

ECONOMAG

INSTALLATION OPERATION & MAINTENANCE MANUAL

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SPARLING

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1.0

General

General

1.1

Measuring System

The Sparling ECONOMAG Model FM 618 flowmeter is an obstructionless device for monitoring the volumetric flow of conductive liquids in full closed pipes. This device can be used to meter most of the liquid applications in water, wastewater, or chemical and other industries. Temperature and pressure limitations are per the meter's specification limits.

The FM 618 consists of a stainless steel sensor lined with Tefzel. A measuring transmitter is integrally mounted to the sensor to form a compact unit.

1.2

Operating Principle

Operation is based on Faraday's Law of Magnetic Induction. An electrically conductive liquid flowing through a magnetic field induces a voltage which is perpendicular to this field and to the direction of the flow. This voltage is proportional to the average flow velocity. See Figure 1.1.

The mathematical formula describing Faraday's law reads:

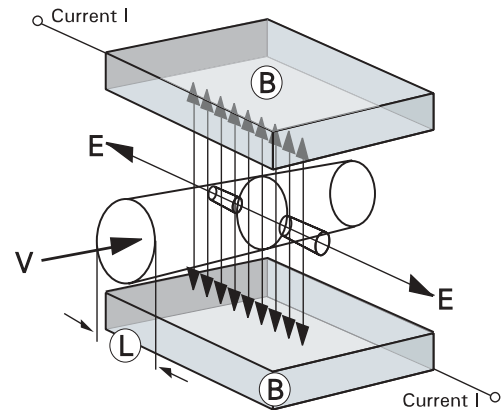
$$E = B \times L \times V$$

E = Induced voltage

B = Magnetic field intensity (flux density)

L = Distance between the electrodes (pipe diameter)

V = Average flow velocity of liquid



Measuring Principle
Figure 1.1

1.3

Application to Magnetic Flow Measurement

In a magnetic flowmeter the liquid acts as a moving conductor as it flows through the pipe. The induced voltage (E) in the liquid is measured by two electrodes mounted opposite each other in the meter sensing head.

The length of the conductor is equal to the distance between electrodes and also the internal diameter (D) of the pipe. The flux density is proportional to the coil current (I), times a constant (k). The above formula can be restated as follows:

$$E = I \times k \times D \times V$$

$$V = \frac{\text{flow}}{\text{cross sectional area}} = \frac{Q}{A} = \frac{Q4}{\pi D^2}$$

$$E = \frac{Q \times I \times 4 \times k \times D}{\pi D^2} = \frac{Q \times I \times 4 \times k}{\pi D}$$

Note that if I is held constant, E is proportional to Q or *the induced voltage is directly proportional to the average flow rate (V)*.

1.4 Interference

1.4.1 Electrochemical Interference

The signal voltage is measured by two electrodes. Galvanic elements form on the surface areas between the ion-conducting liquid and the metal electrodes. The polarization voltages which result are dependent on temperature, pressure, and the chemical composition of the electrodes and liquid. They are direct voltages which cannot be predicted and which can be different at each electrode. These stray, unpredictable voltages may be referred to as "noise". The signal voltage must be separated from the noise.

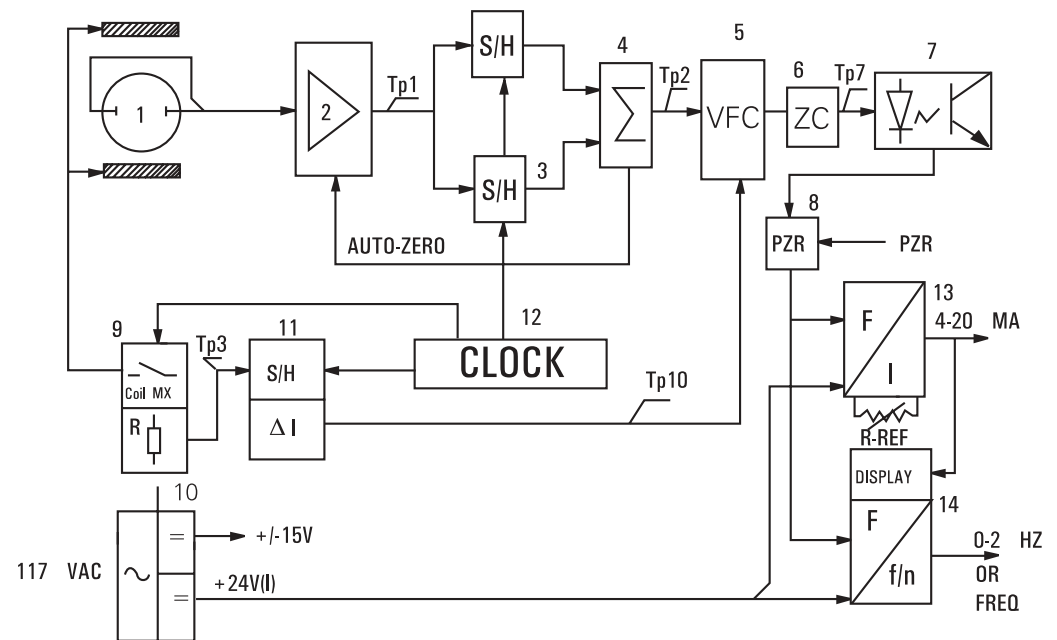
1.4.2 Induction Interference (Quadrature)

Electrode cables connect the electrodes with the meter electronics. Because these cables must run within the magnetic field, a voltage is induced which is proportional to the rate of change of the magnetic field strength. The meter design minimizes the length of conductor within the magnetic field in order to keep the value of this interference as low as possible.

1.4.3 Other Interference Voltages

Pipes and the liquids within them are often used as conductors for electrical grounding. This creates a voltage potential between electrodes which can be high relative to the signal voltage. **Proper grounding of the flowmeter to the liquid is necessary to achieve correct meter operation. Grounding rings are recommended. See Section 3.7 - Grounding.**

1.5 System Operation



- | | | |
|-----------------------------------|--|---|
| 1. Measuring Sensor | 6. Zero Cutoff | 11. Coil Correction Signal |
| 2. Input Amplifier | 7. Input/Output Isolator (Optocoupler) | 12. System Clock Generator |
| 3. Sample-&Hold | 8. Positive Zero Return | 13. Frequency/Current Converter |
| 4. Summation Point | 9. Coil Current Multiplexer | 14. Pulse/Frequency/Display Output PCB (Option) |
| 5. Voltage-to-Frequency Converter | 10. Power Supply Section | |

Block Diagram
Figure 1.2

1.6 Construction

1.6.1 Sensor

The FM 618 ECONOMAG consists of a flangeless stainless steel tube lined with Tefzel with an integral mounted measuring transmitter.

Two stainless steel electrodes are installed in the Tefzel liner. All internal cavities in the sensor housing are filled with the same Tefzel that forms the sensor liner. This prevents collection of moisture. Standard configuration of the sensor is NEMA-4X.

1.6.2 Integral Transmitter

The transmitter is housed in a die-cast aluminum, corrosion resistant, NEMA-4X instrument enclosure. The outputs and electrical connections are made in a separate conduit housing attached to the transmitter housing.



**DISCONNECT POWER BEFORE PROCEEDING. DO NOT
MAKE CONNECTIONS WHILE POWER IS APPLIED.**

1.7

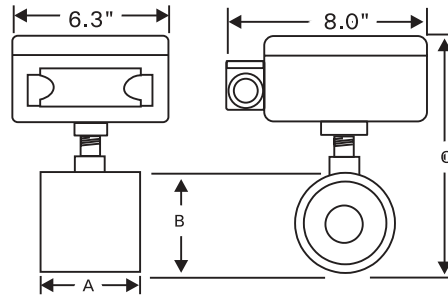
Specifications

Power Requirements	See nameplate for correct rating.		
Fuses	100 Vac \pm 10%	50/60 Hz \pm 10%	0.5 amp
	117 Vac \pm 10%	50/60 Hz \pm 10%	0.5 amp
	230 Vac \pm 10%	50/60 Hz \pm 10%	0.25 amp
	24-30 Vdc \pm 10%		2.0 amp
Fuse	5 x 20 BUSS		
Wire Size	Power – 16 AWG;14 AWG Max – Signal – 18 AWG		
Ground Cable	Third wire ground of power cable		
Standard Accuracy	\pm .75% of rate with flow velocity above 1 fps (0.3 mps)* \pm 0.02 fps below 1 fps regardless of full scale * Accuracy statement based on digital outputs		
Reference Conditions	25° C at 1, 3, and 10 fps full scale. Temperature effect, 0.04% full scale/°C. Voltage effect, 0.3% rate/10% fluctuation		
Repeatability	Within \pm 0.2% FS		
Power Consumption	Less than 15 W		
Output Signals	Standard Isolated Analog and/or optional digital. Analog - 4-20 mA dc into 800 ohms max Digital - Scaled pulse or frequency a. Scaled pulse. 24 Vdc square wave, 25 ms pulse width, 0-10 Hz max. into 150 ohm impedance minimum. b. Unscaled frequency 15 volts plus train, approx. 50 μ s on-time. Frequency rate 0 to - $\frac{K \times Q}{60}$ Hz max into 1000 ohms (see Sect. 5.2).		
Input Signal	Positive zero return (PZR). Connect to remote normally closed (NC) contact to drive outputs to zero when an empty pipe condition can occur.		
Minimum Conductivity	20 micromhos/cm		
Full Scale Velocity Ranges	0-3 to 0-33 fps (0-1 to 0-10 mps)		
Ambient Temperature Limits	-20° to 140°F (-30° to 60°C).		
Liquid Temperature Limits	180°F (82°C)		
Storage Temperature Limits	-20° to 140°F (-30° to 60°C)		
Construction	Metering Tube	Flangeless Stainless Steel	
	Lining	Tefzel	
	Electrodes	316 SS. Hastelloy C optional	
	Housing, Transmitter	Die-Cast Aluminum	
		Hi-build Epoxy Coated	
	Protection rating	NEMA-4X Hose-down proof	
	Electrical rating	General Purpose	

1.8

Interchangeability

The FM 618 transmitter is designed to be used with any FM 618 sensor. Electronics may be interchanged when flow ranges are adjusted with a potentiometer or the R-Ref PCB board is substituted (See sections 5.2 - 5.4). A DVM is required to change span (see Section 5.2). Contact the factory.



Dimensions
Figure 1.3

Table 1 - Flow & Dimensions

Meter Size		Dimensions (Inches)			Flow Rates (GPM) Full Scale		
Inches	mm	A*	B	C	1 fps	3 fps	33 fps
0.5"	15	4.00	2.31	7.75	0.50	1.5	16
1"	25	4.00	2.92	8.9	1.6	4.8	53
1.5"	40	4.00	3.62	9.5	4	13	145
2"	50	4.00	4.25	10.1	7	21	231
3"	80	6.00	5.40	11.3	20	60	660
4"	100	6.00	6.60	12.5	35	105	1155

* Add 3/16" to 1/4" if grounding rings option is selected

2.0 Pre-Installation

2.1 Receiving and Inspection

When the equipment is received, the outside of the package should be inspected for damage. If any damage or shortage is found, notation to that effect should be made on the carrier's delivery receipt.

Visually inspect the sensor and transmitter for damage from rough handling or faulty packaging. If concealed damage is discovered, notify the delivering carrier at once and request an inspection. Confirm telephone conversations in writing. If inspection is not made, prepare an affidavit stating that you notified the transportation company and that they failed to inspect. Save containers and packaging material.

It is essential that the carrier be notified within 15 days from the date of delivery in order to be in a position to present your claim. Make your claim promptly.

Unpacking and handling of ECONOMAG FM618 Magnetic Flowmeters should be consistent with the procedures used to handle field instruments.

2.2 Storage

This equipment should be stored in a clean, dry environment. Do not store outside in an unprotected area. Observe the storage temperature requirements. Unpowered storage should not exceed 2 years.



Do not void your warranty. Dust plugs are for shipment purposes only and are not meant for storage in a dirty or wet environment. Ensure meter does not flood while in storage. Moisture in any junction box will void warranty.

2.3 Return of Equipment

Obtain an **RGA (Returned Goods Authorization)** number from the factory prior to returning any materials. The RGA number should be marked on the outside of the package. Failure to obtain authorization will unnecessarily delay any work to be performed at the factory.

3.0 Installation

3.1

The ECONOMAG can be used to accurately measure the volumetric flow rate of liquids having a minimum conductivity of 20 micromhos/cm.

Application Considerations

The presence of entrained air or gases in the process liquid will not prevent meter operation, but will produce a positive (+) error equal to the percent by volume of gas entrainment.

It is recommended that the ECONOMAG be utilized for liquids which are chemically compatible with Tefzel liner as well as 316SST or Hastelloy C electrodes. It is not recommended that the ECONOMAG be utilized for liquids containing high percentages of abrasive materials. If the liquid to be measured falls into the above categories, contact Sparling's application engineers for clarification. Use of this device outside its specification range could damage the meter and void the warranty.



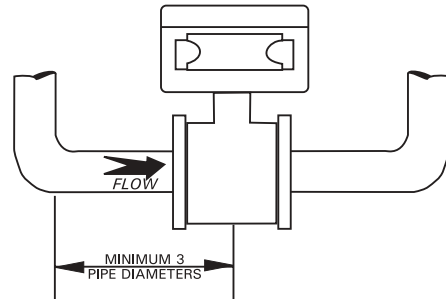
FULL SCALE FLOW RATES SHOULD BE SELECTED ABOVE 3 FEET PER SECOND (1 METER PER SECOND) FOR BEST ACCURACY.

3.2

Site Selection

Select a pipe location which will always be full of liquid. The equipment should be located where the transmitter will be accessible for adjustment. Provide a minimum of 18" clearance to the electronics enclosure.

The meter may be located in vertical or horizontal position. Flow should be **forward** through the meter. Vertical installation with the liquid flow upward minimizes the possibility of slurry separation and assures a full pipe condition (see Figure 3.5).



Full Pipe Required
Figure 3.1

Horizontal installation requires that the sensing electrodes be positioned in the horizontal plane.

The 618 sensor housing should be installed with the **flow forward** in the direction of the arrow. If flow must be reversed (opposite direction from the arrow), see Section 4.2 — Changing the Flow Direction.

If your ECONOMAG is equipped with flow rate indicator or totalizer, you can reorient the display board to suit the desired viewing direction. See Section 3.4 — Remounting the Transmitter Display.

Provide at least three pipe diameters of straight piping approach between an upstream elbow and the midpoint of the meter. More straight approach should be provided after valves or multiple elbows. Provide at least 10 diameters after expanders or lateral pipe runs which are a smaller diameter than the line size (see Figure 3.1).

3.3

Transmitter Housing

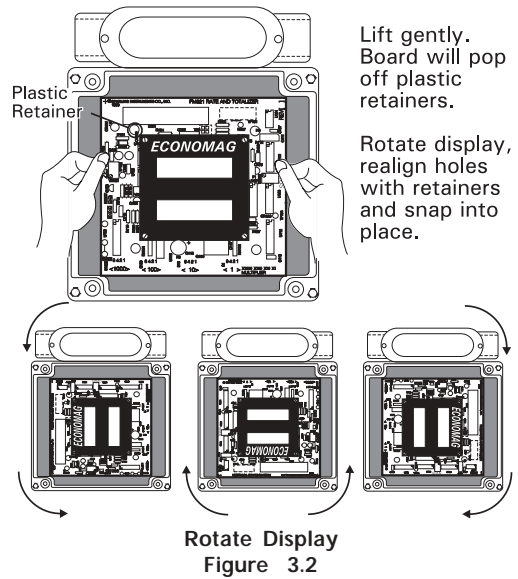
The transmitter has been mounted horizontally to the flow tube. It is recommended that you do not attempt to remove or disturb the transmitter housing from its integral mounting. It could invalidate the electrical rating of the enclosure and create a moisture problem and operational failure of the unit.

3.4

Rotating the Transmitter Display

▼ DISCONNECT POWER BEFORE PROCEEDING

The optional transmitter display can be rotated inside the enclosure in any of four positions for optimum readability. **POWER MUST BE OFF.** To rotate the display, remove the enclosure cover. Simply pull up gently on the corners of the display board to disengage from the plastic retainers. Do not remove screws. Rotate the board 90° or 180° in either direction to the desired position. Be careful not to crimp the wiring and/or the plug. Do not touch any components on the PCB. Press down on the four corners to re-seat the PCB on the retainers. Replace the enclosure cover. Be sure the cover is oriented and seated properly to ensure a proper seal.



3.5

Pipe Connections

The sensor is installed between two process pipe flanges. The sensor contains a Tefzel liner. The integrity of this liner must be maintained for the flowmeter to function. CARE SHOULD BE TAKEN DURING INSTALLATION TO INSURE THAT THIS LINER IS NOT DAMAGED. Depending upon the meter size, a number of bolts will be required to mount the FM 618 between existing flanges, (ANSI, AWWA, DIN, JIS, BS or AS).

Mounting hardware and gaskets are *not* supplied with the FM 618 unless ordered as an option. **It is, however, necessary that gaskets be used to mount this device regardless of flange type (raised or flat-face).** Most commonly used gasket materials are acceptable. See Table 2 for flange and bolt specifications.

Table 2 – Torque, Flange & Bolt Specifications

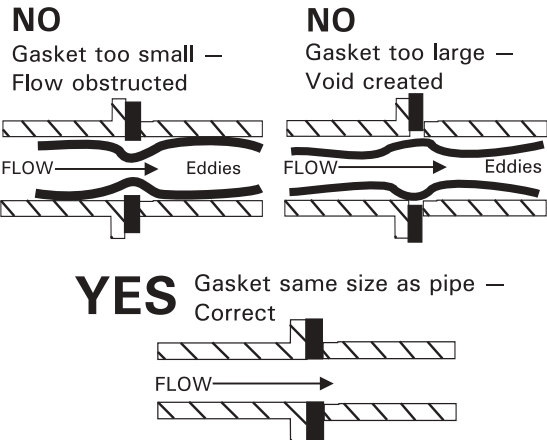
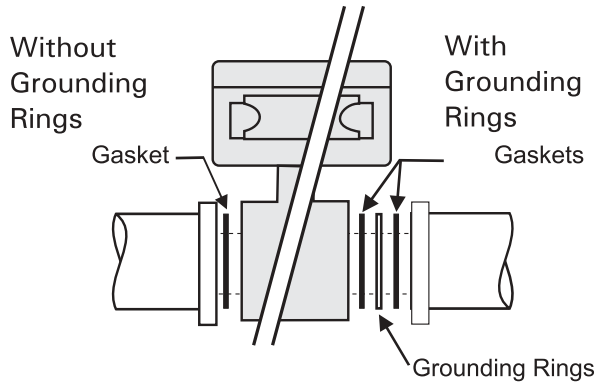
Nom. Meter Size (in)	Maximum Torque		ANSI / AWWA Flange & Bolt Specs (inches)							DIN Flange & Bolt Specs (millimeters)				
	ft-lbs	kg-m	Mating Flange	Pressure Rating (psi)	OD	Bolt Circle	Hole Dia	Bolt Size	Mating Flange (bar)	Pressure Rating	OD	Bolt Circle	Hole Dia	Bolt Size
1.0	17	2.3	1	150	4-1/4	3-1/8	4 @ 5/8	7/16-14 x 6-3/4	25	10	115	85	4 @ 14	M12 X 170
	17	2.3	1	300	4-7/8	3-1/2	4 @ 3/4	5/8-11 x 7-1/2	25	16	115	85	4 @ 14	M12 X 170
2.0	17	2.3	2	150	6	4-3/4	4 @ 3/4	5/8-11 x 7-1/2	50	10	165	125	4 @ 18	M16 X 190
	17	2.3	2	300	6-1/2	5	8 @ 3/4	5/8-11 x 7-1/2	50	16	165	125	4 @ 18	M16 X 190
3.0	24	3.3	3	150	7-1/2	6	8 @ 3/4	5/8-11 x 9-1/2	80	10	200	160	8 @ 18	M16 X 240
	24	3.3	3	300	8-1/4	6-5/8	8 @ 7/8	3/4-10 x 10-1/2	80	16	200	160	8 @ 18	M16 X 240
4.0	30	4.2	4	150	9	7-1/2	8 @ 3/4	5/8-11 x 9-1/2	100	10	220	180	8 @ 18	M16 X 240
	30	4.2	4	300	10	7-7/8	8 @ 7/8	3/4-10 x 10-1/2	100	16	220	180	8 @ 18	M16 X 260



Do not void your warranty by overtightening. Use a torque wrench and refer to torque specs in Table 2 above.

FM 618

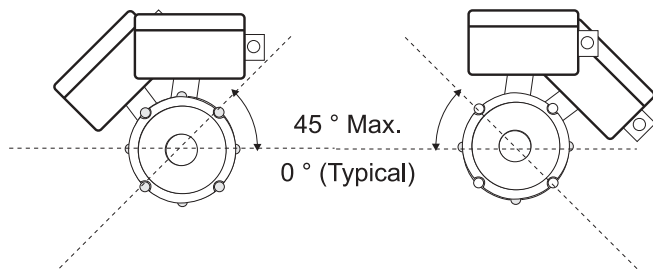
Gasket Installation



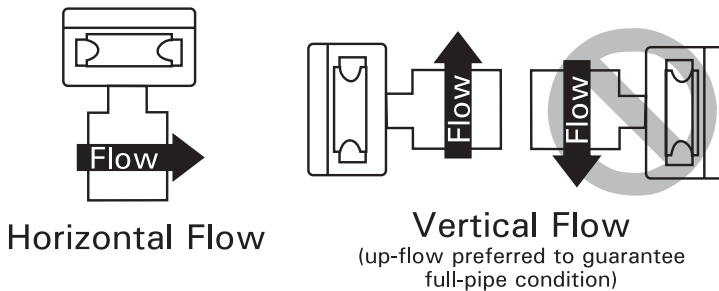
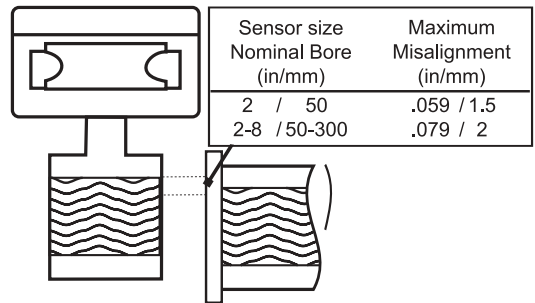
1. Apply silicone grease or other viscous fixative to gasket for temporary positioning
2. Fit gaskets, checking to ensure it is perfectly centered
3. Poorly aligned gasket - can cause catastrophic leaks and flow errors
4. Carefully torque bolts with bolt torque sequence above

Gasket Installation
Figure 3.4

Sensor Position



Sensor Alignment



Horizontal Flow

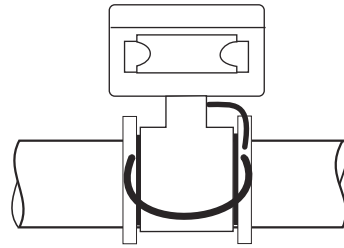
Vertical Flow
(up-flow preferred to guarantee full-pipe condition)

Sensor Position
Figure 3.5

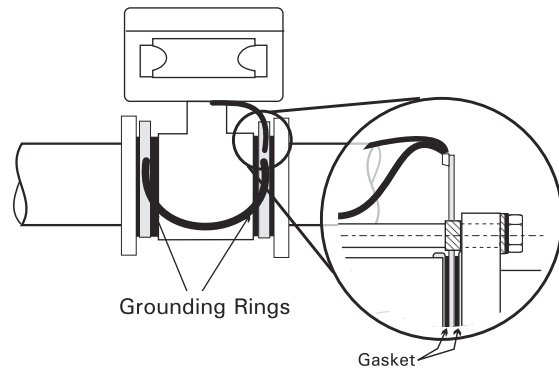
3.6

Grounding

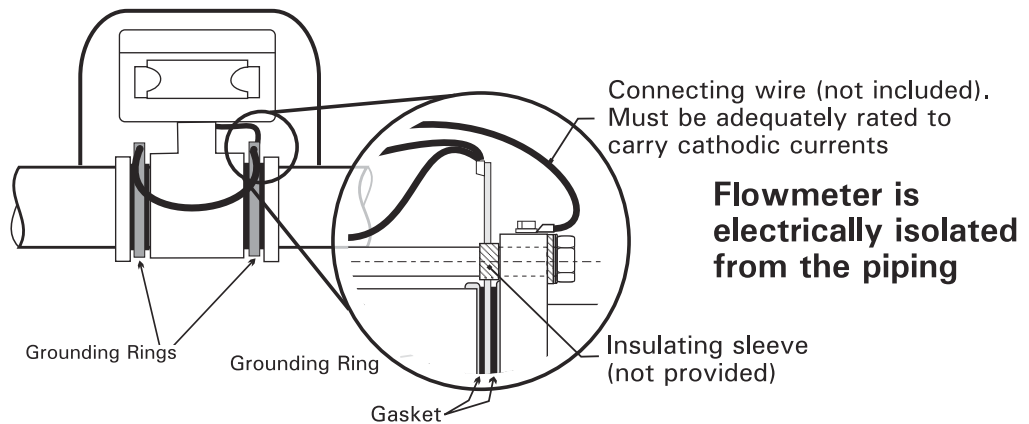
In Unlined Metal Pipelines



In Plastic or Lined Pipeline, Loose Flanges or where Conductivity < 20 micromhos/cm



In Pipes with Cathodic Protection



Grounding
Figure 3.6

▼ **CONTACT OUR TECHNICAL SUPPORT GROUP IF PROCESS LIQUID NEEDS TO BE MAINTAINED AT A POTENTIAL ABOVE OR OTHER THAN GROUND.**

DC and AC voltages can be transmitted through conductive fluids which can lead to magnetic flowmeter instrument errors. Adequate grounding between the liquid and the instrument is essential to ensure correct flow measurement. Magnetic flowmeter should always be grounded at four places: 1) Flowmeter tube, 2) Transmitter, 3) Receiving instrument, 4) the fluid.

▼ **EXTERNAL GROUNDING RINGS SHOULD BE INSTALLED ON ANY METER WHERE THERE IS LINED OR NONCONDUCTIVE PIPE. SEE FIGURE 3.6**

In cases where a nonconductive pipe, or pipe with a nonconductive lining (such as Bitumastic, glass, etc.) or a very low conductivity liquid is present, **grounding rings must be used.**

The grounding rings are in continuous contact with the process liquid providing a direct means for grounding electrical noise in the liquid. The electrical noise potential in the process liquid is at a similar level to the electrical ground plane to which the AC power supply ground is connected. This grounding method stabilizes the electrical field within the sensor measuring section permitting accurate flow detection. Grounding resistance must be less than 20 ohms.

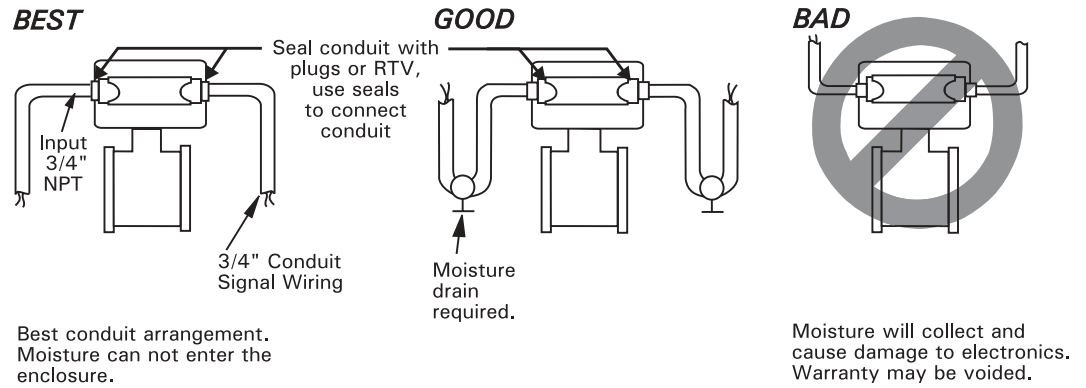
3.7

Electrical Connections

Unscrew the small blind cover of the conduit enclosure to gain access to the I/O PCB. Separate conduit entrances are provided for power and signal wiring. Conduit entrances are 3/4" NPT. Conduit connections should follow good practice and should be routed from below the meter. If the conduit cannot be routed from below, provide moisture traps to prevent moisture from entering the meter enclosure (see Figure 3.7).

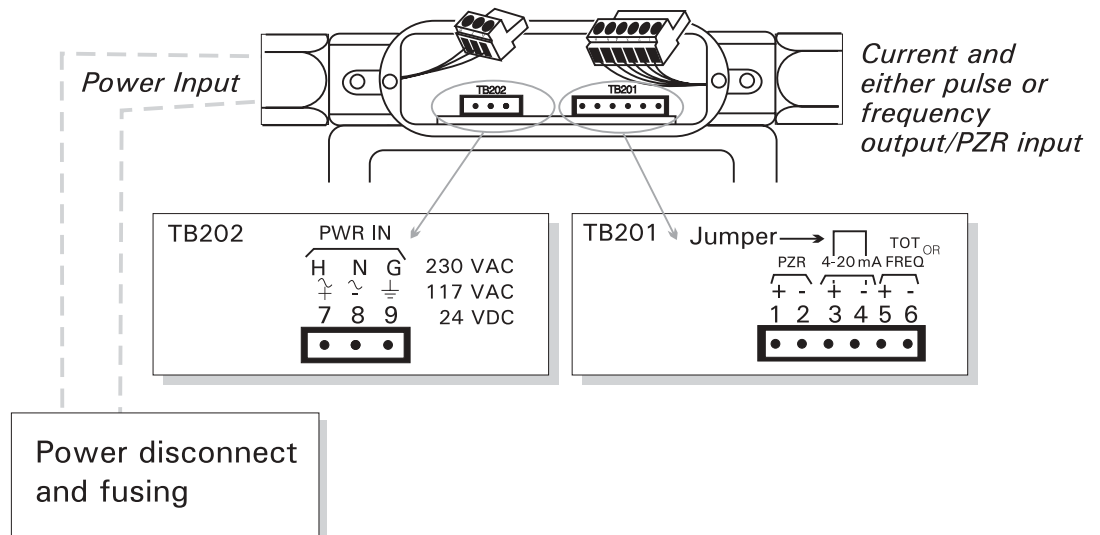


WATERTIGHT CONDUIT, FITTINGS AND CONDUIT SEALS (CORD GRIPS OR RTV SEALANT) ARE REQUIRED TO MAINTAIN THE MOISTURE-FREE INTEGRITY OF ALL ENCLOSURES AND ELECTRONICS IN THE SYSTEM. ENTRY OF MOISTURE WILL VOID SPARLING'S WARRANTY. ALL FITTINGS MUST CONFORM TO NEMA-6P CLASSIFICATIONS. SEAL OFFS MUST BE DONE AT EACH CONDUIT ENTRANCE.



Conduit Connections
Figure 3.7

A connection diagram is located in the conduit connection section. Determine which of the outputs (4-20 mA, pulse or frequency) are to be used. Connect the required outputs to TB 201 as shown below.



Power Connections
Figure 3.8

3.7

Electrical Connections Cont'd.

On TB 202 connect power wires to the power input (terminals 7 & 8). Be sure to connect the ground wire to terminal 9. Connect the Positive Zero Return (PZR) input. Note that meter output is forced to zero when terminals 1 and 2 are jumpered and connected to external, normally closed, contacts. When the meter is equipped with a flow rate indicator you will note a jumper across terminals 3 & 4. **If the 4-20 mA output is to be connected to a load – remove this jumper.** If the jumper remains in position, the 4-20mA output will not be transmitted to the remote device.

The external load on the outputs must be within the limits specified. Calculate the external load by summing the input resistance, including all interconnecting cable. Signal cable of 18-22 gauge is normally adequate.

External load limits

Analog output:	800 ohms max impedance
Pulse output:	150 ohms min impedance
Frequency output:	1000 ohms min impedance

Both outputs are floating and use the same isolated ground. If both outputs are used simultaneously, only one of the common legs can be grounded. If both are grounded, a ground loop will occur causing erroneous signals.



***ONLY ONE LOAD MAY HAVE A LEG STRAPPED TO GROUND
UNLESS THE LOADS ARE ISOLATED FROM EACH OTHER***

4.0 Start-Up

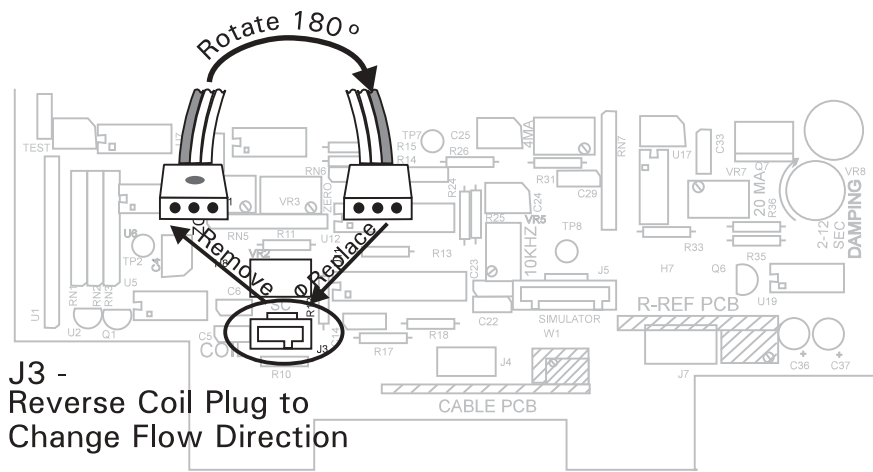
4.1 Start-Up Checks

Prior to applying power, the following checks should be made:

- Check the flowmeter nameplate to insure that the power supply voltage is correct.
- Verify that all electrical input and output connections are correct (see Figure 3.8).
- Check the polarity of external loads connected to the outputs.
- Check the flow direction. If the arrow on the flow sensor is not pointing in the direction of flow - the meter will not function. See Section 4.2 to change flow direction.

4.2 Changing Flow Direction

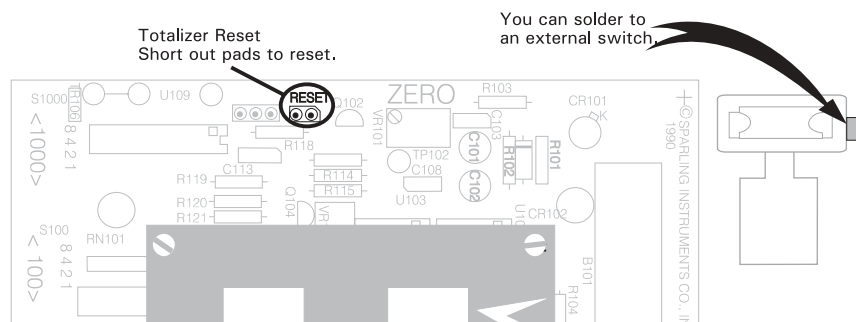
The flow direction can be changed by reversing the position of the coil plug J3 on the amplifier PCB. **POWER TO THE UNIT MUST BE DISCONNECTED BEFORE CHANGING THE COIL PLUG.**



Changing Flow Direction
Figure 4.1

4.3 Resetting the Optional LCD Totalizer

To clear the totalizer display to zero, briefly short out the two solder pads marked "RESET" on the rate/totalizer board.



Zeroing Totalizer Display
Figure 4.2

5.0 Calibration

5.1 Calibration

All flowmeters are calibrated before leaving the factory. No field recalibration is required or recommended. If you require periodic calibration of all instrumentation electronics, this can be easily accomplished in the field using the optional Sparling Microvolt Calibrator P/N AC-678-2. For more information, request a free copy of IDS 678.

5.2 Changing Meter Range (4-20 mA output)

- Required tools:
- Digital Ohmmeter
 - Soldering iron and new metal film resistor, 50 PPM or better (may be required for some range changes).
 - Meter constant K - from the nameplate on the transmitter housing.
 - Q is the desired full scale measuring range in GPM.

Calculate new value for the reference resistor:

$$R_x \text{ (ohms)} = \frac{K \times Q}{7.5}$$

Two examples are shown below:

Example 1: Setting range for 100 GPM

Meter constant (from the nameplate): $K = 1605.85$ (in this example)

Needed: New value for reference resistor (Rx)

$$\text{Solution: } R_x = \frac{1605.85 \times 100}{7.5}$$

$$R_x = 21410 \Omega$$

Example 2: Setting range for 300 LPM

Full scale measuring range (Q) in LPM is 300. Divide by 3.78 to translate to gpm

$$\text{Convert to GPM: } Q = \frac{300}{3.78} = 79.37$$

$$\text{Solution: } R_x = \frac{1605.85 \times 79.37}{7.5}$$

$$R_x = 16994.17 \Omega$$

Note: This calculation requires Q to be in GPM

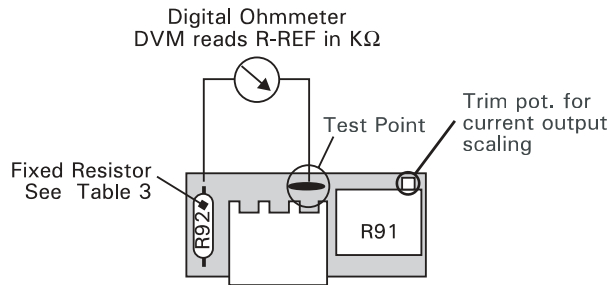
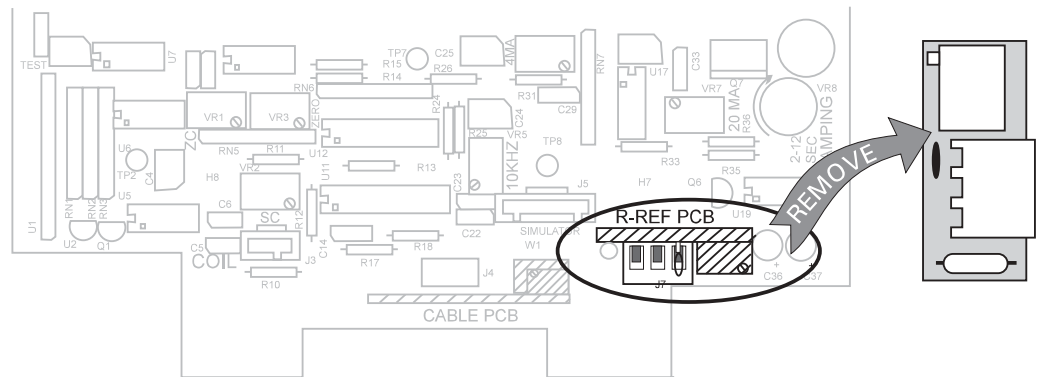
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5.2

Changing Meter Range (4-20 mA output)

Cont'd

▼ **TURN OFF POWER BEFORE PROCEEDING!!**



Changing Meter Range
Figure 5.1

Lift the "R-REF PCB" off the amplifier PCB and connect the digital ohmmeter across the resistor and potentiometer on the board as shown in Figure 5.1. Adjust to the new value of Rx with the trimpot for current scaling. Replace the fixed resistor if necessary to obtain the correct value of Rx (If you do need a new range board or resistor see table below). You will find easier access to the reference PCB, if you first remove rate/total PCB, if fitted.

In our example, adjust the pot to get a reading of 21.41 K ohms. Disconnect the ohmmeter and plug the reference PCB into the main amplifier board. Reapply power and install the enclosure cover. **MAKE CERTAIN TO OBTAIN A GOOD SEAL AROUND THE COVER GASKET.** You must now rescale the digital rate display (if equipped with this option) after changing the meter range. See Section 5.3. Your meter will now be ranged for 100 GPM and the 4-20 output will read 20 milliamps at 100 GPM and 4 milliamps at 0 GPM. The LCD display must also be changed to match the 4-20 output next.

Table 3 – R-Ref Replacement Resistors

R-Ref (K Ω)	R (K Ω)	Sparling P/N
1.5-17	1.05	102898
17-34	15.4	135419
34-50	32.4	104951
50-65	47.5	102749
65-80	61.9	131722
80-93	75.0	131706

5.3

Rescaling Optional Digital Rate Display

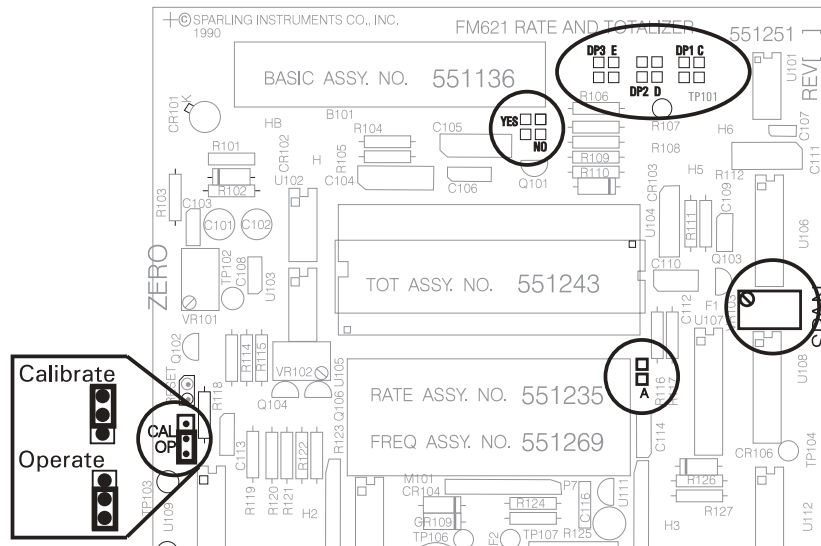
You must perform Section 5.2, Changing Meter Range before beginning this step. Once the 4-20 mA output tracks the flow in desired units, proceed as follows.

On the rate/totalizer board (see Figure 5.2), move the jumper to "CAL" position and adjust "SPAN" pot, until you see the full scale flow in selected units on the display. Then move the jumper back to "OP" position. You may have to change the location of the decimal point by resoldering selection points. **TURN THE POWER OFF.**

The table below shows how to configure or change the position of the decimal point on the rate. When the top and bottom squares are soldered together, you have connected that pair and will be considered "closed". If they are desoldered or there is a gap, they will be considered "open".

FOR	CLOSED	OPEN
X.XXX	"DP3", "D", "C"	"E", "DP2", "DP1"
XX.XX	"E", "DP2", "C"	"DP3", "D", "DP1"
XXX.X	"E", "D", "DP1"	"DP3", "DP2", "C"

Also if the full scale is a number below "400" (disregarding the decimal point), bridge solder point "A" (otherwise leave it open). If you want to activate a dummy zero in the last position of the display (for full scales greater than "2000"), solder "YES" and open "NO" (otherwise "YES" is left open and "NO" is bridged).



Rescaling Rate Display
Figure 5.2

If you are having difficulty programming or rescaling, call Sparling parts order desk and give them serial number and new range and we can ship you new R-Ref PCB.

5.4

Rescaling Pulse Rate Output Option

Series FM 618 flowmeters may be ordered with an additional printed circuit board that provides a scaled 24 Vdc pulse rate output proportional to flow. This circuit board is equipped with pulse rate scaling circuitry to divide the frequency so that each pulse represents a known volume of process liquid in predefined engineering units. Meters are factory set per the original order. The following procedure allows divider resetting in the field if necessary.

Example: Setting the pulse for every 100 gallons

Meter constant K (see nameplate) = 2769.23
 Required output registration R = 100 Gal/Pulse

Needed:

Divided factor, N
 $N = K \times R$

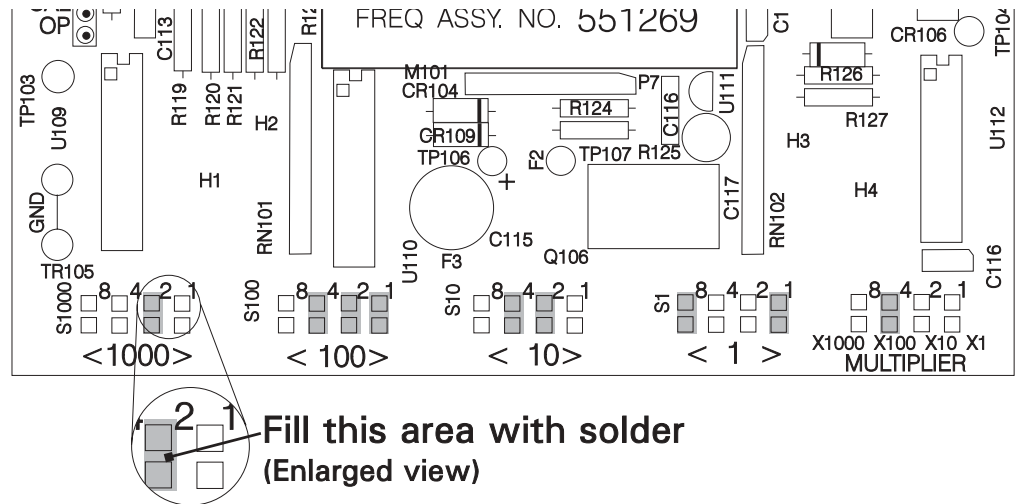
Where:

R = Registration in gallons/pulse
 K = Meter constant in pulses/gallon
 $N = 2769.23 \times 100 = 276,923.0$

N must be defined as 4 significant digits between 0000 and 9999 plus a multiplier of 1, 10, 100 or 1000. In our example 276,923 is rounded off to 276,900.

Restate the N value as the product of a coefficient between 100 and 9999 and a multiplier of 1, 10, 100 or 1000. Where more than one combination is possible, make the coefficient as large as possible and the multiplier small. In this case 276,900 is defined as 2769 x 100.

The coefficient is set by bridging solder points on the rate and totalizer board. Bridge only one multiplier, i.e. 1, 10, 100, or 1000 (see Figure 5.3).



Rescaling Pulse Rate
 Figure 5.3

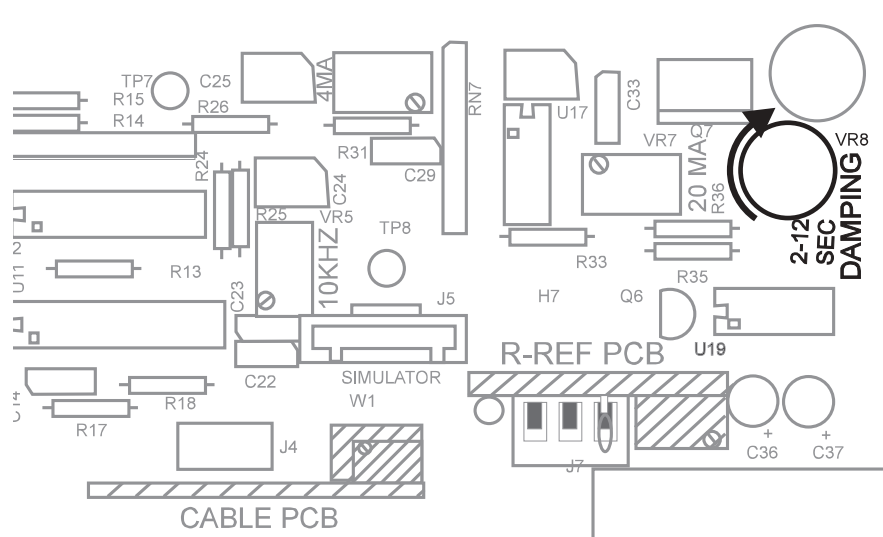
In the example 2769 x 100 above:

- At the <1000> location, solder bridge 2
- At the <100> location, solder 4, 2 and 1. This totals 7.
- At the <10> location, solder 4 and 2. This totals 6.
- Then solder 8 and 1 to give you the last digit, 9. Now select "x 100" just to the right.

5.5

Current Damping Adjustment

Current damping may be selected from 2-12 seconds. This corresponds approximately to the number of seconds to respond 90% to a step change in input. To adjust damping, turn damping pot on the Amplifier PCB clockwise until damping is at desired level.



Current Damping
Figure 5.4

6.0

Maintenance

No routine maintenance is required.

The flow sensor is of stainless steel construction and has no replaceable parts. In the event of a failure, the flow sensor must be replaced. The transmitter is removable.

Sparling's repair/exchange program allows you to expedite replacement of a defective flow sensor or transmitter. If the equipment is within the warranty period (two years), a fixed price will be charged to the buyer for replacement of the defective equipment. The appropriate credit will be issued upon return of the goods to the factory in good condition.

The transmitter electronics utilize IC and LSI components. Troubleshooting integrated circuit devices can be difficult. **It is recommended that PCB level maintenance not be attempted.**

Caution must be exercised when connecting test probes - even a momentary accidental short circuit may damage an IC device. Only qualified technicians should attempt to service this equipment.

In the event of a malfunction in the transmitter, a replacement PCB assembly can be quickly substituted for the defective assembly, thereby minimizing system down time. Servicing by substitution of spare assemblies is more economical than stocking a large variety of IC chips, transistors, diodes, etc. Also, test equipment requirements and the level of technical expertise necessary are minimized. It is suggested that the user contact the Sparling service facility for technical assistance at (800) 800-FLOW. Be sure to have the serial number of your device.

7.0 Troubleshooting

7.1 General

Each flowmeter is rigorously tested during production. The final test stage is a wet flow calibration in Sparling's precision primary flow laboratory traceable to the National Institute of Standards and Technology (NIST). A copy of the calibration record is shipped with each meter. If lost, another may be obtained from Sparling Customer Service.

7.2 Troubleshooting Chart

The following troubleshooting chart should assist in correcting meter malfunction. For additional information, contact Technical Assistance at 800/800-FLOW.

▼ **BEFORE TROUBLESHOOTING, CAREFULLY VERIFY THE OPERATING CONDITIONS OF THE METER:**

1. Verify the interconnecting wiring by using a local milliammeter connected to the current output with no other load connected.
2. Verify that the sensor is completely filled with liquid. An empty or partially full sensor will continue to send a flow signal even with no flow.
3. Verify that the flow test comparison is valid to be sure that the meter is in error.
4. If in doubt, verify the conductivity of the liquid to see that it exceeds 20 micromhos/cm.
5. Verify that there is suitable grounding of the meter and interconnecting piping.

7.3 Circuit Board Replacement

No adjustments are required if a circuit board is replaced. The PCB has been calibrated at the factory. Make sure that the **reference** and connection boards remain together with the original flow sensor. See figure 5.1.

7.4 Electronics PCB Replacement

Meter electronics are mounted on an easily removable PCB. ***This PCB contains no user serviceable parts. If you are swapping the electronics with another meter, see Sections 5.2 through 5.4 and follow the steps carefully.***

Troubleshooting Chart

SYMPTOM	POSSIBLE CAUSE AND CURE
1. Display is blank.	1. Check the power and the fuse. Check all PCB and field connections. See that Terminals 3 & 4 on TB 201 are jumpered.
2. Display is turning black around the edges.	2. Temperature is too high inside the enclosure. Relocate the meter or shield against the heat source. Continuing to power the meter in this condition will permanently damage the display.
3. Display is difficult to read.	3. Improve the lighting conditions if ambient light is dim.
4. Displayed flow rate changes rapidly.	4. Increase damping. Figure 5.4.
5. Recorder trace is too wide (paints).	5. Increase damping. Figure 5.4.
6. Rate display and/or current output does not correctly track the flow.	6. Incorrect selection of R-ref resistance which defines the flow rate for 20 mA. Change the meter range. See section 5.2. Rescale the digital rate display. See section 5.3. Check liquid grounding
7. Display is correct, but totalizer does not correctly track the flow.	7. Incorrect pulse scaling. See section 5.4.
8. Display and outputs are at zero.	8. Dry Sensor Full pipe no flow condition. PZR contact closed. Reverse flow conditions (change flow direction). Possible blown coil drive. See section 7.8.
9. Display and outputs are not zero at zero flow.	9. Leaky valves Some liquid movement.
10. Display and outputs are erratic or wander.	10. Pipe partially full. Large air bubbles are present in the process liquid. Increase the head in the line by restricting downstream flow. Pipe freshly drained. If part of process cycle, utilize PZR to inhibit outputs. Possible blown coil drive. See section 7.8.

If the above steps fail to correct the problem, try different flow rates and disconnecting loads temporarily and see if the problem persists. Please have the following information available when you call:

Meter serial number (see meter nameplate on transmitter housing).

Description of the problem. (Display, current output, totalizer/frequency, all of the above.)

Is the pipe full of liquid?

When does the symptom occur or repeat?

What are the flow rates, the orientation of the meter in the pipeline, environmental conditions and the output loads on the meter?

How did you verify the discrepancy?

Are the gaskets installed and concentric with the bore of the meter?

If the piping material is nonconductive, is the meter properly grounded?

Describe how the meter is grounded to the liquid.

Contact Technical Assistance 800/800-FLOW for additional help.

7.5

Sensor Testing

The sensor consists of a measuring section with electrodes and coils enclosed in a stainless steel housing. Defective sensors should be returned to the factory for replacement. **OBTAIN A RETURNED GOODS AUTHORIZATION PRIOR TO RETURNING MATERIALS TO PREVENT DELAYS.**

7.6

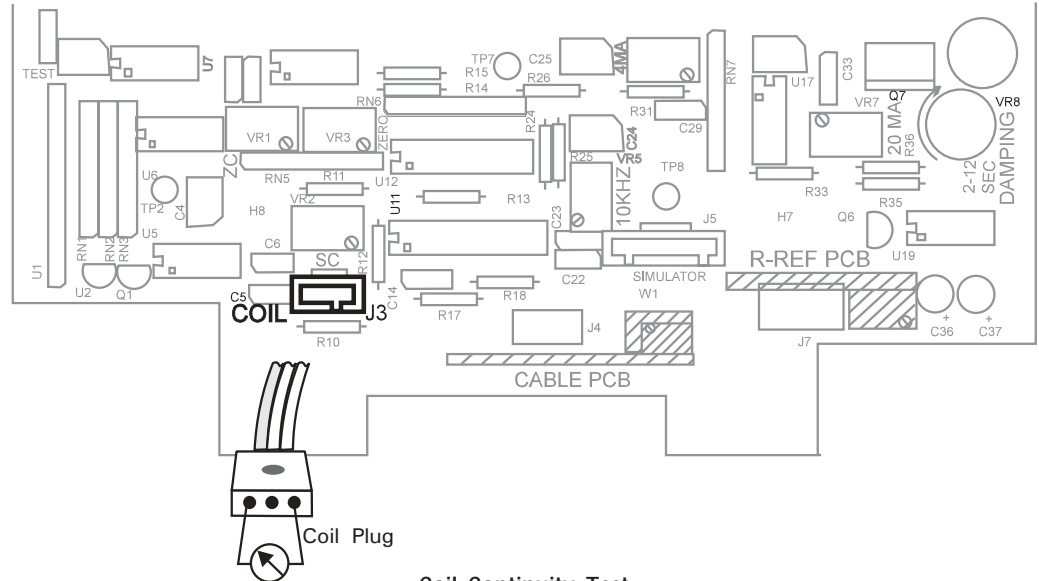
Coil Continuity Testing



DO NOT MAKE OR BREAK COIL CONNECTION WHILE POWER IS APPLIED. DISCONNECT POWER BEFORE PROCEEDING.

Unplug coil plug J3 (Using a short test lead, connect ohmmeter between coil wires and measure resistance of 270 ohms nominal ($\pm 5\%$ if unpowered at 68 °F).

The nominal coil resistance for all sizes is 270 ohms. If the coil resistance is too high or low (including open and short circuits) the sensor must be returned to the factory for inspection and/or repair.



Coil Continuity Test
Figure 7.1

The sensor can fail for the following reasons:

1. Defective coil windings
2. Moisture penetrating the coil housings due to leaking electrodes.
3. Moisture penetrating the sensor junction box due to loose conduit connections or junction box cover.

7.7

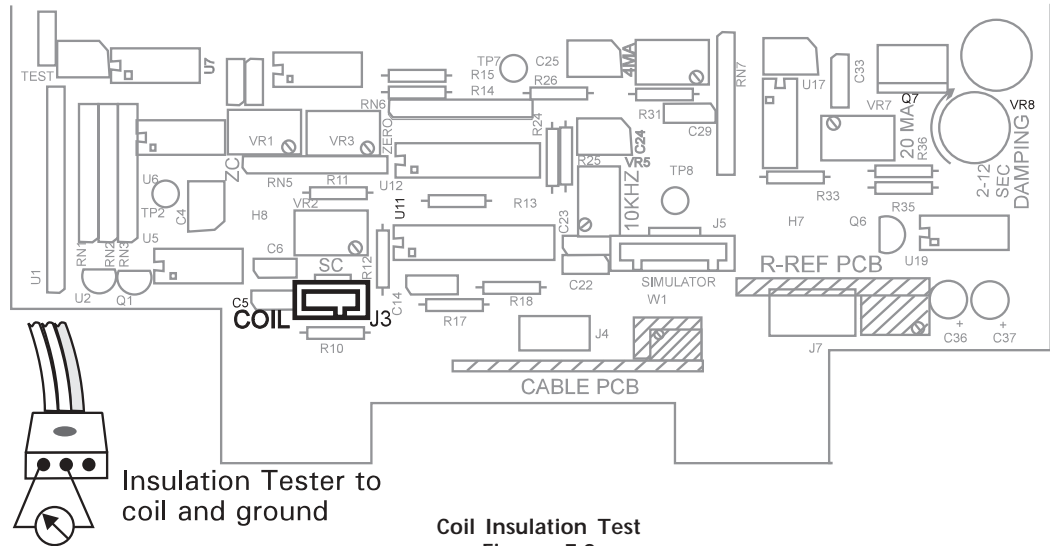
Coil Insulation Test

Required test equipment: Insulation tester 10¹⁰ ohm

Disconnect power and signal cables from the transmitter Junction Box

Disconnect coil plug J3.

Connect insulation tester between coil wire and housing ground. Test the insulation at 500 Vdc. A reading below 10,000 meg ohms indicates moisture in the sensor. The sensor must be returned to the factory for inspection and/or repair.

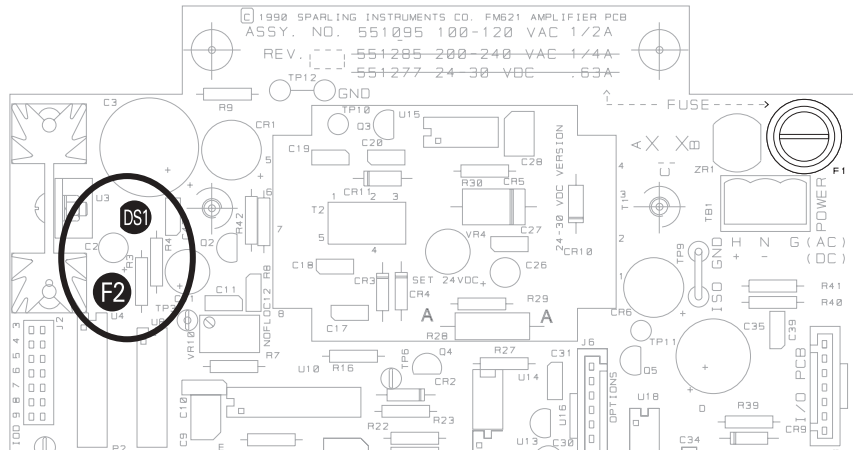


7.8

Coil Check

You can verify whether or not the coils are operating by opening the meter housing and locating LED #DS1. If light is on, coils are powered.

If light is off replace fuse F2. If light comes on, coil is operating properly. If light is still off or if fuse blows again, coil is not working. Call Sparling Customer Service and request an RGA number and return for service (see Section 2.3).



7.9

Electrode Circuit Continuity Test

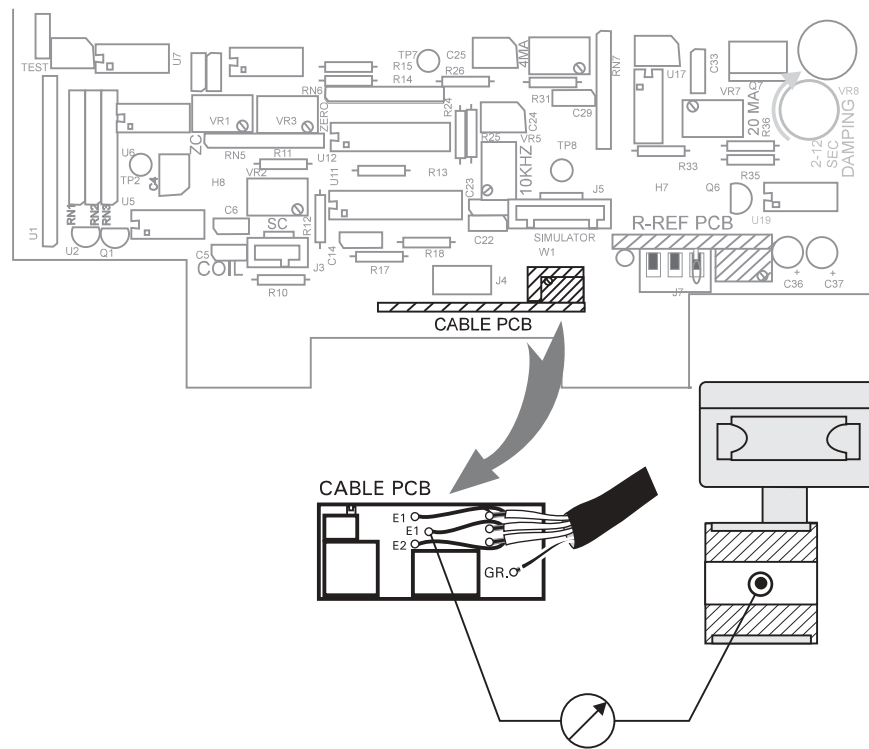
Remove sensor from the pipeline. Drain sensor and dry interior thoroughly.

Unplug electrode cable PCB (Figure 7.3).

Connect ohmmeter to E1 on cable PCB (center conductor of one electrode cable) and to the electrodes which are accessible through the open sensor.

Measure 0 ohms for one electrode and ∞ ohms for the other.

Connect ohmmeter to E2 and repeat the above procedure.



Electrode Circuit Continuity Test
Figure 7.4

7.10

Electrode Circuit Insulation Test

Unplug electrode cable PCB.

Connect insulation tester three ways:

1. Between E1 and housing ground
2. Between E2 and housing ground
3. Between E1 and E2

A reading below 1400 meg ohms at 500 Vdc indicates moisture in the sensor. Return the sensor to the factory for inspection and repair. This applies to sensors that have been removed from the line and the sensor tube has been cleaned and dried.

8.0 Replacement Parts List

<i>Description</i>	<i>Part Number</i>
1. Main Amplifier PCB -4-20 mA standard (does not include R-Ref board) 100 - 117 Vac	551095
2. Rate/Totalizer PCB (optional)	
4-20 mA only	551269
No display and frequency.	
Flow-rate display only	551235
Totalizer display only	551243
Flow and totalizer displays combined	551251
No displays, external	551136
totalizer output only	
3. R-Ref PCB Board	543133
4. Fuse, 5x20 BUSS	
100-117 Vac 0.5 amp	136532
5. Battery	148503
6. Dessicant	148967
7. Enclosure Mounting Adapter	154832

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