Easy Single Button Scaling (SBS)
4-20 mA, 0-5 V, or 0-10 V Field Selectable Inputs
24 V Transmitter Power Supply Standard
Scale Without a Calibrator
Calibrate with a Signal Source
Steady, Accurate Display to ± 199,990
11-Point Linearization for Non-Linear Inputs
Square Root Extraction with Low-Flow Cutoff
41/2 Digit + Extra Zero
NEMA 4X, IP65 Front Panel
2 or 4 Relays + 4-20 mA Output Options
115 VAC, 230 VAC, or 24 VDC Power Options
Lockout Feature
Non-Volatile Memory, No Battery Needed
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INTRODUCTION

This meter is a high performance, easy to use, industrial-grade microprocessor-based digital process meter. It accepts all the standard process signals: 4-20 mA, 1-5V, 0-5V and 0-10V and displays these signals in engineering units on a 4½ digit display. The display includes an extra zero, which may be used to handle numbers up to 199,990. The meter also provides 24 VDC to power the transmitter. Options include 2 or 4 relays and an Isolated 4-20 mA Transmitter Output.

Typical Applications

Level:
- Sump Pump Control
- Water Tank Level
- Round Horizontal Tank Volume Measurement
- Well Draw-down
- Lift Station Control

Flow:
- Square Root Extraction from a DP Transmitter

Pressure:
- Compound Pressure
- High Pressure Alarms

Ordering Information

<table>
<thead>
<tr>
<th>115 VAC Model</th>
<th>230 VAC Model</th>
<th>24 VDC Model</th>
<th>Options Installed</th>
<th>Option Card*</th>
</tr>
</thead>
<tbody>
<tr>
<td>PD690-3-N</td>
<td>PD690-4-N</td>
<td>PD690-2-N</td>
<td>No Options</td>
<td></td>
</tr>
<tr>
<td>PD690-3-14</td>
<td>PD690-4-14</td>
<td>PD690-2-14</td>
<td>2 Relays</td>
<td>PD174</td>
</tr>
<tr>
<td>PD690-3-15</td>
<td>PD690-4-15</td>
<td>PD690-2-15</td>
<td>4-20mA Out</td>
<td>PD175</td>
</tr>
<tr>
<td>PD690-3-16</td>
<td>PD690-4-16</td>
<td>PD690-2-16</td>
<td>2 Relays + 4-20mA Out</td>
<td>PD176</td>
</tr>
<tr>
<td>PD690-3-17</td>
<td>PD690-4-17</td>
<td>PD690-2-17</td>
<td>4 Relays</td>
<td>PD177</td>
</tr>
<tr>
<td>PD690-3-18</td>
<td>PD690-4-18</td>
<td>PD690-2-18</td>
<td>4 Relays + 4-20mA Out</td>
<td>PD178</td>
</tr>
</tbody>
</table>

Ordering example: PD690-3G-14, process meter powered from 115 VAC (-3) with 2 relays (-14).

*Part numbers for Option Cards when purchased separately
Safety Notice

CAUTION: Read complete instructions prior to installation and operation of the Meter.

WARNING: Risk of electric shock.

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

Do not use this meter to directly drive heavy equipment such as pumps, motors, valves, etc.

It is recommended to use this meter in a fail-safe system that accommodates the possibility of meter failure or power failure.

**WARNING**

*Hazardous voltages exist within enclosure. Installation and service should be performed only by trained service personnel.*

**AVERTISSEMENT**

*Les pièces à l’intérieur du boîtier portent des tensions dangereuses. Seules des personnes qualifiées et bien entraînées devraient entreprendre l’étalonnage et la maintenance.*

**DISCLAIMER**

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

Basic Meter

**INPUTS**
Field selectable: 4-20 mA, 0-20 mA, 0-5 V, 1-5 V, 0-10 V.

**DISPLAY**
Bright, large, 0.56" (14.2mm) high efficiency red LEDs. 4½ digits + extra zero may be switched on to display +/- 19,999(0). Leading zeros blanked.

**DECIMAL POINT**
Decimal point may be placed in any of the following positions: 1.9999, 19.999, 199.99, 1999.9, 19999 or 199990 with extra zero.

**CALIBRATION RANGE**
4 mA (1 V) input may be set anywhere in range of the meter. 20 mA (5 V) may be set anywhere in range of the meter above or below 4 mA input. An Error message will appear if Input 1 signal and Input 2 signal are too close together.

<table>
<thead>
<tr>
<th>Input Range</th>
<th>Minimum Difference Between Input 1 &amp; Input 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5 V</td>
<td>0.16 V</td>
</tr>
<tr>
<td>0-10 V</td>
<td>0.32 V</td>
</tr>
<tr>
<td>4-20 mA</td>
<td>1.60 mA</td>
</tr>
</tbody>
</table>

**INPUT IMPEDANCE**
Voltage ranges, greater than 300 KΩ; current ranges, 100-120 Ω.

**LOOP POWER**
(AC powered meters only), Isolated 24 VDC ± 5% @ 20 mA regulated. Maximum loop resistance is 1200 Ω. Available for either signal input or 4-20 mA output, but not both.

**HOLD READING**
Connect terminals H and CM

**ACCURACY**
±0.05% of calibrated span, ±1 count.

**SQUARE ROOT EXTRACTION**
±0.1% F.S. ± 1 count from 10-100% of flow.

**LOW FLOW CUTOFF**
Any input below the Low-Flow Cutoff point will result in a display of zero. May be set from 1 count to 100% of full scale, user selectable.
### 11-POINT LINEARIZATION

<table>
<thead>
<tr>
<th>Input Range</th>
<th>Minimum Span Between Inputs</th>
</tr>
</thead>
<tbody>
<tr>
<td>4-20 mA</td>
<td>(1.6 mA / (Number of points -1))</td>
</tr>
<tr>
<td>0-5 V</td>
<td>(0.16 V / (Number of points -1))</td>
</tr>
<tr>
<td>0-10 V</td>
<td>(0.32 V / (Number of points -1))</td>
</tr>
</tbody>
</table>

*Example: Minimum span for an 11-point, 4-20 mA calibration is 0.16 mA between inputs.*

### ALARM POINTS

Four, any combination of high or low alarms.

### ALARM POINT DEADBAND

0-100% of full scale, user selectable.

### ALARM STATUS INDICATION

Front panel LED.

### LOCKOUT

Jumper J3 restricts modification of calibration values.

### NON-VOLATILE MEMORY

All programming values are stored in non-volatile memory for a minimum of ten years if power is lost. No battery needed.

### NORMAL MODE REJECTION

64 dB at 50/60 Hz

### POWER

AC power, 115 or 230 VAC ±10%, 50/60 Hz, 10 VA.
DC Power, 18-36 VDC; 6 watts maximum.

### ENCLOSURE

1/8 DIN, High Impact plastic, UL 94V-0

### FRONT PANEL

Type 4X, NEMA 4X, Panel Gasket provided

### ENVIRONMENTAL

Operational ambient temperature range: 0 to +60°C. Storage temperature range: -40 to +85°C. Relative humidity: 0 to 90% non-condensing.

### WEIGHT

19.7 oz (559 g) (including options)

### CONNECTIONS

Removable screw terminal blocks (provided) accept 22 to 12 AWG wire.

### WARRANTY

2 years parts & labor.

### EXTENDED WARRANTY

1 or 2 years, refer to the Price List for details.

### UL FILE NUMBER

E160849; 508 Industrial Control Equipment

### Options

Relays

**RATING**

2 or 4 SPDT (form C); rated 2 Amp @ 30 VDC or 2 Amp @ 250 VAC resistive load; 1/14 HP @ 125 / 250 VAC for inductive loads.
RESET

User Select:
1. Automatically when input passes reset point.
2. Automatically + Manually (via user supplied switch or front panel ACK button). Manual reset resets all manually resetable relays.

DEADBAND

0-100% of full scale, user selectable.

HIGH OR LOW ALARM

User may program any alarm for a high or low trip point.

FAIL-SAFE OPERATION

Relay coils are energized in non-alarm condition. In case of power failure, relays will go to alarm state. Fail-Safe operation may be disabled, by removing jumper J2 located on the Options Board.

AUTO INITIALIZATION

When power is applied to the meter, relays will always reflect the state of the input to the meter.

Isolated 4-20 mA Transmitter Output

CALIBRATION RANGE

The transmitter output can be calibrated so that a 4 mA output is produced for any number displayed by the meter. The 20 mA output may correspond to any number that is at least 501 counts greater or smaller than the number corresponding to 4 mA. (Ex. 4 mA = 0, 20 mA = 501) If the span between 4 and 20 mA is less than 501 counts, an error message will appear.

EQUIPMENT NEEDED

The 4-20 mA output is calibrated without the use of a calibrator. No equipment needed.

OUTPUT LOOP-POWER

(AC powered meters only), Isolated 24 VDC ± 5% @ 20 mA regulated. Maximum loop resistance is 1200 Ω. Available for either signal input or 4-20 mA output, but not both.

ACCURACY

± 0.1% F.S., ± 0.004 mA.

ISOLATION

500 VDC or peak AC, input-to-output or input/output-to-power line.

EXTERNAL LOOP-POWER SUPPLY

35 VDC max.

OUTPUT LOOP RESISTANCE

<table>
<thead>
<tr>
<th>Power supply</th>
<th>Min. loop resistance</th>
<th>Max loop resistance</th>
</tr>
</thead>
<tbody>
<tr>
<td>24 VDC</td>
<td>10 Ω</td>
<td>600 Ω</td>
</tr>
<tr>
<td>35 VDC (external)</td>
<td>600 Ω</td>
<td>1000 Ω</td>
</tr>
</tbody>
</table>
Display Messages and Functions

The following table describes the various messages displayed by the meter during programming and operation:

<table>
<thead>
<tr>
<th>Display</th>
<th>Parameter</th>
<th>Description/Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>E-CRL</td>
<td>Select External Calibration</td>
<td>Set meter for calibration using an external calibration source.</td>
</tr>
<tr>
<td>I-CRL</td>
<td>Select Internal Calibration</td>
<td>Set meter for calibration (scaling) using Internal calibration source.</td>
</tr>
<tr>
<td>CRL fb</td>
<td>Perform External Calibration</td>
<td>Calibrate meter using an external calibration source.</td>
</tr>
<tr>
<td>SCALE</td>
<td>Perform Internal Calibration (scaling)</td>
<td>Calibrate meter (scale) using internal calibration source. (Signal source not required).</td>
</tr>
<tr>
<td>InPt 1</td>
<td>Input 1</td>
<td>Set Input 1 calibration value.</td>
</tr>
<tr>
<td>dSpy 1</td>
<td>Display 1</td>
<td>Set Display 1 calibration value.</td>
</tr>
<tr>
<td>InPt 2</td>
<td>Input 2</td>
<td>Set Input 2 calibration value.</td>
</tr>
<tr>
<td>dSpy 2</td>
<td>Display 2</td>
<td>Set Display 2 calibration value.</td>
</tr>
<tr>
<td>dECPt</td>
<td>Decimal Point</td>
<td>Set decimal point or light up extra &quot;0&quot;.</td>
</tr>
<tr>
<td>nPtS</td>
<td>Number of Points</td>
<td>Set meter for 2 to 11 calibration points.</td>
</tr>
<tr>
<td>L or S</td>
<td>Linear or Square</td>
<td>Set meter for Linear or Square Root calibration/scaling.</td>
</tr>
<tr>
<td>Cutoff</td>
<td>Low-Flow Cutoff</td>
<td>Set meter to display zero below programmed cutoff point.</td>
</tr>
<tr>
<td>Alarms</td>
<td></td>
<td>Program alarm/relay set and reset points.</td>
</tr>
<tr>
<td>Output</td>
<td>Output</td>
<td>Set 4-20 mA output values.</td>
</tr>
<tr>
<td>19999</td>
<td>Overrange</td>
<td>Indicates input signal exceeds full-scale range of meter.</td>
</tr>
<tr>
<td>-19999</td>
<td>Underrange</td>
<td>Indicates input signal is below the negative range of meter.</td>
</tr>
<tr>
<td>Error</td>
<td>Error</td>
<td>Indicates calibration was not successful.</td>
</tr>
</tbody>
</table>
SETUP AND PROGRAMMING

Power, Signal, External Functions & Options Connections

⚠️ Disconnect power to the meter before making any connections.

⚠️ Do not connect power or earth ground to any unused or CM terminals.

⚠️ Observe polarity for DC powered Meters. Applying voltage with reverse polarity may damage the instrument.

⚠️ Connecting 230 VAC to a meter specified to accept 115 VAC or connecting AC power to a meter specified to accept DC power will result in damage to the instrument as well as endanger personnel. Keep primary wires separated from signal cables.

Notice:
- Primary voltages must not be accessible to the user.
- Primary wires must be installed in accordance to the applicable standards.

**Terminals Designation**

<table>
<thead>
<tr>
<th>Terminal</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>L, L</td>
<td>AC input power</td>
</tr>
<tr>
<td>V+, V-</td>
<td>DC input power</td>
</tr>
<tr>
<td>P+, P-</td>
<td>24 VDC output power</td>
</tr>
<tr>
<td>S+, S-</td>
<td>Input signal</td>
</tr>
<tr>
<td>AK</td>
<td>External relay acknowledge</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Terminal</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>H</td>
<td>Hold reading</td>
</tr>
<tr>
<td>CM</td>
<td>Common (return) for AK and H</td>
</tr>
<tr>
<td>+, -</td>
<td>4-20 mA output</td>
</tr>
<tr>
<td>1-6</td>
<td>Relay 1-4</td>
</tr>
</tbody>
</table>
Overview
The following field wiring connections are made to removable screw terminal blocks supplied with the meter:

- **Power, Signal Input, Acknowledge and Hold**

Options: Relays & 4-20 mA Output

![Diagram of wiring connections](image)

**Figure 1: Rear View of Meter (Connectors)**

<table>
<thead>
<tr>
<th>Label</th>
<th>Main Board (Lower)</th>
<th>Wire Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>Power</td>
<td>12-18</td>
</tr>
<tr>
<td>None</td>
<td>Signal, Acknowledge, Hold</td>
<td>12-22</td>
</tr>
</tbody>
</table>

**Options Board (Upper)**

<table>
<thead>
<tr>
<th>Label</th>
<th>Main Board (Upper)</th>
<th>Wire Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>J1</td>
<td>4-20 mA Output</td>
<td>12-22</td>
</tr>
<tr>
<td>J2</td>
<td>Relays 1 &amp; 2; NC, NO, Common</td>
<td>12-22</td>
</tr>
<tr>
<td>J3</td>
<td>Relays 3 &amp; 4; NC, NO, Common</td>
<td>12-22</td>
</tr>
</tbody>
</table>

**Wiring Instructions**

1. All field connections to be made with either solid or stranded insulated wire. Strip length = 1/4" (7 mm). Tighten all screw terminals to 4.5 lb-in (0.5 Nm). Do not pre-treat wire with solder.

2. Terminals connected to line voltage (e.g. L, RELAY 1-4): Use AWG # 12-18 copper wire, 600 volt, 60°C or 60/75°C. Connect only one wire to each terminal.

3. Terminals not connected to line voltage (e.g. AK, H, CM, S+, S-, P+, P-, V+, V-, OUTPUT): Use AWG #12-22 wire. If using AWG #20 or smaller wire, up to two wires may be connected to each terminal. If using AWG #18 or larger wire, only one wire may be connected to each terminal.
AC Powered Meters (Power, Signal, External Functions)

Figure 2: Transmitter Powered from Meter

Figure 3: Transmitter Powered from External Power Supply
AC Powered Meters (Continued)

Figure 4: Three-Wire Transducer Powered from Meter

Figure 5: Voltage or Self-Powered 4-20 mA Input
DC Powered Meters (Power, Signal, External Functions)

Figure 6: Transmitter and Meter Powered from Same DC Power Supply

Figure 7: Transmitter and Meter Powered from Separate DC Power Supplies
Relays & 4-20 mA Output

Depending on the model number, the Options Board may contain two or four relays and an Isolated 4-20 mA Transmitter Output. Relay connections are made to removable screw terminal connectors located at J2 and J3 on the Options Board. Connections for the Isolated 4-20 mA Transmitter Output are made to J1 on the Options Board.

![Diagram of Option Card Pinouts]

**Figure 8: Option Card Pinouts**

Notes:
1. Alarm acknowledgement terminals (ACK and COM) are located on the meter main board.
2. In the alarm condition, the NC contact is connected to common in the fail safe mode.

![Diagram of Rear View of Meter (Connectors)]

**Figure 9: Rear View of Meter (Connectors)**
4-20 mA Output

The 4-20 mA output from the meter can either be powered from the meter’s internal transmitter power supply, (if it is not being used to power the input loop), or by an external power supply as the following diagrams illustrate:

![Diagram 1: Meter Powering 4-20 mA Output Loop](image1)

![Diagram 2: External Power Supply Powering 4-20 mA Output Loop](image2)

If the output loop is powered by an external supply, the loop power supply must be turned on before the meter is turned on. Otherwise, the output loop signal may be incorrect.
Programming

Overview
The meter is programmed using the ENTER button and three jumper arrays. The ENTER button controls the meter’s Single Button Scaling (SBS) feature that allows the meter to be completely programmed using just one button. The jumper arrays are used for programming the input signal, lockout, relays acknowledge enable and relays fail-safe operation.

Single Button Scaling (SBS)
Single Button Scaling is a technique that allows the meter to be completely programmed using just the ENTER button. The general method behind (SBS) is to push ENTER when the meter reads the desired value. This value may be a menu title, the entire display or just a single digit. If the meter is not reading the desired value wait and the value will change. When the meter finally reads the desired display push ENTER to accept it.

When the meter is first powered up, it will read a random number. Pushing ENTER will cause the meter to scroll through the following menu titles (if the Lockout Jumper is not installed):

Push ENTER

Display scrolls programming routines. Push ENTER to select desired routine.

CAL 1b* SCALE
dECpt
no. Pt 5
L or 5
RLAr 5
outPut**

Push ENTER

Push ENTER

Push ENTER

Push ENTER

Push ENTER

Push ENTER

2 point Calibration
Set Decimal Point
11 point Calibration
Linearization or Square Root
Program Alarms
Calibrate 4-20 mA Output

* CAL 1b appears if E-CAL is selected
SCALE appears if I-CAL is selected

** Only appears if 4-20 mA output is installed

Figure 12: Menu Scroll (with Lockout Jumper Removed)
**Figure 13: Two-point External Calibration Flow Chart**

1. Push ENTER
2. Push ENTER when [RL] Ib appears and input 1 flashes
3. Apply input 1 signal (e.g. 4 mA)
4. Push ENTER
5. Is entire flashing display OK?
   - YES: Push ENTER
   - NO: Wait for digit to flash
6. Is the flashing digit OK?
   - YES: Push ENTER
   - NO: Push ENTER when OK
7. Wait for digit to scroll
8. Has input 2 been calibrated yet?
   - YES: Calibration Complete!
   - NO: Push ENTER
9. Push ENTER when input 2 flashes (e.g. 20 mA)
10. Is entire display flashing?
    - YES: Push ENTER
    - NO: Push ENTER when OK
Five Basic Digit/Display-setting Instructions

Rather than repeat the Single Button Scaling (SBS) technique for every function it is used in, it will be detailed here and the user can refer to it when necessary.

The Single Button Scaling technique is used to program all the meter's functions that require numbers to be entered. For instance, calibration and scaling values, Low-Flow Cutoff values, alarm set and reset points, 4 and 20 mA output values are set using (SBS).

1. If the flashing display is OK, push ENTER before it stops flashing to accept it. (Whenever a new value is to be programmed or Most Significant Digit has been accepted the entire display flashes, if this is the desired value, press ENTER before it stops flashing to accept it.)
2. If the flashing display is not OK, (or if ENTER was not pushed in time to accept it), wait for Least Significant Digit (LSD) to flash.
3. If a flashing digit is OK, push ENTER before it starts to scroll to accept it.
4. If a flashing digit is not OK, (or if ENTER was not pushed in time to accept it), wait for the digit to scroll and push ENTER when OK.
5. Digits will scroll until ENTER is pushed. When a digit is accepted by pushing ENTER, the next digit to the left flashes.

Basic Meter Programming

Overview

There are four steps for programming the basic meter functions:
1. Select Input
2. Perform Initial Calibration if Needed
3. Select Calibration Method
4. Calibrate or Scale the Meter

Programmed Parameter Values

To simplify programming, the user should write down the desired programming values prior to attempting to program the meter. The form located at the back of this manual provides a convenient method to record the user settings.
Select Input Signal

The meter can be programmed to accept current or voltage input using the Signal Input Selection Array. This jumper array is located at the rear of the instrument, next to the screw terminal block. Remove jumper J3 (if installed) to disable Lockout feature.

<table>
<thead>
<tr>
<th>Input Signal</th>
<th>Jumper J1</th>
<th>Jumper J2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-5, 0-5V</td>
<td>OFF</td>
<td>OFF</td>
</tr>
<tr>
<td>0-10 V</td>
<td>OFF</td>
<td>ON</td>
</tr>
<tr>
<td>4-20,0-20 mA</td>
<td>ON</td>
<td>OFF</td>
</tr>
</tbody>
</table>

**Table 1: Signal Input Selection Array**

Initial Calibration with External Source (If Needed)

Initial calibration is required only when the \(I-\text{CAL}\) feature is to be used with an input other than the default input of 4-20 mA. For best results, allow the meter to warm up for at least 30 minutes.

1. Program the Signal Input Selection Array for desired input per Table 1 above.
2. Apply power with ENTER and ACK buttons pushed. Release when display stops flashing.
3. The meter scrolls through the choices 20, 5, and 10. Which corresponds to input signals of 4-20 mA, 0-5 V or 1-5 V, and 0-10 V. Push ENTER when desired value appears.
4. The meter flashes \(\text{InPt} \ 1\). Apply low end signal, (4 mA or 0 V)*, push ENTER.
5. The meter flashes \(\text{InPt} \ 2\). Apply high end signal, (20 mA, 5 V, 10 V), push ENTER.
6. This completes the Initial Calibration and initializes INPUT 1 and INPUT 2 scaling points to 4.000 & 20.000 mA, 0.000 & 5.000 V, or 0.000 & 10.000 V.
7. Refer to \(I-\text{CAL}\) scaling below for further instructions.

*For 1-5 V input signals, calibrate the meter with input1=0 V, input 2=5 V.
Select Calibration Method

The meter may be calibrated using an external signal source such as a calibrator (E-\text{CAL}) or scaled using the internal source (I-\text{CAL}). With I-\text{CAL}, a 4-20 mA input can be scaled for any display range without applying a signal. To scale inputs such as 0-5 V, 1-5 V or 0-10 V without applying a signal, it is necessary to first complete an Initial Calibration, see Initial Calibration with External Source (If Needed) on page 20.

Scale or Calibrate the Meter

To select a Calibration Method, apply power with \text{ACK} button pressed.

1. When display stops flashing, release \text{ACK} button. Display alternates between E-\text{CAL} and I-\text{CAL}.
2. To calibrate meter with an external source, such as a calibrator, press \text{ENTER} when E-\text{CAL} appears.
3. To scale meter with internal source, press \text{ENTER} when I-\text{CAL} appears.

Select Decimal Point (dECP\text{L})

To program the decimal point or light up the extra "0", push \text{ENTER}. The meter displays \text{SCALE} or \text{CAL} 1b, then dECP\text{L}. Push \text{ENTER} when dECP\text{L} appears. The meter then reads 199990 with the decimal point changing locations and the extra "0" illuminating. Push \text{ENTER} when the decimal point is in the desired position; or if the extra "0" is desired; when the extra "0" is displayed.

Select Linear Input (L or 5)

The meter can be programmed to either process the input signal in a linear fashion (L) or to take the square root of it (5). To program the meter for a linear input, push \text{ENTER}. When (L or 5) appears, push \text{ENTER} again. The meter will flash (L or 5) alternately. Press \text{ENTER} when (L) is flashing. After (L) is selected the meter will switch to indication mode and is ready to be calibrated.

Select Number of Calibration Points (n\text{a. P}\text{tS})

The user may input up to 11 calibration points and corresponding displays to provide custom linearization. To program the number of calibration points, push \text{ENTER}, when (n\text{a. P}\text{tS}) appears, push \text{ENTER} again. The meter displays a number from 2 to 11 that represents the number of calibration points. Push \text{ENTER} when the number equals the desired number of calibration points. As soon as the number of points is programmed, the meter flashes InPt 1 (indicating it is ready to be calibrated). Refer to Scale Using Internal Calibration (I-\text{CAL}), page 22 or Calibrate Using an External Calibrator (E-\text{CAL}) on page 23.
General Calibration/Scaling Instructions

Calibration is performed from the front panel using the **ENTER** button. It does not require any tools or disassembly of the meter. A calibrated signal source is required if external calibration (E-\(\text{CAL}\)) is selected.

**For best results, allow meter to warm up for at least 30 minutes.**

The calibration input signals must be within the range of the meter and input 2 must be greater than input 1. (However, display for input 2 does not have to be greater than desired display for input 1.)

An **Error** message will appear if input 1 signal and input 2 signal are too close together:

<table>
<thead>
<tr>
<th>Input Range</th>
<th>Minimum Difference Between Input 1 &amp; Input 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5 V</td>
<td>0.16 V</td>
</tr>
<tr>
<td>0-10 V</td>
<td>0.32 V</td>
</tr>
<tr>
<td>4-20 mA</td>
<td>1.60 mA</td>
</tr>
</tbody>
</table>

**Table 2: Input Range Minimum Spans**

**Scale Using Internal Calibration (I-\(\text{CAL}\))**

If I-\(\text{CAL}\) (Internal Calibration) was selected above in **Select Calibration Method**, the meter can be scaled without applying an input. Desired values can be programmed using the Five Basic Digit/Display-setting **Instructions** described on page 19. See Figure 13: Two-point External Calibration Flow Chart on page 18.

1. Push **ENTER**, when **SCAL** appears push **ENTER** again.
3. dSPY 1 flashes. Push **ENTER** and program desired value for display 1.
5. dSPY 2 flashes. Push **ENTER** and program desired value for display 2.
Calibrate Using an External Calibrator (E-CAL)

If E-CAL (External Calibration) was selected above in Select Calibration Method, the meter must be calibrated with an external calibrator. Desired values can be programmed using the Five Basic Digit/Display-setting Instructions described on page 19. See Figure 13: Two-point External Calibration Flow Chart on page 18.

1. Push ENTER, when ECAL is appears push ENTER again.
2. InPt 1 flashes. Apply input 1 signal (e.g. 4mA, 1V, etc.) then push ENTER, Program desired display for input 1.
3. InPt 2 flashes. Apply input 2 signal (e.g. 20 mA, 10 V, etc.) then push ENTER. Program desired display for input 2.

Calibration Error (Error)

A meter display of Error during calibration indicates that the calibration process was not successful and the meter needs to be recalibrated.

1. The Error message will appear if input 1 signal and input 2 signal are too close together, see Table 2 on page 22.
2. The Error message will appear if input 1 signal is inadvertently also applied for input 2 calibration, or ENTER is pushed before applying input 2.

Programming Confirmation

The values that have been programmed can be quickly checked to make sure they are the desired values. To do this, apply the desired signal for each point and check the display.
Select Square Root Extraction (L or S)

With the square root extraction function activated, the meter takes the square root of the input signal (the output from a differential pressure transmitter) and displays flow rate. The square root extraction feature is calibrated using the same Single Button Scaling technique that is used for two-point linear calibration. Calibration involves setting only three points: the zero flow rate (usually zero), the high flow rate and the Low-Flow Cutoff point.

To program the meter for square root extraction, push ENTER. When (L or S) appears, push ENTER again. The meter will flash (L or S) alternately. Push ENTER when (S) is flashing. After (S) has been selected the meter will switch to indication mode and is ready to be calibrated.

Program Low-Flow Cutoff (Cutoff)

Low-Flow Cutoff 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.

Example: If Low-Flow Cutoff is set at 12, any rate less than 12 will be displayed as "0".

To program Low-Flow Cutoff:

1. Push ENTER, when Cutoff appears push ENTER again.
2. Set Low-Flow Cutoff per Five Basic Digit/Display-setting Instructions on page 19.

Notes:
1. To disable Low-Flow Cutoff, program cutoff value to zero.
2. Low-Flow Cutoff is only available when using Square Root Extraction.
Round Horizontal Tank Calibration Table

The following tables can be used to calibrate the meter for displaying volume in a round horizontal tank. The right-most column in each table gives an example of actual calibration points for a 500-gallon tank.

**Number of Points: 10**  
**Maximum Error: 0.3% Full Scale**

<table>
<thead>
<tr>
<th>Calib. Point</th>
<th>Input (mA)</th>
<th>Display: (% Volume)</th>
<th>Display: (Example) (500 Gallon Tank)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4.0</td>
<td>0.00</td>
<td>0.0</td>
</tr>
<tr>
<td>2</td>
<td>4.8</td>
<td>1.80</td>
<td>9.0</td>
</tr>
<tr>
<td>3</td>
<td>6.0</td>
<td>7.20</td>
<td>36.0</td>
</tr>
<tr>
<td>4</td>
<td>7.2</td>
<td>14.20</td>
<td>71.0</td>
</tr>
<tr>
<td>5</td>
<td>9.2</td>
<td>28.10</td>
<td>140.5</td>
</tr>
<tr>
<td>6</td>
<td>14.8</td>
<td>71.80</td>
<td>359.0</td>
</tr>
<tr>
<td>7</td>
<td>16.8</td>
<td>85.80</td>
<td>429.0</td>
</tr>
<tr>
<td>8</td>
<td>18.0</td>
<td>92.80</td>
<td>464.0</td>
</tr>
<tr>
<td>9</td>
<td>19.2</td>
<td>98.10</td>
<td>490.5</td>
</tr>
<tr>
<td>10</td>
<td>20.0</td>
<td>100.00</td>
<td>500.0</td>
</tr>
</tbody>
</table>

**Number of Points: 8**  
**Maximum Error: 0.5% Full Scale**

<table>
<thead>
<tr>
<th>Calib. Point</th>
<th>Input (mA)</th>
<th>Display: (% Volume)</th>
<th>Display: (Example) (500 Gallon Tank)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4.0</td>
<td>0.00</td>
<td>0.0</td>
</tr>
<tr>
<td>2</td>
<td>4.8</td>
<td>1.90</td>
<td>9.5</td>
</tr>
<tr>
<td>3</td>
<td>6.4</td>
<td>9.50</td>
<td>47.5</td>
</tr>
<tr>
<td>4</td>
<td>8.4</td>
<td>22.40</td>
<td>112.0</td>
</tr>
<tr>
<td>5</td>
<td>15.6</td>
<td>77.70</td>
<td>388.5</td>
</tr>
<tr>
<td>6</td>
<td>17.7</td>
<td>90.50</td>
<td>452.5</td>
</tr>
<tr>
<td>7</td>
<td>19.2</td>
<td>98.10</td>
<td>490.5</td>
</tr>
<tr>
<td>8</td>
<td>20.0</td>
<td>100.00</td>
<td>500.0</td>
</tr>
</tbody>
</table>

Table 3: Round Horizontal Tank Calibration Points
Isolated 4-20 mA Transmitter Output Programming (\texttt{outPvt})

The Isolated 4-20 mA Transmitter Output option can be programmed without a calibrator. This option can be calibrated so that a 4 mA output is produced for any number displayed by the meter. The 20 mA output may be programmed to correspond to any number that is at least 501 counts greater or smaller than the number corresponding to 4 mA. (Ex. 4 mA = 0, 20 mA = 501 or -501) If the span between 4 and 20 mA is less than 501 counts, an \textit{Error} message will appear and the previously programmed values will be retained in memory until a new set of values is accepted.

\textbf{Setting 4 mA Output Value}

1. Push ENTER, when \texttt{outPvt} appears push ENTER again.
2. All digits flash for 3 seconds, a green LED labeled "4" illuminates indicating the flashing display is the value at which the meter will produce a 4 mA output. Program desired value per \textit{Five Basic Digit/Display-setting Instructions} on page 19.

\textbf{Setting 20 mA Output Value}

1. When ENTER is pushed to complete the programming for 4 mA output, the green LED labeled "20" illuminates indicating the flashing display is the value at which the meter will produce a 20 mA output.
2. Program desired value per \textit{Five Basic Digit/Display-setting Instructions} on page 19.
3. An Error message will be displayed if the 4-20 mA output span is smaller than 501 counts.

\textbf{Programming Confirmation}

The values that have been programmed to produce the 4 & 20 mA outputs can be quickly checked to make sure they are the desired values. To do this, enter the \texttt{outPvt} routine by pushing ENTER and then pushing ENTER again when \texttt{outPvt} appears.

The green "4" LED illuminates indicating the meter is displaying the value at which it will produce a 4 mA output. Confirm that this is the desired value. Push ENTER (within 3 seconds) before the entire display stops flashing and the green "20" LED illuminates indicating the meter is displaying the value at which it will produce a 20 mA output. Confirm that this is the desired value. Push ENTER (within 3 seconds) before the entire display stops flashing and the meter returns to indication mode.
Alarm Programming

Overview

The meter is equipped with four alarm points as a standard feature. Each alarm may be programmed for either a high or low alarm and for 0-100% deadband. Front panel LEDs indicate alarm status.

Options for two or four relays are available.

To program a high alarm, program the set point above the reset point. To program a low alarm, program the set point below the reset point. To program the alarm deadband, set the reset point above or below the set point by an amount equal to the desired deadband value.

Example: Alarm 2 is a high alarm that trips at 1500 and has a deadband of 100. Alarm 2 set point is set at 1500 and its reset point at 1400.

Setting Alarm Set & Reset Points (R₁R₁R₁)

Alarm Set and Reset points are programmed using the Five Basic Digit/Display-setting Instructions described on page 19.

1. Push ENTER and when R₁R₁R₁ appears, push ENTER again. This starts a scan of the four alarm set & reset points. The scan sequence begins with a flashing display of alarm #1 set point. The "1" LED and "S" LED below the display are illuminated to indicate the meter is flashing alarm #1 set point value. Program the desired value for alarm #1 set point using the Five Basic Digit/Display-setting Instructions described on page 19.

2. After Alarm #1 set point has been programmed, the meter displays Alarm #1 reset point, as indicated by the "1" LED and "R" LED below the display. Program the desired value for alarm #1 reset point using the Five Basic Digit/Display-setting Instructions described on page 19.

3. Program the remaining alarm set and reset points in a similar fashion.

4. When alarm programming is complete the meter will display the process input signal and the front panel LEDs will indicate alarm status.


**Programming Confirmation**
To verify that the alarm set and reset points have been programmed as desired, push ENTER, and push ENTER again when RLR-5 appears. Before the display stops flashing #1 set point value, push ENTER again to advance the display to #1 reset point. Continue skipping through the remaining alarm set and reset points. To alter an alarm point value, wait for the first digit to flash and program the desired value using the *Five Basic Digit/Display-setting Instructions* on page 19.

**Alarm Operation**
When the meter detects an alarm, a front panel LED illuminates to indicate which alarm point has tripped. This LED will stay illuminated until the meter display passes through the reset point.

**Set Relays for Fail-Safe Operation**
In the fail-safe mode, the relay coils are *energized* and the Normally Open (NO) contacts are connected to the Common (C) contacts under normal operation. During an alarm condition the relay coils are *de-energized* and the Normally Closed (NC) contacts are connected to the Common (C) contacts. During a power failure the relay contacts reflect an alarm condition.

Removing jumper JP6 disables the fail-safe operation. Jumper JP6 is located on the Display Board, see Figure 14 on page 29. If fail-safe mode is disabled, the operation of the relay contacts is opposite to the one described in the previous paragraph.
Alarm Acknowledgment
The ACK button on the front panel resets the optional relays only and has no effect on the alarm status LEDs.

Automatic & Manual Reset Programming
There are two ways to reset the relays:
1. Automatically when the signal passes through the reset point.
2. Automatically + manually via the front panel ACK button, or a user supplied momentary Normally Open push-button across terminals AK and CM at the rear of the instrument. That is, a relay may be manually reset prior to the signal passing through the reset point or it will automatically reset when the signal passes through the reset point.

A manual reset will reset all relays that are programmed for automatic + manual reset.

Figure 14: Relay Reset & Fail-Safe Jumpers
An array of jumpers located behind the front panel on the Display Board is used to program each relay for either automatic or automatic + manual reset. Refer to page 32 for front panel removal instructions. The top jumper is used for relay 1, the next for relay 2, etc. A relay will automatically reset if no jumper is installed. A relay will automatically reset, plus can be manually reset, if a jumper is installed over its respective pins.

Example Above: Relay 1 is programmed for automatic reset; Relays 2, 3, & 4 are programmed for automatic + manual reset.
Lockout Jumper

Once the meter has been completely programmed, a lockout jumper can be installed to restrict further modification to the meter. This jumper is located at the rear of the instrument and is labeled J3. When ENTER is pushed with the lockout jumper in place, only \texttt{IR} \texttt{Rr 5} and \texttt{o utPut} routines are displayed. These routines may be entered to view their settings, but the settings may not be altered.

SWITCHING INDUCTIVE LOADS

The meter has the ability to suppress electrical noise generated by switching inductive loads. However, installing Resistor Capacitor (RC) Networks improves this performance and prolongs the life of the meter's relay contacts. This suppression can be obtained with RC networks assembled by the user or purchased as a complete assembly. Refer to the following circuits for RC network assembly and installation:

AC & DC Loads

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 1 A through closed contacts

Notes:
1. Use capacitors rated for 240 VAC.
2. Snubbers may affect load release time of solenoid loads, check to confirm proper operation.
3. Install the RC network right at the meter's relay screw terminals. An RC network may also be installed across the load.
Low Voltage DC Loads

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.

RC Networks Available from Precision Digital
RC Networks are available from Precision Digital and should be applied to each relay contact that switches an inductive load. Part number PDX6901.

RESET METER TO FACTORY DEFAULTS
To reset the meter to the factory defaults:
1. Remove the snap-off front cover, see page 32.
2. Using a pair of needle-nose pliers, short out the solder pads located on the top and bottom of the Main Board, to the right of the ACK button below JP6 (see Figure 14 on page 29), until the display shows “reset”.
3. Press the ENTER button. The meter starts scrolling the menus.
4. Press the ACK button, at any time, to exit the menu scroll.
OPTIONS CARD REMOVAL & INSTALLATION

Meter options are installed at the factory. It is NOT necessary to remove the circuit boards from the case to disable the relays’ fail-safe operation. The fail-safe jumper is located on the Display Board, see Figure 14 on page 29. Refer to the following instructions and illustrations to remove the snap-off cover and the circuit boards from the case.

⚠️ **Disconnect power prior to performing the following operations.**

The meter’s snap-off cover is held in place by 6 latches that snap into notches on the snap-off cover. To remove the snap-off cover from the meter, grasp it firmly on its top and bottom edges and pull it forward. The latch plate remains around the meter’s case.

**To remove the circuit boards from the case:**
1. Unscrew the retaining screws holding the circuit boards to the case.
2. Remove the screw terminal connectors at the rear of the meter.
3. Push the boards through the case by applying pressure to the circuit boards at the rear of the meter. Apply pressure evenly to both boards.
4. Do not apply pressure to the vertical display board.

**Figure 17: Front Cover Removal**

5. To avoid electric shock, re-install the circuit boards in the case prior to applying power.

All programming and calibrating can be performed with the circuit boards installed in the case.
To re-install the meter in its case:
1. Fold the Options Board over the Main Board, grasp both boards so the Main Board is on the bottom and the two Boards are separated by about an inch.
2. Insert the two boards together into the case. Be sure both the top and bottom boards engage the rails, which hold them in place.
3. Do not press on the Display Board when seating the assembly in the case.
4. Install washers and retaining screws in 4 corners of meter and install front cover.

Figure 18: Option Card Installation

MOUNTING DIMENSIONS

Figure 19: Mounting Dimensions

Notes:
1. Panel cutout required: 1.772" X 3.622" (45 mm x 92 mm) 1/8 DIN
2. Panel thickness: 0.125" - 0.250" (3.17 mm - 6.34 mm)
3. Clearance: allow 6 inches (152 mm) behind the panel
PROGRAMMED PARAMETER SETTINGS
Use the following table to record how your meter is programmed:

**Input**

- [ ] 4-20 mA
- [ ] 0-5 V
- [ ] 0-10 V
- [ ] Linear
- [ ] Square Root Extraction

Number of Calibration Points _____
Low-Flow Cutoff Value__________

**Calibration Point Values**

<table>
<thead>
<tr>
<th>Input 1 set point</th>
<th>display 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input 2 set point</td>
<td>display 2</td>
</tr>
<tr>
<td>Input 3 set point</td>
<td>display 3</td>
</tr>
<tr>
<td>Input 4 set point</td>
<td>display 4</td>
</tr>
<tr>
<td>Input 5 set point</td>
<td>display 5</td>
</tr>
<tr>
<td>Input 6 set point</td>
<td>display 6</td>
</tr>
<tr>
<td>Input 7 set point</td>
<td>display 7</td>
</tr>
<tr>
<td>Input 8 set point</td>
<td>display 8</td>
</tr>
<tr>
<td>Input 9 set point</td>
<td>display 9</td>
</tr>
<tr>
<td>Input 10 set point</td>
<td>display 10</td>
</tr>
<tr>
<td>Input 11 set point</td>
<td>display 11</td>
</tr>
</tbody>
</table>

**Alarms**

<table>
<thead>
<tr>
<th>Alarm 1 set point</th>
<th>reset point</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alarm 2 set point</td>
<td>reset point</td>
</tr>
<tr>
<td>Alarm 3 set point</td>
<td>reset point</td>
</tr>
<tr>
<td>Alarm 4 set point</td>
<td>reset point</td>
</tr>
</tbody>
</table>

4-20 mA Output Option

<table>
<thead>
<tr>
<th>4 mA display value</th>
<th>20 mA display value</th>
</tr>
</thead>
</table>

Model Number: PD690 Serial Number: ________
## OTHER PRECISION DIGITAL PRODUCTS

<table>
<thead>
<tr>
<th>MODEL</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>PD118</td>
<td>MINIMUX® 8 Point Scanner</td>
</tr>
<tr>
<td>PD141AFO</td>
<td>VIGILANTE® four Point Annunciator with First-Out</td>
</tr>
<tr>
<td>PD202-253</td>
<td>Digital Pressure Gauges</td>
</tr>
<tr>
<td>PD602</td>
<td>Dart Low-Cost 1/8 DIN Process Meter</td>
</tr>
<tr>
<td>PD644</td>
<td>Javelin D High-Voltage DC Panel Meter</td>
</tr>
<tr>
<td>PD650</td>
<td>2.3&quot; LED NEMA 4X Large Display Process Meter</td>
</tr>
<tr>
<td>PD655</td>
<td>1.0&quot; LED NEMA 4X Large Display Process Meter</td>
</tr>
<tr>
<td>PD656</td>
<td>0.8&quot; LED Exp-Proof Large Display Process Meter</td>
</tr>
<tr>
<td>PD660</td>
<td>Low-Cost NEMA 4X Loop Powered Meter</td>
</tr>
<tr>
<td>PD661</td>
<td>Low-Cost Exp-Proof Loop Powered Meter (FM &amp; CSA)</td>
</tr>
<tr>
<td>PD673</td>
<td>4½ Digit Loop Powered 1/8 DIN Meter</td>
</tr>
<tr>
<td>PD675</td>
<td>4½ Digit Loop Powered NEMA 4X Meter (FM &amp; CSA)</td>
</tr>
<tr>
<td>PD677</td>
<td>4½ Digit Loop Powered Exp-Proof Meter</td>
</tr>
<tr>
<td>PD685</td>
<td>3½ Digit Loop Powered NEMA 4X Meter (GeneralPurpose)</td>
</tr>
<tr>
<td>PD686</td>
<td>3½ Digit Loop Powered NEMA 4X Meter (FM &amp; CSA)</td>
</tr>
<tr>
<td>PD687</td>
<td>3½ Digit Loop Powered Exp-Proof Meter (FM &amp; CSA)</td>
</tr>
<tr>
<td>PD691</td>
<td>1/8 DIN Strain Gauge &amp; mV Input Meter (UL Listed)</td>
</tr>
<tr>
<td>PD692</td>
<td>1/8 DIN Analog Input Flow Rate/Totalizer (UL Listed)</td>
</tr>
<tr>
<td>PD693</td>
<td>1/8 DIN Pulse Input Flow Rate/Totalizer (UL Listed)</td>
</tr>
<tr>
<td>PD696</td>
<td>1/8 DIN Loop Powered Flow Rate/Totalizer</td>
</tr>
<tr>
<td>PD697</td>
<td>NEMA 4X Loop Powered Flow Rate/Totalizer</td>
</tr>
<tr>
<td>PD698</td>
<td>Exp-Proof Loop Powered Flow Rate/Totalizer (FM &amp; CSA)</td>
</tr>
<tr>
<td>PD740</td>
<td>Javelin TTC &amp; RTD Temperature Meter (Low-Cost)</td>
</tr>
<tr>
<td>PD750</td>
<td>TC &amp; RTD Temperature Meter (UL Listed)</td>
</tr>
<tr>
<td>PD751-752</td>
<td>10 Ω Cu &amp; 120 Ω Ni RTD Temperature Meters (UL Listed)</td>
</tr>
<tr>
<td>PD755</td>
<td>1.0&quot; LED NEMA 4X Large Display Temperature Meter</td>
</tr>
<tr>
<td>PD756</td>
<td>0.8&quot; LED Exp-Proof Large Display Temperature Meter</td>
</tr>
<tr>
<td>PD757</td>
<td>2.3&quot; LED NEMA 4X Large Display Temperature Meter</td>
</tr>
<tr>
<td>PD765</td>
<td>Trident Process &amp; Temperature Meter (UL Listed)</td>
</tr>
<tr>
<td>PD865</td>
<td>Snooper Modbus Serial Input Meter</td>
</tr>
<tr>
<td>PD940-981</td>
<td>ConsoliDator® Multi-Channel Controllers</td>
</tr>
</tbody>
</table>
How to Contact Precision Digital

- For Technical Support please
call: (800) 343-1001 or (508) 655-7300
fax: (508) 655-8990
e-mail: support@predig.com

- For Sales Support or to place an order please
call: (800) 343-1001 or (508) 655-7300
fax: (508) 655-8990
e-mail: sales@predig.com

- For an online version of this instruction manual
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www.predig.com