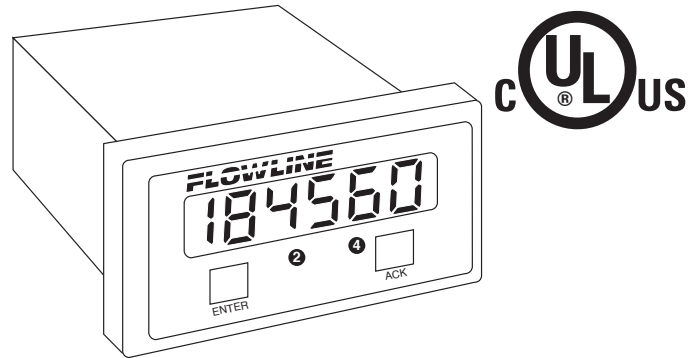# DIGITAL PANEL METERS

Model LI1X Universal Process Meter
Instruction Manual

- Easy S ingle B utton S caling (SBS)
- 4-20 mA, 0-5 V, or 0-10 V Field Selectable Inputs
- 24 V Transmitter Power Supply Standard
- Stand Alone Scaling
- Steady, Accurate Display to ± 199,990
- 11 Point Linearization
- Square Root Extraction with Low-flow Cutoff
- $4\frac{1}{2}$ Digit + Extra Zero
- Type NEMA 4X Front Panel
- 2 or 4 Relays + 4-20 mA Output Options
- Lockout Feature
- Non-volatile Memory, No Battery Needed.

INTRODUCTION

This meter is a high performance, easy to use, industrial-grade micro-processor-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 4$1/2$ 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

115 VAC Model	230 VAC Model	24 VDC Model	Description
LI10-1001	LI10-1001-E	LI10-1001-D	No Options
LI11-1001	LI11-1001-E	LI11-1001-D	4-20mA Output
LI12-1001	LI12-1001-E	LI12-1001-D	2 Relays
LI13-1001	LI13-1001-E	LI13-1001-D	2 Relays + 4-20 mA Output
LI14-1001	LI14-1001-E	LI14-1001-D	4 Relays
LI15-1001	LI15-1001-E	LI15-1001-D	4 Relays + 4-20 mA Output

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.

AVERTISSMENT
Les pièces à l'intérieur du boîtier portent des tensions dangereuses. Seules des personnes qualifiées et bien entraînées devraient entreprondre l'ótalonnage et la maintenance.

DISCLAIMER
The information contained in this document is subject to change without notice. FLOWLINE makes no representations or warranties with respect to the contents hereof, and specifically disclaims any implied warranties of merchantability or fitness for a particular purpose.

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

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. $4^{1/2}$ digits + extra zero may be switched on to display +/- 19,999(0). Leading zero 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.

Input Range:	Minimum Difference Between Input 1 & Input 2:
0-5 V	0.16 V
0-10 V	0.32 V
4-20 mA	1.60 mA

INPUT IMPEDANCE	Voltage ranges, greater than 300 Kohms; current ranges, 100 ohms.
LOOP POWER	(AC Meters only), Isolated 24 VDC ± 5% @ 20 mA regulated. Maximum loop resistance is 1200 ohms. 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	**Input Range**	**Minimum Span Between Inputs**
	4-20 mA	(1.6 mA / (Number of points –1))
	0-5 V	(0.16 V / (Number of points -1))
	0-10 V	(0.32 V / (Number of points -1))

e.g. 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.
CONNECTIONS	Removable screw terminal blocks (provided) accept 22 to 12 AWG wire.
WARRANTY	1 year parts & labor.
UL FILE NUMBER	E193723; 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 PCB.
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 Meters only), Isolated 24 VDC ± 5% @ 20 mA regulated. Maximum loop resistance is 1200 ohms. 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	Power supply	Min. loop resistance	Max loop resistance
	24 VDC	10 ohms	600 ohms
	35 VDC (external)	600 ohms	1000 ohms

Display Messages and Functions

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

Display	Parameter	Description/Comments
E-CAL	Select External Calibration	Set meter for calibration using an external calibration source.
I-CAL	Select Internal Calibration	Set meter for calibration (scaling) using Internal calibration source.
CAL Ib	Perform External Calibration	Calibrate meter using an external calibration source.
SCALE	Perform Internal Calibration (scaling)	Calibrate meter (scale) using internal calibration source. (Signal source not required).
InPt 1	Input 1	Set Input 1 calibration value.
dSPY 1	Display 1	Set Display 1 calibration value.
InPt 2	Input 2	Set Input 2 calibration value.
dSPY 2	Display 2	Set Display 2 calibration value.
dECPt	Decimal Point	Set decimal point or light up extra "0".
no. PtS	Number of Points	Set meter for 2 to 11 calibration points.
L or S	Linear or Square	Set meter for Linear or Square Root calibration/scaling.
CutoFF	Low-flow Cutoff	Set meter to display zero below programmed cutoff point.
ALArS	Alarms	Program alarm/relay set and reset points.
outPut	Output	Set 4-20 mA output values.
19999	Overrange	Indicates input signal exceeds full-scale range of meter.
-19999	Underrange	Indicates input signal is below the negative range of meter.
Error	Error	Indicates calibration was not successful.

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.

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
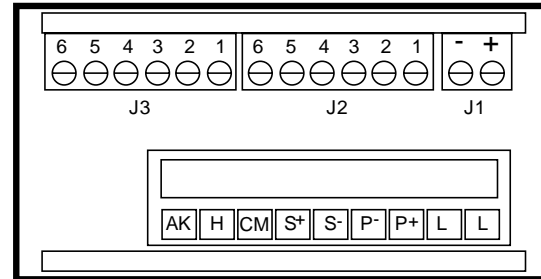
Figure 1: Rear View of Meter (Connectors)

Label	Main PCB (Lower)	Wire Size
None	Power	12-18
None	Signal, Acknowledge, Hold	12-22
	Options PCB (Upper)	
J1	4-20 mA Output	12-22
J2	Relays 1 & 2; NC, NO, Common	12-22
J3	Relays 3 & 4; NC, NO, Common	12-22

Wiring Instructions

1. All field connections to be made with insulated copper wire, either solid or stranded. Tighten all screw terminals to 7 in/lb (0.8 Nm). Strip length = $1/2$ in (7mm). **DO NOT** pre-treat wire with solder.
2. **Terminals L & L**: Use AWG #12-18 wire, 600 volt, 60°C. Connect only one wire to each terminal on the 9-pin connector.
3. **Terminals AK, H, CM, S+, S-, P-, P+:** Use AWG #12-22 wire, 150 volt, 60°c. If using AWG #20 or smaller wire, up to 2 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
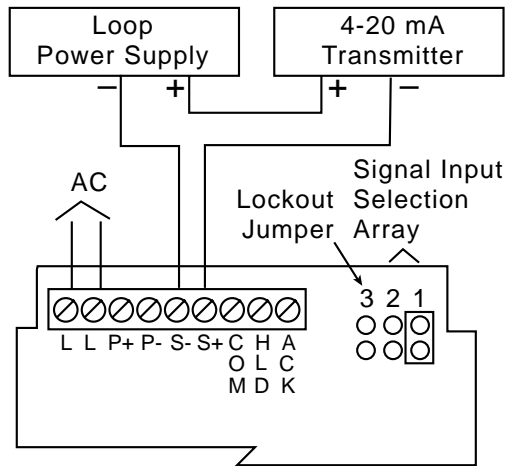
Figure 3: Transmitter Powered from External Power Supply

AC Powered Meters (Continued)
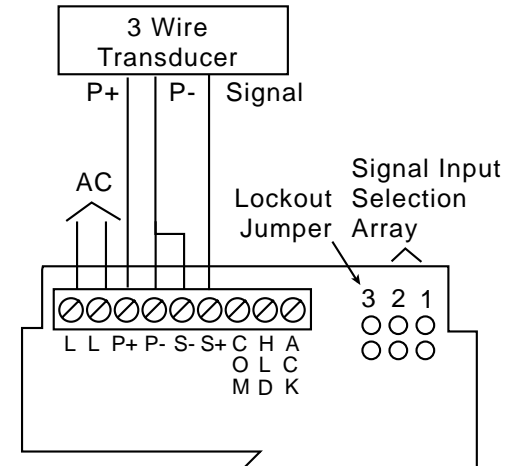
Figure 4: Three-wire Transducer Powered from Meter
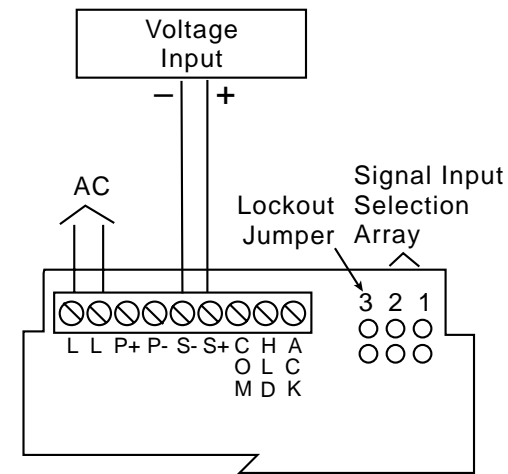
Figure 5: Voltage Input

DC Powered Meters (Power, Signal, External Functions)
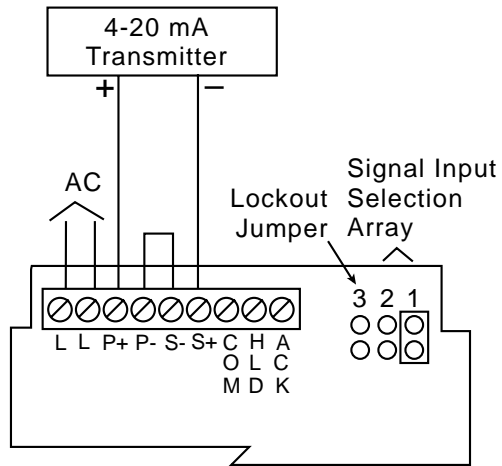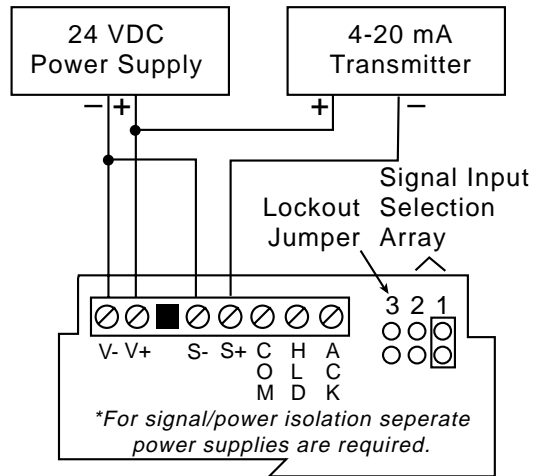

Figure 6: Transmitter and Meter Powered from Same DC Power Supply
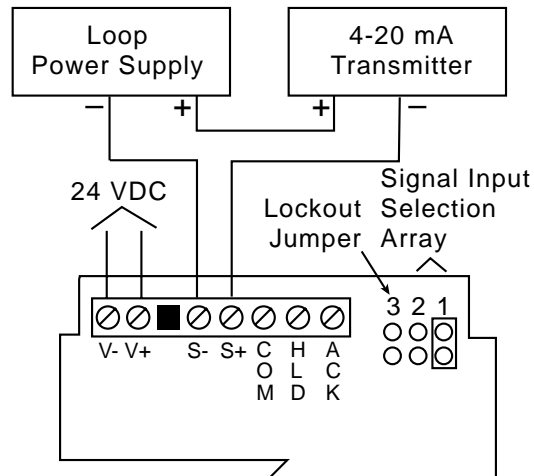
Figure 7: Transmitter and Meter Powered from Separate DC Power Supplies

Relays & 4-20 mA Output

Depending on the model number, the Options PCB 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 PCB. Connections for the Isolated 4-20 mA Transmitter Output are made to J1 on the Options PCB.

	Pin:	Function:
J1	1	Transmitter +
	2	Transmitter -
J2	1	Relay #1 Common
	2	Relay #1 NC
	3	Relay #1 NO
	4	Relay #2 Common
	5	Relay #2 NC
	6	Relay #2 NO
J3	1	Relay #3 Common
	2	Relay #3 NC
	3	Relay #3 NO
	4	Relay #4 Common
	5	Relay #4 NC
	6	Relay #4 NO

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.
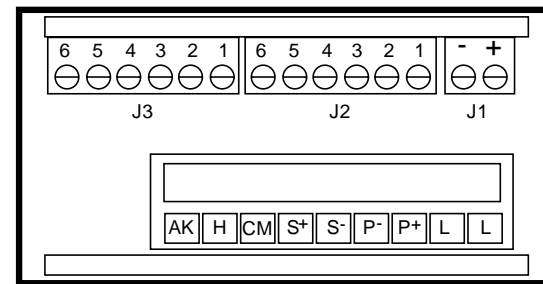
Figure 9: Rear View of Meter (Connectors)

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:
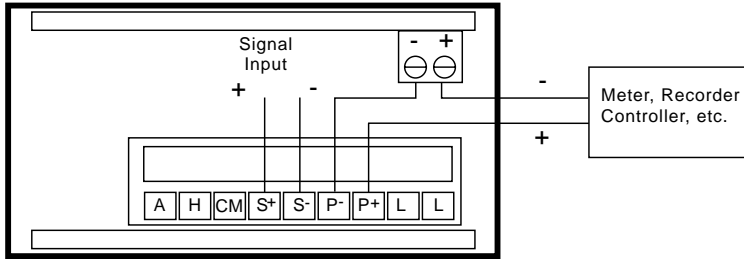
Figure 10: Meter Powering 4-20 mA Output Loop
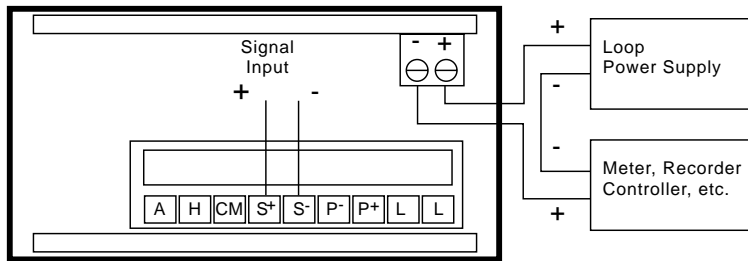
Figure 11: External Power Supply Powering 4-20 mA Output Loop

! 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 **S**ingle **B**utton **S**caling **(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 **B**utton **S**caling 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):
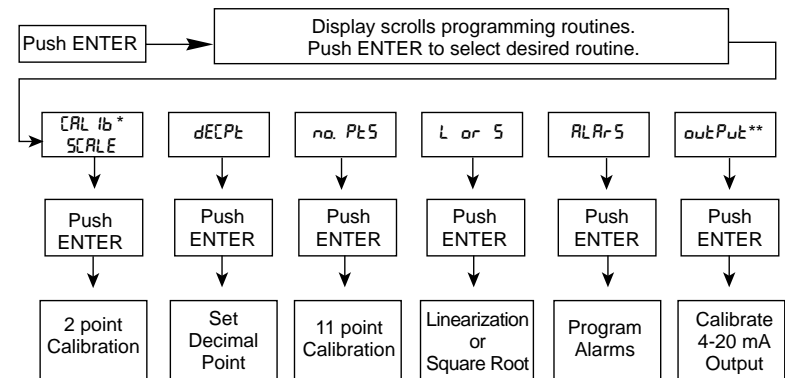
* CAL ib appears if E-CAL is selected   ** Only appears if 4-20 mA output is installed
SCALE appears if i-CAL is selected

Figure 12: Menu Scroll (with Lockout Jumper Removed)

Figure 13: Two-point External Calibration Flow Chart
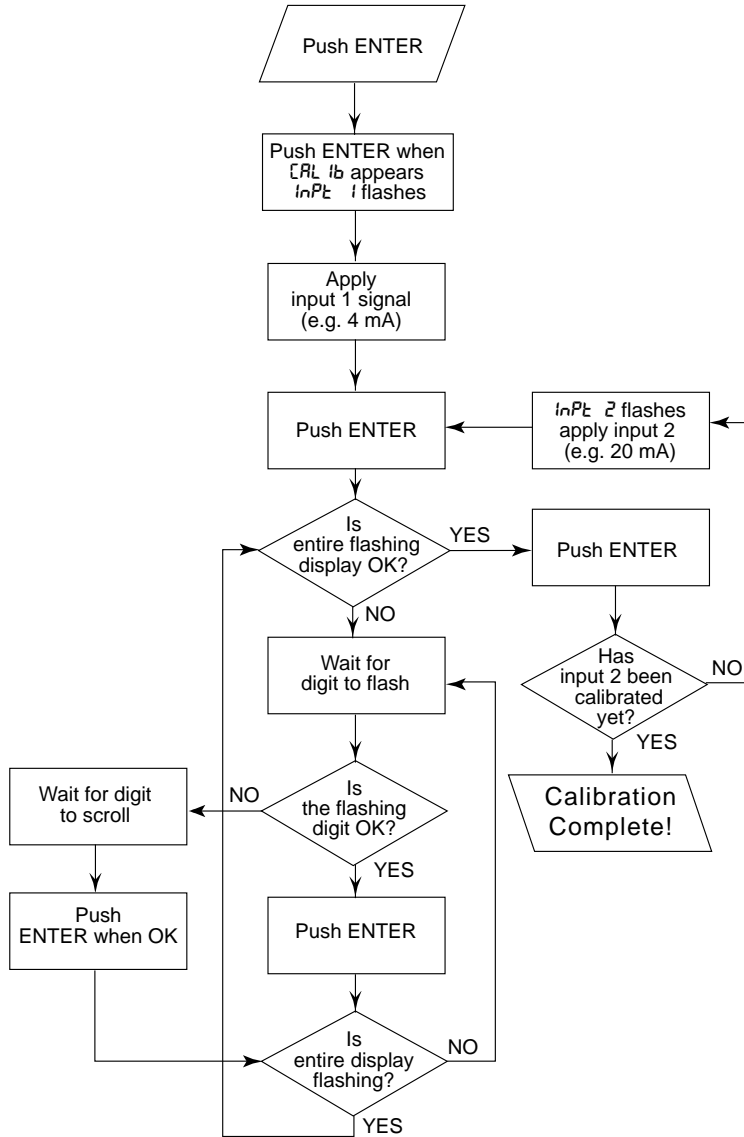
Five Basic Digit/Display-setting Instructions

Rather than repeat the **S**ingle **B**utton **S**caling **(SBS)** technique for every function it is used in, it will be detailed here and the user can refer to it when necessary.

The **S**ingle **B**utton **S**caling 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.

Input Signal	Jumper J1	Jumper J2
1-5, 0-5V	OFF	OFF
0-10 V	OFF	ON
4-20, 0-20 mA	ON	OFF

Table 1: Signal Input Selection Array

Initial Calibration with External Source (If Needed)

Initial calibration is required only when the I-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 $InPt$ 1. Apply low end signal, (4 mA or 0 V)*, push **ENTER**.
5. The meter flashes $InPt$ 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-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-CAL), or scaled using the internal source (I-CAL). With I-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 **ACK** button pressed.
1. When display stops flashing, release **ACK** button. Display alternates between E-CAL and I-CAL.
2. To calibrate meter with an external source, such as a calibrator, press **ENTER** when E-CAL appears.
3. To scale meter with internal source, press **ENTER** when I-CAL appears.

Select Decimal Point ($dECPt$)

To program the decimal point or light up the extra "0", push **ENTER**. The meter displays $SCALE$ or CAL Ib, then $dECPt$. Push **ENTER** when $dECPt$ appears. The meter then reads 199990 with the decimal point changing locations and the extra "0" illuminating. Push **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 **ENTER**. When (L or 5) appears, push **ENTER** again. The meter will flash (L or 5) alternately. Press **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 ($no.$ PtS)

The user may input up to 11 calibration points and corresponding displays to provide custom linearization. To program the number of calibration points, push **ENTER**, when ($no.$ PtS) appears, push **ENTER** again. The meter displays a number from 2 to 11 that represents the number of calibration points. Push **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-CAL), page 22 or Calibrate Using an External Calibrator (E-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-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:

Input Range:	Minimum Difference Between Input 1 & Input 2:
0-5 V	0.16 V
0-10 V	0.32 V
4-20 mA	1.60 mA

Table 2: Input Range Minimum Spans

Scale Using Internal Calibration (I-CAL)

If I-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 SCALE appears push **ENTER** again.
2. InPt 1 flashes. Push **ENTER** and program desired value for input 1.
3. dSPY 1 flashes. Push **ENTER** and program desired value for display 1.
4. InPt 2 flashes. Push **ENTER** and program desired value for input 2.
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 CAL 1b 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 5)

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 **S**ingle **B**utton **S**caling 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 5) appears, push **ENTER** again. The meter will flash (L or 5) alternately. Push **ENTER** when (5) is flashing. After (5) 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

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

Number of Points: eight
Maximum Error: 0.5% Full Scale

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

Table 3: Round Horizontal Tank Calibration Points

Isolated 4-20 mA Transmitter Output Programming (outPut)

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 Error message will appear and the previously programmed values will be retained in memory until a new set of values is accepted.

Setting 4 mA Output Value

1. Push **ENTER**, when outPut 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 *Five Basic Digit/Display-setting Instructions* on page 19.

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 *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.

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 outPut routine by pushing **ENTER** and then pushing **ENTER** again when outPut 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 (ALAr S)

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

1. Push **ENTER** and when ALAr S 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 ᴿᴸᴬʳ5 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,* the Normally Closed (NC) contacts are connected to the Common (C) contacts. During a power failure the relay contacts reflect an alarm condition.
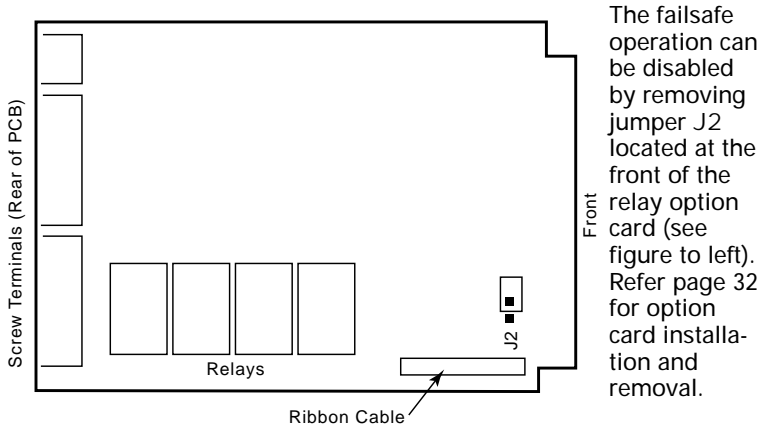

The failsafe operation can be disabled by removing jumper **J2** located at the front of the relay option card (see figure to left). Refer page 32 for option card installation and removal.

Figure 14: Option Card Installation

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.

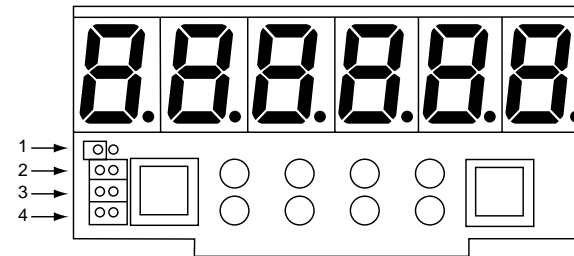A manual reset will reset all relays that are programmed for automatic + manual reset.

Figure 15: Relay Reset Jumpers

An array of jumpers located behind the front panel on the Display PCB 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 ⅂⅂ᴀᵣ5 and ᴏᵤₜᴘᵤₜ 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:
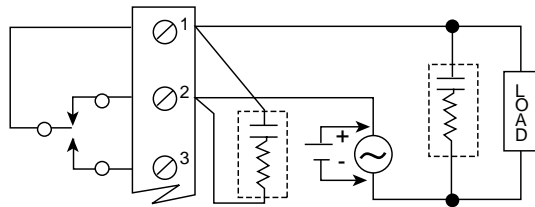
AC & DC Loads

Figure 16: AC & DC Loads

Choose R and C as follows:
R: 0.5 to 1 ohm for each volt across the contacts
C: 0.5 to 1 microfarad 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.
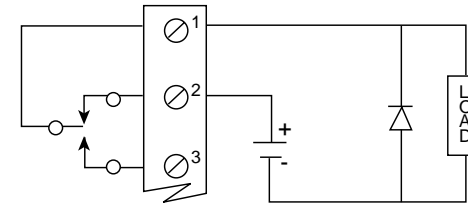
Low Voltage DC Loads

Figure 17: 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

Suppressors are available from FLOWLINE and should be applied to each relay that switches an inductive load.

OPTION CARD INSTALLATION

Options may be ordered installed at the factory or as separate items.

Instructions

1. **Disconnect power to the meter.**
2. Remove all connectors from the back of the meter.
3. Remove the Front Cover, simply pry the top and pull it back.
4. Remove the two screws that retain the PCB.
5. Slide the Main PCB out of case (set it down with display facing forward).
6. Lay the Option PCB to the right of the Main PCB.
7. Connect flexible cable connector CT1 to J5 connector on Main PCB.
8. Check that all the pins are properly seated in the connector.
9. Fold the option board over onto the Main PCB.
10. Slide the two PCBs into the case and secure with four screws and washers.
11. Reassemble front covers and install connectors.

Figure 18: Removing Front Bezel
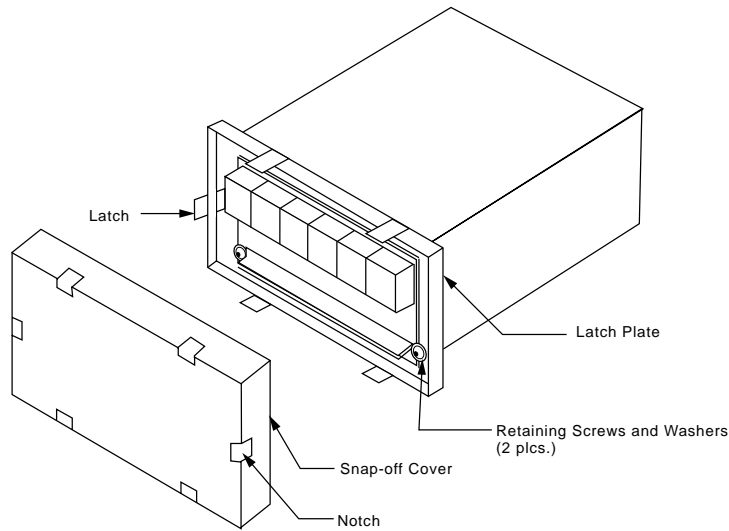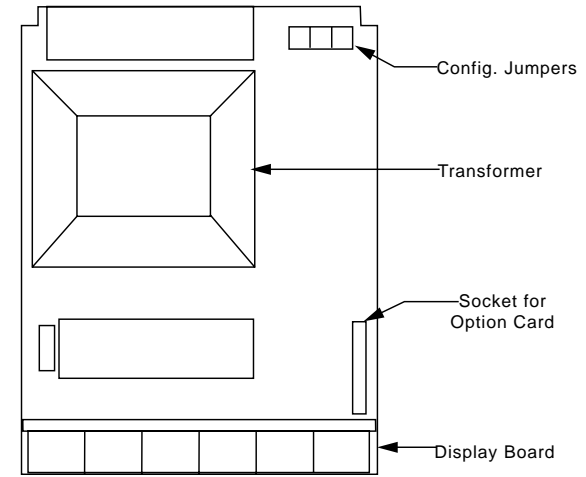
Internal View of Meter for Locating Option Connector

Figure 19: Internal View of Meter (Option Card Socket)
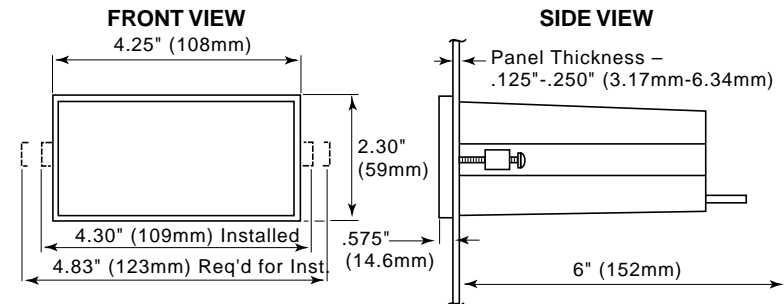
MOUNTING DIMENSIONS

Figure 20: 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. Allow 6 inches (152 mm) behind the panel
4. Weight 16 oz. (454 g)

PROGRAMMED PARAMETER SETTINGS

Use the following table to record how your meter is programmed:

Input
❏ 4-20 mA   ❏ 0-5 V   ❏ 1-5 V   ❏ 0-10 V

❏ Linear   or   ❏ Square Root Extraction

Number of Calibration Points _____

Low-flow Cutoff Value _____

Calibration Point Values

Input 1 set point _____   display 1 _____
Input 2 set point _____   display 2 _____
Input 3 set point _____   display 3 _____
Input 4 set point _____   display 4 _____
Input 5 set point _____   display 5 _____
Input 6 set point _____   display 6 _____
Input 7 set point _____   display 7 _____
Input 8 set point _____   display 8 _____
Input 9 set point _____   display 9 _____
Input 10 set point_____   display 10_____
Input 11 set point_____   display 11_____

Alarms

Alarm 1 set point _____   reset point _____
Alarm 2 set point _____   reset point _____
Alarm 3 set point _____   reset point _____
Alarm 4 set point _____   reset point _____

4-20 mA Output Option
   4 mA display value _____
   20 mA display value _____

Model Number: LI1X _____   Serial Number:_____

NOTES