5. Troubleshooting

Warning: Only qualified personnel should attempt to test this device. The operator assumes all responsibilities for safe practices while troubleshooting.

Caution: The flow transmitter contains electrostatic discharge (ESD) sensitive devices. Use standard ESD precautions when handling the flow transmitter. See Chapter 2, Installation for ESD details.

Quick Check

Use Table 5-1 as a quick check of problems and solutions. More in-depth discussions follow this table.

Table 5-1. Quick Check Troubleshooting

Problem	Solution
No Display	Check fuses. Verify correct power is applied. Verify the ribbon cable between the backplane board J18 and the display J1 is solidly connected and the red stripe is at pin 1. See Figures 2-3 and 2-4.
No Display or Dim Display	Adjust potentiometer R1 (located on display board) clockwise (10 turns maximum) until display appears. See Figures 2-3.
Display is locked up	Cycle the input power or press any key for more than 10 seconds.
Incorrect Readings	Verify that all ribbon cables are firmly seated. See Figure 2-3 and 2-4.

Non-maintenance Observations

At this point, simply observe the system setup to verify operation. No disassembly or testing is required at this time.

Check Serial Numbers

Verify that the serial number of the flow elements and the flow transmitter are the same. The flow elements and the flow transmitter are a matched set and cannot be operated independently of each other.

Check Input Power

Verify that the correct power source is turned on and connected.

Check the Unit Installation

Review the information on instrument installation in Chapter 2 to verify correct mechanical and electrical installation. Verify that all ribbon cables are seated firmly.

- Relay Output Board J1 Þ Backplane Board J21 and/or J22
- Analog Output Board J1 Þ Backplane Board J19
- Display Board J1 Þ Backplane Board J18

Check for Moisture

Check for moisture on the flow transmitter. Moisture on the flow transmitter may cause intermittent operation.

Check Application Design Requirements

Application design problems usually occur with first time application units, although the design should also be checked on units that have been in operation for some time. If the application design does not match field conditions, errors occur.

1. Review the application design with plant operation personnel and plant engineers.
2. Ensure that plant equipment such as pressure and temperature instruments conform to the actual conditions.
3. Verify operating temperature, operating pressure, line size, and gas medium.

Verify Standard Versus Actual Process Conditions

The flowmeter measures the mass flow rate. The mass flow rate is the mass of the gas flowing through a pipe per time. Other flowmeters, such as an orifice plate or a pitot tube, measure the volumetric flow rate. The volumetric flow rate is the volume of gass per time. If the readings displayed by the MT91 does not agree with another instrument, some calculations may be necessary before comparing them. To calculate the mass flow rate, the volumetric flow rate, and the pressure and temperture at the point of measurement must be known. Use the following equation to calculate the mass flow rate (Standard Volumetric Flowrate) for the other instrument.

Equation:

$$Q_S = Q_A \times \frac{P_A}{T_A} \times \frac{T_S}{P_S}$$

Where:

Q_A = Volumetric Flow Q_S = Standard Volumetric Flow
P_A = Actual Pressure T_A = Actual Temperature
P_S = Standard Pressure T_S = Standard Temperature
and Pressure and Temperature are in absolute units.

Example:

Q_A = 1212.7 ACFM Q_S = 1485 SCFM
P_A = 19.7 PSIA T_A = 120°F (580°R)
P_S = 14.7 PSIA T_S = 70°F (530°R)

$$\left(\frac{1212.7\,\text{ACFM}}{1}\right)\left(\frac{19.7\,\text{PSIA}}{580^\circ\,\text{R}}\right)\left(\frac{530^\circ\,\text{R}}{14.7\,\text{PSIA}}\right) = 1485\ \text{SCFM}$$

Troubleshooting Process

Verify Units

Observe the normal display screen to verify that the unit of measure for channel 1 and 2 are the expected units.

If units are correct, proceed to the next section. If units are not correct, refer to Chapter 3 for instructions on selecting measurement units.

Verify Channel Assignment

If there is no reading or faulty reading, make sure that the sensing points are assigned to the correct channel. Refer to Chapter 3 for instructions on assigning sensing points if they need to be assigned.

1. Go to menu level 2.2.1 and select the desired channel (Setup Þ Outputs Þ Assign Heads) .
2. Select 5=View Assigned. An ‘x’ will appear under the sensing point number if it is assigned.

If the correct sensing points are assigned, continue with the next section.

Verify Limits

If there is a no flow indication when flow exists, the DelR min may have been set to high.

1. Go to menu level 4.2.5, select the head number in question and record the DelR value.
2. Go to menu level 5.2.3.1 (Verify Þ Calibration Þ Flow Þ Limits).
3. Press any key to scroll down to the desired display. For example, if sensing point 16 is being tested, press any key until the display shows dRMin 16.

If the dRMin is set below the recorded value in Step 1, continue with the next section.

If the dRMin is set above the recorded value in Step 1, contact Customer Service.

Check for Suspect Sensing Points and Heaters

An annunciator on the normal display will indicate "Check Head" if the flow transmitter detects a problem with one or more sensing points. Use the diagnostics menu to identify which sensing points are suspect.

1. First go to menu level 3.1.1 (Diagnostics Þ System Status Þ Sensors).
2. Suspect sensing points are indicated on the display by a 'x'. Note any suspect sensing points.
3. Go to menu level 3.1.2 (Diagnostics Þ System Status Þ Heaters). This display indicates suspect heaters.
4. Go to menu level 4.2.5 (Calibration Þ Cal Inputs Þ Unipolar rR & dR).
5. Enter the number of the suspect sensing point. Check for valid RefR and DelR levels.
   The RefR signal depends on the temperature of the media and ranges from 1080 (108 high temperature units) at room temperature beyond 1650 (165 for high temperature units) at approximately 350°F (177°C). The DelR depends on the flow rate and can range from 10 (3 for high temperature units) to more than 100 (20 for high temperature units).

If the DelR is very low or zero and the RefR appears normal, the heater circuit may be broken. Measure the resistance of the wiring from HAX to HAS. If the resistance is approximately 20 ohms the input board may have a failed heater component, contact Customer Service.

Verify the Calibration Parameters

The flowmeter uses a set of predetermined calibration parameters to process flow and temperature signals. Most of these parameters should not change. A data package located at the rear of this manual contains the "MT91 Delta R Data Sheet" and the "MT91 Delta R Parameters". These contain the calibration parameters stored in the flow transmitter at the factory. (See Appendix D for an explanation of these parameters.) Verify that these parameters have not changed using the steps described next.

Note: The units being verified are always displayed in the MT91's internal units. Flow is always displayed in SF/S, temperature is displayed in Fahrenheit, and area is displayed in ft^2.

1. Identify the appropriate Delta R Parameter sheets by serial number. At the top of each column is the menu level that displays the parameters. For example, 5.1.1 are the numbers to press to get from the main menu to the submenu.
2. Go to the menu level for the parameters of interest (e.g. 5.1.1 Verify Þ Setup Þ Flow). Note any differences in values.

If parameters in the verify cal categories have changed, this may indicate a problem. Please contact Customer Service. If the parameters have not changed, continue with the next section.

Check the Resistance of the Sensing Points

To simplify the discussion below, the nomenclature J1 and TB1-HD1 will be used to represent all individual sensing points.

Use Table 5-2 to determine if the flow element is wired incorrectly or has failed. Turn off the input power to the flow transmitter. Disconnect the suspect sensing point's connector from the remote enclosure. Measure resistances at the points shown in Table 5-2 by touching the DMM test leads to the connector terminal screws. See Figure 5-1. (Plug the connector back in when finished.)

Note: All resistances referred to below are for standard instruments using 1000 ohms RTDs. For high temperature units, replace 1000 ohms with 100 ohms.

All resistances in Table 5-2 are based on a temperature of 32°F (0°C). Expect reading to be higher at room temperature, approximately 1080 ohms for a standard instrument or 110 ohms for a high temperature instrument. For a closer estimation, use the following equation:

$R_a = R_i \times [1 + (0.00385 \times T)]$

R_i = initial resistance (100 ohms for high temperature flowmeters, 1000 ohms for standard temperature flowmeters)

R_a = actual resistance

T = degrees Celsius

The numbers in Figure 5-1 have been added to the wire designations for discussion purposes and are not found on the connector plugs or wires.

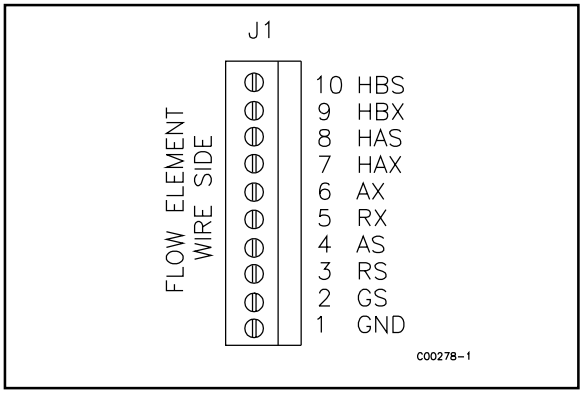

Figure 5-1. J1 Connector Plug on the Backplane Board

Pin Number	Approximate Resistance
2 to 3	1000 ohms
2 to 4	1000 ohms
2 to 5	1000 ohms
2 to 6	1000 ohms
7 to 8	220 ohms
3 to 5	0 ohms
4 to 6	0 ohms

Table 5-2. Resistances at J1 Connector Plug on the Backplane Board

If the measured resistances correspond to Table 5-2, then the sensing point is sound. The problem lies else where. Skip the rest of this section and proceed with the next section, Analog Output Test.

If the measured values do not correspond to Table 5-2, then a problem exists in the flow element or the cable. Wires within the cable could be shorted or open. To isolate a problem with the cable, check the sensing point resistances of the corresponding terminal connector located within the flow element enclosure. Measure resistances at the points shown in Table 5-3 by touching the DMM test leads to the terminal screws. See Figure 5-1.

If the values do not correspond with Table 5-3, remove the cable wires from the terminal connector and measure resistances again. The measured resistances should correspond approximately to the values in Table 5-3.

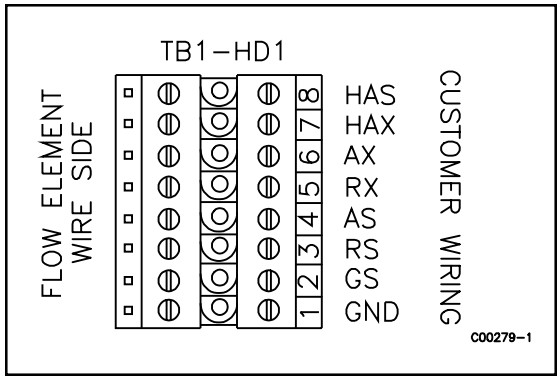

Figure 5-2. TB1-HD1 Terminal Connector

Terminal No.	Approximate Resistance
2 to 3	1000 ohms
2 to 4	1000 ohms
2 to 5	1000 ohms
2 to 6	1000 ohms
7 to 8	220 ohms
4 to 6	0 ohms
3 to 5	0 ohms

Table 5-3. Resistance at TB1-HD1 Terminal Connector

If the measured resistances correspond to Table 5-3, but not to Table 5-2, the cable is defective or the flow element is misswired. Replace cable and recheck resistances. If resistances are still off, contact Customer Service.

If the measured values do not correspond to Table 5-3, then the sensing element is defective. Contact Customer Service.

Check the Analog Outputs

Before using this utility, the analog outputs must be correctly configured. Refer to Chapter 3 for setting up the analog outputs. For signal connections, refer to Figure 2-2 and Table 2-2 in Chapter 2.

1. Go to menu level 3.2.1 (Diagnostics Þ Output Tests Þ Analog Out Test).
2. Select the desired channel.
3. Enter the percent of full scale.

Note: For outputs configured 0 to 5 Vdc and 0 to 10 Vdc, the output should be the selected percentage of the full scale value. For outputs configured as 4 to 20 mA, the output should be 4 mA plus the selected percentage of 16 mA.

4. If the correct value is not obtained, refer to Chapter 3 to re-calibrate the output channel.
5. If the calibration is unsuccessful, remove and replace assembly 015231.

Check the Relays

Refer to Chapter 3 for setting up the relay outputs. For signal connections, refer to Figure 2-2 and Table 2-2 in Chapter 2. This utility will operate the relays regardless of their configuration.

1. Go to menu level 3.2.2 (Diagnostics Þ Output Tests Þ Relay Test).
2. Select the desired relay.
3. The present state of the relay is displayed on the second line. Press the appropriate key to change the state of the relay.
4. To observe the output, connect an ohmmeter between the relay contacts of interest (refer to Figure 2-2 and Table 2-2).
5. If the relay fails to operate, remove and replace assembly 015235.

Run the Calibration Test

See Chapter 3 for a full description of the function of the calibration test and for instructions on scheduling automatic calibration tests. Test for shifts in calibration parameters or unbalance sensing points.

1. Go to menu level 3.3.1 (DiagnosticsÞ Calibration TestsÞ Start Test).
2. Both channels of the analog output board (see Figure 2-2) are driven to preset vales during the test.
3. The sequence of screens A through E shown in Figure 3-8 will display throughout the test.
   a. Screen A displays for 2 minutes while the outputs are held at the zero level.
   b. Screen B displays for 2 minutes while the outputs are held at mid-scale level.
   c. Screen C displays for 2 minutes while the outputs are held at full scale level.
   d. Screen D displays while the system balances and tests each sensing point input channel. From this point until the conclusion of the test, the analog output will be fixed at zero percent scale.
   e. Screen E signals the end of the calibration test. The heaters are turned back on and the system waits three minutes for them to warm up.
4. To view the test results, go to menu level 3.3.2 (DiagnosticsÞ Calibration TestsÞ Display Results). If Screen F appears, the sensing points that the system could not balance will be displayed.
   a. Verify wiring between the flow element and the flow transmitter. If the resistance is very high, the REF EXC and ACT EXC wires may be switched. Switch the REF EXC wire with the ACT EXC wire and vice versa.
   b. At high temperatures, the balance point may be too far from zero to balance out. Verify if this condition exists by breaking the heater circuit of the suspect sensing point by removing one of the heater wires (HTR A SEN or HTR A EXC) from the connector. Then view the sensing point values at menu level 4.2.6. Select the suspect sensing point. Make note of the DelR[x] and RefR[x] values. If DelR[x] does not drop to a value between -1.0 and 1.0, the balance deviation is too large. Contact Customer Service.
5. Screen G will appear next or immediately after selecting menu level 3.3.2.
   a. If the values are not above 3% deviation, the instrument has not drifted more than the daily allowable drift as specified in 40CFR675.
   b. If the values are above 3% deviation, re-calibration of the input board may be necessary, contact Customer Service.

Spares

When system down time is critical, FCI recommends one of each of the following should be kept as a spare: controller board (P/N 015796), input board (P/N 015149), relay board (P/N 015235), analog output board (P/N 015231), display board (P/N 014427) and battery (P/N 011616-01. Removal and replacement of boards may resolve problem faster than troubleshooting. Contact FCI for specific recommendations.

Defective Parts

Before returning any equipment to FCI, please obtain an RA number for authorization, tracking, and repair/ replacement instructions. If a return is required, remove defective unit, replace with spare, calibrate, then return defective unit to FCI freight prepaid for disposition.

Customer Service

1. In the event of problems or inquiries regarding the flowmeter, please contact the Regional or Country Authorized FCI Field Agent. There is an extensive list of these representatives at the front of this manual.
2. Before contacting the FCI representative, please be sure that all the applicable information is near so that a more effective, efficient and timely response may be provided.
3. Refer to Appendix C for specific Customer Service policy provisions.