3. Operation

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

Factory Calibrations

The instrument is delivered in its standard factory set point form unless a custom factory calibration was specified. The standard factory setting is mid-range between no flow and full flow. See Figures 3-1 and 3-2.

If the order included custom factory calibrations and alarm set points, keep all settings unchanged. The instrument is ready for service without changes.

Field Calibrations for Flow Applications

If the factory calibrations were not ordered then follow one of the procedures below based on the particular instrument purchased. If precise measurement is desired, FCI recommends that a FM71 Monitor/Calibrator be used. Then the precise measurement of the signal voltage versus flow rate can be calculated for the alarm set points.

Alarm Set Point Adjustments By Observation or By Measurement

Alarm set points can be adjusted by observation or by precision measurements. The following procedure is adjustment by observation. If adjustment by measurement is desired, obtain an FCI FM71 Calibrator/monitor and follow the instructions found in the FM71 manual. For the highest accuracy, balancing the control circuit and creating a calibration curve should be performed. These subjects are addressed later in this chapter.

Alarm A Set Point Procedure

1. Flow the pipeline at the desired flow direction and rate of flow.
2. Apply power to the instrument and allow 15 minutes for the sensing elements to become active and stabilize.
3. Locate the potentiometer (R5) and the red LED on the control circuit. (See Figure 3-1 or 3-2.)
4. Choose A or B.

A. Detecting No Flow or Decreasing Flow Rate

If the LED is off, turn the potentiometer clockwise until the LED turns on. If the LED is on, turn the potentiometer counterclockwise until the LED turns off, then turn the potentiometer clockwise until the LED just turns on. With the LED on, turn the potentiometer slowly counterclockwise until the LED just turns off. Turn the potentiometer one-half turn past the point at which the LED just turns off. Be aware that the potentiometer may have up to one quarter turn of hysteresis. If the mark is overshot, the procedure should be repeated. See Figures 3-1 and 3-2 for potentiometer position and curve results.

B. Detecting Maximum Flow or Increasing Flow Rate

If the LED is on, turn the potentiometer counterclockwise until the LED turns off. If the LED is off, turn the potentiometer clockwise until the LED turns on, then turn the potentiometer counter clockwise until the LED just turns off. With the LED off, turn the potentiometer slowly, clockwise until the LED just turns on. Turn the potentiometer one-half turn past the point at which the LED just turns on. Be aware that the potentiometer may have up to one quarter turn of hysteresis. If the mark is overshot, the procedure should be repeated. See Figures 3-1 and 3-2 for potentiometer position and curve results.

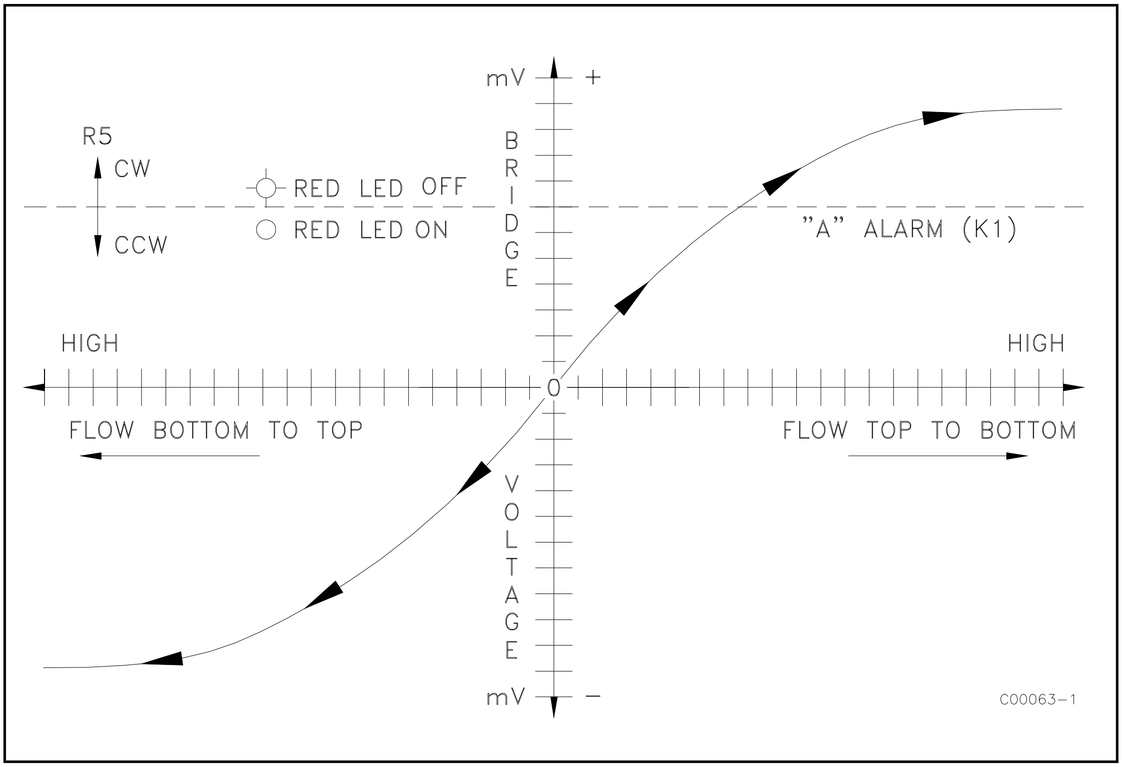

Figure 3-1. Setting Forward and Reverse Alarm Switch Points

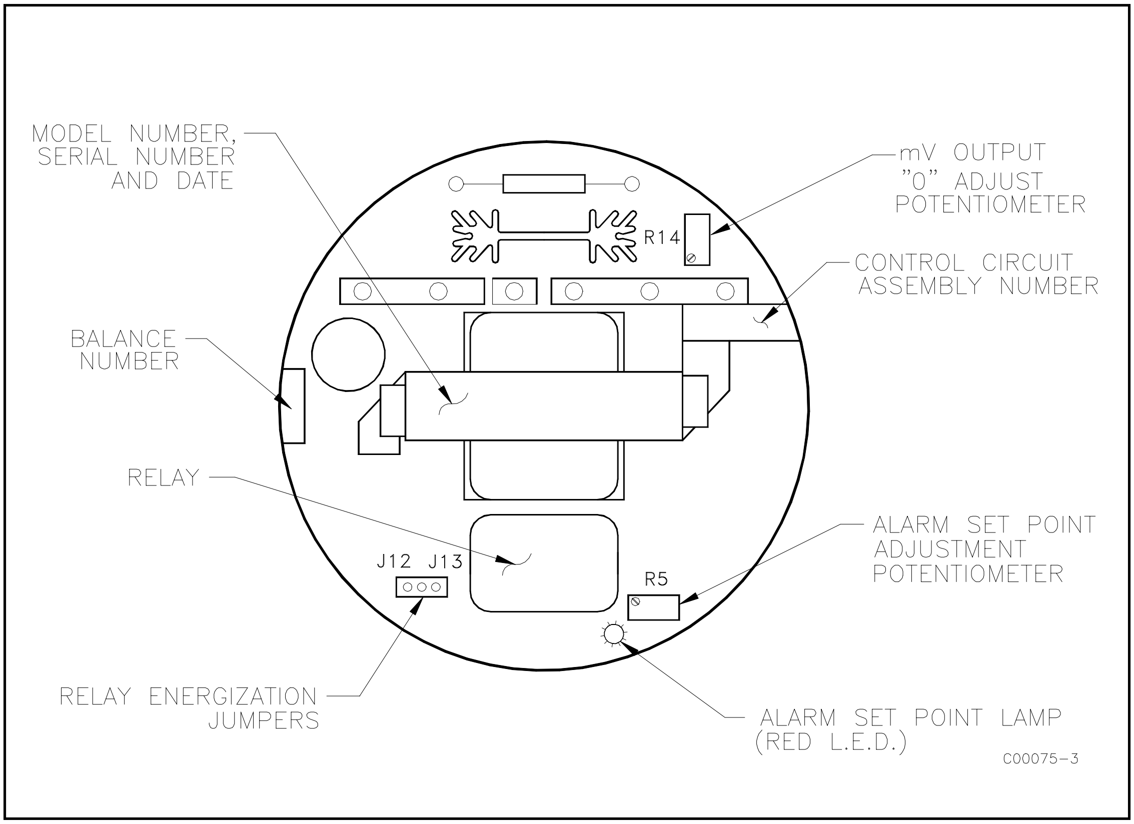

Figure 3-2. Control Circuit Outline Drawing

Balancing

The balance number is the resistance difference between the two RTDs when the heater is on. The balance number is recorded on the edge of the control circuit on a yellow block with the lettering "BALANCE NO." written above it.

Generally it is not necessary to obtain the balance number for an application which requires only a switch. However, for detecting flow direction a precise balance is required since either a small positive or negative voltage output is used as the indicator.

Balancing is useful to obtain a calibration curve for the instrument, it is essential to balance the control circuit. The accuracy of the calibration is dependent on an accurate balance number. Balancing is also needed if the instrument switch points are going to be adjusted by numerical values.

Balance the instrument when the balance number can not be found or if the accuracy seems to be incorrect.

Delta R, the difference between the RTDs are used for balancing. Balancing the voltage (Ohm's law V=I x R) to zero is accomplished by making the difference between the two RTDs zero.

Determining The Balance Number:

Setup Required

FCI FM71D Calibrator

Sensor immersed in process media at zero flow

Power source to power up the switch circuit board

1. Verify the sensor mounting in the process line is correct. Insure there is a no-flow condition in the process line.
2. Verify the correct wiring configuration.
3. Connect the FM71D calibrator (terminal 7, 8 and 9 which is labeled on the FM71D calibrator) to the control circuit, apply power to the instrument.
5. Dial the bridge balance dial to the balance number on the control circuit.
6. Allow the FM71D display to stabilize (at least 10 minutes) at a certain millivolt (the voltage may vary +/-5 mV). If the reading is zero, balance is OK and FM71 may be removed. If the reading is not zero, a new balance number must be generated by the following steps:
7. Dial the bridge balance dial to produce a zero on the FM 71D calibrator readout. The number should be stable over a 10 minute period (it may vary +/- 5 mV).
8. Read the new balance number of the bridge balance dial and record it on the face of control circuit.

Note: The balance number is not permanently fixed into the instrument. When the calibrator is used for that same instrument, then reenter the balance number recorded earlier. It is necessary to enter the balance number or verify the balance of the circuit board to the calibrator each time the FM 71D is used.

Creating a Calibration Curve Using the Millivolt Output Option

The zero adjust procedure should be performed before the instrument calibration curve is measured. Millivolt points in between the actual measurement points may be used for indicating the corresponding flow.

1. Apply power to the instrument and establish a constant flow rate in the pipe for the first data point to be taken. Let the instrument stabilize for 10 minutes.
2. With a high impedance DMM measure the voltage from terminal pin 8 (+) to 11 (-). Record the flow rate versus the meter readout.
3. Repeat steps 1 and 2 at different flow rates. Record enough flow points to be able to make a millivolt versus flow curve.

Creating a Calibration Curve Using an FM71 Calibrator

1. Apply power to the instrument and establish a constant flow rate in the pipe for the first data point to be taken. Let the instrument stabilize for 10 minutes.
2. Attach an FM71 meter to the control circuit. Dial in the balance number found near the edge of the control circuit. The read out /calib. switch should be in the readout position. Record the flow rate versus the meter readout.
3. Repeat steps 1 and 2 at different flow rates. Record enough flow points to be able to make a millivolt versus flow curve.

To set a switch point using numerical values, use the instructions that come in the FM71 manual.

Zero mV Output Adjust

1. Apply power to the instrument and establish a zero flow rate in the pipe.
2. Measure the millivolts from Pin 11 (+) and Pin 8 (-).
3. Adjust potentiometer R 14 for 0.00 mV.
4. Remove power.