

## Safety Summary

All cautions and instructions that appear in this manual must be complied with to prevent personnel injury or damage to the Probe Transmitter or connected equipment. The specified limits of this equipment must not be exceeded. If these limits are exceeded or if this instrument is used in a manner not intended by Marathon Sensors Inc., damage to this instrument or connected devices could occur.

Do not connect this device directly to AC motors, valves, or other actuators. All AC alarm functions must be connected through an interposing DC coil relay with a maximum coil load of 0.5 amps DC. The Probe Transmitter is not rated to act as a safety device. It should not be used to provide interlocking safety functions for any temperature or process functions. Alarm capabilities are provided for probe test and input faults only and are not to be considered or used as safety contacts in any application.

## Connections

The Probe Transmitter has four removable terminal blocks grouped with four terminals each. Each terminal is a wire clamp type with a standard slot screw. Each clamp can accommodate AWG 24 to 12 flexible stranded wire. Maximum torque on the terminal screws should not exceed 0.8 Nm.

The figure below shows the arrangement of the terminals.

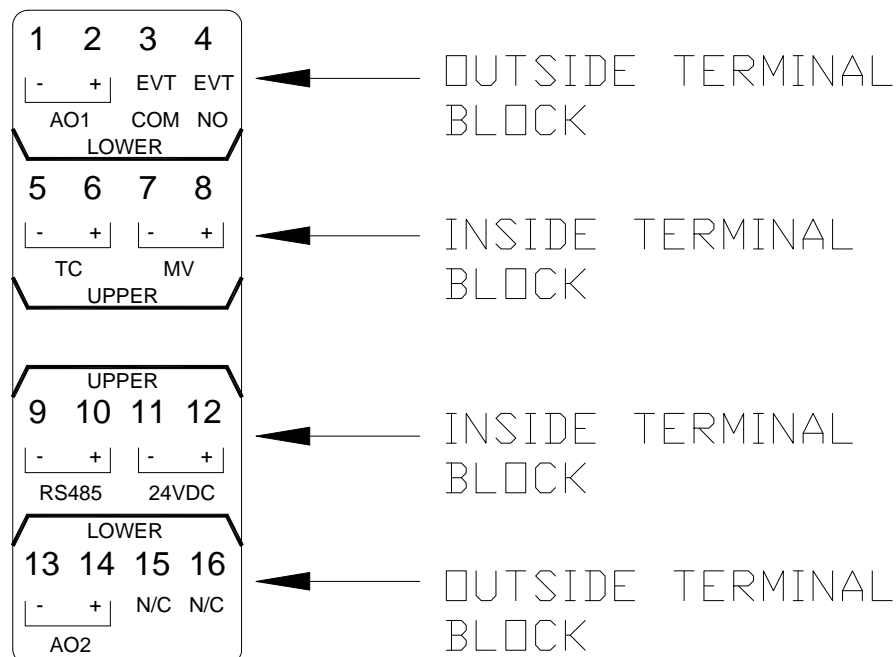


Figure 2 Terminal Layout

The next figure shows a schematic representation of the Probe Transmitter and typical connections required in the field.

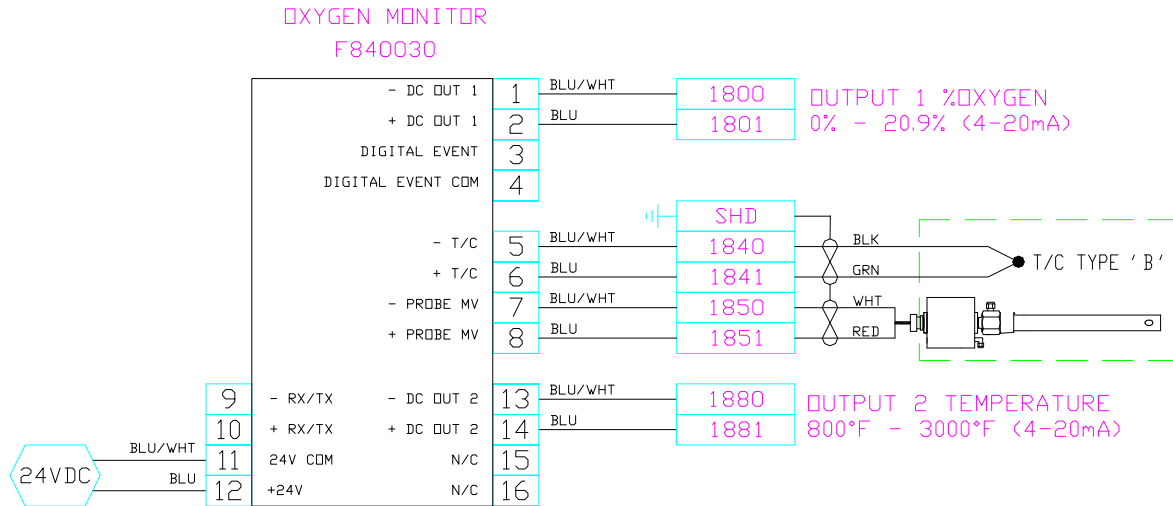


Figure 3 Schematic Connections

### Grounding and Shielding

To minimize the pick-up of electrical noise, the low voltage DC connections and the sensor input wiring should be routed away from high-current power cables. Where it is impractical to do this, use shielded cables with the shield grounded at the Probe Transmitter enclosure ground as show above.

### Parameter Selections

The following tables list the parameters available in the Probe Transmitter. Default values are also listed. The default values are loaded if a reset is force in the device. Changes to these parameters must be specified at the time of order.

#### Process Parameters

The following table shows the process selections and other parameters that effect the process value.

Table 1 Process Parameters

| Parameter Name  | Selection Default | Units or Options               | Range     |
|-----------------|-------------------|--------------------------------|-----------|
| PROCESS TYPE    | %O2               | CARBON, DPT, %O2, MV           |           |
| CARB PROC FACT  | 150               |                                | 0 to 1000 |
| DEWPT PROC FACT | 150               |                                | 0 to 1000 |
| OXYGEN EXPON    | 0002              | POWER OF TEN                   | 0 to 31   |
| TC TYPE         | B                 | B, C, E, J, K, N, NNM, R, S, T |           |

### *Process Type*

Selecting the process type determines what type of calculation the Smart Transmitter is going to do based on the probe millivolt and probe temperature inputs. The default process value for the Smart Transmitter is %O2 with an exponent selection of 2. This is the selection most often used in Boiler control and Combustion applications.

Percent Carbon and dew point are typically processes that are used in steel treating applications. Percent Carbon is the process value most often used for the control of case depth or the percent of carbon in a steel hardening furnace. Dew Point is used in the control for endothermic generators.

### *Carbon Process Factor*

The carbon process factor can be used to adjust the % carbon value. This number takes into account a number of assumptions that the carbon value is based on. Primary among these is the assumed level of CO in the atmosphere. See the Theory of Process Calculation section for a complete explanation of this value.

It maybe necessary to change the apparent furnace carbon as measured by the oxygen probe if this value is different than actual load samples, shim stocks, or gas analysis. The basic rule of thumb is that an increase in the carbon process factor will decrease the apparent carbon level in the furnace. The default value is 150. Typical values can vary from 50 to 400. Increase or decrease the process factor until the desired carbon level is achieved. A process factor that is drastically different than normal may be an indication of a failing probe, water or air leak in the furnace, or excess methane present. Refer to probe troubleshooting guides to determine what other factors maybe effecting the carbon value.

### *Dew Point Process Factor*

The dew point process factor is similar to the carbon process factor but is used to adjust the dew point value if dew point is selected as the process value. This number takes into account a number of assumptions that the dew point value is based on. Primary among these is the assumed level of hydrogen in the atmosphere. See the Theory of Process Calculation section for a complete explanation of this value.

### *Oxygen Exponent*

The range of oxygen is factory configured using the oxygen exponent number. Percent oxygen is the standard setting where the oxygen exponent is set to 2 and the output range is 0.00% to 20.9%. For a part per million (ppm) range the exponent would be set to 6 and the output range of  $0.00 \times 10^{-6}$  to  $99.99 \times 10^{-6}$ .

### *TC Type*

The following table shows the available thermocouple types and the ranges. BOLD indicates the typical oxygen default.

| Thermocouple type | Zero °F    | Zero °C    | Span °F     | Span °C     |
|-------------------|------------|------------|-------------|-------------|
| <b>B</b>          | <b>800</b> | <b>425</b> | <b>3000</b> | <b>1650</b> |
| C                 | 32         | 0          | 3000        | 1650        |
| E                 | 32         | 0          | 1300        | 700         |
| J                 | 32         | 0          | 1300        | 700         |
| K                 | 32         | 0          | 2300        | 1260        |
| N                 | 32         | 0          | 2300        | 1260        |
| NNM               | 32         | 0          | 2000        | 1090        |
| R                 | 300        | 150        | 3000        | 1650        |
| S                 | 300        | 150        | 3000        | 1650        |
| T                 | 32         | 0          | 700         | 370         |

The Cold Junction correction is applied to all thermocouple types.

### *Analog Output Channels*

The analog outputs are factory configured to provide 4 to 20mA signals proportional to selectable process values.

#### **NOTE**

**The Analog Output Channels are isolated self-powered current sources and do not require an external supply.**

If a chart recorder is to be used, it should have input specifications within 4 to 20 mA. If the recorder only responds to VDC inputs it will be necessary to add a 250 ohm dropping resistor across its input terminals.

The ideal location of the recorder is adjacent to the instrument but it may be located remotely if the connecting wires are properly shielded. For best results, the chart recorder input(s) should be isolated from ground.

**Table 2 Analog Outputs**

| <b>Parameter Name</b> | <b>Oxygen Default</b>            | <b>Possible Options</b>            | <b>Possible Ranges</b>  |
|-----------------------|----------------------------------|------------------------------------|---|
| OUTPUT 1 MODE         | O2<br><br>0–20.9%<br>4-20mA      | O2, CARBON, DEWPT, TEMP, LIN, PROG | O2 = 0 – 9999<br>%C = 0.00 – 2.55<br>DP = -99.9 – 212.0<br>Temp = -999 – 3000<br>LIN = -999 – 9999<br>PROG = 0 – 4095 |
| OUTPUT 2 MODE         | TEMP<br><br>800-3000°F<br>4-20mA | O2, CARBON, DEWPT, TEMP, LIN, PROG | O2 = 0 – 9999<br>%C = 0.00 – 2.55<br>DP = -99.9 – 212.0<br>Temp = -999 – 3000<br>LIN = -999 – 9999<br>PROG = 0 – 4095 |

NOTE: SEE PAGE 4 FOR TYPICAL CALIBRATION VALUES.

## **Calibration**

The Smart Transmitter is factory calibrated. The calibration can be verified once a year or according to customer calibration schedules. The instrument should be returned to the factory if calibration is required.

## Process Variable Calculations

The transmitter has a selectable process calculation for percent carbon, percent oxygen, or dewpoint. The following equations are used to derive these values;

### *Percent Oxygen*

$$\%O_2 = \frac{20.95}{e^{(E/0.0215 \cdot T_k)}}$$

Where: E = probe millivolts, Tk = probe temperature in degrees Kelvin.

The 20.95 is the %O<sub>2</sub> in air.

### *Percent Carbon*

$$\%C = 5.102 \frac{e^{((E-786)/(0.043102 \cdot T_k))}}{(29 \cdot PF + 400) + e^{((E-786)/(0.043102 \cdot T_k))}}$$

Where: E = probe millivolts, Tk = probe temperature in Kelvin, and PF is the process factor.

### *Dewpoint*

$$DP = \frac{4238.7}{6.281216 + \log((29 \cdot PF + 400) + (E - 1267.8)/(0.05512 \cdot T_r))} - 459.69$$

Where: E = probe millivolts, Tr = probe temperature in Rankin, PF is the process factor, and DP is the dewpoint in Fahrenheit.

## Communications

The Transmitter is capable of digital communications using the Modbus protocol. This is possible by connecting to the half duplex RS-485 terminals using a shielded twisted pair.

### *Modbus*

The MODBUS protocol describes an industrial communications and distributed control system (DCS) that integrates PLCs computers, terminals, and other monitoring, sensing, and control devices. MODBUS is a Master/Slave communications protocol, whereby one device, (the Master), controls all serial activity by selectively polling one or more slave devices. The protocol provides for one master device and up to 247 slave devices on a RS-485 half duplex twisted pair line. Each device is assigned an address to distinguish it from all other connected devices. All instruments are connected in a daisy-chain configuration.

The instrument communicates with baud rate settings 1200, 2400, 4800, 9600, or 19.2K. The default baud rate is 19.2Kbaud. The default address is 1. Changes to these values can be made by writing to the appropriate memory register.

The Transmitter communicates in Modbus RTU (Remote Terminal Unit) protocol using 8-bit binary data characters. Message characters are transmitted in a continuous stream. The message stream is setup based on the following structure:

#### Number of bits per character:

|                                     |                                   |
|-------------------------------------|-----------------------------------|
| Start bits                          | 1                                 |
| Data bits (least significant first) | 8                                 |
| Parity                              | None only (no bits for no parity) |
| Stop bits                           | 1                                 |
| Error Checking                      | CRC (Cyclical Redundancy Check)   |

The Transmitter recognizes three RTU commands. These are: read single I registers (command 4), read a single H register (command 3), and preset a single H register (command 6)

In Modbus mode, the Transmitter can be only be configured for the 'none' parity option.

The instrument never initiates communications and is always in receive mode unless responding to a query.

### *RTU Framing*

Frame synchronization can be maintained in RTU transmission mode only by simulating a synchronous message. The instrument monitors the elapsed time between receipt of characters. If three and one-half character times elapse without a new character or completion of the frame, then the instrument flushes the frame and assumes that the next

byte received will be an address. The follow command message structure is used, where T is the required character delay. Response from the instrument is based on the command.

|          |         |          |            |          |          |
|----------|---------|----------|------------|----------|----------|
| T1,T2,T3 | ADDRESS | FUNCTION | DATA       | CHECKSUM | T1,T2,T3 |
|          | 8-BITS  | 8-BITS   | N X 8-BITS | 16-BITS  |          |

#### *Address Field*

The address field immediately follows the beginning of the frame and consists of 8-bits. These bits indicate the user assigned address of the slave device that is to receive the message sent by the attached master.

Each slave must be assigned a unique address and only the addressed slave will respond to a query that contains its address. When the slave sends a response, the slave address informs the master which slave is communicating.

#### *Function Field*

The Function Code field tells the addressed slave what function to perform. MODBUS function codes are specifically designed for interacting with a PLC on the MODBUS industrial communications system. Command codes were established to manipulate PLC registers and coils. As far as the Transmitter is concerned, they are all just memory locations, but the response to each command is consistent with Modbus specifications.

The high order bit in this field is set by the slave device to indicate an exception condition in the response message. If no exceptions exist, the high-order bit is maintained as zero in the response message.

#### *Data Field*

The data field contains information needed by the slave to perform the specific function or it contains data collected by the slave in response to a query. This information may be values, address references, or limits. For example, the function code tells the slave to read a holding register, and the data field is needed to indicate which register to start at and how many to read.

#### *Error Check Field (CRC)*

This field allows the master and slave devices to check a message for errors in transmission. Sometimes, because of electrical noise or other interference, a message may be changed slightly while it is on its way from one device to another. The error checking assures that the slave or master does not react to messages that have changed during transmission. This increases the safety and the efficiency of the MODBUS system.

The error check field uses a CRC-16 check in the RTU mode.

The following is an example of a function 03 call for data at memory location 03. The value returned by the instrument is the hex value 1E.

Transmit from Host or Master

| Address | Cmd | Reg HI | Reg LO | Count HI | Count LO | CRC HI | CRC LO |
|---------|-----|--------|--------|----------|----------|--------|--------|
| 01      | 03  | 00     | 03     | 00       | 01       | 74     | 0A     |

Response from Transmitter

| Address | Cmd | Byte Count HI | Byte Count LO | Data HI | Data LO | CRC HI | CRC Lo |
|---------|-----|---------------|---------------|---------|---------|--------|--------|
| 01      | 03  | 00            | 02            | 00      | 1E      | 38     | 4C     |

Note that all the values are interpreted as hexadecimal values. The CRC calculation is based on the A001 polynomial for RTU Modbus. The function 04 command structure is similar to the 03 structure.

The following is an example of a function 06 call to change data in register 01 to 200. The response from the instrument confirms the new value as being set.

Transmit from Host or Master

| Address | Cmd | Reg HI | Reg LO | Data HI | Data LO | CRC HI | CRC LO |
|---------|-----|--------|--------|---------|---------|--------|--------|
| 01      | 06  | 00     | 01     | 00      | C8      | D9     | 9C     |

Response from Transmitter

| Address | Cmd | Reg HI | Reg LO | Data HI | Data LO | CRC HI | CRC LO |
|---------|-----|--------|--------|---------|---------|--------|--------|
| 01      | 06  | 00     | 01     | 00      | C8      | D9     | 9C     |

The Transmitter will respond to several error conditions. The three exception codes that will generate a response from the instrument are:

- 01 – Illegal Function
- 02 - Illegal Data Address
- 03 – Illegal Data Value
- 04 – Slave Device Failure

The response from the Transmitter with an exception code will have the most significant bit of the requested function set followed by the exception code and the high and low CRC bytes.

## Memory Map

NOTE: Modbus refers to the hexadecimal register location. These parameters are formatted as unsigned 16 bit integers. Any real number such as temperature can be evaluated as a signed number, other parameters are bit mapped words that must be evaluated as single bits or bit groups.

| BLOCK 0 |     |                        |  |            |
|---------|-----|------------------------|--|------------|
| HEX     | DEC | PARAMETER              | DESCRIPTION  | READ/WRITE |
| 00      | 0   | Not used               |  | READ ONLY  |
| 01      | 1   | TIME CONTROL<br>SIOSET | <b>LOW BYTE - TIMER CONTROL</b><br>BIT 0 – Timer Disabled (0), Timer Enabled (1)<br>BIT 1 – 7 SPARE<br><br><b>HIGH BYTE – SIO SETUP</b><br>BITS 8 – 9 PARITY SETTING<br>00 = Even Parity, 7 bits, 1 Stop bit<br>01 = No Parity, 8 bits, 1 Stop bit<br>10 = Odd Parity, 7 bits, 1 Stop bit<br><br>BITS 10 – 11 RESPONSE DELAY<br>0 = No delay applied to response<br>1 = 10ms delay applied to response<br>2 = 20ms delay applied to response<br>3 = 30ms delay applied to response<br><br>BITS 12 – 14 BAUD SELECT<br>000 = 76.8K<br>001 = 38.4K<br>010 = 19.2K (DEFAULT)<br>011 = 9600<br>100 = 4800<br>101 = 2400<br>110 = 1200<br>111 = 600<br><br>BIT 15 HOST FORMAT<br>0 = MSI (PROP)<br>1 = MODBUS (DEFAULT) | READ/WRITE |
| 02      | 2   | TC_ZERO<br>TC_SPAN     | <b>LOW BYTE - TC ZERO CALIBRATION<br/>NUMBER</b><br><br><b>HIGH BYTE – TC SPAN CALIBRATION<br/>NUMBER</b>  | READ/WRITE |
| 03      | 3   | MV_ZERO<br>MV_SPAN     | <b>LOW BYTE – MV ZERO CALIBRATION<br/>NUMBER</b><br><br><b>HIGH BYTE – MV SPAN CALIBRATION<br/>NUMBER</b>  | READ/WRITE |
| 04      | 4   | PF                     | PROCESS FACTOR FOR CARBON OR<br>DEWPOINT<br>RANGE = 0 to 4095  | READ/WRITE |

| BLOCK 0 |     |               |   |            |
|---------|-----|---------------|---|------------|
| HEX     | DEC | PARAMETER     | DESCRIPTION   | READ/WRITE |
|         |     |               | DEFAULT = 150   |            |
| 05      | 5   | EVENT<br>LDLN | <b>LOW BYTE – INPUT EVENT CONFIGURATION</b><br>Bits 0 – 3<br>0000 = None<br>0001 = Auto Mode Selected<br>0010 = Remote Setpoint Selected<br>0011 = Acknowledge alarms<br>0100 = Timer Hold<br>0101 = Timer End<br>0110 = Timer Start<br>0111 = Start probe test<br>1000 = Process hold<br>Bits 4 – 7 not used.<br><br><b>UPPER BYTE – LOAD LINE</b>   | READ/WRITE |
| 06      | 6   | CJTRM<br>HADR | <b>LOW BYTE – COLD JUNCTION TRIM</b><br>COLD JUNCTION TRIM (unsigned integer)<br>RANGE = –128 TO +127 WHERE<br>1 COUNT = 1 DEG (C or F) and –128 = 65408<br><br><b>HIGH BYTE – HOST ADDRESS</b><br>BITS 0-7<br>RANGE = 0 – 255  |            |
| 07      | 7   | SPARE         | SPARE   |            |
| 08      | 8   | CONFIG0       | Input Configuration<br><b>BITS 0-3 TC Input TYPE</b><br>0000 = B (DEFAULT)<br>0001 = E<br>0010 = J<br>0011 = K<br>0100 = N<br>0101 = R<br>0110 = S<br>0111 = T<br>1000 = SPARE<br>1001 = SPARE<br>1010 = SPARE<br>1011 = SPARE<br>1100 = SPARE<br>1101 = SPARE<br>1110 = SPARE<br>1111 = SPARE<br>BIT 4 = SPARE<br>BIT 5 0 = NO CJ APPLIED, 1 = CJ APPLIED<br>BIT 6 0 = °F, 1 = °C<br>BIT 7 0 = 60HZ FILTER<br>BIT 8 – 11 Millivolt Input TYPE<br>0000 = LINEAR (DEFAULT)<br>All other bit combinations are spare<br>BITS 12 – 15 are spare | READ/WRITE |
| 09      | 9   | CONFIG2       | SETUP VALUES  |            |

| BLOCK 0 |     |           |   |            |
|---------|-----|-----------|---|------------|
| HEX     | DEC | PARAMETER | DESCRIPTION   | READ/WRITE |
|         |     |           | <b>BITS 0 - 4 OXYGEN EXPONENT</b><br>RANGE = 0 to 31, where 2 = % and 6 = ppm<br>DEFAULT = 2<br><b>BITS 5 - 6 DISPLAY DECIMAL PLACE</b><br>where:<br>0 = no decimal point in display<br>1 = Display XXX.X<br>2 = Display XX.XX<br>3 = Display X.XXX<br>DEFAULT = 0<br><b>BITS 8 – 12 REDOX METAL NUMBER</b><br>RANGE = 0 – 14<br>DEFAULT = 0<br><b>BITS 13 – 15 SPARE</b>   |            |
| 0A      | 10  | FAULT     | FAULT BIT MAP<br>BIT 0 = Temperature Input Open<br>BIT 1 = MV Input Open<br>BIT 2 = Range of input is low<br>BIT 3 = Range of input is high<br>BIT 4 = Timer End<br>BIT 5 = Probe Care Fault<br>BITS 6 – 7 = SPARE<br>BIT 8 = CPU Fault<br>BIT 9 = Min Idle counter = 0<br>BIT 10 = Keyboard failure, stuck key or a key was pressed during power up.<br>BIT 11 = Flash Erase Failed<br>BIT 12 = Flash Checksum Failed<br>BIT 13 = EEPROM Checksum Failed<br>BIT 14 = Flash/EEPROM Size Fault<br>BIT 15 = ADC Fault                 | READ ONLY  |
| 0B      | 11  | ASRC      | ANALOG OUT SOURCES<br><b>LOW BYTE, ANALOG OUTPUT 1</b><br>BITS 0 – 3<br>0000 = N/A<br>0001 = Temperature<br>0010 = Linear Input A<br>0011 = Carbon value<br>0100 = Dewpoint value<br>0101 = Oxygen value<br>0110 = Redox value<br>0111 = Output Power<br>1000 = Control Output 1<br>1001 = Control Output 2<br>1010 = Linear Input B<br>1011 = Programmable*<br><br>*For Programmable, write required output value into DACV1, where DACV1 = 0 is minimum output and DACV1 = 4096 is maximum output.<br><br><b>BITS 4 – 7 SPARE</b> | READ/WRITE |

| BLOCK 0 |     |              |  |            |
|---------|-----|--------------|--|------------|
| HEX     | DEC | PARAMETER    | DESCRIPTION  | READ/WRITE |
|         |     |              | <b>HIGH BYTE, ANALOG OUTPUT 2</b><br>BITS 8 – 12<br>0000 = N/A<br>0001 = Temperature<br>0010 = Linear Input A<br>0011 = Carbon value<br>0100 = Dewpoint value<br>0101 = Oxygen value<br>0110 = Redox value<br>0111 = Output Power<br>1000 = Control Output 1<br>1001 = Control Output 2<br>1010 = Linear Input B<br>1011 = Programmable*<br><br>*For Reference Number and Programmable , write required output value into DACV2, where DACV2 = 0 is minimum output and DACV2 = 4096 is maximum output.<br><br>BITS 13 – 15 SPARE<br><br>Special case: If Analog Output 1 = CONTROL OUTPUT 1 and Analog Output 2 = CONTROL OUTPUT 2 and the Control Mode is dual, then Analog Output 1 is 4-20ma for 0 to +100% PO and Analog Output 2 is 4-20ma for 0 to -100% PO. |            |
| 0C      | 12  | DAC_OFFSET_1 | DAC 1 OFFSET CALIBRATION   | READ/WRITE |
| 0D      | 13  | DAC_SPAN_1   | DAC 1 SPAN CALIBRATION   | READ/WRITE |
| 0E      | 14  | DAC_OFFSET_2 | DAC2 OFFSET CALIBRATION  | READ/WRITE |
| 0F      | 15  | DAC_SPAN_2   | DAC2 SPAN CALIBRATION  | READ/WRITE |
| 10      | 16  | AOUTOF1      | ANALOG OUTPUT 1 OFFSET<br>Minimum source value that correlates to minimum Analog Output of 4 mA. The source value is based on the selection in ASRC lower byte   | READ/WRITE |
| 11      | 17  | AOUTRN1      | ANALOG OUTPUT 1 RANGE<br>Maximum source value that correlates to maximum Analog Output of 20 mA. The source value is based on the selection in ASRC lower byte where   | READ/WRITE |
| 12      | 18  | AOUTOF2      | ANALOG OUTPUT 2 OFFSET<br>Minimum source value that correlates to minimum Analog Output of 4 mA. The source value is based on the selection in ASRC upper byte   | READ/WRITE |
| 13      | 19  | AOUTRN2      | ANALOG OUTPUT 2 RANGE<br>Maximum source value that correlates to maximum Analog Output of 20 mA. The   | READ/WRITE |

| BLOCK 0 |     |           |  |            |
|---------|-----|-----------|--|------------|
| HEX     | DEC | PARAMETER | DESCRIPTION  | READ/WRITE |
|         |     |           | source value is based on the selection in ASRC upper byte where  |            |
| 14      | 20  | SPARE     | SPARE  | READ/WRITE |
| 15      | 21  | SPARE     | SPARE  | READ/WRITE |
| 16      | 22  | SPARE     | SPARE  | READ/WRITE |
| 17      | 23  | TEMPFIL   | Temperature Input Filter in seconds<br>Range = 0 to 3276. The higher the number the faster the reading update.<br>DEFAULT = 1000 | READ/WRITE |

| BLOCK 1 |     |           |  |            |
|---------|-----|-----------|--|------------|
| HEX     | DEC | PARAMETER | DESCRIPTION  | READ/WRITE |
| 18      | 24  | MVFIL     | Millivolt Input Filter in seconds<br>Range = 0 to 3276. The higher the number the faster the reading update.<br>DEFAULT = 1000   | READ/WRITE |
| 19      | 25  | AZERO     | LINEAR OFFSET, Y INTERCEPT LINEAR SCALING FOR INPUT A  | READ/WRITE |
| 1A      | 26  | ANUM      | LINEAR SPAN VALUE FOR INPUT A  | READ/WRITE |
| 1B      | 27  | BZERO     | LINEAR OFFSET, Y INTERCEPT LINEAR SCALING FOR INPUT B  | READ/WRITE |
| 1C      | 14  | BNUM      | LINEAR SPAN VALUE FOR INPUT B  | READ/WRITE |
| 1D      | 15  | PROC      | This value is the calculated process value shown as an integer. The decimal point and exponent values are required to determine the actual scaled value.<br>Range = -999 to 9999.<br>For example: If the process = oxygen, display decimal point = 2, and exponent = 6, and PROC = 1234, then the actual value and displayed as 12.34 ppm. | READ ONLY  |
| 1E      | 16  | COLDJCT   | COLD JUNCTION<br>Where 1 COUNT = 1°F (°C), RANGE = -99 TO 255°F (°C). Note this parameter is an unsigned integer.  | READ ONLY  |
| 1F      | 17  | TEMP      | MEASURED TEMPERATURE<br>Where temperature is presented in degrees C or F, based on the C/F setting. Note this parameter is an unsigned integer of temperature -2721 = 62815<br>Range = max / min range of selected thermocouple.   | READ ONLY  |
| 20      | 18  | MV        | MEASURED MILLIVOLT<br>Where this value is scaled in 0.1 mV increments, i.e. 10001 = 1000.1.<br>Range = 0 to 2000 mV.   | READ ONLY  |
| 21      | 19  | DACV1     | ANALOG OUTPUT 1<br>0 to 4095 is 4 to 20 mA In dual mode 4mA = -100, 12mA = 0, 20mA = +100  | READ/WRITE |

| BLOCK 1 |     |           |   |            |
|---------|-----|-----------|---|------------|
| HEX     | DEC | PARAMETER | DESCRIPTION   | READ/WRITE |
| 22      | 20  | DACV2     | ANALOG OUTPUT 2<br>0 to 4095 is 4 to 20 ma In dual mode 4mA = -100, 12mA = 0, 20mA = +100 | READ/WRITE |
| 23      | 35  | SPARE     | SPARE   |            |
| 24      | 36  | SPARE     | SPARE   |            |
| 25      | 37  | SPARE     | SPARE   |            |
| 26      | 38  | SPARE     | SPARE   |            |
| 27      | 39  | SPARE     | SPARE   |            |
| 28      | 40  | SPARE     | SPARE   |            |
| 29      | 41  | SPARE     | SPARE   |            |
| 2A      | 42  | SPARE     | SPARE   |            |
| 2B      | 43  | SPARE     | SPARE   |            |
| 2C      | 44  | SPARE     | SPARE   |            |
| 2D      | 45  | SPARE     | SPARE   |            |
| 2E      | 46  | SPARE     | SPARE   |            |
| 2F      | 47  | SPARE     | SPARE   |            |

## Operational Specifications

Power input 21.6 to 26.4 volts DC / 130mA

Thermocouple input

| Thermocouple type | Zero °F    | Span °F     |
|-------------------|------------|-------------|
| <b>B</b>          | <b>800</b> | <b>3000</b> |
| C                 | 32         | 3000        |
| E                 | 32         | 1300        |
| J                 | 32         | 1300        |
| K                 | 32         | 2300        |
| N                 | 32         | 2300        |
| NNM               | 32         | 2000        |
| R                 | 300        | 3000        |
| S                 | 300        | 3000        |
| T                 | 32         | 700         |

Bold shows default  
Accuracy after linearization +/- 1 deg F

Millivolt input -200 to 2000 millivolts +/- 0.1 millivolt

Input Impedance 25 Megohm

Cold junction compensation +/- 1 deg F

DC outputs (Isolated) 0 to 20mA (650Ω max).

Isolation 1000V DC/AC

Power input to signal inputs

Power input to communications

No Isolation Thermocouple input to Millivolt input, inputs must be differential.

Calculations Percent carbon 0 – 2.55%, no CO compensation  
Dewpoint -99°F (-72.8°C) – 212 °F (100°C), no hydrogen compensation

**Percent oxygen. 0 – 20.9% (default)**

### CAUTION

DO NOT CONNECT ANY AC SOURCE OR LOAD TO  
INSTRUMENT CONTACTS

Calibration Setups Millivolt Null  
Millivolt Span

Thermocouple Null  
Thermocouple Span  
Cold Junction Trim

Communications port RS-485 Half Duplex Only

|            |  |
|------------|--|
| Protocol   | Modbus RTU   |
| Baud rates | 1200, 2400, 4800, 9600, 19.2K ( <b>19.2K default</b> ) |
| Parity     | None   |
| Address    | 1 – 254 ( <b>Address 1 is default</b> )                |

Housing

|                     |  |
|---------------------|--|
| Material            | Polyamide PA non-reinforced                      |
| Inflammability      | Evaluation Class V0 (UL94)                       |
| Temperature Range   | -40 to 100°C                                     |
| Dielectric Strength | 600 kV/cm (IEC243-1)                             |
| Mounting            | Snaps on to EN 50022 top hat (T) style DIN rail. |

Terminals

Wire clamp screw terminals on four position removable terminal blocks.  
Wire Size                      AWG 24 – 12 flexible stranded, removable terminal blocks.  
Max. Torque                    0.8 Nm

**CAUTION: DO NOT CONNECT OR DISCONNECT HOUSING PLUGS  
WHILE MODULE IS POWERED OR UNDER LOAD.**

Weight                      10 oz

Environmental Conditions

|                                |  |
|--------------------------------|--|
| Operating Temperature          | -20 °C to 55 °C (-4 to 130 F)                              |
| Storage Temperature            | -40 °C to 85 °C (-40 to 185 F)                             |
| Operating and Storage Humidity | 85% max relative humidity, noncondensing, from -20 to 65°C |

**Certifications and Compliance (PENDING)**

Safety                      EN 61010-1, IEC 1010-1  
Safety requirement for electrical equipment for measurement, control, and laboratory use, Part 1

Electromagnetic Compatibility  
*Immunity as specified by EN 50082-2*

|                           |              |                                   |
|---------------------------|--------------|-----------------------------------|
| Electrostatic discharge   | EN 61000-4-2 | Level 3: 8 kV air                 |
| Electromagnetic RF fields | EN 61000-403 | Level 3: 10 V/m<br>80 MHz – 1 GHz |

|   |              |  |
|---|--------------|--|
| Fast Transients                             | EN 61000-4-4 | Level 4: 2 kV I/O<br>Level 3: 2 kV power |
| RF conducted interference                   | EN 61000-4-6 | Level 3: 10 V/rms<br>150 KHz – 80 MHz    |
| <i>Emissions as specified by EN 50081-2</i> |              |  |
| RF Interference                             | EN 55011     | Enclosure class A<br>Power main class A  |

Note: This instrument is designed for installation inside a grounded metal enclosure. Always observe anti-static precautions when installing or servicing any electronic device. Ground your body to discharge any static field before touching the body or terminals of any electronic device.

This specification can change without notification.



## MATERIAL SAFETY DATA SHEET

Product Name: INTERMIX EPOXY PRIMER - Colours  
Component A

### SECTION 01: CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Manufacturer/Supplier: Endura Manufacturing Co. Ltd.  
12425 - 149 Street  
Edmonton, Alberta  
T5L 2J6  
Ph: (780) 451-4242 Fax: (780) 452-5079

24-Hour Emergency  
Number:..... (613) 996-6666 (Canutec)  
Product Name:..... INTERMIX EPOXY PRIMER - Colours  
Item Number:..... UN 1263 CI 3 PG II  
Chemical Family:..... Aromatic Hydrocarbons, Ketones, Alcohols, Glycol ethers, Pigments  
Material Use:..... 2 component Epoxy Primer - intermix system.

### SECTION 02: COMPOSITION / INFORMATION ON INGREDIENTS

| HAZARDOUS INGREDIENTS              | C.A.S.             | LD/50, ROUTE, SPECIES           | LC/50, ROUTE, SPECIES | TLV                      | % WT         |
|------------------------------------|--------------------|---------------------------------|-----------------------|--------------------------|--------------|
| methyl ethyl ketone                | 78-93-3            | >4 g/kg o-r >6 g/kg d-rbt       | >5000 ppm/8h i-r      | 200 ppm                  | 5 - 10       |
| xylene                             | 1330-20-7          | 4.3 g/kg o-r >2 g/kg d-rbt      | 5000 ppm/4h i-r       | 100 ppm                  | 5 - 15       |
| butanol                            | 71-36-3            | .79 g/kg o-r                    | 8000 ppm/4h i-r       | 50 ppm                   | 1 - 5        |
| ethyl benzene                      | 100-41-4           | 3.5 g/kg o-r 17.8 g/kg d-rbt    | N/A                   | 100 ppm                  | 1 - 5        |
| methyl amyl ketone                 | 110-43-0           | 1670mg/kg o-r, 12600mL/kg d-rbt | N/A                   | 50 ppm                   | 1 - 10       |
| quartz                             | 14808-60-7         | N/A                             | N/A                   | 0.05 mg/m <sup>3</sup>   | 10 - 20      |
| <b><u>Some colours contain</u></b> |                    |                                 |                       |                          |              |
| lead chromate                      | 7758-97-6          | 12000 mg/kg o-r                 | N/A                   | .05 ppm                  | 0 - 30       |
| lead sulphate                      | 7446-14-2          | 2000 mg/kg o-r                  | N/A                   | .15 ppm                  | 0 - 5        |
| molybdenum compounds n.o.s.        | -                  | N/A                             | N/A                   | N/A                      | 0 - 5        |
| carbon black                       | 1333-86-4          | >15.4 g/kg o-r >3 g/kg d-rbt    | N/A                   | 3.5 mg/m <sup>3</sup>    | 0 - 5        |
| antimony trioxide                  | 1309-64-4          | N/A                             | N/A                   | N/A                      | 0 - 5        |
| titanium dioxide                   | 13463-67-7         | >25 g/kg o-r >10 g/kg d-rbt     | >6.82 mg/l/4h         | 10 mg/m <sup>3</sup> /8h | 0-30         |
| legend:                            | o=oral<br>d=dermal | i=inhalation<br>rbt=rabbit      | r=rat                 | p=intraperitoneal        | g=guinea pig |

See Sax, N.I. "Dangerous Properties of Industrial Materials" for more information.

### SECTION 03: HAZARDS IDENTIFICATION

Eye Contact:..... Moderately irritating to eyes and can cause tissue damage.  
Skin Contact:..... Low toxicity by skin absorption, but extended contact can cause irritation and dermatitis. Can cause allergic skin reaction.  
Inhalation:..... Vapors are of low to moderate toxicity when inhaled and are irritating to nose, throat and other respiratory passages, especially in higher concentrations. Extended exposure can cause headaches, dizziness, nausea or even loss of muscular control and coordination, narcosis or unconsciousness.  
Ingestion:..... Liquid is of low to moderate toxicity when ingested, but can be hazardous if aspirated into lungs during swallowing or vomiting.  
Additional Information:..... Chronic hazards include narcosis, specific organ damage, permanent brain and nervous system damage or coma if extensively abused. MEK has shown teratogenic effects in laboratory animals. Lead chromate and carbon black are possible carcinogens.