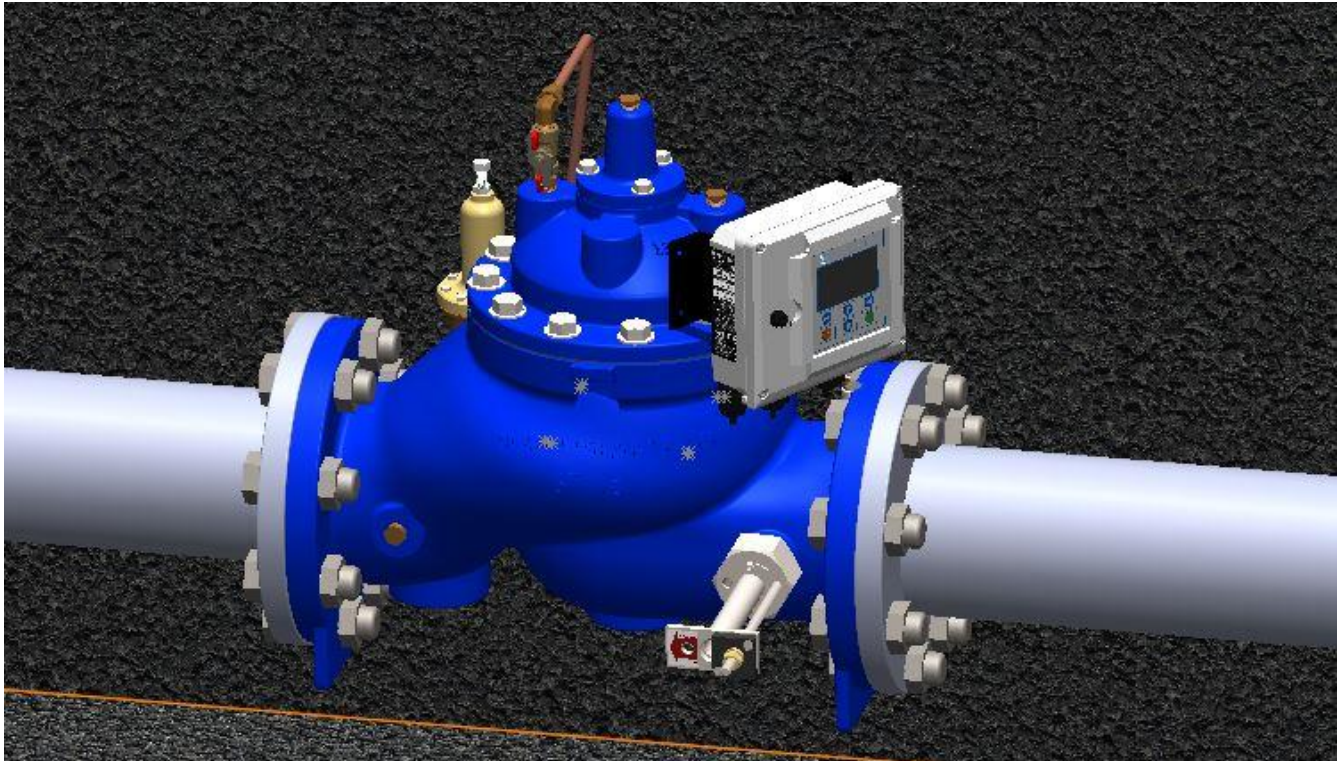


IOM A-0985A – SPI-MV
SINGLE POINT INSERTION FLOW METER VALVE
Installation and Operation Manual

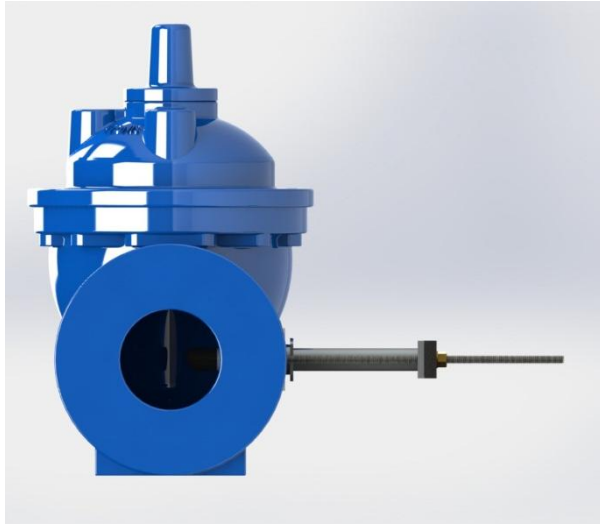


Please read and understand the contents of this manual.
Revision 3.0

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1 Health and Safety: Read First

Throughout this manual are safety warning and caution information boxes. Each warning and caution box will be identified by a large symbol indicating the type of information contained in the box. The symbols are explained below:



This symbol indicates important safety information. Failure to follow the instructions can result in serious injury or death.



This symbol indicates important information. Failure to follow the instructions can result in permanent damage to the meter or installation site.

When installing, operating, and maintaining equipment where hazards may be present, you must protect yourself by wearing Personal Protective Equipment (PPE) and be trained to enter confined spaces. Examples of confined spaces are manholes, pumping stations, pipelines, pits, septic tanks, sewage digesters, vaults, degreasers, storage tanks, boilers, and furnaces.

You must follow all state and local laws, as well as Occupational Safety And Health Administration (OSHA) regulations concerning Personal Protective Equipment, confined-space entry, and exposure to bloodborne pathogens.



WARNING!

Incorrect installation or removal of SPI Mag meters can result in serious injury or death. Read the instructions in this manual on the proper procedures carefully.



WARNING!

Never enter a confined space without testing the air at the top, middle, and bottom of the space. The air may be toxic, oxygen deficient, or explosive. Do not trust your senses to determine if the air is safe. You cannot see or smell many toxic gases.



WARNING!

Never enter a confined space without the proper safety equipment. You may need a respirator, gas detector, tripod, lifeline, and other safety equipment.



WARNING!

Never enter a confined space without standby/rescue personnel within earshot. Standby/rescue personnel must know what action to take in case of an emergency.



WARNING!

Pressurized pipes should only be hot tapped, cut, or drilled by qualified personnel. If possible, depressurize and drain the pipe before attempting any installation.



WARNING!

Carefully read all safety warning tags attached to the meter.

2 Information

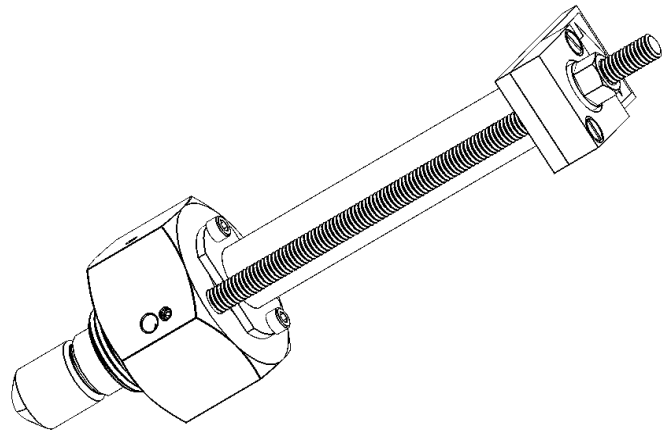
Read this entire manual prior to installing the SPI and/or changing any settings. Retain this manual in your records. DO NOT DISCARD.

2.1 Design Information

With over 100 years of combined waterworks experience, Singer Valve and McCrometer have teamed up to provide a unique solution for in-valve flow measurement. Using McCrometer's proven Single Point Insertion Meter technology along with the reliability of a Singer Valve, the SPI-MV allows users to have both a flow meter solution along with any function of control valve. Whether it is pressure reducing, level control, or sustaining - all can now be installed with a very accurate flow meter solution. Combined with a dual solenoid control pilot system and a Singer Process Control Panel, the SPI-MV can provide flow feedback signals and perform automated flow control, and is capable of functioning within your existing SCADA system.

The Singer Model 106-SPI-MV is a Single Point Insertion Electromagnetic Flow Meter, installed and calibrated for a Singer valve to provide an accurate flow rate that can be utilized with the metering valve as a standalone option or built into a 106-2SC-PCO pilot system and panel to provide complete valve control. The SPI flow meter combines an innovative sensor with a comprehensive electronics package to provide accurate flow measurement for monitoring applications. The insertable sensor uses electromagnetic technology to measure water velocity. SPI has many features to suit a wide variety of applications, and is easily set up using the keypad and readouts.

The streamlined, debris-shedding sensor shape allows the SPI to be used under many flow conditions. The compact insertion design fits in confined spaces and offers complete accessibility. The flow meter can be removed for easy inspection and cleaning. This cost effective flow meter option is available for valve sizes from 3" (75mm) to 36" (900mm). The flow sensor comes pre-calibrated from McCrometer's NIST traceable Calibration Lab and requires no recalibration in the field. With no moving parts and a single-piece design, the SPI's sensor contains nothing to wear or break, and it is generally immune to clogging by sand, grit or other debris.



2.2 Specifications

2.2.1 Flow Measurements

Accuracy: +/-2% of reading +/- 0.03 ft/s zero stability

Velocity Range: +0.3 – 32 ft/s with reverse flow indication

2.2.2 Power Requirements

AC: 100 – 240 VAC, 45 - 66 Hz (10W)

DC: 10 – 35 VDC (10W)

****Note:** Specify power supply type when ordering

2.2.3 Environmental Specifications

Insertion Tube Operating Temperature: Up to 160°F (71°C) at 250 PSI

Insertion Sensor Rating: IP68 (submersible)

Local Converter Operating Temperature: -4°F to 140°F (-20°C to 60°C)

Local Converter Enclosure Rating: IP67 (Temporary Immersion in up to 7ft)

2.2.4 Material Specifications

Probe Head: Polyurethane

Probe Pipe Sleeve: 316 Seamless Stainless-Steel Pipe

Electrode: 580 Grade Carbon Rod

Nipple & Compression Assembly: 316 Stainless Steel

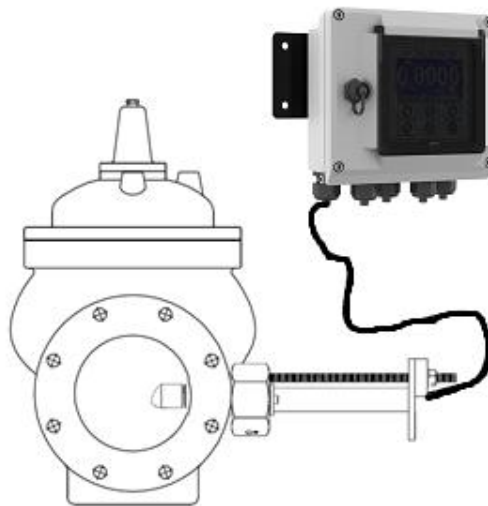
Compression Seal: Buna "N" O – Ring Seal

Thread Seal Between Probe and Probe Pipe: Mixture of Loctite 7649 and Loctite 564

Thread Sealant Tape between Nipple & Valve: PTFE

Sensor Cable: Twinmax Polyurethane

Local Converter Enclosure: Die Cast Aluminum (Standard)



3 Start-up Guide

WARNING: Read all manual sections referred to by this guide for full instructions and ensure safety.

NOTE: If SPI Sensor is not factory installed in the Singer Valve, please refer to Appendix 13.1 for Step-by-step install instructions before proceeding with Start-up Guide.

NOTE: Where required, the **L4 Passcode is 4000000**.

Basic Start-up Site Requirements Checklist:

- External power available to power SPI-MV.
- Pipe primed and pressurized with water.
- Ability to shut off flow and isolate Singer valve for zero flow calibration.
- Ability to flow varying flow through valve.

Proper Installation Checklist:

- Verify SPI-MV is installed with sufficient straight pipe upstream of the valve. See Section 4: *Application Details*.
- Verify SPI-MV sensor probe and the converter are grounded to a grounding ring, grounding rod, or similar. See section 8.8: *Grounding*.

Before Powering the SPI Converter Checklist:

- Verify the correct power type (AC/DC) is being used by checking the SPI-MV converter data plate. In AC converters the power terminal block is green. In DC converters the power terminal block is red. See section 8.7.1: *Terminal*.
- Verify the power wires (L/N/G, or L1/L2/G, or 24V/0V/G) are wired to the SPI-MV converter correctly. See section 8.7.7 *Converter Power Wiring Diagram*
- Verify the SPI-MV sensor probe wires are wired to the SPI-MV converter correctly. See section 8.7.2: *Sensor Wiring*
- If 4-20mA outputs or Pulse Outputs are being used, verify wires are wired to the SPI-MV converter correctly. See sections 8.7.3 and 8.7.4 for more details.
- Verify all cables entering the converter are through the built-in compression glands and that all glands are tightened to maintain the converter's IP67 rating. See section 8.3: *Installing Cables* for more details.
- Ensure the SPI-MV converter rear panel is closed tightly to maintain the converter's IP67 rating.

During Converter Power-up Checklist:

- Ensure converter powers up and passes self-test. See section 8.7.8: *Converter Start-Up*.
 - If convertor fails self-test, error codes will display. Contact factor for support.

Converter Configuration Checklist:

- Use arrows to navigate, See section 9.1 Front Panel Display to the Alarms Menu. Ensure there are no alarms present. If alarms are present, See section 11 Alarm Messages.
- Perform Zero Calibration – See section: 9.4 Menu 1- Sensor (menu position 1.7)
- Set Flow Range and Units – See section: 9.6 Menu 1- Sensor

NAME:

DATE:

SIGNED:

4 Application Details

4.1 Basic Insertion Parameters

For most application you need 3 Pipe diameters straight pipe upstream flange to flange from any in-line device, elbow, or tee.

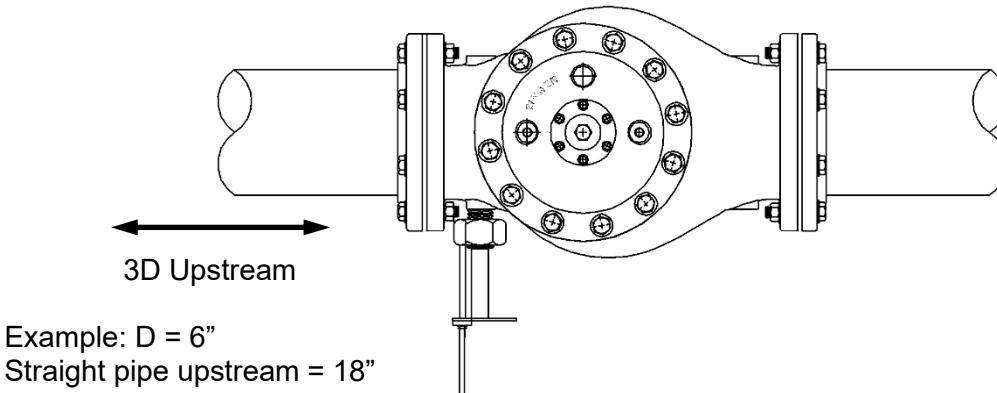


Figure 1: SPI-MV Basic Insertion

4.2 Exceptions

4.2.1 Gate Valve

Gate valve fully open will not cause any effect and can be mounted next to SPI-MV valve. Gate valve not fully open will cause a flow disturbance and will need 3D from SPI-MV valve. 3D including straight pipe including the gate length to the inlet still required.

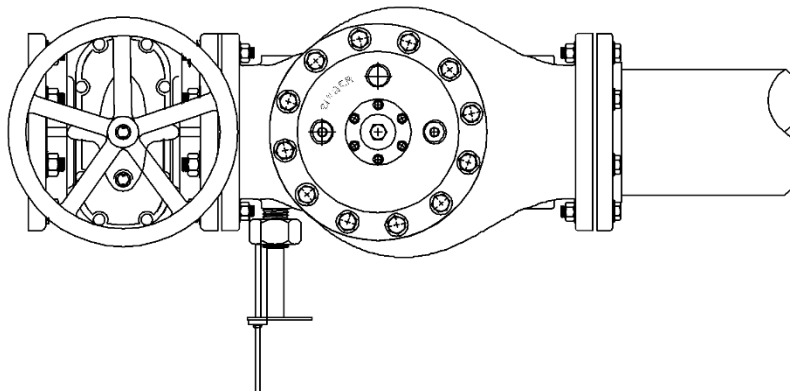


Figure 2: SPI-MV with Gate Valve

4.2.2 Butterfly Valves

A horizontal butterfly valve will cause a larger flow disturbance and will need three pipe diameters from SPI-MV valve

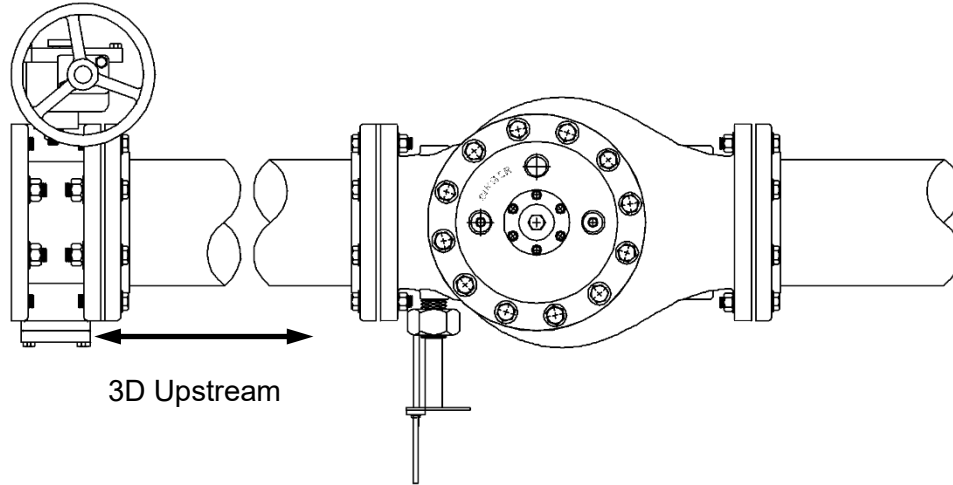


Figure 3: SPI-MV with Horizontal Butterfly Valve

A vertical butterfly valve fully open will cause a small disturbance and therefore will need only one pipe diameter to the SPI-MV valve. 3D including straight pipe including the gate length to the inlet still required.

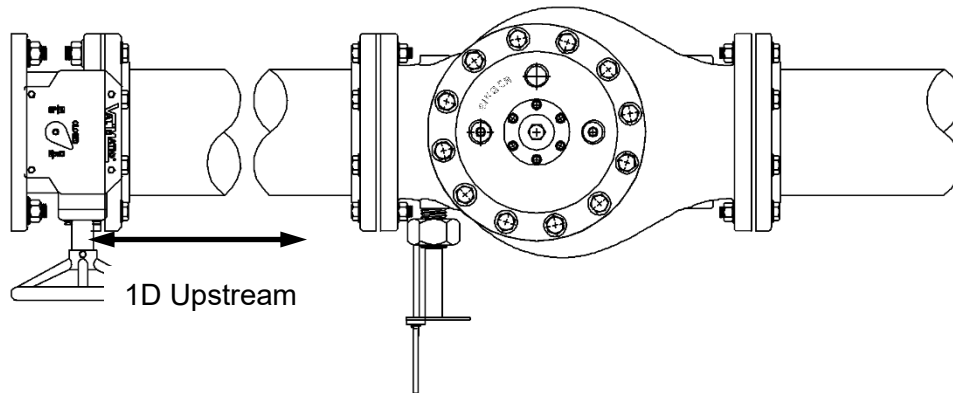
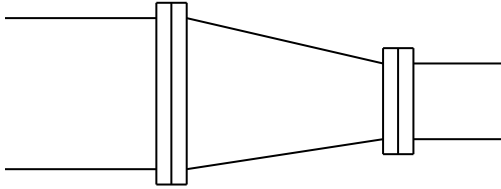


Figure 4: SPI-MV with Vertical Butterfly Valve

4.2.3 Reducers

Concentric Reducer: Does not affect system



Eccentric Reducer: 3D required

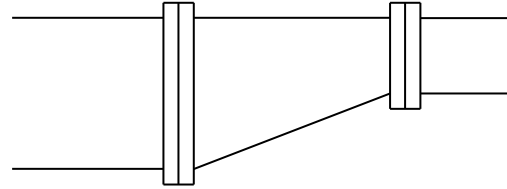


Figure 5: Reducers

4.2.4 Pumps

Pumps usually have a check valve which works well to stabilize flow, therefore use the usual 3 pipe diameter upstream after check valve for pump applications.

4.3 Anti-Cavitation Valve

When the SPI is sold with an Anti-Cavitation trim the valve is calibrated to accommodate this. If you change the valve in the field from a Anti-Cavitation trim or to a Anti-Cavitation trim contact factory.

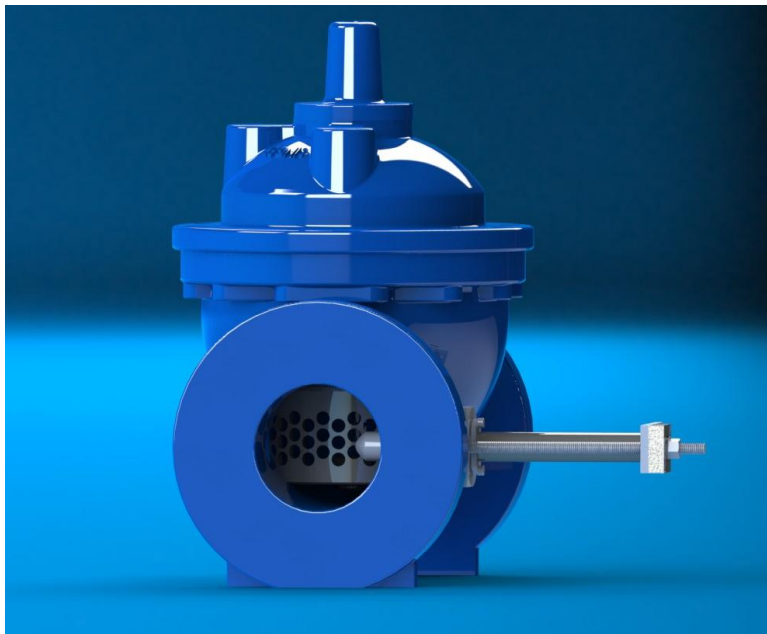


Figure 6: SPI-MV with Anti-Cavitation Cage

Check with a qualified Singer representative or contact Singer directly to see if your system will experience cavitation.

5 Sensor

The SPI insertion sensor makes use of Faraday's Law of Electromagnetic Induction to measure water velocity. Faraday's Law states:

A conductor, moving through a magnetic field, produces a voltage.

Because water is a conductor, water moving through a magnetic field produces a voltage. The magnitude of the voltage is directly proportional to the velocity of the water. The sensor generates an electromagnetic field in the water. A faster water velocity produces a higher voltage. The two velocity electrodes, along with the ground electrode measure this voltage. By accurately measuring this voltage, the velocity is determined.

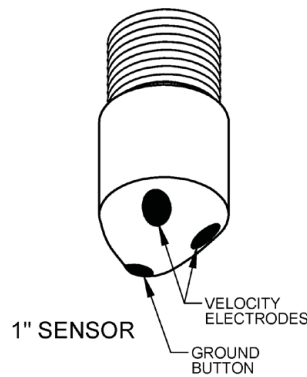


Figure 7: Sensor Electrodes

The velocity measurement provided by the sensor is used to calculate flow. Flow is the amount of fluid moving through a pipe in a period. To calculate the flow, two things are needed: The cross-sectional area of the pipe and the average velocity.

$$\text{Flow} = \text{Average Velocity} \times \text{Area}$$

Each sensor is paired with a Converter that performs these calculations to convert the sensor signal into a flow value. The converter displays the flow on screen as well as retransmitting it as a 4-20mA signal.

5.1 Insertion Hardware

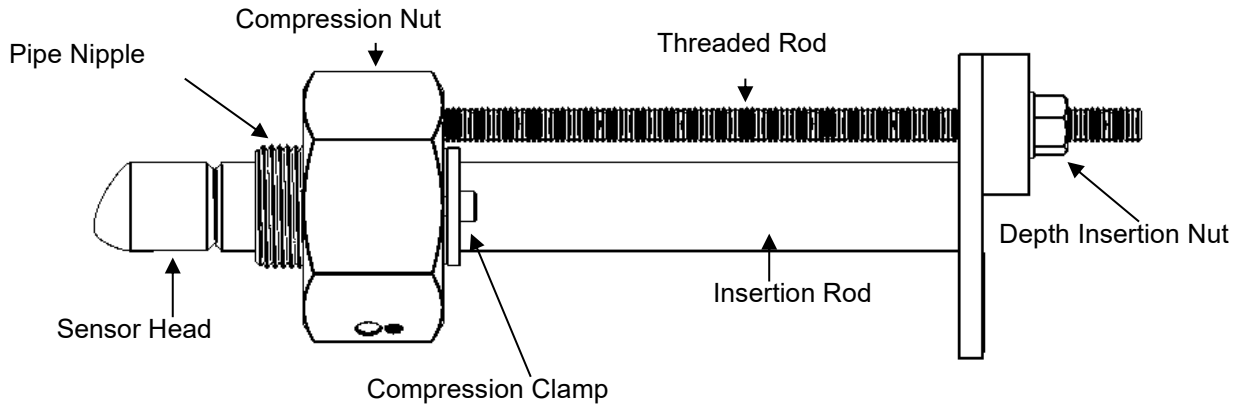
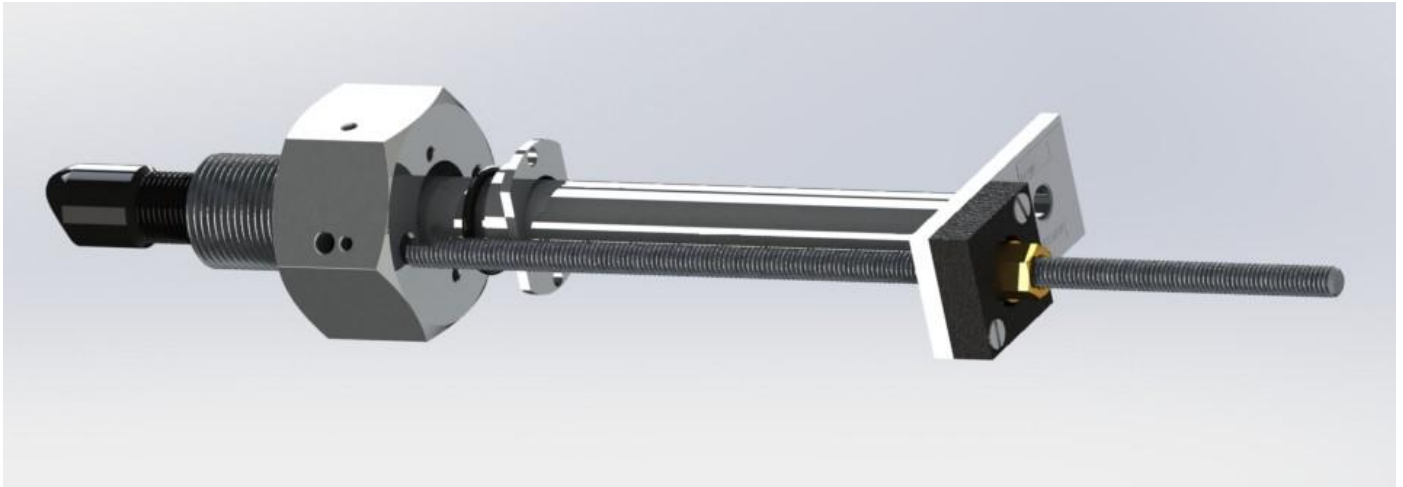


Figure 8: SPI Probe Insertion Assembly

5.2 Insertion Depth

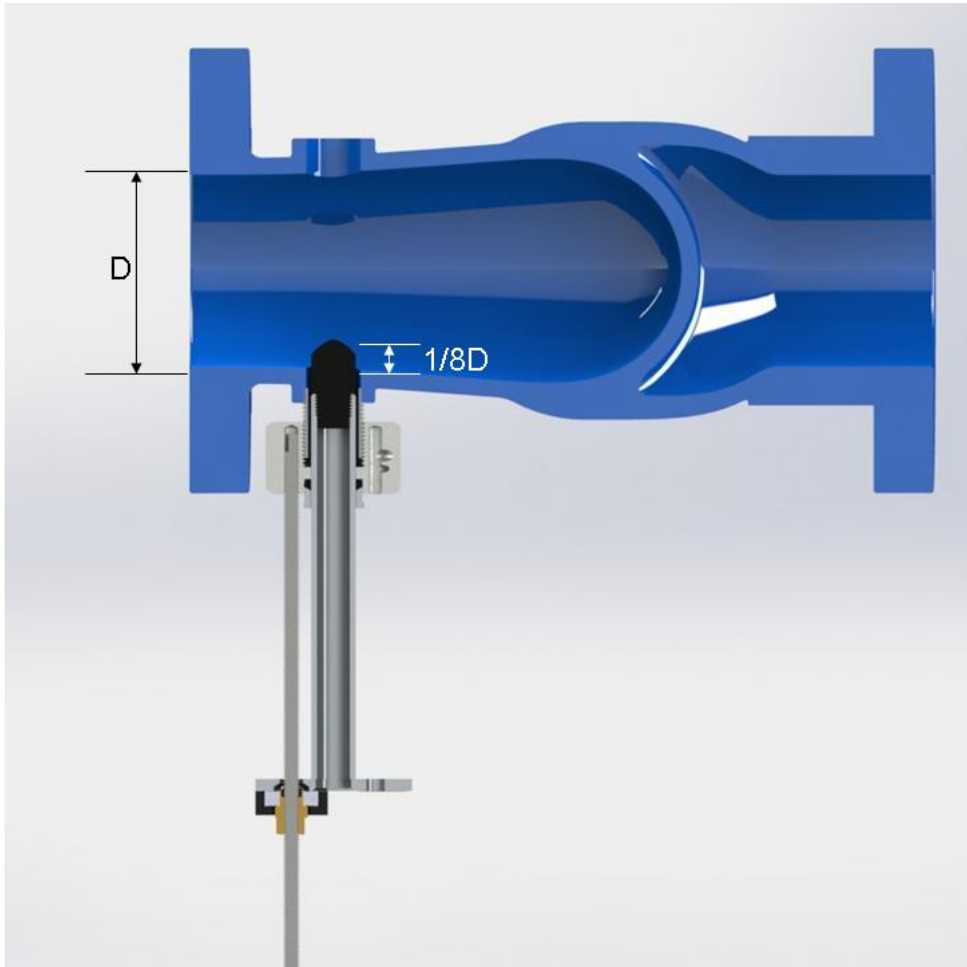


Figure 9: Probe Insertion Depth

McCrometer calibrates the SPI-MV sensor to calculate flow of the valve at an insertion depth of $1/8$ the diameter of the valve. The $1/8$ insertion depth is measured from the internal boss edge to the sensor electrodes. Singer will install the SPI sensor into main valve at the correct insertion depth before all orders are shipped. An insertion clamp lock nut will be added to the threaded rod to ensure that the sensor is maintained at this depth. See *Appendix 13.1 Installation Guide* for detailed installation instructions.

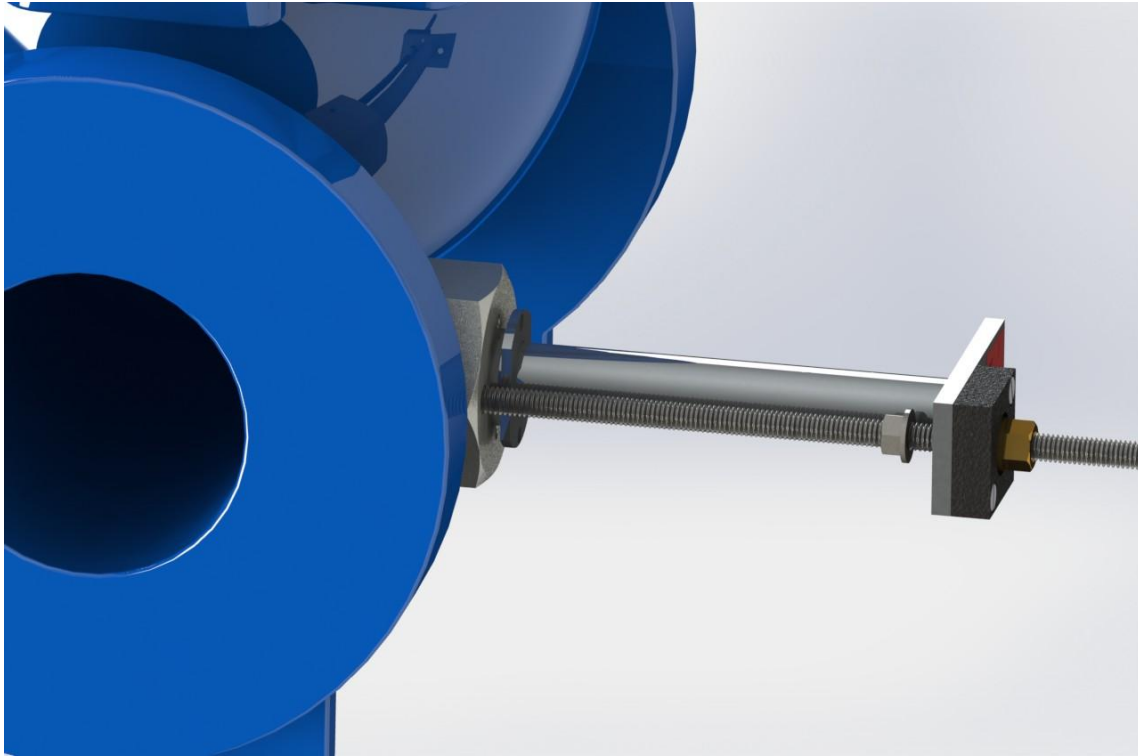


Figure 10: Installed Probe with Clamp Nut

NOTE: Do not remove the insertion clamp nut. An offset of insertion depth will cause an incorrect reading. A lock nut or two jam nuts may be used in place of a clamp nut. At minimum, the correct depth must be marked on the threaded rod before removal.

NOTE: Old style Singer valves bodies **cannot** be retrofitted to have an SPI meter.

6 Meter Removal

To remove the meter, follow the steps below:



WARNING!

The pipe may be under pressure. Serious injury or death may result if proper procedures are not followed.

DEPRESSURIZE THE LINE BEFORE ATTEMPTING REMOVAL OF THE SENSOR.

Loosen the compression clamp seal with an Allen key until the seal just begins to leak. This will relieve the pressure on the compression seal allowing the sensor to be removed. Draping a towel around the compression seal can reduce any spraying water.

Rotate the Depth Insertion Nut to start removing the sensor. This will cause the sensor to rise out of the compression nut and move along the threaded rod. Completely unthread the sensor off the threaded rod to remove the sensor from the valve.



Figure 11: Removing Probe



Figure 12: Valve with Probe Removed

6.1 Maintenance

The SPI is essentially a maintenance free meter with no user serviceable parts. However, the metered fluid may contain solids or other contaminants that coat the sensor electrodes. A periodic inspection may be recommended to ensure the sensor electrodes are clean. To clean the unit, remove the sensor following all of the instructions and safety warning contained in Section above. Once the sensor is removed from the pipe, carefully wipe down the sensor with a soft cloth and a mildly abrasive detergent, such as a liquid kitchen detergent. Once the sensor is clean, reinsert the sensor by rotating the Depth Insertion Nut until the sensor end butts up against the Insertion Clamp Nut. Tighten the Compression Seal and ensure the sensor is level again.

7 SPI Converter Overview

The SPI signal converter is the reporting, input and output control device for the sensor. The converter allows the measurements, functional programming, control of the sensor and data recording to be communicated through the display and inputs & outputs. The microprocessor-based signal converter has a multi-point curve-fitting algorithm to improve accuracy, dual 4-20mA analog outputs, an RS485 communication port, an 8-line graphical backlit LCD display with six-key touch programming, and a rugged enclosure that meets IP67. In addition to a menu-driven self-diagnostic test mode, the microprocessor continually monitors the converter's functionality. The converter will output rate of flow and total volume. The converter also comes standard with password protection and many more features.

The converter is available in both local (Figure 13) and panel mount (**Error! Reference source not found.**) configurations. Local Converters are IP67 rated and stand-alone while Panel-Mount Converters are IP65 rated and intended for integration into a control panel inside an enclosure.

Height 7.3" (18.5 cm)

Width 8.5" (21.6 cm)

Depth 4.3" (10.9 cm)

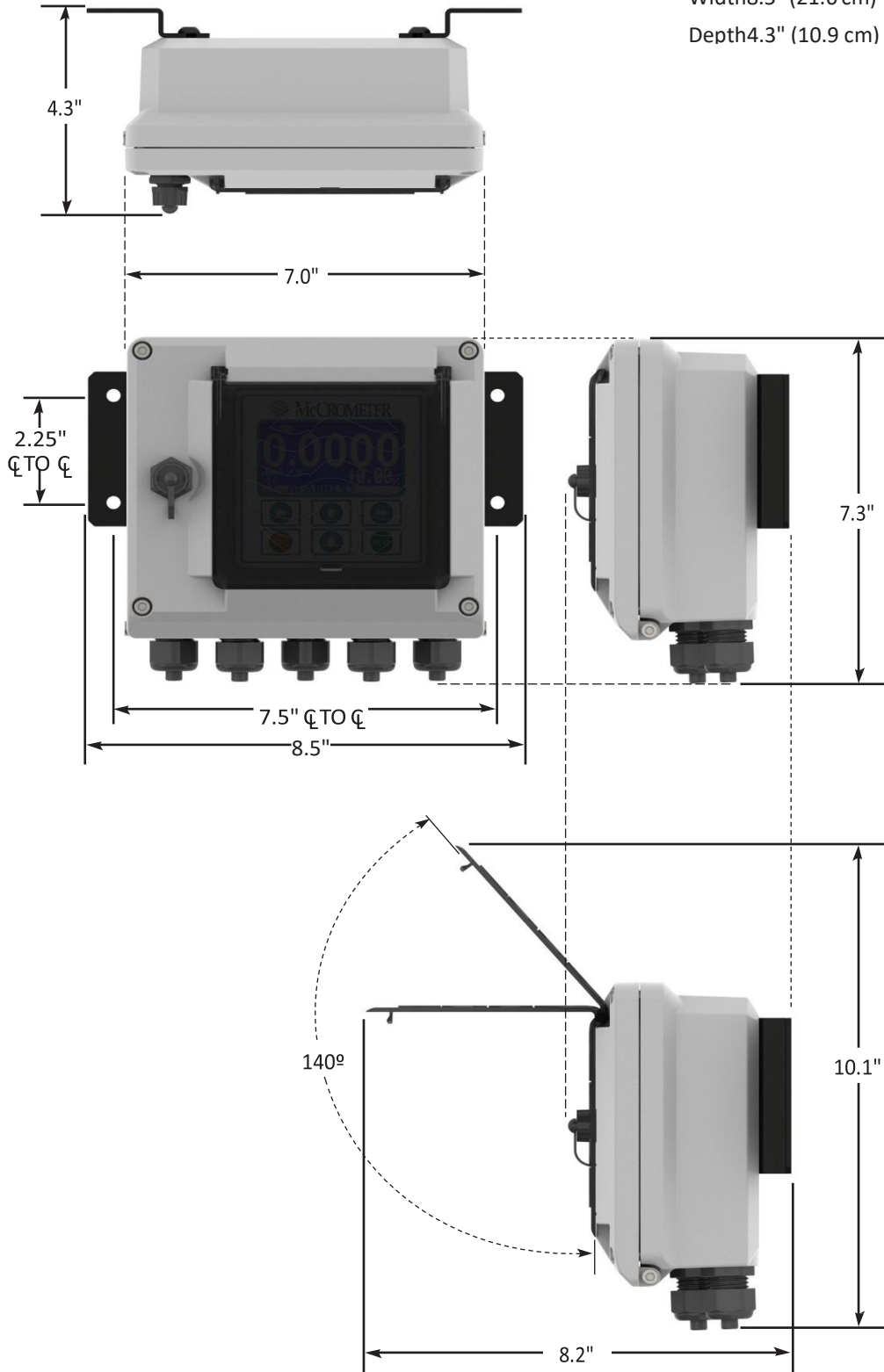
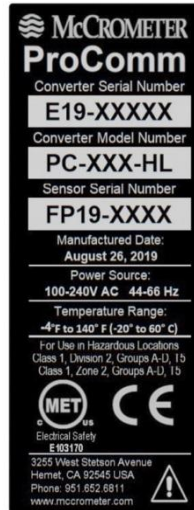


Figure 13: Local Converter Dimensions

8 Converter Installation

8.1 Verify Serial Numbers

The converter and sensor are supplied as a matched system. Verify the meter serial numbers on both the converter and sensor match. This will ensure a properly calibrated system. The tag on the side of the converter has the converter model Number, the converter serial number, the converter model number and the sensor model number. An example is shown below as Figure 15.



Remote mount converter

Figure 15. Converter Serial Number Tag



IMPORTANT: Verify the meter serial numbers on both the converter and sensor match. This will ensure a properly calibrated system. The meter serial number is located on the side of the sensor, and the converter serial number and the meter serial number are located on a label on the side of the converter. Ensure the meter serial number on the sensor and the converter tags match.

8.2 Mounting the Converter

If possible, mount the converter in an electronics shed or environmental enclosure. The sun shield should be oriented in a direction to reduce sun damage and ensure readability.

Mount the converter to a solid surface using four bolts (Figure 16) or to a vertical or horizontal post using two clamps (Figure 17 and Figure 18). This electronic unit is rated IP67 for temporary flooding.

If the brackets are not attached, attach them with the four screws.



Mount the converter to a solid surface with four bolts through the holes in the left and right brackets.

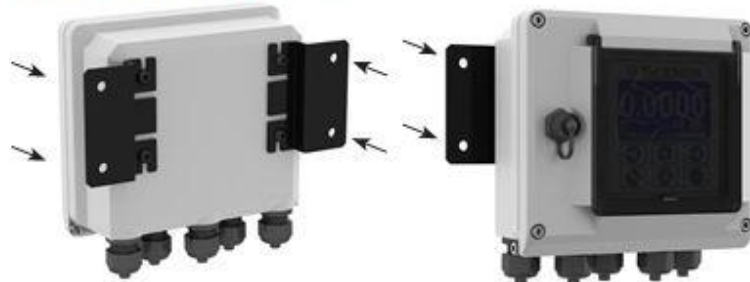


Figure 16. Mounting converter to solid surface

Remove brackets, reverse them, and reattach as shown.



Open clamps and attach around post. Slide bracket tabs onto clamps and tighten them.



Figure 17. Mounting converter to vertical post

Remove brackets, reverse them, and reattach as shown.



Open clamps and attach around post. Slide bracket tabs onto clamps and tighten them.



Figure 18. Mounting converter to horizontal post

8.3 Installing Cables through Cable Glands and Conduit

All electrical cables enter the converter through compression fittings or optional customer-supplied conduit located on the side or bottom of the converter (Figure 19, Figure 20, Figure 21). Ensure that all compression glands are properly tightened and all unused fittings are plugged so the case remains sealed.

The power cable and wiring harnesses are each assigned specific cable glands where they will pass through into the converter. See section 8.4 for cable gland assignment for wiring harnesses and section 8.6 for wiring diagrams.

All cable compression glands must be properly tightened to prevent moisture intrusion and maintain the IP67 rating. To insure IP67 rating, use only round cable 0.24" to 0.47" in diameter.



Figure 19. Remote mount converter with five cable gland pass-throughs



The remote mount converter is shipped with five 1/2" NPT cable glands. Up to three cable glands may be removed and replaced with 1/2" conduits.

Figure 20. Remote mount converter with three conduit pass-throughs



Figure 21. Meter mount converter with three cable gland pass-throughs



Attaching conduit directly to the enclosure may introduce dangerous gasses and moisture into the enclosure creating a dangerous condition and will remove the enclosure's IP67. **Damage caused by attaching conduit to the enclosure or altering the enclosure in any way is not covered by the warranty.**



IMPORTANT: Do not cut or alter the cable length on power or signal cables! Connections to the sensor must be made with cable supplied by McCrometer specifically for that purpose. Do not substitute the supplied cable with other types of cable, even for short runs. For repairs or added lengths of cable, the entire cable between the sensor and the converter must be replaced. (Consult factory for replacement cable.)

8.4 Cable Gland Assignment for Wiring Harnesses

To prevent signal interference and to keep the wiring organized, each cable gland is assigned for a specific wiring harness. Refer to the assignment diagrams (Figure 22, Figure 23) below when you route your cable run.

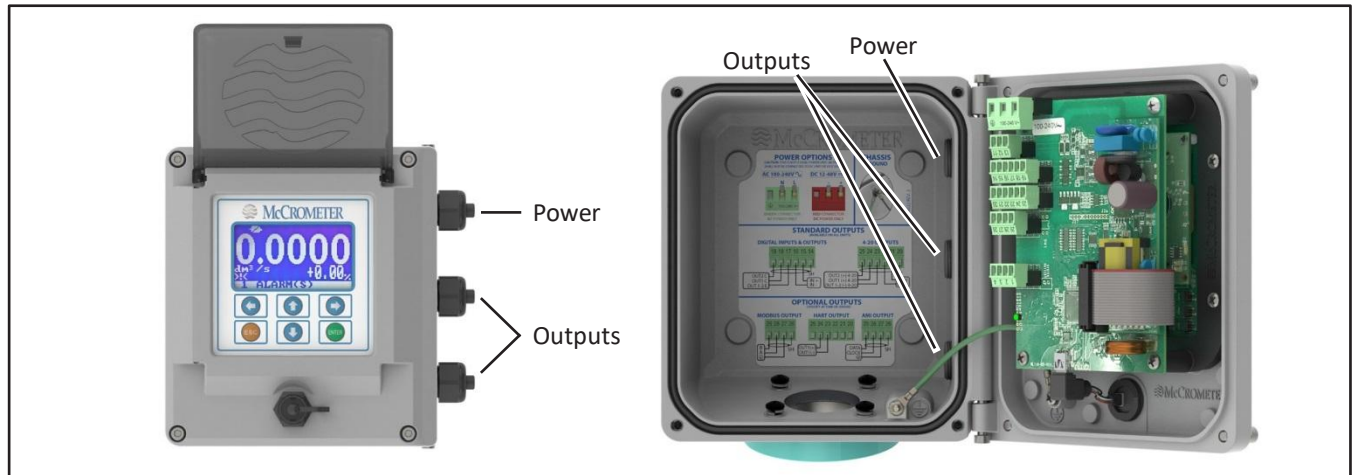


Figure 22. Meter mount converter cable assignments

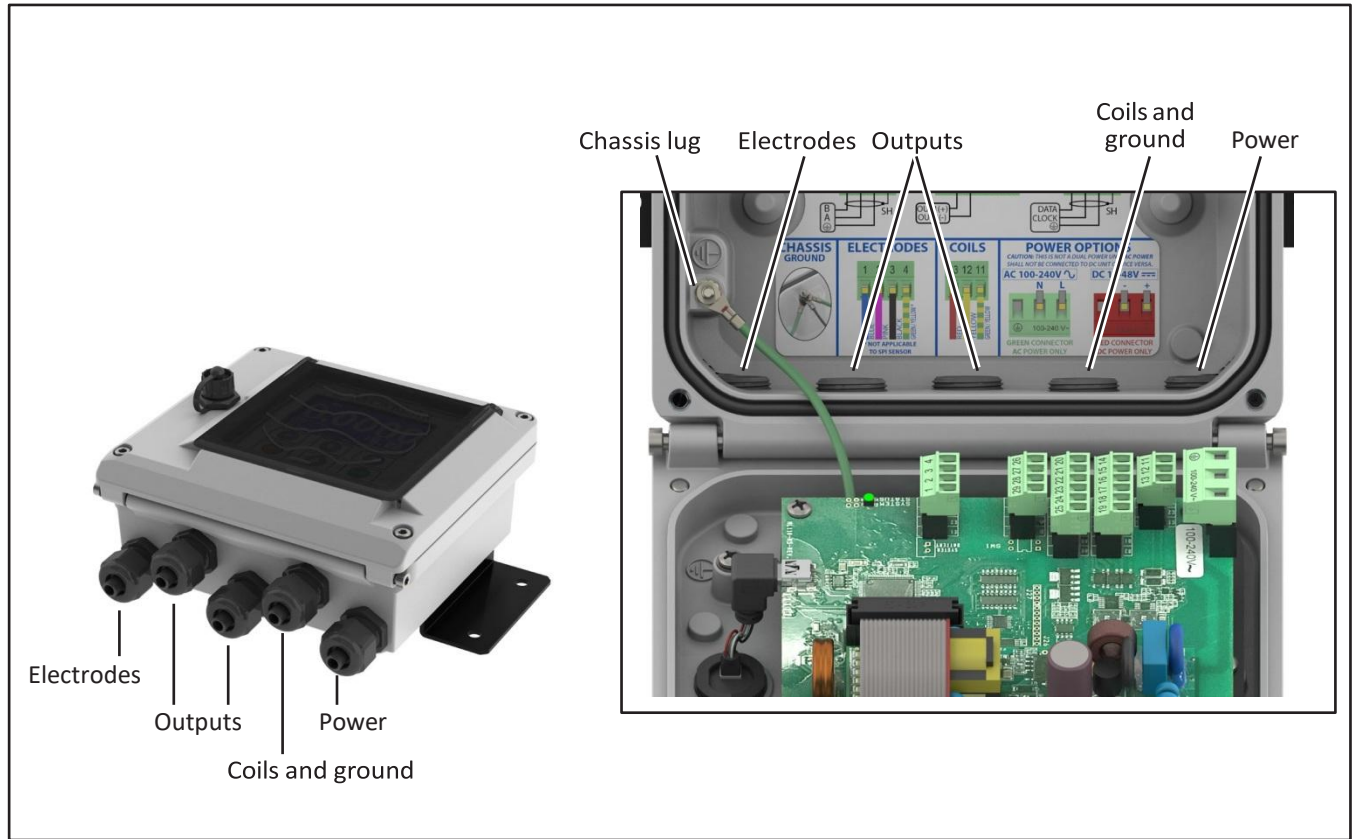


Figure 23. Remote mount converter cable assignments

8.5 Pulling Sensor Cable through Electrical Conduit

It is very important to protect the end of the sensor cable when pulling it through a conduit. Water can accumulate in low portions of conduit. Always use the factory supplied cable cover, or similar method, to seal the end of the cable against water when pulling the cable through conduit (See figure 24). This will ensure proper operation of the meter.

Pulling the Sensor Cable:

1. Tie a rope or cable-snake securely around the middle of the cable cover.
2. Carefully pull the rope or snake until the sensor cable end clears the conduit.
3. Bring the cable end to the converter location. If necessary, secure the cable so that it does not fall back through the conduit.
4. Remove the cable cover by pulling the rip wire. The cable cover will tear off (discard the cover).



CAUTION: Do not cut the cable cover off. Doing so may damage the sensor cable and adversely effect the calibration of the meter.

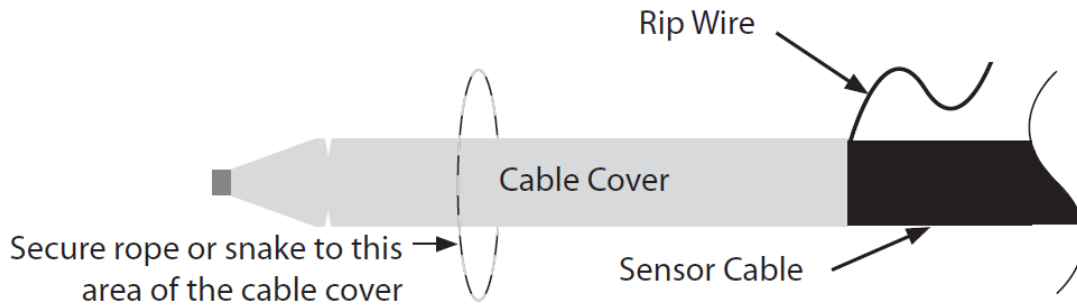


Figure 24: Cable Cover

8.6 Sensor Cable

SPI sensor cable is supplied standard as a 20 ft length.

Never under any circumstance cut the sensor cable. Specify length of cable needed when ordering the valve or have a Singer trained professional install the cable correctly.

The length of sensor cable should to be minimized to ensure the best quality signal. If a long cable is needed for a specific application, install the converter near the SPI-MV valve and run a 4-20mA signal to the end location

8.7 Sensor Electrical Cable Connections

All electrical cables enter the converter through compression fittings located on the bottom of the converter. Ensure that all compression glands are properly tightened and all unused fittings are plugged so the case remains sealed.

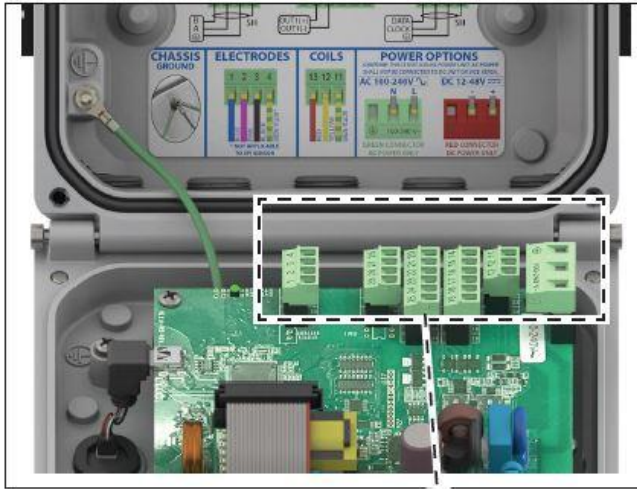
Always disconnect the power cord before attempting any electrical connections

8.7.1 Terminal Block Diagram

All connections are made on the terminal blocks. To access the terminal blocks, loosen the four screws on the front of the converter and open the front panel. The example shown below (Figure 25) does not necessarily represent all converter models, however, it shows the placement for all terminal blocks used in all models.

NOTE: The terminal blocks unplug from the circuit board for easy connection.

Remote mount view



Meter mount view

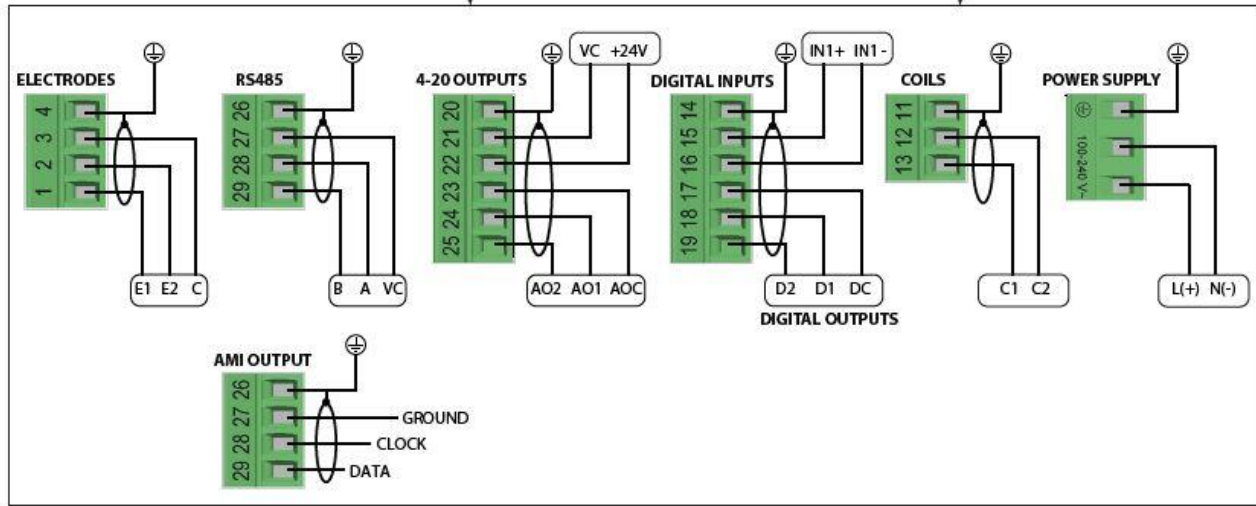
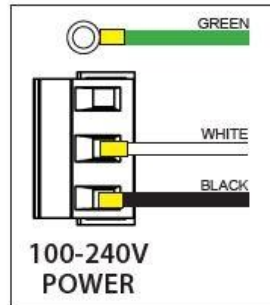
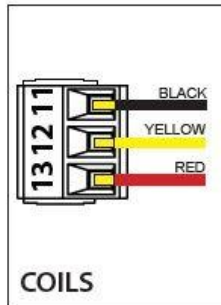
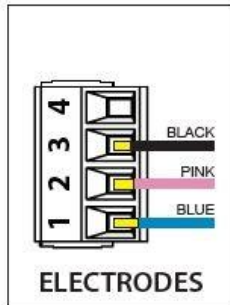


Figure 25. Terminal Block Diagram

8.7.2 Sensor Wiring

SPI Mag

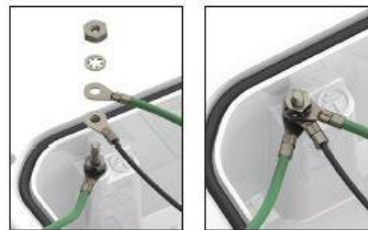


Terminal Block Assignments

Terminal	Cable	Wire Color
#1 (E1)	A	Blue
#2 (E2)	A	Pink
#3 (C)	A	Black

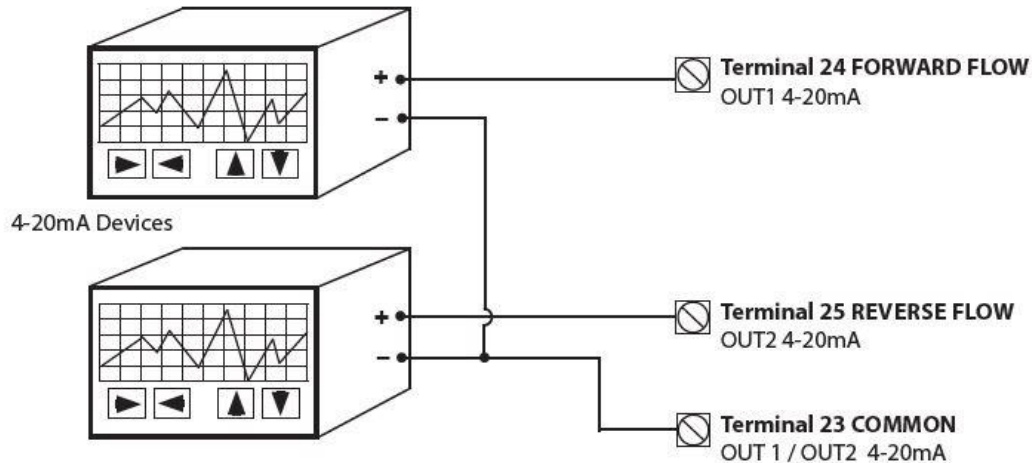
#11 (SH)	B	Black
#12 (C2)	B	Yellow
#13 (C1)	B	Red

All Mag sensors: Chassis Ground Connection



8.7.3 4-20mA Hook-Up

Two isolated 4-20mA current loops are used to output flow data to external devices. Maximum load impedance is 1,000Ω, and the maximum voltage without load is 27VDC. The converter has the capability to detect a loss of load on this output. To disable this function set the value “mA Val. Fault” under the ALARMS menu to zero. A graphical example of the usage of the current loop with external device is shown below:



IMPORTANT - RESISTOR REMOVAL FOR 4-20mA OUTPUTS

It is required to remove the resistors from terminals 23 & 25 and/or 23 & 24 before attaching 4-20mA cables.

FORWARD FLOW: Remove the resistor from terminals 23 and 24.

REVERSE FLOW: Remove the resistor from terminals 23 and 25.

See Section 3.1, "Terminal Block Diagram", Figure 6.

Figure 26: 4-20mA Hook-Up

If the external device requires a voltage input, a precision resistor placed across the input terminals of the external device will change the current to voltage. Calculate the required resistor using Ohm's law ($V = I \times R$). For example, a 250Ω resistor will provide an input voltage of one to five volts with the transmitter range being set from 4mA to 20mA. An additional 4 to 20mA loop output is available.



IMPORTANT

The converter powers the 4-20mA loops. Do not use external power for the 4-20mA loop as it may cause permanent damage to the converter.

8.7.4 Opto-Isolated Pulse Output Hook-Up

The outputs are open collector transistor outputs used to communicate with or activate external devices.

- Opto-isolated output with collector and emitter terminals floating and freely connectable
- Maximum switching voltage: 40 VDC
- Maximum switching current: 100mA
- Maximum saturation voltage between collector and emitter 1.2V@100mA
- Maximum switching frequency (load on the collector or emitter, $R_L=470\Omega$, $V_{OUT}=24VDC$): 1250Hz
- Maximum reverse current bearable on the input during an accidental polarity reversion (VEC): 100mA
- Isolation from other secondary circuits: 500 V

See section 9.10 *Menu 5* – for available output functions.



IMPORTANT

Digital outputs are not isolated from each other. All digital outputs MUST use the same power source.

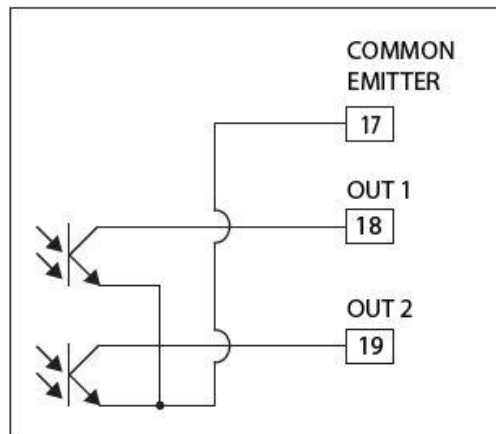


Figure 27: Opto-Isolated Pulse Output Diagram

8.7.5 Opto-Isolated Input

- Opto-isolated input
- 500 V isolation
- 2-40 VDC on voltage
- Input programming per input menu, will perform functions set to ON.

Input example:

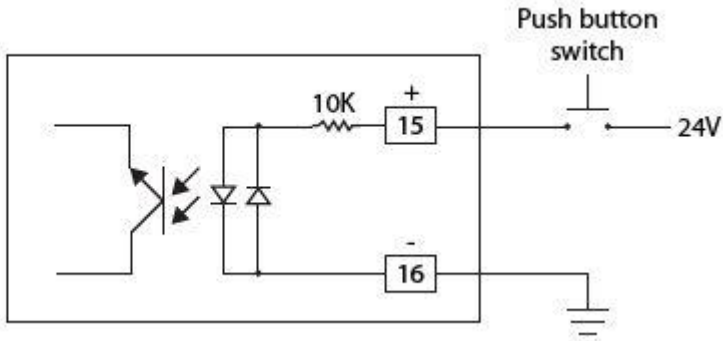


Figure 28: Opto-Isolated Input Diagram

8.7.6 Optional Smart Output Hook Up

The convertor comes pre-wired with an interconnection that should readily connect to most AMI transceivers. Where interconnective devices are not mechanically compatible or where non-standard wiring is encountered, the installer can opt to remove the connector from the end of the converter's interface cable and make direct connection via the wiring table shown at right.

- Signals and associated wire colors in the McCrometer SmartOutput™ interface cable are identified together in the top row of the table at right.
- Corresponding wire colors for transceivers from each compatible AMI vendor are identified in the columns under the top row.

McCrometer AMR Interface Pinout

	1 Power/Clock	2 Data	3 Ground
Badger	Red	Green	Black
Elster	Green	Red	Black
Itron	Black	Red	Green
Neptune	Black	Red	Green
Sensus	Red	Green	Black

8.7.7 Converter Power Wiring Diagram



WARNING!

Hazardous supply voltage can shock, burn, or cause death.

The power supply line must be equipped with external surge protection for current overload (fuse or circuit breaker with limiting capacity not greater than 10A). It must be easily accessible for the operator and clearly identified.

Power connection is made using the power terminal block on the upper right side of the terminal board.

NOTE: The terminal block unplugs from the circuit board for easy connection. Connect earth ground to the protective grounding terminal before making other connections. The power supply of a standard converter is 100-240VAC, 45-66Hz at maximum 20W. DC converter is available as an option.

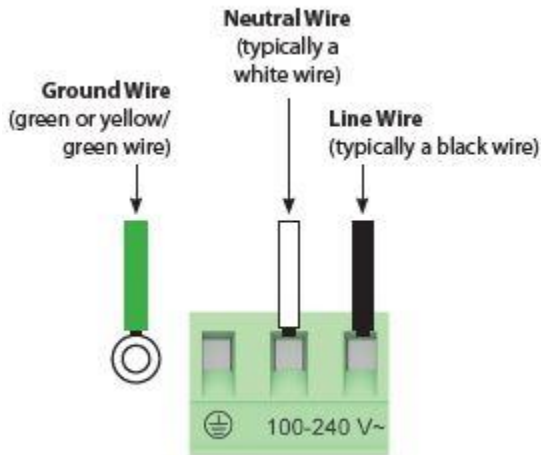


Figure 29: AC Power Supply Terminal Block

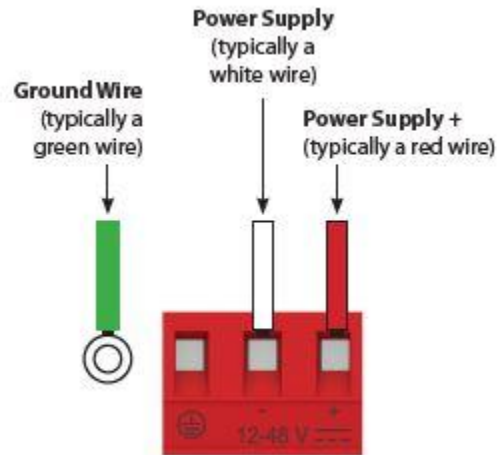


Figure 30: Optional DC Power Supply Terminal block

8.7.8 Converter Start-Up

Before starting up the converter please verify the following:

- Power supply voltage must correspond to that specified on the data plate (located on the side of the converter)
- Electric connections must be wired as described in this manual
- Ground connections must be properly installed

When the converter is powered it initiates a verification cycle of the converter. During the verification cycle the converter displays an incrementing diagnostic number from 0 through 90. When the diagnostic is complete, if an error is found, an error code will be displayed. A text message will also be displayed on the alarm screen. If an error is found, contact factory for support.

NOTE: To view alarms, press the RIGHT arrow key from the main display screen.

8.8 Grounding

One of the most important installation details for magnetic flowmeters, in general, is proper process ground. A proper ground ensures that the fluid and sensor are at the same potential so that only the induced flow signal is measured. The most stable ground reference is the earth ground itself. By connecting the fluid, sensor, and converter to a stable and noise free reference point, the SPI will offer the best performance.

Note: The AC supply ground may not provide adequate grounding. In some cases, an AC ground can induce noise to the low voltage signals generated by the magnetic flowmeter. It is recommended to wire the ground connection to a separate low impedance earth ground or a dedicated instrumentation ground.

These are the recommended grounding arrangements:

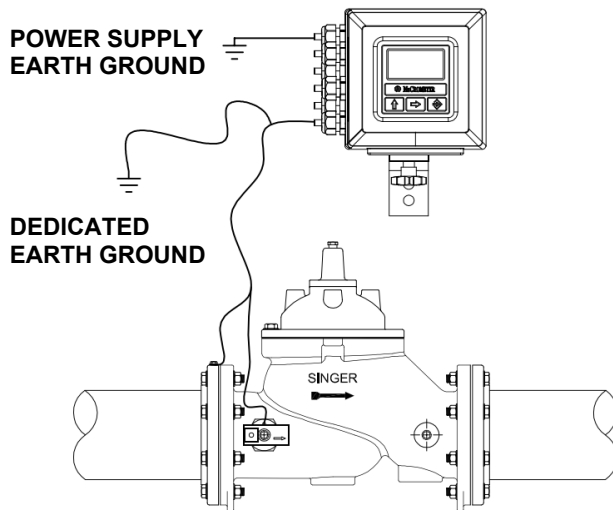


Figure 31: Grounding for conductive pipe or conductive-lined pipe

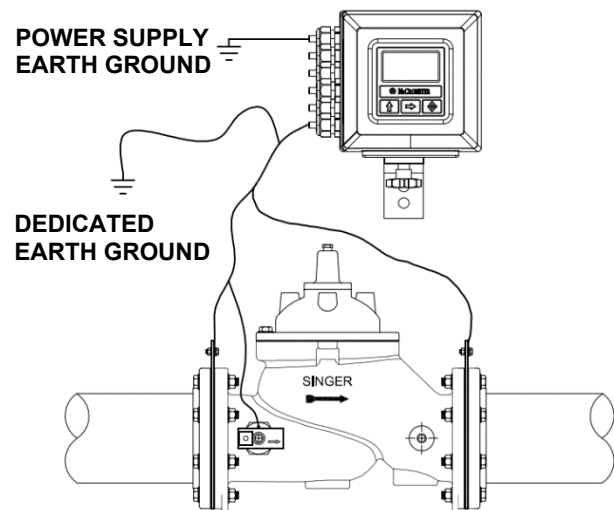


Figure 32: Grounding with grounding rings

Figure

See Figure 33, 34, 35 below for examples of proper converter and probe grounding.



Figure 33: Converter & probe with ground wiring



Figure 34: SPI Converter Grounding

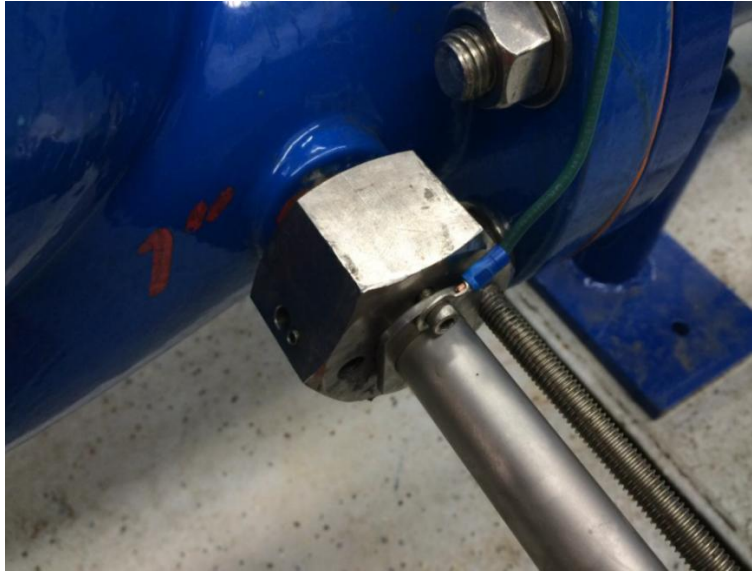








Figure 35: SPI Probe Grounding

9 Menu Navigation

To navigate through the menus on the converter, the keys on the keypad use the following conventions:

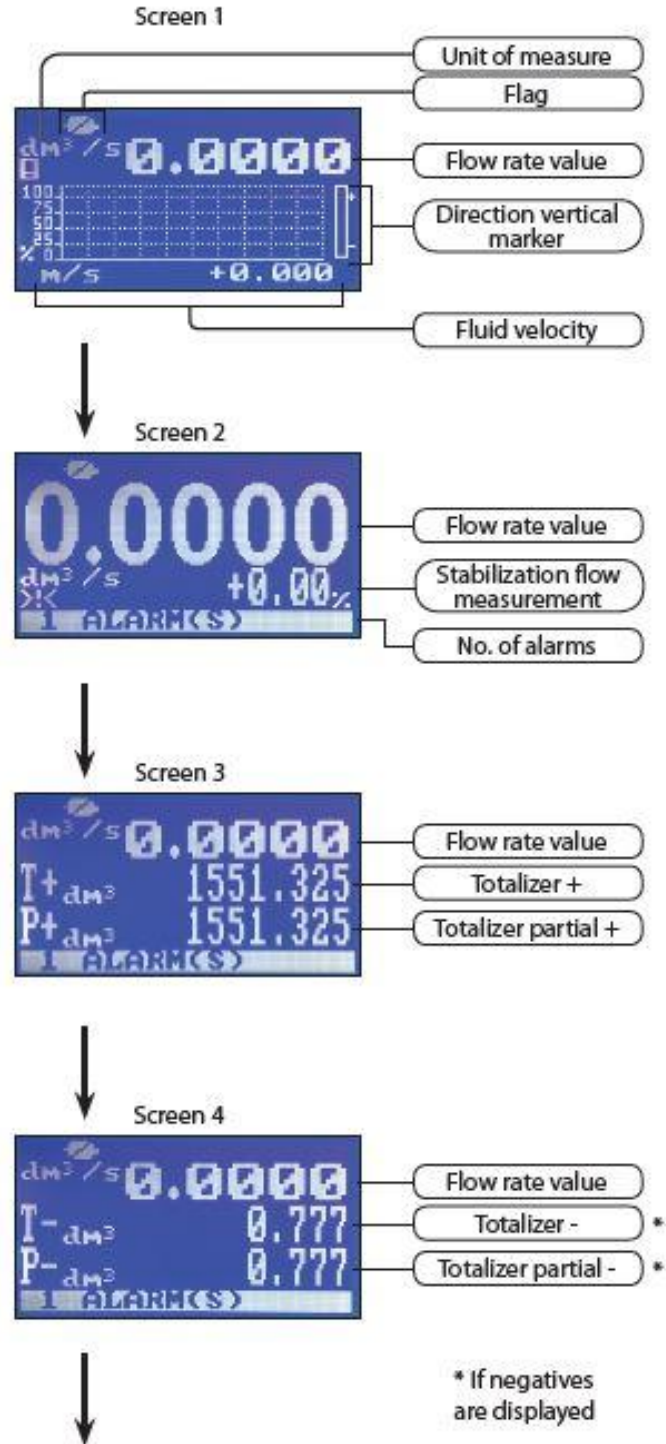
Key	Function
 UP Key	Moves the cursor up to the previous subject on the menu Increases the numeric figure of the parameter highlighted by the cursor
 DOWN Key	Moves the cursor down to the next subject on the menu Decreases the numeric figure of the parameter highlighted by the cursor
 LEFT Key	Moves the cursor to the left on the input field Moves the cursor to the previous subject on the menu
 RIGHT Key	Moves the cursor to the right on the input field Moves the cursor to the following subject of the menu
 ENTER Key	Opens the Quick Start menu for the instrument configuration Enters the selected function Confirms the selected function
 ESC Key	Leaves the current menu Cancels the selected function under progress

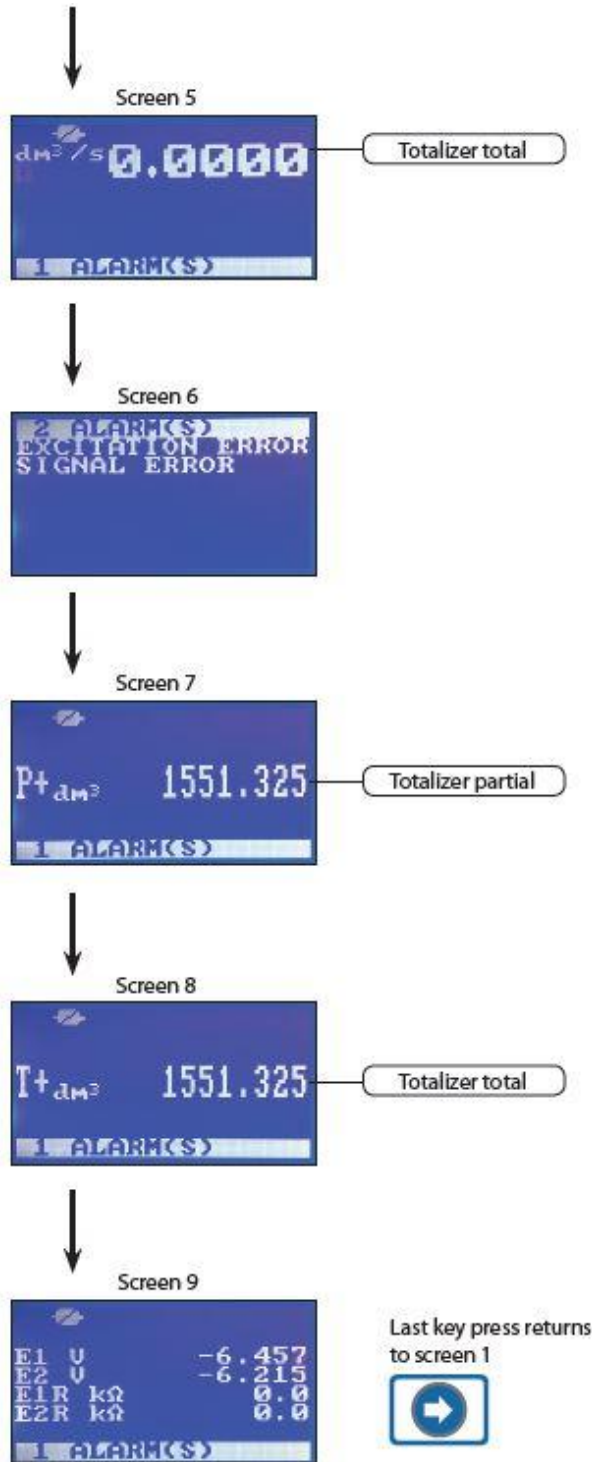
9.1 Front Panel Display

Push the right arrow to change to the next screen display. Each button press changes the screen and cycles through the nine displays shown below



FLAG	DESCRIPTION
∅	Empty pipe
📁	File upload
📁	File download
⚡	Flow rate simulation (flashing)
↔	Calibration (flashing)
⚠	Generic alarm (flashing)
🔊	General alarm only on display physical (flashing)
🔊	Signal error
🔊	Excitation error
⚡	Min flow alarm
⚡	Max flow alarm
⚡	Flow rate overflow
⚡	Pulse 1 overflow
⚡	Pulse 2 overflow





9.1.1 Factory Set Key Code

The converter is delivered with key code L1 = 10000000, and with the "Quick start menu" enabled. Press the Enter/Esc key. The "Quick start" menu can be enabled or disabled.



ATTENTION!

It is very important to record any customized code as it CANNOT be retrieved if it is lost!

9.1.2 Converter Access Code

The access for programming the instrument is regulated by four access levels logically grouped. Every level is protected by a different code. Access levels 1-2-3-4 are freely programmable by user.

```
13-SYSTEM
13.1 L1 code= *****
13.2 L2 code= *****
13.3 L3 code= *****
13.4 L4 code= *****
13.5 010.011.012.013
13.6 011.011.012.014
13.7 255.255.255.000
13.8 FW update
```

The code can be set by keypad or MCP interface. Depending on the level of access, it will be in the visual display functions. These access levels determine which menu functions are available for use depending on the selected access level. See section 5.0, "Menu Descriptions".

Factory preset access codes:

L1	10000000
L2	20000000
L3	30000000
L4	40000000
L5	57291624

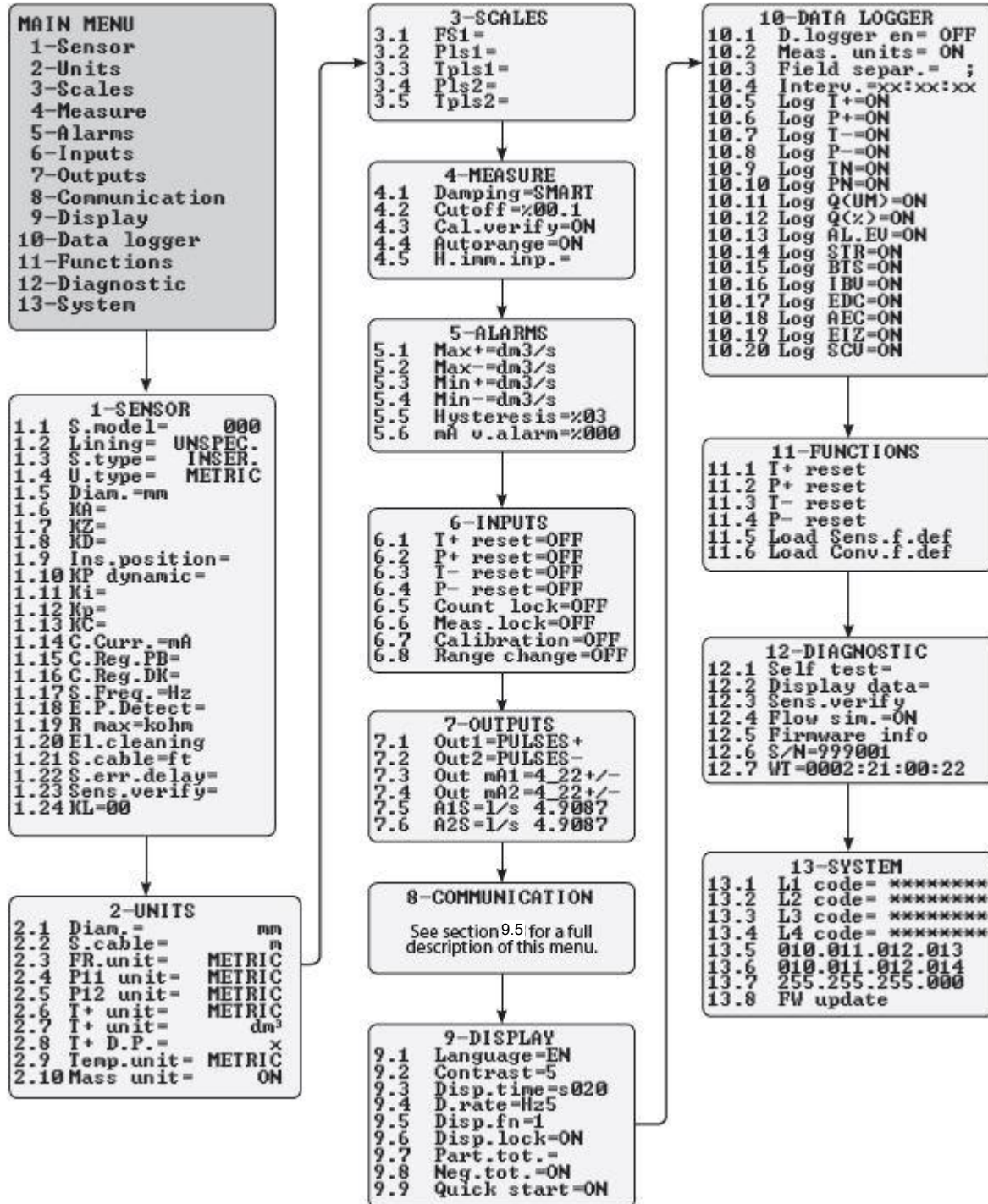


WARNING!

Take careful note of the customized code, since there is no way for the user to retrieve or reset it if lost.

9.2 SPI Menu Structure

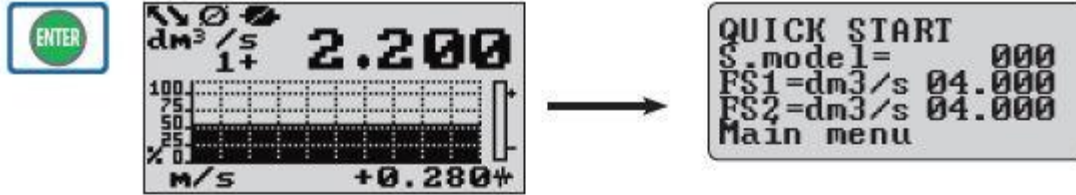
The following is the menu structure for the ProComm converter. NOTE: Some menus change as options are enabled.



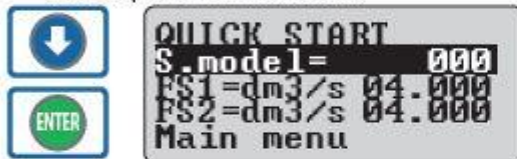
9.3 Programming Example

The steps below demonstrate how to modify the full scale value from the “Quick start menu”.

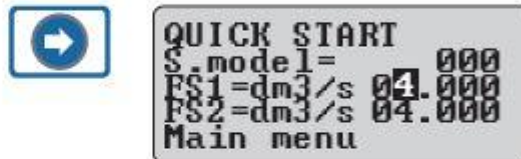
1. Beginning at one of the visualization screens, press the ENTER button to go to the Quick Start Menu.



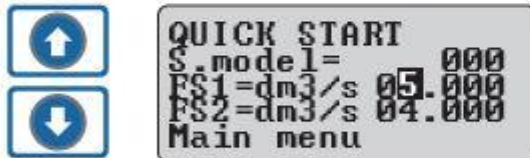
2. Press the DOWN button to select the function FS1 and press the ENTER button.



3. Press the RIGHT button to select the value.



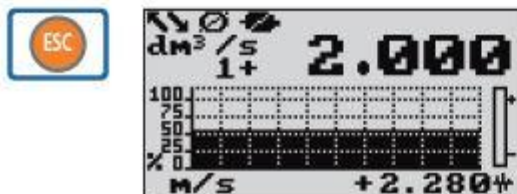
4. Press the up or down buttons to change the value.



5. Press ENTER to confirm the new value.



6. Press ESC to exit to the main page.

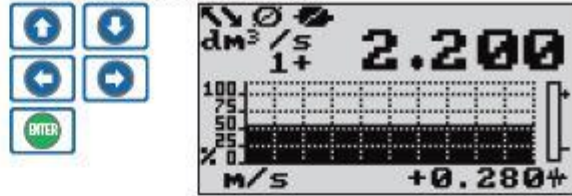


The steps below demonstrate how to modify the Full Scale value from the Main Menu.

- Beginning at one of the visualization screens, press the ENTER button.



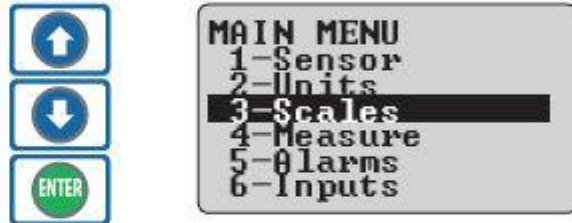
- Use the UP and DOWN buttons to enter numbers. Use the LEFT and RIGHT buttons to move to each position. When finished, press ENTER.



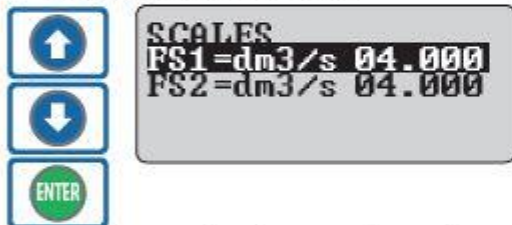
- Press the DOWN button to select Main Menu and press ENTER.



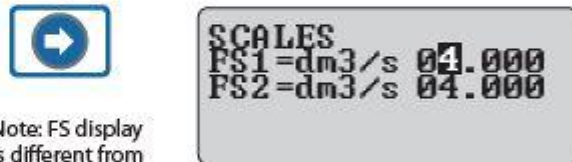
- Press the up or down buttons to select a menu and press ENTER.



- Press the DOWN button to select the function FS1 and press the ENTER button.

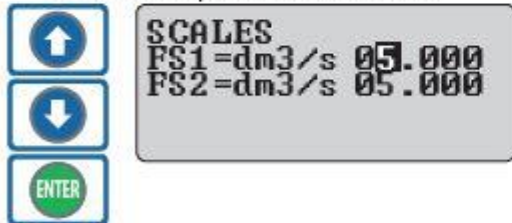


- Press the RIGHT button to select the value.

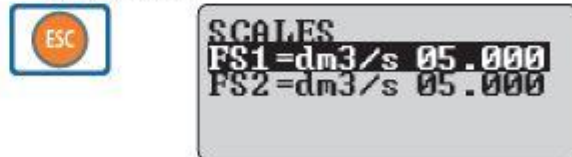


Note: FS display is different from 4-10 full scale.

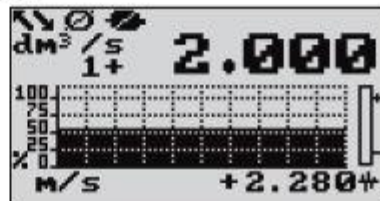
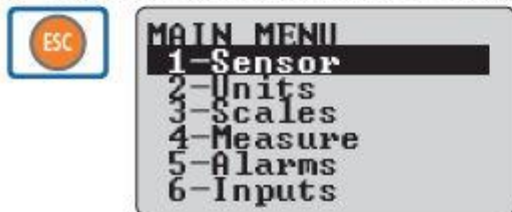
- Press the up or down buttons to change the value and then press ENTER to confirm it.



- When the change is confirmed, press ESC to return to the Main Menu.

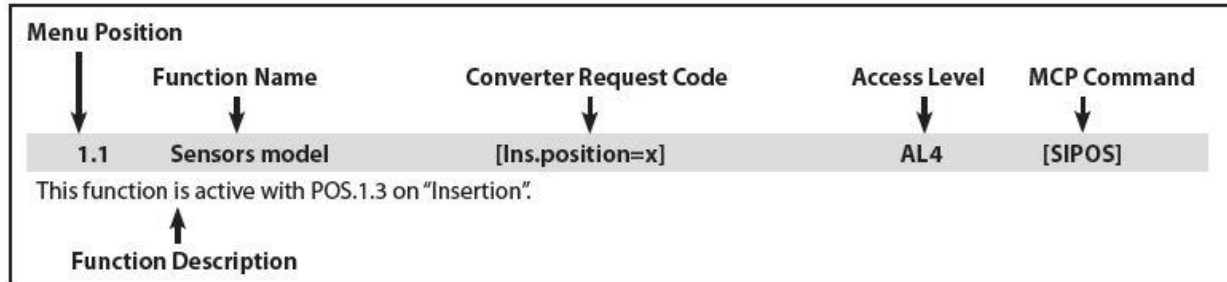


- Press ESC one more time to return to the visualization screen.



9.4 Menu 1- Sensor

The main menu is selected from the Quick Start Menu by pressing the ENTER key and entering the access code (xxxxxxx). The example below shows what information each field contains



Menu Position	Converter Function Code	Function Name	Function Description	Access Level	MCP Command
1.1	[S.mode l=x]	Sensor model		AL4	[SMODL]
1.2	[Lining=UNSPEC.]	Lining Type	Sets the flow sensor lining material type.	AL4	[LIMAT]
1.3	[S.type= FULL BORE]	Type of sensor	Sets the sensor type: Full-bore or insertion.	AL4	[STYPE]
1.4	[U.type= METRIC]	Unit type	Sets type of measurement unit: Metric or Imperial (inch).	AL4	[SUTYP]
1.5	[Diam.= mm xxx]	Diameter	Sets the nominal diameter of the sensor (0-2500). ND is written on the sensor label.	AL4	[PDIMV]
1.6	[KA= +/- xx.xxx]	KA factor	Sets the coefficient of calibration printed on the sensor label.	AL4	[CFFKA]
1.7	[KZ= +/-xxxxx]	KZ	Sets the calibration Factor. Zero adjustment	AL4	[CFFKZ]
1.8	[KD= +/-xxxxx]	KD	Sets the calibration Dynamic Factor	AL4	[CFFKD]
1.9	[Ins.position= x]	Insertion position	This function is active when selection 1.3 is set to "Insertion".	AL4	[SIPOS]
1.10	[KP dynamic= ON/OFF]	KP dynamic	This function is active when selection 1.3 is set.	AL4	[SIPOS]
1.11	[Ki= +/- xx.xxx]	Ki	This function is active when selection 1.3 is set.	AL4	[CFFKI]
1.12	[Kp dynamic= +/-xxxxx]	Kp	This function is active when selection 1.3 is set.	AL4	[SIDKP]
1.13	[KC= +/- xx.xxx]	KC	Sets the calibration factor. This function is active if the sensor model is NOT present on the sensor's table standard parameters.	AL4	[CFFKC]

Menu Position	Converter Function Code	Function Name	Function Description	Access Level	MCP Command
1.14	[C.Curr. = mA xxx.x]	Coils Ex.Current	Sets the excitation coils current. This function is active if the sensor model is NOT present on the sensor's table standard parameters.	AL4	[CEXCC]
1.15	[C.Reg.PB= xxx]	C. Reg. PB	Sets the current regulator parameter. This function is active if the sensor model is NOT present on the sensor's table standard parameters.	AL4	[CRPRB]
1.16	[C.Reg. DK = xxx]	C. Reg. DK	Sets the current regulator parameter.	AL4	[CRDER]
1.17	[S.Freq. = Hz xx]	S. Freq.	Sets the measurement sampling frequency.	AL4	[SFREQ]
1.18	[E.P.Detect= ON]	Empty Pipe Detection	Enables the empty pipe detection function.	AL3	[EPDEN]
1.19	[R max= Kohm xxxx]	Empty pipe D. Thresh.	Sets the maximum value of the electrodes' resistance.	AL4	[EPDTH]
1.20	El.cleaning	Electrode cleaning	Helps keep the electrodes clean. The allowed values are OFF, minimum, average and maximum. It is not recommended to use this function when the liquid has a conductivity less than 100µS/cm (set to OFF).	AL4	[ELCLN]
1.21	[S.cable=m xxx]	Sensor Cable	Sets the length of cable between the sensor and the converter on remote mount converter.	AL4	[SCALN]
1.22	[S.err.delay=m xxx]	Signal error delay	Sets the delay or wait time before an error generates an alarm. This function is useful to prevent zero "dropouts" of the flow signal caused by sporadic events (empty pipe, excitation error, signal error).	AL4	[SEALT]
1.23	[Sens. verify= OFF]	Sensor verify	Enables automatic sensor verification. (See BIV optional function, section 6.4.)	AL3	[ASVFE]
1.24	[KL=00]	Automatic sensor verify enable	Sets coefficient KL values	AL4	[SETKL]

9.5 Menu 2 – Units

Menu Position	Converter Function Code	Function Name	Function Description	Access Level	MCP Command
2.1	[Diam. = mm]	Diameter	Sets the sensor diameter unit of measurement: mm or inch.	AL2	[SDIUM]
2.2	[S.Cable = m]	S.cable length unit of m. type	Sets the sensor cable length for separate version. Select m or ft.	AL2	[SCAUM]
2.3	[FR unit = METRIC]	Flow rate unit of m. type	Sets the flow rate type measurement unit. Select metric or Imperial units.	AL2	[FRMUT]
2.4	[PL1 unit = METRIC]	Pulse 1 unit of m. type	This function is active with selection 7.1. It changes the measurement unit in selection 3.2. Pulse 1 type measurement unit: Metric or Imperial units.	AL2	[PL1UT]
2.5	[PL2 unit = METRIC]	Pulse 2 unit of m. type	This function is active with selection 7.2. It changes the measurement unit in selection 3.4. Pulse 2 type measurement unit: Metric or Imperial units.	AL2	[PL2UT]
2.6	[T+ unit = METRIC]	Totalizer+ unit of m. type	Sets the total direct totalizer measurement unit type: Metric or Imperial units. This function changes the measurement unit in selection 2.7.	AL2	[TTPUT]
2.7	[T+ unit = dm]	Totalizer+ unit of measure	Sets the total direct totalizer measurement unit.	AL2	[TTPUM]
2.8	[T+ D.P. = x]	Totalizer+ Decimal Point pos.	Sets the total direct totalizer decimal point position. Example: T+D.P.= 3 visualized value T+dm ³ 0.000 T+D.P.= 2 visualized value T+dm ³ 0.00	AL2	[TTPDP]
2.9	[Temp. unit = C/F]	Temperature unit of measure	Sets the temperature measurement unit.	AL2	[TMPUT]
2.10	[Mass units = ON/OFF]	Mass units enable	Enable or disable the selection of the mass unit of full scale.	AL2	[MSSUE]

9.6 Menu 3 – Scales

Menu Position	Converter Function Code	Function Name	Function Description	Access Level	MCP Command
3.1	[FS1 = g/s4908.7]	Full Rate Full Scale	The full scale is used to indicate to the meter's maximum flow rate; a volume per time is required.	AL2	[FRFS1]

NOTE: The full scale should be chosen carefully as its parameters are used for several other parameters. There are four fields to fill in order to set this parameter, from left to right: 1) type of unit, 2) type of unit, 3) time unit of measure and 4) numeric value. The selection is made by positioning the cursor on the field to modify. To change the unit of measure type (metric, imperial, mass or volume) see menu 2. The following tables show the units of measure available.

The converter accepts any kind of combination of units of measure satisfying both the following conditions:

- Numeric field value 99999
- $-1/25 \text{ fsmax} \leq \text{numeric field value} \leq \text{fsmax}$.
- Where fsmax is the maximum full scale value available to the sensor, equal to a 10m/s process fluid velocity.

The measure units are shown as appear on the display. The imperial units are differentiated by using capital and small characters.

METRIC	
cm ³	Cubic centimeter
ml	Milliliter
l	Liter
dm ³	Cubic decimeter
dal	Decalitre
hl	Hectolitre
m ³	Cubic meter
ML	Mega Liter

IMPERIAL	
in ³	Cubic inch
Gal	American gallon
GAL	British gallon
ft ³	Cubic foot
bbbl	Standard barrel
BBL	Oil barrel
yd ³	Cubic yard
kgl	KAmerican gallon
KGL	KBritish gallon
IGL	Imperial gallon
IKG	KAmerican Gallon
hf ³	
ttG	
Aft	Acre foot
MGL	Mega gallon
IMG	Imperial mega gallon

MASS UNIT, IMPERIAL	
Oz	Ounce
Lb	Pound
Ton	Short tons

MASS UNIT, METRIC	
g	Gram
kg	Kilogram
t	Ton

Menu Position	Converter Function Code	Function Name	Function Description	Access Level	MCP Command
3.2	[Pls1=g1000.00]	Output Pulse 1	Pls1 is active with POS.7.1. This enables and sets the pulse value on channel 1. This function allows the user to set a signal (a pulse) to be given from the converter when a defined amount of liquid has passed through the sensor.	AL2	[OP1PV]
<p>To set the parameter, complete the two fields, from left to right: 1)measure unit, 2) numeric value. To change the unit type (metric, Imperial, mass or volume), see POS.2.4-2.5 and POS.2.19-2.20. The value of Pls1 depends on nominal diameter POS.1.4. Only those units described (POS.3.1-3.2) above are available for selection.</p> <p>NOTE: Since the converter can not detect which two problems may occur, first, if the pulse is too long, the coils may burn out, and second, if the pulse is too short, the counter may not be able to function due to the possibility of causing damage of the output.</p>					
3.3	[Tpls1=ms0050.0]	Output Pulse 1 time	Tpls1 is active with POS.7.1 is enabled. This sets the duration of the pulse generated on channel, with the liquid volume to generate the pulse value (POS.3.3-3.5) set by the user.	AL2	[OP1PT]
<p>The user must set the corresponding duration of the pulse for output. This value is expressed in milliseconds and has to be between 0.4 and 9999.99.</p>					
3.4	[Pls2=g1000.00]	Output Pulse 2	See menu 3.2, Output Pulse 1	AL2	[OP2PV]
3.5	[Tpls2=ms0050.0]	Output Pulse 2 Time	See menu 3.3, Output Pulse 1 Time	AL2	[OP2PT]

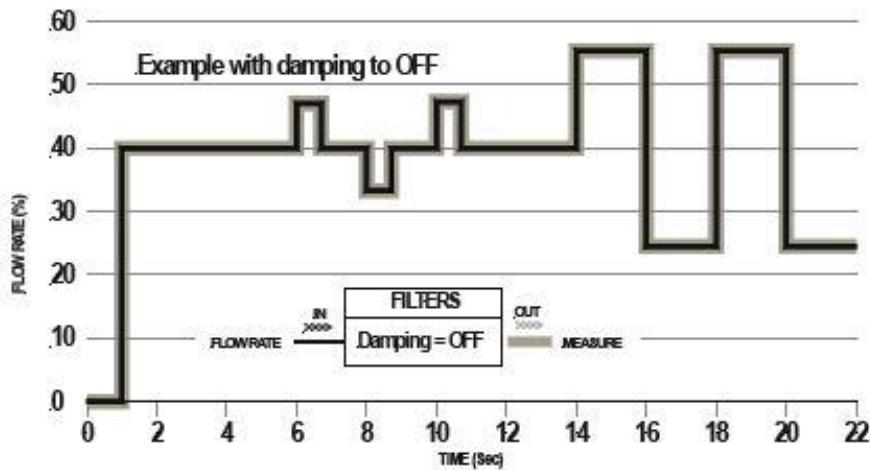
9.7 Menu 4 - Measure

Menu Position	Converter Function Code	Function Name	Function Description	Access Level	MCP Command
4.1	[Damping=SMART]	Damping	This setting adjusts how quickly the converter responds to momentary changes in flow. Settings range from Damping=OFF (immediate response but noisy signal) to 1000s (slow response to changes in flow but quiet signal).	AL3	[MFDMP]

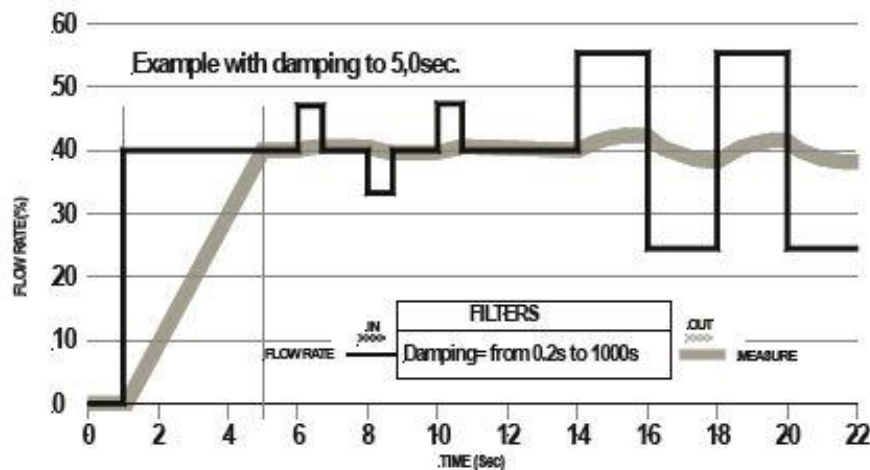
The following diagrams show the instrument's response to changes in flow rate from 0 to 100% using the different settings of the damping function.

The SMART setting is an adaptive filter that adapts automatically to changes in process fluid flow, making the meter very responsive to fast changes in flow and at the same time extremely precise and stable for slow variations.

NOTE: If the rechargeable battery is active, the damping can be set only to SMART.



Damping function OFF. The meter follows the trend of fast changes in flow.



Example with damping mode based on time (from 0.2s to 1000s).

The measure is averaged over a number of samples determined by the value assigned to the dampening function. When the damping parameter is expressed in seconds, the filter works by damping the measurement noise and shows a sudden change of flow rate. Increasing the damping parameter increases measurement stability.

Menu Position	Converter Function Code	Function Name	Function Description	Access Level	MCP Command
4.2	[Cutoff =%00.1]	Cut-off threshold	Sets the low flow cutoff threshold. This function is useful to avoid erroneous totalizer increases at zero flow due to electrical noise.	AL3	[MFCUT]
Note: The allowed range for this function is 0-25% of full scale set. For most applications a value of 2% is recommended.					
4.3	[Cal.verify=ON]	Calibration verify	This function enables automatic verification of the board's coefficients.	AL3	[ACAVE]
Note: As the converter performs continuously a large number of tests, we recommend to use this function only in presence of wide range of temperature.					
4.4	[Autorange=ON]	Automatic scale change enable	Enables the automatic change of scale.	AL3	[ARNGE]
The meter may have two different working ranges in order to suit to the variable process conditions. In order to get the best results out of this function, it is important range N.2 (Fs2) (if enabled) is bigger than N.1 (Fs1) of the full scale 1. The meter will automatically switch to scale 2. When the flow rate decreases again reaching a value on scale 2 equal to the 90% of full scale N.1, the active scale is switched to 1 again. Allowed values for this parameter are ON/OFF. Note: When the autorange is enabled, it is not allowed to use the manual range change. This function does NOT increase measurement accuracy. Its aim is to increase the resolution of 4/20 mA when the meter works at very low flow rates. A typical case would be the flow rate of water distribution with daytime flow is much higher than the night flow.					
4.5	[H.imm.inp.=]			AL3	

9.8 Menu 5 – Alarms

Menu Position	Converter Function Code	Function Name	Function Description	Access Level	MCP Command
5.1	[Max+=dm3/s]	Maximum flow rate threshold direct	Sets the maximum value alarm for direct flow rate setting. When the flow rate value exceeds such the threshold, an alarm message is generated. The value of this parameter is expressed as percentage of the full scale value and may be set from 0 to 125%. Setting this parameter to zero corresponds with disabling the alarm generation.	AL3	[FRAXP]
5.2	[Max-=dm3/s]	Maximum flow rate threshold negative	Sets the maximum value alarm set for reverse flow rate setting. When the flow rate value exceeds such a threshold, an alarm message is generated. The value of this parameter is expressed as percentage of the full scale value and may be set from 0 to 125%. Setting this parameter to zero corresponds with disabling the alarm generation.	AL3	[FRAXN]
5.3	[Min+=dm3/s]	Minimum flow rate threshold positive	Sets the minimum value alarm set for reverse flow rate set. When the flow rate value falls below such a threshold, then an alarm message is generated. The value of this parameter is expressed as percentage of the full scale value and may be set from 0 to 125%. Setting this parameter to zero corresponds with disabling the alarm generation.	AL3	[FRANP]
5.4	[Min-=dm3/s]	Minimum flow rate threshold negative	Sets the minimum value alarm set for reverse flow rate set. When the flow rate value falls below such a threshold, then an alarm message is generated. The value of this parameter is expressed as percentage of the full scale value and may be set from 0 to 125%. Setting this parameter to zero corresponds with disabling the alarm generation.	AL3	[FRANN]

Menu Position	Converter Function Code	Function Name	Function Description	Access Level	MCP Command
5.5	[Hysteresis=%03]	Hysteresis	Sets the hysteresis threshold set for the minimum and maximum flow rate alarms. The value of this parameter is expressed as percentage of the full scale value and may be set from 0 to 25%.	AL3	[ATHYS]
5.6	[mA v.alarm=%000]	Current output value in case of failure	The output current signal can be specified by the user in case of failure of either, empty pipe, coils interrupted, or ADC error.	AL3	[OCACV]
<p>The signal current is set as a percentage (0 to 125%) of the 0/4-20mA current. 125% corresponds to 24mA and does not depend on the selected range (0-20/4-20mA). The NAMUR NE43 recommendation suggests an alarms signalling value for the current output lower than 3.6mA (<18%) or greater than 21mA (>105%). It would be preferable to set the function to 10%. This would bring the current to 2mA in the event of the aforementioned faults and allow the diagnostics shown below:</p> <ul style="list-style-type: none"> • Current < 2mA - 5%: line interrupted, power supply failure or faulty converter • 2mA -5% * current * 2mA + 5%: hardware alarm; • 4mA * current * 20mA: normal working range; • 20mA < current * 22mA: out of range, measure above 100% out of range 					

9.9 Menu 6 – Inputs

Menu Position	Converter Function Code	Function Name	Function Description	Access Level	MCP Command
6.1	[T+ reset=OFF]	[T+ reset=OFF]	When this function is enabled, the related totalizer + may be reset through the on/off input.	AL3	[VTTPE]
6.2	[P+ reset=OFF]	[P+ reset=OFF]	When this function is enabled, the related totalizer + may be reset through the on/off input.	AL3	[VTPPE]
6.3	[T- reset=OFF]	[T- reset=OFF]	When this function is enabled, the related totalizer - may be reset through the on/off input.	AL3	[VTPNE]
6.4	[P- reset=OFF]	[P- reset=OFF]	When this function is enabled, the related totalizer - may be reset through the on/off input.	AL3	[VTTNE]
6.5	[Count lock=OFF]	[Count lock=OFF]	Enables the totalizers counting lock. When this function is active, when applying a voltage to the on/off input terminals, the system stops the totalizers no matter which is the flow rate.	AL3	[TCLIE]

Menu Position	Converter Function Code	Function Name	Function Description	Access Level	MCP Command
6.6	[Meas . lock=OFF]	[Meas.lock=OFF]	When this function is active (ON), applying a voltage to the on input terminals, the measurement is stopped and the meter will display zero flow.	AL3	[MSLIE]
6.7	[Calibration=OFF]	[Calibration=OFF]	When this function is active, applying a voltage to the on/off input terminals, the meter performs an autozero calibration cycle.	AL3	[CALIE]
<p>Note: If the voltage pulse is less than 1 second, the meter performs a calibration cycle to compensate for possible thermal drifts. If the voltage pulse is more 1 second, the meter performs a zero calibration measure. To perform the calibration, it is absolutely necessary for the pipe to be full of liquid and that the liquid is perfectly still. Even very small movement of the liquid may affect the result of the calibration and consequently the accuracy of the system.</p>					
6.8	[Range change=OFF]	[Range change=OFF]	Enables the range change external command. When this function is enabled, applying a voltage to the on/off input terminals, the meter switches to the second measuring range (Fs2).	AL3	[SRCIE]
<p>Note: The autorange does not allow manually changing the range. See POS. 4.4.</p>					

9.10 Menu 7 - Outputs

Menu Position	Converter Function Code	Function Name	Function Description	Access Level	MCP Command
7.1	[Out1=PULSES+]	Output 1 function selection	Sets the selection for Output 1. The functions are listed in the table below.	AL3	[OUT1F]
7.2	[Out2=PULSES-]	Output 2 function selection	Sets the selection for Output 2. The functions are listed in the table below.	AL3	[OUT2F]
<p>FUNCTIONS FOR OUTPUTS 1 AND 2</p> <p>OFF: DISABLE</p> <p>MAX AL. +: MAX DIRECT FLOW RATE OUTPUT (ENERGIZED = AL. OFF)</p> <p>MIN AL. +: MIN DIRECT FLOW RATE OUTPUT (ENERGIZED = AL. OFF)</p> <p>MAX AL.-: MAX INVERSE FLOW RATE OUTPUT (ENERGIZED = AL. OFF)</p> <p>MIN AL.-: MIN INVERSE FLOW RATE OUTPUT (ENERGIZED = AL. OFF)</p> <p>MAX/MIN.-: MAX/MIN INVERSE FLOW RATE OUTPUT (ENERGIZED = AL. OFF)</p> <p>MAX/MIN+/-: MAX/MIN DIRECT FLOW RATE OUTPUT (ENERGIZED = AL. OFF)</p> <p>P.EMPTY: EMPTY PIPE ALLARM OUTPUT (ENERGIZED = AL. OFF)</p> <p>AL.SYSTEM: SUM OF ALL ALARMS "energized interrupted " AND "error input signal "</p> <p>OVERFLOW: OUT OF RANGE ALLARM OUTPUT (ENERGIZED = FLOWRATE OK)</p> <p>ALL ALARMS: SUM OF ALL ALARMS POSSIBLE</p> <p>MANUAL: OUTPUT MAY TAKE A STATE EMPLOYEE FROM AN EXTERNAL CONTROL (MCP, MODBUS, etc.)</p> <p>FLOW DIR.: FLOW DIRECTION (EXCLUDED WHEN THE FLOW IS NEGATIVE)</p> <p>SCALE: INDICATION SCALE</p> <p>FREQ.+: FREQUENCY POSITIVE FLOWRATE</p> <p>FREQ.-: FREQUENCY NEGATIVE FLOWRATE</p> <p>FREQ.+/-: FREQUENCY POSITIVE/NEGATIVE FLOWRATE</p> <p>IMPULSI+: PULSE POSITIVE FLOW RATE</p> <p>IMPULSI-: PULSE NEGATIVE FLOW RATE</p> <p>IMPULSI+/-: PULSE NEGATIVE/POSITIVE FLOW RATE</p>					
7.3	[Out mA1=4_22+/-]	Current output option and range	Sets the current Output 1.	AL3	[OUT1F]

Menu Position	Converter Function Code	Function Name	Function Description	Access Level	MCP Command
7.4	[Out mA2=4_22+/-]	Current output option and range	This function sets the current output 2.	AL3	[OUT2F]

This function is optional and will not appear unless the option has been requested. There are three fields to modify for this function:

- Scale zero: 4 or 0mA
- Full scale: 20 or 22mA
- Field: + = positive, - = negative, blank = both, -0+ = central zero scale

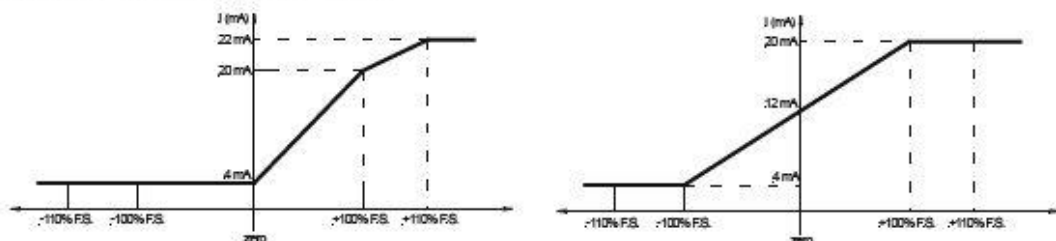
The values corresponding to the scale points are shown in the following chart:

CURRENT VALUES IN mA CORRESPOND TO THE % FULL SCALE VALUE					
POSSIBLE FIELD	REVERSE FLOW VALUE		ZERO	DIRECT FLOW VALUE	
	≤ -110%	-100%	0%	+100%	≥ +110%
Out.mA = 0 ÷ 20 +	0	0	0	20	20
Out.mA = 0 ÷ 22 +	0	0	0	20	22
Out.mA = 4 ÷ 20 +	4	4	4	20	20
*Out.mA = 4 ÷ 22 +	4	4	4	20	21.6
Out.mA = 0 ÷ 20 -	20	20	0	0	0
Out.mA = 0 ÷ 22 -	22	20	0	0	0
Out.mA = 4 ÷ 20 -	20	20	4	4	4
Out.mA = 4 ÷ 22 -	21.6	20	4	4	4
Out.mA = 0 ÷ 20	20	20	0	20	20
Out.mA = 0 ÷ 22	22	20	0	20	22
Out.mA = 4 ÷ 20	20	20	4	20	20
Out.mA = 4 ÷ 22	21.6	20	4	20	21.6
Out.mA = 0 ÷ 20 -0+	0	0	10	20	20
Out.mA = 0 ÷ 22 -0+	0	1	11	21	22
**Out.mA = 4 ÷ 20 -0+	4	4	12	20	20
Out.mA = 4 ÷ 22 -0+	2	4	12	20	22

* Example 1: out 4-22 +

** Example 2: out 4-20 -0+

In hardware alarm conditions "HARDW AL." (interrupted coils, empty pipe, measure error) the current value is programmed by the function "mA v.fault" (pos. 5.6) and it is expressed as percentage of a fixed current range, where: 0% = 0mA and 110% = 22mA.



Menu Position	Converter Function Code	Function Name	Function Description	Access Level	MCP Command
7.5	[A1S=dm ³ /s 4.9087]	Analog Output1 full scale	Sets the full scale value for analog output 1 independently of the main scale of the instrument	AL3	[AO1FS]
7.6	[A2S=dm ³ /s 4.9087]	Analog Output2 full scale	Sets the full scale value for analog output 1 independently of the main scale of the instrument	AL3	[AO2FS]

9.11 Menu 8 - Communication

The Communication menu will populate with commands that are specific to the output mode or protocol that the converter is configured to. The menus shown below are for Hart, MODBUS, and AMR.

HART

Menu Position	Converter Function Code	Function Name	Function Description	Access Level	MCP Command
8.1	[HART pr.=XXXXXX]	Hart Preamble	Number of preamble (Hart function)	AL3	[HARTP]
8.2	[HART o.c.=XXXXXX]			AL3	
8.3	[HART find d=XXXXXX]			AL3	
8.4	[HART w.p.=XXXXXX]			AL3	
8.5	[Dev. Addr=XXXXXX]	Device Address		AL3	[DVADD]

MODBUS

Menu Position	Converter Function Code	Function Name	Function Description	Access Level	MCP Command
8.1	[Dev. Addr=XXXXXX]	Device Address		AL3	[DVADD]
8.2	[Speed=hps9600]	Speed		AL3	
8.3	Parity=no	Parity		AL3	
8.4	Delay=ms00	Delay		AL3	
8.5	[C.timeout=2]	Time Out		AL3	[DVADD]

AMR

Menu Position	Converter Function Code	Function Name	Function Description	Access Level	MCP Command
8.1	I.RD.p.t=MIM087 (Sensus)			AL3	
8.2	MIM086 (Itron 6)				
8.3	MIM085 (Itron 9)				

9.12 Menu 9 - Display

Menu Position	Converter Function Code	Function Name	Function Description	Access Level	MCP Command
9.1	[Language =EN]	Language for all msn	Sets the language selection. There are 2 languages available: EN = English, IT = Italian.	AL1	[LLANG]
9.2	[Contrast =5]	Display Contrast	Sets the display contrast. The contrast can change according to the room temperature. The allowed range is from 0 to 9.	AL1	[DCNTR]
9.3	[Disp.time =s020]	Keyboard Timeout Time	Sets display/keyboard inactivity. The set values are from 020 to 255 second.	AL1	[KBTMT]
9.4	[D.rate =Hz5]	Display Refresh Frequency	Sets the frequency of the display data update. This parameter effects only the display layout and not the response time of the meter itself. The possible choices are: 1/2/5/10 Hz.	AL1	[DISRF]
9.5	[Disp.fn =1]	Display function number	Sets the display of the page making it visible when you start the display. Each display page is associated with a number that corresponds to Pos 9.5.	AL2	[DISFN]
9.6	[Disp.lock =ON]	Display function lock	Locks display page sliding selected by Pos 9.5.	AL2	[DLOKE]
9.7	[Part.tot. =]	Partial totalizer	This function enables the display of partial totalizer in visualization pages	AL2	[PTOTE]
9.8	[Neg.tot. =ON]	Negative totalizer	This function enables the display of negative totalizer in visualization pages	AL2	[NEGTE]
9.9	[Quick start =ON]	Quick start menu	This function enables the display of date and time in visualization pages	AL2	[QSTME]

9.13 Menu 10 – Data Logger

Menu Position	Converter Function Code	Function Name	Function Description	Access Level	MCP Command
10.1	[D.logger en = OFF]	Data logger enable	Enables the data logger.	AL3	[DLOGE]

Menu Position	Converter Function Code	Function Name	Function Description	Access Level	MCP Command
The following functions are activated by [D.logger en= ON]					
10.2	[Meas. units= ON]	Unite of Measure	Measure unit recording enable	AL3	[DLUME]
10.3	[Field separ.= ;]	Field separator character	This function will set the separator character between data logger data.	AL3	[DLFSC]
10.4	[Interv.=xx:xx:xx]	Sample Interval	Sampling interval. This function scans the log frequency. [Interv.= Hours : Minutes: Seconds]	AL3	[DLGSI]
10.5	[Log T+=ON]	Totalizer Total positive	Enable logging of total direct totalizer.	AL3	[DTTPE]
10.6	[Log P+=ON]	Totalizer Partial positive	Enable logging of partial direct totalizer.	AL3	[DTPPE]
10.7	[Log T-=ON]	Totalizer Total Negative	Enable logging of total reverse totalizer	AL3	[DTTNE]
10.8	[Log T--ON]	Totalizer Partial Negative	Enable logging of partial reverse totalizer	AL3	[DTPNE]
10.9	[Log TN=ON]	Totalizer Total Net	Enable logging of total net totalizer	AL3	[DLTNE]
10.10	[Log PN=ON]	Totalizer Partial Net	Enable logging of partial net totalizer	AL3	[DLPNE]
10.11	[Log Q<UM>=ON]	Log Flow rate in measure unit	Enable logging of flow rate in measure unit	AL3	[DFTUE]
10.12	[Log Q<%>=ON]	Log Flow rate in percentage	Enable recording of the flow rate as a percentage of full scale value set.	AL3	[DFPCE]
10.13	[Log AL.EU=ON]	Alarm events	Enable logging of alarm events	AL3	[DALEE]
10.14	[Log STR=ON]	Sensor test result	Enable logging of sensor test results	AL6	[DSTRE]
10.15	[Log BTS=ON]	Board temperatures	Enable logging of board temperature	AL6	[DBTSE]
10.16	[Log IBU=ON]	Internal board voltages	Enable logging of internal board voltage	AL6	[DIBVE]
10.17	[Log EDC=ON]	Electrodes DC voltages	Enable logging of electrodes DC voltage	AL6	[DEDVE]
10.18	[Log AEC=ON]	Electrodes AC voltages	Enable logging of electrodes AC voltage	AL6	[DEAVE]
10.19	[Log EIZ=ON]	Electrodes source impedance	Enable logging of electrodes impedance	AL6	[DESIE]
10.20	[Log SCU=ON]	Sensor coils values	Enable logging of sensor coils value	AL6	[DSCVE]

9.14 Menu 11 – Functions

Menu Position	Converter Function Code	Function Name	Function Description	Access Level	MCP Command
11.1	[T+ reset]	Totalizer Total Positive reset	Resets the total direct totalizer for direct flow rate (+)	AL3	[VTTPR]
11.2	[P+ reset]	Totalizer Par. Positive reset	Resets the total partial totalizer for direct flow rate (+)	AL3	[VTPPR]
11.3	[T- reset]	Totalizer Total Neg. reset	Resets the total reverse totalizer for direct flow rate (-)	AL3	[VTTNR]
11.4	[P- reset]	Totalizer Partial Neg. reset	Resets the partial reverse totalizer for direct flow rate (-)	AL2	[VTPNR]
11.5	[Load Sens.f.def]	Load factory default sensor	Resets the parameters of the sensor factory default	AL3	[LFSDS]
11.6	[Load Conv.f.def]	Load factory default converter	Resets the parameters of the converter factory default.	AL3	[LFDSD]

9.15 Menu 12 – Diagnostic

Menu Position	Converter Function Code	Function Name	Function Description	Access Level	MCP Command
12.1	[Self test=]	Self Test Diagnostic	Meter auto-test function. This function stops the normal functions of the meter and performs a complete test cycle on the input circuits measurement and on the excitation generator.	AL3	[ATSIC]
To activate, after selecting the function, press Enter at the question: "CONFIRM EXEC.?" Press ESCAPE to start the auto-test or any other key to stop the operation. At the end of operation, the converter will revert to one of the initial visualization pages. This function is automatically performed when switching on the device. This function restart the converter.					
12.2	[Display test=]	Test Display	This function performs a physical test graphic display. During this operation, four sequences are displayed to test that the device functions properly.	AL3	NO MCP COMMAND
12.3	[Sens.verify]	Sensor Verify	This function performs a manual sensor verification (if BIV is active)	AL3	[SVERC]

Menu Position	Converter Function Code	Function Name	Function Description	Access Level	MCP Command
12.4	[Flow sim.=ON]	Flow Rate Simulation	Enables flow rate simulation. With this function, it is possible to generate an internal signal that simulates the flow rate and allows for testing the outputs and all the connected instruments.	AL3	[MSIEN]
<p>After enabling it, a ▲▼ appears in the top left of the screen and the flow rate simulation can be:</p> <ul style="list-style-type: none"> • <u>Set</u>: Press Enter on one of visualization pages. This sets the required % flow rate (Fl. rate=%). Pressing the Enter key confirms the value. • <u>Finished</u>: Press Enter on one of the visualization pages and then make a long press on the same key. 					
12.5	[Firmware info]	Firmware Info	Shows the firmware info version/revision (read only)	AL0	[DMVLS]
12.6	[S/N=999001]	Board Serial Number	Shows the board serial number (read only)	AL0	[DMVLS]
12.7	[WT=0002:21:00:22]	Working Time	Shows the instrument's total working time (read only)	AL0	[TWKTM]

9.16 Menu 13 – System

Menu Position	Converter Function Code	Function Name	Function Description	Access Level	MCP Command
13.1	[L1 code = *****]	Access level value code 1	This function enables or disables, for each access level code, the main menu functions. Each level unlocks the functionality of the lower level.	---	[L1ACD]
13.2	[L2 code = *****]	Access level value code 2		---	[L2ACD]
13.3	[L3 code = *****]	Access level value code 3		---	[L3ACD]
13.4	[L4 code = *****]	Access level value code 4		---	[L4ACD]
13.5	[010.011.012.013]	Device IP Address	Device IP network address	AL3	[DIPAD]
13.6	[011.011.012.014]	Client IP Address	Client IP network address	AL3	[CIPAD]
13.7	[255.255.255.000]	Network Mask	Network mask	AL3	[NETMS]
13.8	[FW update]	Firmware Update	<p>This function enables firmware update. The firmware can be uploaded to the SD card (name.file).</p> <p>MCP interface is activated by the command FWUPD = name.file</p>	AL4	[FWUPD]

10 Error Codes

The codes are in hexadecimal format, the meaning is given for each bit. There are several possible error simultaneous combinations (more bits active) then that will give the combined numerical codes.

CODE	ANOMALIES DESCRIPTION	ACTION TO TAKE	
0000	NO ERROR	---	
0001	SENSOR TEST INSULATION: Generator power too low	Contact customer service	
0002	SENSOR TEST INSULATION: Generator power too high		
0004	SENSOR TEST INSULATION: Phase 1 generator voltage too low		
0008	SENSOR TEST INSULATION: Phase 1 generator voltage too high		
0010	SENSOR TEST INSULATION: Phase 1 terminal voltage coils 1 too low		
0020	SENSOR TEST INSULATION: Phase 1 terminal voltage coils 2 too low		
0040	SENSOR TEST INSULATION: Phase 2 generator voltage too low		
0080	SENSOR TEST INSULATION: Phase 2 generator voltage too high		
0100	SENSOR TEST INSULATION: Phase 2 terminal voltage coils 1 too low		
0200	SENSOR TEST INSULATION: Phase 2 terminal voltage coils 2 too low		
0400	SENSOR TEST INSULATION: Insulation loss, current leakage out of tolerance		Check: <ul style="list-style-type: none"> • Wiring between sensor converter • Conditions of use • Set parameters If the problem, persists contact customer service
0800	TEST TEMPERATURE (RESISTANCE) COILS: Temperature (resistance) out of tolerance		
1000	TEST TIME GETTING ON CURRENT PHASE (A): Value out of tolerance		
2000	TEST TIME GETTING ON CURRENT PHASE (B): Value out of tolerance		
4000	TEST RESISTANCE INPUTS ELECTRODES: Input value 1 out of tolerance		
8000	TEST RESISTANCE INPUTS ELECTRODES: Input value 1 out of tolerance		

11 Alarm Messages

MESSAGE	CAUSES	ACTION TO TAKE
NO ALARMS	All works regularly	---
[000] SYSTEM RESTART	---	---
[001] INTERNAL PS FAIL	Internal supply voltage error	Contact the service
[002] CLOCK NOT SET	System Clock not set	Set the system clock from the converter menu 13 (see also MCP function).
[003] SD CARD FAILURE	SD card not found or unreadable	Check and/or replace SD card
[005] F-RAM ERROR	Error writing / reading Flash-RAM	Contact customer service
[006] EXCITATION ERROR	The excitation of the sensor coils resulting from cable is interrupted	Check the connecting cables to the sensor
[007] SIGNAL ERROR	The measure is strongly effected by external noise or the cable connecting the converter to the sensor is broken.	Check the status of the cables connecting the sensor and the device grounding connections for possible presence of noise sources.
[008] PIPE EMPTY	The measuring pipe is empty or the detection system has not been properly calibrated.	Check whether the pipe is empty, or repeat the empty pipe calibration procedure.
[009] FLOW>MAX+	The flow rate is higher than the maximum positive threshold set.	Check the maximum positive flow rate threshold set and the process conditions.
[010] FLOW>MAX-	The flow rate is higher than the maximum negative threshold set.	Check the maximum negative flow rate threshold set and the process conditions.
[011] FLOW<MIN+	The flow rate is lower than the minimum positive threshold set.	Check the minimum positive flow rate threshold set and the process conditions.
[012] FLOW<MIN-	The flow rate is lower than the minimum negative threshold set.	Check the minimum negative flow rate threshold set and the process conditions.
[013] FLOW>FULL SCALE+	The flow rate is higher than the full scale positive value set on the instrument.	Check the full scale positive value set on the instrument and the process conditions.
[014] FLOW>FULL SCALE-	The flow rate is higher than the full scale negative value set on the instrument.	Check the full scale negative value set on the instrument and the process conditions.
[015] PULSE1>RANGE	The pulse generation output 1 of the device is saturated and cannot generate the sufficient number of impulses.	Set a higher unit of volume or, if the connected counting device allows it, reduce the pulse duration value.
[016] PULSE2>RANGE	The pulse generation output 2 of the device is saturated and cannot generate the sufficient number of impulses.	Set a higher unit of volume or, if the connected counting device allows it, reduce the pulse duration value.
[017] CALIBR.ERROR	Calibration Error	Contact customer service
[018] SYSTEM FREQ.ERR	System Freq. Error	Contact customer service
[019] B.DATA NOT INIT	Uninitialized data system	Contact customer service
[020] FL.SENSOR ERROR	Flow rate sensor error	Contact customer service
[021] BATTERY LOW	(Rechargeable) battery depleted	Contact customer service to replace the battery

MESSAGE	CAUSES	ACTION TO TAKE
[022] BATTERY V>MAX	Battery voltage (rechargeable)> max. Allowed	Contact customer service to replace the battery
[023] BATTERY I>MAX	Battery charge current> max. allowed	Contact customer service to replace the battery
[024] MAIN PS V.ERR	Main supply voltage (+ 5V) out of tolerance.	Contact customer service
[025] USB VOLTAGE ERR	Voltage of USB connection out of tolerance.	Contact customer service
[026] SDC ALMOST FULL	SD card space <500 MB.	
[027] SDC FULL	SD card out of memory	SD card memory memory is full. You cannot save logger. Contact customer service to replace the SD card.
[028] BATT.TEMP.CRIT	The battery can not be charged. The temperature is out of range (detected temperature <0 C° or temperature >50°)	

12 Troubleshooting Guide

The table below provides suggestions for fixing common problems. Contact factory for further support.



WARNING!
Ensure device is disconnected or circuit breaker is open per the requirements of IEC 60947-1 and IEC 60947-3 before opening the opening the converter.

Problem	Troubleshooting Steps
Not getting expected 4-20mA output	<ul style="list-style-type: none"> • Ensure the wiring is firmly connected on the 4-20mA output terminals • Verify resistor removed from terminal block • Verify the FS1 setting in the main menu is set to the correct value, matches PLC/SCADA value • Measure output on the 4-20mA terminals and compare it to the calculated current value
Curr. Loop Open Alarm	<ul style="list-style-type: none"> • Ensure the wiring is firmly connected on the 4-20mA output terminals • If the 4-20mA output is not being used, ensure the 4-20mA terminals have a load resistor installed • Remove the wires from the 4-20mA terminals and measure the current output direct
Excitation Fail (0800) Alarm	<ul style="list-style-type: none"> • Ensure the wiring is firmly connected • Disconnect the coil wires from the converter and check their resistance with a standard multi-meter. Contact the factory for the proper value for the sensor.
Noisy Input Alarm	<ul style="list-style-type: none"> • Verify the converter ground is to earth ground • Check for damaged cable between the sensor and converter
Empty Pipe Alarm	<ul style="list-style-type: none"> • Increase threshold to 250 kΩ. • Confirm the pipe is full. If pipe is always full, turn off EP Detect • Check that sensor is properly grounded • Conduct a bucket test to confirm the EP Threshold value is set correctly. Consult the factory for assistance. • Check for damaged cable between the sensor and converter
Unstable Flow Readings	<ul style="list-style-type: none"> • Check installation straight run requirements are met • Check grounding connections • Check power circuit. What other devices are on the circuit • Install dedicated ground circuit
Menu Not Accessible	<ul style="list-style-type: none"> • Confirm the password being used is 400000
Rate Of Flow Report Is Not As Expected	<ul style="list-style-type: none"> • Confirm the unit is programmed correctly by requesting a program setting report from the factory.

13 Appendix

13.1 Installation Guide

Purpose:

To provide a step-by-step procedure for installing the SPI flow meter inline to ensure correct insertion depth and calibration.

13.1.1 SPI Probe Installation:

Step 1:

Ensure you have a 1" NPT drilled hole on the inlet of the valve.



Step 2:

Put a generous amount of thread sealant on the pipe nipple and thread it into the 1" NPT hole on the valve



Step 3:

Put a generous amount of lock tight on the other side of the pipe nipple and thread the compression nut on the pipe nipple. Ensure there is an o-ring in the compression nut on the sensor side.



Step 4:

Tighten the compression nut which in turn will tighten the pipe nipple. Tighten till hand tight to ensure tight water seal. Ensure the ready rod threading holes are horizontal in final tightened position.



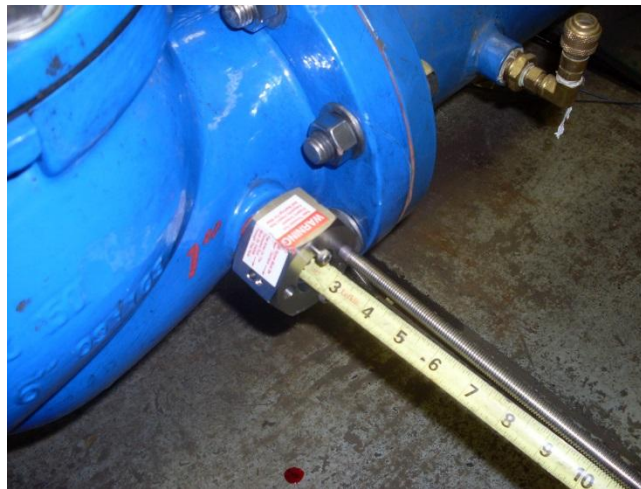
Step 5:

Put some anti-seize on the ready rod and thread the rod into the upstream side of the compression nut. Once threaded tighten set screw



Step 6:

Measure the Length of the Probe, the Boss Length, and the Inner Diameter (also shown in Converter Quick Start Menu)..



Calculate the insertion depth based on the measured values:



- **LENGTH OF PROBE (L)** is measured from the middle of the electrodes on the sensor to the end of the sensor.
- **BOSS LENGTH (B)** is a measurement from the inner of the valve to the end of the compression nut. This is the Fittings & Body Width
- **0.125D** is the insertion depth of the probe into the valve. This is 1/8 of the internal diameter of the valve

Step 7:

Insert the SPI sensor ensuring the flow arrow points down steam and tighten the nut with the socket wrench provided with the SPI package.



Step 8:

Tighten till the correct insertion depth and tighten the compression clamp. Once the compression clamp tightens on the o-ring the SPI sensor is sealed.

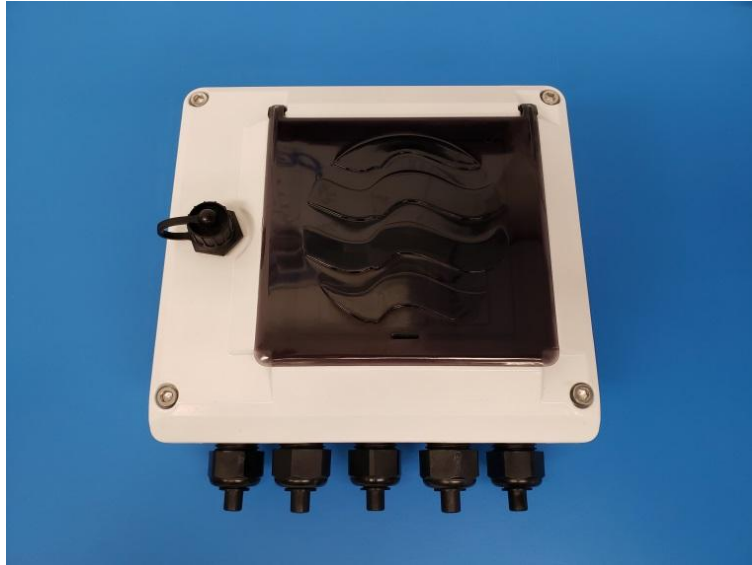


Step 9:

Ensure both the compression nut and SPI sensor are horizontal to ensure correct sensor alignment.

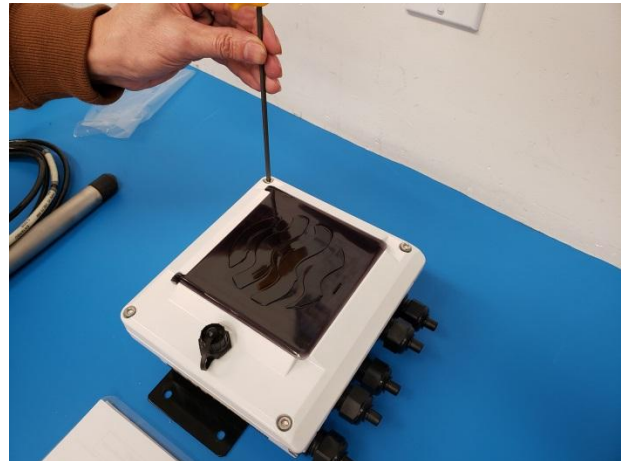


13.1.2 Converter Wiring Installation:



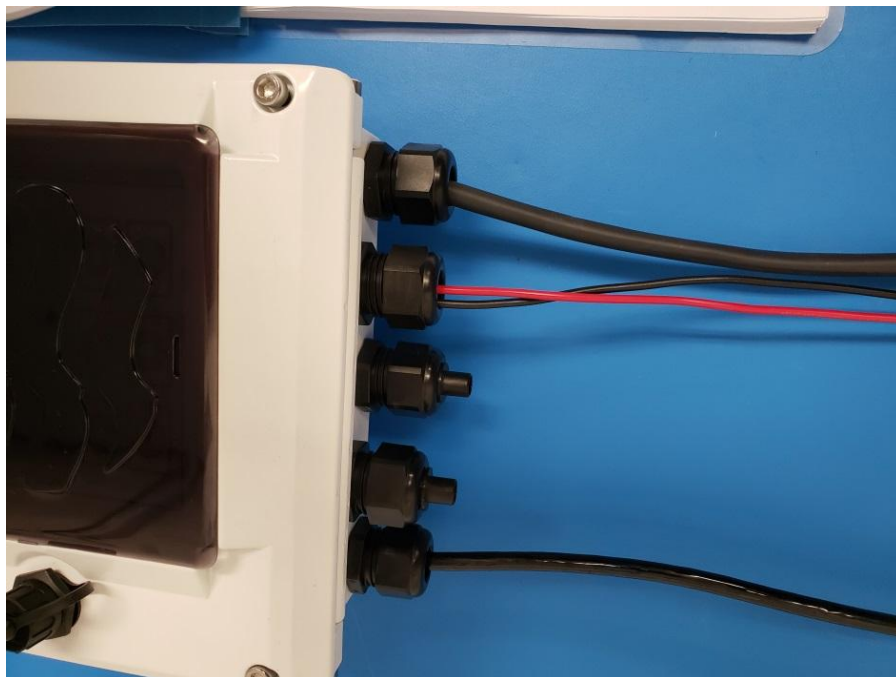
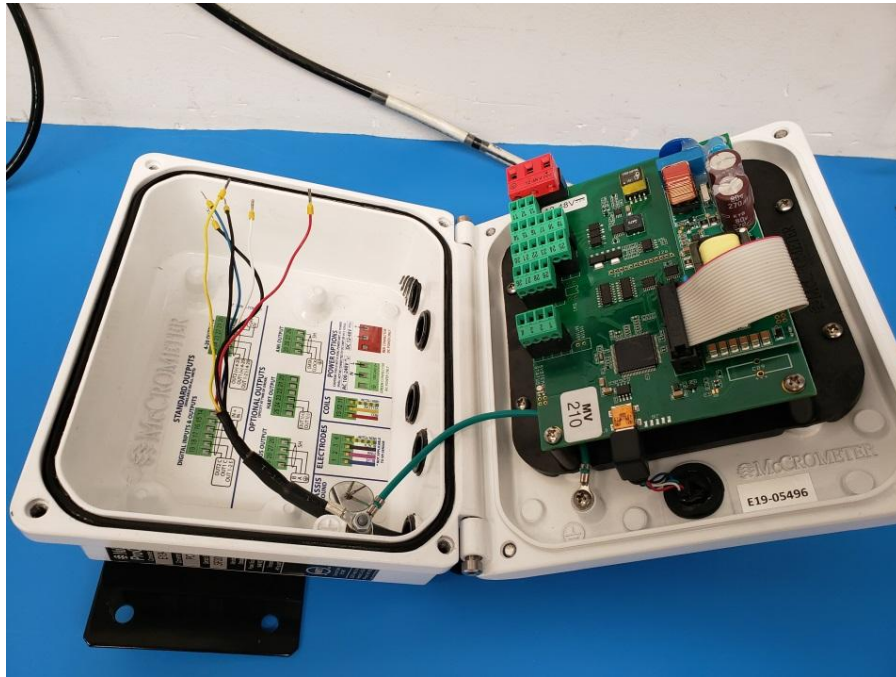
Step 1:

Locate and pull the rip wire on the sensor cable. Open the back of the Converter.



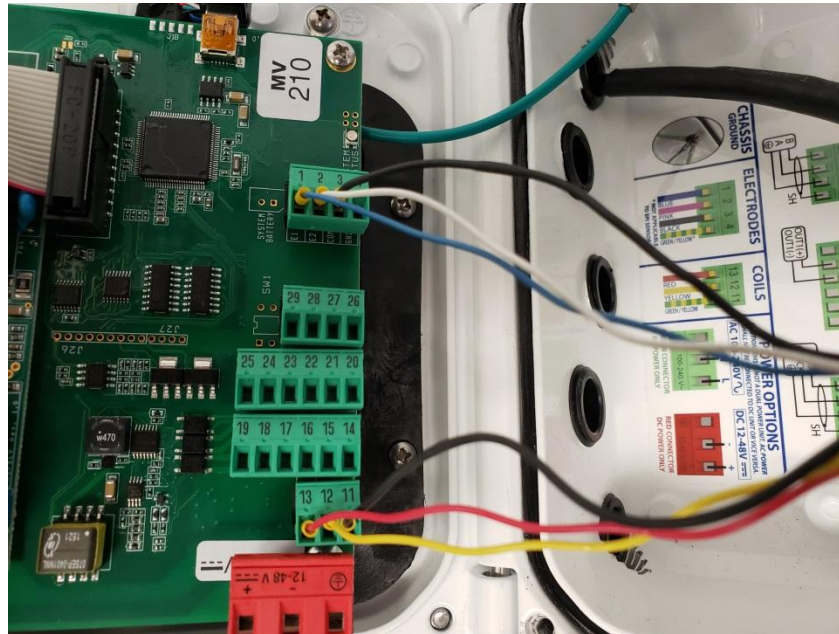
Step 2:

Thread the sensor cable through the enclosure connection and tighten the enclosure connector.

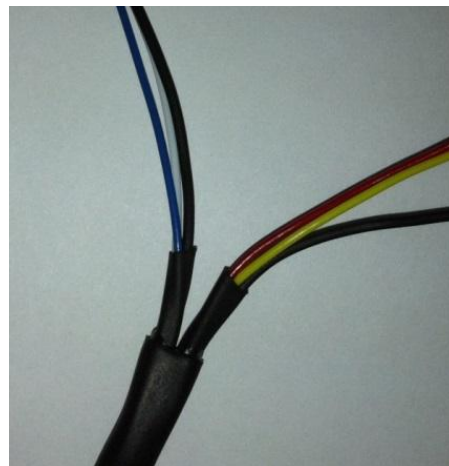


Step 3:

Install the Sensing Electrodes, Reference Ground, Coils and Shield wires. Take note of how the Ground and Shield black wires are heat wrapped separately to indicate which wire is which.

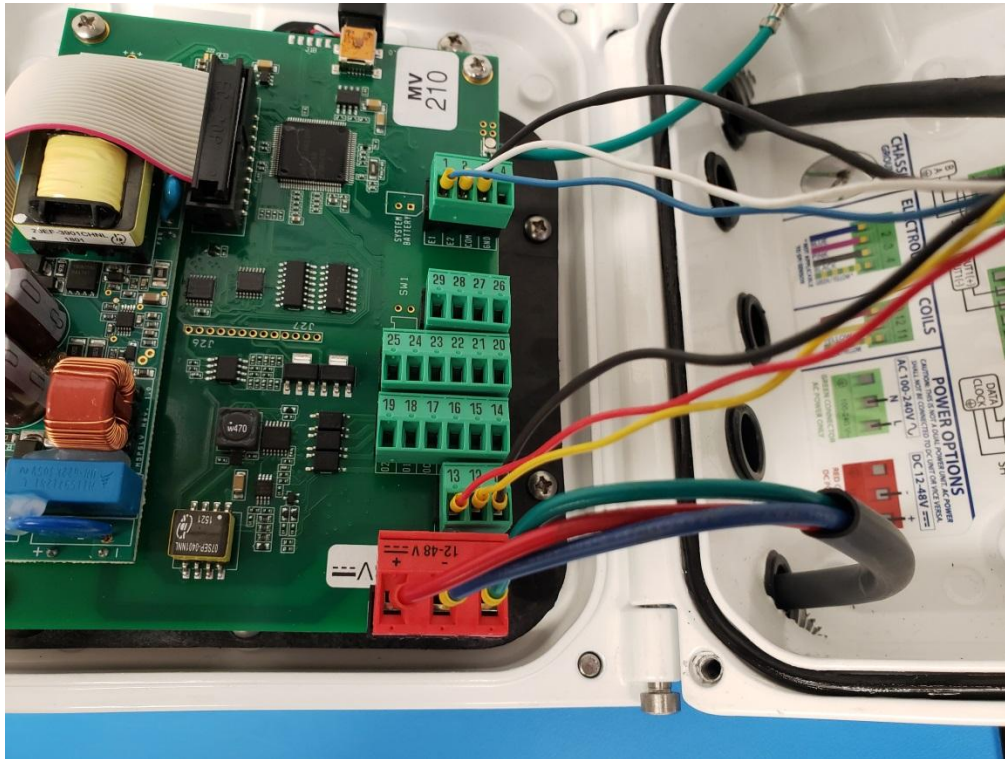


Terminal	Wire Colour	Connection
#1	Blue	Sensing Electrode
#2	White or pink	Sensing Electrode
#3	Black	Reference Ground
#11	Black	Cable Shield
#12	Yellow	Coil
#13	Red	Coil



Step 4:

Install power cable provided with SPI package. Thread the power cable through the enclosure connections and tighten the enclosure connector. Install Line (black), Neutral (white), and Ground (green) wires for 120VAC version. Install Positive (red), Negative (blue) and Ground (green) for the 24VDC version.

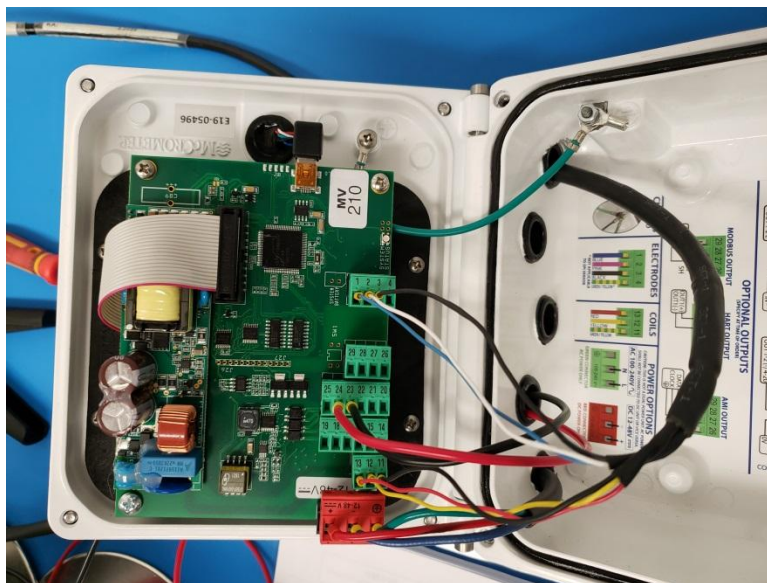
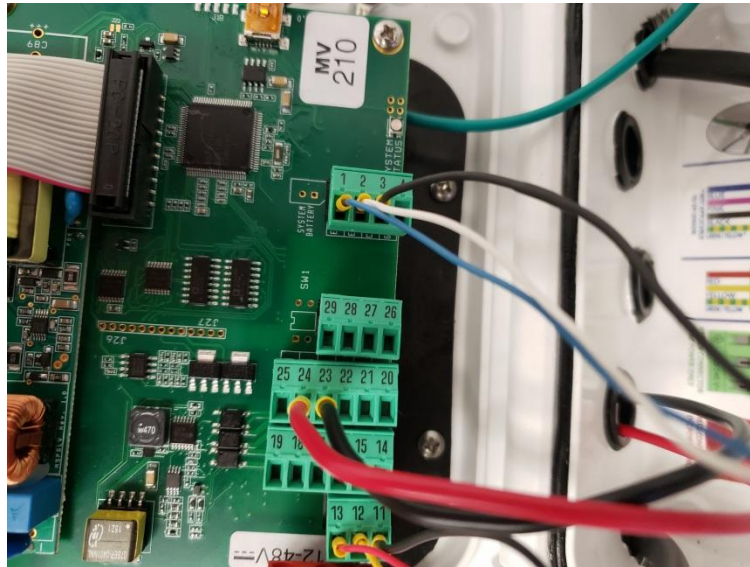


Step 5 (Optional):

Installing the 4-20mA wiring can be done in 1 of 2 outputs or both (Refer to section 8.7.3) Note there are load resistors that need to remain unless the 4-20mA current loop is being used. To install wiring for 4-20mA remove only the load resistor of the output you are using.

Output 1: Common 23 & Output 24

Output 2: Common 23 & Output 25



13.2 Installation Record

The following table can be used to record probe insertion measurements for reinsertion after maintenance.

Date	Sensor Length (C)	Nipple & Nut Length (B)	1/8 Valve Diameter (A)	Insertion Depth (Y)



Please read and understand the contents of this manual.