INSTRUCTION MANUAL

LOW SPAN PFM TRANSMITTER

900GA336-05 THRU -08

We do our level best

Robertshaw
Industrial Products Division
1602 Mustang Drive
Maryville, Tennessee 37801
Phone: (865) 981-3100 Fax: (865) 981-3168

INSTRUCTION MANUAL NUMBER

909GF292

14 November 2002

Declaration of Conformity

We: **Robertshaw**
Industrial Products Division

Declare under our sole responsibility that the product,
Model: **900GA336**
Serial Numbers: **9901001** and above

To which this declaration relates is in conformity with the following standard(s) or other normative documents.

EMC Emissions:

- **FCC 47 CFR Part 15 Class B emissions requirements (USA)**
- **EN 55011:1991 Group 1 Class B ISM emissions requirements (EU)**

EMC Immunity:

- **EN 50082-2:1995 EMC heavy industrial generic immunity standard**

Manufacturer

Signature: Paul D. Kronau

Name: Paul D. Kronau
Title: Sr. Design Engineer
Date: 5 April 1999
Address: **Robertshaw**
Industrial Products Division
1602 Mustang Drive
Maryville, Tennessee 37801
USA

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SECTION I – DESCRIPTION

1.1 GENERAL DESCRIPTION

The ROBERTSHAW Pulse Frequency Modulated (PFM) Transmitters are capacitance level transmitters designed for use with the Level-Lance™ Series of microprocessor based instruments. They employ ROBERTSHAW's patented data transmission scheme for improved accuracy, repeatability and longevity over analog transmission systems. The PFM transmitter converts the input capacitance, level, to a pulse width modulated current signal that can be transmitted, over a pair of common wires, to the receiving instrument, up to one (1) mile away. The PFM transmitter requires no calibration and is equipped with an LED indicator to provide visual indication that the transmitter is functioning.

The PFM transmitter is offered in a number of enclosure options to fit the application requirements of the user. The standard enclosure is weather-proof and an optional, epoxy painted, enclosure is offered for corrosive applications.

The PFM transmitter is typically mounted directly onto the sensing probe, but, with the remote mounting option, it may be remotely mounted up to fifteen (15) feet from the probe. Optional conduit outlet box, conduit and cable assemblies are available to facilitate remote mounted installations. ROBERTSHAW also offers a wide variety of sensing probes to suit the application needs.

The PFM transmitter is designed for intrinsically safe operation when connected through the appropriate barrier to the receiving instrument. The barrier parameters are specified on ROBERTSHAW drawing 907GA811 (See Figure 3.6)

NOTE:
Some ROBERSHAW instruments may have a built in barrier circuit. If these instruments meet the parameters a separate barrier is not required. Consult the instrument manual.

1.2 PART NUMBER IDENTIFICATION

PART NUMBER

Part Number	Description
900GA336-05	PFM Transmitter, Probe Mounted, NEMA 4
900GA336-06	PFM Transmitter, Remote Mounted, NEMA 4
900GA336-07	PFM Transmitter, Probe Mounted, Corrosion Resistant, NEMA 4X
900GA336-08	PFM Transmitter, Remote Mounted, Corrosion Resistant, NEMA 4X

ACCESSORIES

Part Number	Description
032KC190-XX	½" Liquid Tight, Flexible, Conduit Assembly. General Purpose. *
032KC600-XX	Coaxial Cable, Teflon Dielectric, Assembly With Spade Lugs On One End Only. General Purpose. *
032KC650-XX	Combination Of Above Two Items. General Purpose. *
032KC700-XX	Same As 032KC600-XX, Except Also Includes Conduit Outlet Box. NEMA-4. *
032KC710-XX	Same As 032KC650-XX, Except Also Includes Conduit Outlet Box. NEMA-4.*
032KC720-02	Coaxial Cable, Teflon Dielectric, Assembly In 2 Foot Long, ½" Explosion-Proof, Flexible, Conduit With Conduit Outlet Box. Explosion-Proof/NEMA-4.
032KC720-05	Same As Above Except 5 Feet Long.
032KC720-08	Same As Above Except 8 Feet Long.
032KC720-10	Same As Above Except 10 Feet Long.

ACCESSORIES – Cont'd

Part Number	Description
032KC800-XX	Same As 032KC700-XX Above, Except Conduit Outlet Box is Epoxy Painted. NEMA-4X.*
032KC810-XX	Same As 032KC710-XX Above, Except Conduit Outlet Box Is Epoxy Painted. NEMA-4X.*
032KC820-02	Same As 032KC720-02 Above, Except Conduit Outlet Box Is Epoxy Painted. Explosion-Proof/NEMA-4.
032KC820-05	Same As Above Except 5 Feet Long.
032KC820-08	Same As Above Except 8 feet Long.
032KC820-10	Same As Above Except 10 Feet Long.
032KC900-XX	Same As 032KC700-XX, Except Conduit Outlet Box Is Stainless-Steel. NEMA-4X.
032KC910-XX	Same As 032KC710-XX, Except Conduit Outlet Box Is Stainless-Steel. NEMA-4X.*
032KC920-02	Same As 032KC720-02, Except Conduit Outlet Box Is Stainless-Steel. NEMA-4X.
032KC920-05	Same As Above Except 5 Feet Long.
032KC920-08	Same As Above Except 8 Feet Long.
032KC920-10	Same As Above Except 10 Feet Long.
909SD029	Conduit Outlet Box. Explosion-Proof/NEMA-4.
909SD029-50	Conduit Outlet Box, Epoxy Painted. Explosion-Proof/NEMA-4X.
909SD029-51	Conduit Outlet Box, Stainless-Steel. Explosion-Proof/NEMA-4X.

* Substitute The Desired Cable Length, In Feet, For "XX" In Part Number (Maximum Allowable Cable Length is 15 Feet.)

SECTION II - SPECIFICATIONS

2.1 ENVIRONMENTAL:

Operating Temperature:	-30° to +140°F (-34° to +60°C)
Storage Temperature:	-40° to +158°F (-40° to +70°C)
Relative Humidity:	0 to 95% (non condensing)
Vibration:	± 2G 10 to 200 Hz
Shock:	75G's for 11 ms, Without permanent damage
Enclosure:	
Material:	Cast Aluminum
Finish:	Polyurethane Enamel, Blue (Standard)
	Epoxy, Enamel, Gray (Optional)
Ratings:	
Raintight	NEMA-4 (Standard)
Raintight Corrosion Resistant	NEMA-4X (Optional)
Intrinsically Safe: (When Connected As Shown On ROBERTSHAW Drawing 907GA811, Figure 3.6)	Class I, Division 1, Group A, B, C & D; Class I, Zone 0, Group IIC; Class II, Division 1, Group E, F & G.
Weight:	2.5 lbs. (1.14 Kg)

2.2 ELECTRICAL/ELECTRONIC

Supply Voltage:	6 to 30 VDC (Supplied By Level-Lance™ Receiver)
Supply Current:	25 maDC (Max.)
Input Range:	0 to 335 pF
Ambient Temperature Effect:	±0.005 pF/°F (±0.01 pF/°C) or ±0.01%/°F (±0.01%/°C) Which-Ever is Greater
Supply Variation Effect:	None
Linearity:	±0.5%
Repeatability:	±0.01pF
Maximum Distance Between Transmitter and Receiver:	One (1) Mile. For Intrinsically Safe Installations also refer to ROBERTSHAW Drawing 907GA811, Figure 3.6)
Type of Interconnecting Cable:	Two (2) wires (twisted pair recommended, Beldon #8205) in Grounded Metal Conduit or Twisted, Shielded, Pair (Beldon #8762) In Non-Metallic Conduit.
Maximum Distance Between Transmitter and Probe:	Fifteen (15) Feet
Type of Interconnecting Cable:	Coaxial, RG 62/U

2.3 AGENCY CERTIFICATIONS:

UL Listed	File E164999
c-UL Listed	File E164999

PFM Transmitter **900GA336**

FC

Tested To Comply With FCC Standards

FOR HOME OR OFFICE USE

SECTION III - INSTALLATION

3.1 GENERAL

Examine the instrument for possible shipping damages.

IMPORTANT:
If for any reason it is determined that parts should be returned to the factory, please notify the nearest ROBERSHAW sales representative prior to shipment. Each unit must be properly packaged to prevent damage. ROBERTSHAW assumes no responsibility for equipment damaged in shipment due to improper packaging.

Choose the location in accordance with good instrument practice, avoiding extremes of temperature, humidity and vibration. (See SPECIFICATIONS, Section II).

3.2 PROBE

ROBERTSHAW probes are purchased separately from the instruments and are available in a variety of sizes and types with numerous options for the materials and construction. Each probe should be selected for the specific application in order to ensure the best and most reliable operation of the system.

Probes are available with or without insulation. Insulated probes may be used for liquid, solid or interface detection and can also be used on conductive material. Bare probes are normally used with non-conductive materials only.

CAUTION:
When installing an insulated probe, care should be taken to prevent accidental puncture of the probe insulation.

Standard type probes are installed so that the face of the packing gland is flush (or nearly so) with the vessel wall. When installing the probe in a nozzle, recess or open end well, a sheathed probe should be used, with the sheath length equal to the nozzle, recess or well length. This insures that the "active" portion of the probe is extended into the process area and eliminates potential problems due to build-up in the nozzle, recess or well.

3.2.1 HORIZONTAL MOUNTING

Horizontally mounted rod-type probes must be installed in the vessel at the desired point of level detection. Horizontally mounted probes provide the closest control (smallest deadband) in that a small level change at, or near, the probe will produce a large capacitance change.

3.2.2 VERTICAL MOUNTING

Vertically mounted rod-type probes should be installed in either the top or bottom of the vessel. Vertically installed probes allow a variation in the level detection point up and down the length of the probe by means of the instrument zero adjustment.

Continuous level measurements typically require a vertically mounted probe.

3.3 TRANSMITTER MOUNTING

The PFM Transmitter is designed to be mounted remotely from the receiver unit of the system. The separation distance between the receiver and the probe can be up to one (1) mile. See Figure 3.1 for transmitter mechanical mounting details.

The following steps outline the procedure for installing a probe mounted PFM transmitter:

1. Remove the cover from the transmitter assembly and unpack the "Probe Termination Kit".
2. Remove the "Electronics Assembly" from the enclosure base.
3. Install the probe pin in the center rod of the probe. Do Not Over-Tighten.
4. Install the enclosure base on to the probe. Align the conduit hubs as required. Do not use Teflon thread sealing tape on the probe threads.
5. Re-install the "Electronics Assembly" into the enclosure base. Verify that the probe pin makes a good electrical connection with the mating jack.
6. Make the proper electrical connections as detailed in the following sections.
7. Install the enclosure cover.

The PFM Transmitter can also be remotely mounted from probe by up to fifteen (15) feet. You can elect to either purchase the accessory conduit outlet box, conduit and cable assembly from ROBERTSHAW or you can choose to supply your own. When Supplying your own components be sure to comply with the requirements shown in SECTION II – SPECIFICATIONS.

The following steps outline the procedure for installing a remote mounted PFM Transmitter:

1. Remove the mounting flange from the transmitter assembly.
2. Install the mounting flange on the selected mounting surface.
3. Install the transmitter assembly on the mounting flange. Align the conduit hubs as required.
4. Install the conduit outlet box on the probe. Align the conduit hub as required. Do not use Teflon thread sealing tape on the probe threads.
5. Install the conduit between the transmitter and probe mounted conduit outlet box.
6. Install and connect the coaxial cable as detailed in the following sections.
7. Install the covers on both enclosures.

This device complies with part 15 of the FCC rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

3.4 ELECTRICAL CONNECTIONS

All electrical connections must be made in accordance with Figure 3.5. It is important that the conduit be grounded to the process in some way to provide continuity for the capacitance signal. If a metallic vessel is not employed it may be necessary to provide a ground rod inside the vessel.

NOTICE:
Tighten field wiring screws to five (5) pound-inches (0.56 NM)

3.4.1 INTERCONNECTING CABLE

The PFM Transmitter is connected to the Level-Lance™ receiver using two wires (color coded, twisted pair cable is recommended) in grounded metal conduit with no power lines present. Otherwise shielded, twisted pair, cable must be used for this connection. Terminals GND and SIG on the PFM Transmitter are connected to the corresponding terminals of the receiver.

WARNING:
Seal fittings must be installed in all explosion-proof installations.

When installing the optional remote mounted PFM Transmitter the interconnecting cable between the sensing probe and the transmitter must be high temperature Teflon insulated coaxial cable.

NOTE:
Polyethylene dielectric coaxial cable is not recommended for remote mounted PFM applications, due to its poorer temperature stability.

The outer shield of the coaxial cable should be connected to the GND terminal on the PFM Transmitter and the ground screw (green) in the probe mounted conduit outlet box. The center conductor of the cable should be connected to the PROBE terminal on the PFM Transmitter and the screw in the probe rod in the probe mounted conduit outlet box.

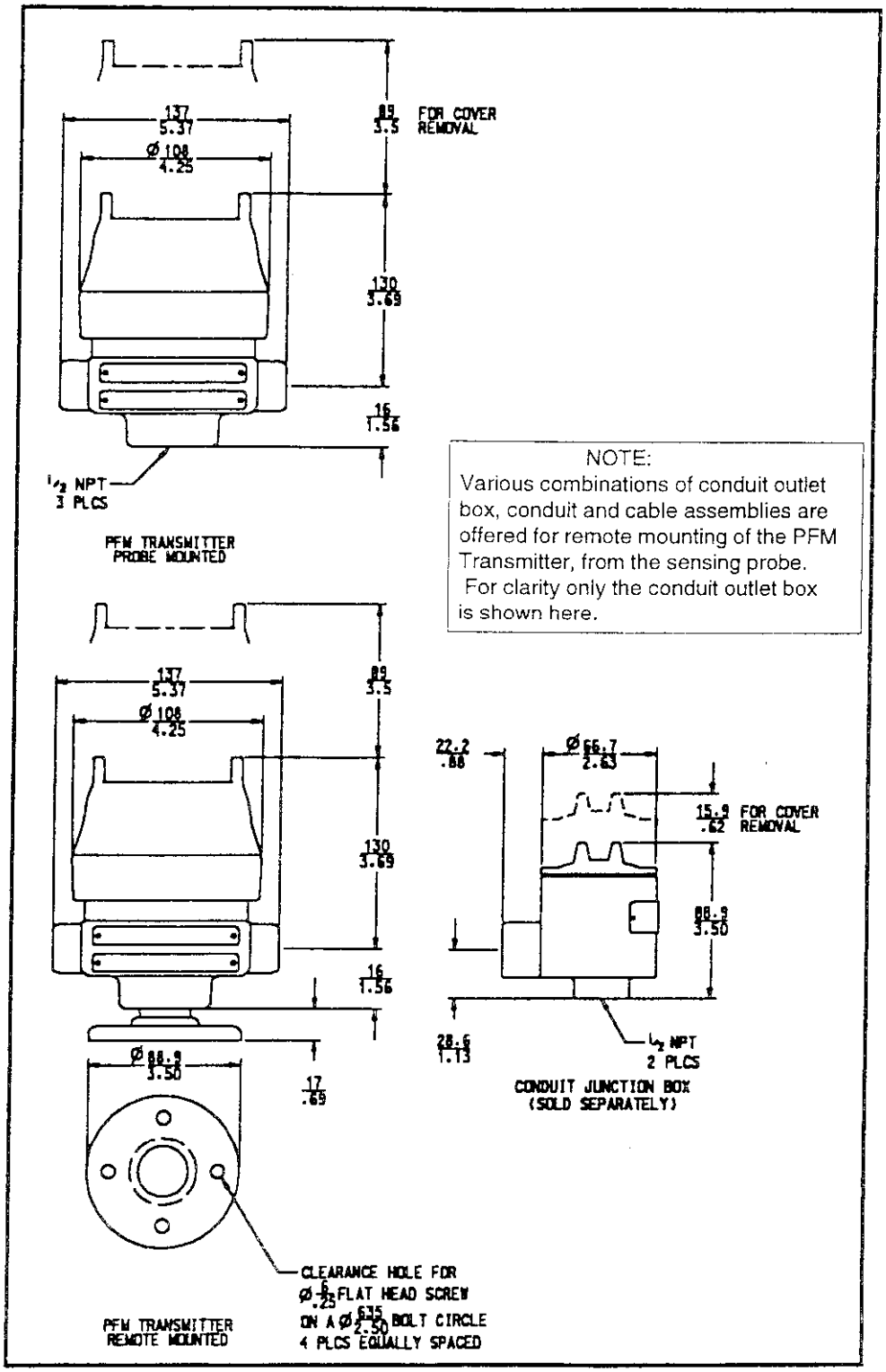


Figure 3.1 Dimensions
PFM Transmitter and Probe Mounted Conduit Outlet Box

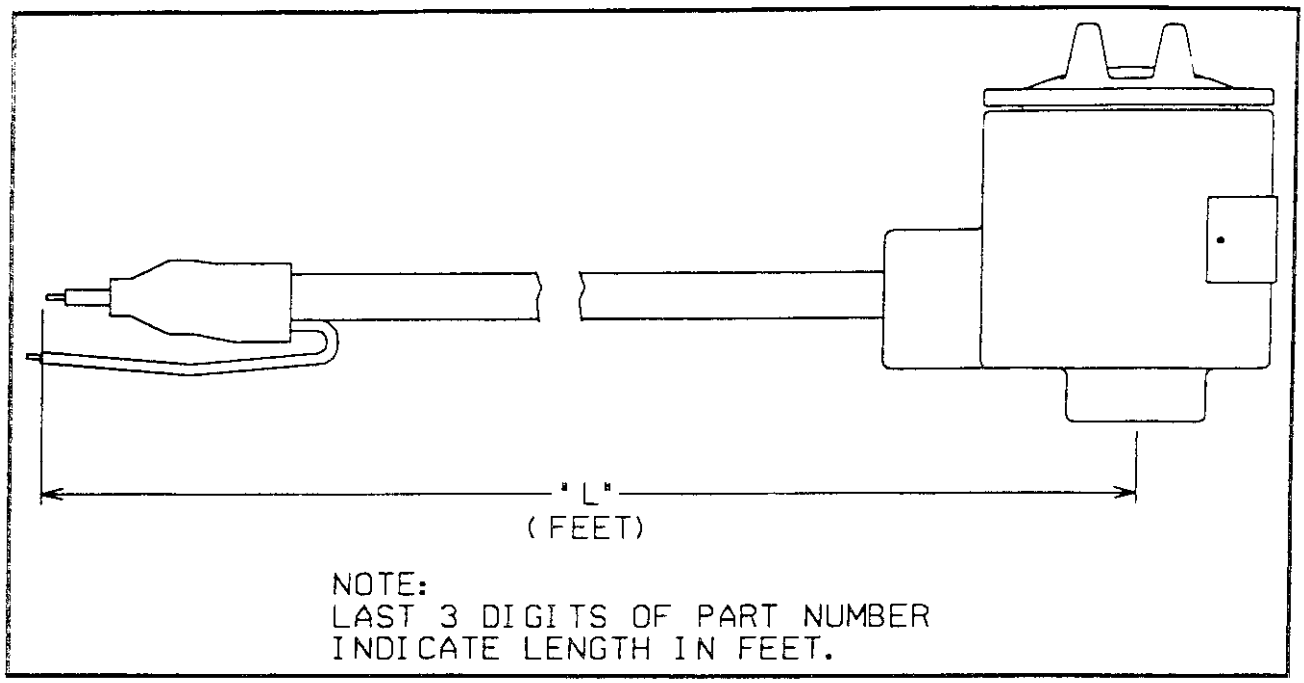


Figure 3.2 Dimensions
Conduit Outlet Box and Cable Assembly
(032KC700-XX, 032KC800-XX & 032KC900-XX)

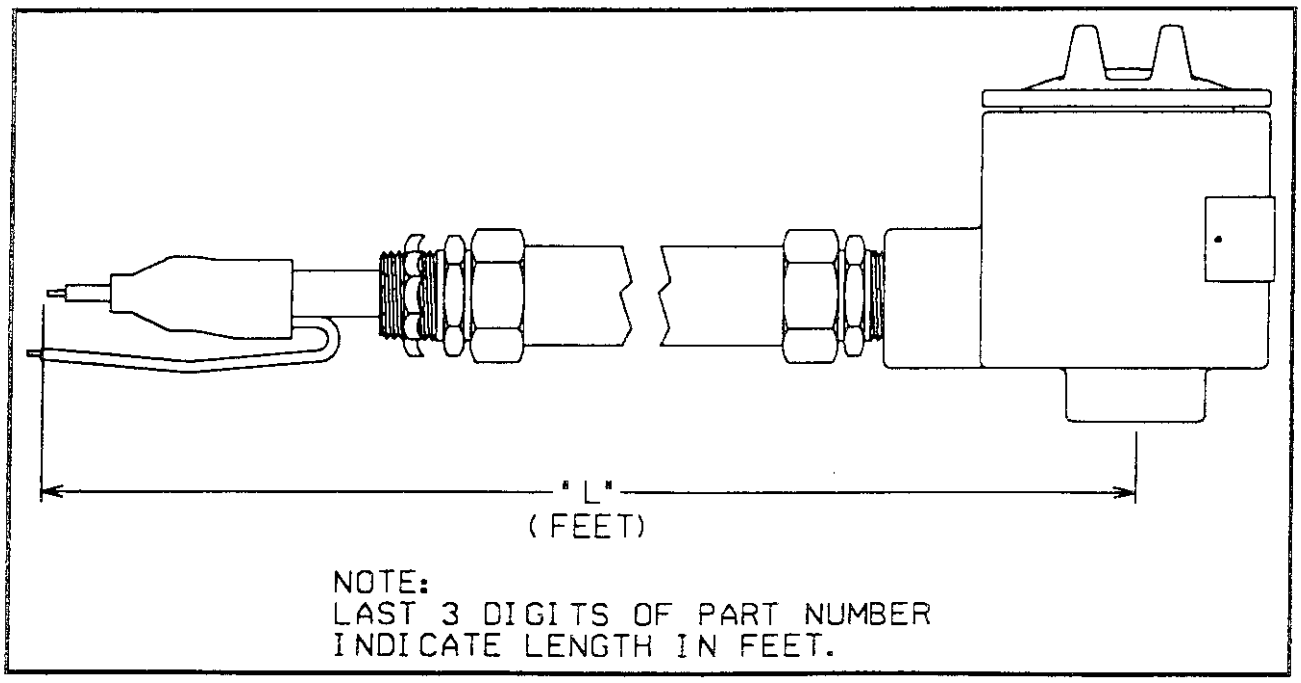


Figure 3.3 Dimensions
Conduit Outlet Box, Conduit and Cable Assembly
General Purpose, NEMA-4 & NEMA-4X
(032KC710-XX, 032KC810-XX & 032KC910-XX)

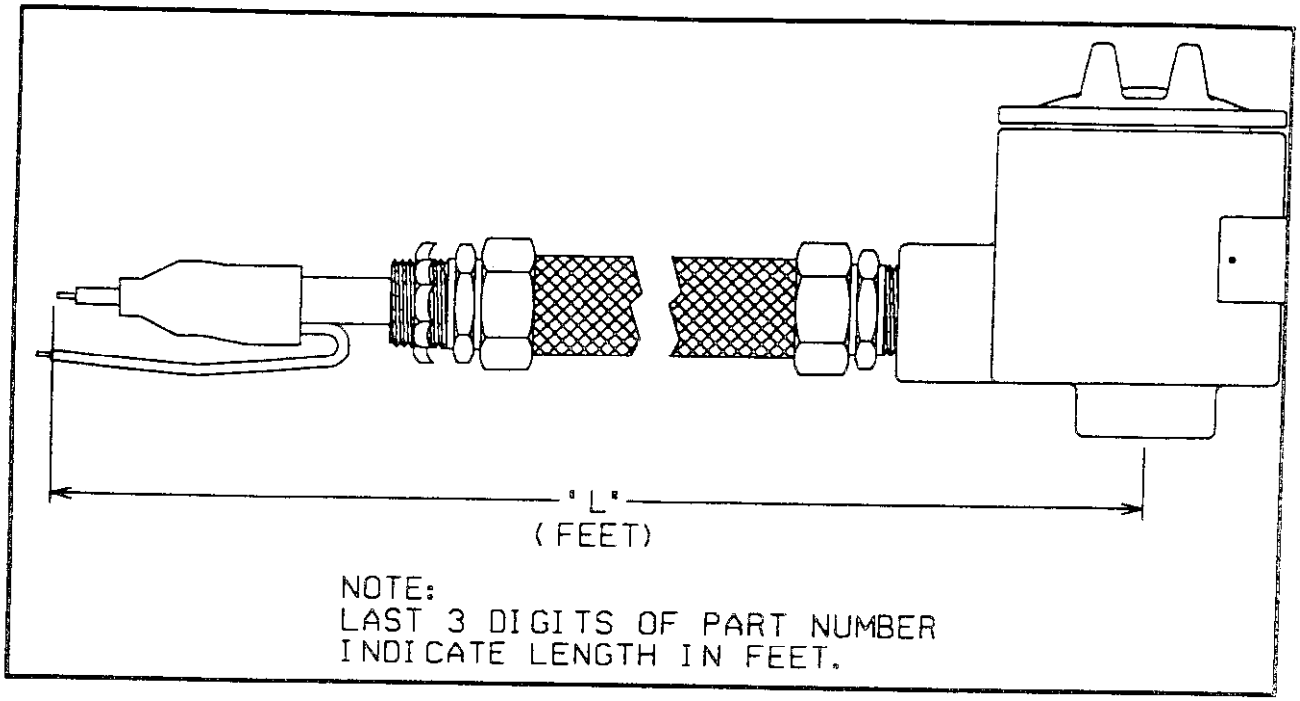


Figure 3.4 Dimensions
Conduit Outlet Box, Conduit and Cable Assembly
Explosion-Proof
(032KC720-XX, 032KC820-XX & 032KC920-XX)

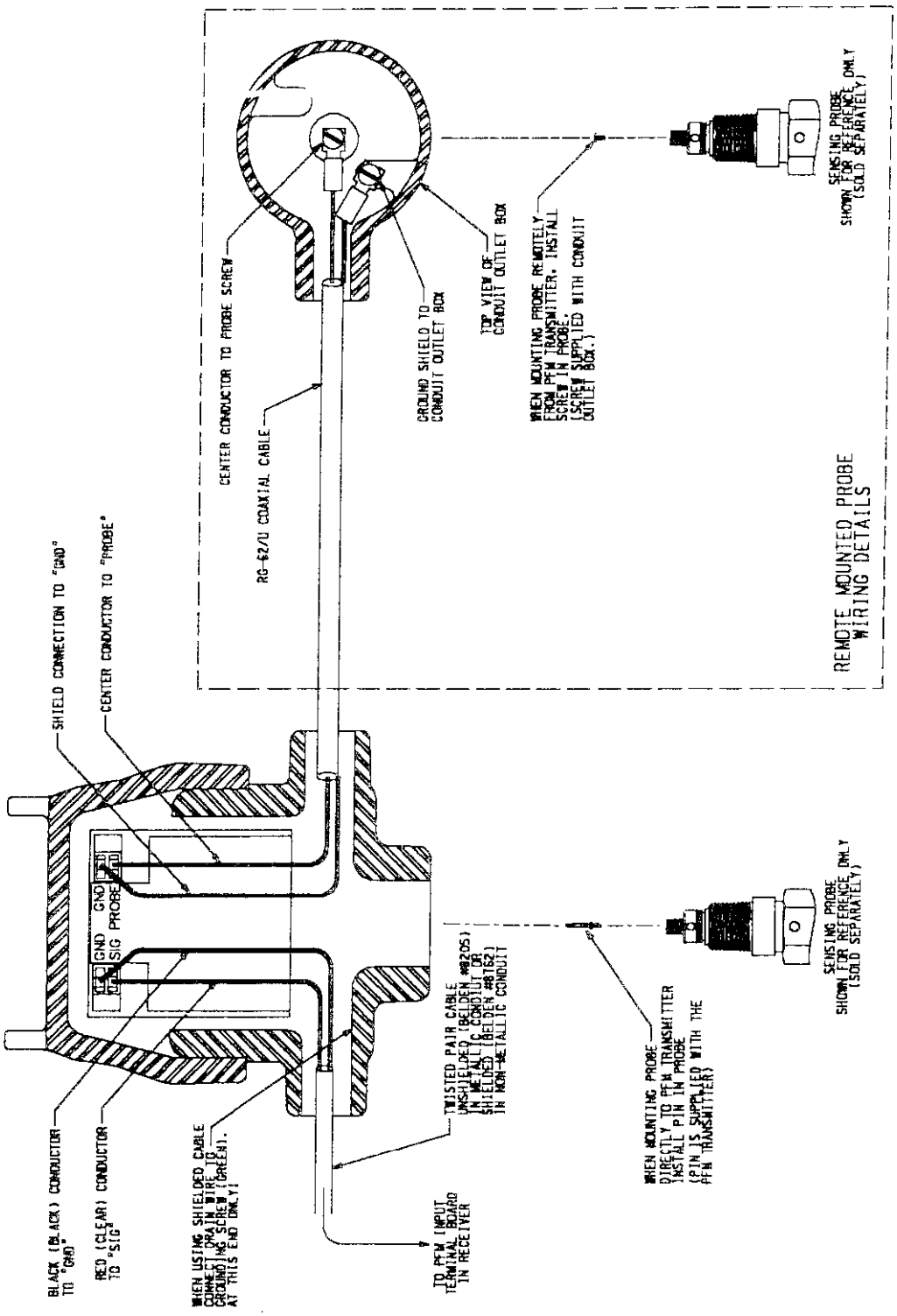


Figure 3.5 Electrical Connections

NOTICE:
Tighten field wiring terminal screws to five (5) pound-inches (0.56 NM)

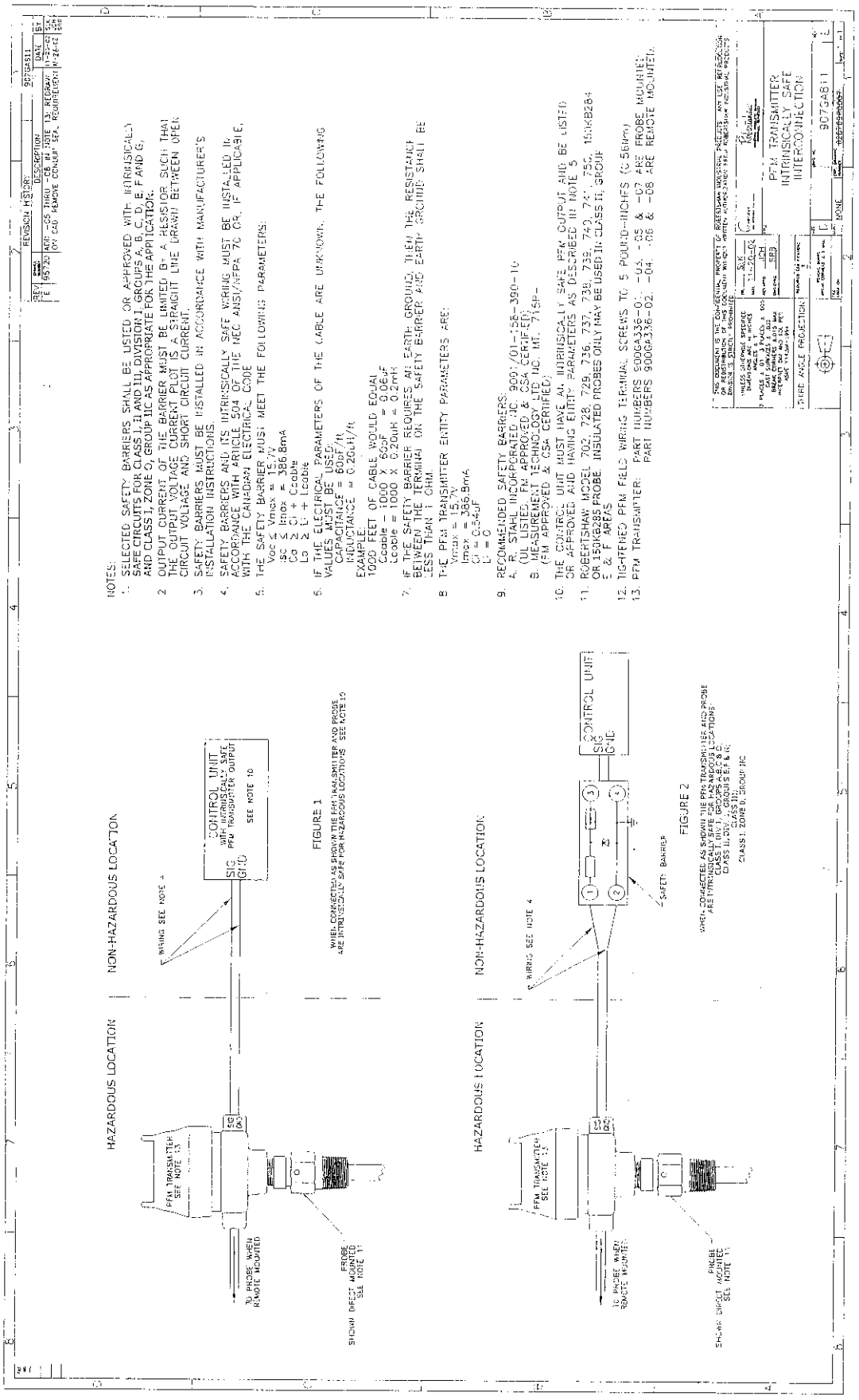


Figure 3.6 Intrinsic safety Requirements

Note: The 900GA336 Low Span PFM Transmitter has entity certification for use with any instrument (controller or receiver) and is intrinsically safe when connected as shown on Robertshaw drawing 907GA811 above.

SECTION IV - OPERATION

4.1 GENERAL

The PFM Transmitter is a capacitance input to pulse frequency modulated current output device. Its input is typically the capacitance change generated by a varying level in a vessel equipped with a rod type sensing probe. The sensing probe provides an increasing capacitance with an increasing level. The actual capacitance change is a function of the sensing probe construction, installation location and the material's dielectric constant. Since there is no calibration required for the PFM Transmitter the actual values are unimportant here as long as they fall within the sensitivity range of the transmitter.

The PFM Transmitter circuitry can be divided into four major function blocks (See Figure 4.1) as shown below:

1. ESD Protection
2. Oscillator
3. Current Pulse Width Modulator
4. 5 VDC Power Supply

The ESD protection attenuates high voltage transients on the probe due to static buildup. The power supply circuitry also has provisions to attenuate disturbances which might occur on the signal lines (lightening, etc.).

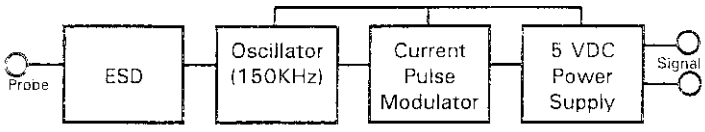


Figure 4.1 Block Diagram

4.2 CIRCUIT DESCRIPTION

The power for the PFM transmitter is supplied over the same two wires that carry the current pulse signal back to the receiver. The receiver which is typically a Level-Lance™ controller provides 12 VDC (18 VDC if the receiver has Short-Stop™ capabilities). The PFM transmitter component values are chosen so that the "Off" portion of the pulse is represented by an approximately 4 ma current and the "On" portion is represented by an approximately 20 ma current. A local LED indicator is included to provide indication of the transmitter status. The LED is on when the current is at its high level.

4.2.1 POWER SUPPLY

The power supply section of the transmitter (D3, D4, C6, IC3, C5, C2 and C4) provide a filtered and regulated 5 VDC supply to the transmitter. The transorb, D3, attenuates disturbances occurring on the signal lines. This device shunts transients in excess of 36 VDC to ground to protect the circuit from potentially damaging occurrences, such as lighting strikes. The filter network consisting of D4 and C6 provide filtering for the incoming supply voltage. The voltage regulator, IC3, reduces the incoming supply voltage (6 to 30 VDC) to a regulated 5 VDC. Capacitor C5 provides for regulator stability and capacitors C2 and C4 provide high frequency bypass for logic IC's.

4.2.2 CURRENT PULSE MODULATOR

The current pulse modulator portion of the circuit is formed by IC2, Q1, DS1 and R8. The 14 stage binary counter, IC2, divides the oscillator frequency by 16,384 (2^{14}) to obtain the desired output pulse width. This division also provides the desired duty cycle (50%) for the output. The voltage pulse from IC2 is then converted to a current pulse by the transistor, Q1. The level of the current pulse is set by the resistor, R6. The LED, DS1, provides visual indication of the output status and is on when the output pulse is at its high level.

4.2.3 OSCILLATOR

The oscillator portion of the circuit is made up of IC1, C1, R4, R5 and C3. The component values are selected so that the natural frequency (no probe connected) is approximately 150 KHz. Capacitor C1 provides a bypass for the unused "control voltage" pin of low power TLC555 timer. The frequency is determined by the RC network consisting of R4 and R5 in conjunction with capacitor C3 and the capacitance of the intrinsic safety barrier circuit.

The timer operates by charging and discharging the capacitance network between two fixed voltages.

These voltages are set at 1/3 and 2/3 the supply voltage. The charge and discharge rates are set by the two resistors. The output frequency of the timer is equal to the frequency on the capacitors. Figure 3.2 shows these two waveforms.

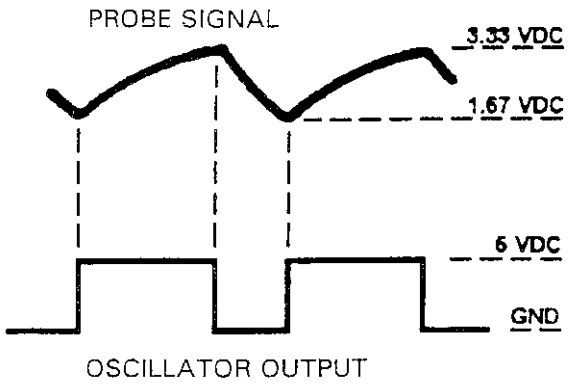
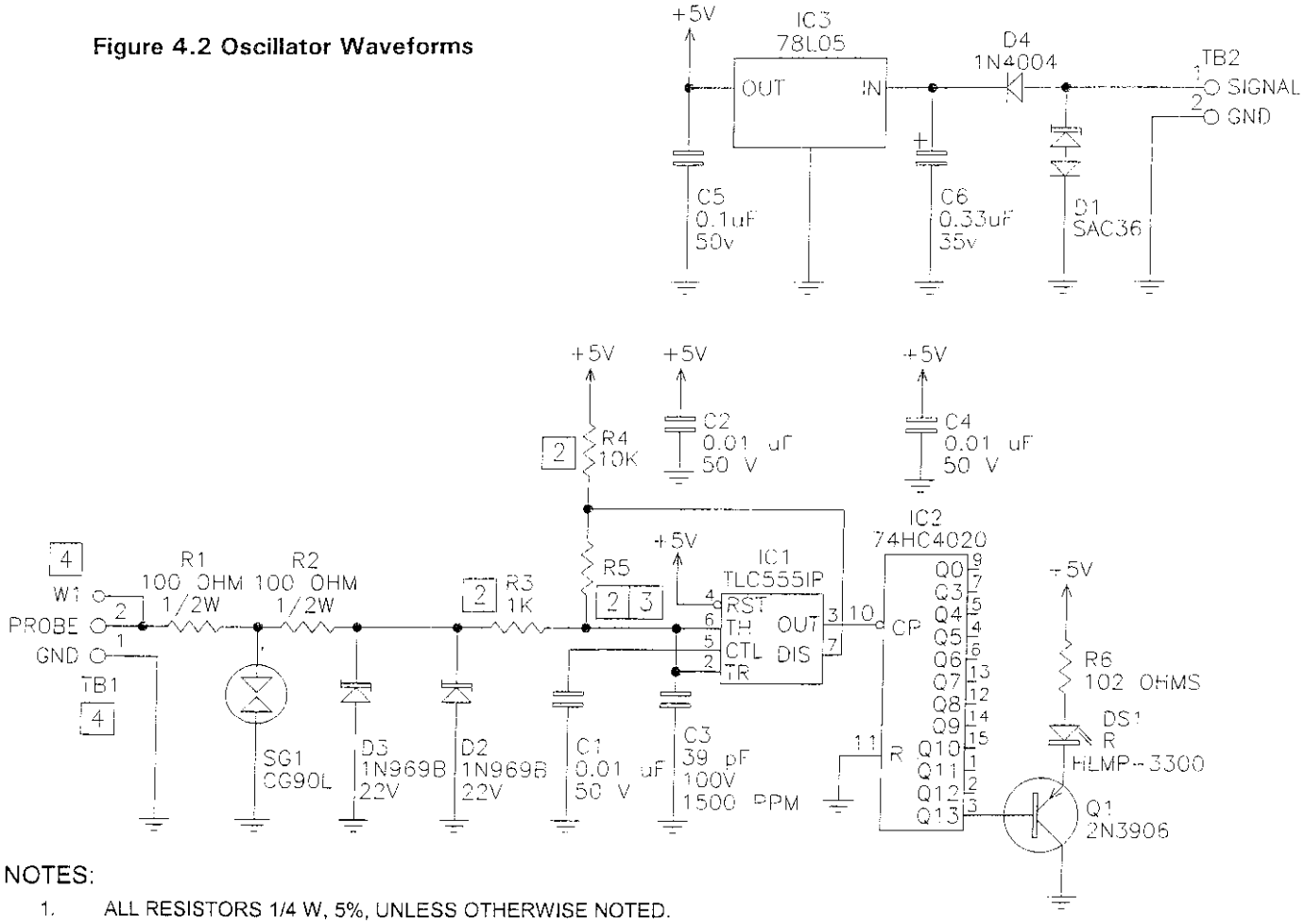


Figure 4.2 Oscillator Waveforms

The parameters of the oscillator are chosen so that the ratio of change in output current pulse width to change in input capacitance is approximately 1 msec./pF.

4.2.4 ESD PROTECTION

The resistors R1 and R2 along with the spark gap SG1 provide static protection from voltage transients on the probe. The resistors serve to limit the current flow and the spark gap provides a nominal voltage threshold of 90 VDC.



NOTES:

1. ALL RESISTORS 1/4 W, 5%, UNLESS OTHERWISE NOTED.
2. DENOTES 1/10 W, 1%, FILM RESISTOR.
3. 200K FOR LOW SPAN PFM TRANSMITTER.
4. "W1" IS FOR PROBE MOUNTED PFM TRANSMITTER. TB1 IS FOR REMOTE MOUNTED PFM TRANSMITTER

Figure 4.3 Schematic

SECTION V – TROUBLESHOOTING

5.1 GENERAL

There is no calibration required on the PFM Transmitter. A review of Section IV (Operation) of this manual will be helpful prior to trouble shooting the transmitter.

Most problems can be traced to the probe, the PFM Transmitter, or associated wiring. When a probe problem is indicated the following procedure should be used to isolate it. A multimeter is needed to perform these tests. The tests should be performed in the order given in the table below.

5.2 PROBE CIRCUIT ELECTRICAL CHECK

MEASUREMENT	READING	REMARKS
On receiver, voltage between the GND and SIG terminals with PFM transmitter disconnected.	11 to 13 VDC	Normal, proceed.
	<11 VDC	Defective receiver.
	>13 VDC	Defective receiver.
On receiver, voltage between the GND and SIG terminals with PFM transmitter connected.	6 to 11 VDC, may be erratic	Normal, proceed.
	1 to 5 VDC	Defective PFM transmitter or interconnecting wiring reversed.
	0 VDC	Interconnecting wiring shorted.
On PFM transmitter, voltage between the GND and SIG terminals with the receiver connected.	0 VDC	Open circuit condition exists in the interconnecting wiring.
On receiver, current between the SIG terminal and its wire from the PFM transmitter. Note: Meter is in series with the (+) lead wire and the SIG terminal.	Approximately 5 to 15 mA, may be erratic and vary with meter used.	Normal proceed.
	0 mA	Interconnecting wiring open.
	Steady 1 to 5 mA	Abnormal, proceed.
	Steady 17 to 26 mA	Abnormal, proceed.
Remove PFM transmitter and measure resistance between center rod of probe and ground using highest scale on meter. Do not touch the probe or meter leads as your body resistance will change the reading.	Greater than 10 Megohm	Normal – problem is most likely a defective PFM transmitter.
	Less than 1 Megohm	Defective probe (shorted) or bare probe used in conductive material.
	1 to 10 Megohm	Leaky probe – probably not causing a problem now but possible future problem.

SECTION VI – SPARE PARTS

6.1 SPARE PARTS

Electronics Assembly (printed circuit assembly, bracket and protective cover) 044KX315

Protective Cover (for printed circuit assembly) 018KB042-01

Probe Pin Kit 909GM079

Remote Mounting Kit

For NEMA 4 (Blue) Version 909GM174-01
For NEMA 4X (Gray) Version 909GM174-03

Enclosure Cover O-Ring 560KB051-57

NOTES:

An Invensys company

Industrial Products Division

U.S.A and Canada
Robertshaw Industrial Products Division
1602 Mustang Drive
Maryville, Tennessee 37801
Telephone: (865) 981-3100 Fax: (865) 981-3168
http://www.robertshawindustrial.com

Exports
Invensys Appliance Controls
1701 Byrd Avenue
P.O. Box 26544
Richmond, Virginia 23261-6544
Telephone: (804) 756-6500 Fax: (804) 756-6561

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