30	SGW2●●●H30	—	SGA12●●●H30	SGA2●●●H30
	125	6	LLL36600U33X	600	SHG4●●●H30	SHW4●●●H30	—	SHA14●●●H30	SHA4●●●H30
	150–200		MJL36800	800	SHG5●●●H30	SHW5●●●H30	—	SHA15●●●H30	SHA5●●●H30

^[1] Size 6 starter enclosures are NEMA 4 painted sheet steel.

^[2] NEMA 12/3R enclosures can be field modified for outdoor non-corrosive and non-service entrance rated applications. See page 19 for more information.

^[3] Replace the three bullets (●●●) in the catalog number with the coil voltage code. Refer to the standard coil voltage codes shown in Table 37.

^[4] **Form H30**, with the possibility of a fourth character to select a lower FLA range (for example, **H308**). See page 45.

Table 37: Coil Voltage Codes

Voltage		Code
60 Hz	50 Hz	
24 ^[1]	—	V01
120 ^[1]	110	V02
208	—	V08
240	220	V03
277 ^[1]	—	V04
480	440	V06
600	550	V07
Specify	Specify	V99

^[1] **Form S** (no charge) must be included with these voltage codes where a separate source of voltage is used for the control coil (for example, order as 8739SCG5V02S).

Note that **24 V** coils are **not** available on Sizes 4–7.

NOTE: For voltage codes used with control transformers, see Table 71 on page 44.

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Type S Accessories (Class 9999)	Catalog 9999CT9701R10/07

Combination Starters

Class 8739—Reversing, Thermal-Magnetic Circuit Breaker

Thermal-Magnetic, 3-Pole Polyphase—600 Vac Maximum, 50–60 Hz

Table 38: Class 8739 Thermal-Magnetic, Full-Voltage Type, Reversing, 460–600 V, with Motor Logic SSOLR (replace ●●● with the voltage code)

Motor Voltage (Starter Voltage)	Ratings				Enclosure				
	Max. Hp Polyphase	NEMA Size	Circuit Breaker		NEMA 1 General Purpose	NEMA 4 & 4X Watertight and Dusttight Stainless Steel (304) (Sizes 0–5) [1]	NEMA 4X Watertight, Dusttight and Corrosion Resistant Polyester	NEMA 12/3R [2] Industrial Use Dusttight and Driptight With External Reset	Without External Reset
			Type	Rating (A)	Type [3]	Type [3]	Type [3]	Type [3]	Type [3]
460 (480)	5	0	HLL36015	15	SBG1●●●H30 [4]	SBW1●●●H30 [4]	SBW11●●●H30 [4]	SBA11●●●H30 [4]	SBA1●●●H30 [4]
	7.5	1	HLL36025	25	SCG3●●●H30 [4]	SCW3●●●H30 [4]	SCW13●●●H30 [4]	SCA13●●●H30 [4]	SCA3●●●H30 [4]
	10		HLL36030	30	SCG7●●●H30 [4]	SCW7●●●H30 [4]	SCW17●●●H30 [4]	SCA17●●●H30 [4]	SCA7●●●H30 [4]
	15	2	HLL36045	45	SDG3●●●H30	SDW3●●●H30	SDW13●●●H30	SDA13●●●H30	SDA3●●●H30
	20		HLL36060	60	SDG1●●●H30	SDW1●●●H30	SDW11●●●H30	SDA11●●●H30	SDA1●●●H30
	25		HLL36070	70	SDG5●●●H30	SDW5●●●H30	SDW15●●●H30	SDA15●●●H30	SDA5●●●H30
	30		HLL36080	80	SEG6●●●H30	SEW6●●●H30	SEW16●●●H30	SEA16●●●H30	SEA6●●●H30
	40		HLL36100	100	SEG3●●●H30	SEW3●●●H30	SEW13●●●H30	SEA13●●●H30	SEA3●●●H30
	50	3	HLL36150	150	SEG5●●●H30	SEW5●●●H30	SEW15●●●H30	SEA15●●●H30	SEA5●●●H30
	60	4	JLL36105	150	SFG5●●●H30	SFW5●●●H30	SFW15●●●H30	SFA15●●●H30	SFA5●●●H30
	75		JLL36200	200	SFG3●●●H30	SFW3●●●H30	SFW13●●●H30	SFA13●●●H30	SFA3●●●H30
	100		JLL36250	250	SFG4●●●H30	SFW4●●●H30	SFW14●●●H30	SFA14●●●H30	SFA4●●●H30
	125–150	5	LLL36400U33X	400	SGG4●●●H30	SGW4●●●H30	—	SGA14●●●H30	SGA4●●●H30
	200		LLL36600U33X	600	SGG2●●●H30	SGW2●●●H30	—	SGA12●●●H30	SGA2●●●H30
	250	6	LLL36600U33X	600	SHG4●●●H30	SHW4●●●H30	—	SHA14●●●H30	SHA4●●●H30
	300–400		MJL36800	800	SHG5●●●H30	SHW5●●●H30	—	SHA15●●●H30	SHA5●●●H30
575 (600)	5	0	HLL36015	15	SBG1●●●H30 [4]	SBW1●●●H30 [4]	SBW11●●●H30 [4]	SBA11●●●H30 [4]	SBA1●●●H30 [4]
	7.5	1	HLL36020	20	SCG8●●●H30 [4]	SCW8●●●H30 [4]	SCW18●●●H30 [4]	SCA18●●●H30 [4]	SCA8●●●H30 [4]
	10		HLL36025	25	SCG3●●●H30 [4]	SCW3●●●H30 [4]	SCW13●●●H30 [4]	SCA13●●●H30 [4]	SCA3●●●H30 [4]
	15	2	HLL36035	35	SDG8●●●H30	SDW8●●●H30	SDW18●●●H30	SDA18●●●H30	SDA8●●●H30
	20		HLL36045	45	SDG3●●●H30	SDW3●●●H30	SDW13●●●H30	SDA13●●●H30	SDA3●●●H30
	25		HLL36060	60	SDG1●●●H30	SDW1●●●H30	SDW11●●●H30	SDA12●●●H30	SDA1●●●H30
	30		HLL36070	70	SEG4●●●H30	SEW4●●●H30	SEW14●●●H30	SEA14●●●H30	SEA4●●●H30
	40	3	HLL36090	90	SEG6●●●H30	SEW6●●●H30	SEW16●●●H30	SEA16●●●H30	SEA6●●●H30
	50		HLL36100	100	SEG3●●●H30	SEW3●●●H30	SEW13●●●H30	SEA13●●●H30	SEA3●●●H30
	60–75		HLL36150	150	SFG5●●●H30	SFW5●●●H30	SFW15●●●H30	SFA15●●●H30	SFA5●●●H30
	100	4	JLL36250	250	SFG4●●●H30	SFW4●●●H30	SFW14●●●H30	SFA14●●●H30	SFA4●●●H30
	125–150	5	JLL36250	250	SGG6●●●H30	SGW6●●●H30	—	SGA16●●●H30	SGA6●●●H30
	200		LLL36400U33X	400	SGG4●●●H30	SGW4●●●H30	—	SGA14●●●H30	SGA4●●●H30
	250–350	6	LLL36600U33X	600	SHG4●●●H30	SHW4●●●H30	—	SHA14●●●H30	SHA4●●●H30
	400		MJL36800	800	SHG5●●●H30	SHW5●●●H30	—	SHA15●●●H30	SHA5●●●H30

[1] Size 6 starter enclosures are NEMA 4 painted sheet steel.

[2] NEMA 12/3R enclosures can be field modified for outdoor non-corrosive and non-service entrance rated applications. See page 19 for more information.

[3] Replace the three bullets (●●●) in the catalog number with the coil voltage code. Refer to the standard coil voltage codes shown in Table 39.

[4] Form H30, with the possibility of a fourth character to select a lower FLA range (for example, H308). See page 45.

Table 39: Coil Voltage Codes

Voltage		Code
60 Hz	50 Hz	
24 [1]	—	V01
120 [1]	110	V02
208	—	V08
240	220	V03
480	440	V06
600	550	V07
Specify	Specify	V99

[1] Form S (no charge) must be included with these voltage codes where a separate source of voltage is used for the control coil (for example, order as 8739SDG3V02S). Note that 24 V coils are not available on Sizes 4–7.

NOTE: For voltage codes used with control transformers, see Table 71 on page 44.

Combination Starters

Class 8738, 8739—Reversing—Approximate Dimensions

Dimensions for Reversing Combination Starters—NEMA 1, 12, and 3R

Table 40: NEMA 1 Enclosure, Sizes 0–2 (see Figure 11)

NEMA Size	Class	Type	Dimensions (in.) ^[1]																Top & Bottom		Sides	Wt. (lb)
			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	13.75	23	8.34	10.63	21	18.91	1.88	1.88	3.75	2.31	1.06	3.25	2.19	1.25	0.88	—	0.25 / 0.75 / 1	0.25 / 0.75 / 1	0.25	49
2	8738, 8739	SDG	15	28.75	9.59	11.63	26.25	21.47	2.19	2	4	2.56	1.25	3.25	2.19	1.25	0.91	—	1 / 1.25	1 / 1.25	0.25	80

^[1] These dimensions are also for **Form FF4T** (standard control transformer), **Form FF4T11** (100 VA additional capacity), and **Form FF4T12** (200 VA additional capacity).

Table 41: NEMA 1 Enclosure, Sizes 3–6 (see Figure 12)

NEMA Size	Class	Type	Dimensions (in.) ^[1]																Top & Bottom		Sides	Wt. (lb)
			A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	W	X	Y	
3	8738, 8739	SEG	18.5	44	10.59	12.5	3	25.97	43.5	0.25	—	2.81	3.5	5	2.69	5.38	1.22	0.91	1 / 1.25 2 / 2.25	0.25 / 0.75	0.25	245
4	8738	SFG	21	51.5	10.53	15	3	30.72	51	0.25	—	2.81	3.5	5	2.69	5.38	1.22	0.91	2.5	0.25 / 0.75	0.25	—
	8739	SFG	18.5	44	10.59	12.5	3	25.97	43.5	0.25	—	2.81	3.5	5	2.69	5.38	1.22	0.91	1 / 1.25 2 / 2.25	0.25 / 0.75	0.25	—
5	8738	SGG	30	77	15.5	22	4	39.41	76	0.25	—	3.5	6.28	9.25	3.19	—	—	—	0.25 / 0.75	3	—	—
	8739	SGG	30	65	13.72	22	4	39.41	64	0.25	—	3.5	6.28	5	3.19	—	—	—	0.25 / 0.75	3	—	—
6	8738, 8739	SHG	36	90	17.03	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

^[1] These dimensions are also for **Form FF4T** (standard control transformer), **Form FF4T11** (100 VA additional capacity), and **Form FF4T12** (200 VA additional capacity).

Table 42: NEMA 12/3R Enclosure (see Figure 13)

NEMA Size	Class	Type	Dimensions (in.) ^[1]										Wt. (lb)
			A	B	C	D	E	F	G	H	I	J	
0–1	8738, 8739	SBA SCA	13.75	10.09	24.75	3.25	2.5	8.75	24	0.38	3.75	20.31	52
2	8738, 8739	SDA	15	10.97	31	3.25	3	9	30.25	0.38	3.75	23.44	95
3	8738, 8739	SEA	18.5	10.59	45	5	3	12.5	44	0.25	3.75	25.59	255
4	8738	SFA	21	10.59	52.5	5	3	15	51.5	0.25	3.75	30.34	—
	8739	SFA	18.5	10.59	45	3.25	3	12.5	44	0.25	3.75	25.59	—
5	8738	SGA	30	15.5	78	9.25	4	22	77	0.25	7.5	39.41	—
	8739	SGA	30	15.5	66	—	4	22	65	0.25	7.5	37.88	—
6 ^[2]	8739	SHA	36	17.03	90	—	—	—	—	—	—	—	—

^[1] These dimensions are also for **Form FF4T** (standard control transformer), **Form FF4T11** (100 VA additional capacity), and **Form FF4T12** (200 VA additional capacity).

^[2] Size 6 enclosures are floor mounting.

Figure 11: NEMA 1 Enclosure (Sizes 0–2)

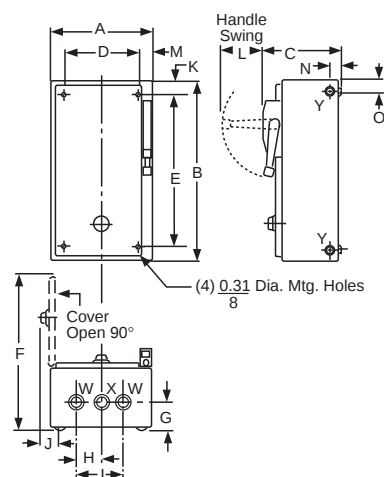


Figure 12: NEMA 1 Enclosure (Sizes 3–6)

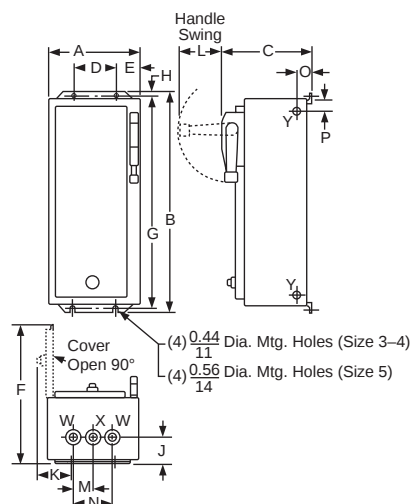
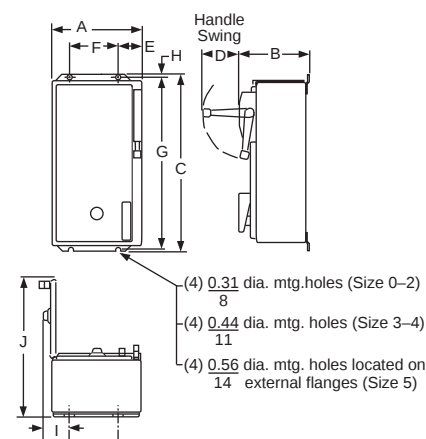


Figure 13: NEMA 12/3R Enclosure



Combination Starters

Class 8738, 8739—Reversing—Approximate Dimensions

Dimensions for Reversing Combination Starters—NEMA 4 and 4X

Table 43: NEMA 4X Polyester Enclosure (see Figure 14)

NEMA Size	Class	Type	Dimensions (in.) ^[1]				
			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

^[1] These dimensions are also for **Form FF4T** (standard control transformer), **Form FF4T11** (100 VA additional capacity), and **Form FF4T12** (200 VA additional capacity).

Table 44: Information on Hubs

Hubs are furnished with each NEMA 4X combination starter as shown in this table. Note that hubs are installed only in stainless steel enclosures; they are not installed in polyester enclosures.

NEMA Size	Hub Size, Quantity = 1	Hub Size, Quantity = 2
0 & 1	0.75 in.	1.00 in.
2	0.75 in.	1.50 in.
3 & 4	0.75 in.	2.50 in.

Table 45: NEMA 4 & 4X Stainless Steel Enclosure (see Figure 15)

NEMA Size	Class	Type	Dimensions (in.)												Bottom W (Hub)	Top & Bot. X (Hub)	Wt. (lb)
			A	B	C	D	E	F	G	H	I	J	K	L			
0-1	8738, 8739	SBW SCW	13.75	8.34	25.19	3.25	2.5	8.75	24	0.59	3	1.63	2.31	18.53	0.75	1	52
2	8738, 8739	SDW	15	9.59	30.03	3.25	2.5	10	29.75	0.63	3	2	2.63	21.03	0.75	1.5	95
3	8738, 8739	SEW	18.5	10.56	45.19	5	3	12.5	44	0.59	3.5	2.63	3.19	25.5	0.75	2.5	255
4	8738	SFW	21	10.53	52.69	5	3	15	51.5	0.59	3.5	2.63	3.19	30.25	0.75	2.5	—
	8739	SFW	18.5	10.56	45.19	5	3	12.5	44	0.59	3.5	2.63	3.19	25.5	0.75	2.5	—
5	8738	SGW	30	15.5	78.09	9.25	4	22	77	0.56	6.09	3	3.5	39.41	0.75	3.5	—
	8739	SGW	30	13.89	66.09	5	4	22	65	0.56	6.09	3	3.5	37.88	0.75	3.5	—
6	8739	SHW	36	17.03	98	—	—	—	—	—	—	—	—	—	—	—	—

Figure 14: NEMA 4X Polyester Enclosure

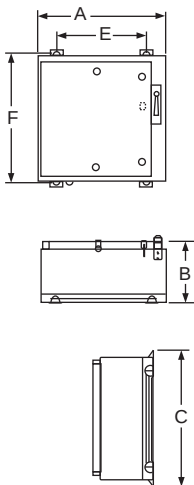
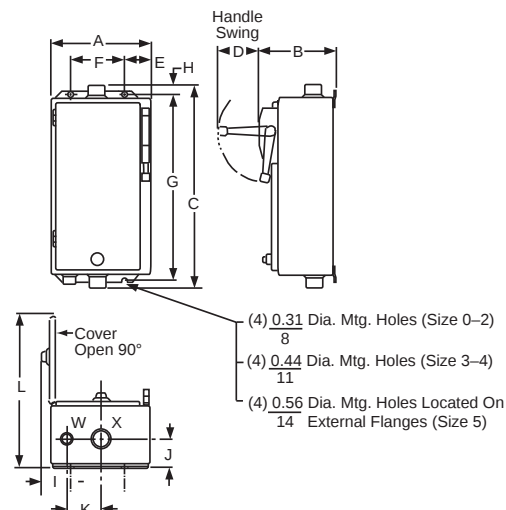


Figure 15: NEMA 4 & 4X Stainless Enclosure



NOTE: Illustrations are for dimensional information only, and may not represent the actual enclosure.

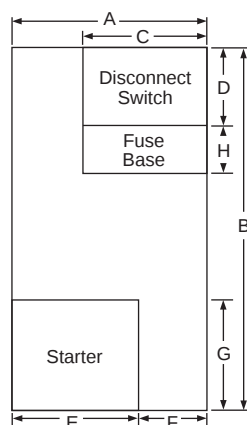
Combination Starters Class 8738, 8739—Reversing—Panel Layout

Panel Layout Drawings

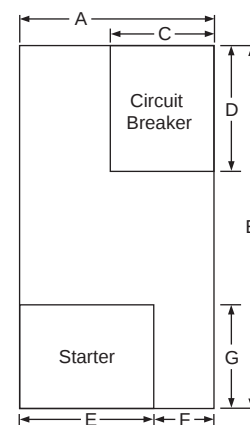
Table 46: Panel Layout Drawings—NEMA 1, 4 & 4X Stainless, 12/3R

Class	NEMA	Dimensions, in.							
		A	B	C	D	E	F	G	H
8738	0, 1	10.75	19	6.9	6.5	7.25	3.5	9	4
8739				6.5	7.9				—
8738	2	12	24	7.5	7.0	7.75	4.25	11	6
8739				7	8.8				—
8738	3	15.5	32.5	9	7.7	15.5	0	14	5
8739				8.25	8.5				—
8738	4	18	39	11.5	20.5	18	0	17	—
8739		15.5	32.5	9.25	10.5	15	0	15	
8738	5 ^[1]	27	59	26	25.0	21	6	21	—
8739		27	58	JLL: 6.8; LLL: 9	JLL: 23; LLL: 24.5	21	6	21	—
8739	6	32	82	LLL: 9; MJL: 12.5	LLL: 26; MJL: 27.5	22.5	9.5	36	—

^[1] Size 5 combination starter does not contain a full-size panel. No usable panel space is available.



Class 8738



Class 8739

Combination Starters

Class 8538, 8539, 8738, 8739—Application Data

Application Data

Table 47: Ratings and Application Data

NEMA Size	Load Voltage	Max. Hp Rating				Continuous Current Rating (A) 600 V Max.	Service- Limit Current Rating (A) ^[1]	Tungsten and Infrared Lamp Load (A), 250 V Max. ^[2]	Resistance Heating Loads (KW) other than Infrared Lamp Loads ^[3]		KVA Rating for Switching Transformer Primaries at 50 or 60 Cycles				3 Ø Rating for Switching Capacitors ^[4]		
		Nonplugging and Nonjogging Duty									Plugging and Jogging Duty ^[5]					Inrush Currents (Worst Case Peak)	
									≤20 Times Peak of Continuous Current Rating							>20 to 40 Times Peak of Continuous Current Rating	
		Single Phase	Poly- phase	Single Phase	Poly- phase				Single Phase	Poly- phase	Single Phase	Poly- phase	Single Phase	Poly- phase	KVAR		
00	115	0.5	—	—	—	9	11	5	—	—	—	—	—	—	—		
	200	—	1.5	—	—	9	11	5	—	—	—	—	—	—	—		
	230	1	1.5	—	—	9	11	5	—	—	—	—	—	—	—		
	380	—	1.5	—	—	9	11	—	—	—	—	—	—	—	—		
	460	—	2	—	—	9	11	—	—	—	—	—	—	—	—		
575	—	2	—	—	9	11	—	—	—	—	—	—	—	—			
0	115	1	—	0.5	—	18	21	10	—	—	0.6	—	0.3	—	—		
	200	—	3	—	1.5	18	21	10	—	—	—	1.8	—	0.9	—		
	230	2	3	1	1.5	18	21	10	—	—	1.2	2.1	0.6	1.0	—		
	380	—	5	—	1.5	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	—	7.5	—	3	27	32	15	—	9.1	—	3.6	—	1.8	—		
	230	3	7.5	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	—	1.5	—	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	—	7.5	45	52	30	—	15.4	—	6.3	—	3.1	—		
	230	7.5	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 ^[6]	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 ^[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 ^[6]	230	—	300	—	—	810	932	—	180	315	—	—	—	—	240		
	460	—	600	—	—	810	932	—	360	625	—	—	—	—	480		
	575	—	600	—	—	810	932	—	450	775	—	—	—	—	600		

[1] Per NEMA Standards paragraph ICS 2-321.20, 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.

[2] **Fluorescent Lamp Loads—300 V 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 Lighting Contactors) section of the *Digest*.

[3] Ratings apply to contactors which are used to switch the load at the utilization voltage of the heat-producing element with a duty that 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.

[4] 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's rated continuous current. In many installations, the impedance of the 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.

[5] 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.

[6] For NEMA Size 6 and 7, the operation rate is as follows: Continuous operation, 3 operations/minute maximum; Jogging or Plugging Duty, 15 operations/minute—3 minutes maximum.

Table 48: Code Letter—Maximum Allowable Motor

Motor Hp Rating	Max. Allowable Motor Code Letter
1.5–2	L
3–5	K
7.5 and above	H

The motor ratings in Table 47 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 what is shown in Table 48. Motors with code letters occurring later in the alphabet may require a larger controller. Consult the Customer Care Center at 1-888-778-2733.

NOTE: Tables and footnotes are taken from NEMA Standards.

Combination Starters

Class 8538, 8539—Non-Reversing—Application Data

The ratings for capacitor switching in Table 47 on page 34 assume the following maximum available fault currents (rms symmetrical amperes):

- NEMA Size 00–3: 5,000 A
- NEMA Size 4–5: 10,000 A
- NEMA Size 6: 18,000 A
- NEMA Size 7: 30,000 A

If the available fault current is greater than these values, connect sufficient impedance in series.

Refer to the instruction material for the actual tested SCCR values.

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 Table 47 on page 34.

Table 49: 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 the 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 shown below.

NEMA Size	Maximum Voltage	Class K5, RK5 or RK1 Fuse (Amperes)	Class J or T Fuse (Amperes)	Inverse-Time Circuit Breaker (Amperes)
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 ^[1]	800
7	600	600	1600 ^[1]	1200

^[1] 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 Table 47 on page 34.

Table 50: Coil Burden (Mean Values)

NEMA Size	No. of Poles	Inrush VA		Sealed VA		Sealed W	
		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 ^[1]	2–3	1495	1780	56	48	27	32
7 ^[1]	2–3	—	1960	—	59	—	36

^[1] 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 to 40 °C (32 to 104 °F).

Combination Starters

Class 8538, 8539—Non-Reversing—Application Data

Table 51: Maintenance of Equipment

Class 9998 repair parts kits are available for all Class 8502 contactors and Class 8536 starters. Instruction bulletins with a complete list of replaceable parts are furnished with all enclosed devices. Bulletins are available online and are listed below along with the appropriate contact parts kit.

NEMA Size	Type	Device		Instruction Bulletin	Supersedes Service Bulletin	Replacement Contacts, Class 9998 Type
		Series	No. of Poles			
00	SA	A	2-3	—	362AS	SL2
		B	2-3	30072-013-08	556AS	SJ1
0	SB	A&B	1-3	30072-013-09	277AS	SL2
			4		277AS & 250AS	SL12
			5		277AS & 250AS	One SL12 & one SL22; or one SL2 & two SL22
1	SC	A&B	1-3	30072-013-10	278AS	SL3
			4		278AS & 250AS	SL13
			5		278AS & 250AS	One SL13 & one SL22; or one SL3 & two SL22
1P	SC	A	2	30072-013-10	278AS	SL3
2	SD	A	2-3	30072-013-11	279AS	SL4
			4		279AS & 293AS	SL14
			5		279AS & 293AS	One SL14 & one SL24; or one SL4 & two SL24
3	SE	A	2	30072-013-01	305AS	SL6
			3	30072-013-01	305AS	SL7
			4	30072-013-03	326AS	Two SL6
			5	30072-013-03	326AS	One SL6 & one SL7
4	SF	A	2	30072-013-02	306AS	SL8
			3	30072-013-02	306AS	SL9
			4	30072-013-03	326AS	Two SL8
			5	30072-013-03	326AS	One SL8 & one SL9
5	SG	A	2	30072-013-18	328AS	SL10
			3	30072-013-18	328AS	SL11
	SGO	B	2	30072-013-103	—	SL10
			3	30072-013-103	—	SL11
6	SH	A	2	—	342AS	SL25
			3	—	342AS	SL26
		B	2	30072-013-12	370AS	SL25
			3	30072-013-12	370AS	SL26
7	SJ	A (Class 8536)	2	—	397AS, 30072-013-13	SL30
			3	—		SL31
		A (Class 8502) C (Class 8536)	2 3	30072-013-59 30072-013-59	—	SL30 SL31

Table 52: Terminals

NEMA Size	Type	Line Terminals on Disconnect Means (the numbers in parentheses are quantities)			Power Terminals on Magnetic Starter			Control Terminals on Magnetic Starter		
		Type of Lug	Wire Range, AWG	Circuit Breaker	Type of Lug	Wire Range	Wires Per Terminal	Type of Lug	Wire Range	Wires Per Terminal
0, 1	SB, SC	Box Lug	14–1/0 Cu/Al	(1) 14–3/0, Al or Cu	Pressure Wire	14–8 Cu	1 or 2	Pressure Wire	16–12 Cu	2
2	SD	Box Lug	14–1/0 Cu/Al	(1) 14–3/0, Al or Cu	Box Lug	14–4 Cu	1	Pressure Wire	16–12 Cu	2
3	SE	Box Lug	14–1/0 Cu/Al	(1) 14–3/0, Al or Cu	Box Lug	14–0 Cu	1	Pressure Wire	16–12 Cu	2
4	SF	Box Lug	6–300 MCM Cu/Al	JLL Circuit Breaker, 150–175 A: (1) 4–4/0, Al or Cu JLL Circuit Breaker, 200–250 A: (1) 3/0–350 MCM, Al or Cu	Box Lug	8–250 MCM Cu	1	Pressure Wire	16–12 Cu	2
5	SG	Box Lug	(1) 4–500 MCM Cu	DJL36400 Circuit Breaker: (1) 2–500 MCM Al; or (1) 2–350 MCM Cu DLL36600 Circuit Breaker: (2) 2/0–500 MCM Al; or (2) 2/0–350 MCM Cu JLL36250 Circuit Breaker: (1) 3/0–350 MCM Al; or (1) 3/0–350 MCM Cu	Box Lug	4–500 MCM Cu	1	Pressure Wire	16–12 Cu	2
6	SH	Box Lug	—	DJL36600, DLL Circuit Breaker: (2) 2/0–500 MCM Al; or (2) 2/0–350 MCM Cu DJL36400 Circuit Breaker: (1) 2–600 MCM Al; or (1) 2–350 MCM Cu MJL36800 Circuit Breaker: (3) 3/0–500 MCM Al; or (3) 3/0–350 MCM Cu PLL34080M68 Circuit Breaker: (3) 3/0–500 MCM Al; or (3) 3/0–350 MCM Cu	Parallel Groove	250–500 MCM Cu	1 or 2	Pressure Wire	16–12 Cu	2
7	SJ	Box Lug	—	PJL, PKL, PLL Circuit Breaker: (4) 3/0–300 MCM, Al or Cu	Parallel Groove	250–500 MCM Cu	1–4	Pressure Wire	16–12 Cu	2

Combination Starters

Class 8538, 8539—Non-Reversing—Application Data

Table 53: 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. This table 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 0–2 contactors and starters.

NEMA Size	Type	No. of Poles—Basic Contactor	Maximum Number of External Auxiliary Units (in addition to the 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.
0–2	SB–SD	1–3	4 single-circuit auxiliary contacts (N.O. or N.C.) ^[1] 2 single-circuit auxiliary contacts (N.O. or N.C.) plus 1 power pole adder (1 or 2 poles, N.O. or N.C.)
		4–5	2 single-circuit auxiliary contacts (N.O. or N.C.)
3–4	SE–SF	2–5	3 single-circuit auxiliary contacts (N.O. or N.C.)
5	SG	2–3	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.)
6–7	SH–SJ	2–3	3 single-circuit auxiliary contacts (N.O. or N.C.)
			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.)

^[1] When adding 4 external auxiliary contacts to one Size 0 or 1 contactor, remove one of the return springs.

Table 54: Factory Installed Additional Auxiliary Contacts—Form Numbers

This table lists the Form designations for use when ordering **factory-installed** electrical contacts. For field modification kits, see Class 9999 Accessories.

Number of N.O. Contacts	Number of N.C. Contacts	Form Number
0	1	X01
0	2	X02
0	3	X03
0	4	X04
1	0	X10
1	1	X11
1	2	X12
1	3	X13
2	0	X20
2	1	X21
2	2	X22
3	0	X30
3	1	X31
4	0	X40

Table 55: Disconnect Switch and Circuit Breaker Interlocks

Class	Type	Series	SPDT (Form Y74) Class 9999 Type	DPDT (Form Y75) Class 9999 Type
Disconnect Switch				
8538 ^[1]	SB, SC, SD	Series B	R6	R7
8538	SBA, SCA, SBG, SCG	Series D & above	TC11	TC21
	SBAS8, SCAS8, SBGS8, SCGS8	Series D & above	TC10	TC20
	SDA, SDA ^[1] , SDG, SDG ^[1]	Series D & above	TC10	TC20
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
	SEA, SEG	Series D & above	TC10	TC20
	SF	Series B & C	R39	R40
	SG	—	R35	R36
8738	SBA, SCA, SBG, SCG	Series E & above	TC11	TC21
	SBAS8, SCAS8, SBGS8, SCGS8	Series E & above	TC10	TC20
	SDA, SDG	Series E & above	TC10	TC20
Circuit Breaker				
8539, 8739	SB, SC, SD, SE, SF, SG	Series K	R26	R27

^[1] Class 8538 type numbers ending in suffix **S8**.

Combination Starters

Class 8538, 8539—Non-Reversing—Application Data

Table 56: Disconnect Switch and Circuit 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					
Vac 50 or 60 Hz	Maximum Current			Vac 50 or 60 Hz	Maximum Current				
	Make (A)	Break (A)	Continuous Carrying Current (A)		Make (A)	VA	Break (A)	VA	Continuous Carrying Current (A)
120	40	15	15	120	30	3450	3	345	10
240	20	10	15	240	15	3450	1.5	345	10
480	10	6	15	480	7.5	3450	0.75	345	10
600	8	5	15	600	6	3450	0.6	345	10

Control Circuit Transformers

Class 9070 Type TF control transformers are normally used in order to provide a lower voltage to the control circuit. (To order a factory-installed transformer with fused protection, specify Form FF4T). The addition of a transformer often requires the use of a larger enclosure (refer to the dimensions on page 19). Table 57 shows the transformer selection for the given sized starters and contactors, with or without auxiliary units.

Table 57: Control Transformer Selection

NEMA Size	Starter Type	Standard Capacity (Form FF4T)	Additional Capacity		
		50 VA (Form FF4T10)	100 VA (Form FF4T11)	200 VA (Form FF4T12)	
		Class 9070, Type ^[1]			
0, 1	SB, SC	TF100	TF150	TF200	TF300
2	SD	TF100	TF150	TF200	TF300
3	SE	TF150	TF200	TF300	TF500
4	SF	TF300	TF300	TF500	T500
5	SG	TF100 and 8501XO20	TF100 and 8501XO20	TF150 and 8501XO20	TF300 and 8501XO20
6	SH	EO3S2 is standard	N/A	EO3FS2 and T100	EO3S2 and TF200
7	SJ	EO19S2 is standard	N/A	EO19S2 and TF100	EO3S2 and TF200

[1] Complete the control transformer Class and Type with the voltage code. See Table 71 on page 44.

NOTE: 9070TF transformers are now standard in Series K combination starters when factory installed.

Table 58: Electronic Motor Circuit Protector (MCP) Selection by Hp Ratings of Induction-type Squirrel-Cage Motors

This table indicates the MCP adjustable trip range that corresponds to the suffix of the circuit breaker catalog number. The MCP motor circuit protector should be adjusted to a level just above locked-rotor current of the motor. This setting provides optimum overcurrent protection for the motor. For more information on MCP instantaneous-trip circuit breakers, refer to the MCP circuit breaker section of this catalog.

3Ø, 60 Hz Voltages				Full-Load Amperes	Suffix
200 Vac	230 Vac	460 Vac	575 Vac		
0.5–5	0.5–7.5	0.75–15	1–20	1.5–25	M71
5–10	5–15	10–30	15–40	14–42	M72
10–25	15–30	25–60	30–75	30–80	M73
20–40	25–50	50–100	60–125	58–130	M74
40–60	50–75	100–150	125–200	114–217	M75

 File E78360
CCN NITW2

Transformers

 File E61239
CCN XPTQ

 File LR37055
Class 5411 06

Combination Starters

Class 8538, 8539—Non-Reversing—Application Data

Table 59: UL Listed Short-Circuit Ratings—Class 8539 Electronic MCP Style

Enclosure	NEMA Size	AIC at 480 Vac (RMS)	AIC at 600 Vac (RMS)
Standard (NEMA 1, 4 and 4X stainless, and 12/3R)	0, 1	100,000	35,000
	2–5	100,000	50,000
	6	65,000	18,000
	7	65,000	30,000

Table 60: UL Listed Short-Circuit Ratings—Class 8539 Thermal-Magnetic Circuit Breaker Style

Enclosure	NEMA Size	AIC at 480 Vac (RMS)	AIC at 600 Vac (RMS)
Standard (NEMA 1, 4 and 4X stainless, and 12/3R)	0, 1	100,000	35,000
	2–5	100,000	50,000
	6	65,000	18,000
	7	65,000	30,000

Table 61: UL Listed Short-Circuit Ratings—Class 8538 Disconnect Switch Style

Enclosure	NEMA Size	NEMA Fuse Class	Available Amperes, RMS Symmetrical
Oversize	0–2	Class H or K	5,000
Standard	0–2	Class R/J	100,000
Standard (non-oversize NEMA 1, 4 and 4X stainless, and 12)	0–3	Class H or K	5,000
	0–3	Class R/J	100,000
	4–5	Class H or K	10,000
	4–5	Class R/J	100,000
	6	Class H or K	18,000
	6	Class R/J	100,000

Table 62: Motor Code Letters

Horsepower	Motor Code Letters
0.5 or less	A-L
0.75–1.5	A-K
2–3	A-J
5–25	A-H
30–125	A-G
150 or more	A-F

NOTE: The combination starter selection tables on pages 15–14 are suitable for motors with locked-rotor current letters according to NEC Table 430-7(b) as listed in Table 62. 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 help ensure proper protection.

Combination Starters

Class 8738, 8739—Reversing—Application Data

Control Circuit Transformers

Space and drilling are provided in all combination starters—in NEMA 1, 4 & 4X stainless, and 12/3R enclosures—for the field addition (or factory installation) of a Class 9070 transformer. For standard control transformer selection in reversing combination starters, see Table 63. For primary fusing of the control circuit, the Class 9999 Type SF4 fuseholder kit is suggested. This kit can be either panel mounted or side mounted on the Type S starter.

Table 63: Control Transformer Selection

NEMA Size	Starter Type	Standard Capacity (Form FF4T)	Additional Capacity		
		50 VA (Form FF4T10)	100 VA (Form FF4T11)	200 VA (Form FF4T12)	
		Class 9070, Type ^[1]			
0 & 1	SB & SC	TF100	TF150	TF200	TF300
2	SD	TF100	TF150	TF200	TF300
3	SE	TF150	TF200	TF300	TF500
4	SF	TF300	TF300	TF500	T500
5	SG	TF100 and 8501XO20	TF100 and 8501XO20	TF150 and 8501XO20	TF300 and 8501XO20
6	SH	EO3S2 is standard	N/A	EO3FS2 and T100	EO3S2 and TF200
7	SJ	EO19S2 is standard	N/A	EO19S2 and TF100	EO3S2 and TF200

[1] Complete the contactor or starter Class and Type with the voltage code. See Table 71 on page 44.

NOTE: 9070TF transformers are now standard in Series K combination starters.

Table 64: Class 8738 UL Short-Circuit Ratings

NEMA Size	Fuse Clip Type	Enclosure [1]	Ampere 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

[1] Standard enclosures include NEMA 1, 4 & 4X stainless, and 12/3R.

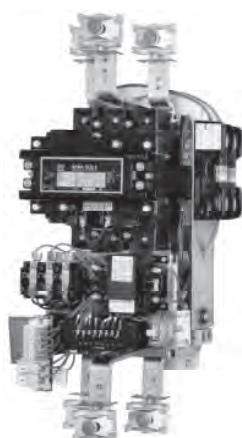
Table 65: Class 8739—UL Listed Short-Circuit Ratings

Motor Circuit Protector and Thermal-Magnetic Styles			
NEMA Size	Enclosure [1]	AIC at 480 Vac (RMS)	AIC at 600 Vac (RMS)
0, 1	Standard	100,000	35,000
2–5	Standard	100,000	50,000
6	Standard	65,000	18,000
7	Standard	65,000	30,000

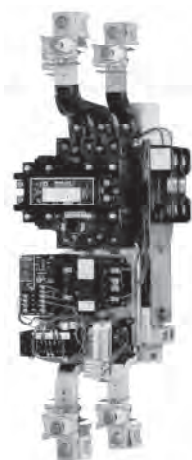
[1] Standard enclosures include NEMA 1, 4 and 4X stainless, and 12/3R.

Combination Starters

Class 8738, 8739—Reversing—Application Data



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 Size 6 and 7 devices come standard with a fused control-circuit transformer rated 240/480-120 V 60 Hz, 220/440-110 V 50 Hz. The purpose of this transformer is to provide an isolated supply, 120 V 60 Hz / 110 V 50 Hz, for the control circuit. NEMA Size 6 and 7 devices can be ordered for other system voltages by specifying the voltage and frequency desired.

Operation Rates—Continuous Operation: 3 operations/minute maximum. Jogging or Plugging Duty: 15 operations/minute—3 minutes maximum.

Field Conversion—Devices can be field converted to other system voltages by one of the following methods, *not by the usual practice of changing the coil*:

1. If the factory wiring is 480 V 60 Hz / 440 V 50 Hz, the device can be converted to 240 V 60 Hz / 220 V 50 Hz by reconnecting the control transformer as illustrated on the instruction sheet furnished 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—for example, 208, 277, 380, 600 V—a new transformer with single-voltage primary must be selected from Table 66 or 67. Control transformer connections are illustrated on the instruction sheet furnished with the controller.
2. If the factory wiring is any voltage *other than* 480 V 60 Hz / 440 V 50 Hz, conversion to another voltage requires replacement of the control transformer. Refer to Table 66 or 67.
3. In Square D combination starters, the standard transformer provided can be used to power a maximum of five Class 9001 Type K illuminated operators powered with transformer-type light modules. When additional capacity to power control relays or other inductive loads is required, a second transformer must be added. Additional capacity can be purchased as Form FF4T 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 V primary and 120 V secondary, which must not be bypassed. Form S controllers are not convertible for operation on common control.

Tables 66 and 67 list the replacement transformers for NEMA Size 6 and 7 Type S contactors and starters. To change voltages on these devices, coils are not changed—instead, transformers are changed to those with the desired voltage.

Table 66: NEMA Size 6 Replacement Control Transformers (150 VA) for Type S Devices

Voltage		Class 9070
60 Hz	50 Hz	Type
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

Table 67: NEMA Size 7 Replacement Control Transformers (200 VA) for Type S Devices

Voltage		Class 9070
60 Hz	50 Hz	Type
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: An N.O. holding circuit contact and an N.C. auxiliary contact come standard. The holding circuit contact may or may not be required for either 3-wire or 2-wire control. NEMA Size 6 and 7 devices have an additional N.C. auxiliary contact wired in the coil control circuit. **Do not use this N.C. contact for any other purpose.**

Combination Starters

Class 8538, 8539, 8738, and 8739—Factory Modifications (Forms)

Factory Modifications (Forms)

Factory-installed modifications are available for the Classes of control equipment listed in the tables below. Kits are also available for many field modifications and normal parts replacement on most control items. Refer to Class 9998 and 9999 products in *Digest* Section 16 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 a UL label is required, consult the local Square D field office. Some Forms **are not** UL Listed.

Table 68: Full Voltage Starters—Cover-Mounted Control Units

Controller	Pilot Device	Factory Modifications	Enclosure Type	Form
Pilot Devices in the Cover Full Voltage Non-Reversing Controllers Only Classes 8538, 8539	Push Buttons ^[1]	Start-Stop	1 ^[2] , 3R, 4, 4X, 12/3R	A
		Start-Stop (maintained contact) ^[3] , ^[4]	1 ^[2] , 3R, 4, 4X, 12/3R	A16
		Start-Stop push button and Hand-Off-Auto selector switch ^[4]	1 ^[2] , 3R, 4, 4X ^[5] , 12/3R	AC
		On-Off ^[4]	1 ^[2] , 3R, 4, 4X ^[5] , 12/3R	A3
		Single oiltight push button (specify marking) ^[4]	1, 3R, 4, 4X ^[5] , 12/3R	A11
	Selector Switches	Hand-Off-Auto	1 ^[2] , 3R, 4, 4X, 12/3R	C
		On-Off ^[4]	1 ^[2] , 3R, 4, 4X ^[5] , 12/3R	C6
		Non-standard markings for pilot devices ^[4]	1, 3R, 4, 12/3R	G12 ^[6]
		Addition of a padlock attachment to Class 9001 operators ^[4]	1, 3R, 4, 12/3R	G122
	Pilot Lights (specify color and type) ^[7]	Without operating interlock	See Table 69 on page 43. ^[7]	
		With operating interlock (add price of each interlock per light)	1, 3R, 4, 4X ^[5] , 12/3R	X
Pilot Devices in Cover Full Voltage Reversing and Multi-Speed Controllers Only Classes 8738, 8739	Push Buttons ^[1]	Forward-Reverse-Stop ^[4]	1, 4, 4X ^[5] , 12/3R	A1
		High-Low-Stop ^[4]	1, 4, 12/3R	A2
		Fast-Off-Slow ^[4]	1, 4, 12/3R	A9
		High-Low push button and Hand-Off-Auto selector ^[4]	1, 4, 12/3R	A10C
		Single oiltight push button (specify marking) ^[4]	1, 4, 4X ^[5] , 12/3R	A11
	Selector Switches	Hand-Off-Auto	1, 4, 4X ^[5] , 12/3R	C
		On-Off ^[4]	1, 4, 4X ^[5]	C6
		High-Off-Low	1, 4, 12/3R	C7
		Forward-Off-Reverse ^[4]	1, 4, 4X ^[5] , 12/3R	C14
		High-Low and Hand-Off-Auto ^[4]	1, 4, 12/3R	CC17
		Slow-Fast ^[4]	1, 4, 4X ^[5] , 12/3R	C19
		Forward-Reverse ^[4]	1, 4, 4X ^[5] , 12/3R	C20
		High-Low-Off-Auto ^[4]	1, 4, 12/3R	C25
		Non-standard markings for pilot devices ^[4]	Any	G12 ^[6]
	Pilot Lights (specify color and type) ^[7]	Without operating interlock	See Table 69 on page 43. ^[7]	
		With operating interlock	1, 4, 4X ^[5] , 12/3R	X ^[8]

^[1] All push buttons are momentary contact unless specified otherwise.

^[2] Selection of various Form combinations may force the use of a larger enclosure.

^[3] Specify the appropriate Class 9001 Type K or SK operator.

^[4] Not available for Size 00.

^[5] This Form is available with a NEMA 4X enclosure only with Class 8538, 8539, 8738, and 8739 devices.

^[6] Specify the marking and/or the required Class 9001 Type KN or SKN legend plate.

^[7] Indicate the pilot light color as Form P1 (red), Form P2 (green), and so forth, as shown in Table 69 on page 43. Unless otherwise requested, standard practice is to wire a red pilot light to indicate that the device is energized. No additional auxiliary contact is required. Also, standard practice is to wire a green pilot light to indicate that the device is de-energized. An additional normally closed auxiliary contact is provided. A wiring diagram must be provided for other pilot light colors or arrangements.

^[8] To determine the maximum number of auxiliary contacts that can be added to each Type S device, and for the appropriate X Form, refer to Table 53 on page 37.

Combination Starters

Class 8538, 8539, 8738, and 8739—Factory Modifications (Forms)

Table 69: Pilot Light Forms

Description	Form			
	Standard	Push-to-Test	LED	LED-Push-to-Test
Red On	P1	P21	P51	P42
Red Off	P71	P81	P91	P43
Red Unwired	P38	P28	P58	P44
Green On	P72	P82	P92	P45
Green Off	P2	P22	P52	P46
Green Unwired	P39	P29	P59	P47
Amber	P3	P23	P53	P63
Clear	P4	P24	P54	P64
Yellow	P35	P25	P55	P48
Blue	P36	P26	P56	P66
White	P37	P27	P57	P67
Red Low—Green Hi	P73	P83	P93	P77
Green Low—Red Hi	P74	P84	P94	P78
Red Off—Green Fwd/Rev	P75	P85	P95	P79
Green Off—Red Fwd/Rev	P76	P86	P96	P80

Table 70: Control Circuit, Full Voltage Controllers Only

Classes	Factory Modifications	Enclosure Type	Form	NEMA Size									
				00	0	1	2	3	4	5	6	7	
8538 8539 8738 8739	Separate control circuit—specify voltage and frequency	Any	S	X	X	X	X	X	X	X	X	X	
	Fused control circuit (without control transformer)												
	One fuse ^[1]	1, 3R, 4, 4X, 12/3R	F	X	X	X	X	X	X	X	—	—	
	Two fuses ^[1]	1, 3R, 4, 4X, 7, 9, 12/3R	F4	X	X	X	X	X	X	X	—	—	
	Control Circuit Transformers ^[2] —Standard capacity (50 or 60 Hz) Note: All orders requesting Form FT will be supplied as Form FF4T.												
	FUSES												
	Primary	Secondary											
	2	1	1, 4, 4X, 12/3R	FF4T	X	X	X	X	X	X	X	X	X
	2	2	1, 4, 4X, 12/3R	F4F10T	X	X	X	X	X	X	X	—	—
	Additional Capacity (50 or 60 Hz)												
	Two fuses in primary and one fuse in secondary												
	100 VA additional capacity	1, 4, 4X, 12/3R		FF4T11	X	X	X	X	X	X	X	X	X
	200 VA additional capacity	1, 4, 4X, 12/3R		FF4T12	X	X	X	X	X	X	X	X	X
	300 VA additional capacity	1, 4, 4X, 12/3R		FF4T13	X	X	X	X	X	X	X	X	X
	400 VA additional capacity	1, 4, 4X, 12/3R		FF4T14	X	X	X	X	X	X	X	X	X
	500 VA additional capacity	1, 4, 4X, 12/3R		FF4T15	X	X	X	X	X	X	X	X	X

^[1] Not available for Sizes 6 and 7.

^[2] See Table 71 on page 44.

Combination Starters

Class 8538, 8539, 8738, and 8739—Factory Modifications (Forms)

Control Circuit Transformer Selection

The standard primary/secondary voltages for control circuit transformers are shown in Table 71.

Table 71: Selection of Control Circuit Transformers—AC-Operated Devices

Voltage, 60 Hz (Primary—Secondary)	Code
120—24 ^[1]	V89
208—120	V84
240—24 ^[1]	V82
240—120	V80
277—120	V85
480—24 ^[1]	V83
480—120	V81
480—240	V87
600—120	V86
Specify	V99

^[1] 24 V 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.

Table 72: Example: Control Circuit Transformer Selection

You have selected 8538SDG16V02S. V02S indicates a coil voltage of 120-60/110-50 wired for separate control. You would like to add **Form FF4T**, with transformer voltages of 480 V primary, 120 V secondary, and solid-state overload relay protection with selectable Class 10/20 trip class (**Form H30**).

The new and complete Class, Type, voltage code, and Form number will be:

Class	Type	Voltage Code	Form (list the Form numbers in alphabetical order)
8538	SDG16	V81	FF4H30T

Table 73: Marine Control

Class	Enclosure Type	Description	Form
8538, 8539, 8738, 8739	12/3R or 4/4X (stainless steel only)	Factory modification of the standard device for use as marine control in accordance with UL508	M10

Table 74: Power Poles, Coil Transient Suppressors, and Terminal Blocks—Full Voltage Controllers Only
Classes 8538, 8539, 8738, 8739

Factory Modifications				Enclosure Type	Class 9999, Type	Form	NEMA Size								
							00	0	1	2	3	4	5	6	7
Power Poles (addition of one) ^[1]	NEMA Size 1, 30 A	Single pole	N.O.	Any	SB6	Y428	—	X	X	X ^[2]	X	X	X	X	X
			N.C.	Any	SB7	Y429	—	X	X	X ^[1]	X	X	X	X	X
		Double pole	N.O./N.O.	Any	SB9	Y430	—	X	X	X ^[1]	X	X	X	X	X
			N.C./N.C.	Any	SB10	Y434	—	X	X	X ^[1]	X	X	X	X	X
	NEMA Size 2	Single pole	N.O.	Any	SB11	Y436	—	—	—	X ^[1]	X	X	X	X	X
			N.C.	Any	SB12	Y437	—	—	—	X ^[1]	X	X	X	X	X
		Double pole	N.O./N.O.	Any	SB14	Y438	—	—	—	X ^[1]	X	X	X	X	X
			N.C./N.C.	Any	SB15	Y439	—	—	—	X ^[1]	X	X	X	X	X
			N.O./N.C.	Any	SB13	Y440	—	—	—	X ^[1]	X	X	X	X	X
				N.C./N.C.	Any	SB13	Y440	—	—	—	X ^[1]	X	X	X	X
Miscellaneous	Coil transient suppressor (120 V only), per coil.			Any	Any	Y145	X	X	X	X	X	X	X	X	X
	Addition of terminal blocks (specify wired or unwired). Wired, per terminal, each Unwired, per terminal, each			1, 4, 12 1, 4, 12	Any	G56● ^[3]	—	X	X	X	X	X	X	X	X
						G50● ^[3]	—	X	X	X	X	X	X	X	X

^[1] Single- or double-circuit power pole adders may be factory or field installed on 2- and 3-pole Type S contactors and starters. This table lists the Form designation for factory-installed power pole adders. Only one power pole adder can be installed per contactor. For field modification kits, see Class 9999 Accessories in the Digest.

^[2] When adding a power pole to a Size 2 device, also specify Form **Y118** (stronger coil, Size 2 only).

^[3] Addition of terminal block 9080CA or 9080GR6 only. Replace the bullet (●) in the Form number with the number of circuits (example: **G505** is a five-circuit, unwired terminal block). Available in groups of five only.

Combination Starters

Class 8538, 8539, 8738, and 8739—Factory Modifications (Forms)

Solid-State Overload Relay Factory Modifications (Forms)

The solid-state overload relay (SSOLR) is available on NEMA Size 00–7.
For Class 8538, 8539, 8738, and 8739 devices.

Form Description

Type S Starter with Motor Logic™ Solid-State Overload Relay (SSOLR)

3: Motor Logic SSOLR, Class 10/20 (Selectable)

0: No additional modifications

1: N.O. auxiliary contact (field convertible to N.C.)

Special SSOLR / Contactor Size Combinations (Base Unit and Feature Units):

(must be specified on Size 00 starter orders)

Blank: SSOLR matched to the starter size (for example, Size 1 contactor and 9-27 A SSOLR)

0: 6–18 A SSOLR on a starter size as indicated by the starter catalog number

1: 9–27 A SSOLR on a starter size as indicated by the starter catalog number

2: 15–45 A SSOLR on a starter size as indicated by the starter catalog number

3: 30–90 A SSOLR on a starter size as indicated by the starter catalog number

4: 45–135 A SSOLR on a starter size as indicated by the starter catalog number

8: 1.5–4.5 A SSOLR on a starter size as indicated by the starter catalog number (only on Feature Units)

9: 3–9 A SSOLR 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 overload relays on two-speed starters.

The catalog number will be alphanumeric. Example:

- Open style, Size 4 two speed starter with Motor Logic SSOLRs
- Single winding, 460 V, constant or variable torque
- High speed FLA = 96 A
- Low speed FLA = 27 A (use Size 2 overload relay)

Catalog number to order: **8810SF01V02H30H302S**

Where:

- Form H30 is a Size 4 contactor with a 45–135 A Motor Logic SSOLR for high speed
- Form H302 is a 15–45 A Motor Logic SSOLR on the low speed contactor.

Table 75: Forms, Motor Logic SSOLR
Classes 8536, 8538, 8539, 8736, 8738, 8739, 8810, and 8940

Factory Modification: Motor Logic SSOLR Class 10/20 (Selectable)	NEMA Size and Overload Current Range								
	00	0	1	2	3	4	5	6	7
	3–9 A	6–18 A	9–27 A	15–45 A	30–90 A	45–135 A	90–270 A	180–540 A	270–810 A
SSOLR—No Additional Modifications	H30	H30	H30	H30	H30	H30	H30	H30	Standard
SSOLR—With Auxiliary Contact	H31	H31	H31	H31	H31	H31	H31	H31	H31

Table 76: Special Starter Combinations with Motor Logic Overload Relay Protection

NEMA Contactor Size	SSOLR Size						
	00 _B	00 _C	0	1	2	3	4
00	[1]	Standard	—	—	—	—	—
0	[1]	[1]	Standard	—	—	—	—
1	[1]	[1]	[1]	Standard	—	—	—
2	[1]	[1]	[1]	[1]	Standard	—	—
3	—	—	—	—	—	Standard	—
4	—	—	—	—	—	—	Standard

[1] Available factory starter combination.

Adapted Bimetallic Overload Relay for Type S NEMA Starter (Forms)

This bimetallic overload relay is available on NEMA Sizes 00, 0, and 1 for Class 8538, 8539, 8738 and 8739 devices. To order a starter with the adapter only, add **Form E** to the catalog number (for example, 8536SBG2V02**ES**). When ordering with the adapter and the bimetallic overload relay installed, refer to Table 77 on page 46.

Form Description

Bimetallic Overload Relay

Class

1: Class 10 Balanced Loads (with single phase sensitivity)

2: Class 20 Balanced Loads (with single phase sensitivity)

3: Class 10 Unbalanced Loads (without single phase sensitivity)

4: Class 20 Unbalanced Loads (without single phase sensitivity)

FLA: Suffix from the TeSys D Overload Relays table below (for example, for 4–6 FLA, use suffix 10)

Terminals: 0 for screw terminal and 6 for ring tongue terminals

Sample catalog number: **8536SCO3V02E2160S**

NEMA Size 1 starter controlling a 7.5 hp motor (11 FLA)—Bimetallic overload relay is LRD16L (9–13 FLA)

Combination Starters

Class 8538, 8539, 8738, and 8739—Factory Modifications (Forms)

Table 77: TeSys D Overload Relays for Size 00–1 Type S Starters, Non-Reversing and Reversing, Classes 8538, 8539, 8736, 8738, and 8739

Current Setting Range, Amperes	Class 20 with Single-Phase Sensitivity		Class 20 without Single-Phase Sensitivity		Factory Installed—Catalog Number Suffix
	Screw Termination	Ring Tongue Connector	Screw Termination	Ring Tongue Connector	
0.40–0.63	LRD04L	LRD04L6	LR3D04L	LR3D04L6	04
0.63–1	LRD05L	LRD05L6	LR3D05L	LR3D05L6	05
1–1.6	LRD06L	LRD06L6	LR3D06L	LR3D06L6	06
1.6–2.5	LRD07L	LRD07L6	LR3D07L	LR3D07L6	07
2.5–4	LRD08L	LRD08L6	LR3D08L	LR3D08L6	08
4–6	LRD10L	LRD10L6	LR3D10L	LR3D10L6	10
5.5–8	LRD12L	LRD12L6	LR3D12L	LR3D12L6	12
7–10	LRD14L	LRD14L6	LR3D14L	LR3D14L6	14
9–13	LRD16L	LRD16L6	LR3D16L	LR3D16L6	16
12–18	LRD21L	LRD21L6	LR3D21L	LR3D21L6	21
17 to 24	LRD22L	LRD22L6	LR3D22L	LR3D22L6	22
23 to 32	LRD32L	LRD32L6	LR3D32L	LR3D32L6	32

TeSys T Factory Modifications (Forms)

Table 78: Communication Codes

Communication Network	Code
Modbus™	2
Profibus®	3
CANopen	4
DeviceNet®	5
Ethernet TCP/IP (communication protocols: Ethernet/IP and Modbus/TCP)	6

Table 79: TeSys T Motor Management System Modifications H6xx or H7xx for use with 8538, 8539, 8738 & 8739 (Enclosed Combination Starters)

Used on Size	Range	Form ^[1]	
		Control Voltage	
		100–240 Vac	24 Vdc
1	0.4–8 A	H61●	H71●
	1.35–27 A	H62●	H72●
2, 3	5.0–100 A	H63●	H73●
4	8–160 (CT 300:5, 3 turns)	H65●	H75●
5	24–480 A (CT 300:5, 1 turn)	H66●	H76●
6	48–960 A (CT 600:5, 1 turn)	H67●	H77●

^[1] Replace the bullet (●) with the code for the the communication option according to Table 78 (for example, H612).

NOTES:

- To order TeSys T starters, use the product configurator.
- The auxiliary contact controlling the starter coil has a maximum rating of 240 Vac.

Interlocks and Control Transformers



An electrical interlock can be factory installed in a combination starter, or installed in the field. For factory modification, specify **Form Y74** for single-pole, or **Form Y75** for double-pole interlocks. For field installation, see Table 80.

A one- or two-pole electrical interlock can be added to the disconnect switch or circuit breaker. In this way, if a separate control circuit is used, the magnetic starter can be de-energized when the disconnect means is switched to the Off position. See Table 80 for proper interlock selection. For electrical ratings of disconnect switch and circuit breaker interlocks, see Table 81.

Table 80: Electrical Interlocks for Disconnect Switches and Circuit Breakers—Field Installation

Class	Type	SPDT ^[1]	DPDT
		Class 9999 Type	Class 9999 Type
Disconnect Switch Interlocks			
8538 ^[2]	SB, SC, SD (Series B)	R6	R7
8538	SBA, SCA, SBG, SCG (Series D and above)	TC11	TC21
	SBAS8, SCAS8, SBGS8, SCGS8 (Series D and above)	TC10	TC20
	SDA, SDA ^[2] SDG, SDG ^[2] (Series D and above)	TC10	TC20
8538, 8738	SB, SC (Series C)	R45	R46
	SD (Series C)	R43	R44
	SE, SF (Series A)	R8	R9
	SE (Series B & C)	R41	R42
	SF (Series B & C)	R39	R40
	SG	R35	R36
	SEA, SEG (Series D and above)	TC10	TC20
8738	SBAS8, SCAS8, SBGS8, SCGS8 (Series E and above)	TC10	TC20
	SBA, SCA, SBG, SCG (Series E and above)	TC11	TC21
	SDA, SDG (Series E and above)	TC10	TC20
Circuit Breaker Interlocks			
8539, 8739	SB, SC, SD, SE, SF, SG (Series K)	R26	R27

^[1] For factory modification, specify **Form Y74** for single-pole, or **Form Y75** for double-pole interlocks.

^[2] Class 8538 type numbers ending in suffix **S8**.

Table 81: Electrical Ratings for Disconnect Switch and Circuit Breaker Interlocks

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					
Vac 50 or 60 Hz	Maximum Current			Vac 50 or 60 Hz	Maximum Current				
	Make	Break	Continuous Carrying Current (A)		Make		Break		Continuous Carrying Current (A)
	(A)	(A)			A	VA	A	VA	
120	40	15	15	120	30	3450	3	345	10
240	20	10	15	240	15	3450	1.5	345	10
480	10	6	15	480	7.5	3450	0.75	345	10
600	8	5	15	600	6	3450	0.6	345	10

Control Transformers

9070TF transformers are now standard in Series K combination starters when factory installed.

Table 82: Control Transformer Selection

NEMA Size	Starter Type	Standard Capacity	Additional Capacity		
			50 VA	100 VA	200 VA
		Form FF4T	Form FF4T10	Form FF4T11	Form FF4T12
		Class 9070 Type ^[1]			
0 & 1	SB & SC	TF100	TF150	TF200	TF300
2	SD	TF100	TF150	TF200	TF300
3	SE	TF150	TF200	TF300	TF500
4	SF	TF300	TF300	TF500	T500
5	SG	TF100 and 8501XO20	TF100 and 8501XO20	TF150 and 8501XO20	TF300 and 8501XO20
6	SH	EO3S2 is standard	N/A	EO3FS2 and T100	EO3S2 and TF200
7	SJ	EO19S2 is standard	N/A	EO19S2 and TF100	EO3S2 and TF200

^[1] Complete the contactor or starter Class and Type with the voltage code. See Table 71 on page 44.

Combination Starters

Class 8538, 8539, 8738, and 8739—Accessories

Internal Auxiliary Switch—Circuit breakers can be furnished with a factory installed auxiliary switch for remote indication of an open/tripped or closed circuit breaker. One auxiliary switch (**Form Y741**) or two auxiliary switches (**Form Y751**) can be furnished. The switches come with normally open and normally closed circuits with a common connection. Contacts must be used on the same polarity and are rated 15 A at 240 Vac. The auxiliary switches are located internally and come with 19–20 in. leads.

Alarm Switch—The alarm switch is used to actuate bell alarms and warning lights. It operates only when the circuit breaker is tripped. The alarm switch is factory installed only (**Form Y742**) and consists of a single-pole, single-throw switch, which is normally open except when the circuit breaker is tripped. The contacts are rated 4 A at 240 Vac. This switch is located in the circuit breaker and comes with 19–20 in. leads.

Transformer Selection—In all disconnect switch and circuit breaker combination starters in enclosures (NEMA 1, 4 & 4X stainless and polyester, and 12/3R), space and drilling are available 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 82 on page 47. For secondary fuse holder, order 9080PF1.

Fuse Block Mounting Brackets—The standard capacity transformer, Class 9070 Type TF100, for the Size 0 and 1 starters mounts to the right of the magnetic starter.

Codes and Standards—Most combination starters and Forms are UL Listed in file E152395, Category NKJH, and CSA approved in File CR 584.