TECH NOTES

FSM-3 SuperMag Insertion Electromagnetic Flow Meter

ONICON
Flow and Energy Measurement

TROUBLESHOOTING GUIDE

OVERVIEW

To thoroughly troubleshoot the FSM-3, the sensor probe, associated wiring, and transmitter diagnostic screens will all need to be examined. Any damage, defects, or water intrusion in the sensor probe will be detectable by taking several resistance measurements. Additionally, any mis-wirings will lead to measurement errors. The advanced diagnostic screen on the FSM-3 transmitter will provide indications that the electrical signal from the sensor probe is erroneous or otherwise beyond the expected condition.

RECOMMENDED TOOLS

- FSM-3 Installation and Operation Guide
- 5/8" Open wrench
- 1" Open or Crescent wrench
- 1/8" Allen (hex) wrench
- 3/16" Allen (hex) wrench
- Phillips head screwdriver
- Spanner/locknut wrench
- Multimeter (V, A, and Ω capable)

POWER/DISPLAY ISSUES

1. Verify 24 VAC/DC is being supplied to the transmitter by measuring directly on the TB1 input terminals with a voltmeter or multimeter. Ensure the meter's power supply is rated for a minimum of 40VA AC or 50W DC.
2. Verify the transmitter screen is lit and displaying values. If there are any issues, such as flickering or frozen display, verify that the ribbon cable connecting the FSM-3 display to the terminal board is properly seated.
3. If issues persist, please contact ONICON Tech Support at 727-447-6140.

OUTPUT ISSUES

1. Remove all signal connections between the meter and external devices. Leave the sensor probe wires (Coil, ELEC1, ELEC2) and power inputs connected to the transmitter.
2. Verify that flow is currently being measured by the meter by scrolling to the Volume Rate screen on the transmitter.
3. Using a multimeter, measure the Analog Output 1 on terminal T5; the terminal labeled "I" will be the 4-20 mA (+), the terminal labeled "V" will be the 0-5/0-10 V (+). The analog signal type and full scale as configured on the meter will be displayed on the Volume Rate screen. Compare this value to the full-scale value and displayed Volume Rate.
4. Using a multimeter, measure the Frequency output (DC Hz) on terminal T5, labeled "F". To determine the output flow rate, multiply this measurement by 60, and then divide by the unit's Meter Factor, which will be located on the factory configuration information that comes attached to the meter. Compare the calculated and displayed Volume Rates.
5. If issues persist, please contact ONICON Tech Support at 727-447-6140.

FLOW MEASUREMENT ISSUES

1. Verify that the flow sensor is installed correctly in accordance with the FSM-3 Manual.
    a. Measure between the outer diameter of the pipe and the underside of the sensor electrical enclosure and verify it is the proper distance for full insertion.
    b. Verify that the pre-load has been applied. If the pre-load is applied, the gap between the top of the collar window and the collar will be approximately 1/32" with the pre-load nut fully seated. If the pre-load is not applied to the sensor or if the sensor is not fully seated inside the pipe, this gap will be 1/16" or greater.
    c. Verify that the sensor probe is not restrained inside the hot tap adapter by loosening the 5/8" hex collet nut (above the 1" hex preload compression fitting) and gently rotating the electronics enclosure. If it does not easily rotate, it is likely that the hot tap adapter threading has been over-torqued and the probe's anti-vibration feature is wedged in the adapter. This will also prevent the probe from complete insertion and pre-loading of the probe to the back of the pipe. If this is the case, please contact ONICON Tech Support at 727-447-6140.
2. Check the meter firmware version (Menu>Meter Data>Versions).
    a. If the App version is prior to 01.01.22, the transmitter may require a firmware update; please contact ONICON Tech Support at 727-447-6140.
3. Check the meter Advanced Diagnostic screen (Menu>Diagnostics>Advanced).
    a. If possible, perform this check with flow present in the system and then **turn off any pumps or VFDs** and repeat the check (Pumps and VFDs are potential sources of electrical noise).
    b. With flow present, the ADC Counts for Flow0 and Flow1 will bounce up and down, centered around 32000 (for example, between 25000 to 39000). At no flow, the value should be roughly 32000. If these values are reaching 65000 or 00000, there is most likely an issue with the sensor circuitry. If only one of the electrodes fail this check, open the transmitter and swap the ELEC1 and ELEC2 terminal blocks' positions on the circuit board. If the symptom in the diagnostic values move to the opposite Flow line, the issue is due to the circuitry of the sensor electrode bank connected to that channel.
    c. The voltages on Flow0 and Flow1 should be within approximately 80% of each other. If these values are significantly different, there is either a sensor circuitry issue, the sensor probe is not oriented properly, or there is excessive flow profile disruption.
4. Open the transmitter enclosure to verify that all wires are in the correct terminal per the provided instructions (see Appendix A) and that all terminals are properly seated on the circuit board.
5. With the sensor probe still in the pipe, unplug the Coil (TB3), ELEC1 (TB1) and ELEC2 (TB2) terminal blocks from the transmitter circuit board and perform the sensor circuitry tests below. Refer to Table 1 for guidance and record the measured values.

IMPORTANT NOTE
Each colored wire on ELEC1 and ELEC2 represents a single electrode on the sensor probe.

    a. Verify continuity between the two Coil terminals. The value should be less than 200 Ω.
    b. Verify isolation between the Coil and Electrodes.
    c. Verify isolation between the individual Electrodes. In water, the resistance between any two should be **greater than** 1 MΩ.
    d. Any deviation from the expected values in Table 1 indicates a potential failure of the sensing probe. If any deviations are measured, contact ONICON for further instructions.

Table 1: In-Pipe Probe Test				
Test	**Point 1**	**Point 2**	**Expected Value**	**Measured Value**
Coil Continuity (5.a.)	TB3 Pin 1	TB3 Pin 2	<200 Ω	
Coil-Electrode Isolation (5.b.)	TB3 Pin 1	TB1 Pin 2	Open	
	TB3 Pin 1	TB1 Pin 3		
	TB3 Pin 1	TB2 Pin 2		
	TB3 Pin 1	TB2 Pin 3		
Electrode-Electrode Isolation (5.c.)	TB1 Pin 2	TB1 Pin 3	>1 MΩ	
	TB1 Pin 2	TB2 Pin 1		
	TB1 Pin 2	TB2 Pin 2		
	TB1 Pin 2	TB2 Pin 3		
	TB1 Pin 3	TB2 Pin 1		
	TB1 Pin 3	TB2 Pin 2		
	TB1 Pin 3	TB2 Pin 3		
	TB2 Pin 1	TB2 Pin 2		
	TB2 Pin 1	TB2 Pin 3		
	TB2 Pin 2	TB2 Pin 3		

6. Remove the meter from the pipe per the instructions in the FSM-3 Installation and Operation Guide. Dry the sensor probe with a cloth.
7. Inspect the probe for cracks or damage and verify that all electrodes are firmly in place, roughly flush with the probe.

8. With the Coil, ELEC1, and ELEC2 terminal blocks still unplugged, perform the sensor circuitry tests below. Refer to Table 2 and Figure 1 for guidance and record the measured values.
   a. Verify Continuity between the Electrodes on the sensor probe and the associated transmitter terminal.
   b. Verify Isolation between the Electrodes on the sensor probe. The two middle Electrodes are the reference/shield Electrodes and are tied together.

Table 2: Out-of-Pipe Probe Test

Test	Point 1	Point 2	Expected Value	Measured Value
Electrode-Terminal Continuity (8.a.)	TB1 Pin 2	Top ELEC1	<20 Ω	
	TB1 Pin 3	Bottom ELEC1		
	TB2 Pin 1	Middle ELEC1		
	TB2 Pin 1	Middle ELEC2		
	TB2 Pin 2	Top ELEC2		
	TB1 Pin 3	Bottom ELEC2		
Electrode-Electrode Isolation/Continuity (8.b.)	Top ELEC1 (**Red**)	Top ELEC2 (Yellow)	Open	
	Bottom ELEC1 (**Black**)	Bottom ELEC2 (Orange)		
	Top ELEC1 (**Red**)	Bottom ELEC1 (**Black**)		
	Top ELEC2 (Yellow)	Bottom ELEC2 (Orange)		
	Top ELEC1 (**Red**)	Bottom ELEC2 (Orange)		
	Top ELEC2 (Yellow)	Bottom ELEC1 (**Black**)		
	Shield	**Shield**	<2 Ω	

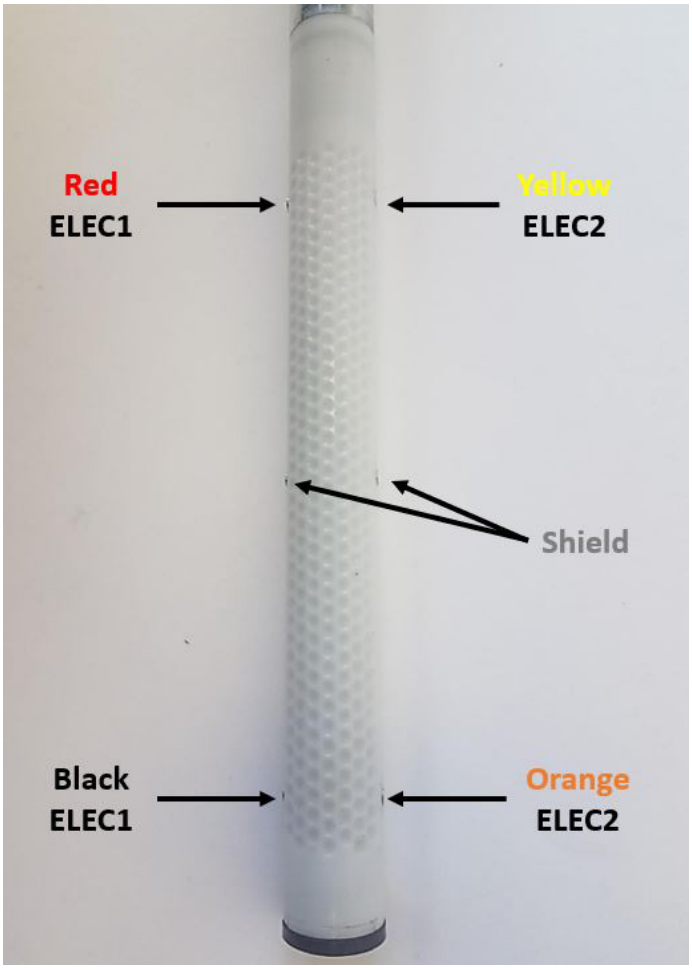


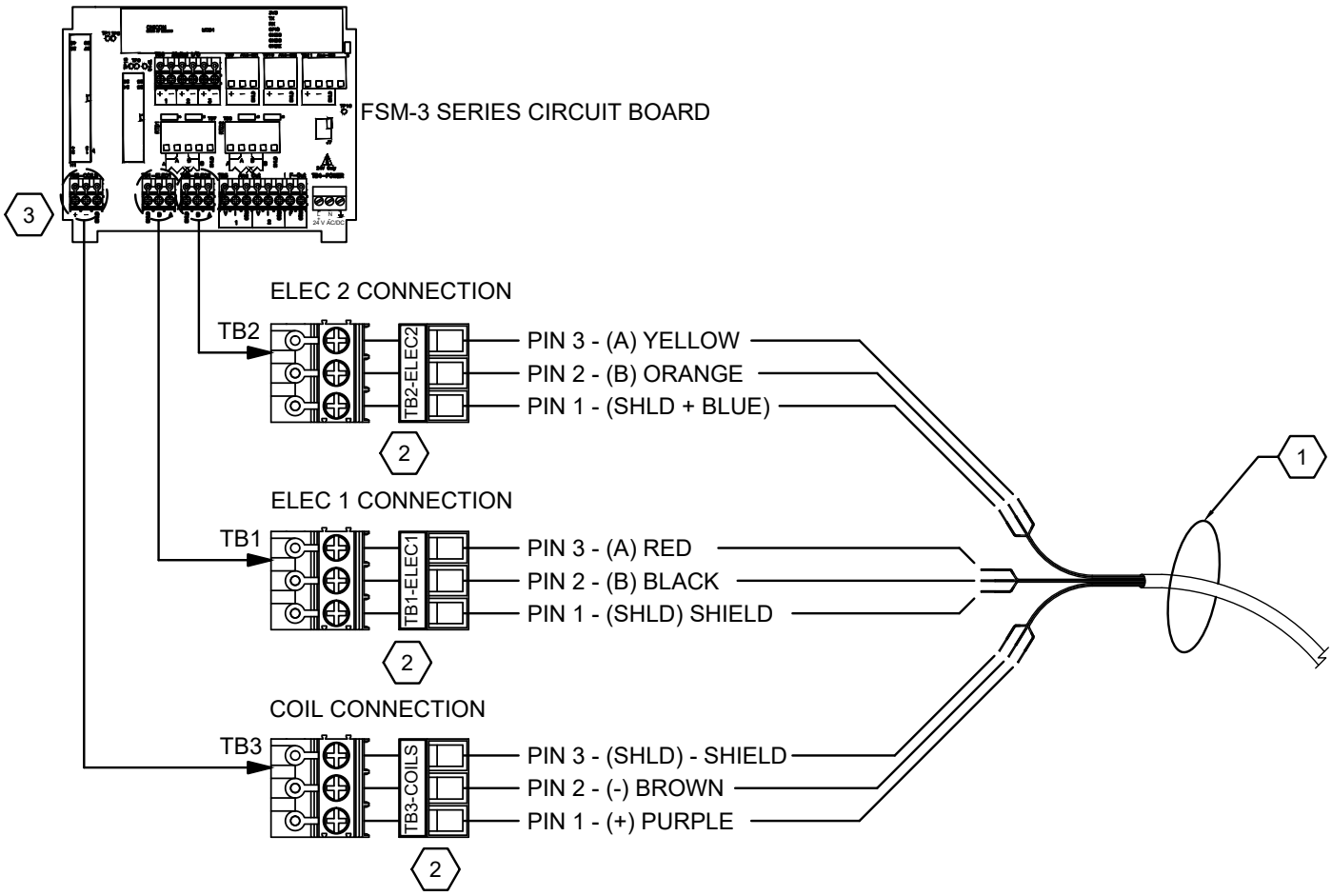
Figure 1: Sensor Electrode Locations

IMPORTANT NOTE

Depending on the orientation of the sensor probe, the ELEC1 and ELEC2 Electrode sets may be on the opposite side of what is shown. To quickly identify the sides, test between the Red wire (TB1 Pin 2) and the each of the two Top Electrodes. The side with the top electrode that demonstrates continuity is the ELEC1 (TB1) set of electrodes.

9. Reinstall the sensor wiring and with the meter powered, perform a Bucket Test:
   a. Obtain a plastic bucket and fill it at least half full of clean water.
   b. Put the sensor down into the water in the bucket and let it sit for several minutes for the water in the bucket to stabilize.
   c. Either stir the water with the sensor stationary or gently move the sensor head back and forth while watching the displayed flow and advanced diagnostic screens. You should see a reaction to the motion of the water/meter.

APPENDIX A: TRANSMITTER WIRING



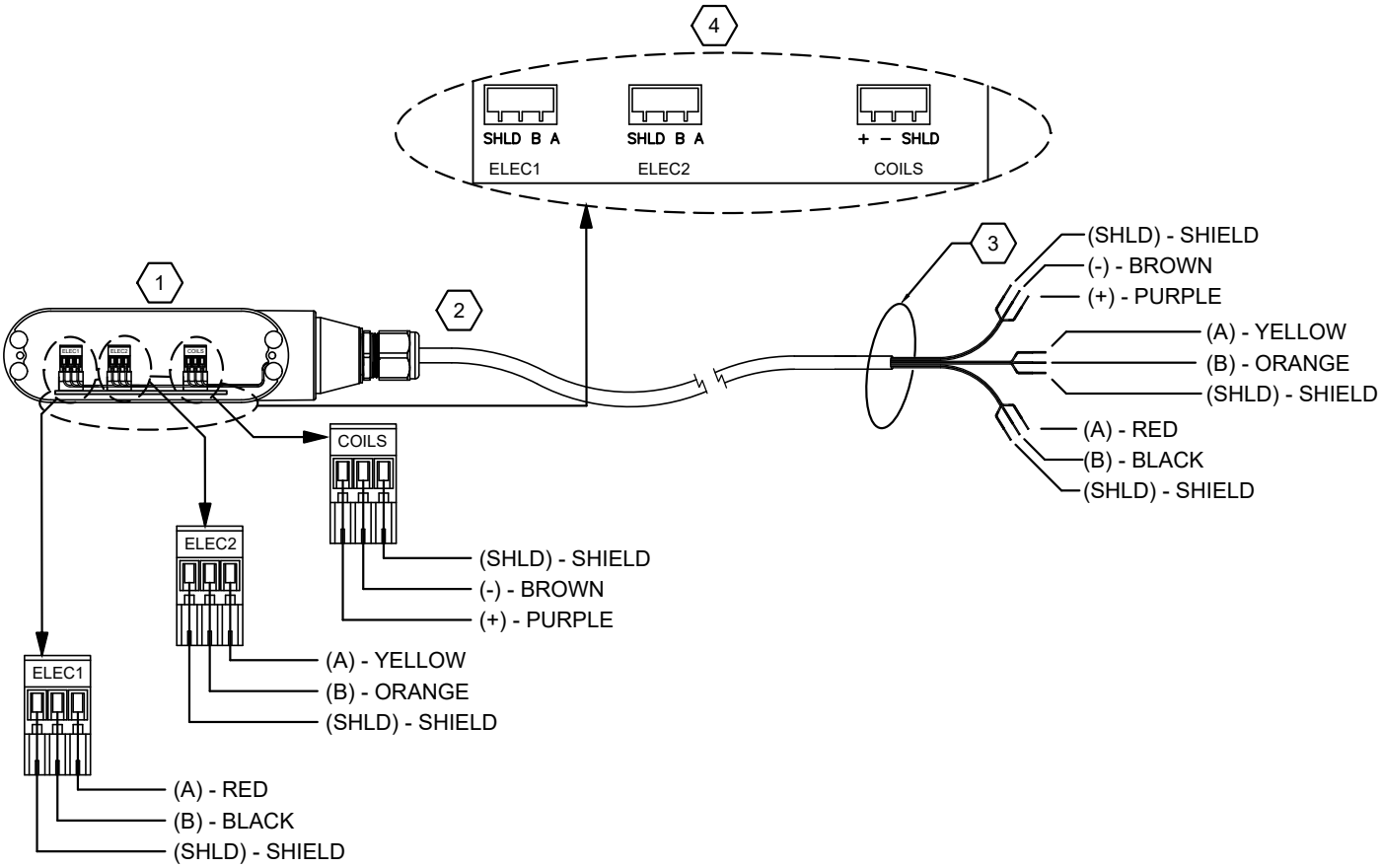
IMPORTANT NOTE

All wiring connections should be performed before power is connected to the flow meter.

Field Wiring

1. Identify the flow sensor coil and electrode wires based on their wire lead colors.
2. Terminate the wires in their pre-labeled terminal blocks.
3. Match the terminal block labels to the silk screen text on the circuit board when re-populating the terminal blocks.

APPENDIX A: TRANSMITTER WIRING CONTINUED



1. Remove flow sensor enclosure cover to gain access to coil and electrode wire terminal blocks.
2. Loosen strain relief fitting to allow cable to be installed / removed easily. Conduit Connection: Remove strain relief and replace with 1/2" MNPT conduit fitting.
3. Electrode and Coil wires are identified by their individual wire colors.

CAUTION

Do Not make wiring connections while the flow meter is powered. Confirm wiring is correct before applying power to the flow meter.

4. Confirm the individual terminal block labels match the text on the circuit board before re-populating terminal blocks.