

ProtEX-MAX PD8-6000 Explosion-Proof Process Meter Instruction Manual



Process

- 0-20 mA, 4-20 mA, 0-5 V, 1-5 V, and ± 10 V Inputs
- Multi-Pump Alternation Control
- Display One Input in Two Different Scales (e.g. Height & Volume)
- Signal Input Conditioning for Flow & Round Horizontal Tank
- 32-Point, Square Root, or Exponential Linearization
- Modern, Sleek and Practical Enclosure
- Display Mountable at 0°, 90°, 180°, & 270° Degrees
- Explosion-Proof, IP68, NEMA 4X Enclosure
- SafeTouch® Through-Glass Button Programming
- Flanges for Wall or Pipe Mounting
- Superluminous Sunlight Readable Display
- Free USB Programming Software & Cable
- 4 Relays + Isolated 4-20 mA Output Option
- Input Power Options Include 85-265 VAC or 12-24 VDC
- Isolated 24 VDC @ 25 mA Transmitter Power Supply
- Modbus® RTU Communication Protocol Standard

PRECISION DIGITAL CORPORATION

233 South Street • Hopkinton MA 01748 USA
Tel (800) 343-1001 • Fax (508) 655-8990

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www.predig.com

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 CAUTION: <i>Read complete instructions prior to installation and operation of the meter.</i>	 WARNING: <i>Risk of electric shock or personal injury.</i>
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- ***This product is not recommended for life support applications or applications where malfunctioning could result in personal injury or property loss. Anyone using this product for such applications does so at his/her own risk. Precision Digital Corporation shall not be held liable for damages resulting from such improper use.***
- ***Failure to follow installation guidelines could result in death or serious injury. Make sure only qualified personnel perform the installation.***
- ***Never remove the instrument cover in explosive environments when the circuit is live.***
- ***Cover must be fully engaged to meet flameproof/explosion-proof requirements.***
- ***Information in this manual supersedes all enclosure, compliance, and agency approval information included in additional product manuals included with this product.***

Limited Warranty

Precision Digital Corporation warrants this product against defects in material or workmanship for the specified period under "Specifications" from the date of shipment from the factory. Precision Digital's liability under this limited warranty shall not exceed the purchase value, repair, or replacement of the defective unit.

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Introduction

The ProtEX-MAX PD8-6000 explosion-proof process meter offers all the functionality of the ProVu PD6000 as a fully FM, CSA, ATEX, and IECEx approved explosion-proof product. Its superluminous LED digits make it easily readable in smoke, dust, fog, and, with the optional SunBright® display, even direct sunlight. It accepts a process current (4-20 mA) or process voltage (0-5V, 1-5V, etc.) signal and displays it on a dual-line, 6-digit SunBright® sunlight readable display.

The meter includes a 24 VDC power supply to drive the transmitter and can be equipped with up to four internal relays and a 4-20 mA output. The PD8-6000 can be programmed and operated without opening the housing by using the built-in SafeTouch® through-glass buttons or the RS485 serial communication port with free Modbus® protocol.

A fully loaded PD8-6000 meter has the following: four SPDT relays, 4-20 mA output, and two 24 VDC power supplies. The four relays can be used for alarm indication or process control applications such as pump alternation control. The 4-20 mA isolated output, Modbus RTU serial communications, and digital I/O options make the PD8-6000 an excellent addition to any hazardous area application.

Ordering Information

SunBright Display Models

85-265 VAC Model	12-24 VDC Model	Options Installed
PD8-6000-6H0	PD8-6000-7H0	No options
PD8-6000-6H7	PD8-6000-7H7	4 relays & 4-20 mA output



WARNING - Cancer and Reproductive Harm - www.P65Warnings.ca.gov

Accessories

Model	Description
PDA1232	RS-232 serial adapter
PDA1485	RS-485 serial adapter
PDA7485-I	RS-232 to RS-422/485 isolated converter
PDA8232-N	USB to RS-232 non-isolated converter
PDA8485-I	USB to RS-422/485 isolated converter
PDX6901	Suppressor (snubber): 0.01 μ F/470 Ω , 250 VAC

Specifications

Except where noted all specifications apply to operation at +25°C.

General

Display	Line 1: 0.60" (15 mm) high, red LEDs Line 2: 0.46" (12 mm) high, red LEDs 6 digits each (-99999 to 999999), with lead zero blanking
Display Intensity	Eight user selectable intensity levels
Display Update Rate	5/second (200 ms)
Overrange	Display flashes 99999
Underrange	Display flashes -99999
Display Assignment	Display lines 1 and 2 may be assigned to PV1, PV2, PCT, d r-u, d gross, d nt-g, max/min, max & min, set points, units (display line 2 only), or Modbus input.
Programming Methods	Four front panel buttons, digital inputs, PC and MeterView Pro software, or Modbus registers.
Noise Filter	Programmable from 2 to 199 (0 will disable filter)
Filter Bypass	Programmable from 0.1 to 99.9% of calibrated span
Recalibration	All ranges are calibrated at the factory. Recalibration is recommended at least every 12 months.
Max/Min Display	Max/min readings reached by the process are stored until reset by the user or until power to the meter is turned off.
Password	Three programmable passwords restrict modification of programmed settings. Pass 1: Allows use of function keys and digital inputs Pass 2: Allows use of function keys, digital inputs and editing set/reset points Pass 3: Restricts all programming, function keys, and digital inputs.
Power Options	85-265 VAC 50/60 Hz, 90-265 VDC, 20 W max or 12-24 VDC ± 10%, 15 W max Powered over USB for configuration only
Isolated Transmitter Power Supply	Terminals P+ & P-: 24 VDC ± 10%. selectable for 24, 10, or 5 VDC supply (internal jumper J4).
Non-Volatile Memory	All programmed settings are stored in non-volatile memory for a minimum of ten years if power is lost.
Fuse	Required external fuse: UL Recognized, 5 A max, slow blow; up to 6 meters may share one 5 A fuse
Normal Mode Rejection	Greater than 60 dB at 50/60 Hz
Isolation	4 kV input/output-to-power line 500 V input-to-output or output-to-P+ supply
Overvoltage Category	Installation Overvoltage Category II: Local level with smaller transient overvoltages than Installation Overvoltage Category III.
Environmental	T6 Class operating temperature range Ta = -40 to 60°C T5 Class operating temperature range Ta = -40 to 65°C
Max Power Dissipation	Maximum power dissipation limited to 15.1 W.

Connections	Screw terminals accept 12 to 22 AWG wire
Enclosure	Explosion-proof die cast aluminum with glass window, corrosion resistant epoxy coating, color: blue. NEMA 4X, 7, & 9, IP68. Default conduit connections: Four ¾" NPT threaded conduit openings and two ¾" NPT metal conduit plugs with 12 mm hex key fitting installed. Additional conduit opening configurations may be available; verify quantity and sizes on specific device labeling during installation.
Mounting	Four slotted flanges for wall mounting or NPS 1½" to 2½" or DN 40 to 65 mm pipe mounting. See Mounting Dimensions on page 58.
Tightening Torque	Screw terminal connectors: 5 lb-in (0.56 Nm)
Overall Dimensions	6.42" x 7.97" x 8.47" (W x H x D) (163 mm x 202 mm x 215 mm)
Approximate Shipping Weight	16.0 lbs (7.26 kg)
Warranty	3 years parts & labor

Process Input

Inputs	Field selectable: 0-20, 4-20 mA, ±10 V (0-5, 1-5, 0-10 V), Modbus PV (Slave)						
Accuracy	±0.03% of calibrated span ±1 count, square root & programmable exponent accuracy range: 10-100% of calibrated span						
Temperature Drift	0.005% of calibrated span/°C max from 0 to 65°C ambient, 0.01% of calibrated span/°C max from -40 to 0°C ambient						
Signal Input Conditioning	Linear, square root, programmable exponent, or round horizontal tank volume calculation						
Multi-Point Linearization	2 to 32 points for PV or PV1 2 to 8 points for PV2 (Dual-scale Level feature)						
Programmable Exponent	1.0001 to 2.9999						
Round H Tank	Diameter & Length: 999.999 inch or cm calculates volume in gallons or liters respectively.						
Low-Flow Cutoff	0-999999 (0 disables cutoff function)						
Decimal Point	Up to five decimal places or none: d.dddddd, d.ddddd, d.dddd, dddd, ddd, dd, or dddddd						
Calibration Range	<table border="1"> <tr> <th>Input Range</th> <th>Minimum Span Input 1 & Input 2</th> </tr> <tr> <td>4-20 mA</td> <td>0.15 mA</td> </tr> <tr> <td>±10 V</td> <td>0.01 V</td> </tr> </table> <p>An error message will appear if the input 1 and input 2 signals are too close together.</p>	Input Range	Minimum Span Input 1 & Input 2	4-20 mA	0.15 mA	±10 V	0.01 V
Input Range	Minimum Span Input 1 & Input 2						
4-20 mA	0.15 mA						
±10 V	0.01 V						
Input Impedance	Voltage ranges: greater than 500 kΩ Current ranges: 50 - 100 Ω (depending on resettable fuse impedance)						
Input Overload	Current input protected by resettable fuse, 30 VDC max. Fuse resets automatically after fault is removed.						

F4 Digital Input Contacts	3.3 VDC on contact. Connect normally open contacts across F4 to COM.
F4 Digital Input Logic Levels	Logic High: 3 to 5 VDC Logic Low: 0 to 1.25 VDC
HART Transparency	Analog input will not interfere with existing HART communications on the wired 4-20 mA signal

Relays

Rating	4 SPDT (Form C) internal and/or 4 SPST (Form A) external; rated 3 A @ 30 VDC and 125/250 VAC resistive load; 1/14 HP (\approx 50 W) @ 125/250 VAC for inductive loads
Noise Suppression	Noise suppression is recommended for each relay contact switching inductive loads; see page 18 for details.
Deadband	0-100% of span, user programmable
High or Low Alarm	User may program any alarm for high or low trip point. Unused alarm LEDs and relays may be disabled (turn off).
Relay Operation	Automatic (non-latching) and/or manual reset Latching (requires manual acknowledge) with/without clear Pump alternation control (2 to 4 relays) Sampling (based on time) Off (disable unused relays and enable Interlock feature) Manual on/off control mode
Relay Reset	User selectable via front panel buttons or digital inputs <ol style="list-style-type: none"> Automatic reset only (non-latching), when the input passes the reset point. Automatic + manual reset at any time (non-latching) Manual reset only, at any time (latching) Manual reset only after alarm condition has cleared (latching) <p><i>Note: Front panel button or digital input may be assigned to acknowledge relays programmed for manual reset.</i></p>
Time Delay	0 to 999.9 seconds, on & off relay time delays Programmable and independent for each relay
Fail-Safe Operation	Programmable and independent for each relay. <i>Note: Relay coil is energized in non-alarm condition. In case of power failure, relay will go to alarm state.</i>
Auto Initialization	When power is applied to the meter, relays will reflect the state of the input to the meter.

Isolated 4-20 mA Transmitter Output

Output Source	Process variable (PV), max, min, set points 1-8, Modbus input, or manual control mode
Scaling Range	1.000 to 23.000 mA for any display range
Calibration	Factory calibrated: 4.000 to 20.000 = 4-20 mA output
Analog Out Programming	23.000 mA maximum for all parameters: Overrange, underrange, max, min, and break
Accuracy	\pm 0.1% of span \pm 0.004 mA
Temperature Drift	0.4 μ A/ $^{\circ}$ C max from 0 to 65 $^{\circ}$ C ambient, 0.8 μ A/ $^{\circ}$ C max from -40 to 0 $^{\circ}$ C ambient <i>Note: Analog output drift is separate from input drift.</i>

Isolated Transmitter Power Supply	Terminals I+ & R: 24 VDC \pm 10%. May be used to power the 4-20 mA output or other devices. Refer to Figure 16 on page 19. All models @ 25mA max.
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External Loop Power Supply	35 VDC maximum									
Output Loop Resistance	<table border="1"> <tr> <th>Power supply</th> <th>Minimum</th> <th>Maximum</th> </tr> <tr> <td>24 VDC</td> <td>10 Ω</td> <td>700 Ω</td> </tr> <tr> <td>35 VDC (external)</td> <td>100 Ω</td> <td>1200 Ω</td> </tr> </table>	Power supply	Minimum	Maximum	24 VDC	10 Ω	700 Ω	35 VDC (external)	100 Ω	1200 Ω
Power supply	Minimum	Maximum								
24 VDC	10 Ω	700 Ω								
35 VDC (external)	100 Ω	1200 Ω								

Serial Communications

Compatibility	EIA-485
Connectors	Removable screw terminal connector
Max Distance	3,937' (1,200 m) max
Status Indication	Separate LEDs for Power (P), Transmit (TX), and Receive (RX)
Slave Id	1 – 247 (Meter address)
Baud Rate	300 – 19,200 bps
Transmit Time Delay	Programmable between 0 and 199 ms
Data	8 bit (1 start bit, 1 or 2 stop bits)
Parity	Even, Odd, or None with 1 or 2 stop bits
Byte-To-Byte Timeout	0.01 – 2.54 second
Turn Around Delay	Less than 2 ms (fixed)

Note: Refer to the PROVU[®] Modbus Register Tables located at www.predig.com for details.

Digital Inputs & Outputs

Channels	4 digital inputs & 4 digital outputs
Digital Input Logic High	3 to 5 VDC
Digital Input Logic Low	0 to 1.25 VDC
Digital Output Logic High	3.1 to 3.3 VDC
Digital Output Logic Low	0 to 0.4 VDC
Source Current	10 mA maximum output current
Sink Current	1.5 mA minimum input current

To be used as pull-up for digital inputs only.
Connect normally open pushbuttons across +5 V & DI 1-4.

+5 V Terminal



WARNING

DO NOT use +5 V terminal (pin 1) to power external devices.

The on-board digital inputs (1-4) are designed to mimic the behavior of the front panel buttons (Menu, F1, F2, & F3).
If you wish to change their behavior, re-assign F1-F3 to the desired function, then change the corresponding digital input to match.

MeterView Pro

System Requirements	Microsoft [®] Windows [®] XP/Vista/7/8/10
Communications Configuration	USB 2.0 (Standard USB A to Micro USB B) Configure device settings one at a time

Product Ratings and Approvals;

FM	Enclosure: Type 4X; IP66 Class I, Division 1, Groups B, C, D Class II, Division 1, Groups E, F, G Class III, Division 1, T5/T6 Class I, Zone 1, AEx d, IIC Gb T5/T6 Zone 21, AEx tb IIIC T90°C; Ta -40°C to +65°C T6 Ta = -40°C to +60°C; T5 Ta = -40°C to +65°C Certificate Number: 3047283
CSA	Class I, Division 1, Groups B, C, D Class II, Division 1, Groups E, F, G Class III, Division 1 Class I Zone 1 Ex d IIC Zone 21 Ex tb IIIC T90°C -40°C < Tamb. < +60° C; Temperature Code T6 -40°C < Tamb. < +65° C; Temperature Code T5 Enclosure Type 4X & IP66 Certificate Number: 2531731
ATEX	 II 2 G D Ex d IIC T* Gb Ex tb IIIC T90°C Db IP68 Ta = -40°C to +°C *T6 = -40°C to +60°C *T5 = -40°C to +65°C Certificate number: Sira 12ATEX1182
IECEX	Ex d IIC T* Gb Ex tb IIIC T90°C Db IP68 Ta = -40°C to +°C *T6 = -40°C to +60°C *T5 = -40°C to +65°C Certificate Number: IECEX SIR 12.0073

Special Conditions for Safe Use:

Use suitably certified and dimensioned cable entry device and/or plug. The equipment shall be installed such that the supply cable is protected from mechanical damage. The cable shall not be subjected to tension or torque. If the cable is to be terminated within an explosive atmosphere, then appropriate protection of the free end of the cable shall be provided. Cable must be suitable for 90°C.

Year of Construction

This information is contained within the serial number with the first four digits representing the year and month in the YYMM format.

For European Community: The ProtEX-MAX must be installed in accordance with the ATEX directive 94/9/EC, and the product certificate Sira 12ATEX1182.

Compliance Information

Safety

Low Voltage Directive	EN 61010-1:2010 Safety requirements for measurement, control, and laboratory use
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Electromagnetic Compatibility

Emissions	EN61326-1:2013 Measurement, control, and laboratory use - Industrial EN 55022:2010 Class A ITE emissions requirements EN61000-6-4:2007+A1:2011 Emission for heavy industrial environments - Generic
Radiated Emissions	Class A
AC Mains Conducted Emissions	Class A
Immunity	EN 61326-1:2013 Measurement, control, and laboratory equipment EN 61000-6-2:2005 EMC heavy industrial generic immunity standard
RFI - Amplitude Modulated	80 -1000 MHz 10 V/m 80% AM (1 kHz) 1.4 - 2.0 GHz 10 V/m 80% AM (1 kHz) 2.0 - 2.7 GHz 10 V/m 80% AM (1 kHz)
Electrical Fast Transients	±2kV AC mains, ±1kV other
Electrostatic Discharge	±4kV contact, ±8kV air
RFI - Conducted	10V, 0.15-80 MHz, 1kHz 80% AM
AC Surge	±2kV Common, ±1kV Differential
Surge	1KV (CM)
Power-Frequency Magnetic Field	30 A/m 70%V for 0.5 period
Voltage Dips	40%V for 5 & 50 periods 70%V for 25 periods
Voltage Interruptions	<5%V for 250 periods

Safety Information



WARNINGS

- Read complete instructions prior to installation and operation of the instrument.
- Installation and service should be performed only by trained service personnel. Service requiring replacement of internal sub-components must be performed at the factory.
- Disconnect from supply before opening enclosure. Keep cover tight while circuits are alive. Conduit seals must be installed within 18" (450mm) of the enclosure or within 2" (50mm) for Zone installations.
- Verify that the operating atmosphere of the instrument is consistent with the appropriate hazardous locations certifications.
- If the instrument is installed in a high voltage environment and a fault or installation error occurs, high voltage may be present on any lead
- Read all product labels completely and follow all instructions and requirements listed on the labels for installation or service.

Installation

Install in accordance with applicable local and national regulations (e.g. NEC).

For Installation in USA: The ProtEX-MAX must be installed in accordance with the National Electrical Code (NEC) NFPA 70.

For Installation in Canada: The ProtEX-MAX must be installed in accordance with the Canadian Electrical Code CSA 22.1. All power supplies below 36 V and input circuits must be derived from a CSA Approved Class 2 source.

For European Community: The ProtEX-MAX must be installed in accordance with the ATEX directive 94/9/EC and the product certificate Sira 12ATEX1182.



WARNING

Disconnect from supply before opening enclosure. Keep cover tight while circuits are alive. Conduit seals must be installed within 18" (450mm) of the enclosure or within 2" (50mm) for Zone installations.

Wiring connectors are accessed by opening the enclosure. To access electrical connectors, remove the 2 captive screws and then remove the electronics module. Connectors are on the rear of the electronics module.

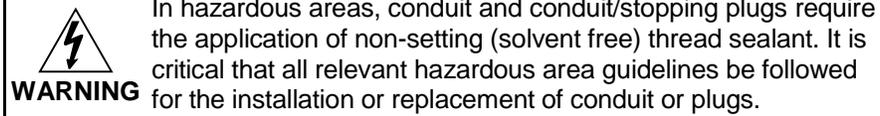
Unpacking

Remove the instrument from packing box. Inspect the packaging and contents for damage. Report damages, if any, to the carrier.

If any part is missing or the instrument malfunctions, please contact your supplier or the factory for assistance.

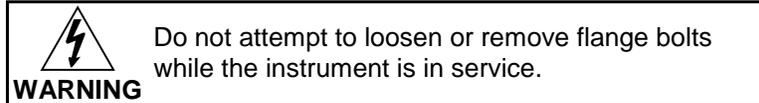
Pre-Installed Conduit/Stopping Plug

The PD8-6000 is supplied with two pre-installed conduit plugs for installations that do not require the use of all conduit entries. The conduit/stopping plugs include an internal 12mm hexagonal socket recess for removal. The pre-installed plugs and their installation are included in the hazardous area approvals for the PD8 Series enclosure.



Mounting

The ProtEX-MAX has four slotted mounting flanges that should be used for pipe mounting or wall mounting. Refer to *Mounting Dimensions*, page 58 for details.



Cover Jam Screw

The cover jam screw should be properly installed once the instrument has been wired and tested in a safe environment. The cover jam screw is intended to prevent the removal of the instrument cover in a flameproof environment without the use of tools. Using a M2 hex wrench, turn the screw clockwise until the screw contacts the aluminum enclosure. Turn the screw an additional 1/4 to 1/2 turn to secure the cover. Caution: Excess torque may damage the threads and/or wrench.

Transmitter Supply Voltage Selection (P+, P-)

All meters, including models equipped with the 12-24 VDC power option, are shipped from the factory configured to provide 24 VDC power for the transmitter or sensor.

If the transmitter requires 5 or 10 VDC excitation, the internal jumper J4 must be configured accordingly.

To access the voltage selection jumper:

1. Remove all the wiring connectors.
2. Unscrew the back cover.
3. Slide out the back cover by about 1 inch.
4. Configure the J4 jumper, located behind the input signal connector, for the desired excitation voltage as shown.

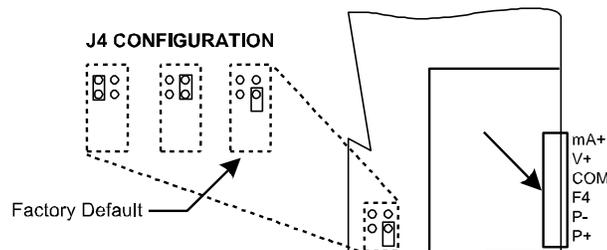


Figure 1. Transmitter Supply Voltage Selection

Connections



WARNINGS

- **Static electricity can damage sensitive components.**
- **Observe safe handling precautions for static-sensitive components.**
- **Use proper grounding procedures/codes.**
- **If the instrument is installed in a high voltage environment and a fault or installation error occurs, high voltage may be present on any lead or terminal.**
- **Follow all fusing and wiring precautions requirements for the instrument integrated to the PD8 Series model number being connected.**

To access the connectors, remove the enclosure cover and unscrew the two captive screws that fasten the electronics module. Signal connections are made to de-pluggable connectors on the back of the electronics module.

Some connectors may be provided already connected. These connections are required for proper operation of the ProtEX-MAX, and should not be removed unless instructed to by this manual.

Wires marked as being used for testing purposes should be removed.

Grounding connections are made to the two ground screws provided on the base – one internal and one external.

After all connections have been completed and verified, apply power to the unit.

Required & Factory Wired Connection

The ProtEX-MAX comes with a pre-wired connection. This connection is detailed below, and must be maintained in order for the instrument to function properly.



WARNING

Observe all safety regulations. Electrical wiring should be performed in accordance with all agency requirements and applicable national, state, and local codes to prevent damage to the meter and ensure personnel safety.

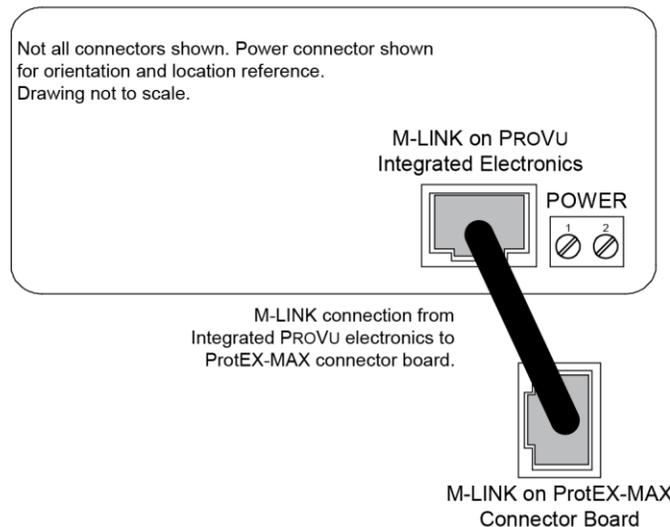


Figure 2: Integrated PROVU Required Connections

Connectors Labeling

The connectors' label, affixed to the meter, shows the location of all connectors available with requested configuration.



Warning! *Do not disconnect the RJ45 M-LINK connector cable. Otherwise the instrument will not function properly.*

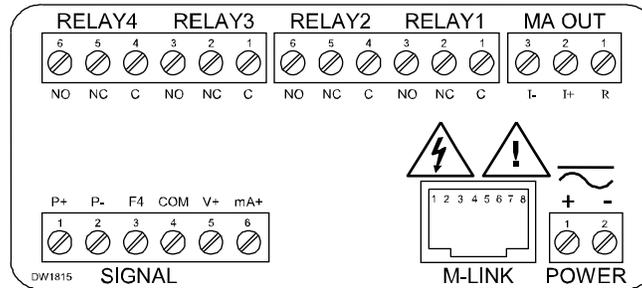


Figure 3. Connector Labeling for Fully Loaded PD6000

Power Connections

Power connections are made to a two-terminal connector labeled POWER on Figure 3 on page 13. The meter will operate regardless of DC polarity connection. The + and - symbols are only a suggested wiring convention.

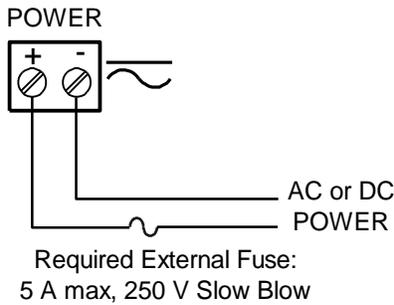


Figure 4. Power Connections

Signal Connections

Signal connections are made to a six-terminal connector labeled SIGNAL on Figure 3. The COM (common) terminal is the return for the 4-20 mA and the ± 10 V input signals.

Current (mA) Connections

The following figures show examples of current connections. There are no switches or jumpers to set up for current inputs. Setup and programming is performed through the front panel buttons.

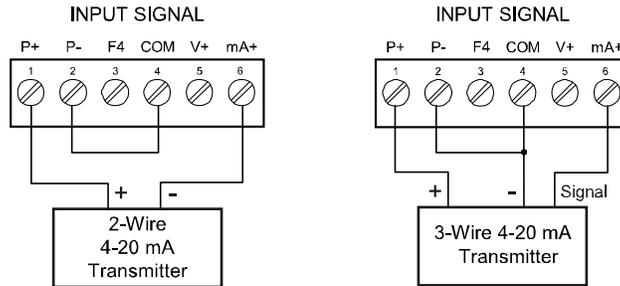


Figure 5. Transmitters Powered by Internal Supply

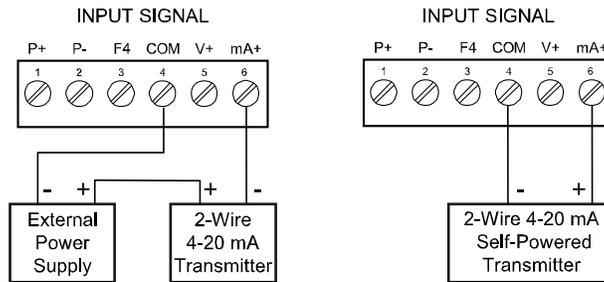


Figure 6. Transmitter Powered by Ext. Supply or Self-Powered

The current input is protected against current overload by a resettable fuse. The display may or may not show a fault condition depending on the nature of the overload. The fuse limits the current to a safe level when it detects a fault condition, and automatically resets itself when the fault condition is removed.

Voltage (V) Connections

The following figures show examples of voltage connections. There are no switches or jumpers to set up for voltage inputs. Setup and programming is performed through the front panel buttons.

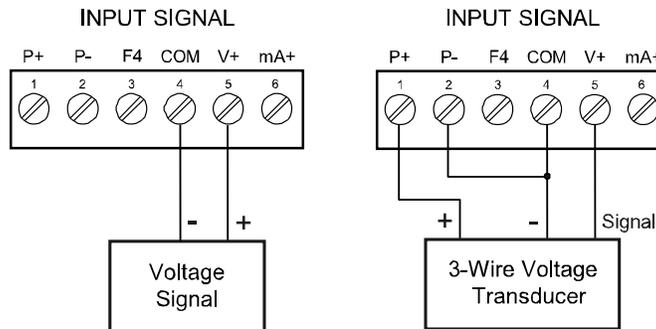


Figure 7. Voltage Input Connections

The meter is capable of accepting any voltage from -10 VDC to +10 VDC.

Serial Communications Connections

The ProtEX-MAX has a 5 position terminal block for connecting RS-485 serial devices.

Figure 8 details the wiring connections from the ProtEX-MAX to an RS-485 serial converter (such as the PDA7485 or PDA8485) for a four-wire network.

ProtEX-MAX to RS-485 Serial Converter Connections	
RS-485 Serial Converter	ProtEX-MAX RS- 485 Connections
$\overline{\text{DI}}$	$\overline{\text{DI}}$
DO	DI
$\overline{\text{DI}}$	$\overline{\text{DO}}$
DI	DO

Figure 8: ProtEX-MAX Connections to a Serial Converter

The ProtEX-MAX has three diagnostic LEDs: a Power (P) LED to show when the module is powered properly, a Transmit Data (TX) LED to show when the module is being transmitted to by the PC side, and a Receive Data (RX) LED to show when the module is sending data to a receiving device.

The following diagrams detail how to connect the RS-485 serial communications from the ProtEX-MAX to a RS-485/RS-232 serial converter (PDA7485) in four wire and two wire configurations.

Three Wire Connections

In order to wire the 5 pins for use as a 3-wire half-duplex RS-485 connection, it is necessary to create a jumper connection between DI – DO and DI- – DO- as shown below.

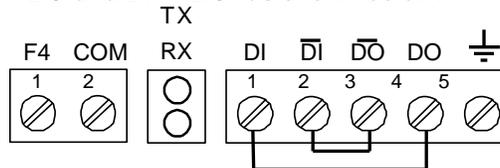


Figure 9. Three-Wire RS485 Connection

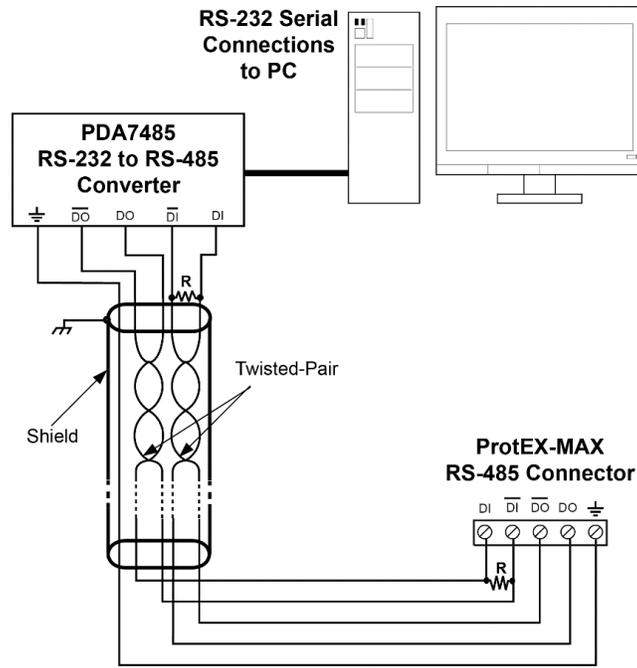


Figure 10: RS-485 Wiring

Notes:

1. Termination resistors are optional and values depend on the cable length and characteristic impedance. Consult the cable manufacturer for recommendations.
2. Refer to RS-232 to RS-485 Converter documentation for further details.
3. Use shielded cable, twisted-pairs plus ground. Connect ground shield only at one location.

 WARNING	<p>Observe all safety regulations. Electrical wiring should be performed in accordance with all agency requirements and applicable national, state, and local codes to prevent damage to the meter and ensure personnel safety.</p>
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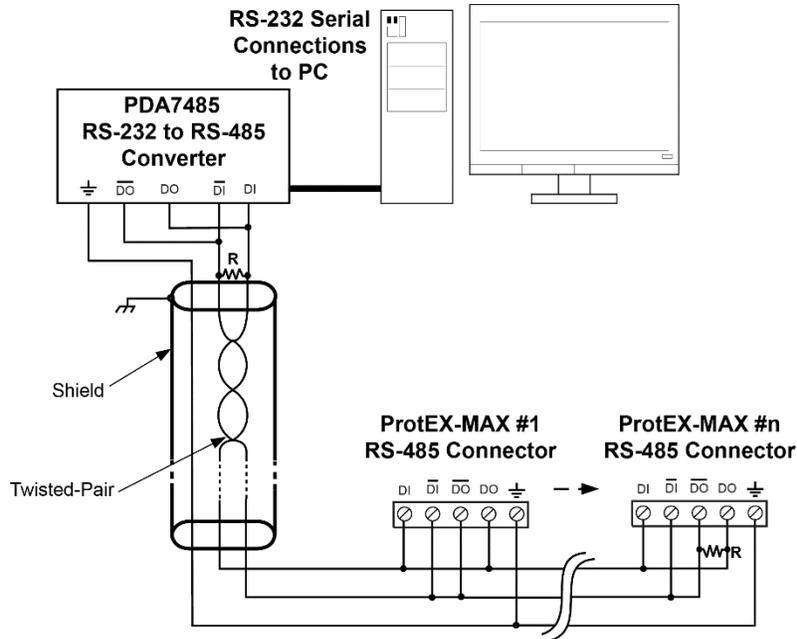


Figure 11: RS-485 Two-Wire Multi-Drop Wiring

Notes:

1. Termination resistors are optional and values depend on the cable length and characteristic impedance. Consult the cable manufacturer for recommendations.
2. Refer to RS-232 to RS-485 Converter documentation for further details.
3. Use shielded cable, twisted-pair plus ground. Connect ground shield only at one location.

 WARNING	Observe all safety regulations. Electrical wiring should be performed in accordance with all agency requirements and applicable national, state, and local codes to prevent damage to the meter and ensure personnel safety.
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When using more than one instrument in a multi-drop or multi-point mode, each meter must be provided with its own unique address. See Modbus RTU Serial Communications on page 46.

Using PROVu Serial Adapters

 NOTICE	PROVu expansion modules and serial adapters are not included in the hazardous area approvals of the ProtEX-MAX. The PDA1232 may be used only while the ProtEX-MAX is in a safe area, and will disable some features while installed.
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PROVu expansion modules and serial adapters are not recommended for use with the ProtEX-MAX. It is recommended that any serial protocol conversion required on the RS-485 communications connection be performed using a PDA7485 RS-232 to RS-485 or PDA8485 USB to RS-485 serial converter located in a safe area.

Relay Connections

Relay connections are made to two six-terminal connectors labeled RELAY1 – RELAY4 on Figure 3. Each relay's C terminal is common only to the normally open (NO) and normally closed (NC) contacts of the corresponding relay. The relays' C terminals should not be confused with the COM (common) terminal of the INPUT SIGNAL connector.

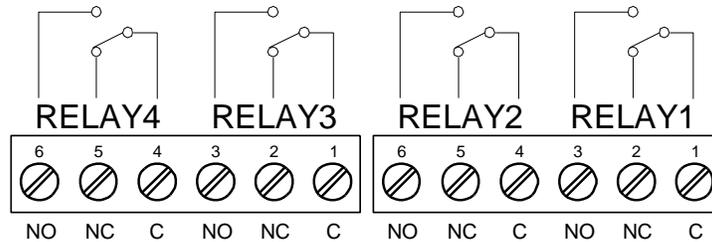


Figure 12. Relay Connections

Switching Inductive Loads

The use of suppressors (snubbers) is strongly recommended when switching inductive loads to prevent disrupting the microprocessor's operation. The suppressors also prolong the life of the relay contacts. Suppression can be obtained with resistor-capacitor (RC) networks assembled by the user or purchased as complete assemblies. Refer to the following circuits for RC network assembly and installation:

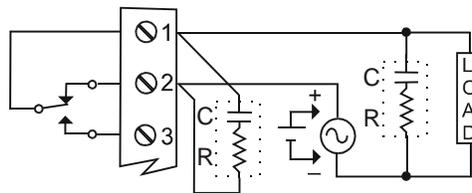


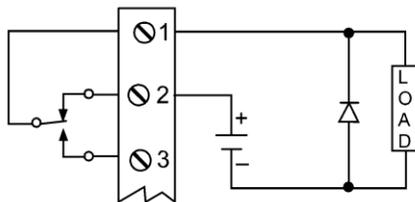
Figure 13. AC and DC Loads Protection

Choose R and C as follows:

- R: 0.5 to 1 Ω for each volt across the contacts
- C: 0.5 to 1 μF for each amp through closed contacts

Notes:

1. Use capacitors rated for 250 VAC.
2. RC networks may affect load release time of solenoid loads. Check to confirm proper operation.
3. Install the RC network at the meter's relay screw terminals. An RC network may also be installed across the load. Experiment for best results.



Use a diode with a reverse breakdown voltage two to three times the circuit voltage and forward current at least as large as the load current.

Figure 14. Low Voltage DC Loads Protection

RC Networks Available from Precision Digital

RC networks are available from Precision Digital and should be applied to each relay contact switching an inductive load. Part number: PDX6901.

Note: Relays are de-rated to 1/14th HP (50 watts) with an inductive load.

F4 Digital Input Connections

A digital input, F4, is standard on the meter. This digital input is connected with a normally open contact across F4 and COM, or with an active low signal applied to F4.

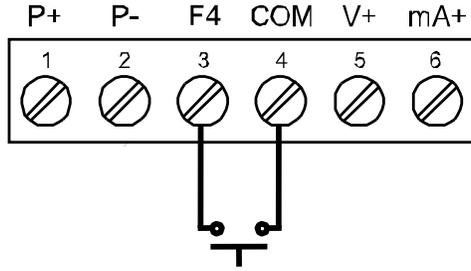


Figure 15. F4 Digital Input Connections

4-20 mA Output Connections

Connections for the 4-20 mA transmitter output are made to the connector terminals labeled MA OUT. The 4-20 mA output may be powered internally or from an external power supply.

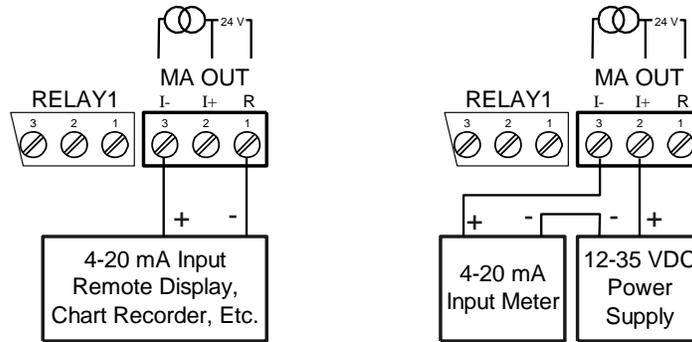


Figure 16. 4-20 mA Output Connections

Analog Output Transmitter Power Supply

The internal 24 VDC power supply powering the analog output may be used to power other devices, if the analog output is not used. The I+ terminal is the +24 V and the R terminal is the return.

Interlock Relay Feature

As the name implies, the interlock relay feature reassigns one, or more, alarm/control relays for use as interlock relay(s). Interlock contact(s) are wired to digital input(s) and trigger the interlock relay. This feature is enabled by configuring the relay, and relative digital input(s) (see page 41).

In one example, dry interlock contacts are connected in series to one digital input which will be used to force on (energize) the assigned interlock power relay when all interlock contacts are closed (safe). The interlock relay front panel LED flashes when locked out. The interlock relay would be wired in-series with the load (N/O contact). See below.

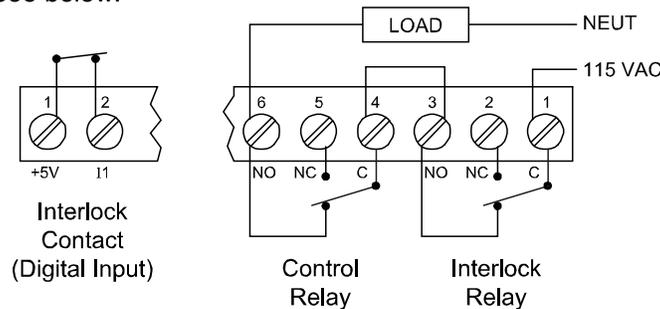


Figure 17. Interlock Connections

Digital I/O Connections

The ProtEX-MAX has a 10-position terminal block for connecting digital inputs and outputs.

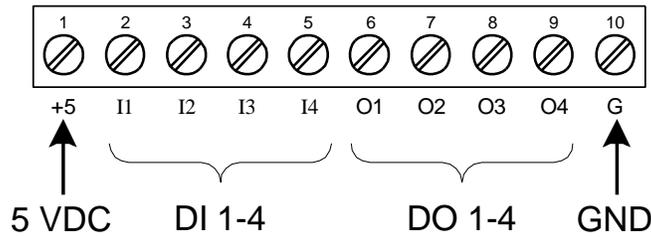


Figure 18: Digital I/O Connections

 NOTICE	<p>The onboard digital inputs (1-4) are configured at the factory to function identically to the front panel pushbuttons (Menu, F1, F2, & F3) in order to work with the SafeTouch buttons. Changing the programming of the digital inputs will affect the function of the SafeTouch buttons.</p> <p>If you wish to change the behavior of the digital inputs, re-assign F1-F3 to the desired function, then change the corresponding digital input to match.</p>
 WARNING	<p>Observe all safety regulations. Electrical wiring should be performed in accordance with all agency requirements and applicable national, state, and local codes to prevent damage to the meter and ensure personnel safety.</p>

External Switch Contacts

The ProtEX-MAX includes 4 digital inputs. These digital inputs are preconfigured at the factory to function as external contacts to duplicate the front button functions of the instrument. The factory configuration uses the following corresponding digital input terminals for external switch contacts.

Digital Input Connection	Factory Default Function
I1	MENU
I2	RIGHT arrow
I3	UP arrow
I4	ENTER arrow

See Digital Inputs & Outputs in the Specification on page 7 for details on the digital inputs.

 NOTICE	<p>The digital inputs are configured at the factory to function identically to the front panel pushbuttons in order to work with the SafeTouch buttons. Changing the programming of the digital inputs will affect the function of the SafeTouch buttons.</p>
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Setup and Programming

The meter is factory calibrated prior to shipment to read in milliamps and volts depending on the input selection. The calibration equipment is traceable to NIST standards.

Overview

There are no jumpers to set for the meter input selection.

Setup and programming may be done through the infrared through-glass SafeTouch buttons, or using the mechanical buttons when uncovered. There is a slide switch located on the connector board. This is used to enable or disable SafeTouch Buttons.

After power and input signal connections have been completed and verified, apply power to the meter.

SafeTouch® Buttons

The ProtEX-MAX is equipped with four sensors that operate as through-glass buttons so that it can be programmed and operated without removing the cover (and exposing the electronics) in a hazardous area.

These buttons can be disabled for security by selecting DISABLE on the switch labeled NO-CONTACT BUTTONS located on the connector board.

To actuate a button, press one finger to the glass directly over the marked button area. Then retract finger more than three inches from the glass before pressing the next button. When the cover is removed, the four mechanical buttons located next to the sensors are used. The sensors are disabled when a mechanical button is pressed and will automatically be re-enabled after 60 seconds of inactivity.

The SafeTouch Buttons are designed to filter normal levels of ambient interference and to protect against false triggering, however, it is recommended that the SafeTouch Buttons be disabled (slide switch to LOCK) if there is an infrared interference source in line-of-sight to the display.

The SafeTouch Buttons are configured by default to duplicate the function of the front panel mechanical pushbuttons associated with the integrated meter. The symbols by each SafeTouch button correspond to a mechanical button as shown in the table on the next page.

SafeTouch Button Tips:

- To the extent possible, install the display facing away from sunlight, windows, reflective objects and any sources of infrared interference.
- Keep the glass window clean.
- Tighten the cover securely.
- Use a password to prevent tampering.



Take caution when cleaning the window glass as it may result in unintentional SafeTouch button events. Only clean the ProtEX-MAX when the system is safely shut down, and inspect the ProtEX-MAX for proper configuration prior to system restart.

Buttons and Status LED Indicators



Button Symbol	Description	LED	Status
 	Menu	1-8	Alarm 1-8 indicator
 	Right arrow/F1	1-8 M	Flashing: Relay in manual control mode
 	Up arrow/F2	T	Flashing: Tare
 	Enter/F3	1-8	Flashing: Relay interlock switch open
<p><i>Note:</i> F4 is a digital input. Alarms 5-8 are enabled when relay expansion module is installed.</p>		<p><i>Note:</i> LEDs for relays in manual mode flash with the "M" LED every 10 seconds. "M" flashing by itself indicates Aout – manual control is used.</p>	

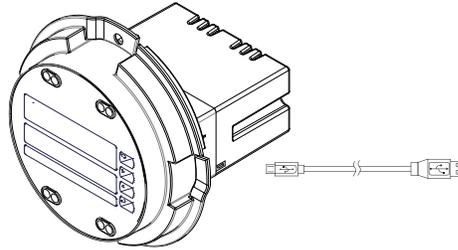
- Press the Menu button to enter or exit the Programming Mode at any time.
- Press the Right arrow button to move to the next digit during digit or decimal point programming.
- Press or hold the Up arrow button to scroll through the menus, decimal point, or to increment the value of a digit.
- Press the Enter button to access a menu or to accept a setting.
- Press and hold the Menu button for three seconds to access the advanced features of the meter.

MeterView® Pro Software

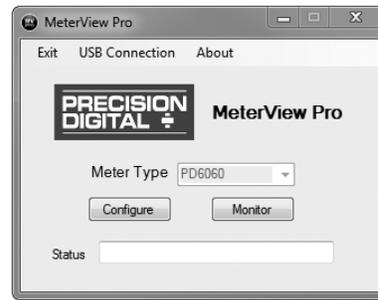
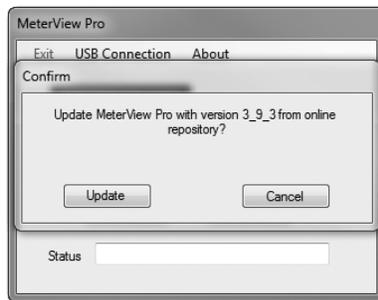
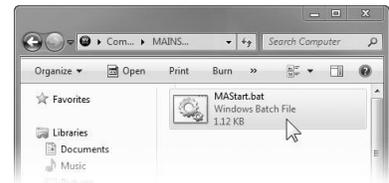
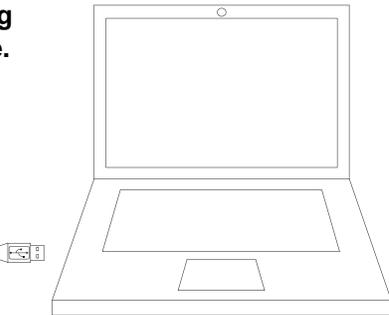
The meter can also be programmed using the PC-based MeterView Pro software included with the meter. This software can be installed on any Microsoft® Windows® (XP/Vista/7/8/10) computer by connecting the meter's onboard USB. The meter is powered by the USB connection, so there is no need to wire anything prior to programming the meter, though USB is intended only for meter configuration.

MeterView Pro Installation

1. Connect one end of the provided USB cable to the internal electronics module and the other end to the computer. The computer will automatically install the driver software it needs to talk to the meter. **Only one meter may be connected at a time. Attaching multiple meters will cause a conflict with the meter software.**



2. Once the driver is installed, an AutoPlay dialog should appear for the drive "MAINSTAL." Click "Open folder to view files." If the computer does not display an AutoPlay dialog for the drive "MAINSTAL," you should open My Computer and double-click on the drive labeled "MAINSTAL."
3. Double-click on the file named "MAStart." The program will open a few windows and install two programs on your computer. Simply follow the onscreen instructions until you see one of the dialogs below. If you receive a "User Account Control" warning, click "Yes."
4. If there is an update available, click the "Update" button to install the new version. Otherwise, click "Configure" to begin programming your meter.



Note: If you decide to update your MeterView Pro software, once the installation has completed, you will be asked if you want to update the setup files located on the meter itself. This way, you will always have the most current version on the meter for future installs.



Warning!

Do not unplug the meter while the new installation files are being written to it. The meter will display uwrite during the process and you will receive an onscreen notification once the process is complete.

Data logging for one meter at a time is available with MeterView Pro software. More advanced data acquisition may be accomplished by using any Modbus RTU compliant software. Additional information regarding configuration and monitoring of the meter using MeterView Pro software is available online. Go to www.predig.com/meterview-pro.

Display Functions & Messages

The meter displays various functions and messages during setup, programming, and operation. The following table shows the main menu functions and messages in the order they appear in the menu.

Display	Parameter	Action/Setting Description
ሀይትሆፕ	Setup	Enter Setup menu
ከፎርም	Input	Enter Input selection menu
ጠገን	4-20 mA	Set meter for 4-20 mA input
ህዕሊት	0-10 VDC	Set meter for ±10 VDC input
ድ-ሀርገሊ	Dual-scale	Press Enter to select dual-scale display for some level applications (Select Yes or No)
ህጠ ስቴ	Units	Select the display units/tags
ደረጃ ፎይት	Decimal point	Set decimal point
ፒህ 1	PV1	PV1 decimal point (Level)
ፒህ 2	PV2	PV2 decimal point (Level)
ፕሮግራም	Program	Enter the Program menu
ሀርገሊ	Scale	Enter the Scale menu
ሀርገሊ 1	Scale 1	Enter the Scale menu for PV1
ሀርገሊ 2	Scale 2	Enter the Scale menu for PV2
ክሊቫሬት	Calibrate	Enter the Calibration menu
ከፎርም 1	Input 1	Calibrate input 1 signal or program input 1 value
ደረጃ 1	Display 1	Program display 1 value
ከፎርም 2	Input 2	Calibrate input 2 signal or program input 2 value (up to 32 points)
ደረጃ 2	Display 2	Program display 2 value (up to 32 points)
የገጽ ስህተት	Error	Error, calibration not successful, check signal or programmed value
ደረጃ ስህተት	Display	Enter the Display menu
ከፎርም 1	Display Line 1	Press Enter to assign the Main display parameter (default: PV)
ከፎርም 2	Display Line 2	Press Enter to assign the small display parameter (default: engineering units)
ድ-ከፎርም	Display intensity	Set display intensity level from 1 to 8
ሪላይ	Relay	Enter the Relay menu
ሪላይ 1	Relay 1	Relay 1 setup
አሰጣጥ 1	Action 1	Set relay 1 action
ሲዎቲክ	Automatic	Set relay for automatic reset
ሲ-ጠገን	Auto-manual	Set relay for automatic & manual reset any time
ሊቫኒንግ	Latching	Set relay for latching operation

Display	Parameter	Action/Setting Description
ሊቫኒንግ	Latching-cleared	Set relay for latching operation with manual reset only after alarm condition has cleared
አልተርጎ	Alternate	Set relay for pump alternation control
ሲምፕሊንግ	Sampling	Set relay for sampling operation
ኆፍ	Off	Disable relay and front panel status LED (Select Off to enable Interlock feature)
ሀይት 1	Set 1	Program set point 1
ሪሲት 1	Reset 1	Program reset point 1
ሪላይ 2	Relay 2	Relays 2-8 setup <i>Note: Relays 5-8 are shown, only if expansion relay module is installed.</i>
ፍላይ-ሲፍ	Fail-safe	Enter Fail-safe menu
ፍላይ 1	Fail-safe 1	Set relay 1 fail-safe operation
ኦን	On	Enable fail-safe operation
ኆፍ	Off	Disable fail-safe operation
ፍላይ 2	Fail-safe 2	Set relays 2-8 fail-safe operation
ደረጃ ስላይ	Delay	Enter relay Time Delay menu
ደረጃ 1	Delay 1	Enter relay 1 time delay setup
ኦን 1	On 1	Set relay 1 On time delay
ኆፍ 1	Off 1	Set relay 1 Off time delay
ደረጃ 2	Delay 2	Enter relays 2-8 time delay setup
ብረት ስላይ	Loop break	Set relay condition if loop break detected
ከፎርም	Ignore	Ignore loop break condition (Processed as a low signal condition)
ኦን	On	Relay goes to alarm condition when loop break is detected
ኆፍ	Off	Relay goes to non-alarm condition when loop break is detected
ሲዎቲክ	Analog output	Enter the Analog output scaling menu
ደረጃ 1	Display 1	Program display 1 value
ሲዎቲክ 1	Output 1	Program output 1 value (e.g. 4.000 mA)
ደረጃ 2	Display 2	Program display 2 value
ሲዎቲክ 2	Output 2	Program output 2 value (e.g. 20.000 mA)
ሪሲት	Reset	Press Enter to access the Reset menu

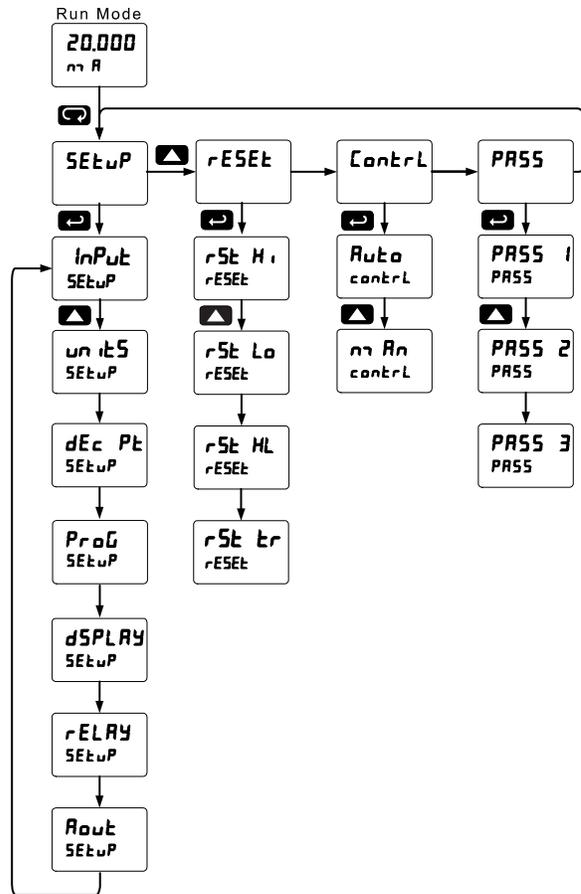
Display	Parameter	Action/Setting Description
rSEt Hi	Reset high	Press Enter to reset max display
rSEt Lo	Reset low	Press Enter to reset min display
rSEt HL	Reset high & low	Press Enter to reset max & min displays
rSEt tr	Reset tare	Reset tare
Control	Control	Enter Control menu
Auto	Automatic	Press Enter to set meter for automatic operation
Man	Manual	Press Enter to manually control relays or analog output operation

Display	Parameter	Action/Setting Description
PASS	Password	Enter the Password menu
PASS 1	Password 1	Set or enter Password 1
PASS 2	Password 2	Set or enter Password 2
PASS 3	Password 3	Set or enter Password 3
unLoc	Unlocked	Program password to lock meter
Locd	Locked	Enter password to unlock meter
999999 -999999	Flashing	Over/under range condition

Main Menu

The main menu consists of the most commonly used functions: *Setup*, *Reset*, *Control*, and *Password*.

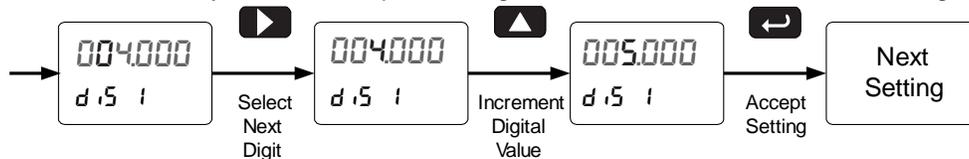
- Press Menu button to enter Programming Mode then press the Up arrow button to scroll main menu.
- Press Menu, at any time, to exit and return to Run Mode. Changes made to settings prior to pressing Enter are not saved.
- Changes to the settings are saved to memory only after pressing Enter/F3.
- The display moves to the next menu every time a setting is accepted by pressing Enter/F3.



Setting Numeric Values

The numeric values are set using the Right and Up arrow buttons. Press Right arrow to select next digit and Up arrow to increment digit value. The digit being changed is displayed brighter than the rest. Press and hold Up to auto-increment the display value. If negative numbers are allowed, the first digit position will include a negative symbol (-) after the 9.

Press the Enter button, at any time, to accept a setting or Menu button to exit without saving changes.

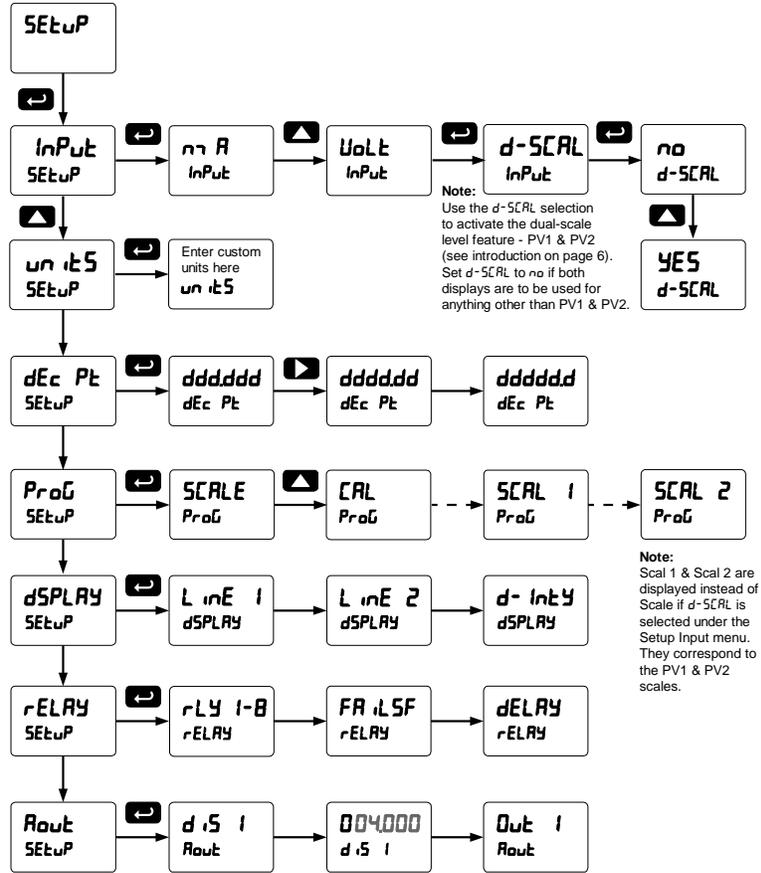


Setting Up the Meter (SEtUP)

The *Setup* menu is used to select:

1. Input signal the meter will accept
2. Dual-scale feature for some level applications
3. Select the display units/tags
4. Decimal point position
5. Programming Menu
6. Display parameter and intensity
7. Relay operation
8. 4-20 mA analog output scaling

Press the Enter button to access any menu or press Up arrow button to scroll through choices. Press the Menu button to exit at any time.



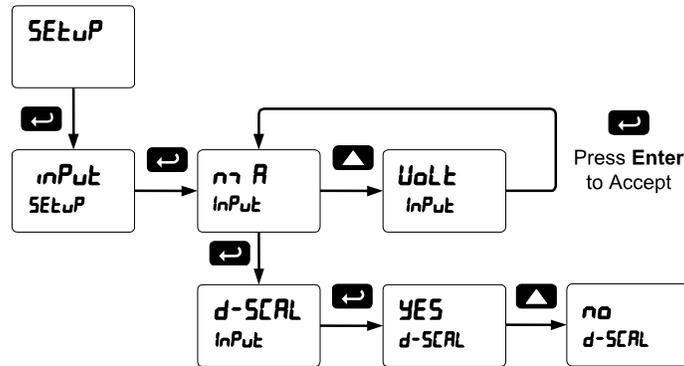
Setting the Input Signal (InPUt)

Enter the *Input* menu to set up the meter to display current (mA) or voltage (Volt) inputs.

The current input is capable of accepting any signal from 0 to 20 mA. Select current input to accept 0-20 mA or 4-20 mA signals.

The voltage input is capable of accepting any signal from -10 to +10 VDC. Select voltage input to accept 0-5, 1-5, 0-10, or ±10 VDC signals.

After selecting *mA* or *Volt* input, *d-SCAL* is displayed; press Enter to select “Yes” or “No”. Selecting “Yes” enables the dual-scale feature, which allows for the Scale (SCALE) and Units (units) menus to be used to scale the same input in two different scales for PV1 & PV2.



Set **d-SCAL** to no if both displays are to be used for anything other than PV1 & PV2.

Setting the Input Units or Custom Tags (u n t5)

Enter the input unit or custom tag that will be displayed if d u n t5 is selected as the line 2 parameter. See the flow chart on page 31 to access the display menu to show the unit or tag on display line 2. The engineering units or custom legends can be set using the following 7-segment character set:

Display	Character	Display	Character	Display	Character	Display	Character
0	0	C	C	K	K	v	V
1	1	c	c	L	L	v v	w
2	2	d	d	m	m	X	X
3	3	E	E	n	n	Y	Y
4	4	F	F	O	O	Z	Z
5	5	G	G	o	o	.	.
6	6	g	g	P	P	/	/
7	7	H	H	q	q	[]
8	8	h	h	r	r]	[
9	9	I	I	S	S	:	=
A	A	i	i	t	t	°	Degree(<)
b	b	J	J	u	u		Space

Notes:

Degree symbol represented by (<) if programming with MeterView® Pro.

The letters “m” and “w” use two 7-segment LEDs each; when selected the characters to the right are shifted one position.

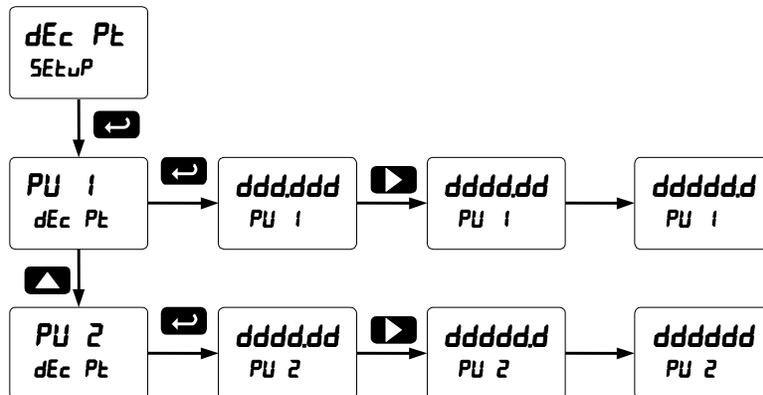
Press and hold up arrow to auto-scroll the characters in the display.

Setting the Decimal Point (dEc Pt)

The decimal point may be set with up to five decimal places or with no decimal point at all.

Pressing the Right arrow moves the decimal point one place to the right until no decimal point is displayed, and then it moves to the leftmost position. Pressing the Up arrow moves the decimal point one place to the left.

If the dual-scale level feature is selected, the decimal point selections for PV1 & PV2 are enabled.



Programming the Meter (Prog)

It is **very important** to read the following information, before proceeding to program the meter:

- The meter is factory calibrated prior to shipment to read in milliamps and volts depending on the input selection. The calibration equipment is traceable to NIST standards.
- Use the *Scale* menu to scale the process input (e.g. 4-20 mA). A calibrated signal source is not needed to scale the meter.
- Use the *Calibrate* menu to apply a signal from a calibrator or a flowmeter.
- The PD6000 is a single input meter with dual-scale capability.

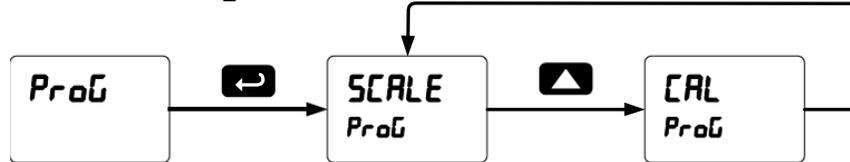
The *Program* menu contains the *Scale* and the *Calibrate* menus.

*Note: The **Scale** and **Calibrate** functions are exclusive of each other. The meter uses the last function programmed. Only one of these methods can be employed at a time. The Scale and Calibrate functions can use up to 32 points (default is 2). The number of points should be set in the Advanced menu under the Multi-Point Linearization (**LINEAR**) menu selection prior to scaling and calibration of the meter, see page 49 for details.*

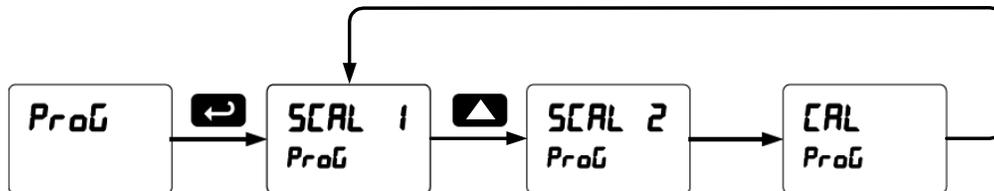
If the dual-scale level feature is selected in the *Setup* menu, the *Scale 1* and *Scale 2* menus are enabled for PV1 & PV2 respectively.

The process input may be calibrated or scaled to any display value within the range of the meter.

Program Menu for Single Scale Process



Program Menu for Dual-Scale Level Applications



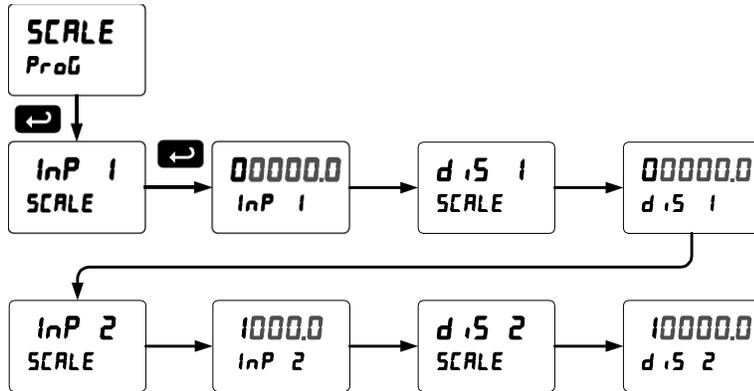
Additional parameters, not needed for most applications, are programmed in the *Advanced Features* menu; see *Advanced Features Menu*, page 44.

Multi-Point Calibration & Scaling

The meter is set up at the factory for 2-point linear calibration. The number of points for multi-point calibration/scaling is set up in the *Advanced Features* menu. Up to 32 linearization points may be selected for PV1 and up to 8 linearization points may be selected for PV2. See page 49 for details.

Scaling the Meter (SCALE)

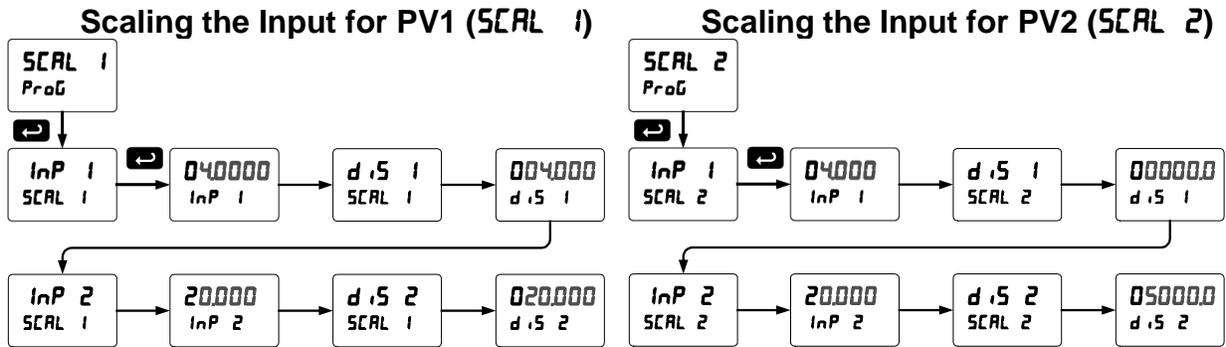
The process input (4-20 mA, ±10 VDC) can be scaled to display the process variable in engineering units. A signal source is not needed to scale the meter; simply program the inputs and corresponding display values.



Dual-Scale for Level Application

The analog input can be displayed in two different scales, by enabling the dual-scale feature (**d-SCALE**) in the *Setup-Input* menu, see page 26.

To enable the dual-scale feature for some level applications you must select d-SCAL in the Input selection menu.



Error Message (Error)

An error message indicates that the calibration or scaling process was not successful.

After the error message is displayed, the meter reverts to the input prior to the failure during calibration or scaling and to input 1 during internal calibration, allowing the appropriate input signal to be applied or programmed.

The error message might be caused by any of the following conditions:

1. Input signal is not connected to the proper terminals or it is connected backwards.
2. Wrong signal selection in *Setup* menu.
3. Minimum input span requirements not maintained.
4. Input 1 signal inadvertently applied to calibrate input 2.

Minimum Input Span

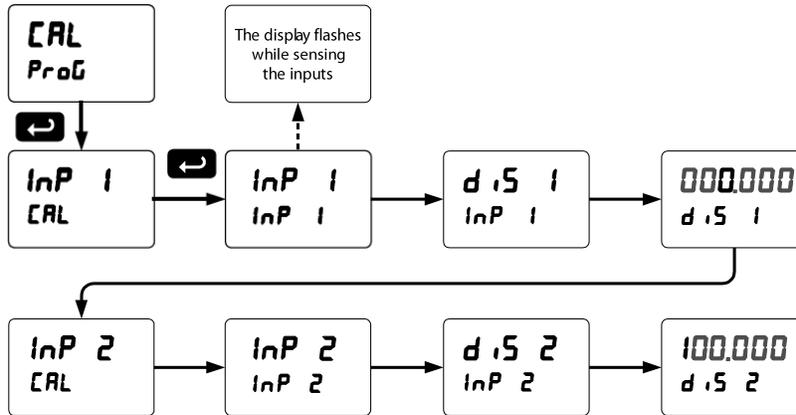
The minimum input span is the minimum difference between input 1 and input 2 signals required to complete the calibration or scaling of the meter.

Input Range	Input 1 & Input 2 Span
4-20 mA	0.15 mA
±10 VDC	0.01 VDC

Calibrating the Meter with External Source (Cal)

Note: To scale the meter without a signal source refer to Scaling the Meter (SCALE), page 29.

The meter can be calibrated to display the process variable in engineering units by applying the appropriate input signal and following the calibration procedure. The use of a calibrated signal source is strongly recommended to calibrate the meter.



Warm up the meter for at least 15 minutes before performing calibration to ensure specified accuracy.

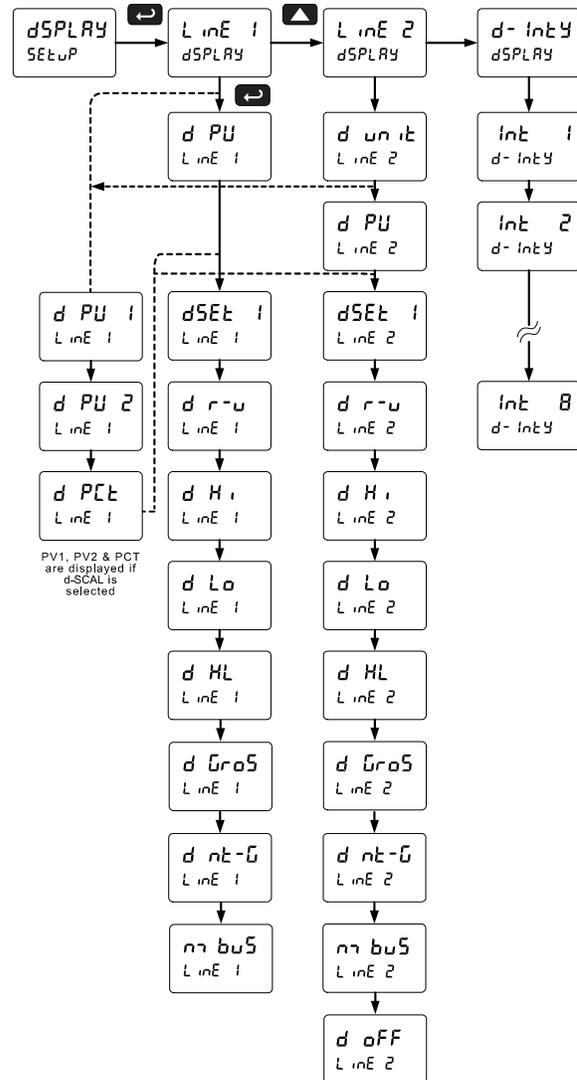
Setting the Display Parameter & Intensity (d5PLAY)

The main display (LINE 1) can be programmed to display:

1. Process value 1 (PV1)
2. Process value 2 (PV2)
3. Percent of PV1 (PCT)
4. Relay set points
5. Max & min values
6. Modbus input
7. Display reading and units
8. Display gross
9. Toggle net & gross

The secondary display (LINE 2) can be programmed to display:

1. Unit
2. Process value 1 (PV1)
3. Process value 2 (PV2)
4. Percent of PV1 (PCT)
5. Relay set points
6. Max & min values
7. Engineering units or custom legends
8. Modbus input
9. Off (no display)
10. Toggle reading and units
11. Display gross
12. Toggle net/gross



Display Intensity: The meter has eight display intensity levels to give the best performance under various lighting conditions. Select intensity 8 for outdoor applications. The default intensity setting is 8.

After setting up the input and display, press the Menu button to exit programming and skip the rest of the setup menu. Press the Menu button again and the Up arrow to reach the *Program* menu and complete the scaling or calibration of the meter.

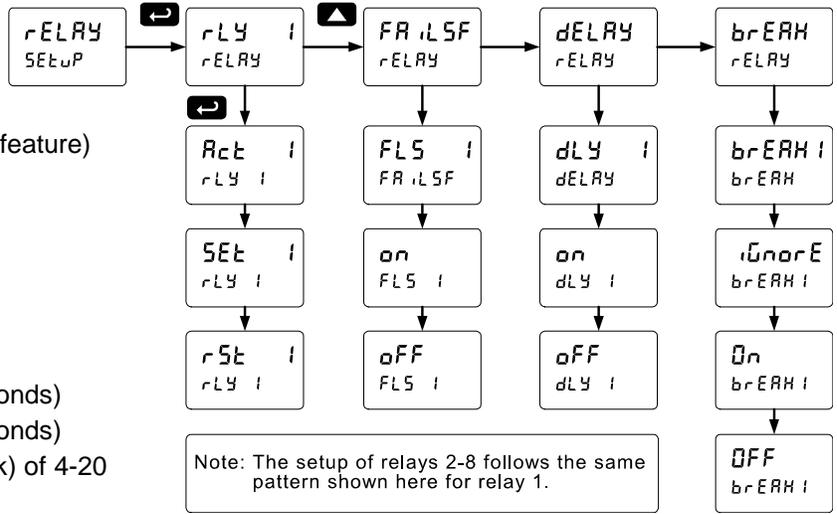
Setting the Relay Operation (rELAY)

This menu is used to set up the operation of the relays.



Caution! During setup, the relays do not follow the input and they will remain in the state found prior to entering the Relay menu.

1. Relay action
 - a. Automatic reset only (non-latching)
 - b. Automatic + manual reset at any time (non-latching)
 - c. Latching (manual reset only)
 - d. Latching with Clear (manual reset only after alarm condition has cleared)
 - e. Pump alternation control (automatic reset only)
 - f. Sampling (the relay is activated for a user-specified time)
 - g. Off (relay state controlled by Interlock feature)
2. Set point
3. Reset point
4. Fail-safe operation
 - a. On (enabled)
 - b. Off (disabled)
5. Time delay
 - a. On delay (0-999.9 seconds)
 - b. Off delay (0-999.9 seconds)
6. Relay action for loss (break) of 4-20 mA input (ignore, on, off)

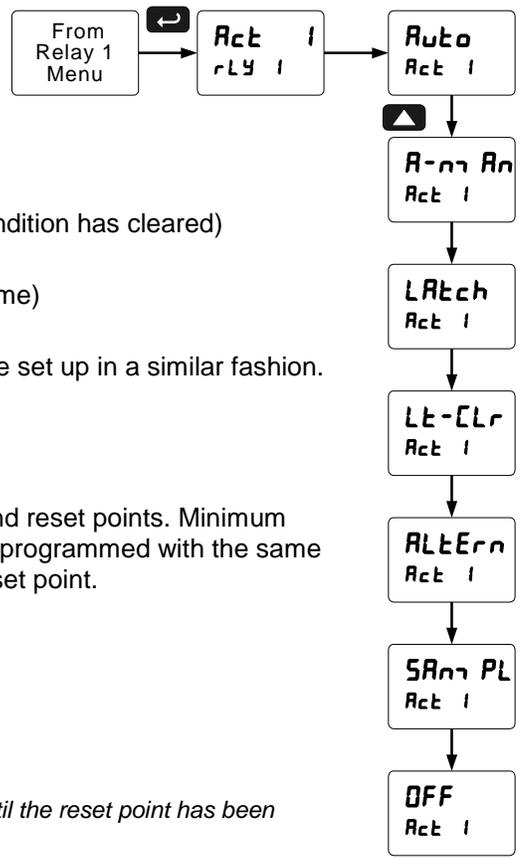


Setting the Relay Action

Operation of the relays is programmed in the *Action* menu. The relays may be set up for any of the following modes of operation:

1. Automatic reset (non-latching)
2. Automatic + manual reset at any time (non-latching)
3. Latching (manual reset only, at any time)
4. Latching with Clear (manual reset only after alarm condition has cleared)
5. Pump alternation control (automatic reset only)
6. Sampling (the relay is activated for a user-specified time)
7. Off (relay state controlled by Interlock feature)

The following graphic shows relay 1 action setup; relay 2-8 are set up in a similar fashion.

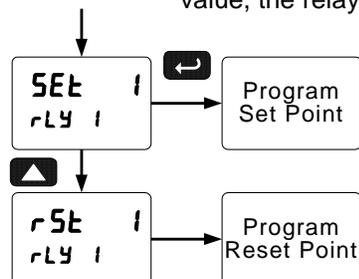


Programming Set and Reset Points

High alarm indication: program set point above reset point.

Low alarm indication: program set point below reset point.

The deadband is determined by the difference between set and reset points. Minimum deadband is one display count. If the set and reset points are programmed with the same value, the relay will reset one count below the set point.



Note: Changes are not saved until the reset point has been accepted.

Setting Fail-Safe Operation

In fail-safe mode of operation, the relay coil is energized when the process variable is within safe limits and the relay coil is de-energized when the alarm condition exists. The fail-safe operation is set independently for each relay. Select **on** to enable or select **off** to disable fail-safe operation.

Programming Time Delay

The *On* and *Off* time delays may be programmed for each relay between 0 and 999.9 seconds. The relays will transfer only after the condition has been maintained for the corresponding time delay.

The *On* time delay is associated with the set point.

The *Off* time delay is associated with the reset point.

Relay Action for Loss of 4-20 mA Input (Loop Break)

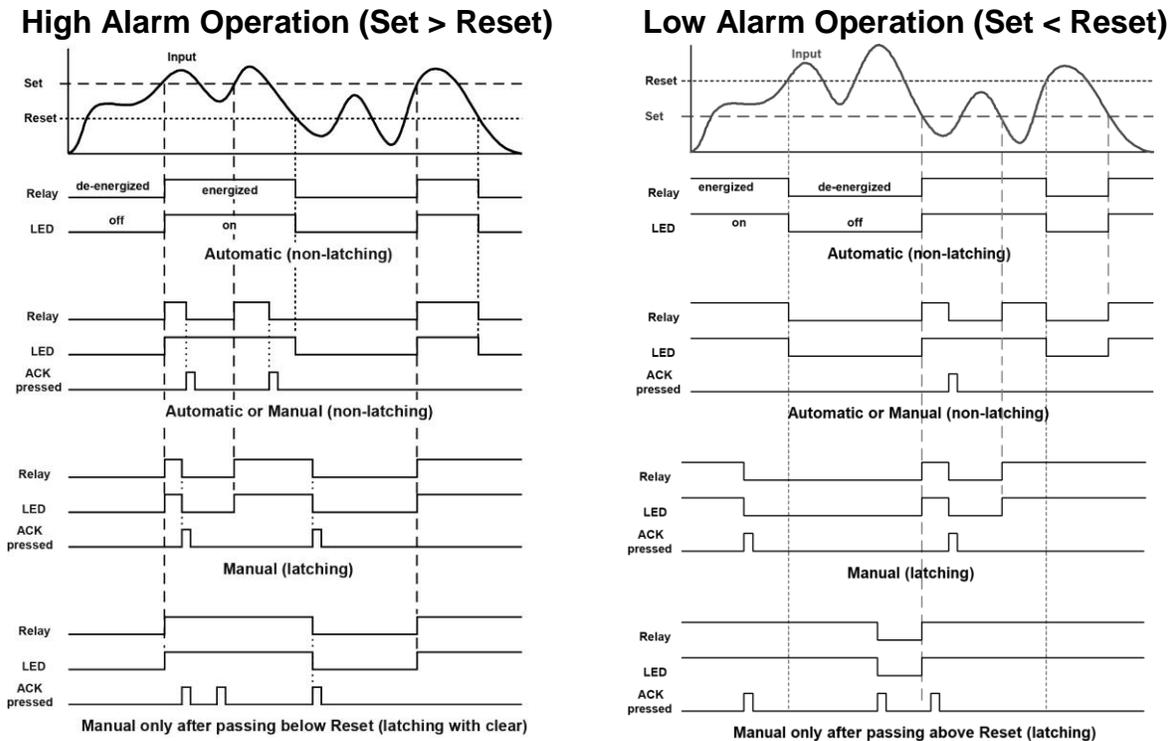
The loop break feature is associated with the 4-20 mA input. Each relay may be programmed to go to one of the following conditions when the meter detects the loss of the input signal (i.e. < 0.005 mA):

1. Turn *On* (Go to alarm condition)
2. Turn *Off* (Go to non-alarm condition)
3. Ignore (Processed as a low signal condition)

Note: This is not a true loop break condition; if the signal drops below 0.005 mA, it is interpreted as a "loop break" condition.

Relay and Alarm Operation Diagrams

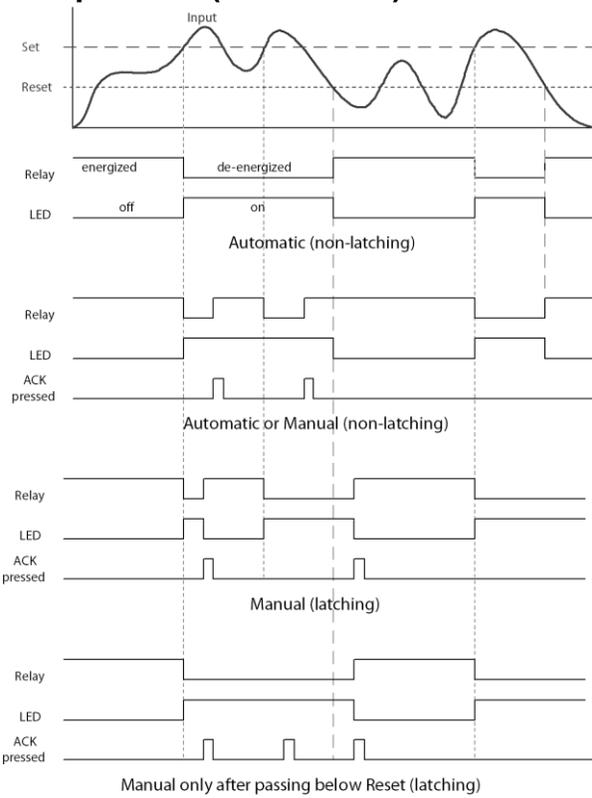
The following graphs illustrate the operation of the relays, status LEDs, and ACK button.



For Manual reset mode, ACK can be pressed anytime to turn "off" relay. To detect a new alarm condition, the signal must go below the set point, and then go above it.

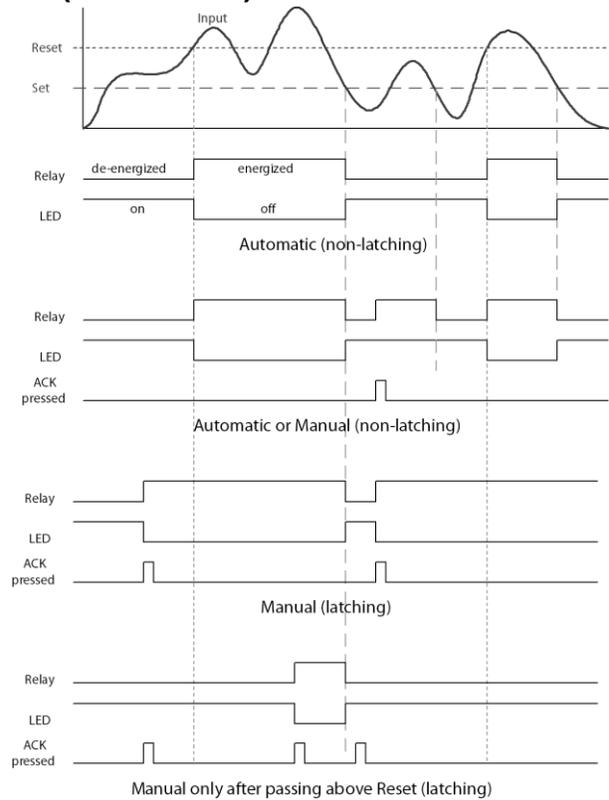
For Manual reset mode, ACK can be pressed anytime to turn "off" relay. For relay to turn back "on", signal must go above set point and then go below it.

High Alarm with Fail-Safe Operation (Set > Reset)



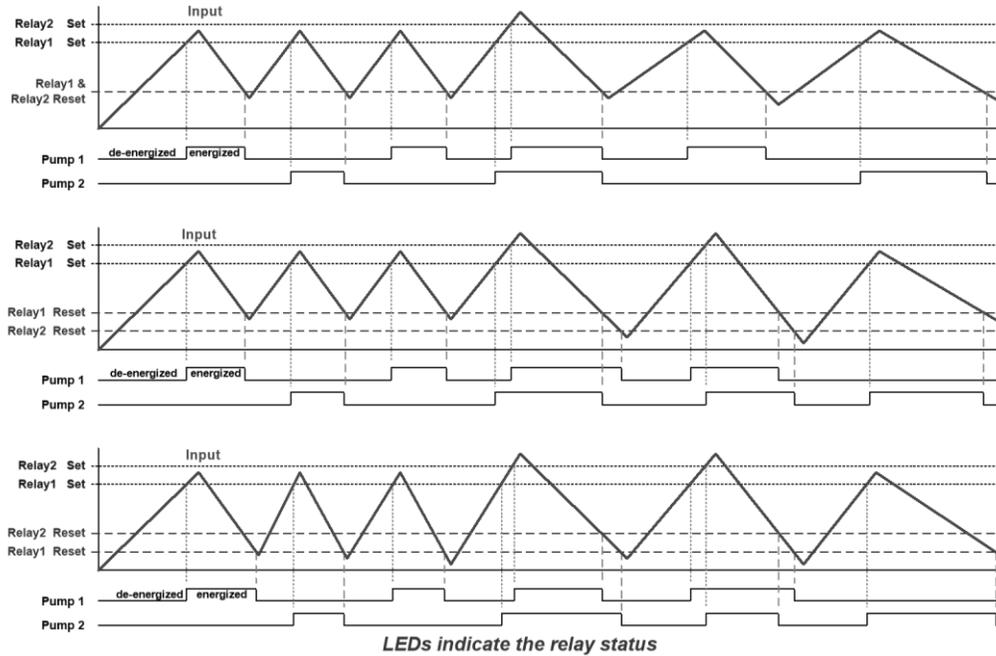
Note: Relay coil is energized in non-alarm condition. In case of power failure, relay will go to alarm state.

Low Alarm with Fail-Safe Operation (Set < Reset)

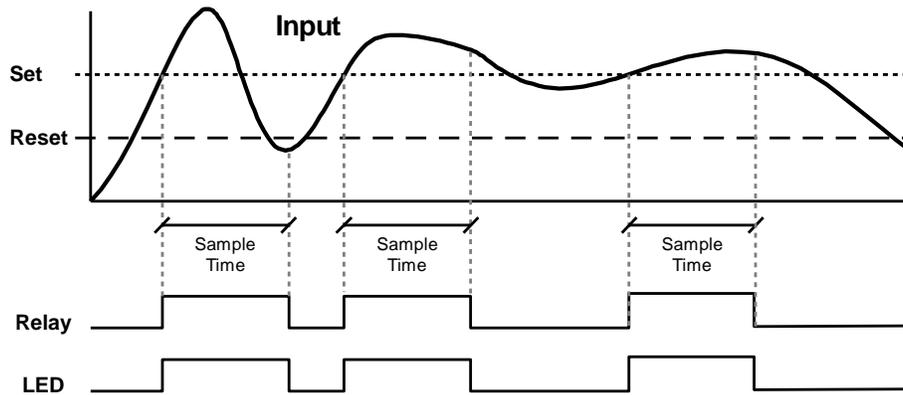


Note: Relay coil is energized in non-alarm condition. In case of power failure, relay will go to alarm state.

Pump Alternation Control Operation



Relay Sampling Operation

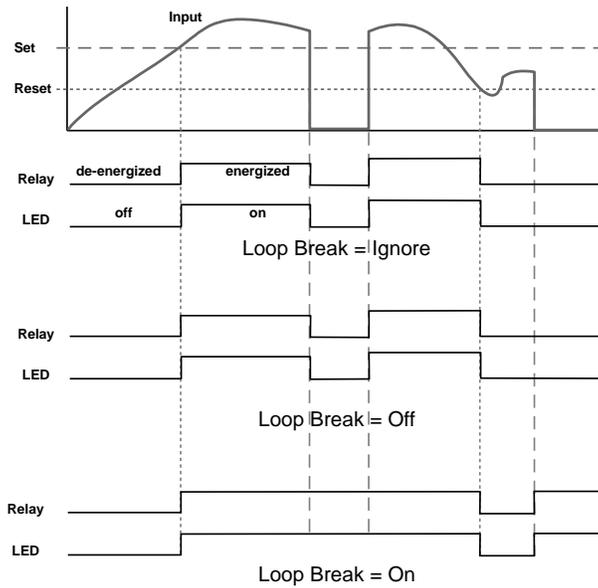


When the signal crosses the set point, the relay trips and the sample time starts. After the sample time has elapsed, the relay resets. The cycle repeats every time the set point is crossed, going up for high alarms and going down for low alarms.

The sample time can be programmed between 0.1 and 5999.9 seconds.

Signal Loss or Loop Break Relay Operation

The following graph shows the loop break relay operation for a high alarm relay.

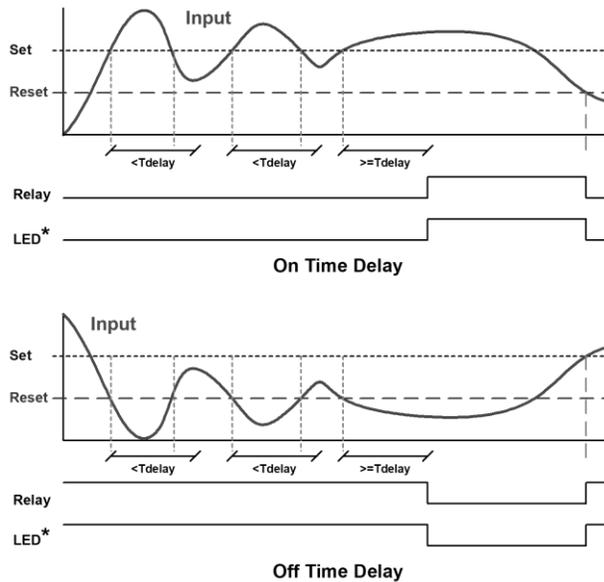


When the meter detects a break in the 4-20 mA loop, the relay will go to one of the following selected actions:

1. Turn *On* (Go to alarm condition)
2. Turn *Off* (Go to non-alarm condition)
3. Ignore (Processed as a low signal condition)

Time Delay Operation

The following graphs show the operation of the time delay function.



When the signal crosses the set point, the *On* time delay timer starts and the relay trips when the time delay has elapsed. If the signal drops below the set point (high alarm) before the time delay has elapsed, the *On* time delay timer resets and the relay does not change state. The same principle applies to the *Off* time delay.

Note: If "Automatic or Manual (R-n Rn)" reset mode is selected, the LED follows the reset point and not the relay state when the relay is acknowledged.

Relay Operation Details

Overview

The relay capabilities of the meter expand its usefulness beyond simple indication to provide users with alarm and control functions. These capabilities include front panel alarm status LEDs as well as either 2 or 4 optional internal relays and/or 4 external relays expansion module. Typical applications include high or low temperature, level, pressure or flow alarms, control applications such as simple on/off pump control, and pump alternation control for up to 4 pumps. There are four basic ways the relays can be used:

1. High or Low Alarms with Latching or Non-Latching Relays
2. Simple On/Off Control with 100% Adjustable Deadband
3. Sampling (Based on Time)
4. Pump Alternation Control for up to 4 Pumps

Relays Auto Initialization

When power is applied to the meter, the front panel LEDs and alarm relays will reflect the state of the input to the meter. The following table indicates how the alarm LEDs and relays will react on power-up based on the set and reset points:

Alarm #	HI or LO Alarm	Set Point	Reset Point	Power-Up Reading	Relay & LED
1	HI	1000	500	499	Off
2	LO	700	900	499	On
3	LO	250	400	499	Off
4	HI	450	200	499	On

Fail-Safe Operation

The following table indicates how the relays behave based on the fail-safe selection for each relay:

Note: NO = Normally Open, NC = Normally Closed. This refers to the condition of the relay contacts when the power to the meter is off.

Fail-Safe Selection	Non-Alarm State		Alarm State		Power Failure
	NO	NC	NO	NC	
Off	Open	Closed	Closed	Open	Relays go to non-alarm state
On	Closed	Open	Open	Closed	Relays go to alarm state

Front Panel LEDs

The LEDs on the front panel provide status indication for the following:

The meter is supplied with four alarm points that include front panel LEDs to indicate alarm conditions. This standard feature is particularly useful for alarm applications that require visual-only indication. The LEDs are controlled by the set and reset points programmed by the user. When the display reaches a set point for a high or low alarm, the corresponding alarm LED will turn on. When the display returns to the reset point the LED will go off. The front panel LEDs respond differently for latching and non-latching relays.

LED	Status
1	Alarm 1
2	Alarm 2
3	Alarm 3
4	Alarm 4

LED	Status
5	Alarm 5
6	Alarm 6
7	Alarm 7
8	Alarm 8

When the display reaches a set point for a high or low alarm, the corresponding alarm LED will turn on. When the display returns to the reset point the LED will go off. The front panel LEDs respond differently for latching and non-latching relays.

For non-latching relays, the LED is always off during normal condition and always on during alarm condition, regardless of the state of the relay (e.g. Relay acknowledged after alarm condition).

For latching relays, the alarm LEDs reflect the status of the relays, regardless of the alarm condition. The following tables illustrate how the alarm LEDs function in relation to the relays and the acknowledge button (Default: F3 key assigned to ACK).

Latching and Non-Latching Relay Operation

The relays can be set up for latching (manual reset) or non-latching (automatic reset) operation.

The On and Off terminology does not refer to the status of the relay's coil, which depends on the fail-safe mode selected.

Relay terminology for following tables

Terminology	Relay Condition
On	Alarm (Tripped)
Off	Normal (Reset)
Ack	Acknowledged



Warning! *In latching relay mode, latched relays will reset (unlatch) when power is cycled.*

Non-Latching Relay (R_uL_o)

In this application, the meter is set up for automatic reset (non-latching relay). Acknowledging the alarm while it is still present has no effect on either the LED or the relay. When the alarm finally goes away, the relay automatically resets and the LED also goes off.

Automatic reset only		
Condition	LED	Relay
Normal	Off	Off
Alarm	On	On
Ack (No effect)	On	On
Normal	Off	Off

Non-Latching Relay (R_o-n_o R_n)

In this application, the meter is set up for automatic and manual reset at any time (non-latching relay). The LED and the relay automatically reset when the meter returns to the normal condition.

The next time an alarm occurs, the operator acknowledges the alarm manually while the alarm condition still exists. This causes the relay to reset, but the LED stays on until the meter returns to the normal condition.

Automatic + manual reset at any time		
Condition	LED	Relay
Normal	Off	Off
Alarm	On	On
Normal	Off	Off
Next Alarm	On	On
Ack	On	Off
Normal	Off	Off

Latching Relay (L_RL_oH)

In this application, the meter is set up for manual reset at any time. Acknowledging the alarm even if the alarm condition is still present resets the relay and turns off the LED.

Manual reset any time		
Condition	LED	Relay
Normal	Off	Off
Alarm	On	On
Ack	Off	Off

Latching Relay (L_L-L_r)

In this application, the meter is set up for manual reset only after the signal passes the reset point (alarm condition has cleared). Acknowledging the alarm while it is still present has no effect on either the LED or the relay. When the alarm is acknowledged after it returns to the normal state, the LED and the relay go off. Notice that the LED remains on, even after the meter returns to the normal condition. This is because, for latching relays, the alarm LED reflects the status of the relay, regardless of the alarm condition.

Manual reset only after alarm condition has cleared		
Condition	LED	Relay
Normal	Off	Off
Alarm	On	On
Ack (No effect)	On	On
Normal	On	On
Ack	Off	Off

Acknowledging Relays

There are two ways to acknowledge relays programmed for manual reset:

1. Via the programmable front panel function keys F1-F3 (Default: F3 assigned to ACK).
2. Remotely via a normally open pushbutton wired across one of the digital inputs and the +5 V terminals on the digital I/O modules, or using the F4 digital input, which is triggered with a contact closure to COM, or with an active low signal (see page 19).

When the ACK button or the assigned digital input is closed, all relays programmed for manual reset are acknowledged.

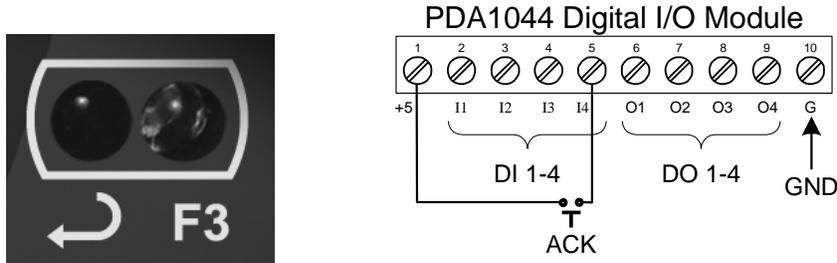


Figure 19. Acknowledge Relays w/ SafeTouch Button or Digital Input

Pump Alternation Control Applications (RLLEr n)

For pump control applications where two or more similar pumps are used to control the level of a tank or a well, it is desirable to have all the pumps operate alternately. This prevents excessive wear and overheating of one pump over the lack of use of the other pumps.

Up to 4 relays can be set up to alternate every time an on/off pump cycle is completed. The set points and reset points can be programmed, so that the first pump on is the first pump off.

Application #1: Pump Alternation Using Relays 1 & 2

1. Relays 1 and 2 are set up for pump alternation.
2. Relays 3 and 4 are set up for low and high alarm indication.

Set and Reset Point Programming			
Relay	Set Point	Reset Point	Function
1	30.000	10.000	Controls pump #1
2	35.000	5.000	Controls pump #2
3	4.000	9.000	Controls low alarm
4	40.000	29.000	Controls high alarm

Pump Alternation Operation

1. Pump #1 turns on when level reaches 30.000, when level drops below 10.000, pump #1 turns off.
2. The next time level reaches 30.000, pump #2 turns on, when level drops below 10.000, pump #2 turns off.
3. If the level doesn't reach 35.000, pump #1 and pump #2 will be operating alternately.
4. If pump #1 cannot keep the level below 35.000, pump #2 will turn on at 35.000, then as the level drops to 10.000, pump #1 turns off, pump #2 is still running and shuts off below 5.000.
5. Notice that with the set and reset points of pump #2 outside the range of pump #1, the first pump on is the first pump to go off. This is true for up to 4 alternating pumps, if setup accordingly.
6. Relay #3 will go into alarm if the level drops below 4.000 and relay #4 will go into alarm if the level exceeds 40.000.

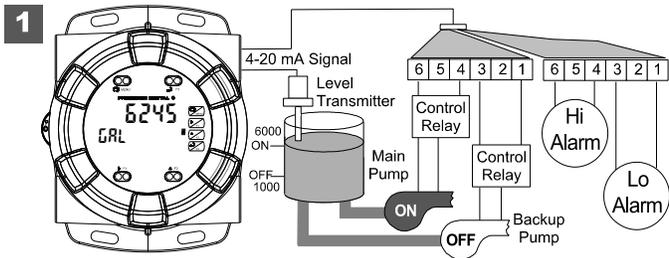
Application #2: Pump Alternation Using Relays 3 & 4

1. Relays 1 and 2 are set up for low and high alarm indication.
2. Relays 3 and 4 are set up for pump alternation.

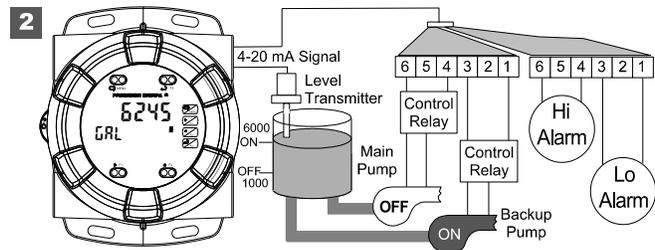
Set and Reset Point Programming			
Relay	Set Point	Reset Point	Function
1	495	750	Controls low alarm
2	7500	6900	Controls high alarm
3	7000	900	Controls backup pump
4	6000	1000	Controls main pump

The following graphics provide a visual representation of a typical pump alternation application with high and low alarm monitoring:

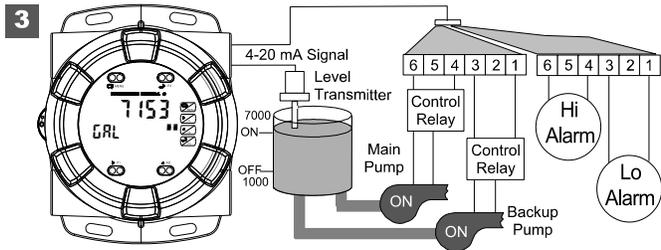
1. Relay #4 turns the main pump on at 6000 gallons and turns it off at 1000 gallons.



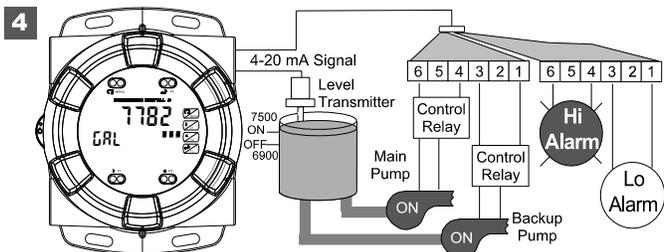
2. With the Pump Alternation feature activated, the next time the level reaches 6000 gallons, relay #3 transfers and starts the backup pump.



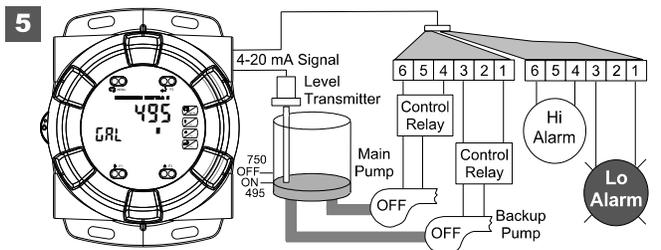
3. If the backup pump is not able to keep up, and the level reaches 7000 gallons, relay #4 transfers and starts the main pump as well.



4. Relay #2 trips the High Level Alarm at 7500 gallons and resets at 6900 gallons.



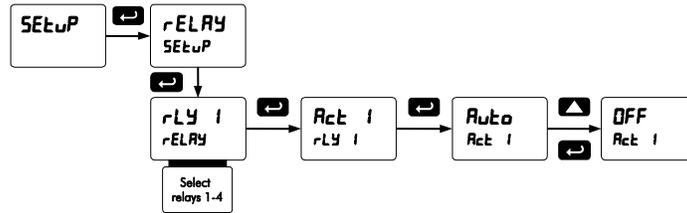
5. Relay #1 trips the Low Level Alarm at 495 gallons and resets at 750 gallons.



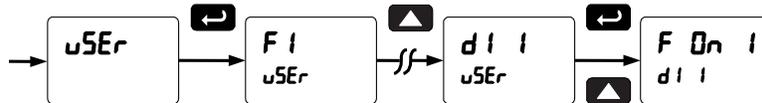
Setting Up the Interlock Relay (Force On) Feature

Relays 1-4 can be set up as interlock relays. To set up the relays for the interlock feature:

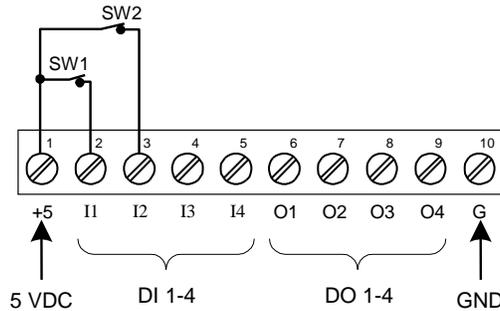
1. Access the *Setup – Relay – Action* menu and set the action to off.



2. In the Advanced features – *User* menu program any of the digital inputs to *Force On* any of the internal relays (1-4).



3. Connect a switch or dry contact between the +5V terminal and the corresponding digital input (DI-1 to DI-4) terminal.



Interlock Relay Operation Example

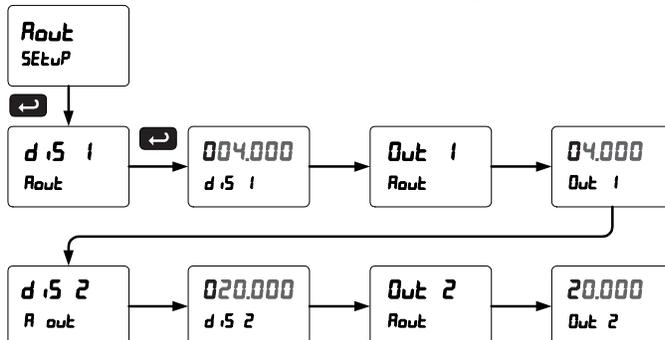
Relays 1 & 2 are configured to energize (their front panel LEDs are off) when SW1 & SW2 switches (above) are closed. If the contacts to these digital inputs are opened, the corresponding front panel LEDs flash indicating this condition. The processes being controlled by the interlock relay will stop, and will re-start only after the interlock relay is re-activated by the digital inputs (switches).

Note: If multiple digital inputs are assigned to the same relay, then the corresponding logic is (AND) – i.e. both switches must be closed to trip the relay.

Scaling the 4-20 mA Analog Output (Rout)

The 4-20 mA analog output can be scaled to provide a 4-20 mA signal for any display range selected. No equipment is needed to scale the analog output; simply program the display values to the corresponding mA output signal.

The *Analog Output* menu is used to program the 4-20 mA output based on display values.



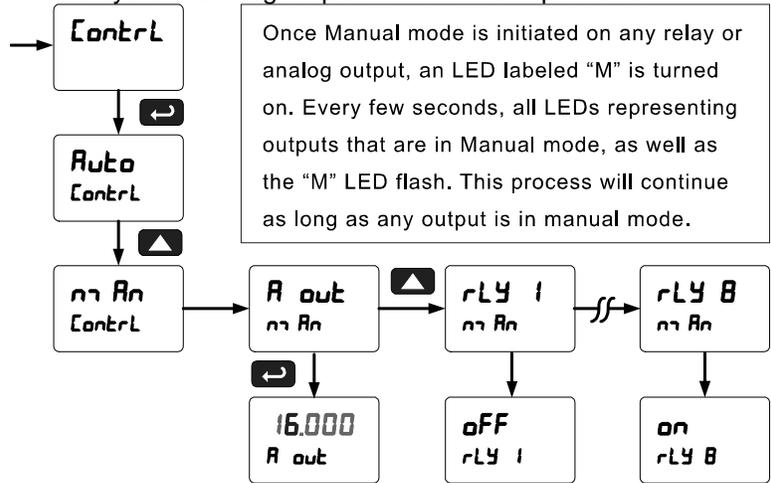
For instructions on how to program numeric values see *Setting Numeric Values*, page 25.

Reset Menu (rESEt)

The *Reset* menu is used to reset the maximum or minimum reading (peak or valley) reached by the process; both may be reset at the same time by selecting “reset high & low” (r5t HL). The tare value used to zero the display may be reset by selecting “reset tare” (r5t tR).

Control Menu (Contrl)

The *Control* menu is used to control the 4-20 mA analog output and the relays manually, ignoring the input. Each relay and analog output can be programmed independently for manual control. Selecting automatic control sets all relays and analog output for automatic operation.



Setting Up the Password (PASS)

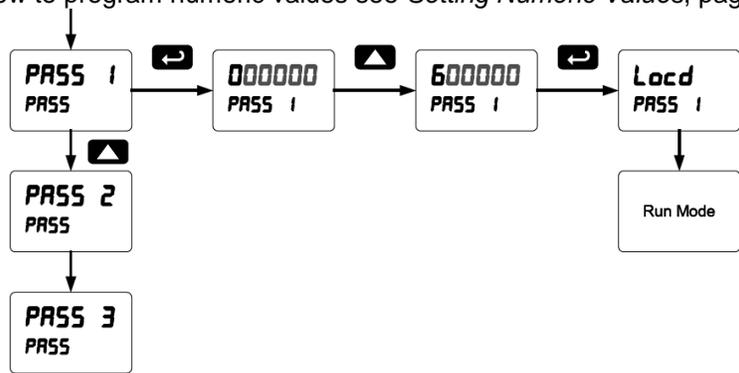
The *Password* menu is used for programming three levels of security to prevent unauthorized changes to the programmed parameter settings.

- Pass 1: Allows use of function keys and digital inputs
- Pass 2: Allows use of function keys, digital inputs and editing set/reset points
- Pass 3: Restricts all programming, function keys, and digital inputs.

Protecting or Locking the Meter

Enter the *Password* menu and program a six-digit password.

For instructions on how to program numeric values see *Setting Numeric Values*, page 25.

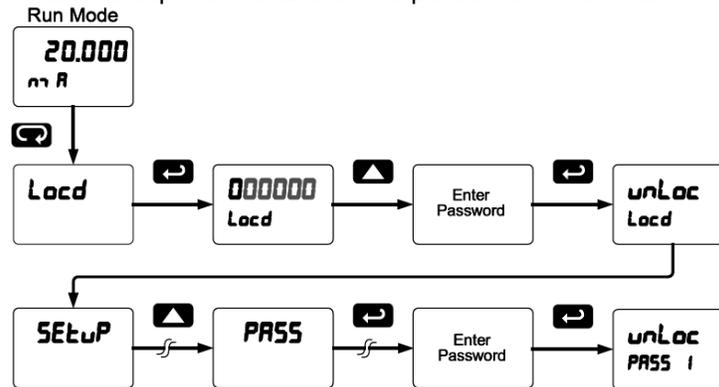


Making Changes to a Password Protected Meter

If the meter is password protected, the meter will display the message *L o c k d* (Locked) when the Menu button is pressed. Press the Enter button while the message is being displayed and enter the correct password to gain access to the menu. After exiting the programming mode, the meter returns to its password protected condition.

Disabling Password Protection

To disable the password protection, access the *Password* menu and enter the correct password twice, as shown below. The meter is now unprotected until a new password is entered.



If the correct six-digit password is entered, the meter displays the message *u n L o c k* (unlocked) and the protection is disabled until a new password is programmed.

If the password entered is incorrect, the meter displays the message *L o c k d* (Locked) for about two seconds, and then it returns to Run Mode. To try again, press Enter while the *Locked* message is displayed.

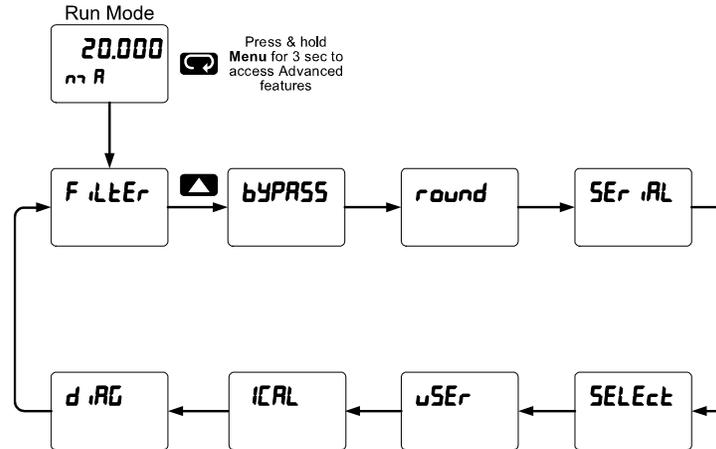
Did you forget the password?

The password may be disabled by entering a master password once. If you are authorized to make changes, enter the master password 508655 to unlock the meter.

Advanced Features Menu

To simplify the setup process, functions not needed for most applications are located in the *Advanced Features* menu.

Press and hold the Menu button for three seconds to access the advanced features of the meter.



Advanced Features Menu & Display Messages

The following table shows the functions and messages of the *Advanced Features* menu in the order they appear in the menu.

Display	Parameter	Action/Setting	Display	Parameter	Action/Setting
F i L T E r	Filter	Set noise filter value	P r o g E	Programmable exponent	Set meter for programmable exponent and enter exponent value
b Y P A S S	Bypass	Set filter bypass value	r h t	Round horizontal tank	Set meter for round horizontal tank volume calculation
r o u n d	Round	Set the rounding value for display variables	l n c h	Dimension	Calculate volume in gallons
S E r i A L	Serial	Set serial communication parameters	l i t r	Dimension	Calculate volume in liters
S L A V E I d	Slave ID	Set slave ID or meter address	d i A m e t e r	Diameter	Enter the tank's diameter in inches
b A u d	Baud rate	Select baud rate	L e n g t h	Length	Enter the tank's length in inches
t r a n s m i t d e l a y	Transmit delay	Set transmit delay for serial communication	C u t o f f	Cutoff	Set low-flow cutoff
P A R I T Y	Parity	Select parity Even, Odd, or None with 1 or 2 stop bits	R o u t P r	Analog output programming	Program analog output parameters
t i m e b y t e	Time byte	Set byte-to-byte timeout	S o u r c E	Source	Select source for the 4-20 mA output
S E L E c t	Select	Enter the Select menu (function, cutoff, out)	O v e r r a n g e	Overrange	Program mA output for display overrange
F u n c t i o n	Signal input conditioning	Select linear, square root, programmable exponent, or round horizontal tank function	U n d e r r a n g e	Underrange	Program mA output for display underrange
L i n e a r	Linear	Set meter for linear function and select number of linearization points	B r e a k	Break	Set input break condition operation
P V 1	PV1	Select PV1 number of linearization points	M a x i m u m	Maximum	Program maximum mA output allowed
P V 2	PV2	Select PV2 number of linearization points	M i n i m u m	Minimum	Program minimum mA output allowed
n o P o i n t s	Number of points	Set PV1 for 2 to 32-point linearization Set PV2 for 2 to 8-point linearization	C a l i b r a t e	Calibrate	Calibrate 4-20 mA output (internal reference source used for scaling the output)
S q u a r e r o o t	Square root	Set meter for square root extraction	4 m A o u t p u t	4 mA output	Enter mA output value read by milliamp meter with at least 0.001 mA resolution

Display	Parameter	Action/Setting	Display	Parameter	Action/Setting
20 mA	20 mA output	Enter mA output value read by milliamp meter with at least 0.001 mA resolution	CL	Current calibration	Calibrate 4-20 mA current input (internal reference source used for scaling the input)
USER	User I/O	Assign function keys and digital I/O	CLo	Current low	Calibrate low current input (e.g. 4 mA)
F1	F1 function key	Assign F1 function key	CLh	Current high	Calibrate high current input (e.g. 20 mA)
F2	F2 function key	Assign F2 function key	UL	Voltage calibration	Calibrate voltage input
F3	F3 function key	Assign F3 function key	ULo	Voltage low	Calibrate low voltage input (e.g. 0 V)
F4	F4 function	Assign F4 function (digital input)	ULh	Voltage high	Calibrate high voltage input (e.g. 10 V)
d1	Digital input 1	Assign digital input 1 – 8, if expansion modules are connected	dRG	Diagnostics	Display parameter settings
dO	Digital output 1	Assign digital output 1 – 8, if expansion modules are connected	LED t	LED test	Test all LEDs
ICL	Internal source calibration	Enter internal source calibration (used for scaling the meter without a signal source)	Info	Information	Display software and S/N information
			ERASE	Erase	Erase MeterView Pro software stored in meter's memory

Noise Filter (FILTER)

The noise filter is available for unusually noisy signals that cause an unstable process variable display. The noise filter averages the input signal over a certain period. The filter level determines the length of time over which the signal is averaged. The filter level can be set between 2 and 199. The higher the filter level, the longer the averaging time and so the longer it takes the display to settle to its final value. Setting the filter level to zero disables the filter function.

Noise Filter Bypass (BYPASS)

The noise filter bypass changes the behavior of the meter so that small variations in the signal are filtered out but large abrupt changes in the input signal are displayed immediately. The bypass value determines the minimum amount of signal change to be displayed immediately. All signal changes smaller than the bypass value are filtered or averaged by the meter. The noise filter bypass may be set between 0.1 and 99.9% of full scale.

Rounding Feature (round)

The rounding feature is used to give the user a steadier display with fluctuating signals. Rounding is used in addition to the filter function.

Rounding causes the display to round to the nearest value according the rounding selected. See examples below:

Rounding Selection	Actual Value	Display Value	Actual Value	Display Value
1	12.022	12.022	12.023	12.023
5	12.022	12.020	12.023	12.025
10	12.024	12.020	12.025	12.030

Modbus RTU Serial Communications (SERIAL)

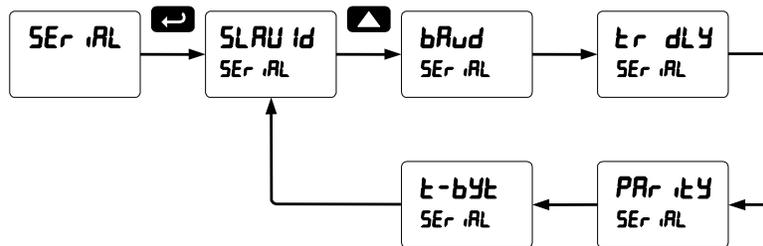
The meter is equipped with serial communications capability as a standard feature using Modbus RTU Serial Communication Protocol.

The meter may be connected to a PC for initial configuration via the onboard micro USB connection. For ongoing digital communications with a computer or other data terminal equipment, an RS-232, or RS-485 option is required; see *Ordering Information* on page 5 for details.

	<p>Do not connect any equipment other than Precision Digital's expansion modules, cables, or meters to the RJ45 M-LINK connector.</p> <p>Warning! Otherwise damage will occur to the equipment and the meter.</p>
---	---

Note: More detailed instructions are provided with each optional serial communications adapter.

Note: Refer to the ProVu® Modbus Register Tables located at www.predig.com for details.



When using more than one meter in a multi-drop mode, each meter must be provided with its own unique address. The meter address (Slave ID) may be programmed between 1 and 247. The transmit delay may be set between 0 and 199 ms. The parity can be set to even, odd, or none with 1 or 2 stop bits.

Serial Communications Overview

RS-232 and RS-485 are standard interfaces approved by the Electronic Industries Alliance (EIA) for connecting serial devices. In EIA terms, the device (e.g. meter) that connects to the interface is called a Data Communications Equipment (DCE) and the device to which it connects (e.g. the computer) is called a Data Terminal Equipment (DTE).

RS-485 can support multi-point connections per line because it uses lower-impedance drivers and receivers.

Line drivers and receivers are used to exchange data between two or more points (nodes) on a serial communications network. Reliable data communications can be difficult in the presence of induced noise, ground level differences, and other hazards associated with installation of a network. When communicating at high data rates, or over long distances in real world environments, RS-232 is often inadequate. The differential data transmission of RS-485 offers superior performance in most applications. Differential signals can help nullify the effects of ground shifts and induced noise signals that can appear as common mode voltages on a network.

A multi-point network consists of multiple drivers and receivers connected on a single bus, where any point (node) can transmit and/or receive data. RS-485 allows multiple drivers and receivers on the same two-wire or four-wire system. The RS-485 standard specifies up to 32 drivers and 32 receivers on a single bus, but with the introduction of "automatic" repeaters and high-impedance drivers/receivers, this number can be extended to hundreds of points (nodes) on a network.

The cabling used for an RS-485 serial communications network should always be a high quality cable such as Belden 8162 or Alpha 6203C. A two-wire system requires two twisted pairs, and a four-wire system requires three twisted pairs (the extra twisted pair is needed for the signal ground).

Figure 20 illustrates how to connect a general four-wire network (a four-wire network actually contains 5 wires).

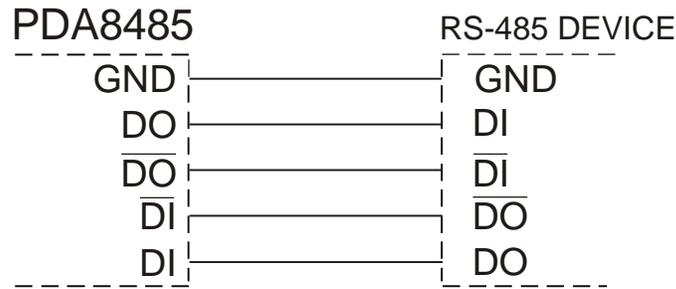


Figure 20: General Four-Wire Network Connection

Figure 21 illustrates how to connect a general two-wire network (a two-wire network actually contains 3 wires). Note that the PDA7485 and PDA8485 have DIP switches that allow for two-wire connections without the need to externally wire the DO to the DI and the $\overline{\text{DO}}$ to the $\overline{\text{DI}}$ (see the converter section for complete details).

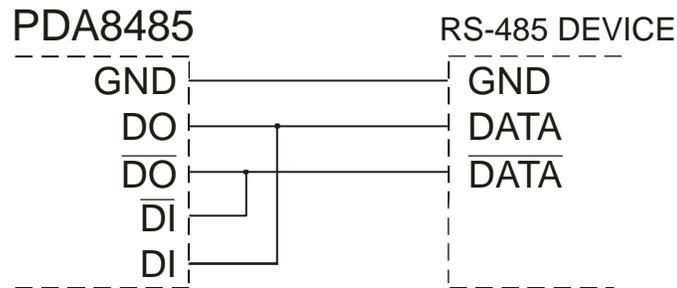
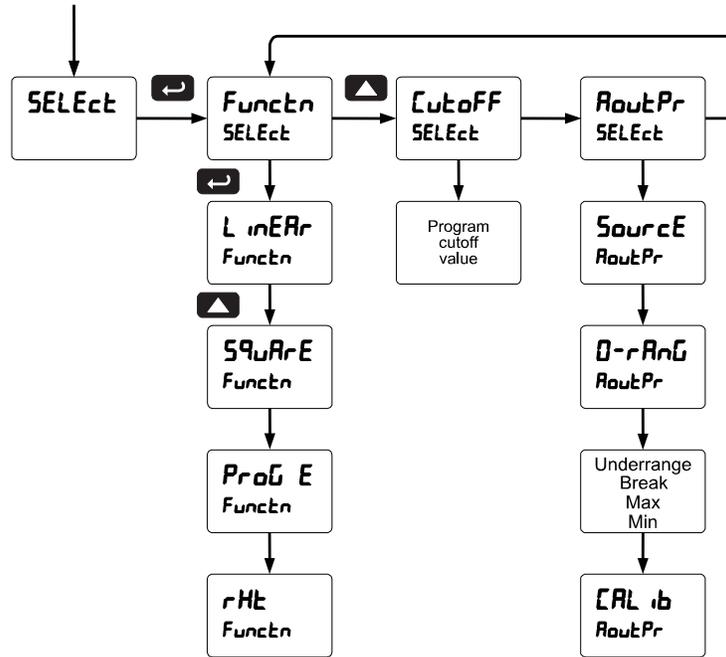


Figure 21: General Two-Wire Network Connection

Select Menu (SELEct)

The *Select* menu is used to select the signal input conditioner applied to the input (linear, square root, programmable exponent, or round horizontal tank), low-flow cutoff, and analog output programming. The multi-point linearization is part of the linear function selection.



Signal Input Conditioning (Functn)

The *Function* menu is used to select the signal input conditioner applied to the input: linear, square root, programmable exponent, or round horizontal tank volume calculation. The multi-point linearization is part of the linear function selection.

Meters are set up at the factory for linear function with 2-point linearization. The linear function provides a display that is linear with respect to the input signal.

Square Root Linearization (SQUArE)

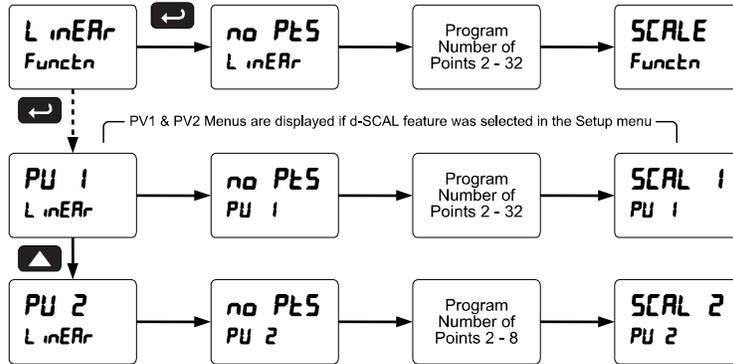
The square root function can be used to linearize the signal from a differential pressure transmitter and display flow rate in engineering units.

Programmable Exponent Linearization (PROG E)

The programmable exponent can be used to linearize the signal from level transmitters in open-channel flow applications using weirs and flumes.

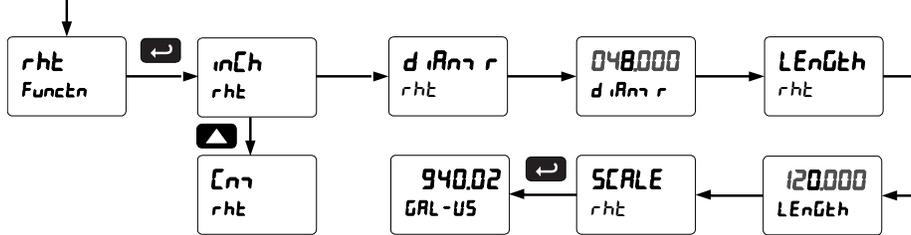
Multi-Point Linearization (L inERr)

Meters are set up at the factory for linear function with 2-point linearization. Up to 32 linearization points can be selected for PV1 under the linear function. The multi-point linearization can be used to linearize the display for non-linear signals such as those from level transmitters used to measure volume in odd-shaped tanks or to convert level to flow using weirs and flumes with complex exponent. If the dual-scale level feature has been selected, the menus for PV1 & PV2 are enabled. PV2 can be programmed with up to 8 linearization points.



Round Horizontal Tank Linearization (rHt)

This function automatically calculates the volume in a round horizontal tank with flat ends. Set the display for the desired decimal point and engineering units before entering the round horizontal tank function. Select units, inches or cm for the tank dimensions. Enter the diameter and the length in inches and the results are calculated automatically in US gallons. The meter can be scaled to display the volume in any engineering unit.



Note: After Scale is displayed continue pressing the Enter button until the meter completes the scaling of the input and display values.

Changing the Volume from Gallons to Liters

In the above graphic, entering the 48" for the diameter and 120" for the length of the round horizontal tank, the meter automatically calculates that the volume of the tank is 940.02 gallons.

1. Convert gallons to liters
 1 US gallon = 3.7854 L
 940.02 gal = 3558.4 L
2. Go to the *Setup* menu and change the decimal point to 1 decimal.
3. Go to the *Program – Scale* menu and press Enter until *d 15 2* is shown on the main display.
4. Press Enter and change the display 2 value to 3558.4.
5. The meter is now displaying the volume in liters.

Note: The display can be scaled to display the volume in any engineering units.

Low-Flow Cutoff (LkOFF)

The low-flow cutoff feature allows the meter to be programmed so that the often-unsteady output from a differential pressure transmitter, at low flow rates, always displays zero on the meter. The cutoff value may be programmed from 0 to 999999. The meter will display zero below the cutoff value. Programming the cutoff value to zero disables the cutoff feature.

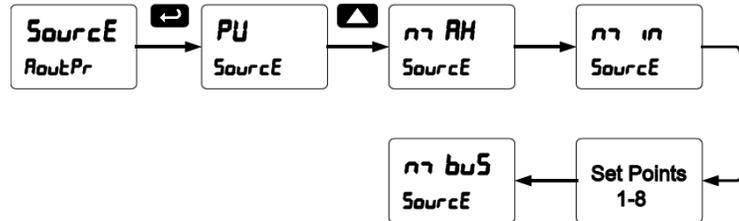
Analog Output Programming (RoutPr)

The *Analog Output Programming* menu is used to program the behavior of the 4-20 mA output. The following parameters and functions are programmed in this menu:

1. Source: Source for generating the 4-20 mA output (e.g. PV)
2. Overrange: Analog output value with display in overrange condition
3. Underrange: Analog output value with display in underrange condition
4. Break: Analog output value when loop break is detected
5. Max: Maximum analog output value allowed regardless of input
6. Min: Minimum analog output value allowed regardless of input
7. Calibrate: Calibrate the internal 4-20 mA source reference used to scale the 4-20 mA output

Analog Output Source

The source for generating the 4-20 mA output may be assigned to the process variable, maximum or minimum value reached by the process, one of the set points, or the Modbus PV input.



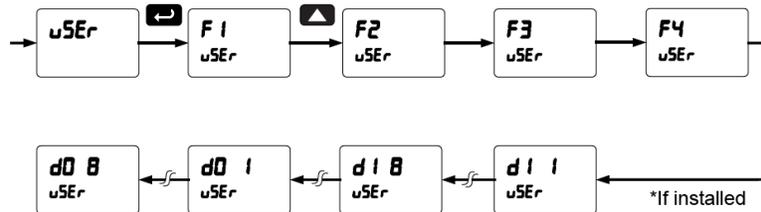
Analog Output Calibration

To perform the analog output calibration, it is recommended to use a milliamp meter with a resolution of at least 0.1 μ A to measure the output current. The values saved internally during this procedure are used for scaling the 4-20 mA output in the *Setup* menu.

Programmable Function Keys User Menu (uSEr)

The *User* menu allows the user to assign the front panel function keys F1, F2, and F3, the digital input F4 (a digital input located on the signal input connector), and up to four additional digital inputs to access most of the menus or to activate certain functions immediately (e.g. reset max & min, hold relay states, etc.). This allows the meter to be greatly customized for use in specialized applications.

Up to four digital outputs can be assigned to a number of actions and functions executed by the meter (i.e. alarms, relay acknowledgement, reset max, min, or max & min, tare, and reset tare). The digital outputs can be used to trigger external alarms or lights to indicate these specific events.



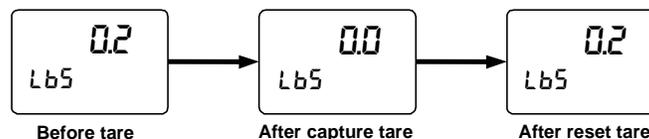
Function Keys & Digital I/O Available Settings

Refer to the following table for descriptions of each available function key or digital I/O setting.

Display	Description	Display	Description
r5t H i	Reset the stored maximum display value	Ln1 H L	Display maximum & minimum display values on line 1
r5t Lo	Reset the stored minimum display value	Ln2 H i	Display maximum display value on line 2
r5t H L	Reset the stored maximum & minimum display values	Ln2 Lo	Display minimum display value on line 2
tArE	Capture tare and zero the display	Ln2 H L	Display maximum & minimum display values on line 2
r5t tr	Reset captured tare and resume normal operation	F On i*	Force relay 1 (*through 4) into the on state. This function is used in conjunction with a digital input expansion module to achieve interlock functionality. See page 41 for details about interlock relays.
rELRY	Directly access the relay menu	Control	Directly access the control menu
SEt i*	Directly access the set point menu for relay 1 (*through 8)	d,SRbL	Disable the selected function key or digital I/O
rLY d	Disable all relays until a button assigned to <i>enable relays</i> (rLY E) is pressed	RcH	Acknowledge all active relays that are in a manual operation mode such as auto-manual or latching
rLY E	Enable all relays to function as they have been programmed	rESEt	Directly access the reset menu
0 Hold	Hold current relay states and analog output as they are until a button assigned to <i>enable relays</i> (rLY E) is pressed	nEnu	Mimic the menu button functionality (digital inputs only)
d Hold	Hold the current display value, relay states, and analog output momentarily while the function key or digital input is active. The process value will continue to be calculated in the background.	r,SHt	Mimic the right arrow/F1 button functionality (digital inputs only)
Ln1 H i	Display maximum display value on line 1	uP	Mimic the up arrow/F2 button functionality (digital inputs only)
Ln1 Lo	Display minimum display value on line 1	EntEr	Mimic the enter/F3 button functionality (digital inputs only)
		RLn i*	Provide indication when alarm 1 (*through 8) has been triggered (digital outputs only)

Tare (tArE)

The tare function zero's out the display. In the case of scale weight, tare is used to eliminate container weight and provide net weight readings. There are two tare functions; Capture Tare and Reset Tare. When the capture tare function is used, the display reading is offset by the displayed amount to make the displayed value zero. This modified display value is the net value. The originally displayed value without the tare offset is the gross value. Both may be chosen as a display option.



Reset tare removes the display offset of the net value, and the gross and net values become the same until a new capture tare is entered.

Internal Source Calibration (ICAL)

The meter is factory calibrated prior to shipment to read in milliamps and volts depending on the input selection. The calibration equipment is traceable to NIST standards.

The use of calibrated signal sources is necessary to calibrate the internal source of the meter. The meter's internal source is what allows the user to scale the meter without applying a signal. Check calibration of the meter at least every 12 months. Each input must be recalibrated separately.

Notes:

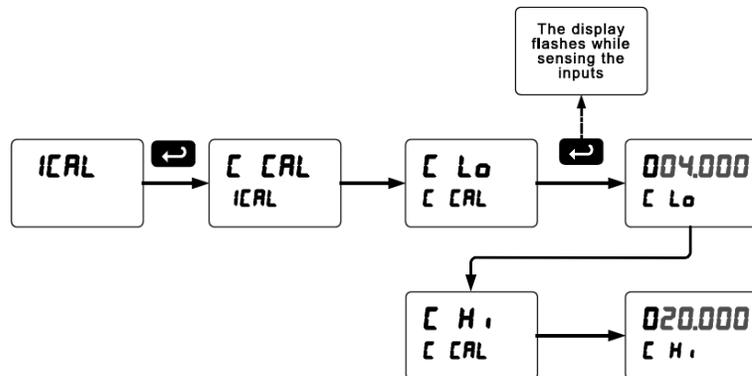
1. If meter is in operation and it is intended to accept only one input type (e.g. 4-20 mA), recalibration of other input is not necessary.
2. Allow the meter to warm up for at least 15 minutes before performing the internal source calibration procedure.

The *Internal calibration* menu is part of the *Advanced Features* menu.

1. Press and hold the Menu button for three seconds to access the advanced features of the meter.
2. Press the Up arrow button to scroll to the *Internal calibration* menu (ICAL) and press Enter.
3. The meter displays either current calibration (C I CAL) or voltage calibration (U I CAL), according to the input setup. Press Enter to start the calibration process.

Example of Internal Calibration for current input:

4. The meter displays *low* input current message (C Lo). Apply the low input signal and press Enter. The display flashes for a moment while the meter is accepting the low input signal.
5. After the display stops flashing, a number is displayed with the leftmost digit brighter than the rest. The bright digit is the active digit that can be changed by pressing the Up arrow button. Press the Right arrow button to move to the next digit.
6. Set the display value to correspond to the input signal being calibrated, typically 4.000 mA.
7. The display moves to the *high* input calibration (C H). Apply the high input signal and press Enter.
8. Set the display for the high input calibration, in the same way as it was set for the low input calibration, typically 20.000 mA.



The graphic above shows the calibration of the current input. The voltage input is calibrated in a similar way.

Tips:

- Low and high input signals can be any valid values within the range of the meter.
- Observe minimum input span requirements between input 1 and input 2.
- Low input should be less than high input signal.

Error Message (Error)

An error message indicates that the calibration or scaling process was not successful.

The error message might be caused by any of the following conditions:

1. Input signal is not connected to the proper terminals, or it is connected backwards.
2. Wrong signal selection in *Setup* menu.
3. Minimum input span requirements not maintained.

Minimum Input Span

The minimum input span is the minimum difference between input 1 and input 2 signals required to complete the calibration or scaling of the meter.

Input Range	Input 1 & Input 2 Span
4-20 mA	0.15 mA
±10 VDC	0.01 VDC

Meter Operation

The meter is capable of accepting current (0-20 mA, 4-20 mA) and voltage signals (0-5 V, 1-5 V, 0-10 V, ± 10 V) and displaying these signals in engineering units from -99999 to 999999 (e.g. a 4-20 mA signal could be displayed as -50.000 to 50.000).

The dual-line display can be customized by the user to operate in such a way as to satisfy a specific application. Typically, the main display is used for the process variable; while the second display is used for engineering units, custom legend, or set point indication.

The analog input can be scaled to display the process in two different scales; for example: with *d-SCAL* enabled, the main display could indicate level in feet and the second display could indicate the volume in gallons.

Additionally, the meter can be set up to display the analog input on the main display and the Modbus input on the second display. The relays and analog output can be programmed to operate from the Modbus PV input.

Buttons Operation

Button Symbol	Description
 	Press to enter or exit Programming Mode, view settings, or exit max/min readings
 	Press to reset max/min readings or other parameter/function assigned through the <i>User</i> menu
 	Press to display max/min readings or other parameter/function assigned through the <i>User</i> menu
 	Press to acknowledge relays or other parameters/function assigned through the <i>User</i> menu

SafeTouch® Buttons

The ProtEX-MAX is equipped with four sensors that operate as through-glass buttons so that it can be programmed and operated without removing the cover (and exposing the electronics) in a hazardous area.

These buttons can be disabled for security by selecting DISABLE on the switch labeled NO-CONTACT BUTTONS located on the connector board.

To actuate a button, press one finger to the glass directly over the marked button area. Then retract finger more than three inches from the glass before pressing the next button. When the cover is removed, the four mechanical buttons located next to the sensors are used. The sensors are disabled when a mechanical button is pressed and will automatically be re-enabled after 60 seconds of inactivity.

The SafeTouch Buttons are designed to filter normal levels of ambient interference and to protect against false triggering, however, it is recommended that the SafeTouch Buttons be disabled (slide switch to LOCK) if there is an infrared interference source in line-of-sight to the display.

The SafeTouch Buttons are configured by default to duplicate the function of the front panel mechanical pushbuttons associated with the integrated meter. The symbols by each SafeTouch button correspond to a mechanical button as shown in the above table.

SafeTouch Button Tips:

- To the extent possible, install the display facing away from sunlight, windows, reflective objects and any sources of infrared interference.
- Keep the glass window clean.
- Tighten the cover securely.
- Use a password to prevent tampering.

 WARNING	Take caution when cleaning the window glass as it may result in unintentional SafeTouch button events. Only clean the ProtEX-MAX when the system is safely shut down, and inspect the ProtEX-MAX for proper configuration prior to system restart.
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F4 Operation

A digital input, F4, is standard on the meter. This digital input is programmed identically to function keys F1, F2, and F3. The input is triggered with a contact closure to COM, or with an active low signal. During operation, F4 operates according to the way it has been programmed in the *Advanced Features – User* menu.

Maximum/Minimum Readings

The max & min readings (peak & valley) reached by the process can be displayed either continuously or momentary:

1. Display briefly by assigning to the F1-F3 function keys or to the digital inputs in the *User* menu.
2. Display continuously by assigning either display to max/min through the *Display* menu.

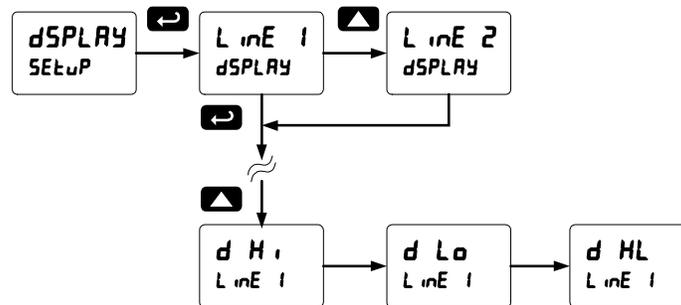
Any of the F1-F3 function keys (buttons) and the digital inputs can be programmed to reset the max & min readings. The meters are set at the factory to display the max reading by pressing the Up arrow/F2 button and to use the Right arrow/F1 button to access the *Reset* menu.

To display max reading using function key with factory defaults:

1. Press Up arrow/F2 button to display maximum reading since the last reset/power-up.
2. To reset max/min press Right arrow/F1 button to access the Reset menu. The max & min displays are reset to actual values.
3. Press Menu to exit max/min display reading.

To display max/min readings continuously:

Assign either display to Max (d H i), Min (d Lo), or toggle between Max and Min (d HL) every 10 seconds.



Troubleshooting

Due to the many features and functions of the meter, it's possible that the setup of the meter does not agree with what an operator expects to see.

If the meter is not working as expected, refer to the *Diagnostics* menu and recommendations below.

Diagnostics Menu (d, RGL)

The *Diagnostics* menu is located in the *Advanced Features* menu, to access *Diagnostics* menu see *Advanced Features Menu*, page 44.

This menu allows the user to test the functionality of all the meter LEDs, check the meter's software and version information, and erase the MeterView Pro software installation files from the meter. Press the Enter button to view the settings and the Menu button to exit at any time.

For a description of the diagnostic messages, see *Advanced Features Menu & Display Messages*, page 44.

Determining Software Version

To determine the software version of a meter:

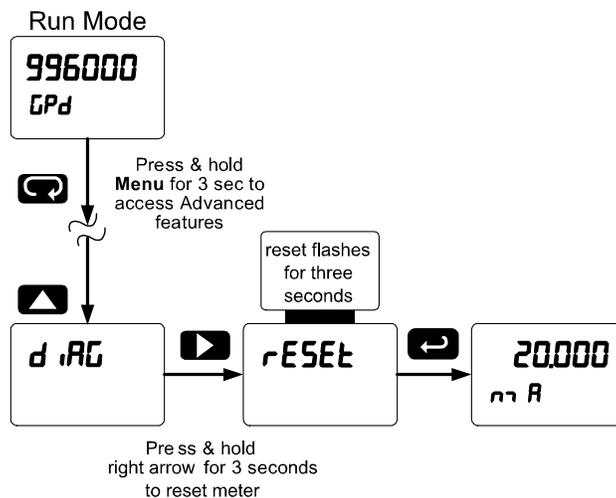
1. Go to the *Diagnostics* menu (d, RGL) and press Enter button.
2. Press Up arrow button and scroll to Information menu (InFd).
3. Press Enter to access the software number (5Ft) and version (vEr) information. Write down the information as it is displayed. Continue pressing Enter until all the information is displayed.
4. The meter returns to Run Mode after displaying all the settings.

Reset Meter to Factory Defaults

When the parameters have been changed in a way that is difficult to determine what's happening, it might be better to start the setup process from the factory defaults.

Instructions to load factory defaults:

1. Enter the *Advanced Features* menu. See *Advanced Features Menu*, page 44.
2. Press Up arrow to go to *Diagnostics* menu
3. Press and hold Right arrow for three seconds, press Enter when display flashes rESEt.
Note: If Enter is not pressed within three seconds, the display returns to the *Diagnostics* menu.
4. The meter goes through an initialization sequence (similar as on power-up), and loads the factory default settings.



Note: The dual-scale selection for some level applications (d-SCAL) is not reset to the single scale factory default. This can be changed using the Setup – Input menu.

Factory Defaults & User Settings

The following table shows the factory setting for most of the programmable parameters on the meter.

Parameter	Display	Default Setting
Input type	INP 1	4-20 mA
Dual-scale feature	D-SLR	No (Single scale)
Filter	FILTER	70
Bypass	BYPASS	0.2
Function	FUNCTION	Linear
Number of points	NOPTS	2
Programming	PROG	Scale
Input 1	INP 1	4.000 mA
Display 1	DIS 1	4.000
Input 2	INP 2	20.000 mA
Display 2	DIS 2	20.000
Decimal point	DDDDDD	3 places
Cutoff value	CUTOFF	0.000 (disabled)
Display assignment	DISPLAY	
Display Line 1	LINE 1	PV: Process variable
Display Line 2	LINE 2	Eng unit default= mA
Display intensity	D-INTY	8
Relay 1 action	ACT 1	Automatic
Relay 1 set point	SET 1	1.000
Relay 1 reset point	RST 1	0.500
Relay 2 action	ACT 2	Automatic
Relay 2 set point	SET 2	2.000
Relay 2 reset point	RST 2	1.500
Relay 3 action	ACT 3	Automatic
Relay 3 set point	SET 3	3.000
Relay 3 reset point	RST 3	2.500
Relay 4 action	ACT 4	Automatic
Relay 4 set point	SET 4	4.000
Relay 4 reset point	RST 4	3.500
Fail-safe relay 1	FLS 1	Off
Fail-safe relay 2	FLS 2	Off
Fail-safe relay 3	FLS 3	Off
Fail-safe relay 4	FLS 4	Off
On delay relay 1	ON 1	0.0 sec
Off delay relay 1	OFF 1	0.0 sec
On delay relay 2	ON 2	0.0 sec
Off delay relay 2	OFF 2	0.0 sec
On delay relay 3	ON 3	0.0 sec

Parameter	Display	Default Setting
Off delay relay 3	OFF 3	0.0 sec
On delay relay 4	ON 4	0.0 sec
Off delay relay 4	OFF 4	0.0 sec
Loop break relay 1	IGNORE	Ignore
Loop break relay 2	IGNORE	Ignore
Loop break relay 3	IGNORE	Ignore
Loop break relay 4	IGNORE	Ignore
Display 1 analog out	DIS 1	4.000
Output 1 value	OUT 1	4.000 mA
Display 2 analog out	DIS 2	20.000
Output 2 value	OUT 2	20.000 mA
Source analog output	SOURCE	Process Variable
Overrange output	O-RANG	21.000 mA
Underrange output	U-RANG	3.000 mA
Loop break output	BRKX	1.000 mA
Maximum output	MAX	23.000 mA
Minimum output	MIN	1.000 mA
Slave ID (Address)	SLAVE ID	247
Baud rate	BAUD	9600
Transmit delay	TR DLY	50 ms
Parity	PARITY	Even
Byte-to-byte timeout	B-BYTE	010 (0.1 sec)
F1 function key	F1	Reset max & min
F2 function key	F2	Line 1: Max (Hi)
F3 function key	F3	Acknowledge relays
F4 function	F4	Acknowledge relays
Digital input 1	DI 1	Menu
Digital input 2	DI 2	Right arrow
Digital input 3	DI 3	Up arrow
Digital input 4	DI 4	Enter
Digital output 1	DO 1	Alarm 1
Digital output 2	DO 2	Alarm 2
Digital output 3	DO 3	Alarm 3
Digital output 4	DO 4	Alarm 4
Password 1	PASS 1	000000 (unlocked)
Password 2	PASS 2	000000 (unlocked)
Password 3	PASS 3	000000 (unlocked)

Troubleshooting Tips

Symptom	Check/Action
SafeTouch buttons do not respond	<p>If mechanical button was pushed. The SafeTouch buttons will be re-enabled automatically 60 seconds after the last button push.</p> <p>If slide switch on connector board is in DISABLE position, switch to ENABLE.</p> <p>Strong direct sunlight may interfere with SafeTouch button operation. It is recommended to operate the buttons by standing so as to block direct sunlight.</p>
Serial Communications Power LED Indicator is off	<ol style="list-style-type: none"> 1. Check modular cable connection 2. Check power to the device
If only the TX (or DATA IN) data status LED is flashing when serial communications attempted	<ol style="list-style-type: none"> 1. Check serial cable 2. Check protocol selected on device 3. Check instrument address & baud rate 4. Check program address & baud rate
If both data status LEDs (TX and RX) are off when trying to communicate	Remove all unnecessary cables and instruments from the bus. Try getting the system to work with only one device (to ease troubleshooting) and then expand the system one device at a time.
Communications slow	Increase the baud rate
Random communication errors	<ol style="list-style-type: none"> 1. Increase the TX delay time 2. Decrease the baud rate
Power LED is off	<ol style="list-style-type: none"> 1. Check modular cable connection 2. Check power to instrument
No display at all	Check power at power connector
Not able to change setup or programming, <i>Lacd</i> is displayed	Meter is password-protected, enter correct six-digit password to unlock
Meter displays error message during calibration (<i>Error</i>)	<ol style="list-style-type: none"> 1. Check signal connections 2. Check input selected in <i>Setup</i> menu 3. Check minimum input span requirements
Meter displays <ol style="list-style-type: none"> 1. <i>999999</i> 2. <i>-99999</i> 	<ol style="list-style-type: none"> 1. Check input selected in <i>Setup</i> menu 2. Check corresponding signal at Signal connector
Display is unstable	<ol style="list-style-type: none"> 1. Check input signal stability and value 2. Check display scaling vs. input signal 3. Check filter and bypass values (increase)
Display response is too slow	Check filter and bypass values
Display reading is not accurate	<ol style="list-style-type: none"> 1. Check signal input conditioner selected: Linear, square root, etc. 2. Check scaling or calibration
Display does not respond to input changes, reading a fixed number	Check display assignment, it might be displaying max, min, or set point.
Display alternates between <ol style="list-style-type: none"> 1. <i>H</i> and a number 2. <i>L</i> and a number 	Press Menu to exit max/min display readings.
Relay operation is reversed	<ol style="list-style-type: none"> 1. Check fail-safe in <i>Setup</i> menu 2. Check wiring of relay contacts
Relay and status LED do not respond to signal	<ol style="list-style-type: none"> 1. Check relay action in <i>Setup</i> menu 2. Check set and reset points
Flashing relay status LEDs	Relays in manual control mode or relay interlock switches opened.
If the display locks up or the meter does not respond at all	Cycle the power to reboot the microprocessor.
Other symptoms not described above	Call Technical Support for assistance.

Note: Certain sequences of events can cause unexpected results. To solve these issues, it is best to start fresh from factory defaults and map changes ahead of time, rather than at random.

Service



WARNINGS

- Installation and service should be performed only by trained service personnel. Service requiring replacement of internal sub-components must be performed at the factory.
- Disconnect from supply before opening enclosure. Keep cover tight while circuits are alive. Conduit seals must be installed within 18" (450mm) of the enclosure.
- Verify that the operating atmosphere of the instrument is consistent with the appropriate hazardous locations certifications.
- If the instrument is installed in a high voltage environment and a fault or installation error occurs, high voltage may be present on any lead
- Read all product labels completely and follow all instructions and requirements listed on the labels for installation or service.

If the enclosure is sound and undamaged, then only the internal electronics housing will need to be returned to the factory for service. Contact the factory for RMA number and return instructions.

Mounting Dimensions

All units: inches (mm)

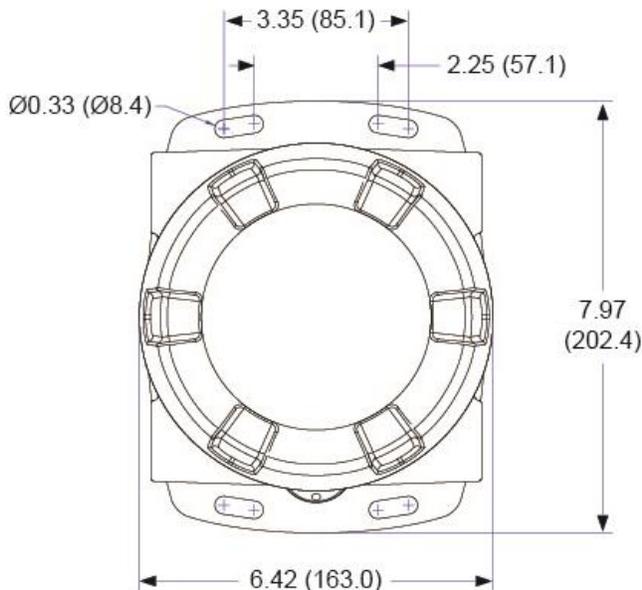


Figure 22: Enclosure Dimensions – Front View

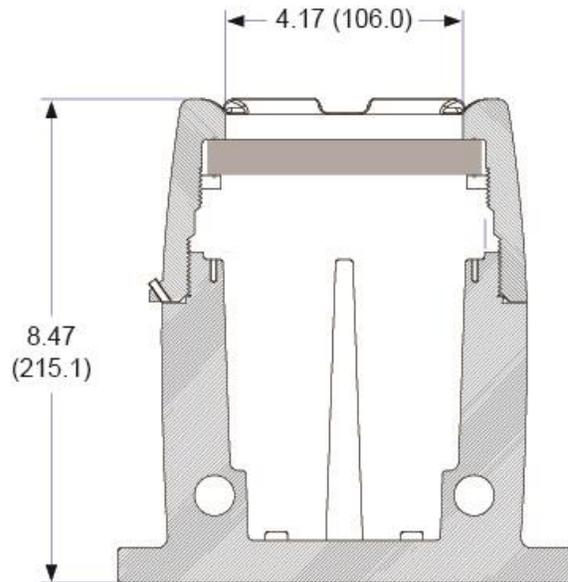


Figure 23: Enclosure Dimensions – Side Cross Section View



EU Declaration of Conformity

Issued in accordance with ISO/IEC 17050-1:2004 and ATEX Directive 2014/34/EU.

We,

Precision Digital Corporation
233 South Street
Hopkinton, MA 01748 USA

as the manufacturer, declare under our sole responsibility that the product(s),

Model PD8 ProtEX-MAX Series

to which this declaration relates, is in conformity with the European Union Directives shown below:

2014/35/EU	Low Voltage Directive
2014/34/EU	ATEX Directive
2014/30/EU	EMC Directive
2011/65/EU	RoHS Directive

This conformity is based on compliance with the application of harmonized or applicable technical standards and, when applicable or required, a European Union notified body certification.

Standards:

EN 55022:2007	EN 61000-6-2:2005	EN 60079-0:2009	EN 61000-6-4:2007
EN 60079-1:2007	EN 61010-1:2001	EN 60079-31:2008	EN 61326:2006

The standards EN 55022:2007, EN 60079-0:2009, EN 60079-1:2007, EN 60079-31:2008, EN 61000-6-4:2007, EN 61010-1:2001, and EN 61326:2006 are no longer harmonized. The requirements of these standards have been checked against the harmonized standard EN 55022:2010, EN 60079-0:2012+A11:2013, EN 60079-1:2014, EN 60079-31:2014, EN 61000-6-4:2007+A1:2011, EN 61010-1:2010, and EN 61326:2013 and there were no major technical changes affecting the latest technical knowledge for the products listed above.

EC Type Examination Certificate: Sira 12ATEX1182

Product Markings:

 II 2 G D
Ex d IIC T* Gb
Ex tb IIIC T90°C Db IP68
Tamb = -40°C to +*°C (*T5 = 65°C, *T6 = 60°C)

ATEX Notified Body for EC Type Examination Certificate: Sira Certification Service, NB 0518
Unit 6, Hawarden Industrial Park
Hawarden, Deeside, CH5 3US, UK

ATEX Quality Assurance Notification No.: SIRA 10 ATEX M462

ATEX Notified Body for Quality Assurance: Sira Certification Service, NB 0518
Unit 6, Hawarden Industrial Park
Hawarden, Deeside, CH5 3US, UK

Signed for and on behalf of Precision Digital Corporation:



Name: Jeffrey Peters
Company: Precision Digital Corporation
Title: President
Date: 02/12/2018

Document No: DoC PD8 {021218}

How to Contact Precision Digital

- For Technical Support, please
Call: (800) 610-5239 or (508) 655-7300
Fax: (508) 655-8990
Email: support@predig.com
- For Sales Support or to place an order, please contact your local distributor or
Call: (800) 343-1001 or (508) 655-7300
Fax: (508) 655-8990
Email: sales@predig.com
- For the latest version of this manual, please visit
www.predig.com

PRECISION DIGITAL CORPORATION

233 South Street • Hopkinton MA 01748 USA
Tel (800) 343-1001 • Fax (508) 655-8990



www.predig.com