SUBMITTAL

1501 Lamb Road • Woodstock, IL 60098 • p: 815.337.1700 • 815.337.1766

Project Name: N-CORPE AUGMENTAION PACKAGE NO. 1 Date: 10/7/2013

Owner Project Number _____ ME Project Number ME-708

Company: MILLER & ASSOCIATES
Attention: CHRIS MILLER
Address: 1111 CENTRAL AVE.
City, State, Zip: KEARNEY, NE 68847
Phone: 308-234-6456

From: Merryman Excavation, Inc.
Attention: Ray Braden
Address: 1501 Lamb Road
City, State, Zip: Woodstock, IL 60098
Phone: 815-337-1700X20

PROJECT MATERIAL SUBMITTAL NO.: 19

Flow Meter

PLEASE SEE COMMENTS ON PAGES 4, 5, 7, 8, 16, 28, 33

Material: Flow Meter
Spec Section: DS.19

☐ Meets Spec Requirements

☒ Meets Specs with Noted Exception

Merryman Excavation, Inc.
PM Name: Ray Braden
Signature: Ray Braden
Date: 10/7/2013

MILLER & ASSOCIATES
CONSULTING ENGINEERS, P.C.

☐ Approved ☒ Approved as Corrected
☐ Rejected ☐ Revise & Resubmit
☐ Submit Specific Item

Material:
Spec Section:

This review is only for general conformance with the design concept of the project and general compliance with the information given in the Contract Documents. Corrections or comments made on the shop drawings during this review do not relieve contractor from compliance with the requirmenets of the plans and specifications. Approval of a specific item shall not include approval of an assembly of which the item is a component. Contractor is responsible for dimensions to be confirmed and correlated at the jobsite: information that pertains solely to the fabrication process or to the means, methods, techniques, sequences and proceedures of construction; coordination of the work of all trades; and for performing all work in a safe and satisfactory manner.

☐ Approved
☐ Approved as Noted
☐ Revised & Resubmitt
☐ Unapproved

Signature: 10-24-13 By: CAM
Project No: 159-P5-003
Date:

FPI Mag™
FULL PROFILE INSERTION
ELECTROMAGNETIC FLOW METER
MODELS 394L AND 395L M-SERIES MAG METER SUBMITTAL

From

McCROMETER
3255 WEST STETSON AVENUE
HEMET, CA 92545

Phone (951) 652-6811
Toll Free (800) 220-2279
Fax (951) 652-3078

www.mccrometer.com

Date: 9/5/2013

30120-52 Rev. 1.4/05-13

Project Name:

Republican River Well Field - Bid Package 1 - North Platte, NE

Purchase Order No.: To Be Determined

Date: 9/5/2013

Customer Name: Mid American Water

Submitted By: Mellen & Associates, Inc

Engineer:

MILLER & ASSOCIATES CONSULTING ENGINEERS
1111 CENTRAL AVE
KEARNEY, NE 68847-6833

- AND –

HDR ENGINEERING, INC.
8404 INDIAN HILLS DR
OMAHA, NE 68114

FPI Mag™ Equipment to be Supplied to McCrometer, Inc.

PART NUMBER	DESCRIPTION	QTY.
Model 395L	FPI Mag™ Meter Forward Flow	1

Nominal Pipe Size in inches (36")

(1) M-Series Electronic Unit, including:

- (1) IP67 Enclosure
- (1) Three-Button Key Pad
- (1) Back-Lit Graphical LCD Display
- (4) Programmable Opto-Isolated Digital Outputs
- (2) 4-20mA Programmable Output for Forward Flow
- (1) 90-265 VAC Powered

(1) Electromagnetic Averaging Sensor, including:

- (1) 2" Bronze Full Port Ball Valve with (1) 2 x Close Stainless Steel Nipple
- (1) 3M Fusion Bonded Epoxy Protective Coating
- (1) Quick Connect Cable Connector (IP68)
- (20) Feet of Submersible Sensor Cable
- (1) Compression Seal
- (1) Set of Retaining/Installation Rods
- (1) Top Plate

(1) Instruction Manual

General Contractor to verify cable length to control panel

IMPORTANT: The MINIMUM port inside diameter for all installation valves is 1-7/8" (48mm).

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PROJECT NOTES

Meter 1:

395L FULL PRO INSERTION (FPI) FORWARD FLOW MAG METER FOR 36" PIPE
This full pipe averaging flow meter comes complete with Mounting Hardware, AC M-Series Converter with forward flow 20mA output, 20 feet of Submersible Cable with quick connect at sensor, Stainless Steel body, 316 Stainless Steel electrodes, NSF Approved Fusion Bonded Epoxy Coating, 2-Year Warranty, 2in Bronze Ball valve and 2in x Close Stainless Steel nipple.
***Pipe ID Range: 32.0-37.99"
***Flow Range: 1000-104,000 GPM, 20mA@ ~~37,500~~ 40,000 GPM
***Completion of 395L Specification Data sheet required at the time of order, longer than standard sensors may be subject to a price adder.
***Additional cable available upon request at $3.00/ft (max. 200')

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GENERAL

The magmeter shall consist of two components; an electromagnetic averaging sensor and a converter unit. The magmeter shall automatically sense and correct for shifting velocity profiles in the pipe by constantly obtaining an area weighted mean velocity. The meter shall be equivalent to the Models 394L and 395L FPI Mag Full Profile Insertion Electromagnetic Flow Meter as manufactured by McCrometer, Inc. in Hemet, California.

CONVERTER

The flow meter converter shall be microprocessor based with a keypad for instrument set up and LCD displays for totalized flow, flow rate engineering units and velocity. The converter shall power the flow-sensing element and provide a galvanically isolated Dual 4-20mA output. It shall be possible, in the test mode; to easily set the converter outputs to any desired value within the range. The 4-20mA scaling, time constants, pipe size, flow proportional output, engineering units and test mode values shall be easily set via the keypad and display. Four separate fully programmable alarm outputs shall be provided to indicate empty pipe, forward/reverse, polarity (normally open/close), analog over-range, fault conditions, high/low flow rates, % of range, and pulse cutoff. The converter shall periodically perform self-diagnostics and display any resulting error messages. All set up data and totalizer values may be protected by a password.

SENSOR

The flow-sensing element shall be of an electromagnetic averaging type design and factory calibrated to NIST traceable standards. The flow sensor shall also be supplied with a bronze full port ball valve or corporation stop and stainless steel nipple. Installation of the averaging sensor shall be accomplished either under flowing conditions or in a dry line through a 2-inch tap via a full port ball valve or corporation stop into the pipe. Profiling or site calibration shall not be required. Measuring electrodes and reference ground electrodes shall be constructed of 316 stainless steel for corrosion protection against the passing fluid. Sensor shall have epoxy coating over the stainless steel to help from attack of UV, chemical resistance and excess buildup. Sensor shall be suitable for clean, potable, raw (check algae content) or other debris-free water applications. The sensor shall not be damaged by extended operation at partially full or empty pipe conditions.

SENSOR CABLE

The sensor cable is 20 feet of multi-conductor; abrasive resistant, PVC jacketed, submersible cable flexible to -40° F. The sensor cable shall not be permanently bonded to the sensor. Additional sensor cable up to a maximum of 200 feet shall be available as an option.

MOUNTING HARDWARE

Stainless steel threaded retaining rods, of sufficient length, shall be provided for the smooth installation of the electromagnetic averaging sensor. Shorter stainless steel retaining rods shall also be provided for the continuous operation of the electromagnetic averaging sensor. In order to provide stable and secure sensor placement, the sensor shall be capable of compression up to 300 lbs. for use in low pressure PVC pipes and 450 lbs. for use in low pressure metal pipes. For applications other than low pressure, contact factory for compression instructions.

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FPI Mag™ Models 394L and 395L Suggested Specifications

The full pipe averaging flow meter comes complete with Mounting Hardware, AC M-Series Converter with Dual 4-20mA output, 20 Feet of Submersible Cable with quick connect at sensor, Stainless Steel Body, 316 Stainless Steel Electrodes, NSF Approved Fusion Bonded Epoxy Coating, 2" Bronze Ball Valve (minimum of 1-7/8" port I.D.), 2" x Close Stainless Steel Nipple, 2-Year Warranty.

MEASUREMENT
Volumetric flow in filled flow conduits 4" (100 mm) to 138" (3,500 mm) utilizing insertable electromagnetic averaging sensor. Flow indication in English Standard or Metric units.

FLOW MEASUREMENT
Method: Electromagnetic
Accuracy for Forward and Bidirectional Sensors:
Up to ± 0.5% from 1 ft/s to 32 ft/s (0.3 m/s to 10 m/s)
Up to ± 1% from 0.3 ft/s to 1 ft/s (0.1 m/s to 0.3 m/s)
Linearity: 0.3% of Range
Repeatability: 0.2% of Reading
395L sensor: forward flow measurement and reverse flow indication.
394L sensor: bidirectional flow measurement.

POWER REQUIREMENTS
AC: 90-265 VAC / 45-66 Hz (20 W/25 VA) or
DC: 10-35 VDC (21 W)
AC or DC must be specified at time of ordering.

MATERIALS
Fusion bonded epoxy (NSF 61 approved) coated 316 stainless steel
Insertion Hardware: 316 Stainless Steel
Compression Seal: Silicone Rubber
Sensor Electrodes: 316 Stainless Steel

OUTPUTS:
Dual 4-20mA Outputs: Galvanically isolated and fully programmable for zero and full scale (0-21mA)

Four separate digital programmable outputs: open collector transistor usable for pulse, frequency, or alarm settings.

- Volumetric Pulse
- Flow Rate (Frequency)
- Hardware Alarm
- High/Low Flow Alarms
- Empty Pipe
- Directional Indication
- Range Indication

ENGINEERING UNITS
Cubic Meter; Kilo Cubic Foot; Cubic Centimeter; Milliliter; Liter; Cubic Decimeter; Decaliter; Hecaliter; Megaliter; Cubic Inches; American Gallons; Imperial Gallons; Cubic Feet; Standard Barrel; Oil Barrel; Cubic Yard; American Kilogallon; Imperial Kilogallon; Acre Feet; Megagallon; Imperial Megagallon

Coordinate with integrator

Pre-set

ISOLATION
All inputs / outputs are galvanically isolated from power supply up to 500 V

CONDUCTIVITY
Minimum conductivity of 5µS/cm

CONVERTER ENCLOSURE
IP67 Die Cast Aluminum
5.75" H x 5.75" W x 6.69" D
(14.6 cm. H x 14.6 cm. W x 17 cm D)

ELECTRICAL CONNECTIONS
Sensor: Quick-Connect (IP68)
Converter: Compression gland seals for 0.125" to 0.375" diameter round cable.

RATINGS
IP68 Submersible Sensor
IP67 Die Cast Aluminum Converter

CERTIFICATIONS AND APPROVALS
Safety: Listed by CSA to 61010-1: Certified by CSA to UL 61010-1 and CSA C22.2 No.61010-1-04
ISO 9001:2008 certified quality management system
CE: Certified (Converter Only)

ENVIRONMENTAL
Pressure / Temperature Limits:
Sensor: Flow temperate range
14° to 170° F (-10° to 77° C) @ 250 PSI
Sensor is submersible (IP68)
Electronics: Operating and storage temperature:
-4° to 140° F (-20° to 60° C)

SYSTEM OPTIONS FORWARD AND BIDIRECTIONAL

- Hastelloy® Electrodes
- DC Power
- Sun Shield
- Extended Warranties Stainless Steel Valve
- Additional sensor cable up to 180'* (Max 200')
- Extension to hardware clearance
- Annual Verification / Calibration
- Sensor Insertion Tool
- Stainless Steel ID Tag

KEYPAD AND DISPLAY
Can be used to access and change set-up parameters using three membrane keys and an LCD display

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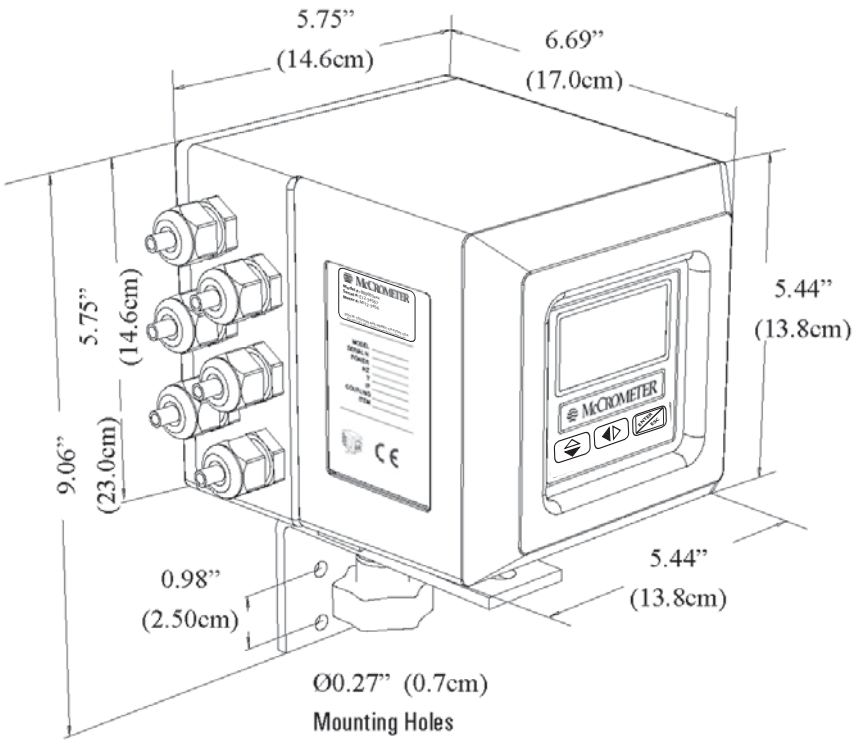
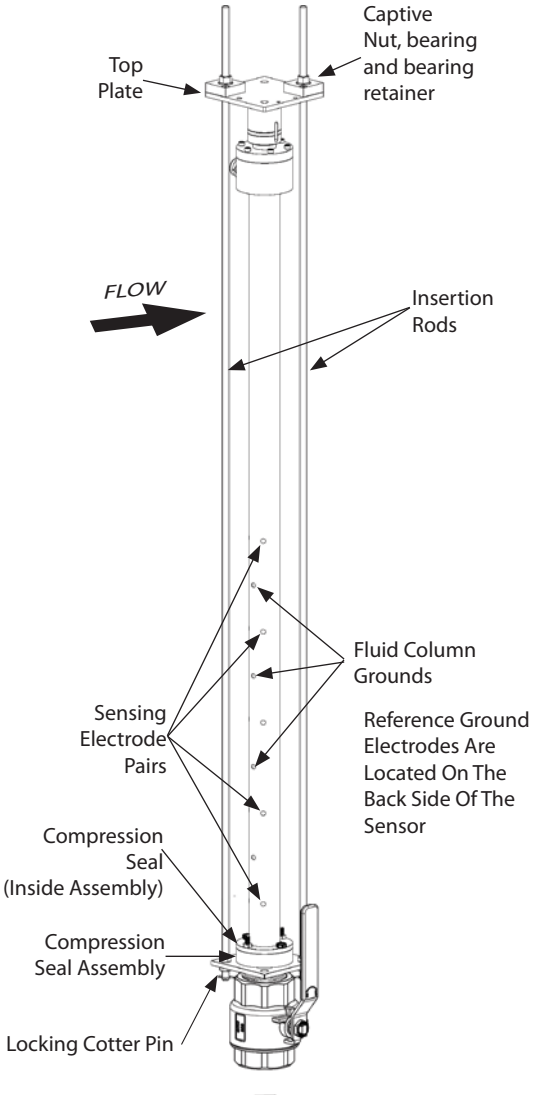
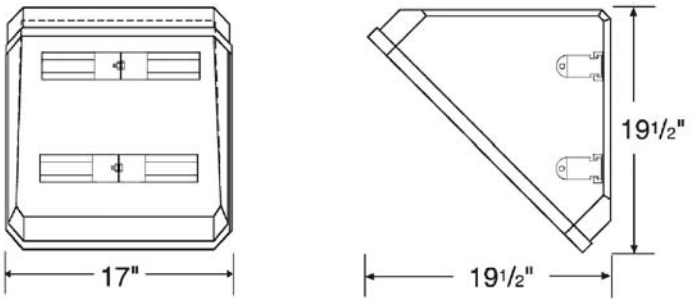


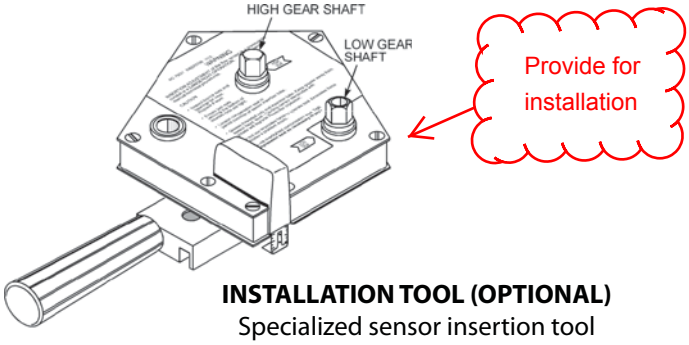
M-SERIES CONVERTER DIMENSIONS



SENSOR ASSEMBLY



SUN SHIELD (OPTIONAL)



INSTALLATION TOOL (OPTIONAL)
Specialized sensor insertion tool used for installation, profiling, and maintenance of the sensor.

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FPI Mag™ Electrical Cable Connections

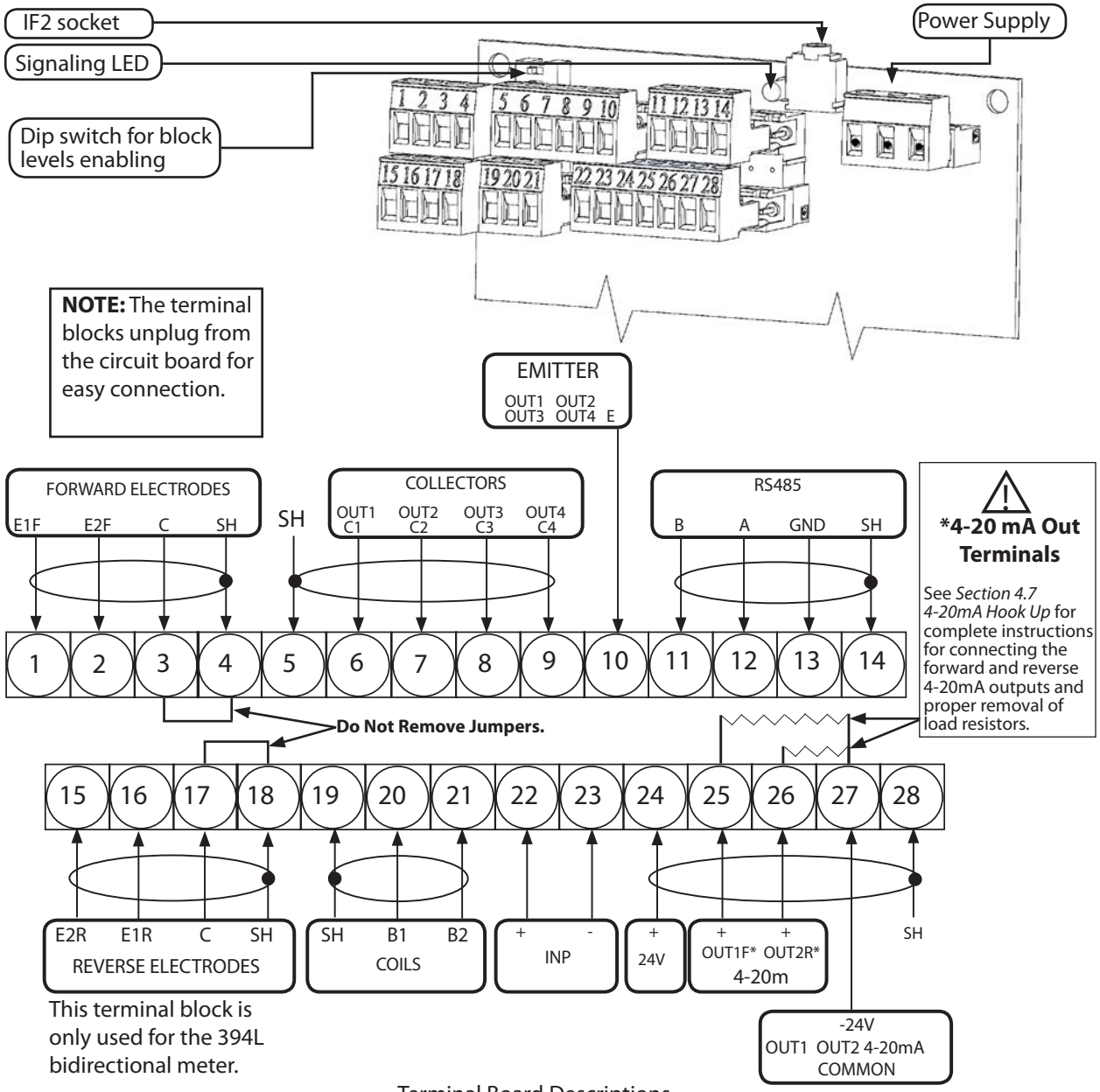
Sensor Electrical Cable Connections

CAUTION - Always disconnect the power cord before attempting any electrical connections.

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

Terminal Board

All connections are made on the terminal board. To access the terminal board, loosen the four screws on the back of the converter to remove the rear cover.



Terminal Board Descriptions

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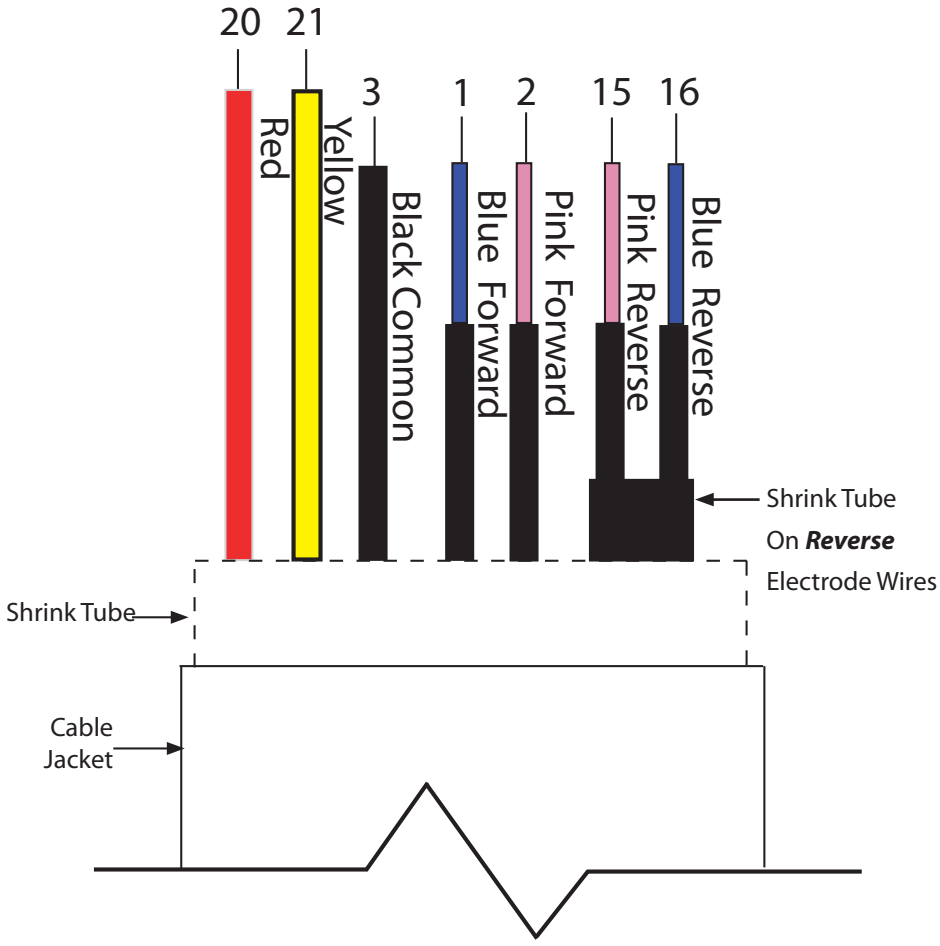
Terminal	Wire Color	Connected To
Chassis Ground Lug*	Purple	Ground
#20 (B1)	Red	Coil
#21 (B2)	Yellow	Coil
#3 (C)	Black	Ground electrodes
#1 (E1F)	Blue	Forward Electrodes 1
#2 (E2F)	Pink	Forward Electrodes 2
#15 (E2R)	Pink (In shrink tube)	Reverse Electrodes 2
#16 (E1R)	Blue (In shrink tube)	Reverse Electrodes 1

Figure 6: Terminal Block M1 Assignments



Sensor Cable Connections

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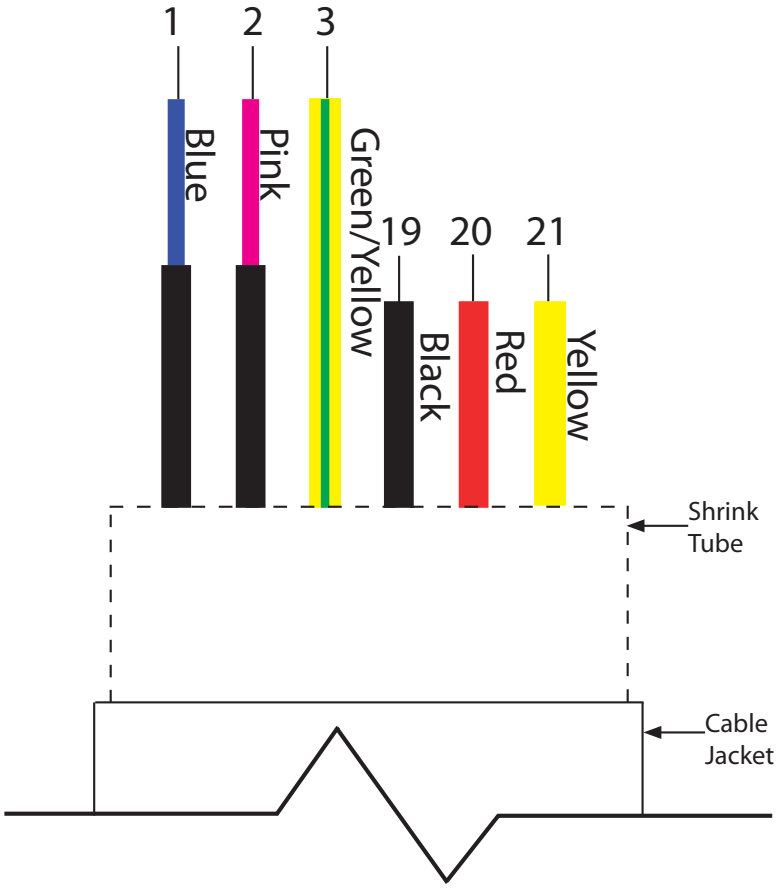
Terminal	Wire Color	Connected To
Chassis Ground Lug*	Purple	Ground
#1 (E1F)	Blue	Right sensing electrodes
#2 (E2F)	Pink	Left sensing electrodes
#3 (C)	Green/Yellow	Ground electrodes
#19 (SH)	Black	Magnet shield / overall cable shield
#20 (B1)	Red	Coil
#21 (B2)	Yellow	Coil

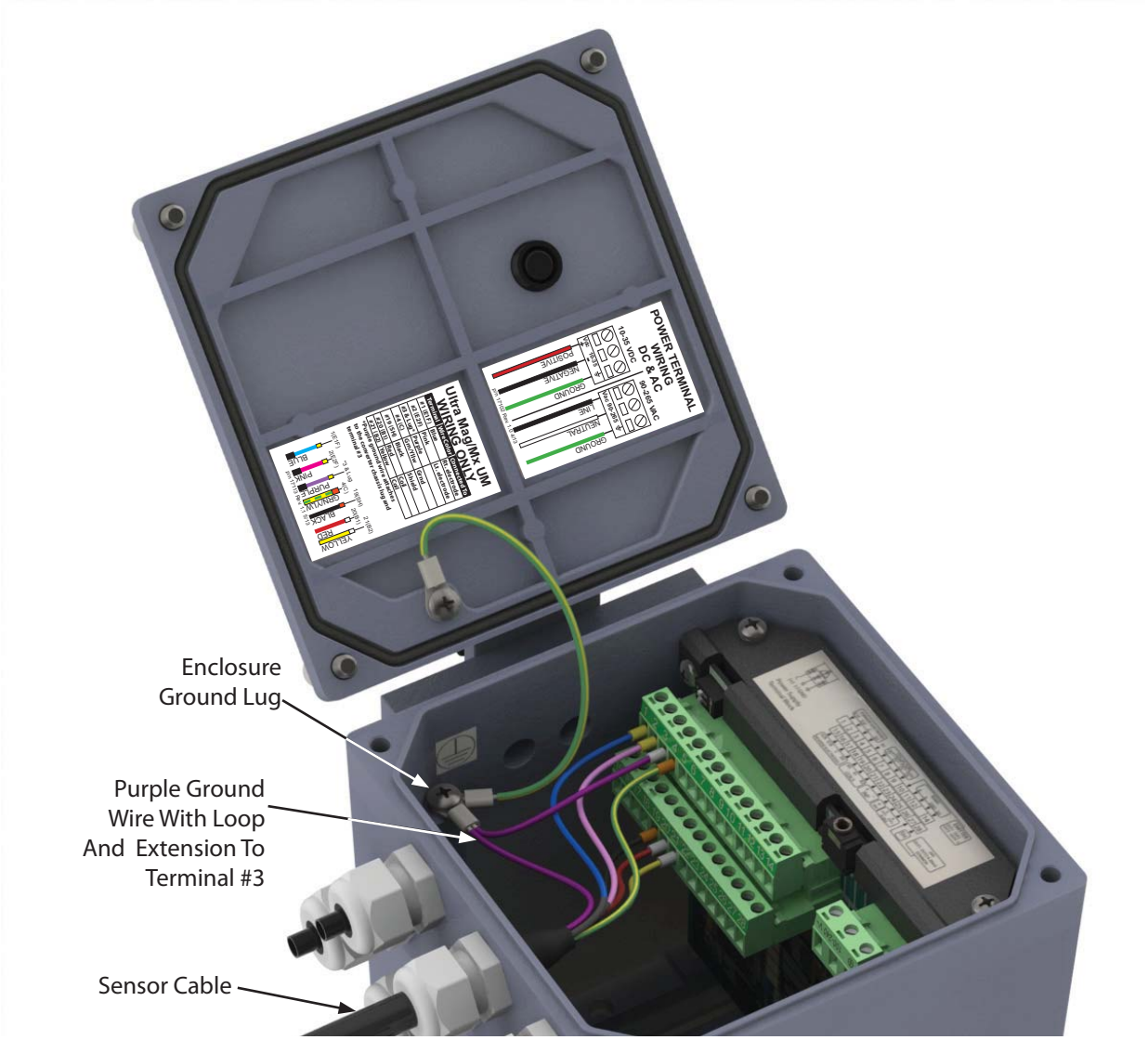
Figure 8: Terminal Block M1 Assignments



Sensor Cable Connections

Ultra Mag And Mx Ultra Mag Converter Grounding

On converters attached to the Ultra Mag or the Mx Ultra Mag flow meters, the sensor cable has a purple ground wire fitted with a loop and a terminal extension . Attach the purple wire to the enclosure's ground terminal lug as shown in *Figure 14* via the wire end loop, then connect the wire extension to Terminal #3.



UM And Mx UM Converter Grounding

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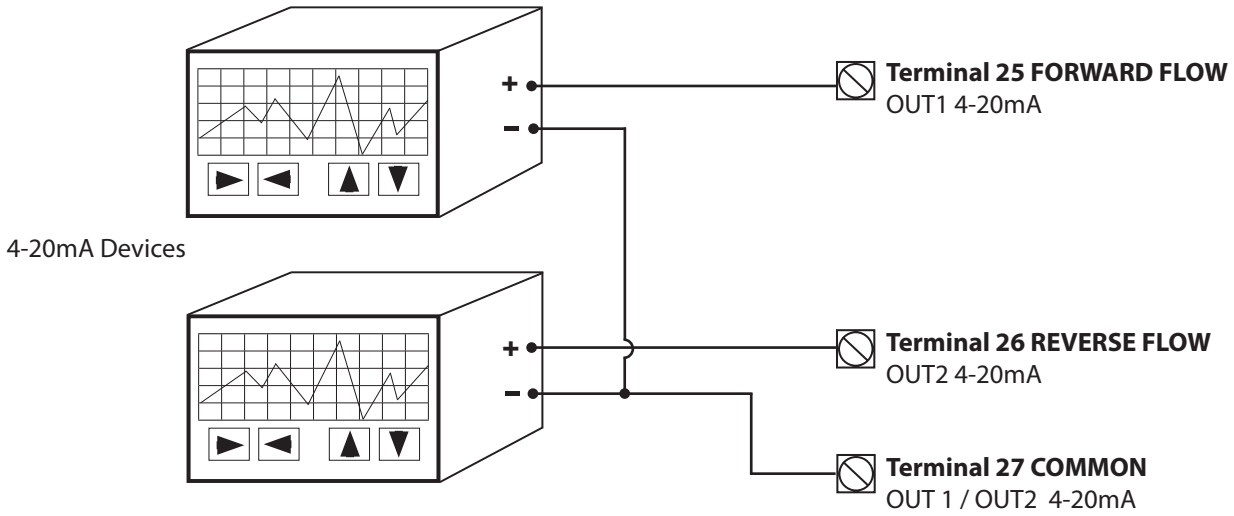
4-20mA Hook-Up

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 (*See Section 8.4.6*). 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 25 & 27 and/or 26 & 27 before attaching 4-20mA cables.

FORWARD FLOW: Remove the resistor from terminals 25 and 27.

REVERSE FLOW: Remove the resistor from terminals 26 and 27.

See *Section 4.2 Terminal Board, Figure 5*.

Figure 15: 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 x 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.

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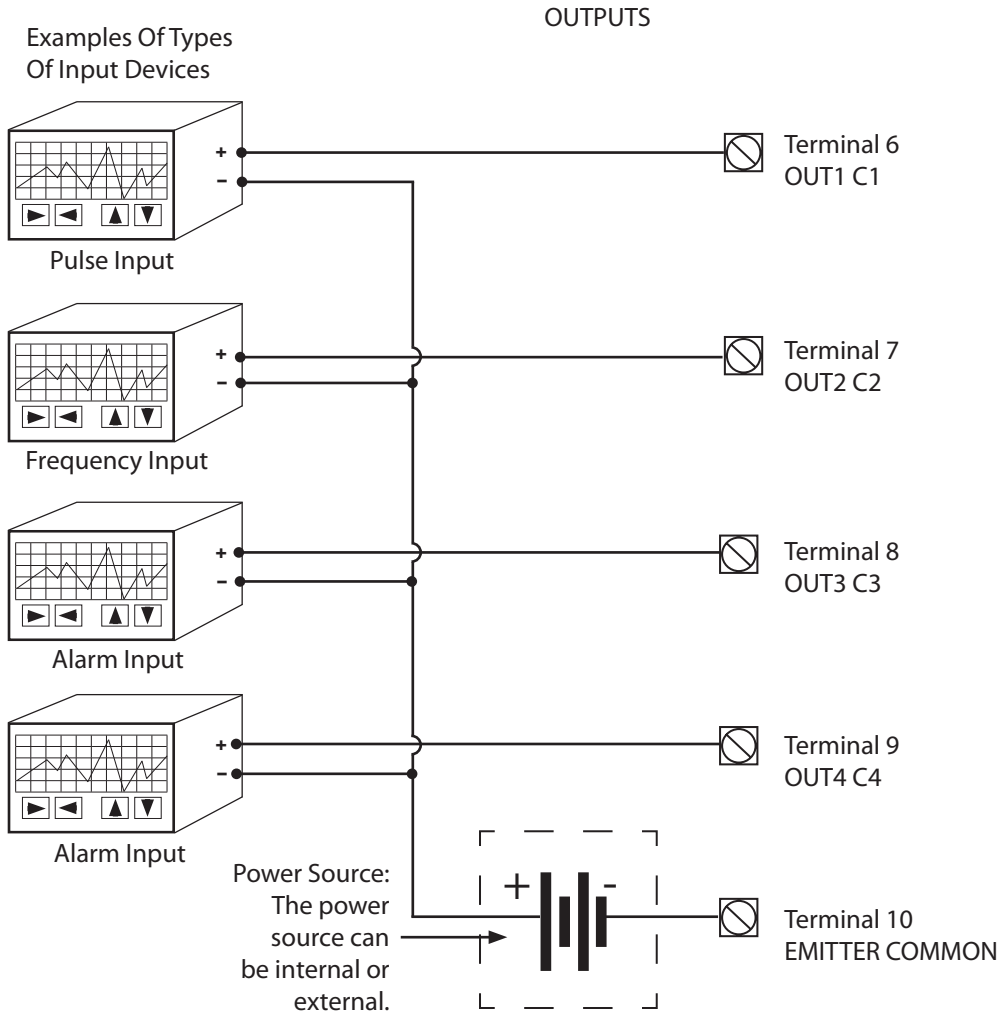
Opto-Isolated Pulse Output Hook-Up

The four outputs are open collector transistor outputs used to communicate with or activate external devices when the flow reaches a predetermined set point.

- 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, RL=470Ω, VOUT=24VDC): 1250Hz
- Maximum reverse current bearable on the input during an accidental polarity reversion (VEC): 100mA
- Insulation from other secondary circuits: 500 V

A common application of outputs should be connected as follows:



IMPORTANT

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

Opto-Isolated Pulse Output Diagram

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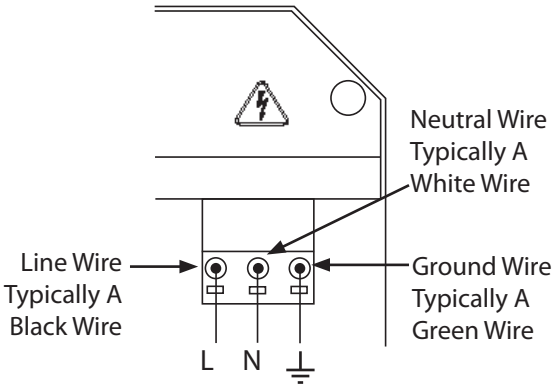
Converter Power Hook-Up

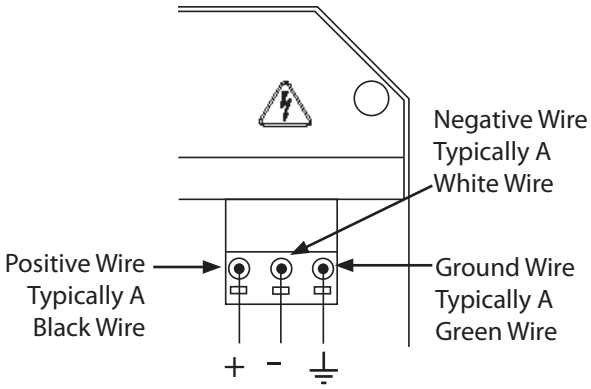
WARNING!! Hazardous supply voltage can shock, burn, or cause death.

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 uplugs 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 90-265VAC, 44-66Hz at maximum 20W. DC converter is available as an option.



AC Power Supply Terminal Block



Optional DC Power Supply Terminal Block

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TO BE COMPLETED BY CUSTOMER AT TIME OF APPROVAL

McCROMETER

FPI Mag™

SPECIFICATION DATA SHEET

NOTE: Custom sensors cannot be manufactured without this information

Model 395L

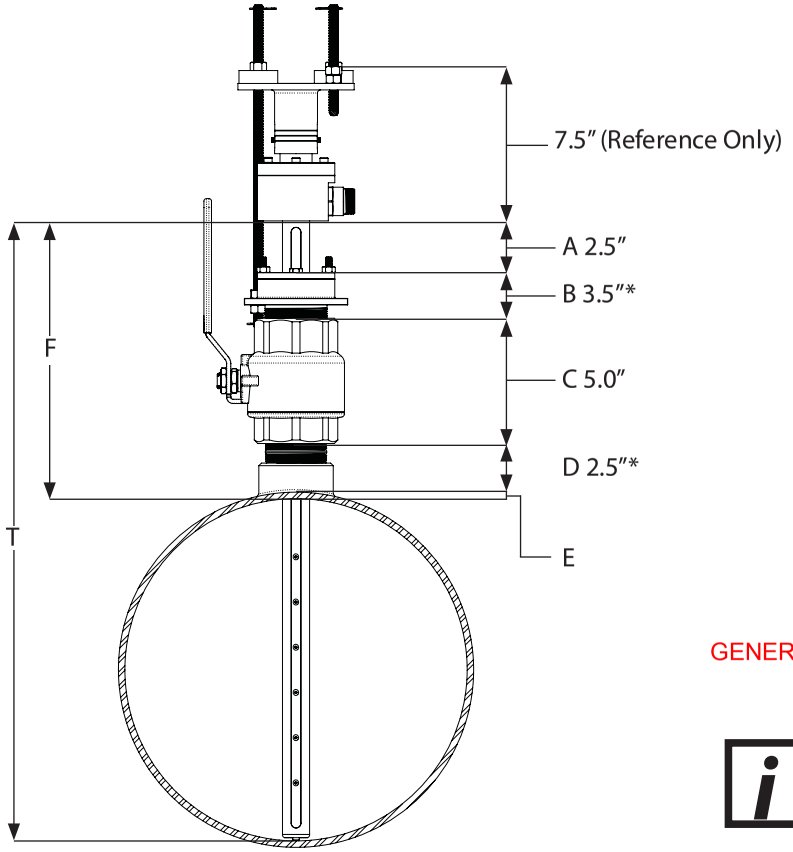
Current Date:	
End User	N-CORPE
Customer Contact	JASPER FANNING
Rep Name	
Site Name (Ex. Well #1)	MEDICINE CREEK DISCHARGE
Application (Ex. Well output)	DISCHARGE FLOW
Metered Fluid (Ex. Raw Water)	GROUND WATER
Model	☐ 395LC - Forward ☐ 394LC Bidirectional
Converter Power	☐ 90-265 VAC ☐ 10-35 VDC
Sensor Cable Length in Feet	

Date received by McCrometer:	
Maximum Flow (Ex: 2500 GPM)	37,500 gpm
Minimum Flow (Ex: 100 GPM)	1,000 gpm
Average Flow (Ex: 1500 GPM)	
Full Scale (Ex: 2500 GPM)	40,000 gpm
Maximum Line Pressure (250 PSI)	125 PSI
Maximum Temperature (170°F)	120°F

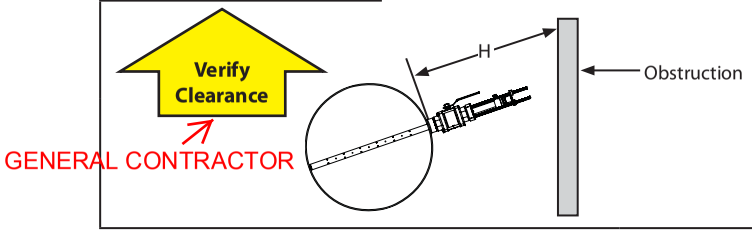
Authorized Customer Signature:_____

The above signature authorizes McCrometer to rely upon the provided specifications.

GENERAL CONTRACTOR VERIFY



A	2.5	Critical Spacing (Standard 2.5")
B		Compression Seal Height (*ID > 25" = 3.5" | ID < 25" = 1.5")
C	5.0	Valve Height (McCrometer Supplied Bronze or SS = 5.0")
D	2.5*	Nipple And Coupling/Saddle Height (*McCrometer Supplied Close Nipple is 1.0"; Industry Standard Coupling or Saddle Default = 1.5", OR Customer Supplied Dimension)
E	1.0	Pipe Wall Thickness - Default 1.0", OR Customer Supplied Dimension
F		F = A + B + C + D + E
ID		Inside Pipe Diameter (Not Nominal Pipe Size)
T		T = Total Sensor Length — T = F + ID
H		Calculated Distance When Close to an Obstruction

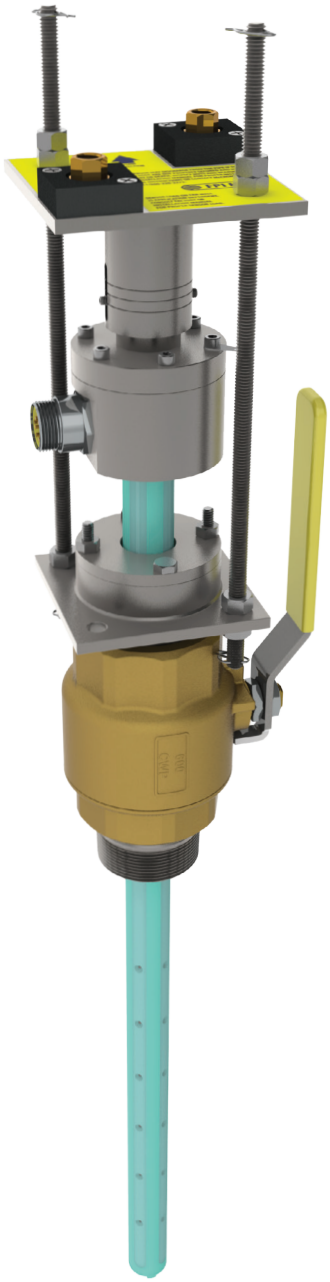


IMPORTANT: Distance H must be at least one sensor length T + C + D + 18"

H = T + C + D + 18"

IMPORTANT: The MINIMUM inside diameter for the installation valve and pipe cut-out to avoid damage to the sensor is 1-7/8" (48mm).

FPI Mag™



Full Profile Insertion Electromagnetic Flow Meter Models 394L & 395L

Sensor Installation, Operation and Maintenance Manual

30120-48 Rev. 1.4
August, 2013

McCROMETER

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- Safety Warnings i

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- 1.2 Shipping Contents 1
- 1.2 Tools 2

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FPI Mag™

SAFETY

Safety Symbols And Warnings

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.

Safety Warnings

When installing, operating, and maintaining McCrometer 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. Specific requirements can be found in the OSHA section of the Code of Federal Regulations: *29 CFR, 1910.132 - 1910.140, Personal Protective Equipment; CFR Title 29, Part 1910.146, Permit-Required Confined-Spaces; and 29 CFR, 1910.1030, Bloodborne Pathogens.*

WARNING!
Incorrect installation or removal of FPI 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.

1.0 FPI Mag™ FULL PROFILE INSERTION FLOW METER

1.1 Instrument Overview

The FPI Mag™ (Full Profile Insertion) flow meter provides accurate flow measurement for full-pipe clean water applications. The electromagnetic *sensor* automatically senses and corrects for shifting velocity in the pipe by constantly obtaining an area weighted mean velocity. Model 394L is a forward and reverse flow measurement *sensor*, and the 395L is a forward only flow measurement *sensor*. The instrument has all of the features needed to suit a wide variety of applications.

The flow meter is comprised of the innovative FPI Mag *sensor* (*item #1 below*) and a *converter* (*item #4 below*). For *converter* installation instructions, see the manual provided for the *converter* purchased with your system.

The *sensor* is easily installed without service interruption, and requires no site calibration. Installation without service interruption can be done only when adhering to safe hot-tapping procedures, or in locations already fitted with an appropriate full port ball valve, corporation stop or gate valve.

1.2 Shipping Contents

Upon receiving the meter, unpack the contents of the shipping box and verify that the following items are included:

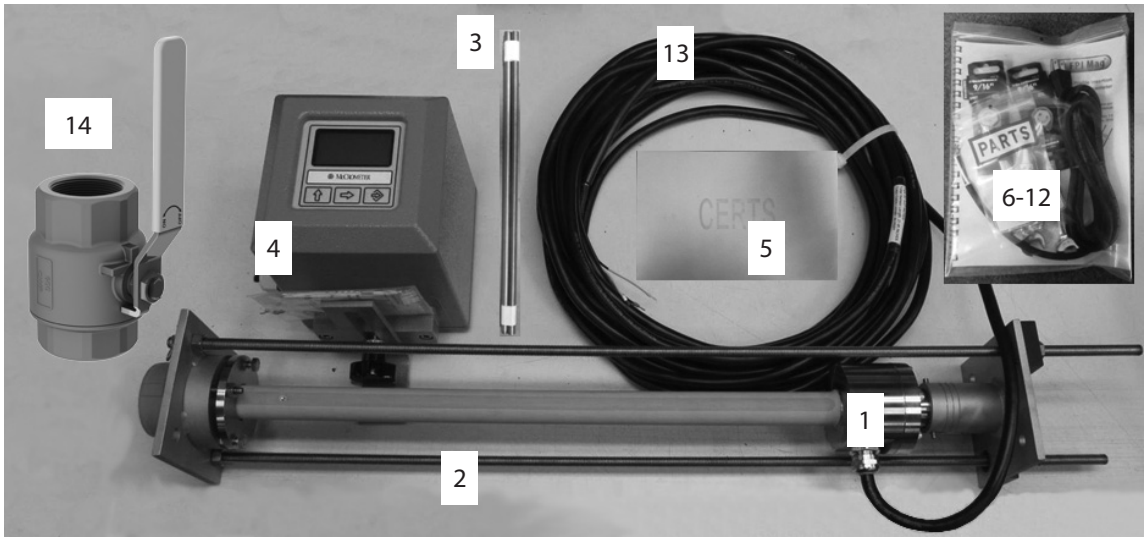

Figure 1: Shipping Box Contents

Item #	Qty.	Description
1	1	FPI Mag *Sensor*
2	2	Long threaded retaining rods
3	2	Short threaded retaining rods
4	1	Converter (M Series or L Series)
5	1	Calibration Certificate
6	1	FPI Mag Installation Operation and Maintenance Manual
7	1	Converter Installation Operation and maintenance Manual

Item #	Qty.	Description
8	2	9/16" or 3/4" reversible ratchet wrench
9	1	Pipe thread sealant
10	8	Hex nut (3/8" or 1/2")
11	4	Locking cotter pin
12	1	Power cord (8', 115 VAC)
13	1	*Sensor* cable with Quick-Connect
14	1	Bronze ball valve & SS nipple

NOTE: If any of the above-listed items are not present, contact the factory before continuing with installation.

1.3 Tools

Tools provided:

Two - 9/16" or 3/4" reversible ratchet wrenches. (Size is dependent on the size of the retaining rods supplied with the *sensor* and determined at the time of order.)

1 - tube of pipe thread sealant

Tools recommended for installation:

1 - Pipe wrench capable of a 4" span

1 - 7/16" wrench or crescent wrench

1 - Sensor Insertion Tool (3/8" Part Number 75031 or 1/2" Part Number 75032)

IMPORTANT
It is recommended that the Sensor Insertion Tool be used for easier and faster installation. *See STEP 12.*

2.0 INSTALLATION

Please read the entire manual before installing the FPI Mag *sensor*. Due to size and pressure requirements determined at the time of order, certain FPI Mag *sensor*s are equipped with more robust 1/2" threaded rods, a heavy spring, a larger top plate and a compression assembly designed to accept the larger insertion rods. For these installations, please replace all references to 3/8" rods and nuts with 1/2". The standard *sensor* size is 1.25". In some smaller applications the FPI Mag may use the smaller 0.75" *sensor*.

STEP 1: Verify Flow Meter Serial Numbers

The FPI Mag flow meter is comprised of two primary components: the *sensor* and the *converter*. The *converter* and *sensor* are supplied as a custom calibrated matched system. Verify the system 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* body on a silver label. An example is shown below.

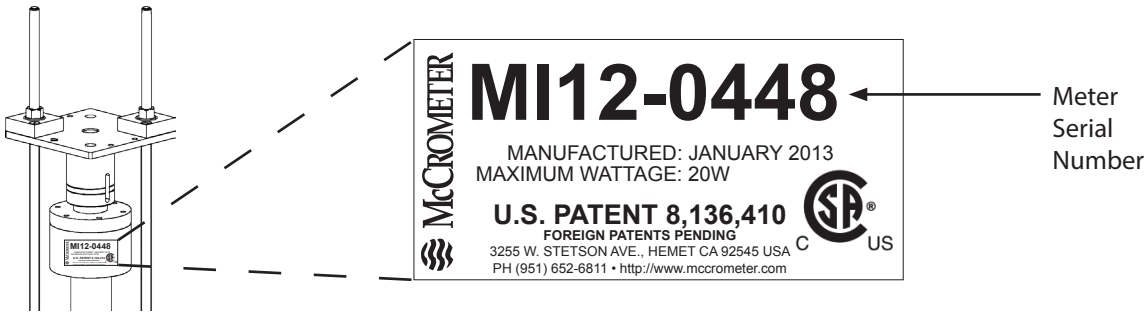

Figure 2: Sensor Serial Number Tag

The tag on the side of the *converter* has the *converter* Model Number, the Converter Serial Number and the Meter Serial Number. An example is shown below.

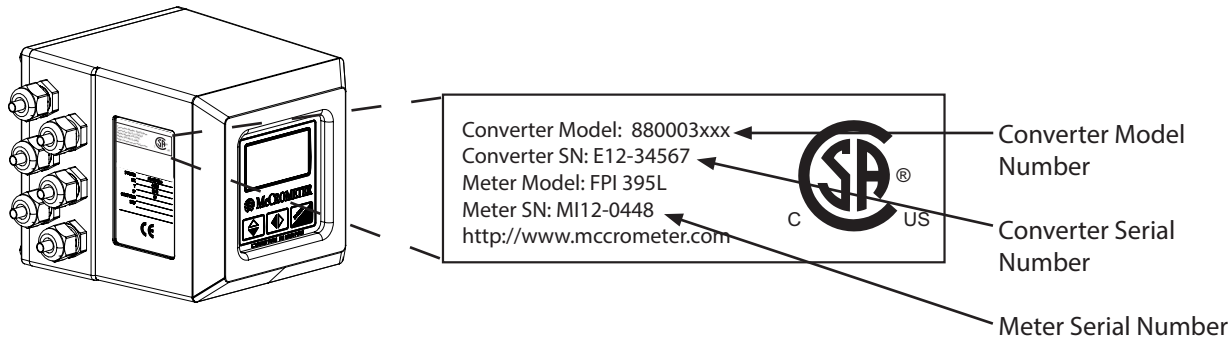

Figure 3: Converter Serial Number Tag

IMPORTANT: Verify the meter serial numbers on both the *converter* and *sensor* match. If the Meter Serial Numbers do not match, contact the factory before continuing with the installation.

2.0 INSTALLATION - Continued

STEP 2: Identify Sensor Parts

This manual refers to the part names of the *sensor*. It is important to be familiar with the parts and their names when following the installation instructions.

The chart below corresponds to the graphic in *Figure 4*.

Diagram Number	Description	Part Number
1	Top Plate for use with 3/8" retaining rods	MIM043
1	Top Plate for use with 1/2" retaining rods	MIM053
2	Sensor Assembly	Contact Factory
3	Set screw (2 ea.)	920001001
4	Spring	920000901
4	Heavy Spring	920000903
5	2" Bronze Full Port Ball Valve with SS Nipple (Min. 1 7/8" dia. port)	430552-2
6	Compression Seal (3/4" sensor)	MIM017-1
6	Compression Seal (1 -1/4" sensor)	MIM012-1
7	Compression Seal Assembly	Contact Factory
8	3/8" SS Long Threaded Rods (2 ea.)	64006
8	1/2" High Strength SS Long Threaded Rods (2 ea.)	X6743
9	3/8" SS Short Threaded Rods (2 ea.)	64006
9	1/2" High Strength SS Short Threaded Rods (2 ea.)	X6743
10	3/8" SS Nut (8 ea.)	93007
10	1/2" SS Nut (8 ea.)	10755
11	Locking Cotter Pin	921000701
12	Captive Nut	42226
12	Captive Nut Bearing Retainer	42225
12	Captive Nut Bearing	92121

2.0 INSTALLATION - Continued

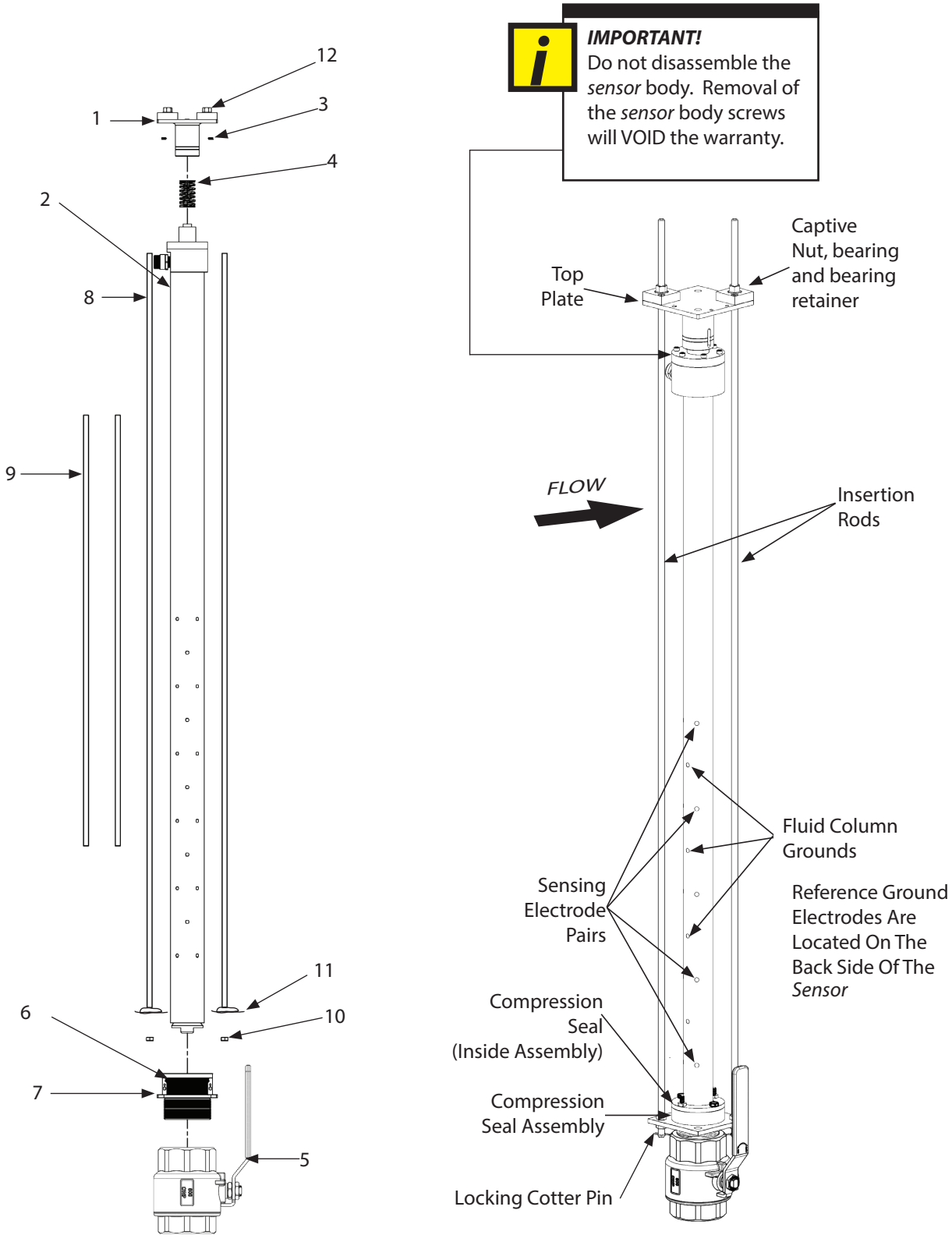

Figure 4: Parts Diagrams

FPI Mag™

2.0 INSTALLATION - Continued

STEP 3: Verify Information On Cable Tags

The *converter* cable has two tags located near where the cable enters the *converter*. Verify the following information is consistent with the specifications provided at the time of order:

- Meter Serial Number
- Pipe I.D. (inches and millimeters)
- KA Factor
- Total Sensor Length
- Total Cable Length

STEP 4: Detach The Cable Quick Connect

The *sensor* cable is fitted with an IP68 rated Quick Connect fitting at the *sensor* connection. For ease of installation, remove the cable from the *sensor* and set aside.

IMPORTANT: When the Quick-Connect cable connection is not attached to the *sensor*, ensure that the threaded caps are attached to the *sensor* connection and the cable connection to keep the wire connectors free of dirt and corrosion. When the cable is connected to the *sensor*, connect the end caps together to keep their interior free from dirt and corrosion.

Figure 5: Sensor cable Quick Connect Fitting With End Caps

2.0 INSTALLATION - Continued

STEP 5: Verify Sensor Installation Location - Upstream And Downstream Straight-Pipe Run Recommendations

Flow disturbers such as partially open valves cause flow disturbances that can adversely affect flow meter accuracy. The table below provides suggestions for the placement of the FPI Mag *sensor* upstream and downstream of common flow disturbers to meet specification accuracy. The upstream and downstream straight-pipe recommendations are conservative, based on research completed in the McCrometer NIST traceable calibration facility. In many cases, the installation distances suggested below can be shortened depending on flow conditions and piping layout.

Flow Disturbance:	***Installation Requirements for Specification Accuracy***					
	Upstream Disturbance			***Downstream Disturbance***		
	High Flow (>8 FPS)	*Mid Flow*	*Low Flow (<2 FPS)*	*High Flow (>8 FPS)*	*Mid Flow*	*Low Flow (<2 FPS)*
Butterfly Valves:***						
Parallel (Coplanar) 100% Open	5 Diameters	2 Diameters	2 Diameters	1 Diameter Min.		
<100% Open	*Not Recommended**	*Not Recommended**	*Not Recommended**			
Perpendicular: 100% Open	5 Diameters	2 Diameters	2 Diameters			
<100% Open	*Not Recommended**	*Not Recommended**	*Not Recommended**			
Gate Valves:*						
100% Open	No Restriction	No Restriction	No Restriction	1 Diameter Min.		
<100% Open	*Not Recommended**	*Not Recommended**	*Not Recommended**			
Elbows:						
Parallel (Coplanar)	5 Diameters	3 Diameters	2 Diameters	2 Diameters	2 Diameters	1 Diameter
Perpendicular	10 Diameters	5 Diameters	3 Diameters	2 Diameters	2 Diameters	1 Diameter
"T" Fitting						
Parallel (Coplanar)	5 Diameters	3 Diameters	2 Diameters	2 Diameters	2 Diameters	1 Diameter
Perpendicular	10 Diameters	5 Diameters	2 Diameters	2 Diameters	2 Diameters	1 Diameter

* McCrometer recommends that any upstream valves within 20 diameters be maintained at 100% open, and that any flow controlling valves be located downstream of the meter location.

Notes:

1. Recommendations given for high, mid, and low flow cases. Flows between can be inferred from data above.

2. The suggestions above are conservative, based on research completed in the McCrometer flowlab facility. In many cases, the installation distances required can be shortened, depending on flow conditions and piping layout. The McCrometer Applications Team is available to review any installation desired by the customer.

3. The table above is not inclusive of each possible installation scenario for the McCrometer FPI. For installations not included in the table, the McCrometer Applications Team is available to review cases and make a determination as to the viability of the installation. Please feel free to contact us with any questions or concerns.

4. The McCrometer Applications Team is available to review any installation for a placement recommendation, including installations not in the above table. Please feel free to contact the factory at 951-652-6811 with any questions or concerns.

2.0 INSTALLATION - Continued

STEP 6: Verify Sufficient Sensor Clearance From Obstructions

The *sensor* installation hardware will protrude from the pipe during installation and when installed requiring sufficient clearance (distance H, the required installation clearance, in *Figure 6* below) from any obstruction. This distance accounts for the length of the *sensor*, the distance from the outer pipe wall to the top of the valve plus: 18" is recommended; 12" is the minimum.

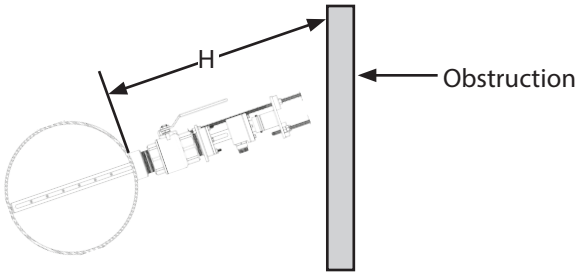

Figure 6: *Sensor* Clearance Distance

Line Size (Inches)	Distance H		
		22"	67"
		24"	67"
4"	51"	30"	71.25"
6"	51"	36"	77.25"
8"	55"	42"	83.25"
10"	55"	48"	89.25"
12"	59"	54"	95.25"
14"	59"	60"	101.25"
16"	59"	66"	107.25"
18"	63"	72"	113.25"
20"	63"	78"-138"	Call Factory

STEP 7: Pipe Valve Installation

WARNING!
Pressurized pipes should only be hot tapped, cut, or drilled by qualified personnel using high quality saddles, valves and stainless steel nipples. If possible, depressurize the pipe before attempting any installation.

The *sensor* comes standard with a 2" bronze ball valve and a 2" x close stainless steel nipple. The 2" x close stainless steel nipple is to be used if the installation site has a female fitting, i.e., a welded coupling. If the installation site has a male fitting, i.e. a 2" nipple, then the supplied 2" x close stainless steel nipple is not required for the *sensor* installation.

Use the supplied pipe sealant or Teflon thread tape when installing the valve onto the pipe.

NOTE: If using an existing valve or corporation stop insure it has a minimum port inside diameter of 1-7/8" (48mm), and a 2" (50mm) NPT female pipe thread output for the *sensor*. Insure that the existing valve and nipple are of high quality.

The valve can be installed onto a welded coupling or pipe saddle. *See Figure 7*. Alternative ball valve or corporation stop sizes may be used or required. Consult factory for alternative configurations.

IMPORTANT: The MINIMUM port inside diameter for all installation valves is 1-7/8" (48mm).

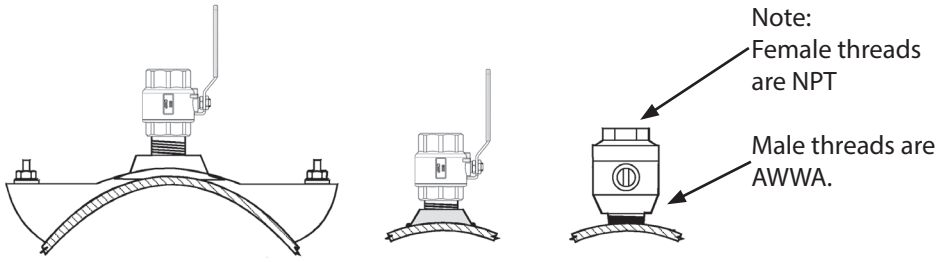

Figure 7: Installation Valve Options

FPI Mag™

2.0 INSTALLATION - Continued

STEP 8: Optional Compression Seal Disassembly For Installation Of Large Sensors

The *sensor* assembly can be installed onto the pipe valve as a whole unit. On larger pipe size installations this can be cumbersome or impractical. In such cases the compression seal assembly can be removed from the *sensor* for easier installation onto the pipe valve. Once the compression seal assembly is installed onto the pipe valve, then the *sensor* can be re-installed into the compression seal assembly.

NOTE: if this step is skipped, proceed to STEP 9.

The following steps describe the separation of the *sensor*, *top-plate* and *retaining rods* from the *compression seal assembly*.

1. The *compression seal* has two bolts and two studs with nuts. Loosen the bolts and nuts on the *compression seal* relieving the pressure on the *compression seal*. DO NOT REMOVE THE BOLTS OR NUTS.

2. On the *compression seal assembly*, remove the locking cotter pins from the bottom of the two *retaining rods* under the 3/8" or 1/2" nuts.

3. Remove the lower 3/8" or 1/2" nuts from the retaining rods.

4. Slide the *sensor* out of the compression seal. The retaining rods will also slide out of the *compression seal assembly*. Carefully set the *sensor* and attached hardware to the side.

5. At this point the compression seal assembly can be installed onto the valve.

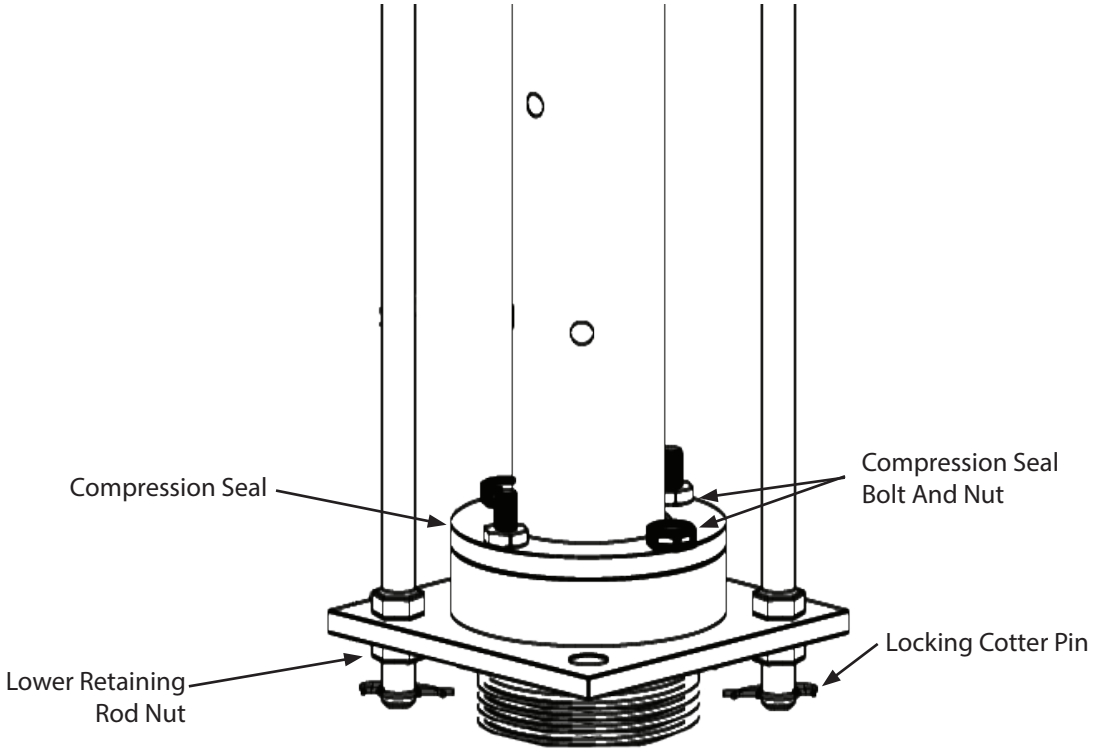

Figure 8: Compression Seal Removal

2.0 INSTALLATION - Continued

STEP 9: Sensor Installation Onto Pipe Valve

The *sensor* assembly uses a compression seal, which keeps the *sensor* watertight when the pipe is under pressure. Care must be taken when installing the *sensor* to avoid leaks. Follow the steps below to install the *sensor* onto the pipe valve:

1. Put a generous amount of the supplied pipe sealant on the compression seal threads. Teflon tape may also be used.

IMPORTANT
If pipe sealant gets on the *sensor* electrodes the velocity signal may be lost. Use care when applying the sealant to the compression seal threads.

2. Place the compression seal threads over the pipe valve. Turn the entire *sensor* assembly clockwise to secure the assembly to the valve. A large pipe wrench can be used to grip the bottom plate of the compression seal to tighten the assembly into the pipe valve.

3. The seal is secure when a large amount of force is required to turn the assembly.

4. The sides of the bottom plate should be parallel with the pipe.

5. Locate the flow direction arrow on the top plate and align it with the direction of the flow in the pipe.

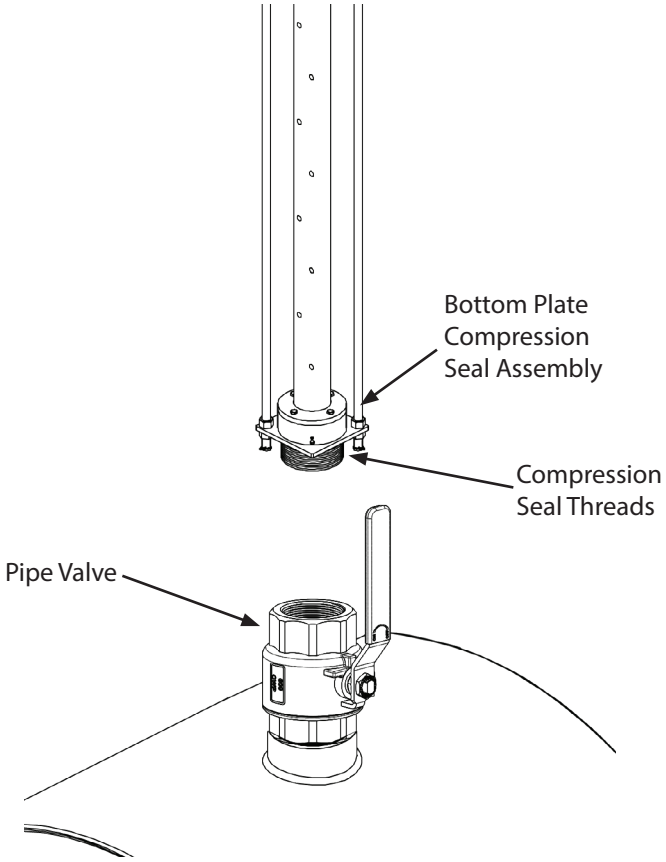

Figure 9: *Sensor* Installation

2.0 INSTALLATION - Continued

STEP 10: Sensor Re-assembly After Optional Compression Seal Assembly Installation

NOTE: use this step if you removed the *compression seal assembly* (STEP 8) and installed it onto the pipe valve separate from the *sensor*. If you installed the sensor without disassembling it, proceed to the next step.

After the compression seal has been installed onto the pipe valve, follow the steps below to reassemble the *sensor* into the compression seal assembly:

1. Apply water to the interior surface of the rubber seal gland. This will act as a lubricant to facilitate the insertion of the *sensor* and ensure its proper axial loading.

2. Insert the *sensor* into the compression seal in the bottom plate while inserting the two retaining rods into their respective holes in the bottom plate and secure with one 3/8" or 1/2" nut above and one below the bottom plate.

3. Ensure the two nuts above and below the compression seal assembly are sufficiently tightened to prevent the threaded rod from rotating.

4. Insert the locking cotter pins through the small holes in the bottom of the retaining rods, just below the bottom 3/8" or 1/2" nuts.

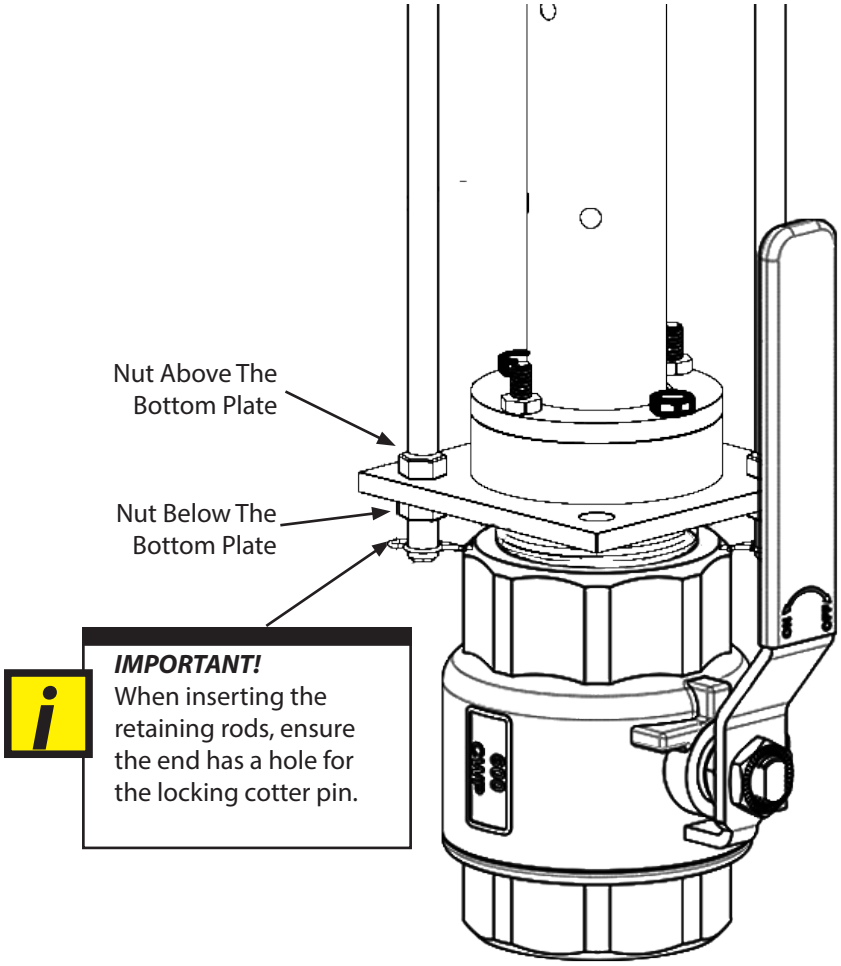

Figure 10: Compression Seal Reassembly

2.0 INSTALLATION - Continued

STEP 11: Inserting The Sensor

The *sensor* can be installed while the line is under flowing conditions. The line water velocity should be as low as possible to prevent *sensor* vibration during the insertion process. The velocity must be under 5 ft/s.

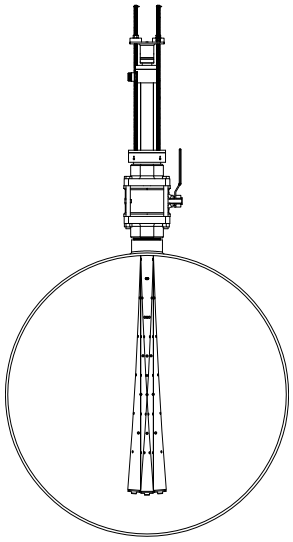

Figure 11: Sensor Vibration

WARNING!
The *compression seal/sensor* assembly may be under pressure. Serious injury may result if proper procedures are not followed. Do not attempt to install the *sensor* without the retaining rods fully assembled.

WARNING!
If the meter was disassembled to assist in the installation of the compression seal assembly onto the valve (STEPS 8 and 10) it is important to ensure that the meter is properly reassembled with both retaining rods completely installed with the 3/8" or 1/2" nuts properly tightened.

Follow the steps below to insert the *sensor* into the pipe.

1. Hand tighten the *compression seal* bolts and nuts. DO NOT FULLY TIGHTEN THE COMPRESSION SEAL BOLTS AND NUTS.

2. If the *sensor* is being installed under flowing conditions follow this step. If not, proceed to the next step. Barely crack open the valve to allow a little water into the compression seal assembly. Some water will leak from the compressions seal. Lightly tighten compression seal bolts and nuts as required to minimize the amount of water exiting the compression seal. A towel draped around the compression seal can reduce spray if necessary.

3. **Open the valve completely.** Failure to open the valve completely will cause the valve to scrape the *sensor* during insertions and may result in permanent damage to the *sensor*.

4. Insert the *sensor* into the pipe by *simultaneously* rotating the two captive nuts on the top plate clockwise (*See Figure 12*) with the provided 9/16" ratchet wrenches or the Sensor Insertion Tool (*See STEP 12*) until the foot of the *sensor* reaches the far wall of the pipe and the load spring starts to compress. Compression of the load spring is indicated by the movement of the set screw on the top plate. *See STEP 13*.

IMPORTANT
It is recommended that the Sensor Insertion Tool be used to rotate the captive nuts to ensure the top plate compresses evenly. *See STEP 12.*

2.0 INSTALLATION - Continued

IMPORTANT
If the captive nuts are not tightened simultaneously, the top plate will become crooked and cause the *sensor* to be inserted at an angle and may cause permanent damage to the *sensor*.

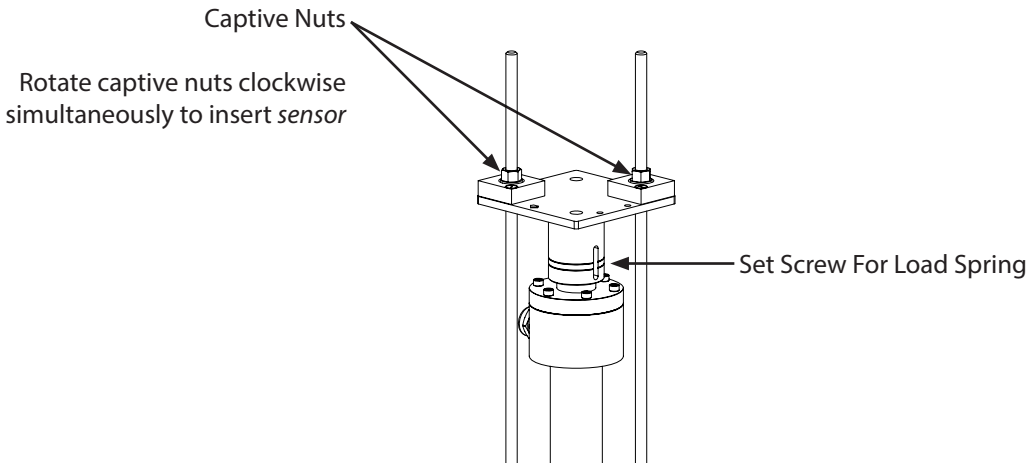

Figure 12: Captive Nuts

NOTE
If the short retaining rods are not used (see *STEP 14)*, run a 3/8" or 1/2" nut down against each captive nut to prevent the captive nut from rotating.

STEP 12: Using The Sensor Insertion Tool - Optional

McCrometer recommends using a Sensor Insertion Tool (P/N 75031 for 3/8" rods, and P/N 75032 for 1/2" rods) to help with inserting the *sensor* and to avoid any damage to the *sensor*.

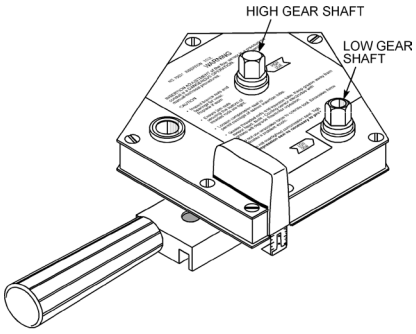

Figure 13: Insertion Tool

Follow the steps below to use the Sensor Insertion Tool:

1. Place the Sensor Insertion Tool over the retaining rods and slide the retaining rods through the holes in the tool until it sits over the captive nuts.

2. Lock it into place with spring locks located on the bottom of the tool.

3. Using the provided wrench rotate the high gear shaft clockwise until the bottom of the *sensor* reaches the far wall of the pipe as indicated in STEP 11. The low gear shaft is used to apply pressure to the *sensor* once the *sensor* has reached the far wall of the pipe. *See STEP 13.*

IMPORTANT
Large line size meters or applications with high pressure may use 1/2" retaining rods. When ordering the Sensor Insertion Tool specify the size required. (P/N 75031 for 3/8" or P/N 75032 for 1/2")

2.0 INSTALLATION - Continued

STEP 13: Applying A Compression Load To The Sensor

A compression load is required to be applied at the top of the *sensor* forcing the bottom of the *sensor* to seat firmly against the far wall of the pipe. The amount of load is indicated by the three lines etched into the top plate and the location of the set screw relative to the lines. *See Figure 14* and the table below.

Set Screw Location	Compression Load	Recommended Use
At the lowest line	300 lbs.	Low pressure plastic pipes
Between the lowest line and the middle line	450 lbs.	Low pressure metal pipes
Between the top line and the middle line	**Consult Factory**	Applications other than low pressure. **Consult factory before applying a compression load greater than 450 lbs.**

For applications other than low pressure the *sensor* load should be increased. Consult factory for the appropriate loading for your application before applying a compression load greater than 450 lbs.

Follow the steps below to apply a compression load to the *sensor*:

1. Rotate the two captive nuts on the top plate simultaneously and evenly until the proper load is indicated by the set screw's relationship to the lines etched on the top plate. *See Figure 14*.

IMPORTANT
If using the Insertion Tool, rotate the two captive nuts using only the **low** gear shaft until the proper load is indicated. DO NOT use the high gears on the insertion tool as this may create too much load too fast and damage the *sensor* or the pipe.

2. Tighten the compression seal bolts and nuts just enough to stop any leaking from the seal. *See Figure 15*.

IMPORTANT
Do not overtighten the compression seal as it may cause damage to the seal itself.

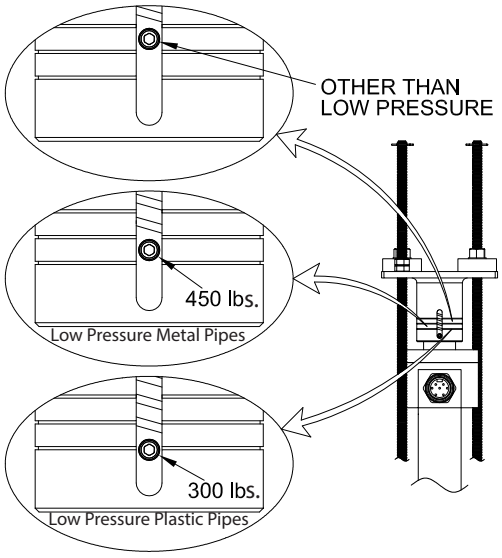

Figure 14: *Sensor* Load Indicators

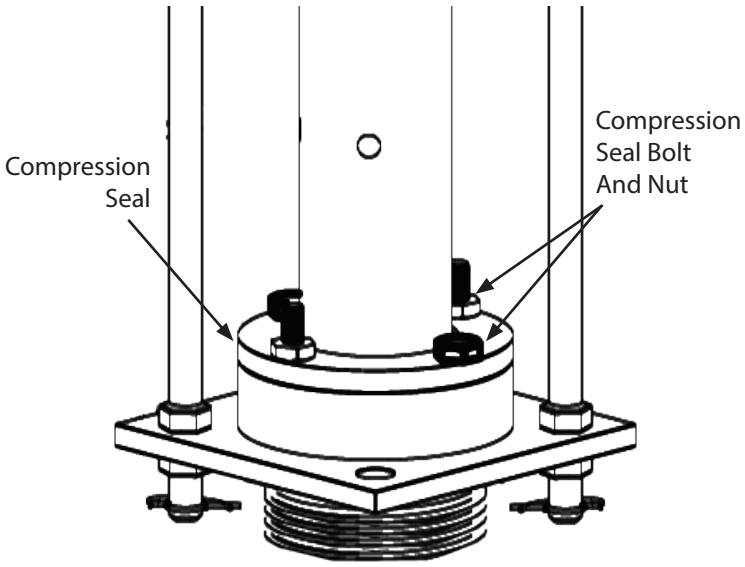

Figure 15: Compression Seal Bolts

FPI Mag™

2.0 INSTALLATION - Continued

STEP 14: Installing The Short Retaining Rods

After the *sensor* has been inserted and the load adjusted, shorter retaining rods can be installed and the longer ones removed. This will make the sensor assembly more compact.

IMPORTANT
The long retaining rods are matched to each *sensor* and are required for removal of the *sensor*. It is important to safely store the long retaining rods and label them with the meter serial number.

Follow the steps below to install the short retaining rods:

1. Insert the two short retaining rods through the two holes in the top plate opposite the two captive nuts with the long retaining rods. Once the short retaining rods are passed through the top plate, thread one nut per rod onto the bottom of the rod about one inch from the bottom.

2. Insert the two short rods end through the corresponding holes on the compression seal bottom plate. Thread a nut onto the bottom of each short retaining rod.

3. Tighten the nuts above and below the compression seal bottom plate to secure the short retaining rods to the bottom plate and to prevent the short retaining rods from spinning.

4. Attach a locking cotter pins to bottom ends of the short retaining rods.

5. Secure the short retaining rods to the top plate with one 3/8" or 1/2" nuts per rod.

6. Remove the long retaining rods and store in a safe, dry location tagged with the meter serial number.

7. Check and adjust the "*Sensor* Load" as necessary. *See STEP 13.*

8. Secure the 3/8" or 1/2" nuts on the top plate by running a second jam nut down and tightening it against the first nut.

9. Attach a locking cotter pin to the top ends of the short retaining rods.

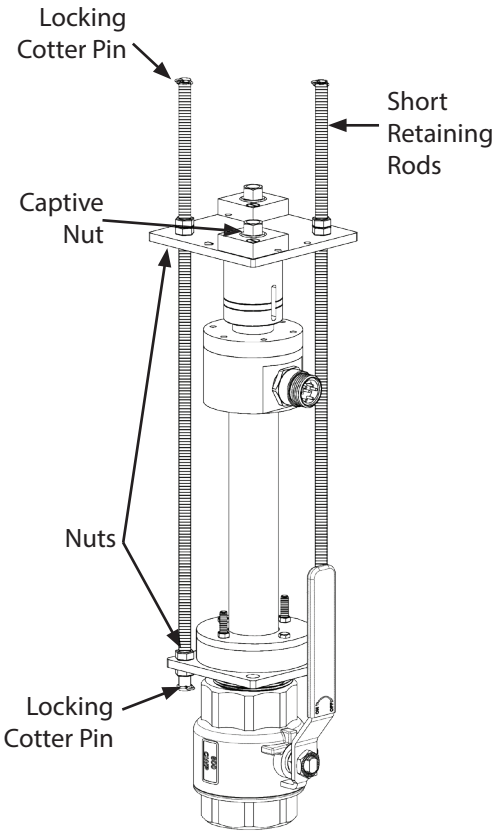

Figure 16: Installed Short Retaining Rods

3.0 Sensor Removal

WARNING!
The pipe may be under pressure. Serious injury or death may result if proper procedures are not followed. Do not attempt to remove the short retaining rods without the long retaining rods properly installed. Do not attempt to remove the *sensor* with only the short retaining rods.

IMPORTANT
Use the long retaining rods provided with the meter for removal. If the rods used for removal are shorter than those provided by the factory, the *sensor* cannot be removed without depressurizing the line.

Follow the steps below to safely remove the *sensor*:

1. Visually inspect the pipe and entire assembly for damage or corrosion paying close attention to any nipples and welded couplings. If there is any doubt as to the condition of any element of the pipe or meter, depressurize the line before attempting to remove the meter.

2. Reduce line velocity to 5 ft/s or less to prevent *sensor* vibration, or depressurize the line.

3. Thread a long retaining rod through the captive nut until the rod nears the compression assembly. Ensure that the bottom of the rod has the hole for the locking cotter pin.

4. Thread a 3/8" nut onto the bottom of the long retaining rod about an inch up from the bottom of the rod.

5. Continue rotating the long retaining rod until the bottom of the rod passes through the holes on the bottom plate.

6. Thread another 3/8" or 1/2" nut onto the bottom of the long retaining rod until it is flush with the bottom plate. Tighten the nuts above and below the bottom plate securely locking the long retaining rod in place. Attach the locking cotter pin into the hole through the bottom of the long retaining rod.

7. Repeat the process for the second long retaining rod.

8. Once both of the long retaining rods are securely in place, completely remove the short retaining rods.

9. Loosen the compression seal bolts 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. NOTE: The compression seal may prevent immediate leakage on *sensors* installed for a long period of time until the *sensor* begins to rise.

10. Rotate the captive nuts on the top plate simultaneously. The *sensor* insertion tool is recommended. *See Installation, STEP 12*. This will cause the *sensor* to rise out of the pipe. If the line is under pressure do not remove the *sensor* from the compression seal completely. Only raise the *sensor* until it is clear of the valve, but still below the compression seal. *See Figure 17*. Once the *sensor* has cleared the valve mechanism, the valve can then be closed. Do not attempt to force the valve closed while the *sensor* is still passing through the valve as permanent damage to the *sensor* can occur.

5.1.11 Once the valve is closed, the entire *sensor* can be removed from the valve.

3.0 Sensor Removal - Continued

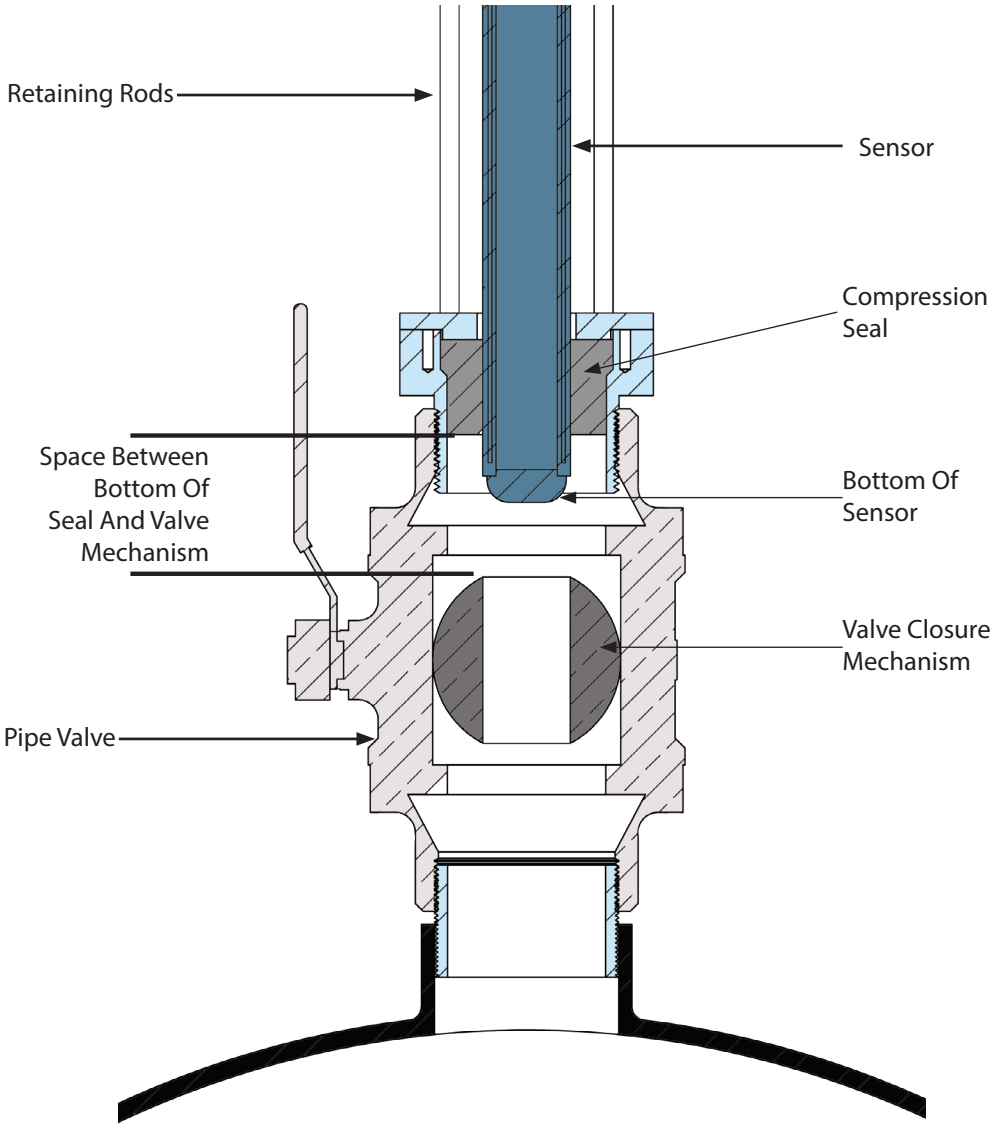

Figure 17: Cross-Section Of Meter Showing Sensor Removal

4.0 Electronics Installation

See the Installation, Operation and Maintenance Manual for the *converter* supplied with your system.

5.0 Maintenance

The FPI Mag is essentially a maintenance free meter with no user serviceable parts. However, the metered fluid may contain solids or other contaminants which may 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 warnings contained in *Section 5.0*. When the *sensor* is removed from the pipe, carefully wipe down the *sensor* with a soft cloth and rubbing alcohol.

6.0 Specifications

MEASUREMENT
Volumetric flow in filled flow conduits 4" (100 mm) to 138" (3500 mm) utilizing insertable electromagnetic averaging *sensor*. Flow indication in English Std. or Metric units.

FLOW MEASUREMENT
Method: Electromagnetic
Accuracy: for Forward and Bidirectional *sensor*s (with either a McCrometer L-Series or M-Series *converter*).
Up to +/- 0.5% from 1 ft/s to 32 ft/s (0.3 m/s to 10 m/s)
Up to +/- 1% from 0.3 ft/s to 1 ft/s (0.1 m/s to 0.3 m/s)
Linearity: 0.3% of Reading
Repeatability: 0.2% of Reading
395L *sensor* has forward flow measurement and reverse flow indication.
394L *sensor* has bidirectional flow measurement.

CONDUCTIVITY
Minimum conductivity of 5µS/cm

MATERIALS
Fusion bonded epoxy (NSF 61 approved) coated 316 stainless steel
Insertion Hardware: 316 stainless steel
Compression Seal: Silicone Rubber
Sensor Electrodes: 316 stainless steel

ELECTRICAL CONNECTIONS
Quick-connect (IP68 rated)

ENVIRONMENTAL
Pressure/Temperature Limits: *Sensor*: Flow Temperature Range 14° to 170° F (-10° to 77° C) @ 250 PSI
Sensor is submersible (IP68)

CERTIFICATIONS
Safety: Listed by CSA to 61010-1: Certified by CSA to UL 61010-1 and CSA C22.2 No.61010-1-04
ISO 9001:2008 certified quality management system

7.0 Returning A Unit For Repair

If the unit needs to be returned to the factory for repair, please do the following:

- Prior to calling for a return authorization number, determine the model number, serial number (located inside the front panel of the *converter*), and reason for return.
- Call the McCrometer Customer Service Department and ask for a Return Authorization (RA) number.
- Ship the meter in the original packaging, if possible. Do not ship manuals, power cords, or other parts with your unit unless required for repair.
- Please make sure the meter is clean and free from foreign debris prior to shipping.
- Write the RA number on the outside of the shipping box. All return shipments should be insured.
- Address all shipments to:

  McCrometer, Inc.
  RMA #
  3255 W. Stetson Avenue
  Hemet, CA 92545

WARRANTY STATEMENT

Manufacturer warrants all products of its manufacture to be free from defects in workmanship and material under normal use and service. The warranty for the ***FPI-Mag*** extends for a period of twenty-four (24) months after date of shipment, unless altered by mutual agreement between the purchaser and manufacturer prior to the shipment of the product. If this product is believed to be defective and is within its warranty period, purchaser shall notify the manufacturer, and will return the product to the manufacturer, postage paid, within twenty-four (24) months after date of shipment by the manufacturer. If the purchaser believes the return of the product to be impractical, manufacturer shall have the option, but will not be required, to inspect the product wherever located. In any event, if the purchaser requests the manufacturer visit their location, the purchaser agrees to pay the non-warranty expenses of travel, lodging and subsistence for the field service response. If the product is found by the manufacturer's inspection to be defective in workmanship or material, the defective part or parts will either be repaired or replaced, at manufacturer's election, free of charge, and if necessary the product will be returned to purchaser, transportation prepaid to any point in the United States. If inspection by the manufacturer of such product does not disclose any defect of workmanship or material, manufacturer's regular service repair charges will apply. Computing devices sold but not manufactured by McCrometer, Inc. are covered only by the original manufacturer's written warranty. Hence, this warranty statement does not apply.

THE FOREGOING WARRANTY IS MANUFACTURER'S SOLE WARRANTY, AND ALL OTHER WARRANTIES, EXPRESS, IMPLIED OR STATUTORY, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, ARE NEGATED AND EXCLUDED. THE FOREGOING WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, GUARANTEES, REPRESENTATIONS, OBLIGATIONS OR LIABILITIES ON THE PART OF THE MANUFACTURER.

Purchaser's sole remedy and manufacturer's sole obligation for alleged product failure, whether under warranty claim or otherwise, shall be the aforestated obligation of manufacturer to repair or replace products returned within twenty-four months after date of original shipment. The manufacturer shall not be liable for, and the purchaser assumes and agrees to indemnify and save harmless the manufacturer in respect to, any loss or damage that may arise through the use by the purchaser of any of the manufacturer's products.

OTHER McCROMETER PRODUCTS INCLUDE:

	Magnetic Flowmeters
	Magnetic Flowmeters
	Magnetic Flowmeters
	Propeller Flowmeters
	Remote Telemetry System
	Propeller Flowmeters
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	Differential Pressure Flowmeters
	Differential Pressure Flowmeters

Represented By:

McCROMETER
www.mccrometer.com

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McCROMETER

M-SERIES
ELECTROMAGNETIC FLOW METER CONVERTER

Installation, Operation and Maintenance Manual

30120-47 Rev. 1.4
May, 2013
Firmware Version 3.00.00

Important Information:

Converter Model Number: _____

Converter Serial Number: _____

Meter Serial Number: _____

RETAIN THIS MANUAL - DO NOT DISCARD

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Lit. 30120-47 Rev. 1.4/05-13

1.0 Safety

1.1 Safety Symbols And Warnings

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.

1.2 Safety Warnings

When installing, operating, and maintaining McCrometer 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. Specific requirements can be found in the OSHA section of the Code of Federal Regulations: *29 CFR, 1910.132 - 1910.140, Personal Protective Equipment; CFR Title 29, Part 1910.146, Permit-Required Confined-Spaces; and 29 CFR, 1910.1030, Bloodborne Pathogens.*

WARNING!
Incorrect installation or removal of FPI 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.

2.0 M-Series Converter Overview

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

The M-Series 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 M-Series microprocessor-based signal converter has a twelve-point curve-fitting algorithm to improve accuracy, dual 4-20mA analog outputs, an RS485 communication port, an 8-line graphical backlit LCD display with 3-key touch programming, and a rugged enclosure that meets IP67. In addition to a menu-driven self-diagnostic test mode, the converter continually monitors the microprocessor's functionality. The converter will output rate of flow and total volume. The converter also comes standard with password protection and many more features.

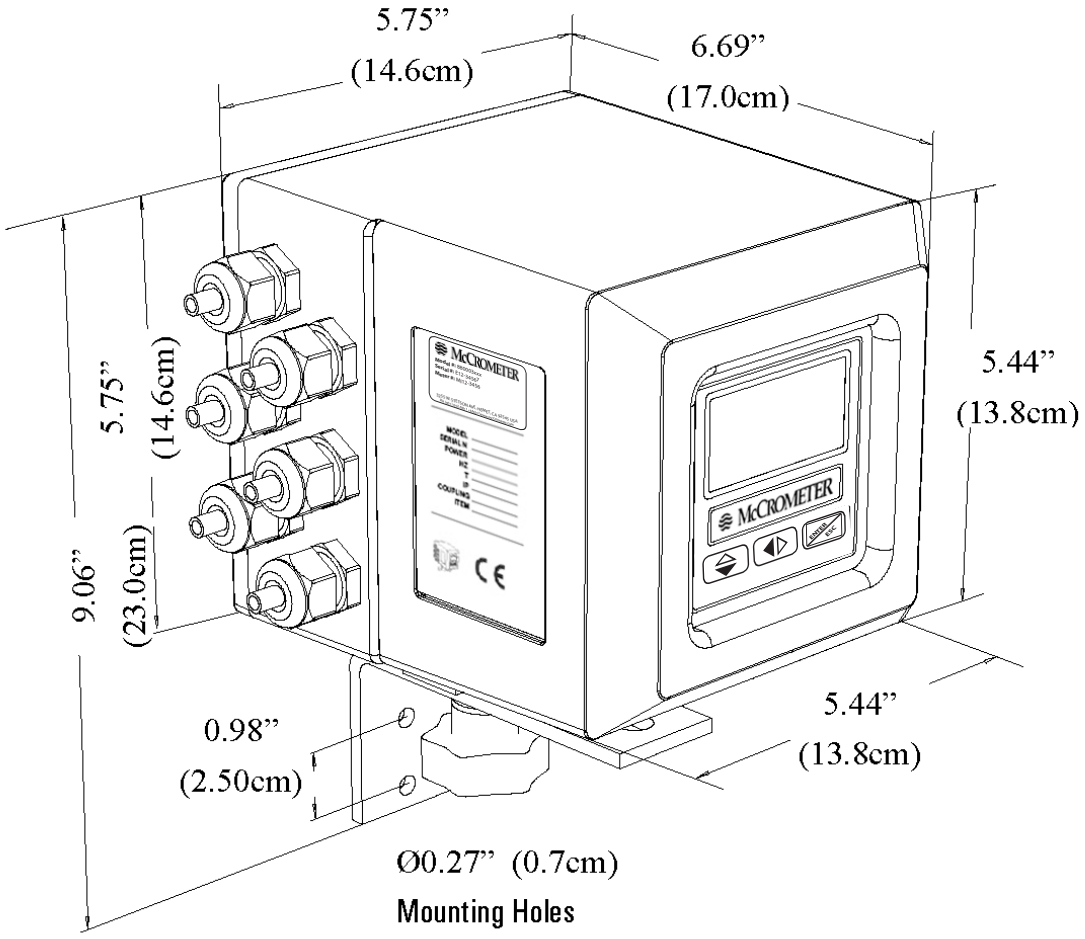


Figure 1: Electronic Converter Dimensions

2.1 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 insure a properly calibrated system.

The tag on the side of the converter has the Converter Model Number, the Converter Serial Number, the Meter Model Number and the Meter Serial Number. An example is Shown below.

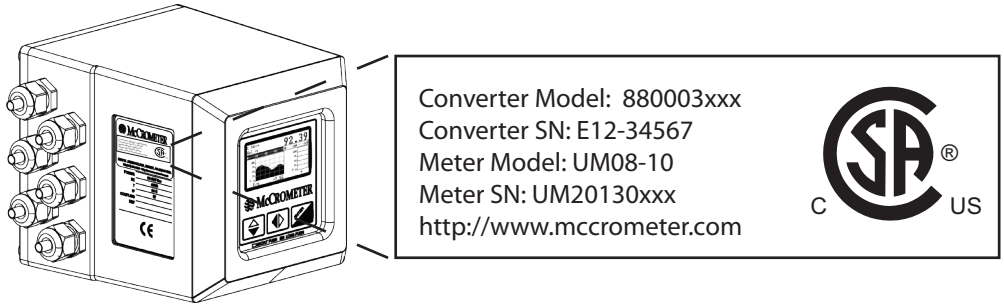


Figure 2: Converter Serial Number Tag

IMPORTANT: Verify the Meter Serial Numbers on both the converter and sensor match. This will insure 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. Insure the Meter Serial Number on the sensor and the converter tags match.

3.0 Converter Installation

3.1 Mounting The Converter

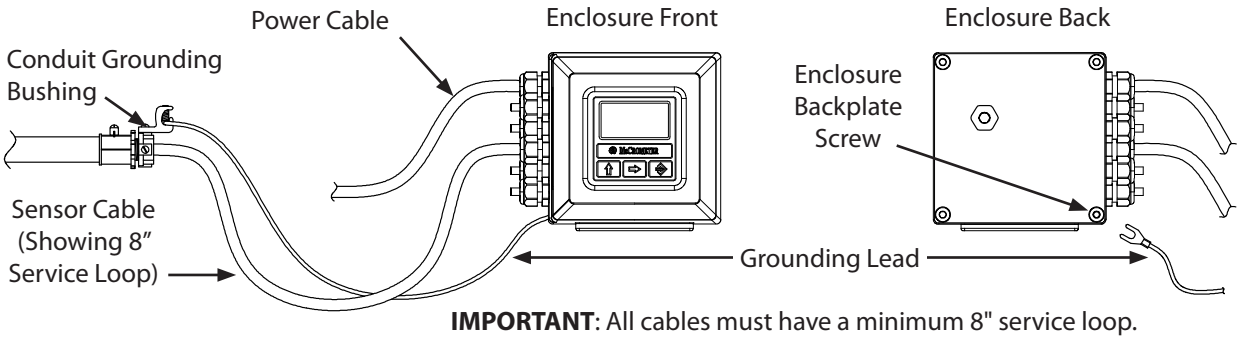
If possible mount the converter in an electronics shed or environmental enclosure. If the converter is mounted outdoors a sun shield is recommended. The sun shield should be oriented in a direction to reduce sun damage and ensure readability. The converter is mounted using 2 bolts. *See Figure 1*. A service loop in the cables is required. *See Section 3.2*. This electronic unit is rated IP67 for temporary flooding.

3.2 Installing Cables To Converter And Service Loop

Conduit of any kind ***CANNOT*** be attached directly to the electronics enclosure. Attaching conduit directly to the enclosure will introduce dangerous gasses and moisture into the enclosure creating a dangerous condition, and will remove the enclosure's IP67 rating. **Attaching conduit to the enclosure or altering the enclosure in any way will void the warranty.**

Any cable running through a conduit must exit the conduit and have a minimum of an 8" service loop before entering the electronics enclosure through the cable glands. All cable compression glands must be properly tightened to prevent moisture intrusion and maintain the IP67 rating. This allows the electronics enclosure to be rotated and the rear panel to be accessed. If electrically bonding (grounding) the enclosure to metallic conduit or raceways, secure a lead wire to the enclosures back panel screw and attach the lead to a listed and approved conduit grounding bushing. See *Figure 3*. To insure IP67 rating use only round cable 0.125" to 0.375" in diameter.

WARNING: Do not connect any form of conduit directly to the converter enclosure. Doing so will allow moisture and potentially dangerous gasses to enter directly into the converter. Attaching any conduit to the enclosure, or altering the enclosure in any way will void the warranty.



IMPORTANT: All cables must have a minimum 8" service loop.

Figure 3: Cable Installation, Service Loop And Bonding To Metallic Conduit

3.3 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 4*. This will insure 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.

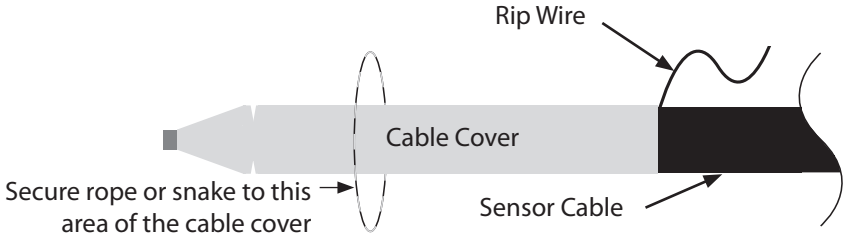


Figure 4: Cable Cover

4.0 FPI Mag™ Electrical Cable Connections

4.1 Sensor Electrical Cable Connections

CAUTION - Always disconnect the power cord before attempting any electrical connections.

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

4.2 Terminal Board

All connections are made on the terminal board. To access the terminal board, loosen the four screws on the back of the converter to remove the rear cover.

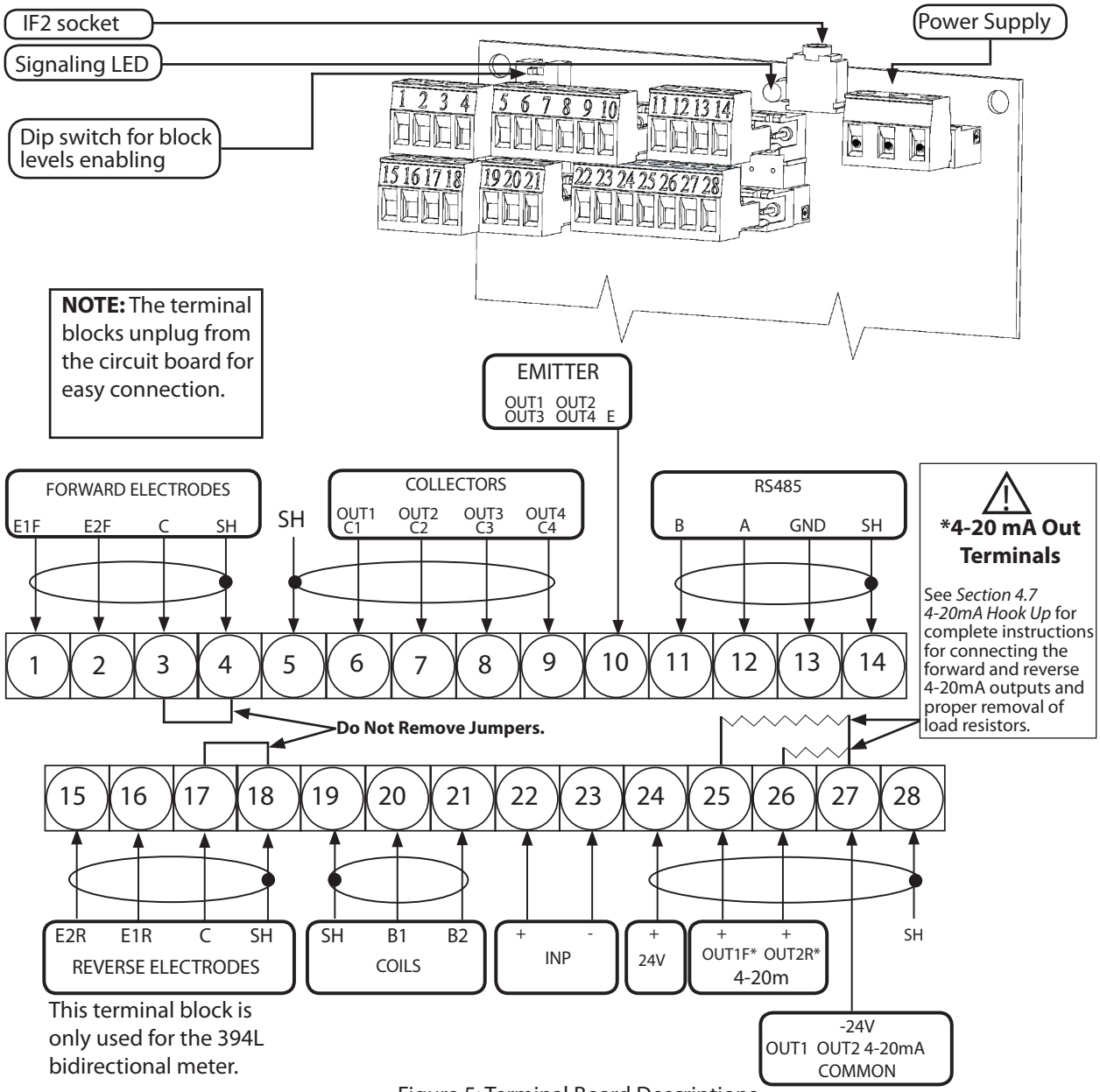


Figure 5: Terminal Board Descriptions

4.3 FPI Mag 394L Bidirectional Sensor Cable

Terminal	Wire Color	Connected To
Chassis Ground Lug*	Purple	Ground
#20 (B1)	Red	Coil
#21 (B2)	Yellow	Coil
#3 (C)	Black	Ground electrodes
#1 (E1F)	Blue	Forward Electrodes 1
#2 (E2F)	Pink	Forward Electrodes 2
#15 (E2R)	Pink (In shrink tube)	Reverse Electrodes 2
#16 (E1R)	Blue (In shrink tube)	Reverse Electrodes 1

Figure 6: Terminal Block M1 Assignments

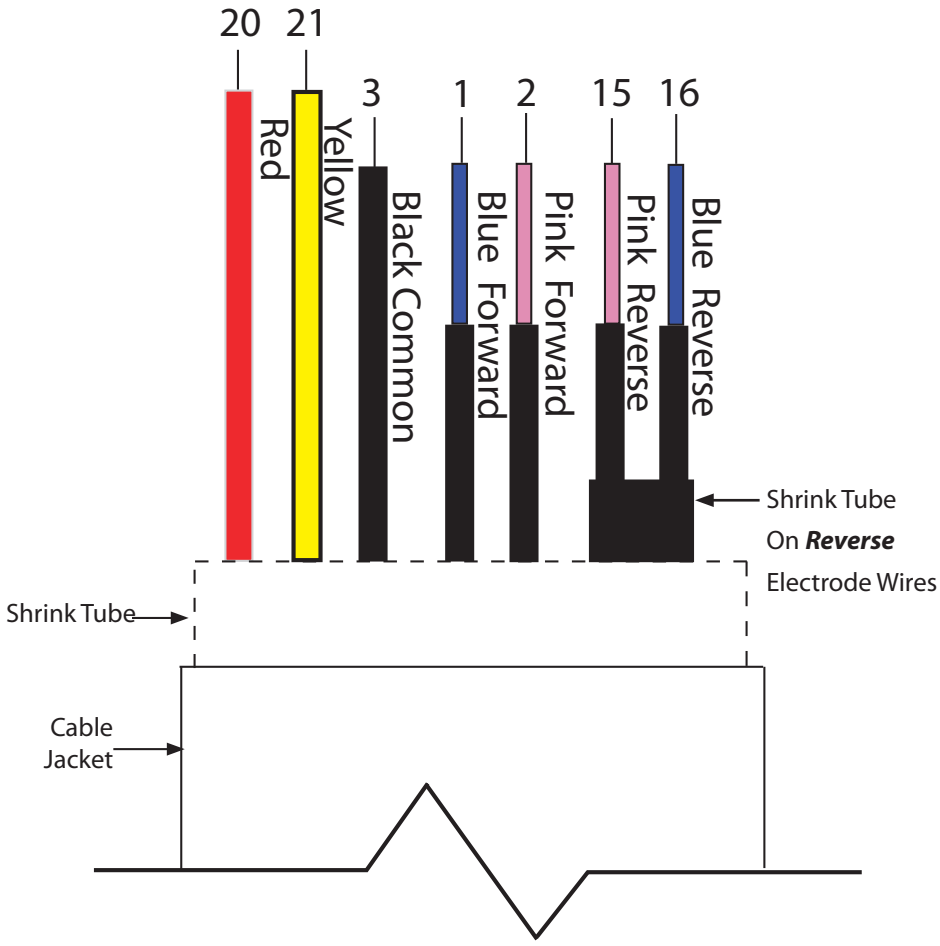


Figure 7: FPI Mag 394L Sensor Cable Connections

4.4 FPI Mag 395L Forward Only Sensor Cable

Terminal	Wire Color	Connected To
Chassis Ground Lug*	Purple	Ground
#1 (E1F)	Blue	Right sensing electrodes
#2 (E2F)	Pink	Left sensing electrodes
#3 (C)	Green/Yellow	Ground electrodes
#19 (SH)	Black	Magnet shield / overall cable shield
#20 (B1)	Red	Coil
#21 (B2)	Yellow	Coil

Figure 8: Terminal Block M1 Assignments

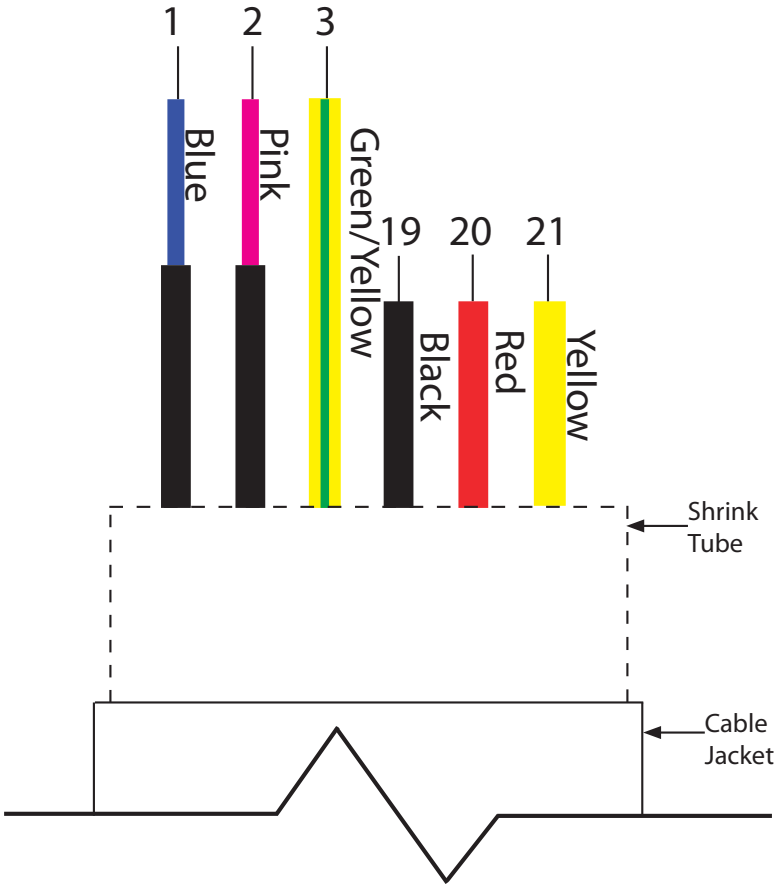


Figure 9: FPI Mag 395L Sensor Cable Connections

4.5 SPI Mag™ 282L Sensor Cable

Terminal	Wire Color	Connected To
Chassis Ground Lug*	Purple	Ground
#1	Blue	Sensing electrode
#2	White	Sensing electrode
#3	Black	Reference ground
#19	Black	Magnet shield / overall cable shield
#20	Red	Coil
#21	Yellow	Coil

Figure 10: Terminal Block M1 Assignments

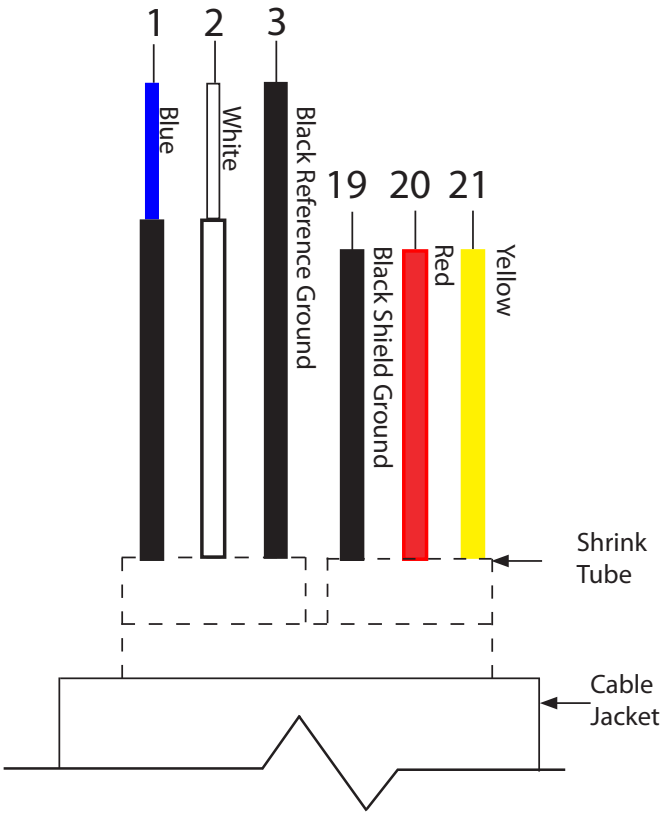


Figure 11: SPI Mag 282L Sensor Cable Connections

4.6 Ultra Mag And Mx Ultra Mag Sensor Cable

Terminal	Wire Color	Connected To
#1 (E1F)	Blue	Right sensing electrodes
#2 (E2F)	Pink	Left sensing electrodes
#3 & Chassis Ground Lug*	Purple	Ground
#4 (C)	Green/Yellow	Ground electrodes
#19 (SH)	Black	Magnet shield / overall cable shield
#20 (B1)	Red	Coil
#21 (B2)	Yellow	Coil

Figure 12: Terminal Block M1 Assignments

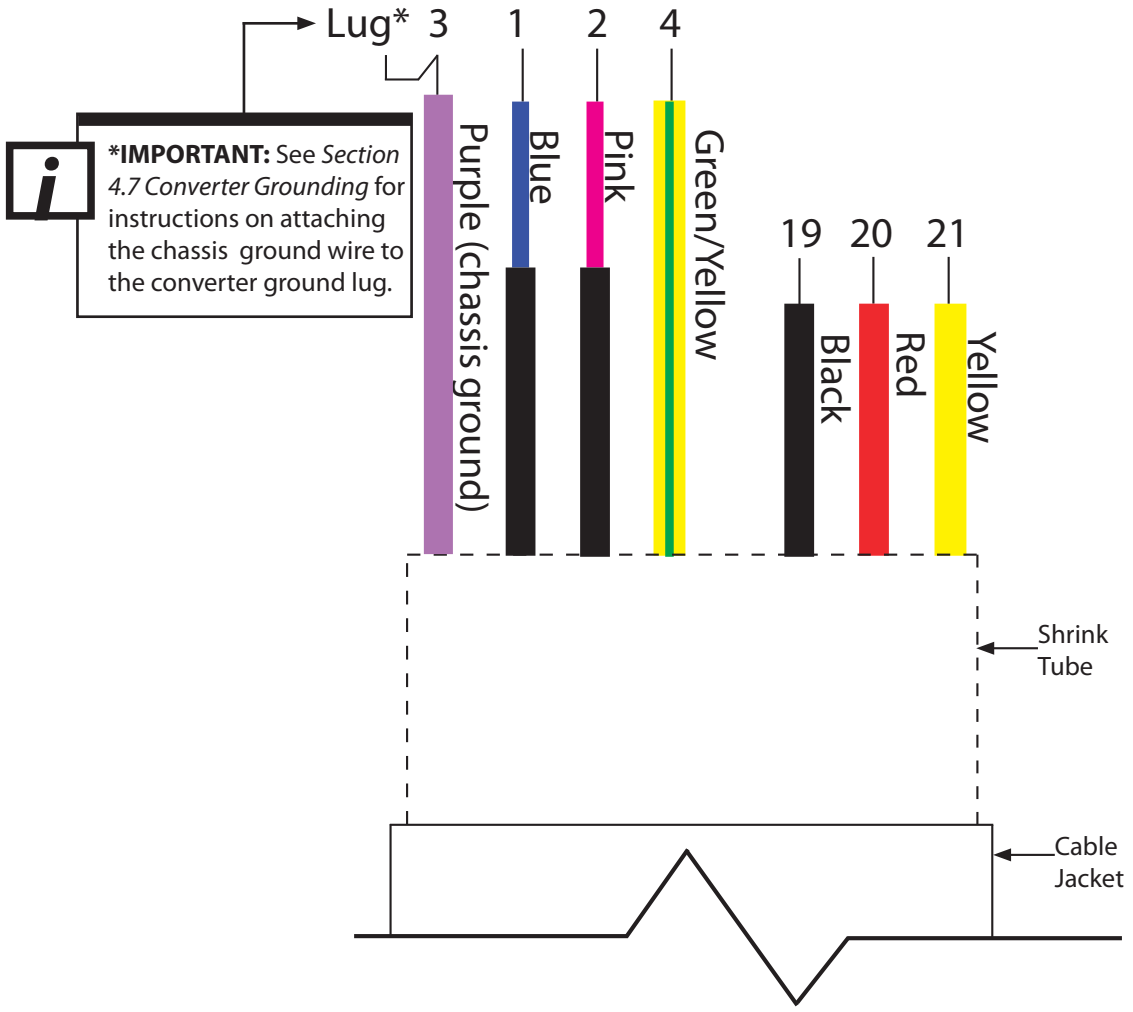


Figure 13: Ultra Mag And Mx Ultra Mag Sensor Cable Connections

4.7 Ultra Mag And Mx Ultra Mag Converter Grounding

On converters attached to the Ultra Mag or the Mx Ultra Mag flow meters, the sensor cable has a purple ground wire fitted with a loop and a terminal extension . Attach the purple wire to the enclosure's ground terminal lug as shown in *Figure 14* via the wire end loop, then connect the wire extension to Terminal #3.

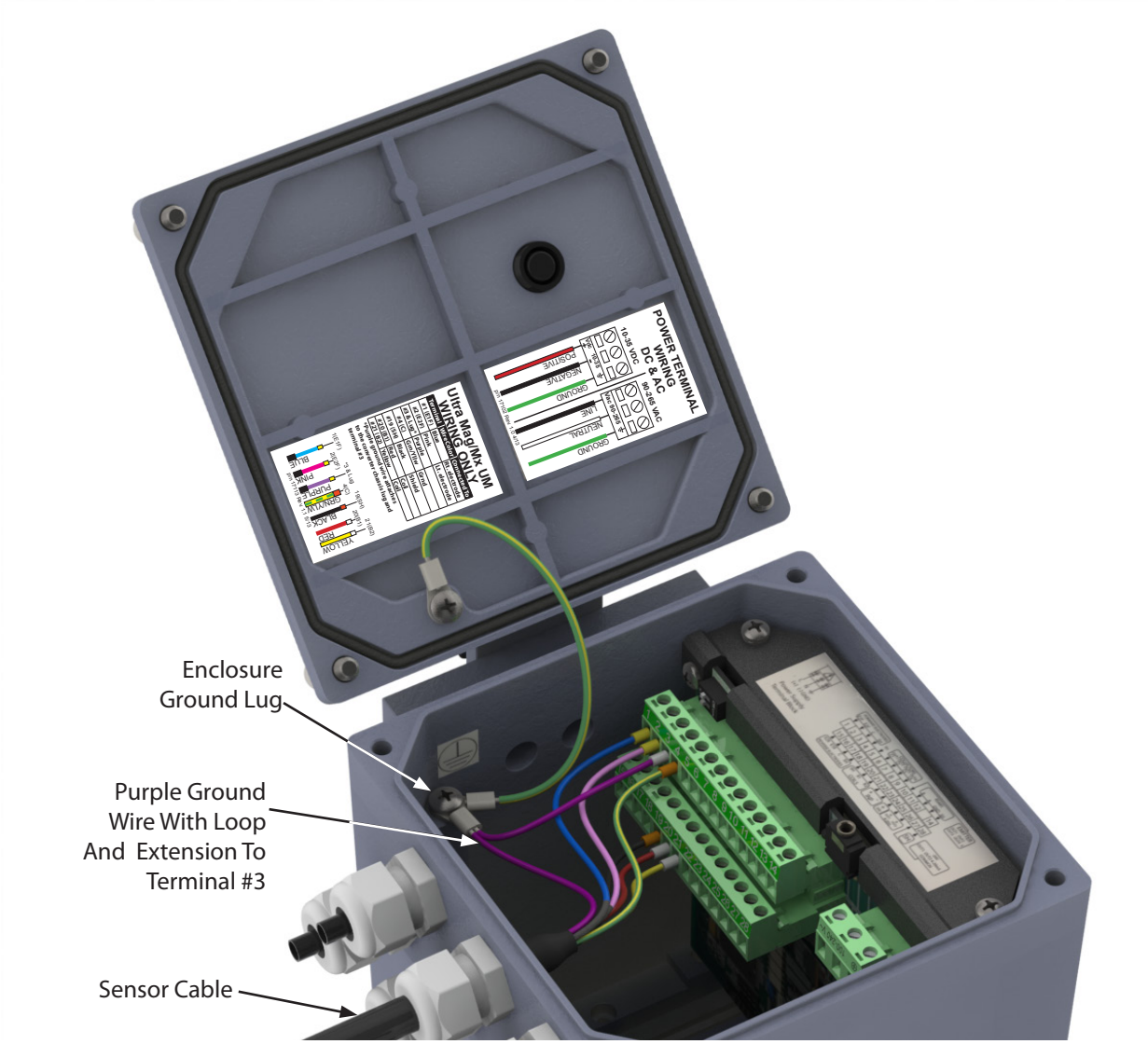
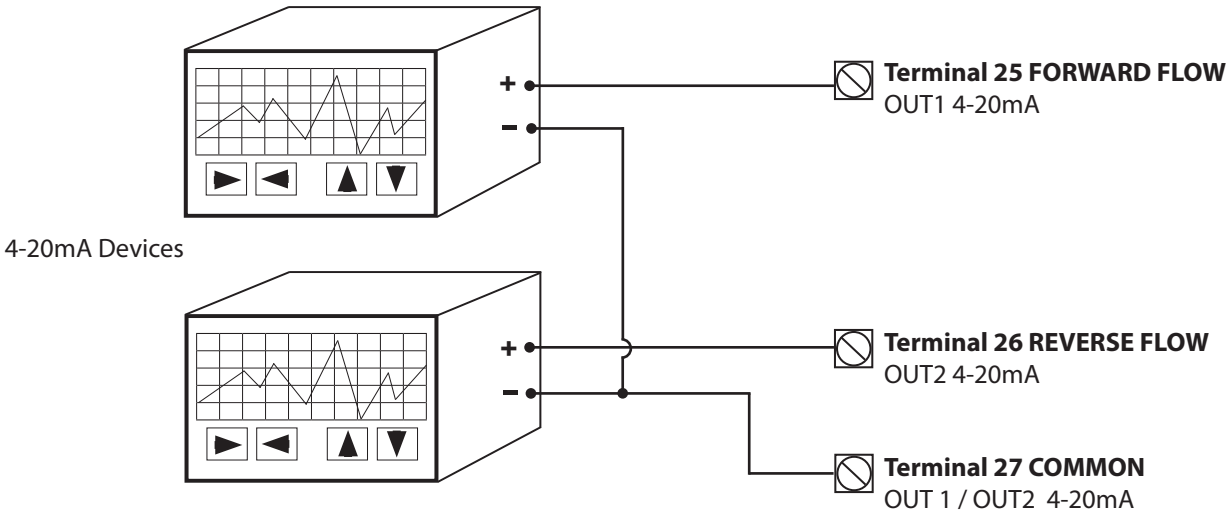


Figure 14: UM And Mx UM Converter Grounding

4.8 4-20mA Hook-Up

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 (*See Section 8.4.6*). 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 25 & 27 and/or 26 & 27 before attaching 4-20mA cables.

FORWARD FLOW: Remove the resistor from terminals 25 and 27.

REVERSE FLOW: Remove the resistor from terminals 26 and 27.

See *Section 4.2 Terminal Board, Figure 5*.

Figure 15: 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 x 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

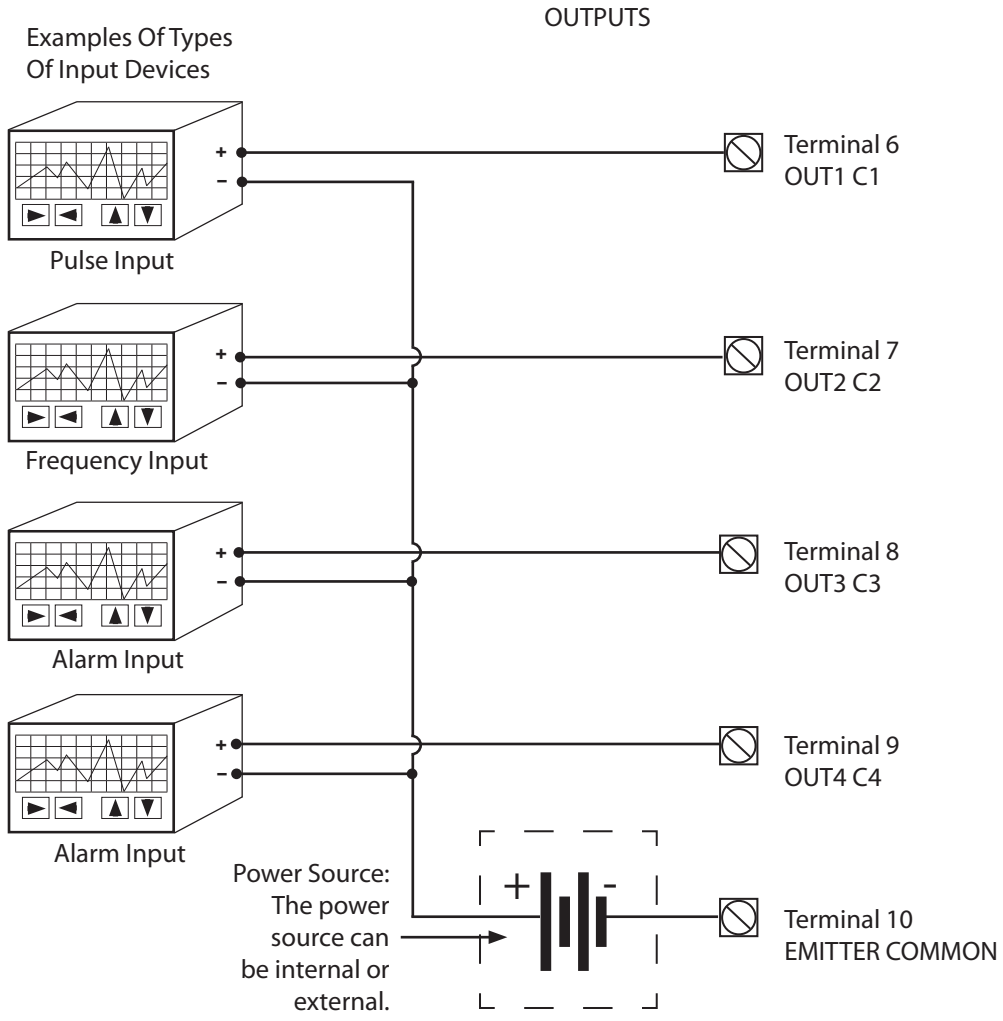
The converter powers the 4-20mA loops. Do not use external power for the 4-20mA loop as it may cause permanent damage to the converter.

4.9 Opto-Isolated Pulse Output Hook-Up

The four outputs are open collector transistor outputs used to communicate with or activate external devices when the flow reaches a predetermined set point.

- 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, RL=470Ω, VOUT=24VDC): 1250Hz
- Maximum reverse current bearable on the input during an accidental polarity reversion (VEC): 100mA
- Insulation from other secondary circuits: 500 V

A common application of outputs should be connected as follows:



IMPORTANT

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

Figure 16: Opto-Isolated Pulse Output Diagram

4.10 Converter Power Hook-Up

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 uplugs 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 90-265VAC, 44-66Hz at maximum 20W. DC converter is available as an option.

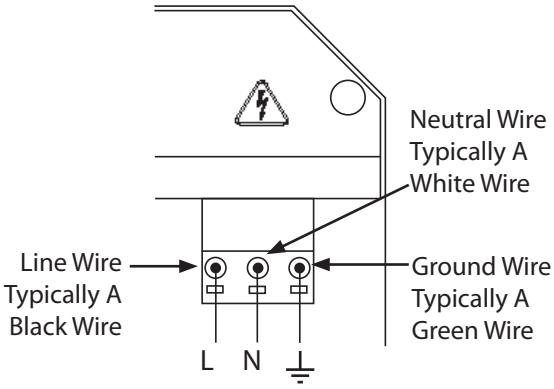


Figure 17: AC Power Supply Terminal Block

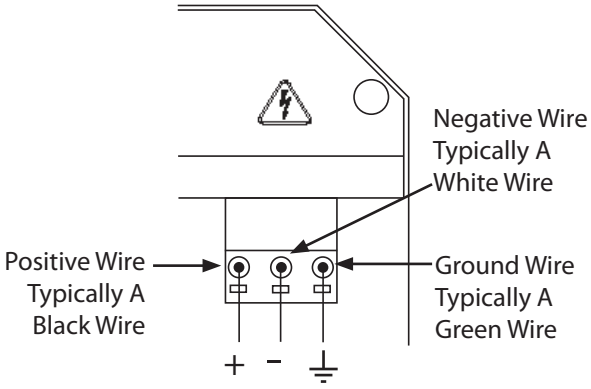


Figure 18: Optional DC Power Supply Terminal Block

5.0 Converter Start-Up - All Sensors

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 number will be displayed referencing the chart at the back of this manual. A text message will also be displayed on the alarm screen.

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

5.1 Menu Navigation

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

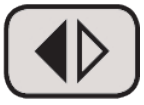
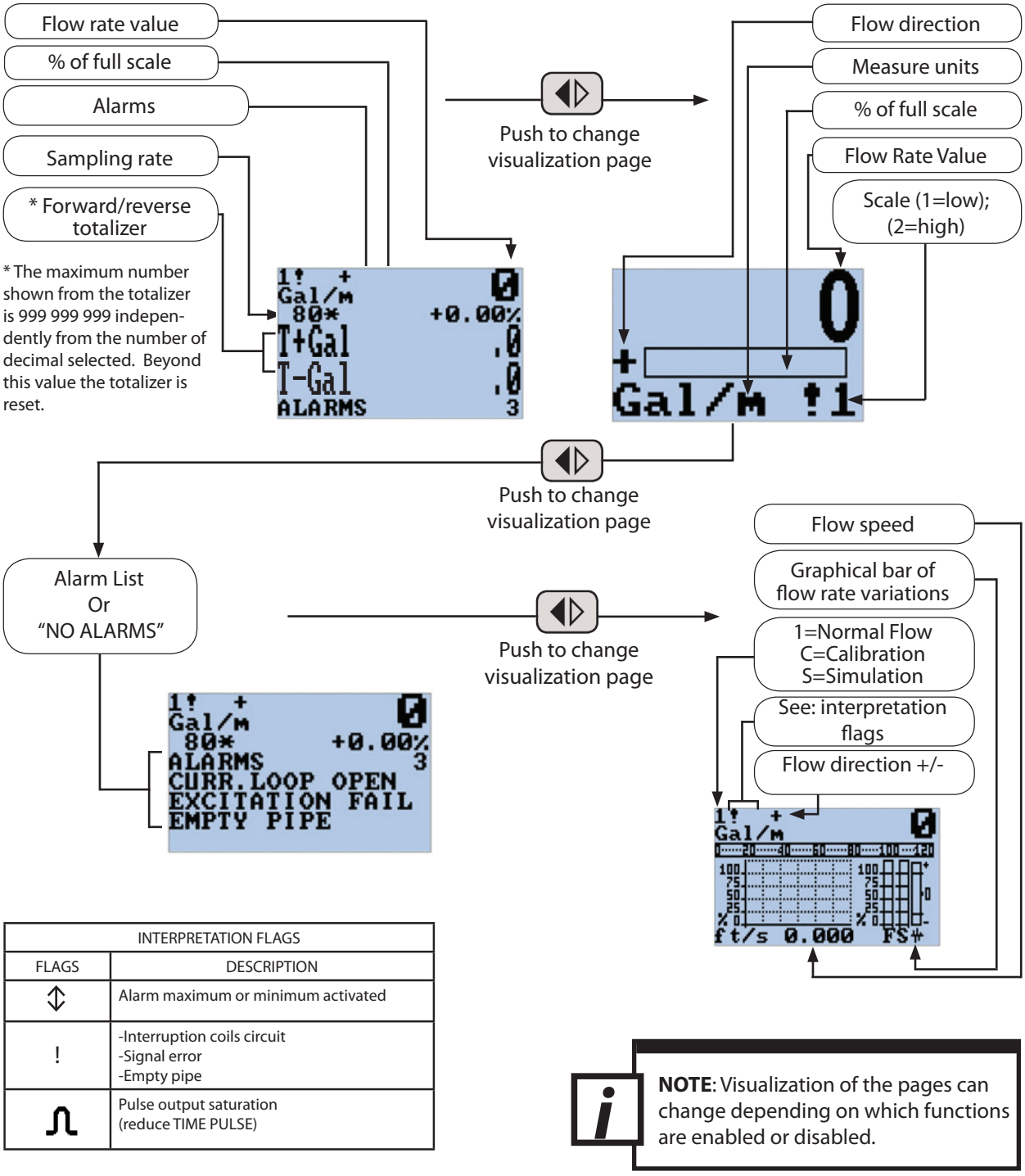
Key:	Function:
 **Up/Down Key**	UP/DOWN KEY (for moving cursor up or down) **SHORT PRESSING (< 1 SECOND):** Moves the cursor up to the previous subject on the menu Increases the numeric figure of the parameter highlighted by the cursor **LONG PRESSING (> 1 SECOND):** Moves the cursor down to the next subject on the menu Decreases the numeric figure of the parameter highlighted by the cursor
 **Right/Left Key**	RIGHT/LEFT KEY (for moving cursor right or left) **SHORT PRESSING (< 1 SECOND):** Moves the cursor to the right on the input field Moves the cursor to the following subject of the menu Changes the display of the process data **LONG PRESSING (> 1 SECOND):** Moves the cursor to the left on the input field Moves the cursor to the previous subject on the menu
 **Enter/Esc Key**	ENTER/ESC KEY (for changing settings) **SHORT PRESSING (< 1 SECOND)**: Opens the Quick Start menu for the instrument configuration Enters the selected function Cancels the selected function under progress **LONG PRESSING (> 1 SECOND):** Confirms the selected function Leaves the current menu

Figure 19: Converter Key Conventions

5.2 Front Panel Display

Short-press the Right/Left arrow key to view different display screens.



INTERPRETATION FLAGS	
FLAGS	DESCRIPTION
↕	Alarm maximum or minimum activated
!	-Interruption coils circuit -Signal error -Empty pipe
⎍	Pulse output saturation (reduce TIME PULSE)

NOTE: Visualization of the pages can change depending on which functions are enabled or disabled.

Figure 20: Front Panel Display Examples

5.3 Factory Pre-Setting

5.3.1 Key Codes

The converter is delivered with key code L2 = **000002**, and with the "Quick start menu" enabled. Press the Enter/ Esc key. The "Quick start menu" is enabled from the section: Menu "8-Display", section 8.8.

With access code L2 = 000000, the request of the code is disabled.

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

5.4 M-Series Menu Structure

The following is the menu structure for the M-Series converter. **NOTE:** Some menus change as options are enabled.

0. Quick Start
Fs1=
Tot. MU=
Pls1=
Pls2=
Tpls1=
Tpls2=
Frq1=
Frq2=
ND =
Cut-off=
Simulation=
Contrast
Language
Batching Setup
Regulat. Setup
Flow meas. Setup
Smart Meas.set=
Main menu

1. Sensor →
ND=
KA=
KA-=
Cable Len =
S. Rate=
E.p. Detect=
Ei signal=
Ep thr=
Zero Cal.
Zero -Cal.

2. Scale →
FS1=
Tot.MU=
Pls1=
Pls2=
Tpls1=
Tpls2=
Frq1=
Frq1=

3. Measure →
AC Filter=
M Filter=
Cutoff=
E.Savings=

4. Alarms
Max thr+=
Max thr-=
Min thr+=
Min thr-=
Hyst.=
mA v fault=
Hz v fault=

5. Inputs →
T + RESET=
T - RESET=
Count lock=
Calibration=

6. Outputs →
Out1setup=
Out2setup=
Out3setup=
Out4setup=
mA1 setup=
mA2 setup=

7. Communication →
IF2 Pr=
RS485 bps=
A. delay=
Address=
Rem. addr=
Remoute=

8. Display
Language=
Contrast=
Quickstart=
Net total=
T+ reset=
T- reset=

9. Data Logger →
YYYY / MM / DD
Acquisition=
Display events
Clear events

10. Diagnostic →
Calibration
Self Test
Simulation=
Electrodes test=
Display data=

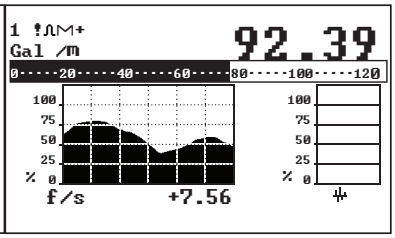
11. Internal data
L2 code=
Load fact. pres.
Load user pres.
Save user pres.
s/n=
KS=
KZ=
KZ-
DAC1 20mA
DAC1 4mA
DAC2 20mA
DAC2 4mA

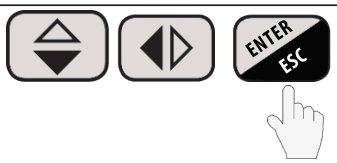
Figure 21: M-Series Menu Structure

6.0 Programming Example

The steps below demonstrate how to modify the full scale value from 4 Gal/m to 5 Gal/m from the "Quick start menu".

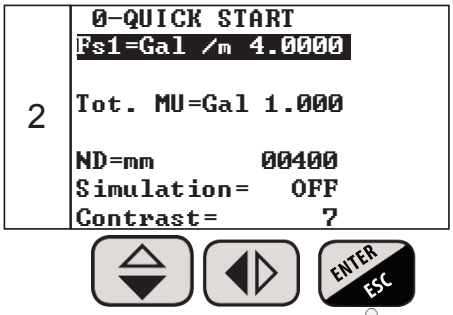
1





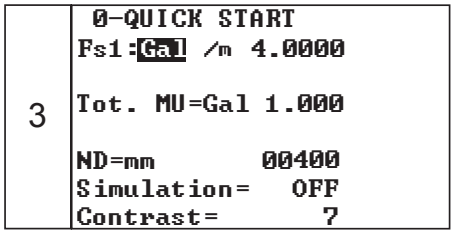
Enter the "Quick Start Menu"

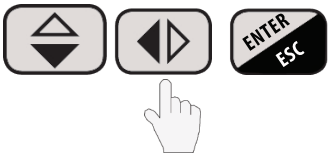
2



Access the function "Fs1"

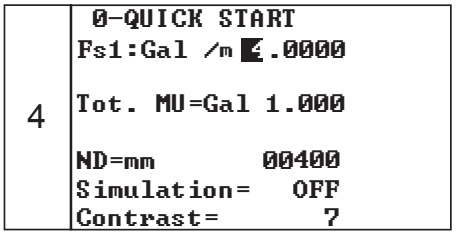
3

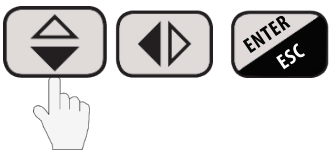




Push Repeatedly

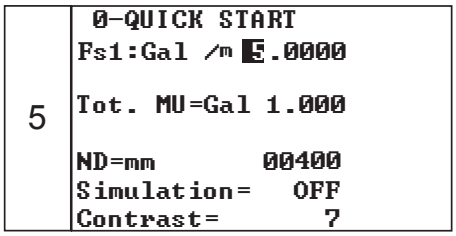
4

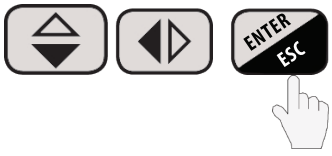




Change the value

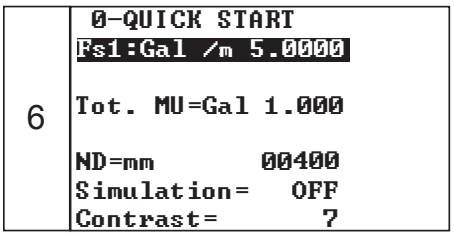
5





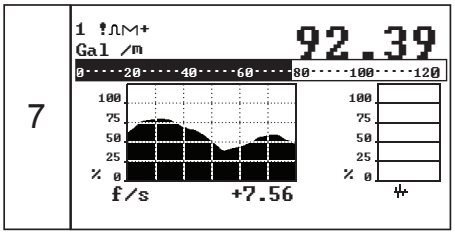
Confirm the new value with a short press

6



Long push to exit to the main page

7



Main visualization page

Figure 22: Programming Example Screens

7.0 Menu 0 - Quick Start

NOTE: The Quick Start menu is configured at the factory. Some menus may not be available in your configuration. If the quick start menu is not present as the first menu option, then it has been disabled (*See Section 8.8.3 in the Display Menu*). The instructions that follow explain each menu position within the Quick Start menu.

7.1 POS 0.1 FS1- The Full Scale range 1. The units of measure and full scale range of the meter that defines the 20mA output. Generally this value is set 10% over the anticipated max flow. US standard & metric units are selectable from this menu.

To change the full scale value, highlight the "Fs1" menu and press the Enter/Esc key. The unit will highlight. Press the Up/Down key to scroll thru the different available units. See *Appendix 1.0* for available units of measure.

Figure: 23

Figure: 24

Once you have selected the desired unit press the Right/Left key twice to highlight the lower case letter that represents the time unit. Again press the Up/Down key to scroll thru the available time units. Once the unit of measure and time unit have been selected press the Right/Left key to select the numeric value. Pressing the Up/Down key to set the digit and Right/Left key to move to the next digit.

Figure: 25

Figure: 26

Once the desired value is entered press the Enter/Esc key to exit/highlight the menu.

If a unit you are looking for is not in the current list press the Right/Left key and scroll to the "/" between the unit of measure and time unit selections and press the Up/Down key to switch between U.S. Standard and Metric units.

Figure: 27

Once the desires value is entered quick push the Enter/Esc key to highlight the entire line and then long push Enter/Esc to exit back to the display.

7.2 POS 0.1 Tot. MU - The totalizer unit/multiplier as well as the visible decimal place is set here.

To change the totalizer unit/multiplier select the "Tot. MU" menu by highlighting the menu and press the Enter/Esc key. This will highlight the unit/multiplier. See *Appendix 1.0* for available units of measure.

Figure: 28

Figure: 29

Press the Up/Down key to scroll through the available units until the desired unit has been selected.

NOTE: The totalizer multiplier is built into the unit of measure, so for gallons multiplied by 1000, select Kgal.

Once the unit of measure is selected press the Right/Left key twice to highlight the numeric value to the right. Then press the Up/Down key to change the decimal resolution displayed for this totalizer. Changing the decimal resolution will not change the multiplier. The available selections are 00001, 001.0, 01.00, and 1.000.

Figure: 30

Figure: 31

If the desired unit of measure is not in the current list, press the Right/Left key and scroll to the blank space between the unit/multiplier and the numeric decimal resolution selection and press the Up/Down key to switch between U.S. Standard and Metric units.

Figure: 32

7.3 POS 0.3 Pls1 - The pulse increment value and unit of measure for the pulse output 1. This option is only available when "out1" in *Menu 6 - Outputs 8.6.1* is set to "#1 IMP".

7.4 POS 0.4 Pls2 - The pulse increment value and unit of measure for the pulse output 2. This option is only available when "out2" in *Menu 6 - Outputs 8.6.2* is set to "#2 IMP".

7.5 POS 0.5 Tpls1- Duration of the pulse output 1 expressed in milliseconds. This option is only available when out1 in *Menu 6 - Outputs 8.6.1* is set to #1 IMP+. The pulse duration can be set from .4 to 9999.99.

IMPORTANT
The converter cannot detect the type of device it is connected to so it is up to the user to verify the setting is compatible with the external device receiving the pulse. Incorrect settings can damage the receiving device. See section *8.6 Menu 6 -Outputs* for output specifications

7.6 POS 0.6 Tpls2 - Duration of the pulse output 1 expressed in milliseconds. This option is only available when out2 in *Menu 6 - Outputs 8.6.2* is set to #2 Freq. The pulse duration can be set from .4 to 9999.99.

7.7 POS 0.7 Frq1- Full scale frequency value for output 1. This option is only available when out1 in *Menu 6 - Outputs 8.6.1* is set to #1Freq. The value is set in hertz between 1.0 to 1,000.0.
NOTE: When the high frequency output is present the maximum value may go up to 10,000.0 hz.

7.8 POS 0.8 Frq2- Full scale frequency value for output 1. This option is only available when out1 in *Menu 6 - Outputs 8.6.2* is set to #2Freq. The value is set in hertz between 1.0 to 1,000.0.
NOTE: When the high frequency output is present the maximum value may go up to 10,000.0 hz.

7.9 POS 0.9 ND - Inside Pipe Diameter. The inner diameter of the pipe entered in millimeters. Setting the ND value to zero will cause the converter to display the velocity instead of flow rate. Totalizer will then increment in feet or meters. **NOTE**: Nominal pipe size and the pipe inside diameter are in most cases different from one another. The calculation of a paired FPI Mag system is derived fromthe pipe inside diameter. Insure the correct value is supplied for a properly calibrated system.

7.10 POS 0.10 Cut-off - Cutoff point which all flow is reported as zero. This value is set as a percentage of the full scale.

7.11 POS 0.11 Simulation - Simulation enable. Setting this menu to ON will generate an internal signal that simulates flow and allows the outputs and all connected instruments to be tested. After simulation is set to ON, the flow can be set to a percentage based on the current FS1 setting -125% to 125%.

To enable the simulation function, use the Right/Left key to highlight the Simulation menu and press the Enter/Esc key, you will be prompted for code L2. Use the Up/Down and Right/Left keys to enter the code 00002. Then press the Enter/Esc key to enter the code.

Figure: 33

Figure: 34

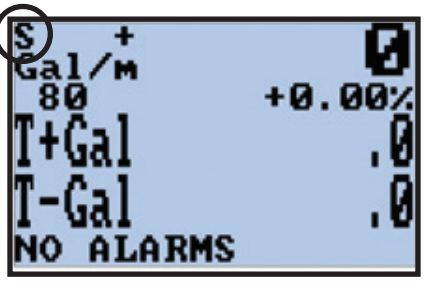
The simulation function can now be toggled from OFF to ON by using the Up/Down key. Select ON to turn on the Simulation mode and press the Enter/Esc key.

Figure: 35

Figure: 36

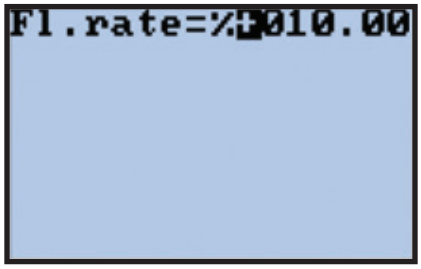
Press and hold the Enter/Esc key to exit back to the visualization page. **NOTE:** There will now be a "S" in the upper left corner, this indicates the simulation mode is active.

Figure: 37



Press the Enter/Esc key. This will bring up the flow simulation set up screen. Use the Right/Left key and the Up/Down key to enter in the flow rate percentage value for the simulation. Press the Enter/Esc key to enter that value.

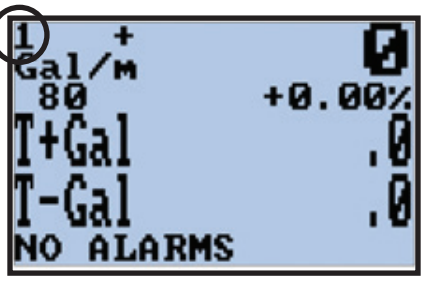
Figure: 38



The converter will start to read flow. It may take a few seconds for the readings to appear. Repeat the above steps as needed to observe the different flow rates desired.

To exit out of simulation mode, re-enter into the simulation set up screen (see above) and then press and hold the Enter/Esc key. This will exit out to the visualization screen, and the "S" in the upper left corner of the screen will return to a "1".

Figure: 39



7.12 POS 0.12 Contrast - Display contrast set point. The display contrast can be changed to make the display appear more visible based on the users preference. This menu can be set 0 to 15 with the change only taking affect once the menu selection has been selected by pressing the enter key. The factory default is 5.

NOTE: If set to high or too low the display can become unreadable. If this happens wait 60 seconds from the time of the last button push for the display to time out to the visualization page. From the visualization page press and hold the Right/Left button. The display will cycle through a different preset display contrast settings every 8 seconds. Release the button once you have found a setting that can be read.

7.13 POS 0.13 Language - Choose a language to display the converter menus in. Available options are EN = English, IT = Italian, FR = French, SP = Spanish and DE = German.

7.14 POS 0.14 Batching setup - Batching filter setup. Automatically adjusts all filtering options for a batching type application. The batching filter is a quick response filter that will quickly react to rapid changes in flows and due to the rapid response, the flow may appear unstable. This filter is good for applications that require accurate flow within very short time spans. To initiate the Batching filter press the Enter/Esc key while the menu option is selected, then press and hold the Enter/Esc key. The word "DONE" will flash when the filter is enabled.

7.15 POS 0.15 Regulat. Setup - Regulate filter setup. Automatically adjusts all filter options for an application that requires a regulated output. The Regulate filter is a medium response filter that will react moderately to changes in flows. This filter is good for applications that have moderate flow instabilities but require a stable flow report. To initiate the Regulate filter, press the Enter/Esc key while the menu option is selected, then press and hold the Enter/Esc key. The word "DONE" will flash when the filter is enabled.

7.16 POS 0.16 Flow meas. setup - Flow measure filter setup. Automatically adjusts all filter options for a general flow measurement application. The Flow Measurement filter will react slowly to changes in flow. This filter is good for applications that have relatively unchanging flows, but some flow instability or noise, yet require a stable flow report. To initiate the Regulate filter, press the Enter/Esc key while the menu option is selected, then press and hold the Enter/Esc key. The word "DONE" will flash when the filter is enabled.

7.17 POS 0.17 SMART meas.set.- SMART Measure filter setup. Automatically adjusts all filter options for an application that requires a steady, dampened output when the flow rate is not increasing or decreasing. This filter has the ability to switch to a more responsive, if noisier, response rate when the flow rate begins increasing or decreasing. The SMART filter is a mixed response filter that will react to changes in flow but tend toward a quieter, calmer signal in relatively steady flows. To initiate the Regulate filter, press the Enter/Esc key while the menu option is selected, then press and hold the Enter/Esc key. The word "DONE" will flash when the filter is enabled.

7.18 POS 0.18 Main menu - allows access to the main menu which contains advanced configuration menus. **NOTE:** If the Quick Start menu is disabled, from the flow visualization press the Enter/Esc. The L2 passcode screen will appear. Enter the passcode of 000002, then press the Enter/Esc key.

8.0 Main Menu Descriptions

Press the key Enter/Esc key to go to the Main menu directly when the "Quick start menu" is disabled. When it is not disabled you can select the Main menu from the "Quick start menu". The functions in the Quick Start menu and the Main menu are explained below. Please note that some functions are only displayed if other functions are enabled or with the insertion of additional modules.

8.1 Menu 1- Sensor

8.1.1 POS 1.1 ND Inside Pipe Diameter The inner diameter of the pipe entered in millimeters. **NOTE:** The flow accuracy will only be as good as the accuracy of the actual pipe ID entered into the converter. The "Nominal Pipe Size" often referred to can be different from the actual pipe ID and if used cause a substantial error in flow reading. Setting the ND value to zero will cause the converter to display the velocity instead of flow rate. Totalizer will then increment in feet or meters.

8.1.2 POS 1.2 KA - Factory calibrated gain for the forward flow. Do not change the value.

8.1.3 POS 1.3 KA- - Factory calibrated gain for the reverse flow. Used ONLY for bidirectional meters. Do not change the value.

8.1.4 POS 1.4 Cable length - Cable length set in increments of 10 meters, rounded to the nearest 10 meter increment.

8.1.5 POS 1.5 S. rate - Factory calibrated frequency sampling rate. Do not change the value.

8.1.6 POS 1.6 E.P. Detect - Set the empty pipe alarm to on or off. Factory default = ON.
NOTE: Setting the E.P. Detect to "off" can cause the sensor to display environmental/electrical noise as flow.

8.1.7 POS 1.7 E.I. Signal - Factory set value. Do not change the value.

8.1.8 POS 1.8 E.p. thr - Empty Pipe Threshold is the numeric value selected during the Empty Pipe Calibration function. In some cases it may be required to manually adjust this value to be more compatible with an installation. For assistance adjusting this value contact McCrometer Technical Support. Available settings are from 0-250.

8.1.9 POS 1.9 Zero Cal. - Zero point calibration function for the forward flow.

To perform the Zero point Calibration select the Zero Cal. Menu by highlighting the menu and press the Enter/Esc key. This will enable the zeroing function. You will see a percent value that is positive or negative.

IMPORTANT
The water must be perfectly still before starting the Zero Cal process or an offset will be introduced into the flow report.

Figure: 40

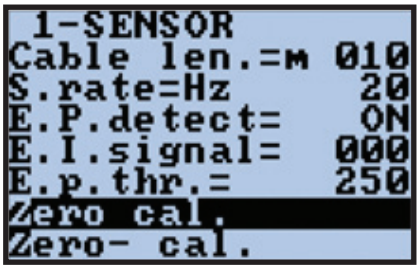
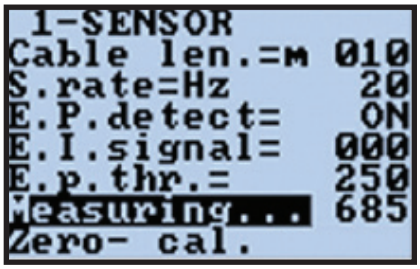
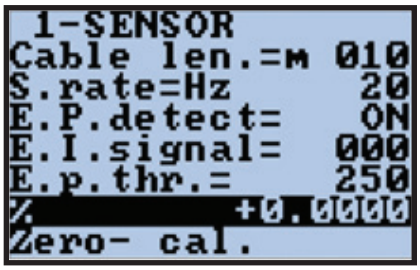


Figure: 41



Now press and hold the Up/Down button and release when the message "Measuring. . . " appears. The converter counts up from zero to 1,000, after which the zero point is set. The new value should be less than before the autozero was performed. if not, then verify that there is no flow in the pipe and repeat.

Figure: 42



8.1.10 POS 1.10 Zero - Cal., Zero point calibration function for the reverse flow. See above instructions and repeat for the reverse zero calibration.

8.2 Menu 2 - Scales

8.2.1 POS 2.1 FS1- The Full Scale range 1. The full scale units of measure of the meter that defines the 20mA output and the general maximum flow for the meter. U.S. Standard and metric units are selectable from this menu. See *Appendix 1.0* for available units of measure.

To change the full scale value, highlight the "Fs1" menu and press the Enter/Esc key. The unit will highlight. Press the Up/Down key to scroll thru the different available units.

Figure: 43

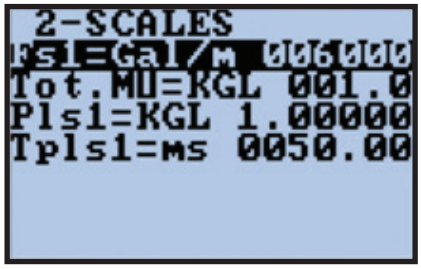
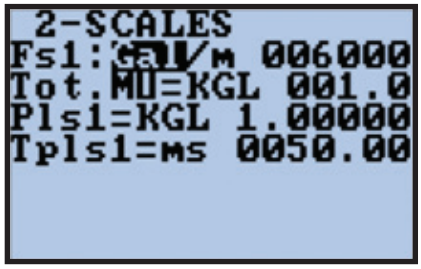


Figure: 44



Once you have selected the desired unit press the Right/Left key twice to highlight the lower case letter that represents the time unit. Again press the Up/Down key to scroll thru the available time units. Once the unit of measure and time unit have been selected press the Right/Left key to select the numeric value. Press the Up/Down key to set the digit and the Right/Left key to move to the next digit.

Figure: 45

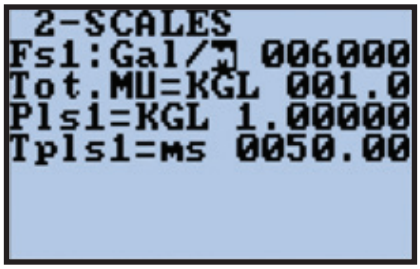
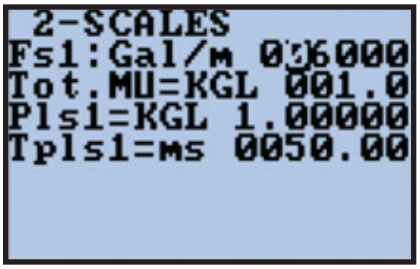
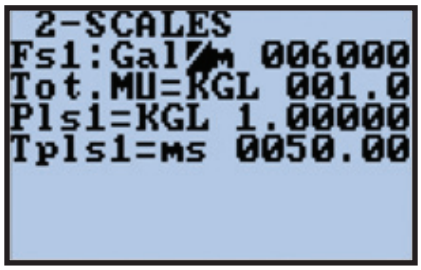


Figure: 46



If a unit you are looking for is not in the current list press the Right/Left key and scroll to the "/" between the unit and time unit selection and press the Up/Down key to switch between U.S. standard & metric units.

Figure: 47



Once the desired value is entered quick push Enter/Esc to high light the entire line and then long push Enter/Esc to exit back to the display.

8.2.2 POS 2.2 Tot. MU - Totalizer Multiplier Unit. To change the Totalizer Multiplier unit select the "Tot. MU" menu by highlighting the menu and press the Enter/Esc key. This will highlight the unit/multiplier line. See *Appendix 1.0* for available units of measure.

Figure: 48

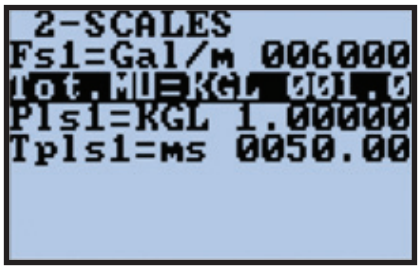
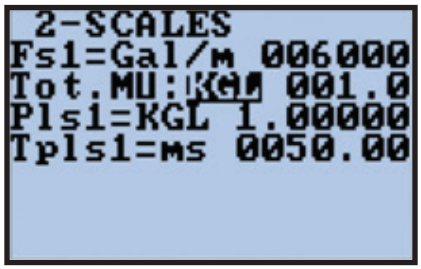


Figure: 49



Press the Up/Down key to scroll thru the different available unit until the desired unit has been selected. Note the totalizer multiplier is built into the unit of measure so if you want gallons times 1000 you must select Kgal. Once selected, press the Right/Left key twice to highlight the numeric value to the right. Pressing the Up/Down key will change the decimal resolution displayed for this totalizer but will not change the multiplier. The available selections are 00001, 001.0, 01.00, and 1.000.

Figure: 50

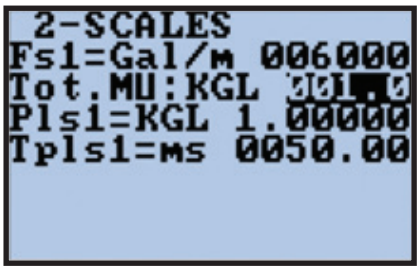
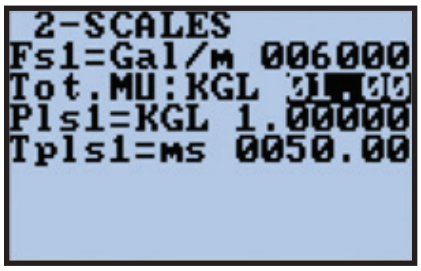
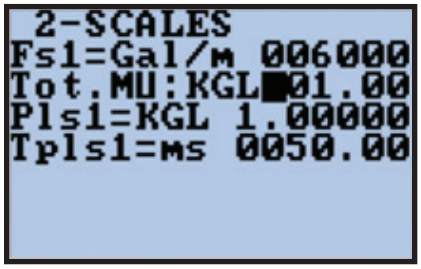


Figure: 51



If a unit you are looking for is not in the current list press the Right/Left key and scroll to the blank space between the unit/multiplier and the numeric decimal resolution selection and press the Up/Down key to switch between US standard & metric units.

Figure: 52



8.2.3 POS 2.3 Pls1 - The pulse increment value and unit of measure for the pulse output 1. This option is only available when "out1" in *Menu 6 - Outputs 8.6.1* is set to "#1 IMP".

8.2.4 POS 2.4 Pls2 - The pulse increment value and unit of measure for the pulse output 2. This option is only available when "out2" in *Menu 6 - Outputs 8.6.2* is set to "#2 IMP".

8.2.5 POS 2.5 Tpls1- Duration of the pulse output 1 expressed in milliseconds. This option is only available when out1 in *Menu 6 - Outputs 8.6.1* is set to "#1 IMP". The pulse duration can be set from .4 to 9999.99.

8.2.6 POS 2.6 Tpls2 - Duration of the pulse output 1 expressed in milliseconds. This option is only available when out2 in *Menu 6 - Outputs 8.6.2* is set to "#2 IMP". The pulse duration can be set from .4 to 9999.99.

8.2.7 POS 2.7 Frq1- Full scale frequency value for output 1. This option is only available when out1 in *Menu 6 - Outputs 8.6.1* outputs is set to "#1Freq (+/-)". The value is set in hertz between 1.0 to 1,000.0. **NOTE:** When the high frequency output is present the maximum value may go up to 10,000.0 hz.

8.2.8 POS 2.8 Frq2- Full scale frequency value for output 1. This option is only available when out2 in *Menu 6 - Outputs 8.6.2* is set to "#2FREQ (+/-)". The value is set in hertz between 1.0 to 1,000.0.

IMPORTANT
The converter cannot detect the type of device it is connected to so it is up to the user to verify the setting is compatible with the external device receiving the pulse. Incorrect settings can damage the receiving device. See section *8.6 Menu 6 -Outputs* for output specifications

8.3 Menu 3 - Measure

8.3.1 POS 3.1 AC Filter: AC frequency Filter. This filter deals with AC noise from the power source, poor earth grounding and electrical noise on the fluid column. **NOTE:** This is a factory set filter. Changing this filter will have a direct effect on meter response time and should only be adjusted with the assistance of McCrometer Technical Support.

8.3.2 POS 3.2 M Filter: Measure Filter. The measure filter is a variable averaging smart filter that evaluates extreme changes in flow and accepts or rejects those changes based on the current setting. **NOTE**: This is a factory set filter. Changing this filter will have a direct effect on meter response time and should only be adjusted with the assistance of McCrometer Technical Support.

8.3.3 POS 3.3 Cut-off: Cutoff point which all flow is reported as zero. This value is set as a percentage of the full scale.

8.3.4 POS 3.4 E.saving: E.saving. Energy savings mode. This function is used when the instrument is powered by a battery, solar, or other DC source power with limited available power. This function provides an energy savings between 60 to 80% depending on the flow conditions. The energy consumption is controlled by reducing the number of active coil cycle during times of stable flow. When the flow is stable fewer measuring cycles are required to produce a flow report. When the flow suddenly changes, a higher number of coil cycles will be needed report that change. The converter will monitor and adjust the number of cycles used to capture the flow report as needed.

8.4 Menu 4 - Alarms

8.4.1 POS 4.1 Max Thr + : Max Thr +, Maximum flow threshold, forward flow. This is the set point to trigger a high flow alarm set as a percentage of full scale. This function is disabled when set to zero.

8.4.2 POS 4.2 Max Thr - : Maximum flow threshold, reverse flow. This is the set point to trigger a high flow alarm set as a percentage of full scale. This function is disabled when set to zero.

8.4.3 POS 4.3 Min thr +: Minimum flow threshold, forward flow. This is the set point to trigger a low flow alarm set as a percentage of full scale. This function is disabled when set to zero.

8.4.4 POS 4.4 Min thr -: Minimum flow threshold, reverse flow. This is the set point to trigger a high flow alarm set as a percentage of full scale. This function is disabled when set to zero.

8.4.5 POS 4.5 Hyst.: Alarm Hysteresis. Set 0-25%. This sets the lag in response based on a percentage of the full scale. Example if the alarm triggers at 100% and the hysteresis is set to 2% then once triggered the current rate must change beyond 2% to exit out of the current alarm state. This setting applies to all alarms.

8.4.6 POS 4.6 mA v. fault: mA value fault. Current output value during alarm events set as a percentage 0-120% of the current output range. The current range 0/4mA to 20/22mA is set in *8.6 Menu 6 - Outputs*. For example, if an empty pipe alarm is present and the mA v. fault value is set to 10% and the current scaling is set 4 to 20mA, then the current output would send a 2mA signal until the empty pipe alarm is cleared. This function is disabled when set to zero.

8.4.7 POS 4.7 Hz v. fault: Hertz value fault. Frequency output value during alarm events set as a percentage 0-125% of the frq1/frq2 range. For example, if an empty pipe alarm is present and the Hz v. fault value is set to 110% and the Frq1 scaling is 100 Hz, then the frequency output on channel 1 would send a 110 Hz signal until the empty pipe alarm is cleared. This function is disabled when set to zero.

8.5 Menu 5 - Inputs

8.5.1 POS 5.1 T+ reset: Positive Totalizer Reset Enable. Set by turning on or off. This allows for the positive total totalizer to be reset through the input.

8.5.2 POS 5.2 T- reset: Negative Totalizer Reset Enable. Set by turning on or off. This allows for the negative total totalizer to be reset through the input.

8.5.3 POS 5.3 Puls.reset: Pulse Output Reset Enable. Set by turning on or off. This allows for the totalized pulses to be reset through the input.

8.5.4 POS 5.4 Count lock: Totalizer Count Lock Input Enable, Set by turning on or off. This allows for the totalizers to be locked (frozen) when the input is active.

8.6 Menu 6 - Outputs

8.6.1 POS 6.1 Out 1: Transistor output channel 1. See tables on the next page for available settings.

8.6.2 POS 6.2 Out 2: Transistor output channel 2. See tables on the next page for available settings.

8.6.3 POS 6.3 Out 3: Transistor output channel 3. See tables on the next page for available settings.

8.6.4 POS 6.4 Out 4: Transistor output channel 4. See tables on the next page for available settings.

8.6.5 POS 6.5 Out mA1: Current output channel 1. See tables on the next page for available settings.

8.6.6. POS 6.6 Out mA2: Current output channel 2. See tables on the next page for available settings.

Outputs available for open collector transistor outputs #1 & #2 only:

Function Symbol	Function Explanation
#1 IMP+	Pulse on output 1 for forward flow rate. Only assignable to channel 1. This option will trigger 1 pulse per totalizer count for the forward flow totalizer.
#1 IMP-	Pulse on output 1 for reverse flow rate. Only assignable to channel 1. This option will trigger 1 pulse per totalizer count for the reverse flow totalizer.
#1 IMP	Pulse on output 1 for forward and reverse flow rate. Only assignable to channel 1. This option will trigger 1 pulse per totalizer count for both the forward and reverse flow totalizers.
#2 IMP +	Pulse on output 2 for forward flow rate. Only assignable to channel 2. This option will trigger 1 pulse per totalizer count for the forward flow totalizer.
#2 IMP -	Pulse on output 2 for reverse flow rate. Only assignable to channel 2. This option will trigger 1 pulse per totalizer count for the reverse flow totalizer.
#2 IMP	Pulse on output 2 for forward and reverse flow rate. Only assignable to channel 2. This option will trigger 1 pulse per totalizer count for both the forward and reverse flow totalizers.
#1 FREQ+	Frequency on output 1 for forward flow rate. Only assignable to channel 1. This option will trigger a frequency output for forward flow.
#1 FREQ-	Frequency on output 1 for reverse flow rate. Only assignable to channel 1. This option will trigger a frequency output for reverse flow.
#1 FREQ	Frequency on output 1 for forward and reverse flow rate. Only assignable to channel 1. This option will trigger a frequency output for both forward and reverse flow.
#2 FREQ+	Frequency on output 2 for forward flow rate. Only assignable to channel 2. This option will trigger a frequency output for forward flow.
#2 FREQ-	Frequency on output 2 for reverse flow rate. Only assignable to channel 2. This option will trigger a frequency output for reverse flow.
#2 FREQ	Frequency on output 2 for forward and reverse flow rate. Only assignable to channel 2. This option will trigger a frequency output for both forward and reverse flow.

Outputs available for open collector transistor outputs #1 through #4.

Function Symbol	Function Explanation
SIGN	Flow direction output (energized = reverse flow)
RANGE	Not Supported
MAX AL+	Max. forward flow rate output (energized = alarm off)
MAX AL-	Max. reverse flow rate output (energized = alarm off)
MAX AL	Max. forward and reverse flow rate output (energized = alarm off)
MIN AL+	Min. forward flow rate output (energized = alarm off)
MIN AL-	Min. reverse flow rate output (energized = alarm off)
MIN AL	Min. forward and reverse flow rate output (energized = alarm off)
MAX+MIN	Max. and min. flow rate alarm output (energized = alarm off)
EMPTY PIPE	Empty pipe alarm output (energized = alarm off)
OVERFLOW	Out of range alarm output (energized = flow rate is in range)
Hardw AL.	Cumulative alarm output; interrupt coils, empty pipe, and/or measure error (energized = alarms off)
EXT. COMM.	Not Supported

CURRENT VALUES IN mA ASSOCIATED TO THE % VALUE OF FULL SCALE					
POSSIBLE FIELD	REVERSE FLOW VALUE		ZERO	DIRECT FLOW VALUE	
	≤ - 110%	-100%	0%	+100%	≥+110%
OutmA= 0 ÷ 20 +	0	0	0	20	20
OutmA= 0 ÷ 22 +	0	0	0	20	20
OutmA= 4 ÷ 20 +	4	4	4	20	20
OutmA= 4 ÷ 22 +	4	4	4	20	20
OutmA= 0 ÷ 20 -	20	20	0	0	0
OutmA= 0 ÷ 22 -	22	20	0	0	0
OutmA= 4 ÷ 20 -	20	20	4	4	4
OutmA= 4 ÷ 22 -	22	20	4	4	4
OutmA= 0 ÷ 20	20	20	0	20	20
OutmA= 0 ÷ 22	22	20	0	20	22
OutmA= 4 ÷ 20	20	20	4	20	20
OutmA= 4 ÷ 22	22	20	4	20	22
OutmA= 0 ÷ 20 —0+	0	0	10	20	20
OutmA= 0 ÷ 22 —0+	0	1	11	21	22
OutmA= 4 ÷ 20 —0+	4	4	12	20	20
OutmA= 4 ÷ 22 —0+	4	4.8	12.8	20.8	22

8.7 Menu 7 - Communication

8.7.1 POS 7.1 IF2 pr.: Protocol for IF2 port. Set to DPP or HTP. This set the protocol used for communication to the IF2 device, either Data Packet Protocol (DPP) or Hyper Text Protocol (HTP). Default is DPP.

8.7.2 POS 7.2 RS485 bps: RS485 output speed. This sets the RS485 baud rate (4800, 9600, 19200, or 38400).

8.7.3 POS 7.3 A. delay: Instrument answer delay. This sets the answer delay in microseconds (0, 20, 40, 60, 80, 100, 120, or 140).

8.7.4 POS 7.4 Address: DEVICE ADDRESS (0 to 255) – This sets the address of the device for RS485 communication.

8.7.5 POS 7.5 Rem.addr: REMOTE ADDRESS (0 to 255) – This sets the address of a second remote converter.

8.7.6 POS 7.6 Remote u.conn: REMOTE CONNECTION – Pressing this connects the remote terminal. The connection will be interrupted after 10 seconds of inactivity

8.8 Menu 8 - Display

8.8.1 POS 8.1 Language: Converter language. This sets the converter language EN (English), IT (Italian), FR (French), SP (Spanish), or DE (German).

8.8.2 POS 8.2 Contrast: Display contrast set point. The display contrast can be changed to make the display appear more visible based on user preference. This menu can be set 0 to 15. The change will take affect once the menu selection has been selected by pressing the Enter/Esc key. The factory default is 5.

NOTE: if set to high or too low the display can become unreadable. If this happens then wait 60 seconds from the time of the last button push for the display to time out to the visualization page. From the visualization page press and hold the Right/Left button. The display will cycle through a different preset display contrast settings every 8 seconds. Release the button once you have found a setting that can be read.

8.8.3 POS 8.3 Quick start: Quick Start Menu Enable. This setting toggles between on and off. If set to "off" it will hide the quick start menu.

8.8.4 POS 8.4 Net total: Totalizer Net Enable. This setting toggles between on and off. Setting this menu to on will replace the current forward and reverse totalizers with the net totalizers on the visualization.

8.8.5 POS 8.5 T+ reset: Totalizer reset, forward. Resets the forward flow totalizer.

8.8.6 POS 8.6 T- reset: Totalizer reset, reverse. Resets the reverse flow totalizer.

To reset the totalizer highlight the totalizer reset option to be reset. Quick press the Enter/Esc key. The display will show "EXECUTE?". Press and hold the Enter/Esc to continue. The display will flash "Done". The visualization pages will now show the totalizer as reset.

NOTE: There is no function to reset the Net Totalizer. To reset the Net Totalizer, both the "+" and the "-" totalizers must be reset.

Figure: 53

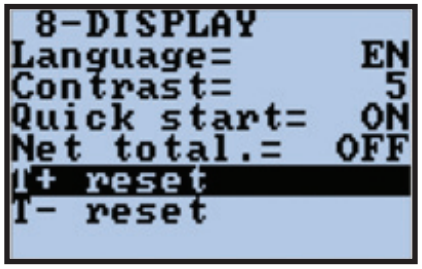


Figure: 54

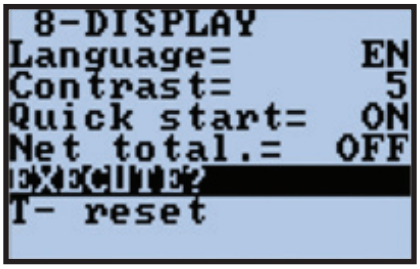
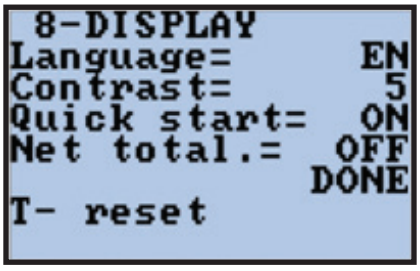


Figure: 55



8.9 Menu 9 - Data Logger

8.9.1 POS 9.1 YYYY/MM/DD: Date and time. This sets the date and time in the converter. The format for entering the date and time is year / month / day and time is hours : minutes : seconds.

8.9.2 POS 9.2 Acquisition: Event logger for internal alarms. This setting toggles between on and off. This menu enables event logging to capture alarm events internally for diagnostic purposes. This data can't be extracted.

8.9.3 POS 9.3 Display events: Displays the stored alarm events on-screen in order up to a maximum of 64 events.

8.9.4 POS 9.4 Clear events: Clears all stored events.

8.10 Menu 10 - Diagnostics

8.10.1 POS 10.1 Self-test: Converter self test. Executed command. Running the self-test will cause the converter to run an internal diagnostic test that will check for internal hardware and software errors. The converter will reboot. Once the self-test is complete if any errors are found then the error code for each error will be displayed. Refer to section *9.0 Alarm Messages* for a list of possible error codes.

8.10.2 POS 10.2 Simulation: Simulation enable. Setting this menu to ON will generate an internal signal that simulates flow and allows the outputs and all connected instruments to be tested. After simulation is set to ON, the flow can be set to a percentage based on the current FS1 setting of -125% to 125%.

To enable the simulation function highlight the Simulation menu and press the (enter/esc) key. Toggle the simulation function from OFF to ON using the Up/Down key. Press and hold the (enter/esc) key to exit back to the main menu and once again to exit to the visualization page.

Figure: 56

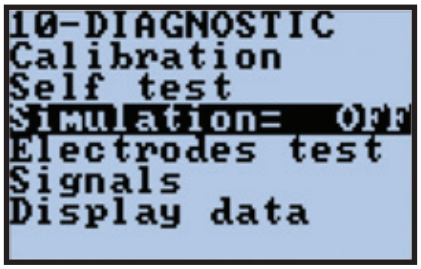
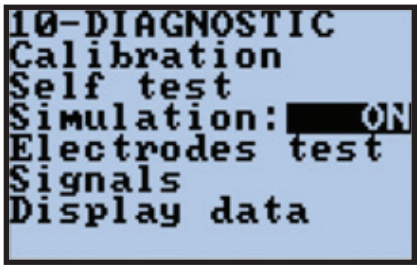
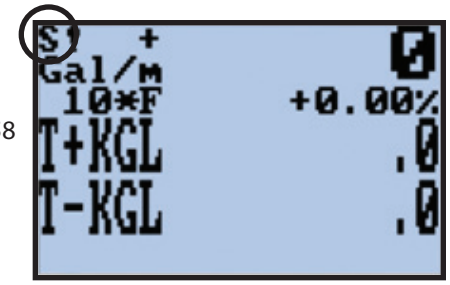


Figure: 57



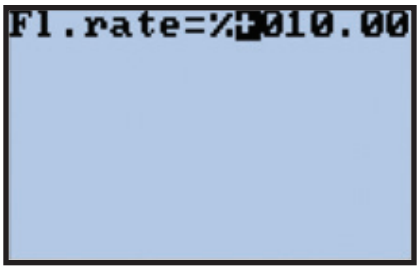
NOTE: you will now have an "S" in the upper left corner, this indicates the simulation mode is active.

Figure: 58



Press the Enter/Esc key. This will bring up the flow simulation set up screen. Use the Right/Left key and the Up/Down key to enter in the flow rate percentage value for the simulation. Press the Enter/Esc key to enter that value.

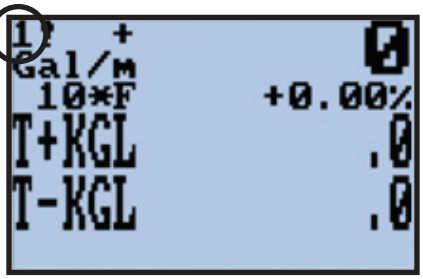
Figure: 59



The converter will start to read flow. It may take a few seconds for the readings to appear. Repeat the above steps as needed to observe the different flow rates desired.

To exit out of simulation mode, re-enter into the simulation set up screen (see above) and then press and hold the Enter/Esc key. This will exit out to the visualization screen, and the "S" in the upper left corner of the screen will return to a "1".

Figure: 60



8.10.3 POS 10.3 Electrodes test: Executed function. This function tests the internal electrode circuits for proper operation. This is a factory service menu.

8.10.4 POS 10.4 Signals: This menu displays graphical representations to various input and output signals. This is a Factory service menu.

8.10.5 POS 10.5 Display data: Numeric display for various internal settings and raw measured signals. This is a Factory service menu.

8.11 Menu 11 - Internal Data

8.11.1 POS 11.1 L2 code: Level 2 passcode. This menu changes the 2 level passcode. The factory default is 000002.

CAUTION - if the passcode is changed from the default value and is lost, it CANNOT be recovered. In the event the passcode is lost the converter can be returned to the factory to be reset. Note all data is lost during this process.

8.11.2 POS 11.2 Load fact. Pres.: Load factory presets. This is an executed menu. Executing this menu will reset all programmed values to the original factory default values.

NOTE: This menu is customized for a specific sensor. Confirm the converter has not been moved or paired with another sensor prior to executing this menu.

8.11.3 POS 11.3 Load user pres.: Load User Presets. This is an executed menu. Executing this menu will reset all programmed values to a user defined set of programming values. These values are set using the "Save user pres." Menu.

To reload the factory or user presets select the desired set of presets by highlighting the menu and press the Enter/Esc key.

Figure: 61

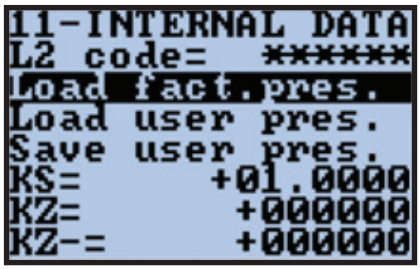
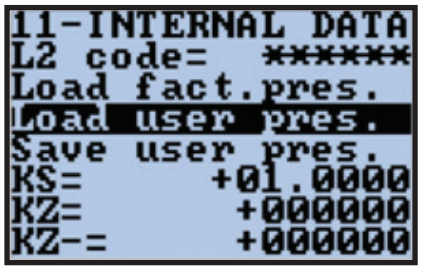


Figure: 62



You will be asked if you want to "execute?" the function. Press and hold the Enter/Esc key. This will load the saved preset values. The display will flash "DONE" once the converter has finished reprogramming the preset values.

Figure: 63

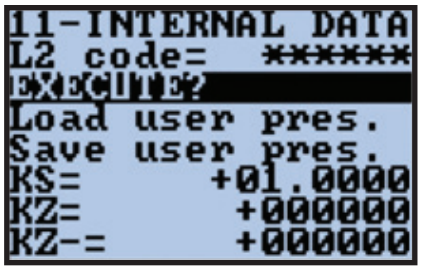
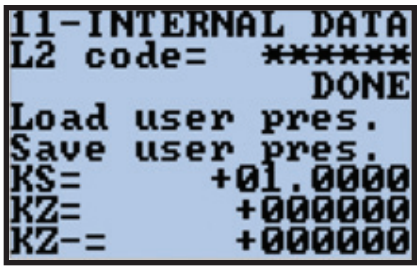


Figure: 64



8.11.4 POS 11.4 Save user pres.: Saves user presets. This is an executed menu.

To save a user defined program start by reviewing each and every programming menu and confirm that each value is set as desired. Once it is confirmed the programming is set as desired, navigate to the "Save user pres." menu and press the Enter/Esc key. You will be prompted if you want to "execute?". Press and hold the Enter/Esc key and the display will flash "DONE". Your user defined presets have now been saved and can be recalled anytime by executing the "Load user pres." function.

Figure: 65

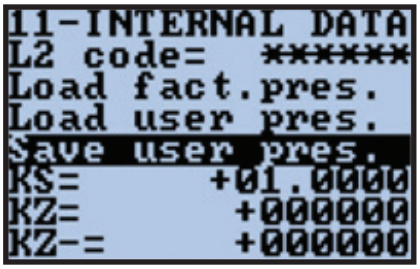


Figure: 66

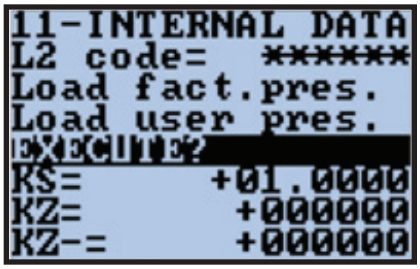
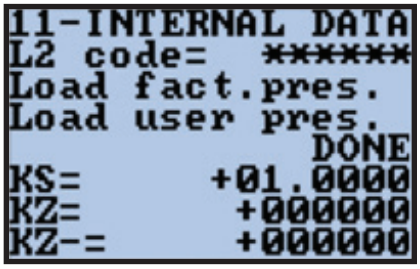


Figure: 67



8.11.5 POS 11.5 S/n: Converter serial number. This is the converter's 6-digit serial number.

8.11.6 POS 11.6 KS: Field adjustment coefficient. This value is a direct multiplier that is used as a field adjustment/correction coefficient.

8.11.7 POS 11.7 KZ: Forward zero point coefficient. The forward zero point coefficient is selected when the zero calibration is run. This menu will allow for manual adjustments of the forward zero point.

8.11.8 POS 11.8 KZ- : Reverse zero point coefficient. Used ONLY for forward and reverse sensors. The reverse zero point coefficient is selected when the zero calibration is run. This menu will allow for manual adjustments of the reverse zero point

8.11.9 POS 11.9 DAC1 20mA: Current output channel 1 20 mA trim. This is a factory service menu.

8.11.10 POS 11.10 DAC1 4mA: Current output channel 1 4 mA trim. This is a factory service menu.

8.11.11 POS 11.11 DAC2 20mA: Current output channel 2 20 mA trim. This is a factory service menu.

8.11.12 POS 11.12 DAC2 4mA: Current output channel 2 4 mA trim. This is a factory service menu.

9.0 Alarm Messages

During meter setup, you may see error messages and codes. These messages and codes are explained below.

MESSAGES	ANOMALIES	ACTION TO TAKE
NO ALARMS	Everything works regularly	-------
MAX ALARM	The flow rate is higher than the maximum threshold set	Check the maximum flow rate setting and process conditions. (Menus Max Thr and +Fs1)
MIN ALARM	The flow rate is lower than the minimum threshold set	Check the minimum flow rate threshold setting and process conditions. (Menu +Fs1)
FLOW RATE >FS	The flow rate is higher than the full scale value set on the instrument	Check the full scale value setting on the instrument and the process conditions/ (Menu Fs1)
PULSE/FREQ .FS	The output channel is saturated.	Set a bigger frequency unit or, if the connected counting device allows it, reduce the pulse duration value. (Menu Tpls)
EMPTY PIPE	The measuring pipe is empty or the detection system has not been properly calibrated	Check whether the pipe is empty.
INPUT NOISY or MEASURE 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, the grounding connections of the devices or the possible presence of noise sources
EXCITATION FAIL	The coils or the cable connecting the sensor are interrupted	Check the connecting cables to the sensor
CURR. LOOP OPEN	The 0/4-20ma output on board or the optional one are not correctly closed on a valid load	Verify the load is applied to the output (max 1000 ohm) or a resistor is in place. To disable the alarm, set the "mA VAL.FAULT" value (menu alarm) to 0.

ERROR CODES	ANOMALY DESCRIPTION	ACTION TO TAKE
0001	Problem with watch-dog circuit	ADDRESS TO FACTORY TECHNICAL SUPPORT
0002	Wrong configuration work data in EPROM	
0004	Wrong configuration safety data in EPROM	
0008	Defective EPROM	
0010	Defective keyboard (one or more keys are pushed during the test)	
0020	Power supply voltage (+3.3) is out of range	
0040	Power supply voltage (+13) is too low (<10V)	
0080	Power supply voltage (+13) is too high (>14V)	
0200	Timeout calibration input (input circuit is broken)	

ERROR CODE	ANOMALY DESCRIPTION	ACTION TO TAKE
0400	Gain input stage is out of range	Check the status of the cables connecting the sensor to the converter, the grounding connections of the devices or the possible presence of strong and anomalous noise sources
0800	Interruption on the coils circuit	Check the status of the cables connecting the sensor to the converter
0C00	Cumulative alarm 0800+0400	See single code

10.0 Specifications

POWER REQUIREMENTS:
AC: 90-265 VAC / 45-66 Hz (20W/25VA) or
DC: 10-35 VDC (21 W)
AC or DC must be specified at time of ordering.

DUAL OUTPUTS:
Dual 4-20mA Outputs: Galvanically isolated and fully programmable for zero and full scale (0-21mA)

Four separate digital programmable outputs: Isolated protected open collector transistor swtiches usable for pulse, frequency, or alarm settings.

- Volumetric Pulse
- Flow Rate (Frequency)
- Hardware Alarm Conditions
- High/Low Alarm
- Empty Pipe

ENGINEERING UNITS:
Cubic Meter; Kilo Cubic Foot; Cubic Centimeter; Milliliter; Liter; Cubic Decimeter; Decaliter; Hecaliter; Cubic Inches; American Gallons; Imperial Gallons; Cubic Feet; Standard Barrel; Oil Barrel; Cubic Yard; American Kilogallon; Imperial Kilogallon; Acre Feet; Megagallon; Imperial Megagallon

STANDARDS:
IP67 Die Cast Aluminum Converter

CERTIFICATIONS:
Safety: Listed by CSA to 61010-1:
Certified by CSA to UL 61010-1 and
CSA C22.2 No.61010-1-04

CE: Certified (Converter Only)

ELECTRICAL CONNECTORS:
Converter: Compression gland seals for 0.125" to 0.375" Diameter round cable.

GALVANIC ISOLATION:
All inputs / outputs are galvanically isolated from power supply up to 500V

CONVERTER ENCLOSURE:
IP67 Die Cast Aluminum
5.76" H x 5.76" W x 6.73" D
(14.6 cm. H x 14.6 cm. W x 17 cm D)

ENVIRONMENTAL:
Pressure / Temperature Limits:
Electronics: Operating and storage temperature:
-4˚ to 140˚ F (-20˚ to 60˚ C)

KEYPAD AND DISPLAY:
Can be used to access and change set-up parameters using three membrane keys and an LCD display

M-Series OPTIONS FORWARD AND BIDIRECTIONAL:
RS485 Modbus Protocol

***Note regarding Cable Length:** McCrometer recommends minimizing cable length. Electromagnetic flow meters may have unfavorable signal strength to noise ratio in electrically noisy environments. Longer lengths of cable increase the likelihood of interferance. In those cases where the meter's signal must be transmitted a long distance, or where the environment may be particularly noisy, we suggest using the converter's analog output(s). That allows locating the converter as close as possible to the metering location.

11.0 Returning A Unit For Repair

If the unit needs to be returned to the factory for repair, please do the following:

- Prior to calling for a return authorization number, determine the model number, serial number (located inside the front panel of converter), and reason for return.
- Call the McCrometer Customer Service Department at 1-800-220-2279 and ask for a Return Authorization (RA) number.
- Ship the meter in the original packaging, if possible. Do not ship manuals, power cords, or other parts with your unit unless required for repair.
- Please make sure the meter is clean and free from foreign debris prior to shipping.
- Write the RA number on the outside of the shipping box. All return shipments should be insured.
- Address all shipments to:

  McCrometer, Inc.
  RMA #
  3255 W. Stetson Avenue
  Hemet, CA 92545

12.0 Troubleshooting Guide

Problem	Troubleshooitng Steps
Not getting expected 4-20mA output	• Insure the wiring is firmly connected on the 4-20mA output terminals • Verify the FS1 setting in the Quick Start menu is set to the correct value • Measure output on the 4-20mA terminals and compare it to the calculated current value
Curr. Loop Open Alarm	• Insure the wiring is firmly connected on the 4-20mA output terminals • If the 4-20mA output is not being used, insure 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	• Insure 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. • Insure the wiring is firmly connected to any PreAmp being used.
Noisy Input Alarm	• Verify there is a jumper on terminals 3 and 4 • Verify the converter ground is to earth ground • Check for damaged cable between the sensor and converter
Empty Pipe Alarm	• Confirm the pipe is full • Verify there is a jumper on terminals 3 and 4 • Check EP Threshold. Set to 192 if short cable (less than 50 ft.), set to <120 if longer cable (50 ft. to 100 ft.). Consult the factory for assistance in selecting the correct value. • 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	• Check grounding connections • Check power circuit. What other devices are on the circruit • Install dedicated ground circuit
Menu Not Accessible	• Confirm the password being used is 000002 • Verify dip switches in the back panel next to the terminals 1 and 2 are both down.
Rate Of Flow Report Is Not As Expected	• Confirm the unit is programmed correctly by requesting a program setting report from the factory.

Appendix 1.0 Units of Measure

The tables below show the units of measure available for selection.

U.S. Standard	
in3	Cubic Inches
Gal	U.S. Gallons
IGL	Imperial Gallons
ft3	Cubic Feet
bbl	Standard Barrels
BBL	Oil Barrels
KGL	Kilo Gallons
IKG	Imperial Kilo Gallons
kf3	Kilo Cubic Feet
Aft	Acre Feet
MGL	Mega Gallons
IMG	Imperial Mega Gallons

Metric	
ml	Milliliters
cm3	Cubic Centimeters
l	Liters
dm3	Cubic Decimeter
dal	Decaliter
hl	Hectoliter
m3	Cubic Meter

Time	
s	Seconds
m	Minutes
h	Hours
d	Days

Appendix 2.0 Conversion Tables

Table of Decimal Equivalents

Fraction	Decimal
1/8	.125
1/4	.25
3/8	.375
1/2	.5
5/8	.625
3/4	.75
7/8	.875

Table of Conversions

Multiply	By	To Get
Centimeters	0.3937	Inches
Centimeters	0.03281	Feet
Inches	25.4	Millimeters
Feet	30.48	Centimeters
Sq. Ft.	144.0	Sq. In
Sq. In	0.006944	Sq. Ft.
Cu. In	0.0005787	Cu. Ft.
Cu. Ft.	7.481	Gallons
Cu. Ft.	1728.0	Cu. In
Cu. Ft.	0.02832	Cu. Meters
Cu. Ft.	28.32	Liters
Cu. Meters	35.31	Cu. Ft.
Cu. Meters	264.2	Gallons
US Gallons	3.785	Liters
US Gallons	0.1337	Cu. Ft.
US Gallons	0.003785	Cu. Meters
US Gallons	.8326748	Imperial Gallons
Liters	0.2642	Gallons
$^oF = (^oC \times 9/5) + 32$	$^oC = (^oF - 32) \times 5/9$	

WARRANTY STATEMENT

Manufacturer warrants all products of its manufacture to be free from defects in workmanship and material under normal use and service. The warranty for the ***M-Series Converter*** extends for a period of twelve (12) months after date of shipment (if the converter is purchased alone), unless altered by mutual agreement between the purchaser and manufacturer prior to the shipment of the product. If the M-Series converter is purchased with a flow sensor system, the Warranty Statement for the flow sensor shall apply.

If this product is believed to be defective and is within its warranty period, purchaser shall notify the manufacturer, and will return the product to the manufacturer, postage paid, within twelve (12) months after date of shipment by the manufacturer. If the purchaser believes the return of the product to be impractical, manufacturer shall have the option, but will not be required, to inspect the product wherever located. In any event, if the purchaser requests the manufacturer visit their location, the purchaser agrees to pay the non-warranty expenses of travel, lodging and subsistence for the field service response. If the product is found by the manufacturer's inspection to be defective in workmanship or material, the defective part or parts will either be repaired or replaced, at manufacturer's election, free of charge, and if necessary the product will be returned to purchaser, transportation prepaid to any point in the United States. If inspection by the manufacturer of such product does not disclose any defect of workmanship or material, manufacturer's regular service repair charges will apply.

THE FOREGOING WARRANTY IS MANUFACTURER'S SOLE WARRANTY, AND ALL OTHER WARRANTIES, EXPRESS, IMPLIED OR STATUTORY, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, ARE NEGATED AND EXCLUDED. THE FOREGOING WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, GUARANTEES, REPRESENTATIONS, OBLIGATIONS OR LIABILITIES ON THE PART OF THE MANUFACTURER.

Purchaser's sole remedy and manufacturer's sole obligation for alleged product failure, whether under warranty claim or otherwise, shall be the aforestated obligation of manufacturer to repair or replace products returned within twelve months after date of original shipment. The manufacturer shall not be liable for, and the purchaser assumes and agrees to indemnify and save harmless the manufacturer in respect to, any loss or damage that may arise through the use by the purchaser of any of the manufacturer's products.

NOTES:

OTHER McCROMETER PRODUCTS INCLUDE:

	Magnetic Flowmeters
	Magnetic Flowmeters
	Magnetic Flowmeters
	Propeller Flowmeters
	Wireless Telemetry Systems
	Propeller Flowmeters
	Differential Pressure Flowmeters
	Differential Pressure Flowmeters
	Differential Pressure Flowmeters

Represented By:

McCROMETER
www.mccrometer.com

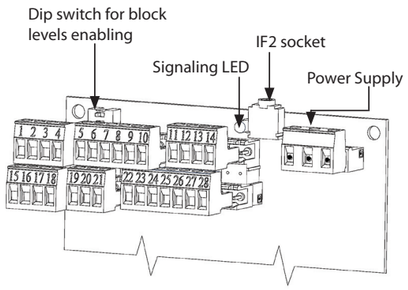
3255 WEST STETSON AVENUE • HEMET, CALIFORNIA 92545 USA
TEL: 951-652-6811 • 800-220-2279 • FAX: 951-652-3078 Printed In The U.S.A. Lit. 30120-47 Rev. 1.4/05-13

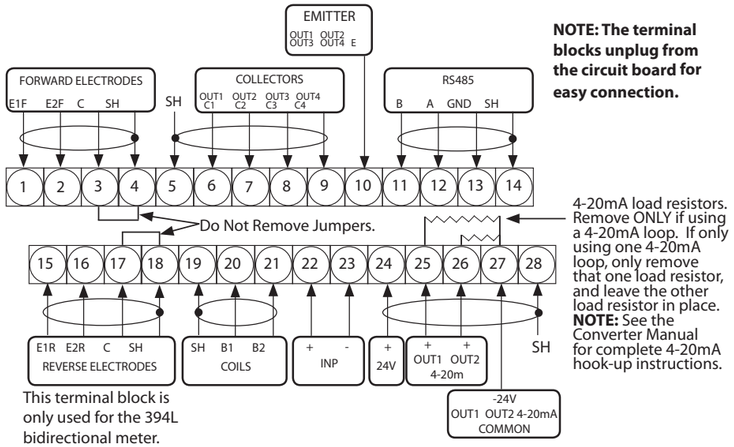
STEP 11: TERMINAL BOARD CONNECTIONS (M-SERIES CONVERTER)

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

All connections are made on the terminal board. To access the terminal board, loosen the four screws on the back of the converter to remove the rear cover.

CAUTION! Always disconnect the power cord before attempting any electrical connections.





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

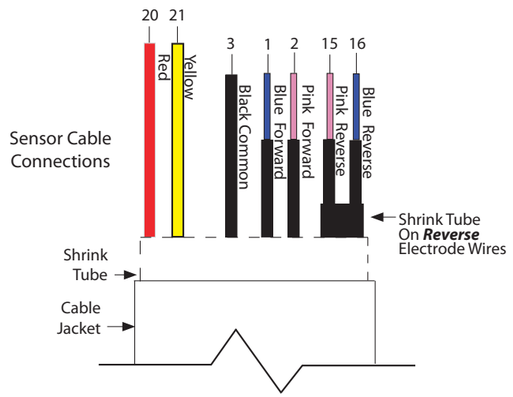
4-20mA load resistors. Remove ONLY if using a 4-20mA loop. If only using one 4-20mA loop, only remove that one load resistor, and leave the other load resistor in place. **NOTE:** See the Converter Manual for complete 4-20mA hook-up instructions.

This terminal block is only used for the 394L bidirectional meter.

394L BIDIRECTIONAL WIRING DIAGRAM

Terminal Block Assignments

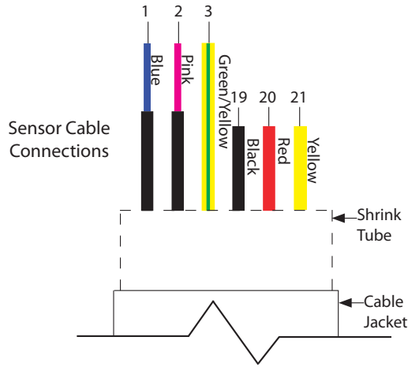
Terminal	Wire Color	Connected To
#20 (B1)	Red	Coil
#21 (B2)	Yellow	Coil
#3 (C)	Black	Ground electrodes
#1 (E1F)	Blue	Forward Electrodes 1
#2 (E2F)	Pink	Forward Electrodes 2
#15 (E2R)	Pink (In shrink tube)	Reverse Electrodes 2
#16 (E1R)	Blue (In shrink tube)	Reverse Electrodes 1



395L FORWARD ONLY WIRING DIAGRAM

Terminal Block Assignments

Terminal	Wire Color	Connected To
#1 (E1F)	Blue	Right sensing electrodes
#2 (E2F)	Pink	Left sensing electrodes
#3 (C)	Green/Yellow	Ground electrodes Combination of: Purple, green/yellow and drain wires from sensing electrode cables
#19 (SH)	Black	Magnet shield / overall cable shield
#20 (B1)	Red	Coil
#21 (B2)	Yellow	Coil



CONTACT INFORMATION

McCROMETER
www.mccrometer.com

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TEL: 951-652-6811 • 800-220-2279 • FAX: 951-652-3078

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McCROMETER

FPI Mag™

Models 394L & 395L

Full Profile Insertion

Electromagnetic Flow Meter

Quick Start Guide

30120-65 Rev. 1.2
August, 2013

SAFETY WARNINGS

WARNING! Incorrect installation or removal of FPI Mag meters can result in serious injury or death. Read the instructions and the safety warnings in the supplied manual carefully before installation. This guide is not intended as a substitute for reading the manual.

CONTENTS

1 - FPI Mag Sensor
2 - Long threaded retaining rods
2 - Short threaded retaining rods
1 - Converter (M Series or L Series)
1 - Calibration Certificate
1 - FPI Mag Installation, Operation and Maintenance Manual
1 - Converter Installation, Operation and Maintenance Manual
2 - 9/16" or 3/4" reversible ratchet wrenches
1 - Pipe thread sealant
8 - Hex nuts (3/8" or 1/2")
4 - Locking cotter pins
1 - Power cord (8', 115 VAC)
1 - Sensor cable with Quick-Connect
1 - Bronze ball valve & SS nipple

TOOLS

Tools Provided:

Two - 9/16" or 3/4" reversible ratchet wrenches. (Size is dependent on the size of the retaining rods supplied with the sensor and determined at the time of order.)

One- tube of pipe thread sealant

Tools recommended for installation

One - Pipe wrench capable of a 4" span

One - 7/16" wrench or crescent wrench

One- Sensor Insertion Tool (3/8" or 1/2")

NOTE: It is recommended that the Sensor Insertion Tool be used for easier and faster installation. See STEP 12.

INSTALLATION STEPS

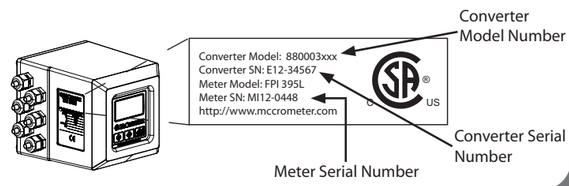
STEP 1: VERIFY FLOW METER SERIAL NUMBERS

Verify the system serial numbers on both the sensor and converter match to ensure a properly calibrated system.

The Meter Serial Number is located on the side of the sensor body on a silver label.

Meter Serial Number

The tag on the side of the converter has the Converter Model Number, the Converter Serial Number and the Meter Serial Number.



STEP 2: DETACH THE CABLE QUICK CONNECT

The sensor cable is fitted with an IP68 rated Quick Connect fitting at the sensor connection. Detach the cable prior to sensor installation.

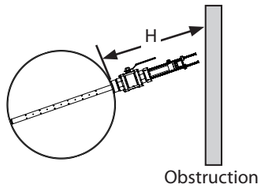
IMPORTANT: When the cable is not attached to the sensor, connect the end caps to the sensor and cable connections to keep them free of dirt and corrosion. When the cable is attached to the sensor, connect the end caps together.

STEP 3: SENSOR INSTALLATION LOCATION

This Quick Start Guide is designed to provide installation instructions when the location of the sensor installation has been predetermined. If not, see the FPI Mag Installation, Operation and Maintenace manual (Lit. No. 30120-48) , *See Section 2.0 Installation, STEP 5 - Verify Sensor Installation Location - Upstream And Downstream Straight Pipe Runs.*

STEP 4: SENSOR CLEARANCE

The sensor will protrude from the pipe during installation and when installed requiring sufficient clearance from any obstruction.



Line Size (Inches)	Distance H
4"	51"
6"	51"
8"	55"
10"	55"
12"	59"
14"	59"
16"	59"
18"	63"
20"	63"
22"	67"
24"	67"
30"	71.25"
36"	77.25"
42"	83.25"
48"	89.25"
54"	95.25"
60"	101.25"
66"	107.25"
72"	113.25"
78"-138"	Call Factory

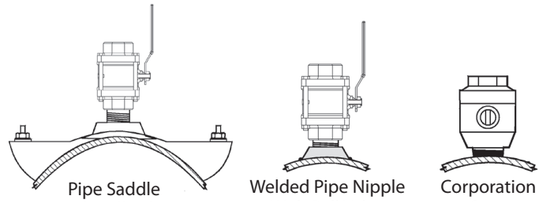
Actual clearance value varies by application.

STEP 5: PIPE VALVE INSTALLATION

WARNING! Pressurized pipes should only be hot tapped, cut, or drilled by qualified personnel using high quality saddles, valves and stainless steel nipples. If possible, depressurize the pipe before attempting any installation.

The *sensor* comes standard with a 2" bronze ball valve and a 2" x close stainless steel nipple. The 2" x close stainless steel nipple is to be used if the installation site has a female fitting, i.e., a welded coupling. If the installation site has a male fitting, i.e. a 2" nipple, then the supplied 2" x close stainless steel nipple is not required for the *sensor* installation.

Use the supplied pipe sealant or Teflon thread tape when installing the valve onto the pipe.



IMPORTANT: The MINIMUM port inside diameter for all installation valves is 1-7/8" (48mm).

STEP 6: OPTIONAL COMPRESSION SEAL DISASSEMBLY FOR INSTALLATION

The *sensor* assembly can be installed onto the pipe valve as a whole unit. On larger pipe size installations this can be cumbersome or impractical. In such cases the compression seal assembly can be removed from the *sensor* for easier installation onto the pipe valve. Once the compression seal assembly is installed onto the pipe valve, then the *sensor* can be re-installed into the compression seal assembly.

NOTE: if this step is skipped, proceed to STEP 8.

1. Loosen, but do not remove, the bolts and nuts on the compression seal relieving the pressure on the compression seal assembly.

2. On the compression seal assembly, remove the locking cotter pins from the bottom of the two retaining rods under the 3/8" or 1/2" nuts.

Remove the 3/8" or 1/2" nuts from the retaining rods.

3. Slide the sensor out of the compression seal. The retaining rods will also slide out of the compression seal assembly. Carefully set the sensor and attached hardware to the side.

At this point the compression seal assembly can be installed onto the valve.

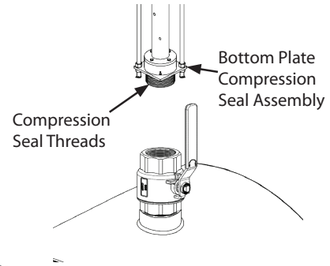
STEP 7: SENSOR INSTALLATION ONTO PIPE VALVE

The sensor assembly uses a compression seal, which keeps the sensor watertight when the pipe is under pressure. Care must be taken when installing the sensor to avoid leaks.

1. Visually inspect all elements of the installation to ensure they are structurally sound and of high quality materials, including all welds, couplings and nipples.

2. Put a generous amount of the supplied pipe sealant on the compression seal threads. Teflon tape may also be used. **NOTE: If pipe sealant gets on the sensor electrodes the velocity signal may be lost.**

3. Place the compression seal threads over the pipe valve. Turn the entire sensor assembly clockwise to secure the assembly to the valve.



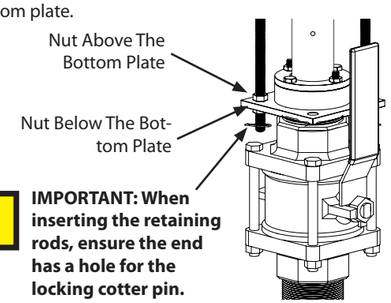
The seal is secure when a large amount of force is required to turn the assembly. Line up the arrow (on the top plate with the direction of the flow. The sides of the bottom plate should be parallel with the pipe.

STEP 8: SENSOR RE-ASSEMBLY AFTER OPTIONAL COMPRESSION SEAL ASSEMBLY INSTALLATION

NOTE: Use this step if you removed the *compression seal assembly* (STEP 6) and installed it onto the pipe valve separate from the *sensor*. If you installed the sensor without disassembling it, proceed to the next step.

1. Apply water to the interior surface of the seal gland. This will act as a lubricant to facilitate the insertion of the sensor and ensure its proper axial loading.

2. Insert the sensor into the compression seal in the bottom plate while inserting the two retaining rods into their respective holes in the bottom plate and secure with 3/8" or 1/2" nuts above and below the bottom plate.



IMPORTANT: When inserting the retaining rods, ensure the end has a hole for the locking cotter pin.

3. Ensure the two nuts above and below the compression seal assembly are sufficiently tightened to prevent the threaded rod from rotating.

4. Insert the locking cotter pins through small holes in the bottom of the retaining rods, just below the 3/8" or 1/2" nuts.

STEP 9: INSERTING THE SENSOR

The sensor can be installed while the line is under flowing conditions. The line water velocity should be as low as possible to prevent sensor vibration during the insertion process. The velocity must be under 5 ft/s.

WARNING! The compression seal/sensor assembly may be under pressure. Serious injury may result if proper procedures are not followed. Do not attempt to install the sensor without the retaining rods fully assembled.

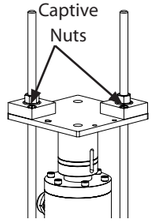
If the meter was disassembled to assist in the installation of the compression seal assembly on to the valve it is important to ensure that the meter is properly reassembled with both retaining rods completely installed with the 3/8" or 1/2" nuts properly tightened.

Ensure the two compression seal bolts are hand tightened.

Barely crack open the valve and tighten compression seal bolts as required to minimize leaks. A towel draped around the compression seal can reduce spray if necessary.

Open the valve completely. Failure to open the valve completely will cause the valve to scrape the sensor during insertion and may result in permanent damage to the sensor.

Insert the sensor into the pipe by *simultaneously* rotating the two captive nuts on the top plate clockwise until the foot of the sensor reaches the far wall of the pipe and the load spring is compressed. It is recommended that the Sensor Insertion Tool be used to rotate the captive nuts to ensure the top plate compresses evenly.



IMPORTANT: If the captive nuts are not tightened simultaneously, the top plate will become crooked and cause the sensor to be inserted at an angle and may cause permanent damage.

NOTE: If the short retaining rods are not used, run a 3/8" or 1/2" nut down against each captive nut to prevent the captive nut from rotating.

A load is now applied at the top of the sensor forcing the bottom of the sensor to seat against the far wall of the pipe. The amount of load is indicated by the three lines and set screw at the top of the sensor. The bottom line indicates a 300 lb. load.

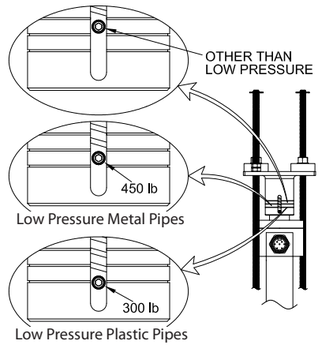
Recommended sensor loads are 300 lbs. or less for low pressure plastic pipes and 450 lbs. for low pressure metal pipes.

For applications other than low pressure the sensor load should be increased. Follow the instructions below until the set screw is between the top and middle lines. Consult factory for the appropriate loading for your application.

Rotate the two captive nuts on the top plate until the proper load is indicated. If using the Insertion Tool, rotate the two captive nuts using only the low gear shaft until the proper load is indicated. DO NOT use the high gears on the insertion tool as this may create too much load too fast and damage the sensor or the pipe.

Tighten the compression seal bolts again.

NOTE: Tighten compression seal bolts/nuts just enough to stop the seal from leaking. Do not overtighten the compression seal as it may cause damage to the seal itself.



STEP 10: INSTALLING THE SHORT RETAINING RODS

After the sensor has been inserted and the load adjusted, shorter retaining rods can be installed and the longer ones removed. This will make the sensor more compact.

IMPORTANT: The long retaining rods are matched to each sensor and are required for the removal of the sensor. It is important to safely store the long retaining rods and label them with the meter serial number.

1. Insert the two short retaining rods through the two holes in the top plate opposite the two captive nuts with the long retaining rods. Once the short retaining rods are passed through the top plate, thread one nut per rod onto the bottom of the rod about one inch.

2. Insert the two short rod ends through the corresponding holes on the compression seal bottom plate. Thread a nut onto the bottom of each short retaining rod.

3. Tighten the nuts above and below the compression seal bottom plate to secure the short retaining rods to the bottom plate.

4. Attach the locking cotter pins to each end of the short retaining rods.

5. Secure the short retaining rods to the top plate with one 3/8" or 1/2" nut per rod.

6. Remove the long retaining rods.

7. Check and adjust the "Sensor Load" as necessary. See Step 9.

8. Secure the 3/8" or 1/2" nuts on the top plate by running a second jam nut down and tightening it against the first nut.

9. Attach a locking cotter pin to the top ends of the short retaining rods.