INSTALLATION AND SERVICE INSTRUCTION
FOR
ANALOG 2-WIRE FLOW TRANSMITTER

MOORE PRODUCTS CO., Spring House, PA 19477
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WARRANTY

PARTS LIST

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SIGNIFICANT CHANGES IN ISSUE 2

Significant changes for issue 2 are indicated by change bars in the page margins. Some of these changes are listed below.

SECTION | CHANGE
---------|---------
1.2 SPECIFICATIONS | Revised
5.6 RETURN FOR REPAIR | Section Added
PARTS LIST | Updated
1.0 INTRODUCTION
This Installation And Service Instruction for the P/N 15973-10 Analog 2-Wire Flow Transmitter is arranged in five sections. Section 1, INTRODUCTION, provides general information on product description, model designation and specifications. Section 2, INSTALLATION, contains installation considerations and mechanical and electrical installation of the Transmitter. Section 3, CALIBRATION, includes calibration calculations, and procedures. Section 4, CIRCUIT DESCRIPTION, furnishes a block diagram level description of the Deflection Sensor Board. Section 5, MAINTENANCE, presents preventive maintenance and troubleshooting procedures.

IMPORTANT
Save this Instruction and make it available for installation and maintenance of the Transmitter.

1.1 PRODUCT DESCRIPTION
The Analog 2-Wire Flow Transmitter converts a frequency input signal to a 4-20 mA analog output signal. A Moore Products Model 140 or Model 141 Meter Body with a deflection sensor supplies the input signal which is proportional to the rate of flow of a process fluid through the Meter Body. The two wires that carry power from a user supplied 10 to 40 Vdc power supply to the Transmitter also carry the Transmitter’s 4-20 mA analog output.

All electrical connections are to a terminal block within the Transmitter. With appropriate safety barriers, the installation can be intrinsically safe for use in a hazardous location.

The Transmitter may be either wall or pipe mounted but must be within 50 feet of the Meter Body. The Transmitter may also be directly mounted to a Model 141 Meter Body using a pipe nipple.
1.2 SPECIFICATIONS

1.2.1 MECHANICAL

Installation Dimensions ........................................... See Figure 2-1
Enclosure Classification ........................................... NEMA 4
Mounting ................................................................. Wall, Pipe or Nipple
Connections ............................................................. #6 screws on terminal block (See Parts List drawing)

User Supplied Power Supply

Power Requirements (Vsupply)

Minimum ................................................................. 10 Vdc @ 0 Ohm Load
Maximum ............................................................... 40 Vdc @ 1500 Ohm Load

Maximum Load Resistance .................................... Vsupply – 10 .02 Amps

Analog Output, Deflection Sensor Board

Standard Calibration .................................................. 4-20 mAcdc
Accuracy ................................................................. ±0.10%, Full Scale
Voltage (Developed Across User Supply 250 Ohm ±0.1%, 1/2W Resistor) ............. 1-5 Vdc

Classification

Intrinsically Safe ..................................................... Factory Mutual approved for the following hazardous locations:
Class I, Division 1, Groups A, B, C, D
Class II, Division 1, Groups E, F, G
Class III, Division 1

1.2.3 ENVIRONMENTAL

IEC Location Classification ..................................... D2 (IEC 654-1)

Operating Temperature Range .................................. –40°C to + 85°C (–40°F to +185°F)

Transportation and Storage

Temperature Limits .................................................. –40°C to + 85°C (–40°F to +185°F)

Relative Humidity ..................................................... 5% to 100%

* Consists of the range resistor plus the loads contributed by any other equipment connected in the loop. See Figure 2-2.
Section 2

2.0 INSTALLATION

Read this entire section before beginning installation of the Transmitter. This section describes Transmitter installation in both hazardous and non-hazardous locations. The Transmitter carries a nameplate with the location classification for which it has been approved.

WARNING

While all Transmitter installations should be in accordance with the National Electrical Code (NEC), installations in hazardous locations must be in accordance with NEC.

An intrinsically safe system can be formed when a Transmitter and energy limiting barriers are installed for 2-wire operation in accordance with this instruction and the energy limiting barrier manufacturer’s instructions. A non-incendive system can be formed with the Transmitter installed for 2-wire operation in accordance with this instruction.

2.1 INSTALLATION CONSIDERATIONS

The following items should be considered when planning for a safe, properly operating Transmitter installation.

— Choose a wall, pipe or nipple mount that locates the Transmitter as close as possible to the Meter Body. This minimizes the length of sensor cable and improves signal strength. The maximum sensor cable length must not exceed 50 feet.

— Do not pipe or nipple mount the Transmitter if it will be subject to excessive vibration. Consider a wall-mount close to the Meter Body.

— If the Transmitter is to be mounted in a hazardous area, signal and sensor cable runs should be enclosed in 1/2” conduit. Refer to Figure 2-2 to connect a Transmitter in a non-hazardous location. Refer to Figures 2-3, 2-4, and 2-5 for a Transmitter to be connected with a Model 140 or 141 Meter Body.

— A recorder, controller, or other device connected to the Transmitter must not, under any circumstances, employ or generate voltages in excess of 250 Volts RMS (380 V Peak).

— The Transmitter must be powered from a user supplied 10-40 Vdc power supply. Ensure that sufficient length of signal cable is available.

Industrial environments often contain particulate, liquid, and gaseous contaminants. Particulate matter, usually dust and dirt, is abrasive and can cause intermittent contact in connectors associated with circuit subassemblies. A layer of dust on circuit boards will interfere with semiconductor heat dissipation. Liquid and gaseous contaminants can have a corrosive effect on metal, rubber, plastic, and circuit board components. Extended exposure to these contaminants may result in equipment malfunctions. Identify contaminants and implement methods to reduce their presence.

CAUTION

Mounting the Transmitter where the specified ambient temperature limitations may be exceeded can adversely affect performance and may cause damage.
2.2 MECHANICAL INSTALLATION

This section provides mechanical installation procedures for the Transmitter. If a Meter Body is also being installed, it should be installed according to its Installation And Service Instruction.

2.2.1 MOUNTING

The Transmitter is either wall, pipe or nipple-mounted. Figure 2-1 shows the mounting dimensions for the wall and pipe-mounted versions.

For wall-mounting, the enclosure is secured by user supplied 5/16" hardware inserted through the mounting ears on either side of the enclosure.

Two 5/16", blind, threaded holes on the back of the enclosure are used to secure a universal pipe-mounting bracket for a vertical or horizontal pipe-mounted installation. Figure 2-1 illustrates a typical vertical pipe-mounted installation. All hardware for mounting the Transmitter must be supplied by the user. A 2" pipe-mounting kit P/N 15896-24 is available from Moore Products Co. The kit's contents are listed in Table 2.1.

### TABLE 2.1 Two-Inch Pipe-Mounting Kit

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<td>8874-7</td>
</tr>
<tr>
<td>Hex Nut 5/16-18, qty. 2</td>
<td>1-7783</td>
</tr>
<tr>
<td>Lockwasher 5/16, qty. 2</td>
<td>1-7312</td>
</tr>
<tr>
<td>Pipe Mounting Bracket</td>
<td>8883-7</td>
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<tr>
<td>Screw, Round Head 5/16-18, qty. 2</td>
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<tr>
<td>Lockwasher, 5/16, qty. 2</td>
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The Transmitter can also be nipple-mounted on a Model 140 Meter Body. Depending on the length of flowmeter sensor cable, user-supplied nipples ranging in length from 1-1/2" to 3-1/2" can be used to secure the Transmitter to the Meter Body.

Prior to securing the nipple to the Transmitter and Meter Body, route the flowmeter sensor cable through the nipple and apply a commercially available thread sealant to both ends of the nipple.

2.3 ELECTRICAL INSTALLATION

All electrical connections are made to #6 screws on a terminal block and a ground screw located beneath the terminal box cover (see Figure 2-1). For access, remove the 4 screws, cover and gasket from the enclosure.

On each side of the Transmitter's enclosure (in line with the terminal block) are 1/2" NPT conduit openings for routing cables through appropriate connectors and fittings. The signal cable is fed through the opening on the left side, the flowmeter sensor cable is fed through the opening on the right side. User supplied 1/2" NPT conduit connectors or cable connectors can be installed in the openings as appropriate. For a NEMA 4 environment, the enclosure requires a water tight seal; therefore, the cables must be run in 1/2" conduit and proper sealing compound used at the connectors.

**WARNING**

Remove power from all wires and terminals to be connected. This will eliminate electrical shock hazard.

2.3.1 SIGNAL CABLE

A signal cable connects the Transmitter to the user's receiving instrument and power supply, as shown in Figure 2-2. The signal cable should have one twisted pair of conductors, 20 gauge (AWG) or larger with solid or stranded wires. Shielding is optional.

Install a crimp-on ring or spade tongue terminal for #6 screws on each stranded conductor. If shielded cable is installed, it should be grounded only at one end, usually the Receiver.

2.3.2 FLOWMETER CABLE

A flowmeter sensor cable connects the Transmitter to the meter body's deflection sensor. The flowmeter sensor cable should not exceed 50 feet in length. Use 22 gauge (AWG) or larger, 3 conductor, foil shield cable (Belden 8771, Alpha 2403 or equal; above 60°C (140°F), Belden 83395 or equal). Install terminals on all conductors as stated in the above paragraph. The foil shield (drain wire) should be insulated with heat shrink tubing to prevent accidental shorting of the sensor signal. The shield should be grounded only at one end - the ground screw at the Transmitter.

Refer to the meter body's Installation And Service Instruction for flowmeter sensor cable connections at the meter body.

2.3.3 NONHAZARDOUS LOCATIONS

Refer to Figure 2-2 for a diagram of a Transmitter installation in a nonhazardous location and the required terminal connections.

2.3.4 INTRINSICALLY SAFE LOCATIONS

An intrinsically safe system must use energy limiting barriers. Refer to Figures 2-3, 2-4, and 2-5 for a Transmitter to be connected with a Model 140 or 141 Meter Body. Barriers must be installed in accordance with the manufacturer's instructions.
FIGURE 2-1 Dimensions and Mounting Variations
NOTES:

1. SHIELD MUST BE INSULATED FROM METER BODY AND GROUNDED AT FLOW TRANSMITTER. USE 22 GAUGE OR LARGER, 3 CONDUCTOR, FOIL SHIELDED CABLE (BELDEN #8771 OR #83396, ALPHA #2403 OR EQUAL) 50 FEET (15 METERS) MAXIMUM LENGTH.

2. FIELD WIRE PARAMETERS:

<table>
<thead>
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<th>GROUP C</th>
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<tr>
<td>L</td>
<td>425 Mhz</td>
<td>425 Mhz</td>
<td>11</td>
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<tr>
<td>C</td>
<td>0.5uF</td>
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3. METER BODY MUST BE GROUNDED. USE SCREW PROVIDED.

4. RANGE RESISTOR, 250 OHM ±0.1%, 1/2 WATT FOR 1-5 VOLT INPUT TO RECEIVER

5. **P** INDICATES TWISTED PAIR CONDUCTORS.

---

**FIGURE 2-2** Terminal Connections for Transmitter in Non-Hazardous Location

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PA-1212-2
### APPROVED BARRIERS

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**Manufacturer + Taylor**

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**Manufacturer + Honeywell**

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**Manufacturer + Leeds & Northrup**

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**Notes**

- FM CSA APPROVED
- Specification and Changes Reported
- 15032-1420

**FIGURE 2-5** Intrinsically Safe Installation, Approved Barriers for Use With 2-Wire Transmitter With Model 140 or 141
Section 3

3.0 CALIBRATION
To assure instrument accuracy, it is suggested that the calibration of the Transmitter be performed initially in the shop and checked on-line following installation. Further on-line calibration checks may be performed as required by the plant maintenance schedule without having to disconnect the sensor cable inputs. It is not necessary to open the output current loop to insert a meter to measure the output current.

WARNING
If the Transmitter is connected to a Meter Body located in a Class I, Division 1 area, the battery powered P/N 14943 Calibrator is the only test equipment that can be used with the Transmitter to retain the intrinsically safe rating of the Meter Body.

The following sections include instructions to calibrate the Transmitter.

3.1 TEST EQUIPMENT
The following test equipment is required to calibrate the Transmitter.

1. Pulse Generator
   Moore Products Co. P/N 14943 Calibrator; see Instruction SD14943 for specifications
   or
   Function Generator
   Output: square wave
   Amplitude: TTL or adjustable to 5V peak-to-peak
   Frequency Range: 1 to 100 Hz

2. Digital Multimeter (DMM) or Electronic Calibrator
   Resolution: 3-1/2 digit
   Accuracy: ±0.1% or better

3. Power Supply capable of providing 10-40 Vdc @ 0.03 Amps. Needed for in-shop calibration.
3.2 PREPARATION
The following steps must be performed prior to calibrating
the Transmitter.

1. Calculate the meter body's full scale frequency in
   pulses per second as follows:
   A. Obtain the full scale flow rate in gallons per min-
      ute (gal/min) to be sensed by the deflection
      sensor.
   B. Read and record the K-factor in pulses per gallon
      (p/gal) from the stainless steel tag attached to the
      Meter Body.
   C. Determine the Meter Body's full scale frequency
      in pulses per second (p/sec) from the following
      equation.

      \[
      \text{FULL SCALE FREQUENCY (p/sec)} = \frac{\text{FULL SCALE FLOW RATE (gal/min)} \times \text{K-FACTOR (p/gal)}}{60 \text{ (sec/min)}}
      \]

      **EXAMPLE:** A 1" Meter Body has a K-factor of 60.37 p/gal and the full scale
      flow rate is 50 gal/min. The full scale frequency is 50.31 p/sec.
      \[
      \frac{50 \text{ gal/min} \times 60.37 \text{ p/gal}}{60 \text{ sec/min}} = 50.31 \text{ p/sec}
      \]

2. Calculate Output Current
   This step is performed when a Moore Products Co.
   Calibrator (P/N 14943) is to be used for the calibration
   signal source. When the calibrator is used and the full
   scale frequency calculated in 1 above does not cor-
   respond with one of the calibrator's preset frequen-
   cies, the calibrator's next lower preset frequency must
   be used and the Transmitter's output current calcu-
   lated with the following equation. (The preset fre-
   quencies are 4, 8, 16, 20, 24, 32, 40 or 48 p/sec.)

   \[
   \text{FULL SCALE OUTPUT (mA)} = \left[ \frac{\text{CALIBRATOR SETTING (p/sec)} \times 16 \text{ (mA)}}{\text{FULL SCALE FREQUENCY (p/sec)}} \right] \times 4 \text{ (mA)}
   \]

   **EXAMPLE:** A 1" Meter Body has a K-factor of 60.37 p/gal and the full scale
   flow rate is 50 gal/min. The full scale frequency is 50.31 p/sec and
   the full scale output current is 19.27 mA with the calibrator set at
   48 p/sec.

   \[
   \text{FULL SCALE OUTPUT} = \left[ \frac{48 \text{ p/sec}}{50.31 \text{ p/sec}} \times 16 \text{ mA} \right] \times 4 \text{ mA} = 19.27 \text{ mA}
   \]

3. Determine the value of coarse span resistance Rx as
   illustrated in Figure 3-1.

   \[
   \text{Rx (kilohms)} = \frac{10240 \text{ kilohm/sec}}{\text{FULL SCALE FREQ IN p/sec}}
   \]

   **EXAMPLE:** A 1" Meter Body with a K-factor of 60.37 p/gal and a full scale flow
   rate of 50 gal/min has a full scale frequency of 50.31 p/sec. The
   value of Rx is 203.5K ohms.

   \[
   \text{Rx} = \frac{10240 \text{ kilohm/sec}}{50.31 \text{ p/sec}} = 203.5K \text{ ohm}
   \]

   **NOTE**
   The dividend is a constant with units assigned to yield an answer
   in kilohms.
NOTES:
1. Rx IS THE COARSE SPAN RESISTANCE. IT IS EQUAL TO THE SUM OF THE RESISTANCES PARALLELED BY AN OFF
   (OR OPEN) SWITCH.
2. SWITCHES S4, S5, AND S6 ARE SHOWN IN THE OFF POSEI-
   TION. OTHERS ARE SHOWN IN THE ON POSITION.

FigURE 3-1 Calibration Settings and Adjustments
4. Refer to Figure 3-1 and open and close switches in SW1 to select values of series resistance whose sum will be between the value of Rx calculated above and Rx = 10K.

EXAMPLE: In the EXAMPLE in step 3, a value of 203.5K was obtained for Rx. Refer to Figure 3-1 and select R41, R42 and R43.

R41 = 113.0K
R42 = 60.4K
R43 = 30.1K
Rx = 203.5K (equal to calculated value)

Refer to Figure 3-1 and set switch sections 4, 5 and 6 of SW1 to the 'OFF' position. All other sections should be in the 'ON' position. (The 10K SPAN trimpot will be capable of 'fine' adjusting the value of Rx.)

5. To obtain a fast response during calibration, select the HIGH output response speed on ganged jumper plug W1 as shown in Figure 3-1. Following calibration, set W1 according to the full scale output frequency.

EXAMPLE: W1 must be set to the HIGH position for 50.31 p/sec.

6. If calibrating the Transmitter on-line with the Transmitter in a control loop, observe proper plant maintenance procedures to switch the controller to the manual mode.

7. Remove the housing cover to expose the Deflection Sensor Board.

8. Refer to Figure 3-1. Connect the DMM across diode CR13. Connect the calibrator or function generator as shown. Do not disconnect the leads from the deflection sensor.

3.3 PROCEDURE

Perform either step 1 or step 2 depending on selected test equipment. Refer to Figure 3-1 for location of calibration connections and components.

1. When Using Calibrator
   A. Select 0 Pulses/Sec. and switch calibrator to 'ON' position.
   B. Adjust ZERO trimpot R37 for a DMM reading of 4.00 mA.
   C. Set calibrator to the full scale frequency in p/sec as calculated in step 1 or 2 of section 3.2.
   D. Adjust SPAN trimpot R15 for the full scale output obtained in step 2 of section 3.2.
   E. Position jumper W1 according to the table in Figure 3-1.

2. When using Function Generator
   A. Set function generator to obtain a square wave output (TTL or adjust to 5V peak-to-peak) at 0 p/sec and turn power 'ON'.
   B. Adjust ZERO trimpot R37 for a DMM reading of 4.00 mA.
   C. Set function generator for the full scale frequency determined in step 1 of section 3.2.
   D. Adjust SPAN trimpot R15 for 20.00 mA
   E. Position jumper W1 according to the table in Figure 3-1.

The calibration of ZERO and SPAN is completed.

NOTE

During on-line calibration, the zero and full scale current can be monitored from an indicator, recorder, control console, etc. connected in the output current loop and located in the control room.

3.4 STATIC PRESSURE AND HYSTERESIS ADJUSTMENTS

The following procedures will need to be performed only when the process normally runs below 20% of full scale. Static pressure and hysteresis adjustments are made with the Transmitter completely installed. When normal operation is below 20% of full scale, the Transmitter must be adjusted to balance out the effects of static pressure on the deflection sensor. This may be followed by a hysteresis adjustment to raise the threshold level so that process noise at zero flow rate will not cause a Transmitter output above 4 mA.

The following procedure is for the sample flow process shown in Figure 3-2. Modify the procedure as required by the on-line process.

3.4.1 PREPARATION

Perform the following steps prior to adjusting the static pressure and hysteresis circuits.


2. Ensure that the user's dc power supply and output current loop are connected as shown in the installation section.

3. Turn pump ON and purge all air from the pipe by opening valve V2.

4. Once a steady flow is established, close V2.

5. Refer to Figure 3-1 and turn hysteresis potentiometer R84 fully counterclockwise to minimum hysteresis.
3.4.2 PROCEDURE

Observe the DMM and note if the output current is higher than 4.00 mA, although the flow rate is 0 gal/min with V2 closed. If there is a difference, it is the result of static pressure variations being exerted on the deflection sensor.

The objective of this procedure is to adjust one of the static pressure pots (R11 or R13) to obtain minimum output. Final trimming with R54, the hysteresis adjustment, may also be necessary.

Refer to Figure 3-1 while performing the following procedure.

1. Make a small turn (approximately 10°) on R11 and wait until the reading on the DMM stabilizes. Note the minimum and maximum indications.

2. Make another small turn in the same direction on R11. Note the minimum and maximum indications. Repeat step 2 several times. If the average value is closer to 4.00 mA than the value obtained in step 1, then the adjustment was made in the right direction. If the average value is further from 4.00 mA, then turn R11 to its full counterclockwise stop and try the same procedure on R13.

3. Continue this procedure by making small changes of either R11 or R13 until the meter indicates as close as possible to 4.00 mA. This will take place when the resistances developing the positive and negative noise excursions are balanced.

4. If varying either R11 or R13 fails to bring the DMM indication to 4.00 mA, then an adjustment of R54, the hysteresis pot, is necessary. Vary either R11 or R13 to the value closest to 4.00 mA, then turn R54 slowly clockwise until the DMM indicates 4.00 mA.

5. This completes the procedure. Disconnect the DMM and secure the cover and gasket on the enclosure.

IMPORTANT

Ensure that the housing and terminal box covers (with gaskets) are installed on the Transmitter's enclosure following calibration and prior to placing the unit in operation.
Section 4

4.0 CIRCUIT DESCRIPTION

The Analog 2-Wire Flow Transmitter contains a Deflection Sensor Board that converts a Meter Body’s deflection sensor signal, that varies with the rate of process flow, to a 4 to 20 mA output current in a 2-wire system.

As shown in the Installation section, the two wires which supply the user’s 10-40 Vdc power to the Transmitter’s terminals also carry the 4 to 20 mA output current to the field. A 1 to 5 Vdc output can be derived for other instruments in the loop by adding a 250 ohm, 0.1%, 1/2 watt signal conditioning resistor in series with the output current.

4.1 DEFLECTION SENSOR BOARD

Refer to the block diagram of the Deflection Sensor Board in Figure 4-1 while reading the following circuit description. The physical layout of the Board is shown in Figure 3-1.

The two strain gage resistors (R) mounted on the deflection sensor bar vary in resistance with the rate of process flow through the Meter Body. Voltages are produced which vary at the same frequency as the fluid oscillations in the Meter Body. The higher the rate of flow, the higher the input frequency of the signals to the Deflection Sensor Board.

When normal operation is at flow rates below 20% of full scale, the Deflection Sensor Board must be adjusted to balance out the effects of static pressure on the deflection sensor. Static Pressure Adjusts, trim pots R11 and R13, are adjusted at zero flow rate for a 4 mA output current from the Transmitter. At flow rates higher than 20% of full scale, the static pressure adjustment is not required.

The low signal voltage produced at the deflection sensor is amplified by the Voltage Amplifier to produce a signal approximately 1 volt peak-to-peak at its output.

The Hysteresis Adjust R54 may be required to obtain a 4 mA output current at zero flow rate if the Static Pressure Adjust is incapable of doing so. When necessary, the Hysteresis Adjust raises the threshold level of the Comparator so that process noise will not cause a Board output current above 4 mA.

During normal operation, the input signal triggers the Comparator and produces a square wave output whose frequency is proportional to the rate of flow.

The Opto-Coupler receives the square wave signals and provides isolation between the input (referenced to chassis ground) and the output (referenced to signal common). The Frequency Doubler uses a pair of exclusive OR circuits to double the frequency of the square wave input and drive the Detector.

The Detector is a precision monostable multivibrator that produces a pulse at its output whose width is proportional to the frequency of the square wave input. The higher the flow rate, the higher the frequency of the square wave into the Detector and as a result, the wider the square wave pulse at the output of the Detector. The Span adjustment trims the pulse width and sets the full scale output to 20 mA during calibration.

At zero flow rate, or during calibration when zero pulses per second are applied to TP1, the Detector and the E/i Converter are turned off and 4 mA flows in the output current loop when 10 to 40 Vdc is applied to the Transmitter’s output terminals. The zero adjustment in the 3.7 mA Current Source provides the means to obtain 4 mA in the current loop. For example, if 0.33 mA flows in the Internal Power Supply (producing the +6V and +5V supplies), the zero trimpot (R37) is adjusted for 3.7 mA for a total of 4 mA of output current. The DC to DC Converter produces the V+ supply as a result of the series current in the 3.7 mA Current Source.

At maximum flow rate, or during calibration when the full scale frequency is applied to TP1, the Detector’s output varies the effective resistance of the E/i Converter causing a current of 20 mA to flow in the output current loop. The Span adjustment (R15) is trimmed during calibration for a 20 mA output current.
Section 5

5.0 MAINTENANCE
This section contains preventive maintenance, troubleshooting, and board replacement procedures. A parts list is located at the back of this Instruction.

IMPORTANT
The electrical safety of the 2-Wire Transmitter system may be adversely affected by improper maintenance or use of non-factory components. Such action could nullify the intrinsically safe ratings of the system.

5.1 PREVENTIVE MAINTENANCE
An effective preventive maintenance program for the Transmitter is one which maintains the system in operation by preventing the conditions from occurring which could cause an interruption of service. It consists of cleaning, visual inspection and, depending on the plant’s maintenance schedule, periodic on-line calibration checks.

5.1.1 CLEANING
The Transmitter should be cleaned as often as operating conditions require. Excessive accumulation of dust or dirt on the enclosure prevents efficient heat dissipation and can cause overheating and component breakdown. The design of the Transmitter’s enclosure minimizes the amount of dust or dirt that can reach the interior, providing the housing and terminal box covers and gaskets are installed and tightly fastened. Cleaning of the Transmitter’s interior should not be necessary.

5.1.2 VISUAL INSPECTION
Once the Transmitter is calibrated, properly installed and placed on-line, periodic visual inspection of the circuit board is not necessary unless the operating environment and the plant’s maintenance schedule dictates otherwise. In such cases check for loose or broken connections, damaged circuit board, or heat-damaged components. Periodically check that covers and gaskets are installed and tightly fastened, mounting hardware is intact and that the external enclosure is clean.

External wiring and all connections should be inspected on a periodic basis.

5.2 SYSTEM TROUBLESHOOTING
The following system troubleshooting procedures and guidelines will isolate, in most cases, the trouble to either the signal source (Meter Body and input cable), the Deflection Sensor Board, or the output wiring and power supply.

Table 5.1 provides symptom versus possible failure information to quickly isolate a problem.

<table>
<thead>
<tr>
<th>SYMPTOM</th>
<th>POSSIBLE FAILURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loss of output signal (0 mA) at normal flow.</td>
<td>1. Loop voltage source failure</td>
</tr>
<tr>
<td></td>
<td>2. Break in output loop wiring</td>
</tr>
<tr>
<td>Output signal drops to 4 mA at normal flow.</td>
<td>3. Deflection Sensor Board</td>
</tr>
<tr>
<td></td>
<td>1. Deflection sensor</td>
</tr>
<tr>
<td></td>
<td>2. Break in input loop wiring</td>
</tr>
<tr>
<td>Known flow rate not in agreement with output current on DMM.</td>
<td>4. Deflection Sensor Board</td>
</tr>
<tr>
<td></td>
<td>1. 10-40 Vdc input voltage</td>
</tr>
<tr>
<td></td>
<td>2. Calibration (section 3.0)</td>
</tr>
<tr>
<td></td>
<td>3. Deflection sensor</td>
</tr>
</tbody>
</table>

While troubleshooting, the diagram in Figure 2-3 should be referred to and a DMM should be connected across diode CR13 as shown in Figure 3-1 to monitor the loop current.

A. Output Wiring and Power Supply
A loss of power supply voltage to terminals (+) and (-) will cause the loop current at the DMM to drop to 0 mA. Other instruments in the loop (indicators, recorders, controllers) will respond accordingly.
An open circuit at the Transmitter terminals or a break in a wire in the output current loop will cause the same symptoms as a loss of power supply voltage.
An apparent loss of signal at a receiver may be caused by receiver failure.
Repair as required. Check the wiring between the Transmitter, power supply, and other instruments in the current loop. Check the power supply and its power fuse.
B. Signal Source
A loss of input signal from the Meter Body’s deflection sensor to the Deflection Sensor Board due to a failed deflection sensor or a break in the input wiring will typically cause the current displayed by the DMM to fall to 4 mA, regardless of process flow rate. Repair as required. Check the wiring between the Meter Body and the Transmitter. Refer to the Meter Body’s Installation and Service Instruction for repair procedures should the deflection sensor appear defective.

C. Deflection Sensor Board
To isolate the Deflection Sensor Board as the source of failure, ensure that a known good deflection sensor is installed, that the input wiring is good, and that the output wiring and power supply are in proper order. If the Transmitter is on-line, note the DMM current reading and its correspondence to the actual process flow. If the Transmitter is off-line, perform the calibration procedure in section 3. Replace the Board if the tests so indicate. Refer to section 5.3 for a board replacement procedure.

5.3 BOARD REPLACEMENT
A faulty Deflection Sensor Board should be replaced and returned to the factory for repair. Calibrate the Transmitter after installing a replacement board.

5.3.1 DEFLECTION SENSOR BOARD
The following procedure describes the method used to remove the Deflection Sensor Board from the Transmitter’s enclosure.

WARNING
Remove power from the (+) and (-) terminals to eliminate shock hazard.

1. Remove four screws and the housing cover from the enclosure to expose the Deflection Sensor Board.

2. Unplug the wires from the Board as follows:

<table>
<thead>
<tr>
<th>Color</th>
<th>Terminal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black</td>
<td>SIG</td>
</tr>
<tr>
<td>Red</td>
<td>+V</td>
</tr>
<tr>
<td>White</td>
<td>GND</td>
</tr>
<tr>
<td>Yellow</td>
<td>-</td>
</tr>
<tr>
<td>Brown</td>
<td>+</td>
</tr>
</tbody>
</table>

3. Remove the four screws which secure the Board. Remove the output transistor heat sink screw.

4. Remove the Board from the enclosure.

Reverse the above procedure when a Deflection Sensor Board is installed.

5.4 RECOMMENDED SPARE AND REPLACEMENT BOARDS
It is recommended that one spare Deflection Sensor Board be stocked for every 1 to 10 in service. Replacement boards are available from the factory. A Parts List is at the back of this Instruction.

IMPORTANT
An electronic assembly must be placed in a static shielding bag before it is packaged for shipment.

IMPORTANT
Moore Products Co. assumes no responsibility for product performance on devices repaired by user.

5.5 MAINTENANCE RECORD
An accurate record keeping system for maintenance operations should be established and kept up to date. Data extracted from the record can serve as a basis for ordering supplies such as spare parts. In addition, it’s useful as a troubleshooting tool by providing historical maintenance data. Scheduled and unscheduled maintenance should be recorded.

INSTRUCTION NOTE
This Installation And Service Instruction is a Factory Mutual approved document. Subsequent issues to be filed with FM for approval.
5.6 RETURN FOR REPAIR

TO RETURN EQUIPMENT

- Call the Service Department at (215) 646-7400, ext 4RMA (4762) weekdays between 8:00 a.m. and 4:45 p.m. Eastern Time to obtain an RMA number. Mark the RMA number prominently on the outside of the shipment.

- When calling for an RMA number, provide the reason for the return. If returning equipment for repair, failure information (e.g., error code, failure symptom, installation environment) will be requested. A purchase order number will also be needed.

MATERIAL SAFETY DATA SHEET

- A Material Safety Data Sheet (MSDS) must be included with each item being returned that was stored or used anywhere hazardous materials were present.

PACKAGING

- Package assembly in original shipping materials. Otherwise, package it for safe shipment or contact the factory for shipping recommendations.

An electronic module must be placed inside a static shielding bag to protect it from electrostatic discharge.

WARRANTY

The Company warrants all equipment manufactured by it and bearing its nameplate, and all repairs made by it, to be free from defects in material and workmanship under normal use and service, if any part of the equipment herein described, and sold by the Company, proves to be defective in material or workmanship and if such part is within twelve months from date of shipment from the Company’s factory, returned to such factory, transportation charges prepaid, and if the same is found by the Company to be defective in material or workmanship, it will be replaced or repaired, free of charge, f.o.b. Company’s factory. The Company assumes no liability for the consequence of its use or misuse by Purchaser, his employees or others. A defect in the meaning of this warranty in any part of said equipment shall not, when such part is capable of being renewed, repaired or replaced, operate to condemn such equipment. This warranty is expressly in lieu of all other warranties, guarantees, obligations, or liabilities, expressed or implied by the Company or its representatives. All statutory or implied warranties other than title, are hereby expressly negated and excluded.

Warranty repair or replacement requires the equipment to be returned to one of the following addresses:

Equipment manufactured or sold by MOORE PRODUCTS CO.

MOORE PRODUCTS CO.
Sunnymount Pike
Spring House, PA 19477 USA

Equipment manufactured or sold by MOORE PRODUCTS CO. (CANADA) INC.

MOORE PRODUCTS CO. (CANADA) INC.
2KM West of Mississauga Rd, Hwy. 7
Brampton, Ontario, Canada

Equipment manufactured or sold by MOORE PRODUCTS CO. (UK) LTD.

MOORE PRODUCTS CO. (UK) LTD
Copse Road,
Luton, Yecvli,
Somerset, BA22 8RN, England

Warranty will be null and void if repair is attempted without authorization by a member of the Moore Products Co. Service Department.

Moore Products Co. assumes no liability for errors or omissions in this document or for the explanation and use of information included in this document. The information herein is subject to change without notice.

5-3
**Parts List**

**ANALOG 2-WIRE FLOW TRANSMITTER**

Drawing No. 15973-10PL

P/N 15973-10

<table>
<thead>
<tr>
<th>Item No</th>
<th>Part No</th>
<th>Description</th>
<th>Req'd</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>15995-15</td>
<td>Housing</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>15996-29</td>
<td>Cover</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>15995-11</td>
<td>Cover Gasket</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>15996-30</td>
<td>Cover</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>15996-12</td>
<td>Cover Gasket</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>7418-391</td>
<td>Terminal Block</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>7418-392</td>
<td>Marker Strip</td>
<td>1</td>
</tr>
<tr>
<td>8</td>
<td>17033-138</td>
<td>Terminal Washer</td>
<td>1</td>
</tr>
<tr>
<td>9</td>
<td>15981-11</td>
<td>Detection Sensor Board</td>
<td>1</td>
</tr>
</tbody>
</table>

| A       | 1-0085   | +4.40 x 5-16 Riv     | 1     |
| B       | 1-1174   | +6.32 x 1-1/4 Riv    | 2     |
| C       | 1-1273   | +6.32 x 7-1/16 Riv   | 2     |
| D       | 1-1284   | +10.32 x 3-1/8 Sl. Ht.| 1    |
| E       | 1-7230   | +2 Mod. Lbr        | 1     |
| F       | 1-1763   | +6 Int. Th. Lbr     | 4     |
| G       | 1-1865   | +8.32 x 3-1/8 Lbl    | 6     |

* Recommended On-Hand Spare Parts, Always Specify Range, Serial No., or Other Nameplate Information When Ordering Spare Parts.*

1984, Superseded 11/90

REF. 5015973-10