M2110F SMART FLOW GAUGE OPERATING INSTRUCTIONS

Meriam's M2110F Smart Flow Gauge is a microprocessor-based pressure sensing device with algorithms to calculate flow. The gauge provides laminar flow element, Accutube and Orifice Plate flow measurements. Three configurations are available: Battery, SetPoint, and Current Loop models.

All models are programmable through the front keypad. The user's program information is stored in non-volatile memory, and is retained when the power to the gauge is removed. SetPoint and Current Loop models can also be programmed through the RS-232 serial communication connection.

The Battery model is powered by its internal lithium batteries. This model does not provide any outputs or RS-232 communications.

SetPoint and Current Loop models have outputs that can be used for control or indicating functions. Both models also have RS-232 communications capability. In addition to configuring the gauge, the RS-232 port can be used to monitor and log the measured flow data and output status. It can also be used as part of a control system with digital capabilities.

The SetPoint model provides two relay outputs. These relays can be connected in normally open or normally closed configurations for fail-safe operation. SetPoint detection can be set from 0 to +120% of the full scale flow range and is powered by 115VAC, 230 VAC, or 24VDC.

The Current Loop model provides a 4 to 20 mA output, and is intended to be used as a flow transmitter on a three or four wire loop. Zero and span are set through user-programmable registers, from 0 to +120% of the full scale flow range. The Current Loop model is powered by 24VDC only.

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1 OVERVIEW

The Meriam Instrument M2110F Gauge is a microprocessor based flow-sensing device that can be used in conjunction with a primary flow element to measure flow rate of clean dry gases. Compatible primary elements include Laminar Flow Elements (LFE), Accutube and Orifice plates. The gauge operates on the principle of measuring differential pressure across the primary element then calculating the flow rate based on user scaling input. The calculated flow rate is then displayed in the selected engineering unit or output for process control or monitoring.

1.1 Features

- Microprocessor –control for reliability and flexibility
- Remote control via RS232 serial link using ASCII character transfer
- Parameters to allow easy configuration of the unit
- Built-in non-volatile memory for storing register settings
- 4-½ digit LCD display with backlight for flow readout

1.2 Models

- Battery Powered Display Indicator only
- Current Loop Model with 4-20 mA Flow Rate Output and RS232 serial interface port
- 10 inH_2O sensors available
- AC powered models have an RS232 serial interface port and SPDT outputs

1.3 Flow Calculation Model

1.3.1 Laminar Flow element

Flow = B_Coefficient * dP + C_Coefficient * dP^2

Where: dP = Differential pressure (inH_2O @ 4 °C)
B-Coefficient and C-Coefficient are provided with the LFE

1.3.2 Accutube or Orifice Plate element

Flow = Flow Constant * √dP

Where: dP = Differential pressure (inH_2O @ 60 °F)

Warning

The user must scale the gauge for the correct flow measurement display by entering the proper values of the Measurement Model, B-Coefficient, C-Coefficient and or Flow Constant.

2 Safety Warnings

The table below defines the safety symbols, signal words and corresponding safety messages used in the manual to identify potential hazards and are intended to warn persons about hazards that could result in personal injury or equipment damage.

	This is the Read Instruction Manual symbol. This symbol indicates that you must read the instruction manual.
	This is the Safety Alert symbol. This symbol indicates a WARNING. Warnings alert you to actions that can cause personal injury or pose a physical threat. Please read these carefully.
	This is the Safety Glasses symbol. This symbol indicates that you must wear approved safety glasses during the task.
	This is the Safety Gloves symbol. This symbol indicates that you must wear approved safety gloves during the task.
	Indicates a potentially hazardous situation which, if not avoided, will result in death or serious injury.
	Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.
	Indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury.
	Indicates information essential for proper product installation, operation or maintenance.

Information in this document is subject to change without notice. Check the Meriam web site (www.meriam.com) for the latest manual revision.

For customer assistance please call your local Meriam representative or Meriam directly.

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3 Certification / Safety / Warnings

⚠ DANGER Fire/Explosion Hazard. This instrument is not intrinsically safe. DO NOT use or service in areas that may contain flammable gas or vapors, combustible dusts or ignitable fibers where an unintended spark can cause a fire/explosion.

⚠ WARNING Do not exceed the Pressure Limits listed in the Specifications section of this manual. Failure to operate within the specified pressure limit could result in death or serious injury.

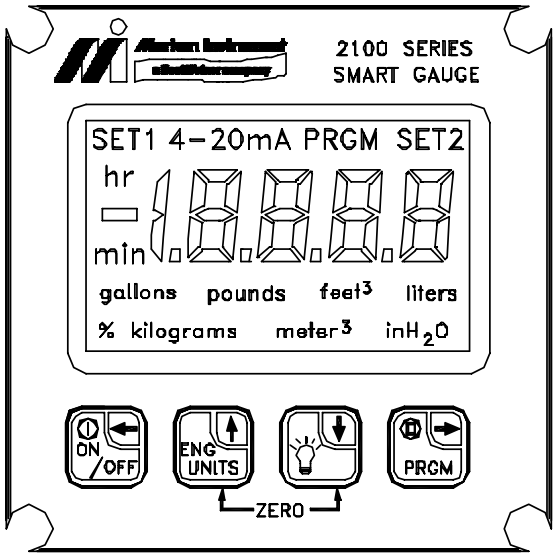
⚠ CAUTION

- Do not exceed the Maximum Input Voltage listed under “Input Power” in the Specification section of this manual
- Do not exceed the Switch Rating listed under “I/O” in the Specifications section of this manual.
- Disconnect power before servicing.
- Substitution of components may impair operation and safety.

4 FRONT PANEL

Warning

All settings must only be entered by qualified personnel, paying particular attention to the safety and precautionary warnings. Changes to the register settings may cause incorrect flow rate display values.



4.1 FLOW METER DISPLAY

4.1.1 Indicators

When the gauge is in the normal measurement mode of operation it will display the Flow Rate, Engineering Unit and Time Base on the LCD display. The top of the display will show the following possible status indicators: **PRGM**, **SET1**/**SET2** or **4-20mA**, which will be described below.

PRGM:
When the gauge is in **Program Mode** the display will illuminate the **PRGM** indicator, which prompts the user for further keypad entry data.

SET1/SET2:
The SetPoint models will illuminate the **SET1 or SET2** indicators to show active level sensing relay outputs. This indicator is also used to indicate that the register that is being edited is used to configure the relay level sensing function. These configuration registers include P5, P6 and P7 for the M2110F Relay Output Model.

4-20mA:
The Current Loop models will display the **4-20mA** indicator when the 4-20 mA analog output is enabled or when the user is editing the 4-20mA configuration register. These configuration registers include P5, P6, and P7 for the M2110F Analog 4-20mA Output Model.

Decimal Point:
The decimal point is used to indicate the status of the Low Flow CutOff detection. If the Low Flow CutOff is active the display will show a flashing decimal point.

4.1.2 Display Refresh Rate

The M2110F Flow gauge converts signal data from the differential pressure sensor at a rate of ten conversions per second depending on the operating mode of the gauge. The display is then refreshed at a rate of approximately three updates per second with a value that can be filtered by a user selectable time constant.

Note: All internal calculations, analog and contact outputs, and serial interface values are updated at the maximum sampling rate.

4.1.3 Display Resolution

The differential pressure sensor range and the A/D conversion hardware in the device define the display resolution. Note that since the Flow Gauge display is user-scaled to flow units, the full scale and resolution depends on the calibration scaling. If a specific value will not fit on the 4½-digit display the auto-range feature will decrease the resolution to allow the display value to fit the available digits.

4.2 KEYPAD OPERATIONS

The front panel keypad incorporates multifunction keys where the functionality will depend on the mode of operation of the gauge.

- **Measure Mode** is the normal operating display mode of the gauge. This mode is always default after power-up or reset.
- **Program Mode** is used to configure the gauge for operation. A PRGM indicator on the display denotes this mode.

4.2.1 ON/OFF or BACKSPACE

Mode of Operation	 Document Symbol: **(Backspace←)**
Measure Mode	• **Battery** models: Toggles the gauge ON and OFF. • **SetPoint** and **Current Loop** models: "Resets" the gauge.
Program Mode	**Backspace** function: **Program Mode (P# displayed):** backspace key will exit to **Measure Mode**. **Data Edit Mode:** Backspace key is used to abort edit operation and exit the register without making any changes. Note: When editing a multi-digit value, each backspace key press will backup one digit, until finally exiting the register.

4.2.2 ENGINEERING UNITS or UP ARROW

Mode of Operation	 Document Symbol: **(Up↑)**
Measure Mode	**No** function in this mode. Will generate error code if pressed.
Program Mode	**Program Mode (P# displayed):** Scrolls up through the available programmable registers. **Data Edit Mode:** This key allows editing the register value by increasing the value of the flashing digit. As part of the P9 editing process the **Engineering Unit** selection can be changed. While changing the units the current unit indicator remains solid, and the newly selected unit indicator will flash. Scrolling through the available units is done by pressing the **Up↑** or **Down↓** keys. The flashing unit is selected using the **PRGM/ENTER→** key, or the process may be aborted by using the **Backspace←** key.

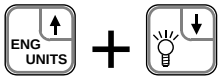
4.2.3 BACKLIGHT or DOWN ARROW

Mode of Operation	 Document Symbol: **(Down↓)**
Measure Mode	Toggles the display Backlight on and off. Note that the default Backlight status for the Battery model is OFF to conserve battery life. The other models will retain the prior Backlight status as default.
Program Mode	**Program Mode (P# displayed):** Scrolls down through the available programmable registers. **Data Edit Mode:** This key allows editing the register value by decreasing the value of the flashing digit. As part of the P9 editing process the **Engineering Unit** selection can be changed. While changing the units the current unit indicator remains solid, and the newly selected unit indicator will flash. Scrolling through the available units is done by pressing the **Up↑** or **Down↓** keys. The flashing unit is selected using the **PRGM/ENTER→** key, or the process may be aborted by using the **Backspace←** key.

4.2.4 PRGM or ENTER

Mode of Operation	 Document Symbol: **(PRGM/Enter→)**
Measure Mode	Selects **Program Mode**, which allows access to the programmable registers P0-P10.
Program Mode	**Program Mode (P# displayed):** Opens the selected register for editing. **Data Edit Mode:** When the desired value is selected, pressing the **PRGM/ENTER→** key accepts and stores the value. When editing a multi-digit value, each key press will accept the current digit and proceed to the next until finally accepting the complete value and closing the register.

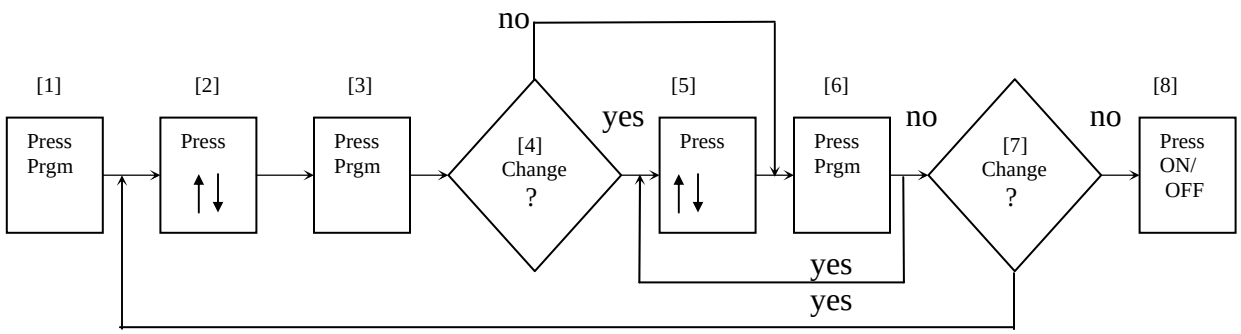
4.2.5 ZERO FUNCTION

Mode of Operation	 Document Symbol: **(Up↑** *and* **Down↓)**
Measure Mode	In **Measure Mode**, pressing the **Up↑** *and* **Down↓** keys at the same time resets the zero reference of the gauge (see page 16).
Program Mode	In **Program Mode**, for convenience, this function will reset to P0. **Program Mode (P# displayed):** Function will reset the register index to P0. **Data Edit Mode:** After opening a register for editing, this function will reset the register's data value to default. Note that even when using this "reset" function, the **PRGM/Enter→** key must be pressed to accept the new value. This allows for further editing after reset of the value.

5 PROGRAMMING

IMPORTANT:
Programmable registers above P0 cannot be adjusted unless the correct lockout code is entered or the lockout code is disabled.

PROGRAM MODE ACCESS



Notes

[1] Enter program register selection mode
[2] Select register number to change
[3] View the value of the register currently selected
[4] Do you want to change the value? If not go to [6]
[5] Increase or decrease the value of the blinking digit, enter PRGM after each digit adjustment is made
[6] After modifying the final digit, PRGM will "store" the new value into memory
[7] Do other programmable registers need to be changed? If so, return to [2]
[8] Exit the program select mode and return to measurement display mode

Key Functions

Backspace : This key can be used to abort data entry and escape back to the measure mode display
Program : Enters data for storage or mode change
Up Arrow : Increments menu selections or digits being edited
Down Arrow : Decrements menu selections or digits being edited

5.1 PROGRAMMABLE REGISTER LIST

All M2110F Flow Gauges have programmable registers that allow the gauge to be configured to fit the flow measurement application. The programmable registers are numbered P0 through P10 and each register controls a specific aspect of the gauge's performance.

During any register editing operation the display will return to the measure mode display after one minute of keypad activity. This will ensure that the gauge will be available for flow measurement observation even if it was unintentionally left in the program display mode.

P#	Name	Description	Value Range	Notes
P0	Lockout Code	Lockout for security.	00 to 99	00 = Disabled. Pg. 14
P1	Time-out	Automatic shutoff in minutes of keypad inactivity.	0 (disabled), 1, 2, 5, 10, 15, 25	Battery models only. Pg. 14
P2	Damp Rate	Exponential damping time in seconds.	0.1, 0.2, 0.5, 1, 2, 5, 10, 15, 25, 50	0.1 = No Damping. Pg. 15
P3	Measurement Mode	Identifies the primary element characteristic (Square Root or Linear)	0) inH2O display	Std. InH2O @ 20°C Pg. 15
			1) Laminar Flow Element	LFE InH2O @ 4°C
			2) Square Root Element	SQRT InH2O @ 60°F
P4	Low Flow CutOff	Minimum display value that will be viewed on the LCD and Serial I/O.	-19999 to Max. Full Scale	Decimal flashes when activated. Pg. 16
P5	SetPoint Options	SetPoint Model: defines which relay outputs are active.	0 = Disabled. 1 = SET1 only. 2 = SET2 only. 3 = Both enabled.	Setpoint and Current Loop models only. Pg. 17
		Current Loop Model: defines the status of the 4 - 20 mA outputs.	0 = 4-20 disabled 1 = 4-20 enabled	
P6	SET1	Controls SET1 relay or 4.00 mA value.	–20% to +120% FS	User defined value. Pg. 17
P7	SET2	Controls SET2 relay or 20.0 mA value.	–20% to +120% FS	User defined value. Pg. 17
P8	Deadband	Sets the amount of deadband in percent of full scale for relays.	0 (disabled), 0.1, 0.2, 0.5, 1, 2, 5, 10%	SetPoint model only. Pg. 19
P9	B-Coefficient / Flow Constant Scaling	The scaling constant required to calibrate the flow measurement equation.	Mantissa range +/- 9,999 Exponent Range E+9 to E-9 Total Range 0 to 2250	A valid P9 setting is required for P3=1 or 2.
	Engineering Units	After the entry of numeric data, access to the units selection is allowed.		User can scroll through possible engineering units. Pg. 20
P10	C-Coefficient Scaling	The scaling constant required to calibrate the flow measurement equation.	Mantissa range +/- 9,999 Exponent Range E+9 to E-9 Total Range +/- 2.0	P10 required for LFE devices. P3 = 2 only. Pg. 21

6 STARTUP REQUIREMENTS

The initial power up of the M2110F Flow Gauge will require register configuration to match the requirements of the application. The user will be required to enter data to properly characterize the connected flow element. This information can be obtained from the supplier of the primary element.

6.1 Power-Up Sequence

After applying power to the units the gauge will perform the following functions:

Sequence of power-up or reset

1. Display test is performed; all segments of the LCD display are turned on
2. Firmware revision is displayed
3. Full-scale flow is displayed in the selected Engineering Units
4. All prior register values are restored and activated
5. **Measure Mode** displays the flow in Engineering Units

6.2 Power-Up Error Conditions

6.2.1 Register Range Errors

After power-up of the unit, the gauge will do a self-check of register settings to determine proper settings. If register data is determined to be out of range, the gauge will reset those values to in-range defaults. The user will then be notified of improper configuration settings with an error code display, see Error Code section for details.

Note:
If at power-up the register P9: B-Coefficient / Flow Constant is at a value of zero, the gauge will display inH_2O units in measure mode. If the user attempts to toggle the display to engineering units using the UP ARROW the gauge will display an error and prompt the user to enter the P9 register value.

6.2.2 Non-Register Data errors

If the error condition is a not a register range error, the gauge will display the error code and then lock-up in the error state.
Clearing the error condition can only be accomplished through a power down reset of the unit. This will involve removing the battery connection on battery models and unplugging Setpoint and Current Loop models. If the error cannot be cleared and an error code indicating a fatal fault is present, the units may have a hardware problem that can only be corrected by servicing the unit.

6.3 Measurement Model

1. Access P3: Measurement Model
2. Configure the device for the connected primary element

   P3 = 0 (Standard inH2O display @ 20°C)
   - Direct differential pressure reading from primary element

   P3 = 1 (Laminar Flow Element @ 4°C)
   - Elements requiring measurement equation: Flow = B_Coeff*dP + C_Coeff*dP^2

   P3 = 2 (Square Root Flow Element @ 60°F)
   - Elements requiring measurement equation: Flow = Flow Constant*$\sqrt{dP}$

Where: B_Coeff and C_Coeff and Flow Constant are calibration constant supplied with the primary element device.

6.4 Low Flow CutOff

1. Access P4: Low Flow CutOff
2. Sets a flow level for which the readout LCD and serial port devices will display a clamped measurement value.
   - For P4 >= 0.0 (Positive or Zero)
     - If the measured flow value is below the Low Flow CutOff, the unit display will be forced to a zero display value. The decimal point will flash to indicate an active Low Flow CutOff.
   - For P4 < 0.0 (Negative)
     - If the measured flow value is more negative than the Low Flow CutOff, the unit will display the P4 value. The decimal point will flash to indicate an active Low Flow CutOff.

6.5 B Coefficient/Flow Constant

1. Access P9: B Coefficient/Flow Constant
2. Scales the primary element modeling equation / sets engineering units
   - Input the proper setting of this register for both modeling types
3. Select the proper engineering units to match the scaling coefficients see **Engineering Units** below

6.6 C Coefficient

1. Access P10: C Coefficient
2. Input the proper setting of this register for P3=0 (Laminar Flow Element Modeling)
3. Return to measure mode and verify display for configured units

6.7 Zero Flow Reference

1. Zero the gauge with zero flow through the primary element
2. Press the **UP AND DOWN ARROW** KEYS simultaneously
3. If lockout is in-active display will flash **0000** during zero sampling
   - Gauge returns to **MEASURE MODE**
4. If lockout is active prompt will be L 00
   - Enter Lockout Code
   - Display will flash **0000** during zero sampling
5. Setpoints might be active(See page 12 for details)

7 ZERO REFERENCE

The gauge zeroing process requires that a flow generating less than 5% of the differential pressure sensors full-scale range be present. This differential pressure generated from the primary element as the zero reference will be measured by the pressure sensor and used as a zero reference for all future flow calculations. Prior to zeroing the gauge all flow should be cut off to the primary element used as the differential pressure source for the gauge sensors.

7.1 AFFECT ON OUTPUTS

The SetPoint and Current Loop outputs are calculated based on the displayed flow. Since re-zeroing the gauge may change the calculated flow, these outputs may be affected by the zeroing procedure. For safety purposes the process should be in a zero flow condition with static pressure when the zeroing is initiated. After the zeroing the threshold settings for the relay or current loop outputs should be checked for proper operation.

7.1.1 RE-ZEROING THE GAUGE / OUTPUTS DISABLED (P5=0):

1. Gauge in **MEASURE MODE** with zero flow through primary element
2. Press the **UP AND DOWN ARROW** KEYS simultaneously
3. If lockout is in-active display will flash **0000** during zero sampling
   - Gauge returns to **MEASURE MODE**
4. If lockout is active prompt will be L 00
   - Enter Lockout Code
   - Display will flash **0000** during zero sampling
   - Gauge returns to **MEASURE MODE**

7.1.2 RE-ZEROING THE GAUGE / OUTPUTS ENABLED (P5=1, 2 or 3):

1. Gauge in **MEASURE MODE** with zero flow through primary element

2. Press the **UP AND DOWN ARROW** KEYS simultaneously

3. If lockout is in-active display will flash **0005 and count down to 0000**
   - Press **PRGM/ENTER** before count reaches **0000** to acknowledge warning
   - The display will again count from **0005 to 0000**
   - Press the **UP AND DOWN ARROW** keys before count reaches **0000**
     - The display will flash **0000** several times while sampling the new zero
     - Gauge returns to **MEASURE MODE**

4. If lockout is active prompt will be L 00
   - Enter Lockout Code
   - Display will flash **0005 and count down to 0000**
   - Press **PRGM/ENTER** before count reaches **0000** to acknowledge warning
   - The display will again count from **0005 to 0000**
   - Press the **UP AND DOWN ARROW** keys before count reaches **0000**
     - The display will flash **0000** several times while sampling the new zero
     - Gauge returns to **MEASURE MODE**

Warning

Never re-zero the gauge when connected to an active controlled process or when known flow is present. The re-zeroing process will alter the instrument's measurement output and could cause a sudden change in analog or relay contact outputs.

7.2 FACTORY ZERO

The “Factory Zero” can be restored through the serial interface on the SetPoint and Current Loop gauge models. This is the factory zero value determined during sensor calibration and is typically 0.0.

7.3 RANGE CHECK

The Smart Gauge can be zeroed only when the measured differential pressure is within ±5% of sensors full-scale rating. If the applied differential pressure is greater than 5% of the rated value then an error code will be displayed when zeroing is attempted.

8 ENGINEERING UNITS

The Engineering units are modified as part of the P9: B-Coefficient/Flow Constant editing process. The purpose of this dependency is to require the user to enter the required unit scaling prior to selecting the engineering units. Note that the P10: C-Coefficient value may also need to be entered to provide proper scaling to the units selected.

The following engineering units are available on the M2110F Flow Gauge:

1. **Gallons /Minute or /Hour**
2. **Pounds /Minute or /Hour**
3. **Cubic Feet /Minute or /Hour**
4. **Liters /Minute or /Hour**
5. **Percent /Minute or /Hour**
6. **Kilograms /Minute or /Hour**
7. **Cubic Meters/Minute or /Hour**
8. **InH_2O Units**[1] –Sensor differential pressure
9. **User Units**[2] –User Defined Units

Notes:

[1] When **InH_2O** units are selected the P9: B-Coefficient/Flow Constant and P10: C-Coefficients are not applicable to the display scaling. The **InH_2O** display data is a direct read of the pressure sensor with the applied P3 related temperature compensation.

[2] The menu selection indicated by all units flashing and is considered the **USER UNITS** selection. In measure mode, indication that the **USER UNITS** are selected is shown by the absence of all unit indictors.

8.1 CHANGING ENGINEERING UNITS

The user should only change the engineering units at the time of setup and calibration. The engineering unit display value is a direct function of the measurement model P3, and the scaling coefficients that are entered into the P9 and P10 register values.

GAUGE IN MEASURE MODE

1. Press **PRGM/ENTER** to access P0 prompt
   - If lockout is in-active prompt will be P0
     - Increment P# using **UP or DOWN ARROW** until P9 is displayed
   - If lockout is active prompt will be L 00 with first digit flashing
     - Enter Lockout Code
     - Increment P# using **UP or DOWN ARROW** until P9 is displayed
2. When P9 is displayed press **PRGM/ENTER** to access P9 value
   - Modify the P9 decimal value used for the mantissa of the scaler
   - Press **PRGM/ENTER** when finished modifying value
   - Modify the P9 decimal value used for the exponent of the scaler
   - Press **PRGM/ENTER** when finished modifying value
   - The current engineering units will now be flashing
     - Use the **UP/DOWN ARROWS** to select the new engineering units
     - Press **PRGM/ENTER** after selecting the new units
   - Press **ON/OFF** to return to **MEASURE MODE**

9 PROGRAMMABLE REGISTERS

9.1 P0 – LOCKOUT CODE

All Models

This feature provides security in the Smart Gauge. It is designed to prevent unauthorized personnel from tampering with or inadvertently changing the configuration of the gauge. The lockout is controlled by a 2-digit setting in the P0 register. If the lockout code is active, the gauge will prompt for the lockout code before allowing any changes to register value. If the correct code is not entered when prompted, an error message will be displayed. If the operator action was to re-zero the gauge, the gauge will simply return to normal **Measure Mode** operation, without accepting any change. If the operator action was entering **Program Mode**, the gauge will enter a "view-only" status (see page 25), denoted by the PRGM indicator flashing.

In **Program Mode** (and during lockout code prompting), the register value is shown as "L xx" to assist in identifying the register. The "L " indicates "Lockout", and "xx" will consist of the current value.

P#	Name	Description	Value Range	Notes
P0	Lockout Code	Lockout for security.	00 to 99	00 = Disabled.

GAUGE IN MEASURE MODE

1. Press **PRGM/ENTER** to access P0 prompt
2. If lockout is in-active prompt will be P0
   - Press **PRGM/ENTER** to access P0 value
   - Press the **UP or DOWN ARROWS** to change each digit
   - Press **PRGM/ENTER** to enter each digit
   - Press the **BACKSPACE** to return to **MEASURE MODE**
3. If lockout is active prompt will be L 00
   - Enter Lockout Code then continue as in 2) above

9.2 P1 – SHUTOFF TIMER

Battery Models Only

This register sets the automatic shutoff time. The Battery model will automatically shutoff if there is no keypad activity for this length of time. This feature can be disabled by selecting zero in the P1 register. This will allow the gauge to remain on until the ON/OFF key is pressed. Please note that usable battery life will be reduced if the unit remains powered even when not in use. During programming, the choices found in the register correspond to the actual time-out values, in minutes.

P#	Name	Description	Value Range	Notes
P1	Time-out	Automatic shutoff in minutes of keypad inactivity.	0 (disabled), 1, 2, 5, 10, 15, 25	Battery model only.

GAUGE IN MEASURE MODE

1. Press **PRGM/ENTER** to access P0 prompt
2. If lockout is in-active prompt will be P0
   - Increment P# using **UP ARROW** until P1 is displayed
   - Press **PRGM/ENTER** to access P1 value
   - Press the **UP or DOWN ARROWS** to change the selection
   - Press **PRGM/ENTER** to enter the time-out selection
   - Press the **BACKSPACE** to return to **MEASURE MODE**
3. If lockout is active prompt will be L 00
   - Enter Lockout Code then continue as in 2) above

9.3 P2- DISPLAY DAMP RATE

The Smart Gauge has a selectable damping rate, which is used to filter the display. The damp rate setting is approximately the time it will take for the gauge to ramp from one stable value to another. The filter characteristic is exponential; changing at a slower rate as the final value is approached.

The "time constant" of the exponential equation is roughly one-fifth of the damp rate setting. This means that the damped value will be roughly 63% of final value after a time equal to one-fifth of the register setting.

The damping function only affects the LCD display and RS232 data values. It does not affect the action of the relay outputs or the 4 to 20 mA outputs.

P#	Name	Description	Value Range	Notes
P2	Damp Rate	Exponential damping time in seconds.	0.1, 0.2, 0.5, 1, 2, 5, 10, 15, 25, 50	0.1 = No Damping.

GAUGE IN MEASURE MODE

1. Press **PRGM/ENTER** to access P0 prompt
2. If lockout is in-active prompt will be P0
   - Increment P# using **UP ARROW** until P2 is displayed
   - Press **PRGM/ENTER** to access P2 value
   - Press the **UP or DOWN ARROWS** to change the selection
   - Press **PRGM/ENTER** to enter the damp rate selection
   - Press the **BACKSPACE** to return to **MEASURE MODE**
3. If lockout is active prompt will be L 00
   - Enter Lockout Code then continue as in 2) above

All Models

9.4 P3 – MEASUREMENT MODEL

The M2110F Flow Gauge will correctly measure flow when used with a primary element: LFE, Accutube or Orifice plate by measuring the differential pressure across the primary element. Register P3 is used to describe the primary element measurement characteristics as either square root or linear function. If P3=0 then the gauge will display the differential pressure developed across the primary element.

P#	Name	Description	Value Range	Notes
P3	Measurement Mode	Identifies the primary element characteristic (Square Root or Linear) The measured differential pressure is automatically compensated for the temperature reference defined for each selection.	0) inH2O display	Std. inH2O @ 20°C P9 and P10 not used.
			1) Laminar Flow Element	LFE inH2O @ 4°C
			2) Square Root Element	SQRT inH2O @ 60°F P10 not used

GAUGE IN MEASURE MODE

1. Press **PRGM/ENTER** to access P0 prompt
2. If lockout is in-active prompt will be P0
   - Increment P# using **UP ARROW** until P3 is displayed
   - Press **PRGM/ENTER** to access P3 value
   - Press the **UP or DOWN ARROWS** to change the selection
   - Press **PRGM/ENTER** to enter the measurement model selection
   - Press the **BACKSPACE** to return to **MEASURE MODE**
3. If lockout is active prompt will be L 00
   - Enter Lockout Code then continue as in 2) above

9.5 P4 – LOW FLOW CUTOFF

All Models

This register is used by the gauge to set a minimum active displayable flow value. Once the flow measurement falls below this value the LCD on the front panel and the serial port will show zero flow. This will allow the user to set a low flow threshold so that erroneous or noisy data at the low end of the measurement element will not be displayed by the gauge. A typical setting value for this register might be 0.0 to prevent system noise from causing negative flow measurements from being displayed.

The decimal point is used to indicate the status of the Low Flow CutOff detection. When the unit is in the measure mode of operation and the flow rate falls below the Low Flow CutOff value. The display will show **zero** with a **flashing decimal point**.

P#	Name	Description	Value Range	Notes
P4	Low Flow Display CutOff	Flow threshold at which the display will be held at zero.	-19999 to Max. Full Scale	Display shows zero with flashing decimal when measurement falls below this threshold.

GAUGE IN MEASURE MODE

1. Press **PRGM/ENTER** to access P0 prompt
2. If lockout is in-active prompt will be P0
   - Increment P# using **UP ARROW** until P4 is displayed
   - Press **PRGM/ENTER** to access P4 value
   - Press the **UP or DOWN ARROWS** to change each digit
   - Press **PRGM/ENTER** to enter each digit
   - When the flashing decimal point is displayed, press the **UP or DOWN ARROWS** to change the decimal point position and sign
   - Press the **BACKSPACE** to return to **MEASURE MODE**
3. If lockout is active prompt will be L 00
   - Enter Lockout Code then continue as in 2) above

9.6 P5 – SETPOINT OPTIONS

SetPoint & Current Loop Models Only

This register defines the output action for SetPoint and Current Loop models. Note that if an output is disabled by this register the SetPoint value in its corresponding register (P6, P7) has no impact.

In **Measure Mode**, the indicators "SET1" and/or "SET2" will illuminate when the corresponding relay is energized. The "4-20mA" indicator will illuminate when the Current Loop output is enabled. In **Program Mode**, the indicators "SET1", "SET2", and "4-20mA" will illuminate as appropriate to assist when scrolling through the register's choices. *Note that if P5 is set for active, the outputs will continue to update even in **Program Mode**, according to the currently programmed values.*

P#	Name	Description	Value Range	Notes
P5	SetPoint Options	SetPoint Model: defines which relay outputs are active.	0 = Disabled. 1 = SET1 only. 2 = SET2 only. 3 = Both enabled.	Not found on Battery model.
		Current Loop Model: defines the status of the 4 - 20 mA output.	0 = 4-20 disabled 1 = 4-20 enabled	

GAUGE IN MEASURE MODE

1. Press **PRGM/ENTER** to access P0 prompt
2. If lockout is in-active prompt will be P0
   - Increment P# using **UP ARROW** until P5 is displayed
   - Press **PRGM/ENTER** to access P5 value
   - Press the **UP or DOWN ARROWS** to change the selection
   - Press **PRGM/ENTER** to enter the setpoint option selection
   - Press the **BACKSPACE** to return to **MEASURE MODE**
3. If lockout is active prompt will be L 00
   - Enter Lockout Code then continue as in 2) above

9.7 P6 and P7 – SETPOINT (SET1 and SET2)

SetPoint & Current Loop Models Only

9.7.1 Setpoint Model

These programmable registers define the flow values at which the relay outputs will energize. The relay will energize when the flow exceeds its corresponding value, and de-energize when the flow drops below the value minus the deadband. Register P6 defines the SET1 relay detection threshold and P7 defines the SET2 relay detection threshold.

9.7.2 Current Loop Model

These programmable registers define the 4 to 20 mA output scaling and range. The P6, SET1 value defines the flow rate that will be represented by a 4.00 mA output signal. The P7, SET2 value defines the flow rate that will be represented by a 20.00 mA output signal. Other flow values provide an output that is linearly scaled between the two end points P6 and P7. For values beyond the defined range the output is limited from 4.00 to 20.38 mA. The P6 (4-mA) register can be set greater than the P7 (20-mA) register, to create a reverse acting output. The limits are –20% to +120% full scale, but P6 and P7 cannot be set at equal values.

9.7.3 Data Entry

These programmable registers are entered in the current Engineering Unit used by the gauge, which are illuminated during edit of these programmable registers. For example, if the gauge is set to read in gallons/minute, and a value of 110 is put into the P6 register the SET1 relay will energize at 110 gallons.

In **Program Mode**, the indicators "**SET1**", "**SET2**", and "**4-20mA**" will illuminate as appropriate to assist in identifying the edited register. For example, when scrolling to and/or editing P6, "**SET1**" will illuminate indicating that SET1 is being edited. The same indication applies to the access of the P7/"**SET2**" value. The "**4-20mA**" will be illuminated if the gauge is a Current Loop model to indicate that the 4-20mA range is being edited.

9.7.4 Scaling Dependency

If the Engineering Unit is changed along with the appropriate scaling factors the value in the P6 and P7 programmable registers may also require correction to reflect the changes to the scaling and units.

P#	Name	Description	Value Range	Notes
P6	SET1	Controls SET1 relay or 4.00 mA value.	–20% to +120% FS	User defined value. P6 cannot equal P7
P7	SET2	Controls SET2 relay or 20.0 mA value.	–20% to +120% FS	User defined value. P6 cannot equal P7

GAUGE IN MEASURE MODE

1. Press **PRGM/ENTER** to access P0 prompt
2. If lockout is in-active prompt will be P0
   - Increment P# using **UP ARROW** until P6 or P7 is displayed
   - Press **PRGM/ENTER** to access the register value
   - Press the **UP or DOWN ARROWS** to change each digit
   - Press **PRGM/ENTER** to enter each digit
   - When the flashing decimal point is displayed, Press the **UP or DOWN ARROWS** to change the decimal point position and sign
   - Press **PRGM/ENTER** to enter the decimal and sign
   - Press the **BACKSPACE** to return to **MEASURE MODE**
3. If lockout is active prompt will be L 00
   - Enter Lockout Code then continue as in 2) above

9.8 P8 – DEADBAND

SetPoint Models Only

This register is found on the SetPoint model only. The deadband can be set to 0 (disabled), 0.1, 0.2, 0.5, 1, 2, 5 and 10% of full scale flow. The relay will energize at the value in its corresponding P6 and P7 programmable registers for increasing flow values. The relay will de-energize at a value equal to the corresponding P6 and P7 register, minus the deadband value for decreasing flow values. With a 0% deadband setting, the relays will energize and reset precisely at the values in the corresponding P6 and P7 programmable registers. The programming choices found in the register menu correspond to the actual deadband values in percent full scale.

P#	**Name**	**Description**	**Value Range**	**Notes**
P8	Deadband	Sets the amount of deadband in percent of full scale for relays.	0 (disabled), 0.1, 0.2, 0.5, 1, 2, 5, 10%	SetPoint model only.

GAUGE IN MEASURE MODE

1. Press **PRGM/ENTER** to access P0 prompt
2. If lockout is in-active prompt will be P0
   - Increment P# using **UP ARROW** until P8 is displayed
   - Press **PRGM/ENTER** to access P8 value
   - Press the **UP or DOWN ARROWS** to change the selection
   - Press **PRGM/ENTER** to enter the deadband setting selection
   - Press the **BACKSPACE** to return to **MEASURE MODE**
3. If lockout is active prompt will be L 00
   - Enter Lockout Code then continue as in 2) above

9.9 P9 – FLOW MEASUREMENT B-COEFFICIENT

All Models

The Flow Gauge calculates flow based on the differential pressure that develops across the primary element used in the flow path. By defining the characteristics of the differential pressure drop as a square root or linear function the smart gauge can calculate the flow rate from the sampled differential pressure. The P9 register defines the scaling for the square root primary element, while the P9 and P10 programmable registers together specify the linear coefficients for the LFE primary elements.

The P9 register is entered in multiple parts, decimal digit (mantissa) and x10 factor (exponent). This is required because of the wide range of the B-coefficient values depending upon the size, type and rating of the primary element. This register is entered first as the decimal (mantissa) part using the normal entry method. Following the entry of this value the display will prompt the user for a x10 factor (exponential) value in the range of E-9 to E+9. Only after the user has edited the P9 value will access to the unit selection list be allowed.

Example : B-Coefficient = .000123 : From primary element data sheet
B-Coefficient = .000123 = 1.23×10^{-4} = 1.23 E -4
Data Entry Display for P9: 1.230 (After Program mode enter)
- E3 (After Decimal digit enter)

P#	Name	Description	Value Range	Notes
P9	B-Coefficient Scaling	The scaling constant required calibrating the flow measurement equation.	Mantissa range +/- 9.999 Exponent Range E+9 to E-9 Total Range 0 to 2250	1) P9 is required for LFE and Square Root devices. 2) If P5 = setpoints enabled ,and P9 is set to zero Pg. 25
		Engineering Units Selection List	Gallons /Minute /Hour Pounds /Minute /Hour Cubic Feet /Minute /Hour Liters /Minute /Hour Percent /Minute /Hour Kilograms /Minute /Hour Cubic Meters /Minute /Hour InH_2O Units User Units	The actual Flow display magnitude will depend on the scaling values entered in to P9 and P10.

GAUGE IN MEASURE MODE

1. Press **PRGM/ENTER** to access P0 prompt
2. If lockout is in-active prompt will be P0
   - Increment P# using **UP ARROW** until P9 is displayed
   - Press **PRGM/ENTER** to access the register value
   - Press the **UP or DOWN ARROWS** to change each digit
   - Press **PRGM/ENTER** to enter each digit
   - When the flashing decimal point is displayed, Press the **UP or DOWN ARROWS** to change the sign
   - Press **PRGM/ENTER** to enter the value and sign
3. If lockout is active prompt will be L 00
   - Enter Lockout Code then continue as explained in 2) above

4. The display shows the exponent value for P9. Press the **UP or DOWN ARROWS** to change the exponent digit.
   - Press **PRGM/ENTER** to enter the digit, the decimal point will flash
   - Press the **UP or DOWN ARROWS** to change the sign of the exponent
   - Press **PRGM/ENTER** to enter the exponent value
   - The present engineering units will be flashing. Press the **UP or DOWN ARROWS** to scroll through the possible units.
   - Press **PRGM/ENTER** to enter the selected units

5. The current engineering unit will now be flashing
   - Use the **UP/DOWN ARROWS** to select the new engineering unit
   - The user can rotate through the list of possible units and time bases
   - Press **PRGM/ENTER** after selecting the new units

6. Press the **BACKSPACE** to return to **MEASURE MODE**

9.10 P10 – FLOW MEASUREMENT C-COEFFICIENT

All Models

The Flow Gauge calculates flow based on the differential pressure that develops across the primary element in the flow path. By defining the characteristics of the differential pressure drop as a square root or linear function, the smart gauge can calculate the flow rate from the sampled differential pressure. The P9 register defines the scaling for the square root primary element, while the P9 and P10 programmable registers together specify the linear coefficients for the LFE primary elements.

The P10 register is entered in multiple parts, decimal digit (mantissa) and x10 factor (exponent). This is required because of the wide range of the C-coefficient values depending upon the size, type and rating of the primary elements. This register is entered first as the decimal (mantissa) part using the normal entry method. Following the entry of this value the display will prompt the user for a x10 factor (exponential) value in the range of E-9 to E+9.

Example: C-Coefficient = .000123: From primary element data sheet
C-Coefficient = .000123 = 1.23 x 10^{-4} = 1.23 E -4
Data Entry Display for P10: 1.230 (After Program mode enter)
\- E4 (After Decimal digit enter)

P#	Name	Description	Value Range	Notes
P10	C-Coefficient Scaling	The scaling constant required calibrating the flow measurement equation.	Mantissa range +/- 9.999 Exponent Range E+9 to E-9 Total Range +/- 2.0	P10 required for LFE devices.

GAUGE IN MEASURE MODE

1. Press **PRGM/ENTER** to access P0 prompt
2. If lockout is in-active prompt will be P0
   - Increment P# using **UP ARROW** until P10 is displayed
   - Press **PRGM/ENTER** to access the register value
   - Press the **UP or DOWN ARROWS** to change each digit
   - Press **PRGM/ENTER** to enter each digit
   - When the flashing decimal point is displayed, Press the **UP or DOWN ARROWS** to change the sign.
   - Press **PRGM/ENTER** to enter the value and sign

3. The display shows the exponent value for P10. Press the **UP or DOWN ARROWS** to change the exponent digit.
   - Press **PRGM/ENTER** to enter the digit, the decimal point will flash
   - Press the **UP or DOWN ARROWS** to change the sign of the exponent
   - Press **PRGM/ENTER** to enter the exponent value
   - Press the **BACKSPACE** to return to **MEASURE MODE**
4. If lockout is active prompt will be L 00
   - Enter Lockout Code then continue as in 2) above

10 REGISTER SECURITY

10.1 DESCRIPTION

When a gauge is "locked" for security purposes, it does not allow access to register data without first providing the lockout code. A gauge is "locked" by entering a lockout code into the P0 register. After pressing a key on a locked gauge for a desired function "L 00" will appear on the display, with the first 0 flashing. This is the prompt to enter the lockout code.

10.2 VIEW-ONLY STATUS

If a user attempts to enter **Program Mode** without providing a correct lockout code, the gauge briefly provides an error message, and then enters a "view-only" status, denoted by the PRGM indicator flashing. In this mode, all programmable registers except the lockout code register itself can be viewed, but not changed.

In this view-only status, the operator navigates through the programmable registers exactly the same as if programming the programmable registers. However, the keys that would change a value are simply ignored by the gauge. Thus, the **PRGM/Enter→** key will open a register normally; the **Backspace←** key will close the register, and then return to **Measure Mode** as expected. The **Up and Down Arrow keys** do nothing within the register.

GAUGE IN MEASURE MODE

1. Press **PRGM/ENTER** to access P0 prompt
2. If lockout is active prompt will be L 00
   - Enter Lockout Code
   - Press the **UP or DOWN ARROWS** to change each digit
   - Press **PRGM/ENTER** to enter each digit

If the correct code was entered, the gauge will perform the requested function. Otherwise, an error message is displayed, and the gauge either returns to **Measure Mode**, or enters a "view-only" status for the programmable registers (if **Program Mode** was requested).

11 SERIAL PORT SERVICE

SetPoint & Current Loop Models Only

The M2110F Smart Flow Gauge SetPoint and Current Loop models provide RS-232C communication capability. To use the serial service, connect a standard "dumb terminal" or personal computer with terminal software as shown in the wiring diagram on page 29. Set the terminal communication for 9600 baud, 8 data bits, no parity, one stop bit, and no handshaking. The terminal should be able to display at least 24 lines and 70 columns.

11.1 THE MENU

All programmable items of the gauge are available from the menu. Included with the menu is a complete summary of all data representing the current programming and operating status.

A sample view of the menu is shown below for reference. The top line identifies the gauge, firmware revision, and copyright. The second line displays the gauge model, the full-scale sensor range, and the sensor identifier. Next is a reminder notice to the operator (explained below).

Finally, all programmable registers and functions are formatted on the menu. The menu item includes its menu-selection character, and the current register data as applicable. To change an item, simply select its character from the terminal keypad; the appropriate sub-menu, notes, and instructions are presented for operator entry. Note that the serial menu typically provides more flexibility for entering data values, compared with the gauge's keypad.

```
SmartGauge/M2110F (vX.XX).  (c) Copyright 2010 Meriam
SetPoint model.  Sensor = 28.00 InH2O
-----------------------------------------------------------------
Notice!  Changing any value will PAUSE Gauge Operation; see manual!
-----------------------------------------------------------------
Current Full Scale:   25.00 Cu.Ft./hour
-----------------------------------------------------------------
A) P0, LockOut Code     = Disabled
B) P2, Damp Rate        = 0.2 Seconds
C) P3, Measurement Mode = Square Root
D) P4, Minimum Display  = 1.0000    Cu.Ft./hr.
E) P5, SetPoint Ctrl    = Disabled
F) P6, SET1             = 0.0000    Cu.Ft./hr.
G) P7, SET2             = 0.0000    Cu.Ft./hr.
H) P8, Dead Band        = 0.0 % Full Scale
I) P9, B Coefficient    = 1.2340E-01
       & Units
J) P10,C Coefficient    = Not Available P3=2(Square Root)
L) Restore Factory Zero     M) ReZero Gauge
X) EXIT Interactive Menu

Select Choice:
```

11.2 ACCESSING THE MENU

When the gauge is powered up or reset, it will print the menu to the serial port. Also, hitting the ENTER key from the terminal will reprint the menu. If the terminal is not connected when the gauge prints the menu after power up, the user will see no screen text until he/she presses the ENTER key to establish communications with the device.

11.3 IMPACT ON OPERATION

Use of the serial port service is independent of the operating mode of the gauge, and vice versa. It is not necessary to change to **Program Mode** to use any of the menu's features, editing programmable registers or re-zeroing. The gauge continues its active operation regardless of the serial port service, except for the pausing explained in the next paragraph. Any keypad activity from the front panel of the gauge will also be processed regardless of the serial port status. If entries are made through the keypad and the serial port simultaneously, the last entry received will be active.

While the serial port is transferring data, the other functions of the gauge are paused to allow this task to complete. In this paused state, the display is frozen and the outputs are not updating. Typically, the data transfers are very short and thus the interruption is minimal. However, selecting a register for edit will completely stop normal gauge operation, because the gauge is awaiting the operator's input. During this state, the display is blanked and as soon as the operator selection or entry is complete, the gauge resumes normal operation.

Warning

The Notice of "PAUSE Gauge Operation" near the top of the menu is a reminder about this explanation. It is particularly important when a gauge is in service as an in-process instrument, since the gauge will not respond to process conditions while it is paused.

11.4 TIMEOUT

When the menu is displayed, it has no impact on gauge operation or performance. Therefore, the menu will remain displayed indefinitely, or until the operator takes action or the gauge is reset. When the gauge is stopped awaiting operator input the gauge's display is blanked and the outputs are frozen. In this state, if there is no terminal keyboard activity for approximately one-minute, the operation will time-out and the gauge is returned to its operating mode.

11.5 DATA MONITORING

Selecting "X" from the menu will EXIT the menu and begin data monitoring. If the gauge was in **Program Mode**, it will be returned to **Measure Mode** to allow data monitoring.

During data monitoring, every analog-to-digital conversion from the pressure sensor is displayed on the terminal. The additional load of the continuous serial communication will slightly reduce the overall performance of the gauge. The resulting data rate will typically be about ten (10) conversions per second, depending on various operating conditions. Note that the data sent to the terminal *will be damped* according to the damp rate set in register P2.

The data includes the pressure value and Engineering Units, as well as the output status of either the relay SET1 ON, SET2 ON or the 4-20 mA output value, if set. Note that this status indication is the internal calculated value, as there is no feedback hardware on the gauge. "Over Pressure!" is indicated if the input pressure exceeds 120% of the full-scale sensor range. This indication acts on the direct measurement of pressure regardless of the damp rate setting.

If the gauge is taken out of serial **Measure Mode** the data monitoring function will pause with a message. The menu is available at this time, as it is at any time, by hitting ENTER from the terminal. When the gauge is returned to **Measure Mode**, if the menu was not activated, data monitoring will automatically resume.

Data logging can be accomplished be invoking the appropriate logging function of the terminal software.

To EXIT the data monitoring function, simply hit ENTER on the terminal to restore the menu.

11.6 LOCKOUT

If the lockout feature is active, see register P0, the serial menu will prompt for the lockout code if necessary. For security purposes, an asterisk (*****) is displayed instead of the character as it is typed. When entering a new lockout code through the serial port, however the code is displayed as it is typed, since there is no confirmation step.

12 **ERROR CODES**

All Smart Gauge models have an error/message feature to inform the operator of problems with the operation or programming of the gauge. These Error Codes and messages are identified and described in the table below.

ERROR	DESCRIPTION
"OP"	Overpressure warning. The measured pressure exceeds the full-scale pressure by 20% of full scale or more. **Sensor is at risk of permanent damage!**
E001	Automatic Shutoff timer has expired (Battery model only); gauge is shutting down normally.
E002	Requested ZERO value is not within 5% of full-scale pressure, and therefore ignored.
E003	Requested SET1 or SET2 is out of range. Must be greater than 0 and less than +120% Full Scale.
E004	SET1and SET2 values are equal. This configuration is not acceptable on Current Loop models. To disable the output, Set register P5 = 0 (see page 1).
E005	User register found to be out of range after powerup. The register was forced to a default value and then re-saved to memory by the initialization function.
E006	User entered incorrect Lockout Code. Gauge is locked. A view-only status will be entered if Program Mode was requested.
E007	Access to P10 register was rejected because P10 is invalid when P3 = 0 or P3=2.
E008	Entry of the P9 or P10 register value was out of range. Access to P9 was rejected because of P3 = 0 setting. The output functions P5 were disabled because user entered P9 = 0.
E009	Access to P5, P6, or P7 was rejected because the value of P9 = 0.0. The user must enter a usable value into P9 before access to P5-P7 is allowed.
E010	Full Scale Range for Engineering Units selected is beyond scale of display (>19,999) or the full-scale range is equal to zero because of incorrect P9 or P10 register setting.
E011	User attempted to use the ENG arrow key in measure mode. This key has no function in this mode, see P3 setup and P9 entry for units selection process.
E012	User attempted to enter P4 Low Flow Cut Off value greater than or equal to the Full Scale Units.
E020	Low Battery (or power supply) Warning. This error will show repeatedly approximately every 10 seconds, so long as the voltage supply remains low.
E030*****	EEProm Error. Display alternates between "E030" and a sub-Ecode. This error is generated if the EEProm data is out of range after power-up. Units can recover from these errors by OFF/ON reset. The variables are forced into range after the OFF/ON reset. If the unit cannot recover from the Error, the fault may be due to hardware malfunction. Please consult the factory for assistance. All programmable registers should be rechecked for valid data after power-up.
	SUB-ECODE **DESCRIPTION** Note: Ecode is accumulation of errors. Example: ECode 129 = Error 1 and Error 128
	1 Factory sensor detection error: Sensor range or type is invalid
	2 Not Used
	4 Not Used
	8 Factory or User Zero value is out of range
	16 User register found out of range
	32 Factory configured data pressure incorrect
	64 Factory configured temperature data incorrect
	128 EEProm data storage error
E110	Displayed flow or pressure range error. The value to be displayed is out of range. Check the settings of P3, P9 and P10. **Note**: P9 cannot equal zero when P3 = 1 (LFE) or 2 (Sq.Rt) modes.
E210*	Internal display error. Cannot display character. Consult factory, possible hardware problem.
E211*	Internal display error.
E213*	Internal display error. Attempting to display 2.0000 on the display.

- These Error codes may indicate a hardware or other internal problems; if the problem cannot be corrected by cycling the input power supply on and off, please take note of the error code and operating conditions, and contact Meriam Instrument at (216) 281-1100.

13 SUPPLEMENTARY INFORMATION

13.1 Application Example

13.1.1 Laminar flow element

Primary Element:	Laminar Flow Element (LFE) Model 50MJ10-9 Nominal Air flow Range = 3.00 cubic feet/minute B-Coefficient = 4.2847E-1 C-Coefficient = -5.0523E-3	
Gauge requirement:	M2110F with 10.00 inH2O sensor	
Application requirements:	Monitor airflow in units of cubic feet/minute Setup Relay outputs to detect low limit at 1.25 cu.ft/min	
Settings:	P3 = 1	: Measurement Model = LFE
	P5 = 1	: Setpoint Option = SET1 Only
	P6 = 1.250	: SET1 limit = 1.250 cu.ft/min
	P9 = 4.285	: Rounded decimal part of the B-Coefficient
	= - E1	: Exponent of B-Coefficient
	P10 = -5.052	: Rounded decimal part of the C-Coefficient
	= - E3	: Exponent of C-Coefficient

13.1.2 Accutube/Orifice Plate flow element

Primary Element:	Accutube Flow Element Maximum Air flow Range = 750 SCFM DP at maximum air flow = 15 inH_2O	
Application requirements:	Monitor airflow in units of cubic feet/minute Setup Relay outputs to detect low limit at 25 cu.ft/min	
Gauge requirement:	M2110F with 28.000 inH_2O sensor	
Settings:	P3 = 2	: Measurement Model = Square Root Device
	P5 = 1	: Setpoint Option = SET1 Only
	P6 = 25	: SET1 limit = 25 cu.ft/min
	P9 = 193.65	: Flow Constant = $\frac{MaximumAirFlowRange}{\sqrt{DPatMaximumAirFlow}}$

13.2 Maintenance

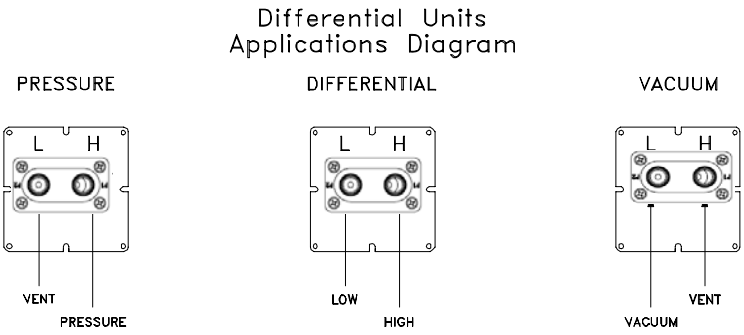
13.2.1 Battery Model Smart Gauge

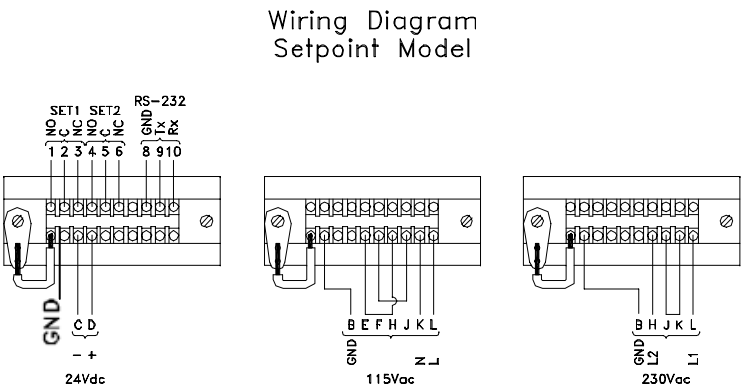
The battery can be changed by removing the front face cover on the smart gauge and then removing the PC board assemblies as described below.

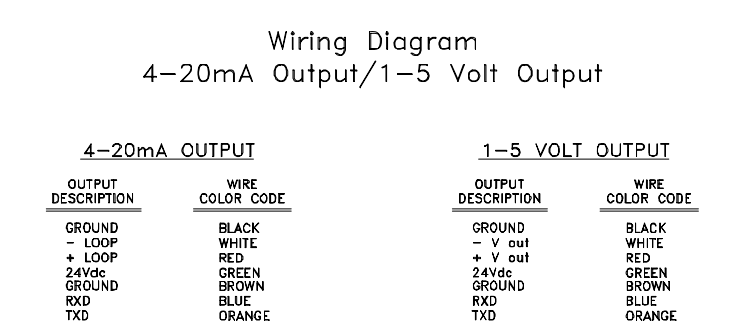
1. Remove the four (4) front face screws.
2. Carefully fold down front face cover and slide electronics board assembly forward until the sensor ribbon cable can be unplugged.
3. Slide the assembly completely out of the housing, unplug battery board and attach replacement.
4. Re-assemble the unit in reverse order.
5. Check to ensure that the sensor cable, battery board and front panel are re-connected properly before reattaching the front faceplate.

14 INSTALLATION

Differential pressure sensors have two pressure connections on the back of the gauge. The diagram below shows the correct connections to obtain the desired type of pressure measurement.







The **SetPoint model** utilizes the multi-function terminal strip shown at the left. This terminal strip has a NEMA 1 rating. The SPDT relays are not powered internally by the gauge. Jumpers from the 24Vdc, 110Vac or 220Vac power sources can be used if required.

The **Current Loop model** uses a cannon connector that is designed to meet NEMA 4X requirements. The charts at the left show the terminal and wiring arrangement. See wiring schematics for the three and four wire, 4 to 20 mA loops shown.

Note: The Smart Gauge comes with 1/8" FNPT pressure port(s). Gauge and Absolute models only use one pressure port. The unused port vents the enclosure/sensor to atmosphere. **DO NOT REMOVE THE SINTERED PLUG (ALLEN HEAD FITTING)**. The Smart Gauge should be panel-mounted or held firmly in one *hand* while a small wrench is used to tighten the 1/8" MNPT pipe thread. Do not tighten the fitting without using a wrench on the manifold.

14.1 ELECTRICAL CONNECTIONS

Setpoint models come with a terminal block interface while the Current Loop model comes with an eight-pin circular connector/cable interface. Note: The cable is supplied with the Current Loop model.

14.1.1 Power Supply Options

The M2110F SMART GAUGE can be supplied in three possible hardware configurations.

1. Battery Model ..…….Unit powered by internal batteries
   NO EXTERNAL POWER SUPPLY REQUIRED

2. Setpoint Model ……..Unit includes two programmable relay outputs
   EXTERNAL POWER SOURCE: 24 VDC, 115 VAC or 230 VAC

3. Current Loop Model …….Unit includes 4-20 mA output
   EXTERNAL POWER SOURCE: 24 VDC

14.1.2 Setpoint Model Interface Connections

Terminal	Description	Function	Notes	
1	SET1 / NO	Relay1 output	Normally open	
2	SET1 / C	Relay1 output	Common	
3	SET1 / NC	Relay1 output	Normally closed	
4	SET2 / NO	Relay2 output	Normally open	
5	SET2 / C	Relay2 output	Common	
6	SET2 / NC	Relay2 output	Normally closed	
7	No Connection	None		
8	RS232 Common	RS232 interface common connection	0 VDC	
9	RS232 Tx	RS232 transmit output connection	For Serial Menu	
10	RS232 Rx	RS232 receive input connection	For Serial Menu	
A	Frame Ground	Earth Connection		
B	GND	AC Ground		
		DC POWER SUPPLY CONNECTIONS		
C	0 VDC	Common	Connect only if not using AC inputs	
D	+24 VDC IN	+24 VDC Input Nominal	Connect only if not using AC inputs	
		AC POWER SUPPLY CONNECTIONS Reconnectable 115/230 Primary	**115 VAC INPUT**	**230 VAC INPUT**
E		Reconnectable Transformer Primary	Jumper E to H	NC
F		Reconnectable Transformer Primary	Jumper F to J	NC
H	L2	Reconnectable Transformer Primary	(See E above)	L2 / 230 VAC
J		Reconnectable Transformer Primary	(See F above)	Jumper J to K
K	N	Transformer Primary Fused Input	Line Neutral	
L	L1 / L	Transformer Primary Fused Input	L 115 VAC	L1 / 230VAC

Note: See Appendix for wiring specifics.

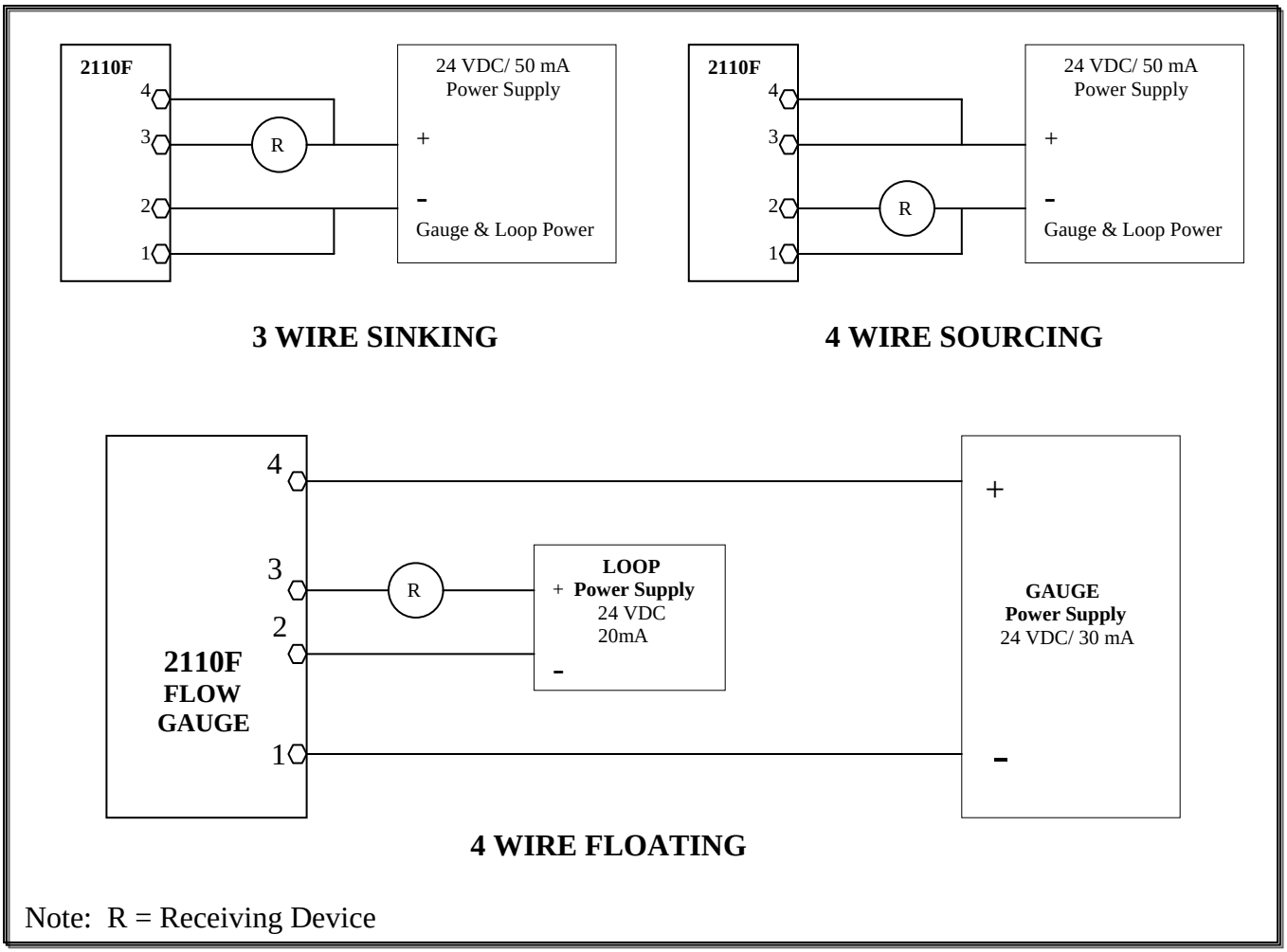
14.2 CURRENT LOOP MODEL WIRING

14.2.1 Current Loop Model Interface Connections

The Current Loop Model connections are made through the supplied interface cable. The cable is connected to an eight (8) pin circular receptacle on the back of the unit. These connections will be defined by wire color coding of the cable.

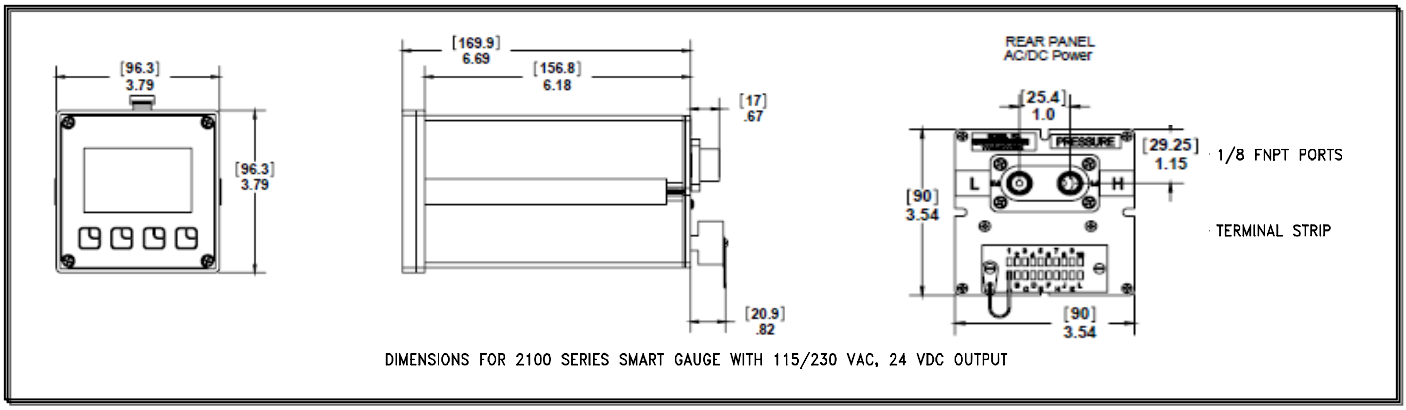
Pin #	Wire Color	Description	Function	Notes
1	BLACK	0 VDC IN	Gauge Power Supply Common	0 VDC Input
2	WHITE	-LOOP	4-20 mA Analog Return	(+) mA output to receiver
3	RED	+LOOP	4-20 mA Loop Power Input	
4	GREEN	+24VDC IN	Gauge Power Supply Input	+ 24 VDC Input Nominal
5	NOT USED			
6	BROWN	RS232 Common	RS232 interface common connection	0 VDC
7	BLUE	RS232 Rx	RS232 receive input connection	For Serial Menu
8	ORANGE	RS232 Tx	RS232 transmit output connection	For Serial Menu

Note: See Appendix for wiring specifics.



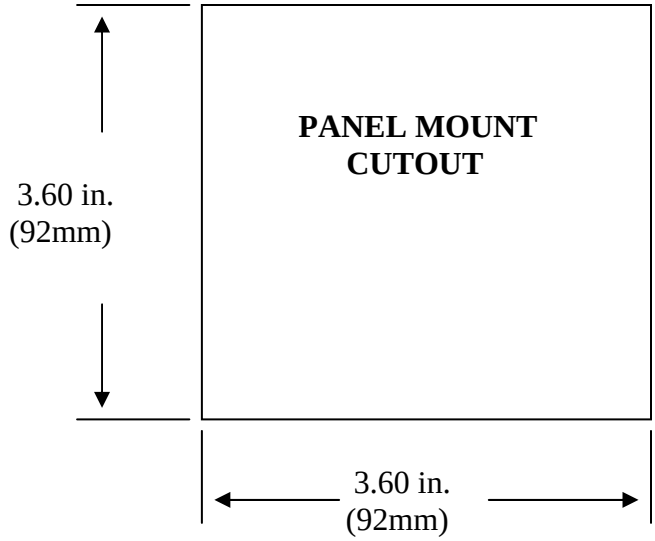
Note: R = Receiving Device

14.3 OUTLINE DIMENSIONS



14.3.1 Panel Mounting

1. Make a ¼ DIN panel cutout per drawing.



2. Remove the two 6-32 socket head screws in the grooves at the rear of the gauge.
3. Slide the panel mount jacks out of the groove.
4. Insert the gauge through the front of the panel.
5. From the rear, insert the panel mount jacks in the grooves on the side of the gauge, and slide them firmly against the panel.
6. Replace the two 6-32 socket head screws.
7. Tighten the panel mount jack against the panel with the two socket head screws.
8. Refer to the note on page 30 when making pressure connections.

15 PRODUCT SPECIFICATIONS

TYPE & RANGE:
DN: Differential Non-Isolated
CI: Compound Isolated
GI: Gauge Isolated
AI: Absolute Isolated
DI: Wet/Wet Differential Isolated

MEDIA COMPATIBILITY: Non-isolated sensor for clean, dry, non-corrosive gases. Isolated sensor for fluids compatible with 316SS. DI sensors have viton o-rings (consult factory for further options).

ACCURACY*: Indication: ± 0.05% of Full Scale (includes combined effects of linearity, repeatability, hysteresis and temperature). Analog output: ± 0.05% of Full Scale + 3 counts. AC-powered gauges require 15 minute warm-up. NIST certification supplied.

ZERO DRIFT: ± 0.015% of full scale. Zeroing prior to measurement eliminates this effect.

TEMPERATURE:
Storage: -40 °F to 140 °F (-40 °C to 60 °C)
Operating: -4 °F to 122 °F (-20 °C to 50 °C)

PRESSURE LIMITS: 2x range for AI, GI, and CI sensors. 2x range for DN sensors when pressurized on high side only; 150 PSI static when applied to both sides of the sensor simultaneously. 3x range for DI sensors when pressurized on high side only, 1000 PSI static when applied to both sides of the sensor simultaneously. 3x range or 150 PSI on low side whichever is less.

DISPLAY: 4 1/2 digit, 0.6 inch (15.24 mm) LCD.

PRESSURE CONNECTIONS: 1/8" female NPT. Brass on non-isolated, 316SS on isolated sensors.

INPUT POWER: SetPoint model is standard with selectable 110V AC 50/60 Hz, 220V AC 50/60 Hz, or 24V DC power. Included are an RS 232C interface and two programmable SPDT relays, rated 1.0 amp resistive @ 24V DC, 0.5 amp resistive @ 115V AC.

Battery models are powered by two Lithium "D" Cells. Battery Life is approximately 100 days at a 100% duty cycle.

I/O: Included are an RS 232C interface and two programmable SPDT relays, rated 1.0 amp resistive @ 24V DC, 0.5 amp resistive @ 115V AC.

Option 1: Lithium Battery model with replaceable battery board with automatic shut-off (programmable). No outputs available.

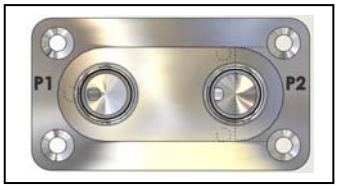
Option 2: Current Loop model with 4-20mA output, 24V DC (50mA) power and RS 232C.

ENCLOSURE: 4 lbs. 1/4 DIN (3.8" X 3.8" X 6.5") aluminum enclosure with epoxy finish. Standard model is NEMA 4X on front panel only. Battery and Current Loop models are NEMA 4X throughout.

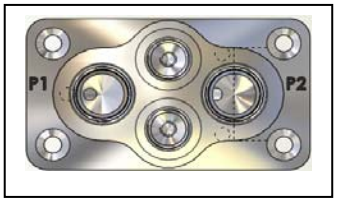
MOUNTING: 1/4 DIN panel mounting standard. Options: 2" pipe mount bracket; or portable handle.

Sensor Ranges

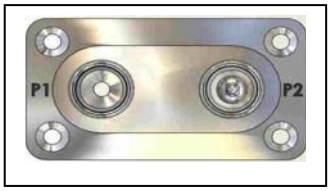
Sensor Type	Available Ranges	Native Engineering Units
DN = Differential Non Isolated	0-10, 0-28, 0-200, 0-415, 0-2000	Inches of H2O @ 20°C
GI = Gauge Isolated	0-15, 0-30, 0-50, 0-100, 0-300, 0-500, 0-1000, 0-3000	PSI
CI = Compound Isolated	-15 to 15, -15 to 30, -15 to 50, -15 to 100, -15 to 500. -15 to 1000, -15 to 3000	PSI
AI = Absolute Isolated	0-17, 0-38, 0-100, 0-1000	PSIA
DI = Differential Isolated	0-5, 0-15, 0-30, 0-100, 0-300, 0-500, 0-1000	PSID



DN/DI Pressure Manifold



DI with Optional Flushing Ports



AI, GI, or CI Pressure Manifold

Range Limits and Indication

Sensor Type	Hard Under Range	Soft Under Range	Certified Range (F.S.)	Soft Over Range	Hard Over Range
DN	Under -20% [1]	-20 to 0%	0 to 100%	100 to 120%	Over 120%
DI	Under -20% [2]	-20 to 0%	0 to 100%	100 to 120%	Over 120%
GI	Under -20% [3]	-20 [3] to 0%	0 to 100%	100 to 120%	Over 120%
CI	NA [4]	NA [4]	0 to 100%	100 to 120%	Over 120%
AI	NA [5]	NA [5]	0 to 100%	100 to 120%	Over 120%

Notes:

[1] DN units will measure to -20% (or -10 PSID, whichever is greater pressure relative to absolute zero) and +120% of full scale pressure. Calibration certification is for 0 – F.S. (Full Scale Only).

[2] DI units will measure to -20% (or -150 PSI, whichever is greater pressure relative to absolute zero) and +120% of full scale pressure. Calibration certification is for 0 – F.S. (Full Scale Only).

[3] GI units will measure to -20% (or -10 PSIG, whichever is greater pressure relative to absolute zero) and +120% of full scale pressure. Calibration certification is for 0 – F.S. (Full Scale Only).

[4] CI units will measure to negative barometric pressure (typically -14.7 PSIG) and to +120% of full scale pressure. Calibration certification is for -14.5 PSIG to F.S. (Full Scale Only).

[5] AI units will measure to +120% of full scale pressure. Calibration certification is for 0 PSIA to F.S. (Full Scale Only).

Hard Over & Under:
Display will read "OP" (Under -20% or Over 120%).

Soft Over & Under:
Display will still read out at (± 20%).

16 Service and Calibration

In the event an M2110 requires service or needs to be returned for factory recertification, battery replacement, or re-calibration, please contact Meriam at the numbers listed below. The battery board should only be replaced by properly trained technicians in a controlled environment. Contact Meriam for further details

DO NOT send any unit in for service without first contacting Meriam for a Return Material Authorization (RMA) number. If this number has not been obtained and clearly marked on the return packaging, the unit will be returned at the shipper's expense. An RMA number will be provided by the Meriam Repair Department when you call, fax or e-mail your information. Certification for Non-Hazardous Materials will also be required. The RMA number must accompany all incoming packages to insure proper tracking, processing and repair work.

To assist us in processing your service request, please have the Model & Serial Number of the unit available when you call. This information is located on the product label.

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