Installation & Operation

Marsh Multi-Mag™
Insertable Electromagnetic Averaging Magmeter – 2” and 3” Sensors
Models 285 and 287
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WARRANTY STATEMENT

Manufacturer warrants all products of its manufacture to be free from defects in workmanship and material under normal use and service. This warranty extends for a period of twelve (12) months after date of shipment, unless altered by mutual agreement between the purchaser and manufacturer prior to the shipment of the product. In addition, the Multi-Mag sensor is warranted for an additional forty-eight (48) months (60 months total). If this product is believed to be defective, purchaser shall notify manufacturer and will return the product to the manufacturer, postage paid, within twelve (12) months after date of shipment (60 months for the sensor) 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 aforesaid 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.
**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 Health and Safety 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.

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**WARNING!**
Never enter a confined space without first 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 tapped, cut, or drilled by qualified personnel. If possible, depressurize and drain the pipe before attempting any installation.
The Multi-Mag is installed in two stages:

1. Multi-Mag sensor installation
2. Electronics installation and connection

This chapter includes both installation stages. After the sensor and electronics are installed, the instrument is set up for the site. This is included in Chapter 2, *Setting up the Multi-Mag.*

**Note:** The transmitter and sensor are supplied as a matched system. Check serial numbers to ensure matched pair.
Sensor installation - 2" and 3" Sensor

Please read the following information before installing the Multi-Mag sensor.

Site selection

Install the sensor at an adequate distance from elbows, T-junctions, Y-junctions, active valves, etc. Whenever possible, install the sensor downstream from a bend or junction.

Refer to the Application Schematics (located in the Appendix) to find the best sites for several typical applications.

Sensor mounting hardware

The Multi-Mag sensor is inserted into the pipe through a two-inch corporation stop or valve.

Pulling sensor cable through underground electrical conduit

Pools of water may collect in underground electrical conduit. If the sensor cable is pulled through underground electrical conduit, seal the end of the sensor cable with electrical tape to keep water out of the sensor cable.

Electrical conduit that is run from a manhole or vault must be sealed to keep corrosive or dangerous gases out of the meter electronics.
**Location, position, and clearance**
To find the best sensor location, refer to the application schematics located in the appendix to this manual.

In general, locate the sensor downstream from pipe bends, junctions, or obstructions. Install the sensor 90° out of plane from upstream elbows.

If you have any questions, or would like technical assistance in selecting the best possible location for installing the Multi-Mag sensor, please call the McCrometer Customer Support Department (1-800-220-2279).

**Sensor clearance**
Because the sensor will protrude from the pipe when installed, a clearance of at least the total sensor length plus the distance from the outer pipe wall to the top of the valve plus 9" (229 mm) (distance H, below) must be allowed. See Multi-Mag Sensor Specification (2" and 3" Sensor Specification Sheet).
NOTE
Valves are optional or supplied by user.
Install pipe valve

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

**Using a corporation stop**

Install a 2" (50mm), full port corporation stop with a 2" (50mm) NPT female pipe thread output (McCrometer part number 438000401). Follow the installation instructions for the corporation stop.

**Using a pipe valve**

1. Install a pipe nipple using a pipe saddle, welded thread-o-let, or other means.

2. Install a 2", full port valve (ball or gate).

3. Make an access hole in the pipe (2" (50mm) recommended, 1-7/8" (48mm) minimum).

4. If possible, save the pipe section removed when the access hole is made. This can be used to verify the pipe thickness.

---

*Ford pipe saddle*
*Factory supplied ball valve*  
*Bronze PN 43055 or S/S PN 43059*  
*MMI supplied nipple*  
*S/S PN 43060*

*Welded pipe nipple with*  
*Factory supplied ball valve*  
*Bronze PN 43055 or S/S PN 43059*

*Factory supplied corporation stop*  
P/N 438000401
Install sensor assembly on the 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. Put a liberal amount of the pipe sealant (supplied with the sensor) on the compression seal threads. (Teflon tape may also be used.)

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

3. 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.
Insert the sensor

1. Lubricate the compression seal and sensor with soap and water (a bar of soap is provided). This will prevent the compression seal from binding, as well as ease insertion.

2. Tighten the two compression seal bolts (located on the sensor bottom plate).

3. After the sensor assembly (with restraining rods in place) has been installed onto the valve and the compression seal bolts have been tightened, fully open the valve. If the valve is not fully open, it may scrape the side of the sensor.

4. Insert the sensor into the pipe by simultaneously rotating the two captive nuts on the top plate clockwise with the two ratchet wrenches provided.

**NOTE**
If the captive nuts are not tightened simultaneously, the top plate will become crooked and the captive nuts will bind.

**IMPORTANT**
Do not use oil or grease-based lubricants, as they could coat the electrodes, causing a velocity signal loss.

**CAUTION**
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 restraining rods fully assembled.

**NOTE**
The water velocity should be as slow as possible when the sensor is installed (to prevent sensor vibration). The velocity must be under 5 ft/sec (1.5 m/sec), optimum is zero.

**CAUTION**
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 restraining rods fully assembled.
A profiling insertion tool (P/N 75031) is available to help with inserting the sensor. Place the profiling insertion tool over the captive nuts and rotate the high gear shaft clockwise until the bottom of the sensor reaches the far wall of the pipe. The low gear shaft is used when torque on the high gear is excessive due to high pressure in the pipe.
**Sensor load**

A load is applied at the top of the sensor forcing the bottom of the sensor against the far wall. This keeps the sensor firmly in place against the far wall of the pipe. The amount of load is indicated by the two lines and set screw at the top of the sensor (see drawing). The bottom line indicates a 300-lb. load. The top line indicates a 600-lb. load.

1. Rotate the low gear shaft until the proper load is indicated.

   Recommended sensor loads are 300 lbs. or less for plastic pipes, 450 lbs. for metal pipes.

2. Tighten the compression seal bolts.

   **NOTE**
   
   Tighten the compression seal bolts only enough to seal the sensor. If the compression seal bolts are too tight, the compression seal may grip the sensor, and will distort when the sensor is moved into the pipe. The compression seal bolts will be tightened after the sensor is inserted.

**Install the short restraining rods**

After the sensor has been inserted and the load adjusted, shorter restraining rods can be installed and the longer ones removed. This will make the sensor assembly compact and reduce the chances of injury by the protruding rods.

1. Secure the short restraining rods to the bottom plate with two 3/8" nuts.

2. Secure the short restraining rods to the top plate with one 3/8" nut and Locktite™ or two 3/8" nuts.

3. Install the locking cotter pins.

4. Remove the long restraining rods.

   **NOTE**
   
   If the short rods are not used, run a 3/8" nut down against each captive nut.
Secure the threaded rod to the bottom plate with two nuts and a locking cotter pin.

Rue™ Ring locking cotter pin installation.

1. Push the pin through the hole and over the end of the threaded rod.
2. Automatic lock captures pin.
3. Optional manual lock tension joint.

Two nuts or Locfit™ to keep the nuts from vibrating loose.
Assembling or disassembling the sensor

The sensor is shipped fully assembled. However, if sensor repair or replacement is required, the sensor may need to be disassembled or reassembled. To disassemble the sensor, follow the assembly instructions in reverse.

Attach the top plate to the sensor

1. Place the spring on top of the tension indicator at the top of the sensor.

2. Slide the spring housing of the top plate over the spring. Secure the top plate to the sensor with the two stainless steel 1032 x 5/8 set screws. Use a 3/32 hex key wrench to tighten the set screws.

**IMPORTANT**

Make sure the sensor is aligned with the flow arrow on the top plate. The sensor is aligned when the electrodes are facing the opposite direction from the flow arrow.
Restraining rod and compression seal assembly

1. Screw the restraining rods onto the captive nuts on the top plate until the restraining rods are about an inch above the captive nuts. The distance above the captive nuts for both restraining rods should be equal.

2. Screw one 3/8-16 S/S nut up about an inch onto the bottom of each restraining rod.

3. Insert the restraining rods through the appropriate holes in the compression seal bottom plate and secure with 3/8-16 S/S nuts.

4. Insert the locking cotter pins to keep the bottom nuts from vibrating loose.
Electronics installation

Mount the electronic housing

Mount the electronics in an electronics shed or environmental enclosure, or outdoors with the optional sun shield (part number 0624B339001). The meter is mounted using three heavy bolts (see dimensions, below). The electronics is not suitable for underground vault or manhole installations where submersion could occur.
Electrical cable connections

Sensor connections

**CAUTION**

All cable entries must be properly sealed.

Glands must be appropriate for sealing on the cable size in use.

Unused cable entries must be plugged.

Electrical installation and earthing must be in accordance with relevant national and local standards.

The transmitter and sensor are supplied as a matched system. Check serial numbers to ensure matched pair.

Sensors are supplied with an integral cable. The transmitter end of the cable, the power supply, and any output cables must be prepared and connected as detailed in the relevant parts of this manual.

Transmitters

**CAUTION**

Unused cable entries must be blanked with the permanent blanking plugs supplied.
Transmitter connections

For service, call 951-652-6811.
External totalizer/frequency outputs

Electromechanical connections

Telemetry, electronic counters, etc.
Alarm outputs

NOTE

Inductive loads may be suppressed by diodes (D) - 1N4004 or similar.

Inrush currents are limited to 1 Amp by resistor R (e.g., 27Ω 1W for 24V systems.

Operation of outputs is programmable (see Configuration for details).

Frequency and alarm outputs share a common return with contact input

Relay and timers
Contact input

Volt-free contact

Voltage signal or logic signal

Open collector (or grounded contact)

Using an alarm for automatic range change
Current output

NOTE
Output is fully programmable (see Configuration).
Output is electrically separated from all other Multi Mag connections.
External isolators are not normally required and may significantly limit accuracy if used.
Maximum load resistance is $800\,\Omega$.
Power hookup

Power supply connections (AC version transmitter)

Power supply connections (DC version transmitter)
## Fuse Replacement

**IMPORTANT**

Disconnect AC power before checking fuses.

<table>
<thead>
<tr>
<th>Component Ref.</th>
<th>McCrometer Part No.</th>
<th>Description</th>
<th>Supplier</th>
<th>Approvals</th>
</tr>
</thead>
<tbody>
<tr>
<td>F1-DC</td>
<td>180002102</td>
<td>FUSE 3.15A AS.T 20mm</td>
<td>SHURTER 034-3122</td>
<td>IEC 127/111</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>BUSSMAN S506/3.15A</td>
<td>BS4265</td>
</tr>
<tr>
<td>F1-AC</td>
<td>180002101</td>
<td>FUSE 500mA AS.T 20mm</td>
<td>SHURTER 034-3114</td>
<td>BS4265</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>BUSSMAN S504/500mA</td>
<td>UL BS4265</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>BUSSMAN S506/500mA</td>
<td>IEC 127/111</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>UL BS4265</td>
</tr>
</tbody>
</table>
Setting up the Electronics

After the Multi-Mag sensor is installed and all of the connections have been made, the electronics must be set up for the installation site.

Displays

The display comprises a 5-digit, 7-segment digital upper display line and two 16-character dot-matrix lower display lines. The upper display shows the flow value. The middle display line shows alarm codes on the left, when an alarm is present (see Faultfinding), and flow units in the center.
**Rapid reset/escape**

Depressing this switch for five seconds and then releasing it will exit the menu system and return to normal operating mode.

**Startup**

Ensure all necessary electrical connections have been made, and switch on the power supply to the flowmeter.

After a short delay, the bottom line of the display will alternate between “Marsh Multi-Mag” and “V1.1 23/02/95”. In a few seconds, the flow rate will appear on the display, together with the flow rate units.

**Page and parameter analogy**

The main menu is accessed similarly to opening various pages in a book. Each page contains a group of parameters that are related to each other.

Pages 1 to 3 are generally accessible; the remainders are password protected.

Pages represent the groups of parameters provided by the transmitter which, if required, may be viewed or changed as shown on this and the following pages.
Getting started

The transmitter is delivered set up either with your chosen units, or set with our standard default values.

WARNING!
Ensure plant safety while configuring at all times.

If you need to change the transmitter configuration for any reason, this may be done depressing the membrane switches on the front of the transmitter.
Operation

Viewing user information (read only).

1. 532

Continual update of flow rate

Flow

Ugal / Min

Units

Press to advance to next parameter to be read on line 3 of display

% 0.681

% of Flow Range

> 103527686 UGal

Forward flow total value

< 0 UGAL

Reverse flow total value

* 103527686 UGal

Net flow total value

Alm Clr

Active alarms - Any alarms are displayed sequentially if more than one alarm is present. * Alm Clr is displayed when no alarms are present.

Vel 1.345 ft/sec

Flow velocity

Login

0 0 0 0

Advance to “Access to Secure Parameters”

i Information.

Reverse flow is not calibrated on the Model 285 and should only be used as a reverse indication. The Model 284 should be used when accurate bi-directional operation is required.
Access to secure parameters

A five-digit security code is used to prevent tampering with the secure parameters.

**Security codes**

A code number, between 00000 and 99999, must be entered to gain access to the secure parameters. A default user code of “00001” has been installed, but this may be changed if required with the “Login Key 1” parameter (see *Menu layout*).

An engineer code (default 00002) is used to gain access to test procedures, security code settings, and parameters not essential at the user level. This code can be changed if required with the “Login Key 2” parameter (see *Menu layout*).

At the flashing cursor on the first digit of the login code number, press either ▲ or ▼ to reach the required digit. To set this digit and pass to the next digit, press ◄. Continue until all digits have been set, and depress ✂ to enter the complete code. If an incorrect value is entered, access to subsequent programming pages is prevented and the display reverts to the operating page.

**Flow range parameter**

Press © to advance to the next parameter.

Press * to advance to the next page.

These two switches are used to advance to all subsequent parameters and pages. If a parameter is changed, it is automatically stored on operation of the © switch.

---

Do not use the same password for both Security Level 1 and Security Level 2.
Changing parameter values and variables

When a parameter is selected, which holds one or more variable units (e.g., "flow unit" parameter, which can be liters, cubic meters, gallons, etc.), proceed as follows to change the units ("Flow Rng" selected):

![Diagram]

*Indicates current flow range numeric value.*

*Flow Unit* selected (US gallons).

Press ▲ or ▼ to change the units.

**NOTE:** The existing units will flash at the first depression of the switch, and further switch depressions will change the type of units displayed.

Depressing the switch will now enter the newly selected units (Imperial gallons)

This type of action is similar for all variable units. Where numerical values are to be changed, initial depression of the switches cause the first of five digits to be highlighted by a flashing cursor. Change the value with the ▲ or ▼ switches, the particular digit with the switch, and enter the final selection with the switch.
Menu layout

Below is a summary of all the parameters contained in the menu.
Parameter access and change

The correct security level must be selected. Select the parameter to read the value, or to change it as necessary. All real-time data displayed is updated each second. Use the switch to move between pages. Use the switch to move between parameters. The and switches change displayed values and units. The switch will accept the chosen value or unit.
<table>
<thead>
<tr>
<th>Desired Output</th>
<th>Flow Units</th>
<th>Flow Mult</th>
<th>Full Scale</th>
<th>PLS Fact</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Pulse = 1000 Gal</td>
<td>UGal</td>
<td>x1</td>
<td>Not Needed</td>
<td>.001</td>
</tr>
<tr>
<td>1 Pulse = 1000 Gal</td>
<td>UGal</td>
<td>k</td>
<td>Not Needed</td>
<td>1.0</td>
</tr>
<tr>
<td>1 Pulse = 1000 Gal</td>
<td>UGal</td>
<td>m</td>
<td>Not Needed</td>
<td>1000.0</td>
</tr>
<tr>
<td>800 Hz = Freq</td>
<td>UGal</td>
<td>x1</td>
<td>800 GPM</td>
<td>60</td>
</tr>
</tbody>
</table>

Diagram details:
- **Enter required output pulses per flow-volume unit.**
- **PLS Fact**: Flowrate (%) below which pulse output and totalizer cease to operate.
- **PLS Cutoff**: Maximum output frequency in Hz.
- **PLS Mix**: Display of present output frequency in Hz (five value).
- **PLS Hz**: Idle state for Pulse Output with no output pulse (e.g., at zero flow).
- **PLS Idle**: 0 = Low (output transistor ON) 1 = High (output transistor OFF)
- **PLS Size**: Enter output pulse width in msecs (Value will be rounded up to nearest 10ms). Set to 0' for square wave output.

Information:
- When A "1" is selected, holding the ▼ key down for five seconds will reset the displayed totalizer. Resetting the net totalizer will reset both the positive and negative totalizer values.
- The maximum which can be entered must not exceed 21,000. The value entered may be displayed with a small error in the decimal digits, e.g., 1.900 may be displayed as 1.890. This is a display characteristic and the value 1.900 will be used by the Multi-Mag.
Do not use the same password for both Security Level 1 and Security Level 2.

Select Alarm 1 output functions.
- '1' = selected. '0' = deselected.

Idle state for alarm output. With no alarm active:
- 0 = Low (O/P transistor ON)
- 1 = High (O/P transistor OFF)

- Alm No1 Idle
  - Alm No1 En
    - 0 = Alarm output disabled (set to idle state).
    - 1 = Alarm output enabled.

- Alm No1 Fault
  - Alarm occurs for System fault.

- Alm No1 Fwd
  - Alarm occurs for forward flow.

- Alm No1 Rev
  - Alarm occurs for reverse flow.

- Alm No1 Cutoff
  - Alarm occurs for Pulse Output Cutoff.

- Alm No1 Mtsnor
  - Alarm occurs for empty sensor.

- Alm No1 Hi
  - Alarm occurs for Flow > 'Alm Trip Hi'.

- Alm No1 Lo
  - Alarm occurs for Flow < 'Alm Trip Lo'.

- Alm No1 Anlg
  - Alarm occurs for Analog Output over range.

- Alm No1 Pts
  - Alarm occurs for Pulse Output over range.

Identical to, but independent of, Alarm 1.

Select high and low flow alarm trip points.
- High flow alarm trip point as % of range (default = +110%).
- Low flow alarm trip point as % of range (default = -110%).

Enter hysteresis for alarms as % of range.

Set to '1' if Hi/Lo Alarms as to be displayed (default = 0).

Returns to Alm Trip Hi

Returns to Alm No1 Idle

Returns to Alm No2 Idle
Set up function of external logic input.
- Select 'Zero' to set flowrate output to zero.
- Select 'Hld' to hold flowmeter output value.
- Select 'Clr' to reset all totalizers.
- Select 'Anlg' to select Anlg No2 Range.

Set up empty pipe detection.
Set empty pipe detector trip threshold (default = 50).

Sensor calibration details, etc.
Serial No.
(up to 13 characters).

Tag No. (if required)
Sensor calibrated bore, in millimeters.
1 inch = 25.4 mm
Displays the current velocity in the sensor (live value).
Sensor gain
Sensor zero
Factory set. Do not change.

Returns to Snsmr Trip

Inpt

Mtsnrs Trip

Mtsnrs mV
Actual measured value related to fluid conductivity.

Returns to Mtsnrs Trip

Inpt Idle
Enter inactive state of input contact
'1' for Hi normal
'0' for Lo normal
(Defaulted)

Returns to Inpt

Snsmrs No

Snsmr Tag
Snsmr Size
Snsmr Vel
Snsmr Fact 1
Snsmr Fact 2
Snsmr Fact 3
Snsmr Fact 4

Factory set. Do not change.
‘Test Mode’

Set to ‘1’ to enable.

Test Mode

Test Flow
Displays current flowrate.
If in ‘Test Mode’, any value may be entered manually.

Test %
Flow rate as a percentage.

Test Hz
Output frequency.

Test mA
Output current.

Test Vel
Flow velocity.

Test Alm
Shows currently active alarms; ‘Cl’ indicates no alarms active.

Test Tvx
Live flow velocity (uncorrected for sensor calibration).

‘Test Mode’

Set display resolution.
Enter number of decimal places required on flow display (0-5).

Disp Res

Disp Mode

Serial Communication display mode (Read Only) - attempts to edit this parameter result in display of ‘Keypad Version No.’ with eventual return to normal operation.

Login Key 1

Login Key 2
Set Level 2 security password.

Information.
Depressing this switch for five seconds (rapid reset/escape) will cancel the test mode and return the unit to normal operation.

Caution.
Access is NOT possible without the correct password. ‘Lost’ passwords can ONLY be reset by the factory authorized service engineers.

* If the sensor is empty or disconnected, the alarms ‘mtSnr’ and Coil will be displayed as appropriate.

‡ The maximum which can be entered must not exceed 21000. The value entered may be displayed with a small error in the decimal digits, e.g., 1.900 may be displayed as 1.899. This is a display characteristic and the value 1.900 will be used by the Fio-System.

Do not use the same Password for both Security Level 1 and Level 2.
Faultfinding

A very powerful test mode, especially useful during commissioning and plant faultfinding, enables all external devices connected to the electronics to be tested over the full range of flow rates.

This mode can be used regardless of flow conditions at the sensor, or even with the sensor disconnected, and does not require the use of additional equipment.

**WARNING!**

Observe all safety measures.

Take all precautions to avoid risk to personnel, plant, and risk of explosion in hazardous areas.

Do NOT open the transmitter main casing. There are no user serviceable parts or adjustments inside.

Service access is restricted to the termination area.

Should the electronics fail to operate, first check the power supply, then the power supply connections and fuse located in the termination area. If necessary, replace the fuse with one of the correct rating.

Check that all external connections are made correctly.

**Alarms**

The transmitter has built-in diagnostics with alarm indications.

The table below shows possible alarm indications, and the Faultfinding Flow Chart indicates checking procedures to find the problems causing the alarms.

<table>
<thead>
<tr>
<th>Display</th>
<th>Alarm</th>
</tr>
</thead>
<tbody>
<tr>
<td>MtSnsr</td>
<td>Empty sensor</td>
</tr>
<tr>
<td>Hi</td>
<td>High flow</td>
</tr>
<tr>
<td>Lo</td>
<td>Low flow</td>
</tr>
<tr>
<td>Anlg</td>
<td>Analog over range</td>
</tr>
<tr>
<td>Pls</td>
<td>Pulse frequency limited</td>
</tr>
<tr>
<td>Coil</td>
<td>Sensor coil open circuit</td>
</tr>
<tr>
<td>19, 20, 21</td>
<td>See Faultfinding Flow Chart</td>
</tr>
</tbody>
</table>

For method of interrogating the local display see **Startup**.
Faultfinding Flow Chart

10 - 21 System Alarms
19 - Possible totalizer error
20 - Possible memory error
21 - Possible configuration error
To reset: (10-21) if alarm persists contact MII

RS232
Connect RS232 terminal to communicate with transmitter. Menu commands shown

Power
If the display is not functioning, then there is no power.
Check power source and the transmitter fuses.
(NOTE: DC FIO Systems contain red PCBs)

Alarms: ALM1 & ALM2
Alarm Problem: Two time to check.
Check that the wanted alarm is selected and any unwanted (default) alarms are deselected.
The remote equipment is compatible with the transmitter's open collector output.
(Note: Capitive load may cause the output to current limit. If so, connect a 22 ohm resistor in series with the ALM terminal.)
Dual current option: ALM2 = Reverse analog OP.

PLS
Connect terminal and check that transmitter is sending pulses.
Read Ps H (54)
If necessary modify Ps Fact (91)
Yes - check connecting arrangement.
No - Select Test Mode (C9+1) and enter test flow rate (C2)
(Note: FlowA = FWD Flow FlowB = REV Flow

ANLG
Connect terminal and check flow (Reg Item 41).
Modify, if necessary.
Current cannot reach Full Scale - check loop resistance <500 ohms.
If OK, current not correct, remove cables from transmitter and read value from: Arg RA. Check against local meter.

MTSNS/MSG
Check connections against drawings in the manual.

Msnsr
Dirty electrodes?
Test for fouled electrodes: if flow is at zero monitor Msnr Volts (A2).
If value is >50 then electrodes OK
If flow present use an ANALOG meter to measure resistance to earth from SG1/SGC2. Value >50 kohms (for water).
Msnr will be displayed if voltage between D31 and D32 >1 volt. If so, clean electrodes.

Msnsr
Is the pipe full?
Short circuit SG1 and SG2 to SIGND at transmitter.
If alarm ceases check connections are correct.
Check cable continuity.

Coil
Check sensor cable continuity for CD1 and CD2.
Sensor coil <50 ohms resistance.
If sensor and cable OK, Ts is faulty.

FLOWRATE
WRRONG?
Connect terminal and check the following calibration factors:
(461) = 1 (FRODE INS)
(462) = 1 (FRODE PROF)
SS = Pipe size
SS / 1000 = D13 Fact 1

Is the pipe full?

When communicating with Multi-Mag log in at ENGINEER level (3+engineer). Log in Level 2.

Remember: FIO System has a test mode for setting flow and testing all outputs and alarms. See Menu (Test Mode)
Test mode

Select *Engineer* security level (see *Access to secure parameters*). Set Test Mode parameter to “1” and enter an appropriate flow rate in the Test Flow parameter. Output responses may now be viewed from the various test parameters (see *Configuration* for full details of operation).

**Example:**

Assume the flow range is 500 UGAL/MIN and 20 mA = 100% Flow (500 UGAL/MIN)

If 250 is entered as the test flow parameter then the 4-20 mA output will be set to 12 mA and all other outputs will indicate values appropriate for the test flow value.

Depressing the [ ] switch for five seconds will cancel the test mode and return the unit to normal operation.
Application Schematics

The purpose of the application schematics is to show different applications and the best sensor location for a particular application.

Clearance

Because the sensor will protrude from the pipe when installed, a clearance length should be allowed. See Obstruction Diagram below and Sensor Specification Sheet.

Skewed profiles

The sensor may not operate within specifications in a location where the profile is skewed. These locations are indicated by an ESTIMATED ERROR notation in the application schematics. Errors are estimated for flow at +/-10 ft/sec (±3 m/sec). If the velocity is less than ±10 ft/sec, the error will be less.

To avoid velocity “hot” or “cold” spots, choose an insertion angle that is away from the hot spot.

Distance $H$ must be at least the total sensor length plus the distance from the outer pipe wall to the top of the valve plus 9” (distance $H$). See sensor specification sheet.
The best locations are greater than 5 diameters upstream or 10 diameters downstream from the elbow.

90° Elbow
(errors are estimated for flow at 10 ft/sec) (3 m/sec)
The best locations are greater than 5 diameters upstream or 10 diameters downstream from the junction.

T-Junction

(errors are estimated for flow at 10 ft/sec) (3 m/sec)
The best locations are greater than 5 diameters upstream or 10 diameters downstream from the junction.

Y-Junction

(errors are estimated for flow at 10 ft/sec) (3 m/sec)
The purpose of an active valve is to vary the flow. An active valve will produce a distorted profile that changes as the flow changes. As a result, the sensor should be installed at least 10 diameters upstream or 25 diameters downstream from an active valve to obtain 1% accuracy. The upstream side is the preferred location.

**Active Valves**

(errors are estimated for flow at 10 ft/sec)
The best locations are greater than 10 diameters downstream or 1 diameter upstream from the junction.

Small-Large Pipe Junction

(errors are estimated for flow at 10 ft/sec)
There may not be enough room in some pump stations to allow for the sensor to be installed an appropriate distance downstream from the last pump. If this is the case, the sensor will have to be installed in a manhole outside the pump station. Check with McCrometer for instruments that are best suited for pump station applications.

**Pump Station**

*(errors are estimated for flow at 10 ft/sec)*
Multi-Mag Ordering Information

The standard Multi-Mag includes:

- NEMA 4X (IP65) enclosure
- 4-key keypad
- 3-line backlit LCD display
- One flow-proportional or frequency (transistor type) output for flow rate or for external electronic totalizer or PLC (Customer supplied relay required to convert (transistor type) output to contact closure.
- One 4-20 mA flow output
- Two alarm outputs
- Multi-Mag™ Sensor (Available for 2 or 3 inch tap. Customer specified.)
- 20-foot sensor cable
- Installation and Operation Manual

Options

- Extended sensor cable (maximum length 500’) and (maximum 300’) for Model 284 (used for bi-direction flow capability).
- Pole mounting kit
- Sensor insertion tool
- High temperature sensor (175°F/80°C)
- Sun shield
- Additional Installation and Operation manuals
### Spare parts list

<table>
<thead>
<tr>
<th>Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>F1-AC, 500mm fuse for AC unit</td>
</tr>
<tr>
<td>F1-DC, 3.15A fuse for DC unit</td>
</tr>
</tbody>
</table>

### Option parts list

<table>
<thead>
<tr>
<th>Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Installation and Operation Manual</td>
</tr>
<tr>
<td>Sensor insertion tool</td>
</tr>
<tr>
<td>Additional 1/2&quot; NPT cable glands (.187/.250 O.D.)</td>
</tr>
<tr>
<td>Sun shield</td>
</tr>
<tr>
<td>Pole mounting kit</td>
</tr>
<tr>
<td>Sensor cable (specify length up to 500' for Model 285 and 287)</td>
</tr>
<tr>
<td>Sensor cable (specify length up to 300' for Model 284)</td>
</tr>
</tbody>
</table>
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 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 Ave
  
  Hemet, CA 92545
## Conversion Tables

### Table of Decimal Equivalents

<table>
<thead>
<tr>
<th>Fraction</th>
<th>Decimal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/8</td>
<td>.125</td>
</tr>
<tr>
<td>1/4</td>
<td>.25</td>
</tr>
<tr>
<td>3/8</td>
<td>.375</td>
</tr>
<tr>
<td>1/2</td>
<td>.5</td>
</tr>
<tr>
<td>5/8</td>
<td>.625</td>
</tr>
<tr>
<td>3/4</td>
<td>.75</td>
</tr>
<tr>
<td>7/8</td>
<td>.875</td>
</tr>
</tbody>
</table>

### Table of Conversions

<table>
<thead>
<tr>
<th>Multiply</th>
<th>By</th>
<th>To Get</th>
</tr>
</thead>
<tbody>
<tr>
<td>Centimeters</td>
<td>0.3937</td>
<td>Inches</td>
</tr>
<tr>
<td>Centimeters</td>
<td>0.03281</td>
<td>Feet</td>
</tr>
<tr>
<td>Inches</td>
<td>25.4</td>
<td>Millimeters</td>
</tr>
<tr>
<td>Feet</td>
<td>30.48</td>
<td>Centimeters</td>
</tr>
<tr>
<td>Sq. Ft.</td>
<td>144.0</td>
<td>Sq. In</td>
</tr>
<tr>
<td>Sq. In</td>
<td>0.006944</td>
<td>Sq. Ft.</td>
</tr>
<tr>
<td>Cu. In</td>
<td>0.0005787</td>
<td>Cu. Ft.</td>
</tr>
<tr>
<td>Cu. Ft.</td>
<td>7.481</td>
<td>Gallons</td>
</tr>
<tr>
<td>Cu. Ft.</td>
<td>1728.0</td>
<td>Cu. In</td>
</tr>
<tr>
<td>Cu. Ft.</td>
<td>0.02832</td>
<td>Cu. Meters</td>
</tr>
<tr>
<td>Cu. Ft.</td>
<td>28.32</td>
<td>Liters</td>
</tr>
<tr>
<td>Cu. Meters</td>
<td>35.31</td>
<td>Cu. Ft.</td>
</tr>
<tr>
<td>Cu. Meters</td>
<td>264.2</td>
<td>Gallons</td>
</tr>
<tr>
<td>US Gallons</td>
<td>3.785</td>
<td>Liters</td>
</tr>
<tr>
<td>US Gallons</td>
<td>0.1337</td>
<td>Cu. Ft.</td>
</tr>
<tr>
<td>US Gallons</td>
<td>0.003785</td>
<td>Cu. Meters</td>
</tr>
<tr>
<td>US Gallons</td>
<td>.8326748</td>
<td>Imperial Gallons</td>
</tr>
<tr>
<td>Liters</td>
<td>0.2642</td>
<td>Gallons</td>
</tr>
</tbody>
</table>

°F = (°C x 9/5) + 32  
°C = (°F - 32) x 5/9
Multi-Mag Specifications and Submittal Sheets

Multi-Mag Specifications

Measurement
2 and 3 Inch Sensors - Volumetric flow in filled flow conduits 4” (101.6 mm) to 120” (3 m) utilizing insertable electromagnetic averaging sensor. Flow indication in English Std. or Metric units.

Flow Measurement
Method: Electromagnetic
Zero Stability: ±0.03 ft/s (±.009 m/s)
Linearity: 0.3% of range
Repeatability: 0.20% of range
Accuracy: ±1% of reading from 0 to +20 ft/s + zero stability
Has reverse flow indication.
(Other models available with highly accurate reverse flow capabilities)
Range: (nominal pipe sizes)

Sensor Size-Velocity Range for Pipe Sizes

![Velocity Range - 2" Multi-Mag](image1)

![Velocity Range - 3" Multi-Mag](image2)
(Contact factory for information on models with bi-directional flow capability or velocities in excess of above specifications.)

**Materials**
- 2 and 3 Inch Sensor: Fiberglass
- Cable: Polyurethane outer jacket
- Insertion Hardware: 316 Stainless Steel exposed to flow.
- Compression Seal: Silicone Rubber
- Sensor Electrodes: Carbon
- Number of electrodes varies with sensor length.

**Transmitter Enclosure**
- NEMA 4X/IP65. Separate termination and electronics compartments. Glass filled polypropylene with clear polycarbonate window.

**Transmitter-Dimensions**
- 8.4"H x 6.4"W x 2.8"D
- (214mm x 163 mm x 70 mm)

**Transmitter-Weight**
- 3.2 lbs. (1.5kg)

**Potable Water Applications**
- Suitable for use in contact with potable water. Water Byelaws Scheme (WBS) Approved Product. Meets BS6920 - Cert. # 9706516

**Configuration and Set-Up**
- Programming can be easily done on site using the keypad. Two levels of user defined password protection are provided.

**Outputs**
- **Analog**: Galvanically isolated and fully programmable for zero and full scale. Output capability ≤16V. (800 ohm, 4-20mA) Secondary range enabled by external input or programmed alarm condition as a percent of full scale.
- **Pulse/Frequency**: One frequency/pulse output for flow rate or for external totalizer. Capable of sinking <250 mA @ <35V.

**Dual Alarms**
- (2 separate outputs): Isolated protected transistor switch capable of sinking <250mA @ <35V. Note: Not isolated from frequency output. Fully programmable for high/low flow rates. % of range, empty-pipe, fault conditions, forward/reverse, polarity (normally open/close), analog over-range, pulse over-range, pulse cutoff, etc.

**Environmental**
- **Pressure/Temperature Limits**: 
  - Sensor: Flow Temperature Range
    - 32° to 110°F (0° to 44°C) @ 250 psi
  - **Electronics: Temperature limits**
    - Operating: -14° to 140°F (-25° to +60°C)
    - Storage: 5° to 167°F (-15°C to +75°C)
Electrical Connections
0.5 inch NPT with gasket seal

Keypad and Display
*Can be used to access and change all set-up parameters using four membrane keys and 3-line display.*
3-Line, 16 character, backlit LCD display with large 1/2" numerals for flow rate and two lines for engineering units, totalizers, alarm status, velocity and percent of range.

Isolation
Galvanic separation to 50VDC between analog, pulse/alarm, and earth/ground.

Electrical Safety
Meets ANSI/ISA-S82.10-1988 and S82.03-1988

Power Supply
Universal switch mode.
AC: 85 to 265V 45 to 400 Hz at 20VA max. or DC: 11 to 40V at 20VA max.
\*AC or DC must be specified at time of ordering.*

Vibration Specification
Meets BS2011: Part 2.1Fc: 1983

Internal Totalizer
9-digit totalizer. Can be programmed to reset via external input or the keypad. Reset from keypad can be password protected.

Test Mode and Output Circuit Loop Verification
After transmitter has been programmed, operation of the test mode will drive all outputs to a programmed value which provides a total system test.

Ordering Information
Multi-Mag flowmeter includes modified NEMA 4X/IP65 (separate termination and electronics compartment) glass filled polypropylene electronics enclosure with polycarbonate window, 2 or 3 inch electromagnetic velocity sensor with 20' cable, 4 membrane keys for configuring the transmitter, 3-line LCD backlit display with one line of 5-1/2" numerals for flow rate indication and 2 lines containing 16 characters for viewing engineering units, velocity, totalizer, alarm status and flow rate expressed as a percent of full scale, one flow proportional or frequency output (transistor type) for flow rate or for external totalize, a 4-20 mA output for flow and one instruction manual.
Options include high temperature sensor, extended sensor cable, (Maximum length 500’ (152 m)), pole mounting kit, insertion tool, sun shield, and additional instruction manuals.

Contact factory for Sensor Mounting Hardware Ordering Information
MULTI-MAG SENSOR SPECIFICATION SHEET

2" Taps

Note: Production cannot proceed without this information.

Company Name ____________________________________________
Site Tag/ID _______________________________________________
Customer Contact __________________________________________
Model/Sensor Type __________________________________________
Date Received ______________________________________________
Sales Order ________________________________________________
Coordinator ________________________________________________

Typical Installations
Valves, Nipples, etc. are accessories or customer supplied.

2" CLEARANCE REQUIRED

A

2"

B

2 1/2"

COMPRESSION SEAL HEIGHT

C

VALVE HEIGHT

CUSTOMER SUPPLIED DIMENSION

D

NIPPLE HEIGHT

E

PIPE THICKNESS

F

CUSTOM STACK HEIGHT

G

ADD A-E

H

IMPORTANT NOTE:
Check here to use standard stack height (15°)
D+E must be less than 16.4°

INSIDE DIAMETER OF PIPE

ID

TOTAL FIBERGLASS LENGTH

PIPE ID + STACK HEIGHT

STANDARD STACK HEIGHT = 15°

CALCULATE DISTANCE H IF PIPE IS CLOSE TO OBSTRUCTION

IMPORTANT: Distance H must be at least one sensor length T + C + D + 9°.

CAUTION: 1-7/8" (48 mm) clearance must be maintained through valve and the pipe wall to allow sensor insertion.

Pipe Materials:
Schedule Number:
Total Cable Length:
Fluid Type:
Estimated Max Velocity:

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MULTI-MAG SENSOR SPECIFICATION SHEET FOR HIGH STRENGTH SENSOR

3" Taps

Note: Production cannot proceed without this information.
This spec sheet is for sensors requiring 3" Taps

Typical Installations
Valves, Nipples, etc. are customer supplied.

CAUTION
2-7/8" (73 mm) clearance must be maintained through valve and the pipe well to allow sensor insertion.

IMPORTANT: Distance H must be at least one sensor length T + C + D + 9".

TOTAL FIBERGLASS LENGTH
PIPE ID + STACK HEIGHT

CALCULATE DISTANCE H IF PIPE IS CLOSE TO OBSTRUCTIONS

Pipe Material
Schedule Number
Total Cable Length
Fluid Type
Estimated Max Velocity

Company Name
Site Tag/ID
Customer Contact
Model/Sensor Type
Date Received
Sales Order
Coordinator

2" CLEARANCE REQUIRED

2" COMPRESSION SEAL HEIGHT

VALVE HEIGHT
C

NIPPLE HEIGHT
D

PIPE THICKNESS
E

STACK HEIGHT
ADD A-E

INSIDE DIAMETER OF PIPE
ID

T

H