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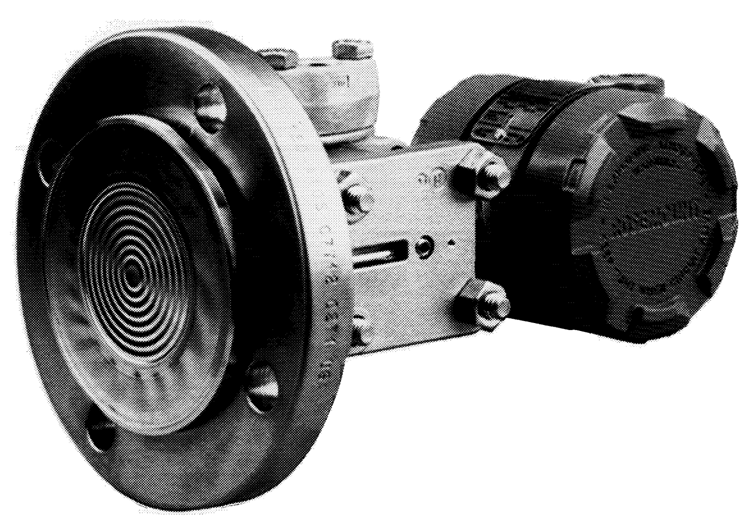
Rev. AB

Model 1151LT Flange-Mounted Liquid Level Transmitter



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SNF-0004

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Section 1

INSTALLATION

INTRODUCTION

Flange-mounted liquid level transmitters measure hydrostatic pressure head. This pressure is equal to the liquid height above the tap multiplied by the specific gravity of the liquid. It is independent of volume or vessel shape.

The quality of a measurement depends to a great extent on proper installation of the transmitter and impulse piping.

Installations in food, beverage, and pharmaceutical processes may require sanitary seals and fittings. Regulations may dictate special installation requirements needed to maintain sanitation and cleanability considerations. See Product Data Sheet PDS 2599 for more information on Rosemount sanitary pressure instruments.

Model 1151 transmitters are designed for use in harsh process environments. Take care, however, to select a mounting location that exposes the transmitter to a minimum of temperature gradients, temperature fluctuations, vibration, and shock.

CAUTION
Factory Mutual explosion-proof certification is standard for the Model 1151 transmitter series. Install transmitters in accordance with all applicable codes and standards in order to maintain these certified ratings.

MOUNTING

The Model 1151LT Transmitter is flange-mounted directly to the vessel. Models are available for standard 3- and 4-inch flanges with Class 150 or 300 ratings. Refer to Figure 4-2 for transmitter dimensions.

The low-side process flange has a ¼–18 NPT connection. A flange adapter union is supplied for ½–14 NPT process connection. The flange adapter allows the transmitter to be easily disconnected from the process by removing the flange adapter bolts. On open vessels the low-side process flange is open to the atmosphere and should be mounted with the threaded hole pointing down. On closed vessels this connection is used for the dry or wet leg.

To ensure a tight seal on the flange adapter: finger-tighten both bolts, wrench-tighten the first bolt, wrench-tighten the second bolt, and finally re-tighten first bolt. Torque the bolts to approximately 29 ft-lb.

The transmitter electronics housing may be rotated for mounting convenience, but be sure to reseal the module threads with a thread sealant after rotation. Use the procedure for connecting the sensor module in Section 3.

CAUTION
Do not rotate the electronics housing without resealing the module threads. Failure to reseal the module threads may allow moisture to enter the electronics compartment and damage the electronics.

IMPULSE PIPING

The reference leg impulse piping between the process and transmitter must transfer the pressure seen at the process taps to the transmitter. There are several possible sources of error:

- Leaks.
- Friction loss—particularly if purging is used.
- Liquid in gas line (a head error).
- Gas in liquid line.

WIRING

Field wiring terminal blocks are located in a separate compartment on one side of the electronics housing. Figure 1-1 illustrates the terminal blocks and field wiring connections. Connections can be made by removing the cover from the side designated as TERMINAL SIDE on the nameplate. The upper pair of terminals are the SIGNAL terminals, and the lower terminals are the TEST terminals. The test terminals have the same 4–20 mA or 10–50 mA current signal as the signal terminals and are for use with the optional integral meter or for testing

Shielded cable should be used for best results in electrically noisy environments.

CAUTION
Do not connect powered signal wiring to the test terminals. This will destroy the diode in the test connection.

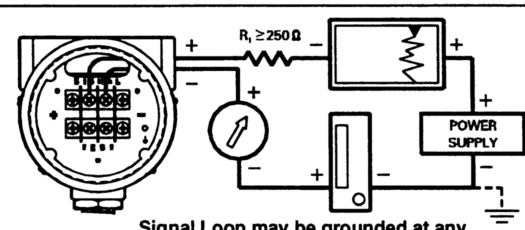


FIGURE 1-1. Field Wiring Connections

If the test diode is accidentally destroyed, the transmitter can still be operated without local indication by jumping the test terminals.

It is a good practice to shield signal wiring and run it in conduit. Use twisted pairs for best results. Do not run signal and power wiring together or near heavy electrical equipment.

Refer to Figure 4-7 in the Specifications and Reference Section for CSA Intrinsic Safety Approvals.

Conduit connections on the transmitter housing must be sealed or plugged with a sealing compound to avoid accumulation of moisture in the housing. If the connections are not sealed, mount the transmitter with the electrical housing downward for draining.

Signal wiring may be ungrounded (floating) or grounded at any place in the signal loop. The transmitter case may be grounded or ungrounded. Power supply regulation is not critical. Even with a power supply ripple of one volt peak-to-peak, the ripple in the output signal would be negligible.

Because the transmitter is capacitance-coupled to ground, insulation resistance should not be checked with a high-voltage meter. No more than 100 V should be used in circuit checks.

Output current is limited to 30 mA dc on the 4–20 mA dc units, and 90 mA dc on the 10–50 mA dc units.

LIQUID LEVEL MEASUREMENTS

Pressure transmitters used for liquid level applications measure hydrostatic pressure head. This pressure is equal to the liquid height above the tap multiplied by the specific gravity of the liquid. Pressure head is independent of volume or vessel shape.

OPEN VESSELS

A pressure transmitter mounted near a tank bottom measures the pressure of the liquid above.

Pressure is sensed by the process flange and transmitted to the high pressure side of the sensing element. The low pressure side is vented to the atmosphere. Pressure head equals the liquid's specific gravity multiplied by the liquid height above the tap.

Zero range suppression is required if the transmitter lies below the zero point of the desired level range. See Figure 1-2.

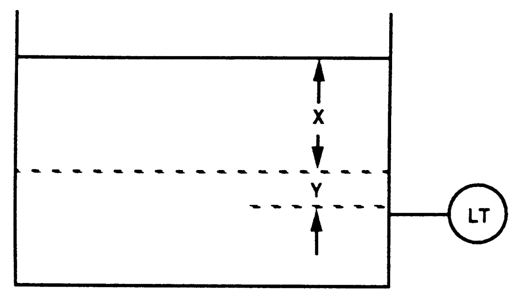
CLOSED VESSELS

Pressure above a liquid affects the pressure measured at the bottom of a closed vessel. The liquid's specific gravity plus the vessel pressure summed and multiplied by the liquid height equals the pressure at the bottom of the vessel.

To measure true level, subtract the vessel pressure from the vessel bottom pressure. To do this, make a pressure tap at the top of the vessel and connect this to the low side of the transmitter. Vessel pressure is then equally applied to both the high and low sides of the transmitter. The resulting differential pressure is proportional to liquid height multiplied by the liquid's specific gravity.

Dry Leg Condition

Low-side transmitter piping will remain empty if gas above the liquid does not condense. This is a dry leg condition. Range determination calculations are the same as those described for bottom-mounted transmitters in open vessels. See Figure 1-2.



Let **X** equal the vertical distance between the minimum and maximum measurable levels (500 in.).
Let **Y** equal the vertical distance between the transmitter datum line and the minimum measurable level (100 in.).
Let **SG** equal the specific gravity of the fluid (0.9).
Let **h** equal the maximum head pressure to be measured in inches of water.
Let **e** equal head pressure produced by **Y** expressed in inches of water.
Let **Range** equal **e** to **e** + **h**.

Then h= (X)(SG)
= 500 0.9
= 450 inH2O
e= (Y)(SG)
= 100 0.9
= 90 inH_2O
Range = 90 to 540 inH_2O

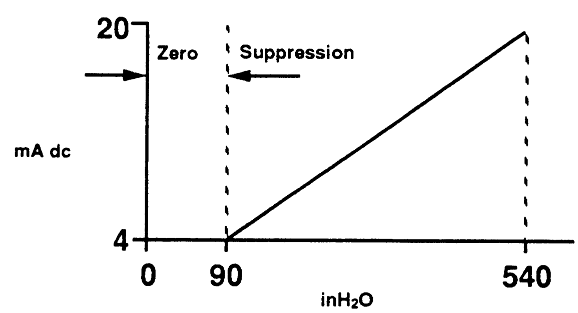
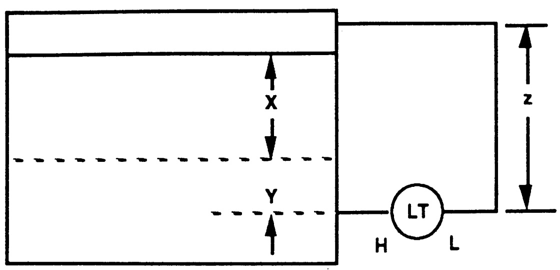


FIGURE 1-2. Open Tank Level Measurement.

Wet Leg Condition

Condensation of the gas above the liquid causes the low side of the transmitter piping to slowly fill with liquid. The pipe is purposely filled with a convenient reference fluid to eliminate this potential error. This is a wet leg condition.

The reference fluid will exert a head pressure on the low side of the transmitter. Zero elevation of the range must then be made. See Figure 1-3.



Let **X** equal the vertical distance between the minimum and maximum measurable levels (500 in.).
Let **Y** equal the vertical distance between the transmitter datum line and the minimum measurable level (50 in.).
Let **z** equal the vertical distance between the top of the liquid in the wet leg and the transmitter datum line (600 in.).
Let **SG₁** equal the specific gravity of the fluid (1.0).
Let **SG₂** equal the specific gravity of the fluid in the wet leg (1.1).
Let **h** equal the maximum head pressure to be measured in inches of water.
Let **e** equal the head pressure produced by **Y** expressed in inches of water.
Let **s** equal head pressure produced by **z** expressed in inches of water.
Let **Range** equal **e s** to **h + e – s**.

Then h = (X)(SG_1)
= 500 1.0
= 500 inH_2O
e = (Y)(SG_1)
= 50 1.0
= 50 inH_2O
s = (z)(SG_2)
= 500 1.1
= 550 inH_2O
Range = **e s** to **h + e – s**.
= 50 550 to 500 + 50 660
= 610 to 110 inH_2O

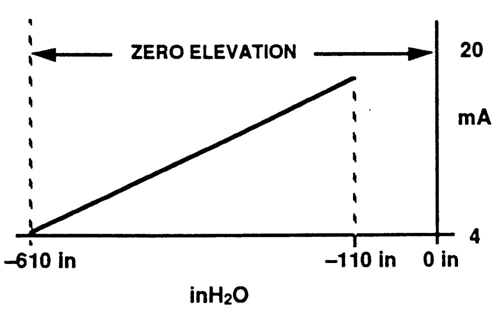


FIGURE 1-3. Wet Leg Example.

CALIBRATION

Model 1151 transmitters are available in output currents of 4–20 and 10–50 mA dc. A description of current output codes and their calibration information follows.

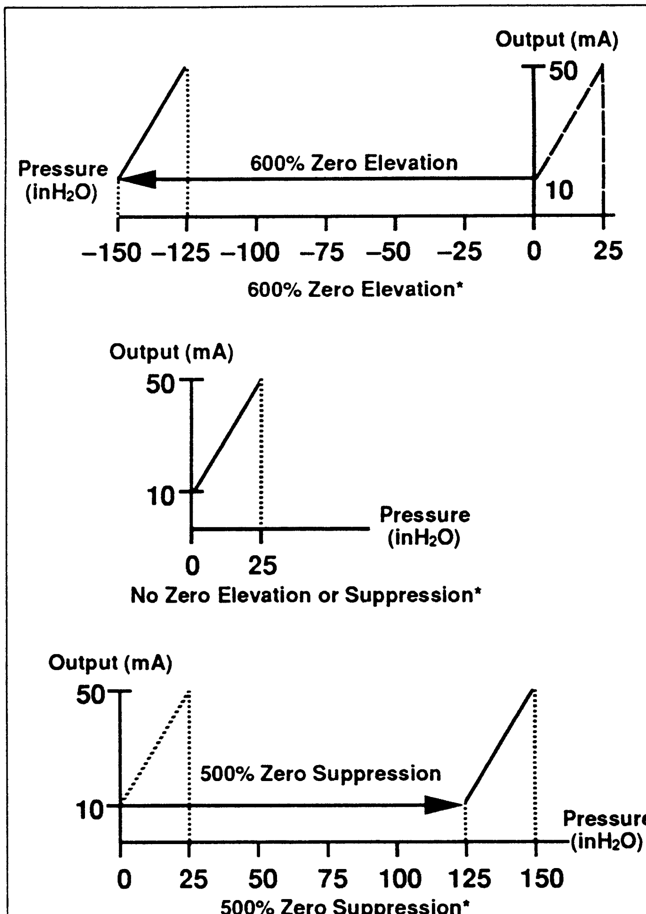
4–20 mA OUTPUT

A Model 1151 Liquid Level Transmitter with 4–20 mA dc output current is coded E. This current output may be referred to as "E output option."

10–50 mA OUTPUT

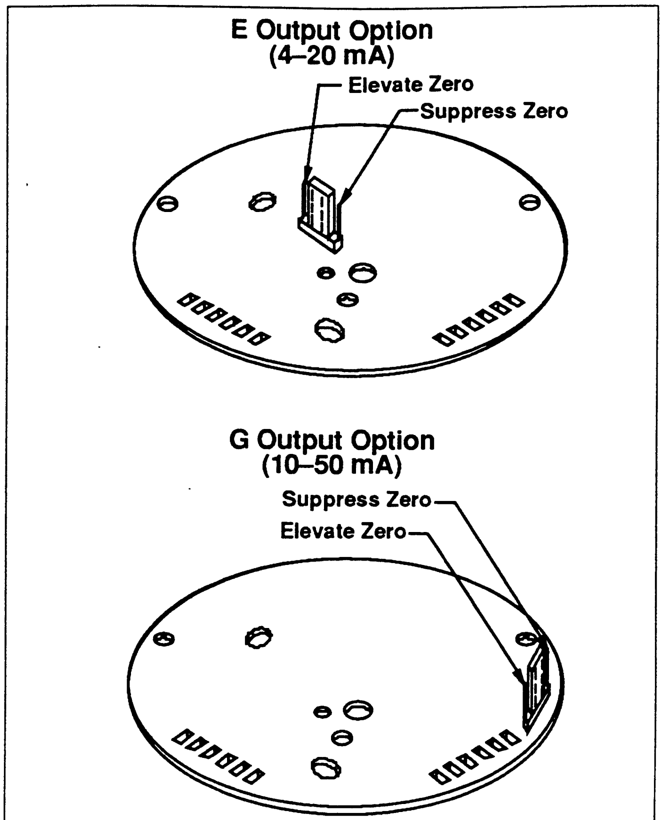
A Model 1151 Liquid Level Transmitter with 10–50 mA dc output current is coded G. This current output may be referred to as "G output option."

CAUTION
When replacing housing covers, tighten the covers enough to make contact with the O-ring seals. If the covers are not tightened enough, moisture can enter the housing and cause transmitter failure.



*Graphs based on a range 4 (0–25 inH_2O to 0–150 inH_2O) Model 1151 with a calibrated span of 25 inH_2O.

FIGURE 1-4. Zero Adjustment Range.



NOTE
The jumper pin is located on the component side of the amplifier board. Jumper pin positions may vary from those shown. The board must be unplugged from transmitter to gain access to the component.

FIGURE 1-5. Elevation and Suppression Jumper Settings.

SPAN ADJUSTMENT RANGE

The span on all Model 1151 transmitters is continuously adjustable to allow calibration anywhere between maximum span and $^1/_6$ of maximum span. For example, the span on a Range 4 transmitter can be adjusted between 25 inH$_2$O and 150 inH$_2$O.

ZERO ADJUSTMENT RANGE

The zero on an Model 1151LT can be adjusted for up to 500% suppression or 600% elevation. See Figure 1-4. The zero may be elevated or suppressed to these extremes with the limitation that no applied pressure within the calibrated range exceeds the full-range pressure limit. For example, a Range 4 transmitter cannot be calibrated for 100 to 200 inH$_2$O (only 100% zero suppression) because 200 inH$_2$O exceeds the 150 inH$_2$O full-range pressure limit of a Range 4.

To make large elevation or suppression adjustments, it is necessary to move a jumper pin assembly on the component side of the amplifier board. See Figure 1-5.

The jumper pin has three positions. Leaving the jumper in the middle position allows normal levels of elevation and suppression. To make larger elevation or suppression adjustments, move the jumper to the ELEVATE ZERO position, marked EZ, or to the SUPPRESS ZERO position, marked SZ.

NOTE
Always check to ensure that the jumper is fully seated on its pins. If the jumper has not been placed in any of the three positions, the amplifier board will provide normal levels of elevation or suppression. Also, a slide switch replaces the jumper pin on some older amplifier boards.

ZERO AND SPAN ADJUSTMENT

The zero and span adjustment screws are accessible externally and are located behind the nameplate on the side of the electronics housing. See Figure 1-6.

The output of the transmitter increases with clockwise rotation of the adjustment screws.

The zero adjustment screw and the ELEVATE/SUPPRESS ZERO jumper have no effect on span. Span adjustment, however, does affect zero. This effect is minimized with zero based spans. Therefore, when calibrations having elevated or suppressed zeros are made, it is easier to make a zero based calibration and achieve the required elevation or suppression by adjusting the zero adjustment screw (and ELEVATE ZERO/SUPPRESS ZERO jumper as required).

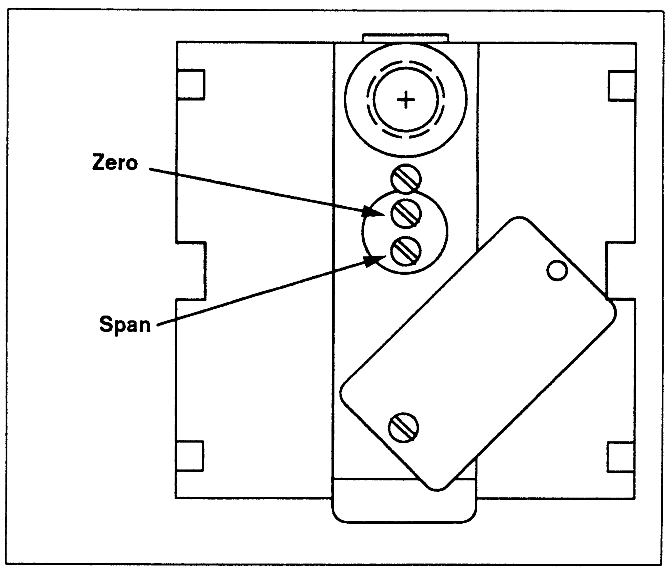


FIGURE 1-6. Zero and Span Adjustment Screws.

A degree of mechanical backlash is present in the zero and span adjustments, so there will be a dead band when direction of adjustment is changed. Because of the backlash, the simplest procedure, if the desired setting is overshot, is to purposely overshoot a larger amount before reversing the direction of the adjustment.

Model 1151LT Range 4 Example: For a desired calibration of 0 to 100 inH_2O, use the following procedure:

1. Adjust zero. With zero input applied to the transmitter, turn the zero adjustment screw until the transmitter reads 4 mA.
2. Adjust span. Apply 100 inH_2O to the transmitter high side connection. Turn the span adjustment screw until the transmitter output reads approximately 20 mA.
3. Release the input pressure and readjust the zero output to read 4 mA ±0.032 mA.
4. Reapply 100 inH_2O to the transmitter. If the output reading is greater than 20 mA, multiply the difference by 0.25 and subtract the result from 20 mA. Adjust the 100% output to this value. If the output reading is less than 20 mA, multiply the difference by 0.25 and add the result to 20 mA. Adjust the 100% output to this value.

   Example: The full scale transmitter output is 20.100 mA. Multiplying 0.100 by 0.25 gives the product 0.025. Subtracting the product 0.025 from 20.00 mA gives the difference 19.975 mA. Adjust the 100% output to this value.
5. Release input pressure and readjust the zero.
6. Apply 100% input and repeat steps 3 through 5 if full scale output is not 20 ±0.032 mA.

NOTE
Under operating conditions that subject the transmitter to temperature extremes or significant vibration, mechanical backlash may occur in the zero and span adjustment screws. To improve the accuracy of zero and span settings in these circumstances, back off the adjustment screws slightly after final adjustment to break contact between the potentiometer blades and the adjustment screw slot surfaces.

ELEVATED OR SUPPRESSED ZEROS

Non-zero based calibrations are termed as having elevated or suppressed zeros. Calibrations that have a lower calibrated value below zero are termed elevated. Compound ranges are included in this category. Calibrations that have a lower calibrated value above zero are termed suppressed.

The easiest way to calibrate transmitters with elevated or suppressed zeros is to perform a zero based calibration and then elevate or suppress the zero by adjusting the zero adjustment screw.

Model 1151LT Range 4 Suppression Example: For a desired calibration of 20 to 120 inH_2O proceed as follows:

1. Calibrate the transmitter to 0 to 100 inH_2O as described in the zero and span adjustment information.
2. Apply 20 inH_2O to the high side process connection and adjust the zero until transmitter output reads 4 mA. Do not use the span adjustment.

Model 1151LT Range 4 Elevation Example: For a calibration of –120 to –20 inH_2O, proceed as follows:

1. Calibrate the transmitter to 0 to 100 inH_2O as described in the zero and span adjustment information.
2. Apply 120 inH_2O to the low side process connection and adjust the zero until transmitter output reads 4 mA. Do not use the span adjustment.

NOTE
For large amounts of elevation or suppression, it may be necessary to reposition the ELEVATE/SUPPRESS ZERO jumper. To do this, remove the amplifier board and move the jumper to the ELEVATE or SUPPRESS position as required.

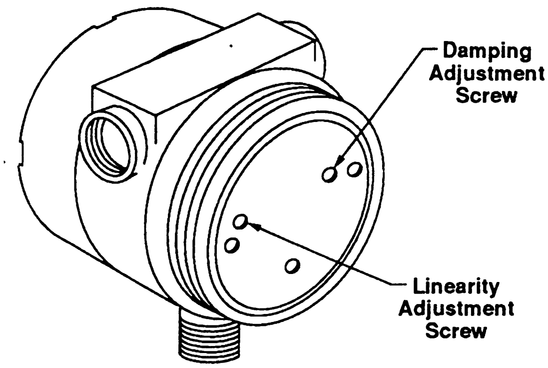
LINEARITY ADJUSTMENT

In addition to the span and zero adjustments, a linearity adjustment screw is located on the solder side of the amplifier board. See Figure 1-7. This is a factory calibration adjusted for optimum performance over the calibrated range of the instrument and is not normally adjusted in the field. The user may, however, maximize linearity over a particular range with the following procedure:

1. Apply mid-range pressure and note the error between theoretical and actual output signal.
2. Apply full-scale pressure. Multiply the error noted in step 1 times six and then that product times the range down factor, which is calculated as shown below.

   $$\text{range down factor} = \frac{\text{max. allowable span}}{\text{calibrated span}}$$

   Add the result to the full scale output for negative errors, or subtract the result from the full-scale output for positive errors, by turning the control



Access to linearity and damping adjustments is gained by removing cover on circuit board side.

Location of linearity adjustment screws may vary slightly between output codes. B output has no damping adjustment screw.

FIGURE 1-7. Damping and Linearity Adjustment Screws.

marked "linearity." See Figure 1-7. Example: At 4-to-1 range down the mid-scale point is low by 0.05 mA. Therefore, turn the linearity control until full-scale output increases by (0.05 mA × 6 × 4) = 1.2 mA.

3. Readjust zero and span.

DAMPING ADJUSTMENT

The amplifier boards are designed to permit damping of rapid pulsations in the pressure source by adjusting the control marked "Damping" located on the solder side of the amplifier board. See Figure 1-7. The settings available provide time constant values between 0.2 seconds and 1.66 seconds. The instrument is calibrated and shipped with this control set at the counterclockwise stop, giving a 0.2 second time constant. It is recommended that the shortest possible time constant setting be selected. Since the transmitter calibration is not influenced by the time constant setting, the damping may be adjusted with the transmitter connected to the process. Turn the damping control clockwise until the desired damping is obtained.

CAUTION
The damping control has positive stops at both ends. Forcing it beyond the stops may cause permanent damage.

HAZARDOUS LOCATIONS

In order to maintain the explosion-proof rating for the installed transmitter, the following conditions must be met (see Functional Specifications for approved locations):

- Ensure that covers are on hand-tight, and that the threads are not damaged.
- Screw the sensor—if sensor-mounted—into the electrical housing with at least five threads engaged.
- Install conduits with appropriate seals, and in accordance with established codes.
- Close any unused conduit connection with a threaded metal plug. Ensure that at least five threads are engaged.
- Inspect the sealing barrier between the circuit side and the terminal side of the electronics housing. The barrier must not be damaged and the terminal blocks must be intact.
- The retaining clips on the external span and zero adjustment screws must be in place. Refer to Functional Specifications for a list of hazardous location approvals.

In hazardous areas, intrinsic safety installations are often preferred over explosion-proof installations. In this type of installation, the transmitter and sensor are located in a hazardous area, and the current signal leads are connected to equipment in a non-hazardous area through intrinsic safety barriers that limit the voltage and current fed into the hazardous area. Installation must be made in accordance with the barrier manufacturer's instructions for the specific barrier used.

Section 2
OPERATION

INTRODUCTION

This section describes the basic operation of the Model 1151LT Liquid Level Transmitter. The block diagram in Figure 2-1 illustrates the operation of the Rosemount Model 1151 Series Pressure Transmitter system.

The following theory of operation description describes each of the functional parts of the Model 1151LT for both E and G output options.

THEORY OF OPERATION

This theory of operation information describes the functional parts of a Rosemount Model 1151LT Transmitter. Refer to Figure 2-1, which is a block diagram that illustrates the relationship of these parts. Figures 4-3 and 4-4 are schematic diagrams located in the Specifications and Reference Data Section of this manual. These schematics are for reference use only.

δ-CELL™ SENSOR

The δ-Cell is a variable capacitance sensing element in the Rosemount Model 1151 Series Pressure Transmitters. See Figure 2-2.

This sensor is a completely sealed capacitance sensing element that allows direct electronic sensing of pressure-induced diaphragm deflection. Differential capacitance between the sensing diaphragm and the capacitor plates is electronically converted to a two-wire, 4–20 mA dc or 10–50 mA dc signal.

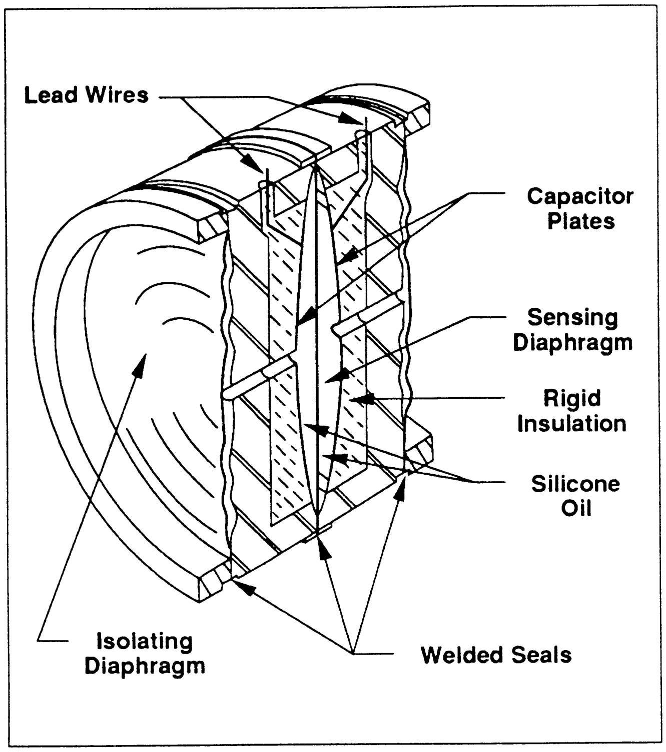


FIGURE 2-2. The δ-Cell.

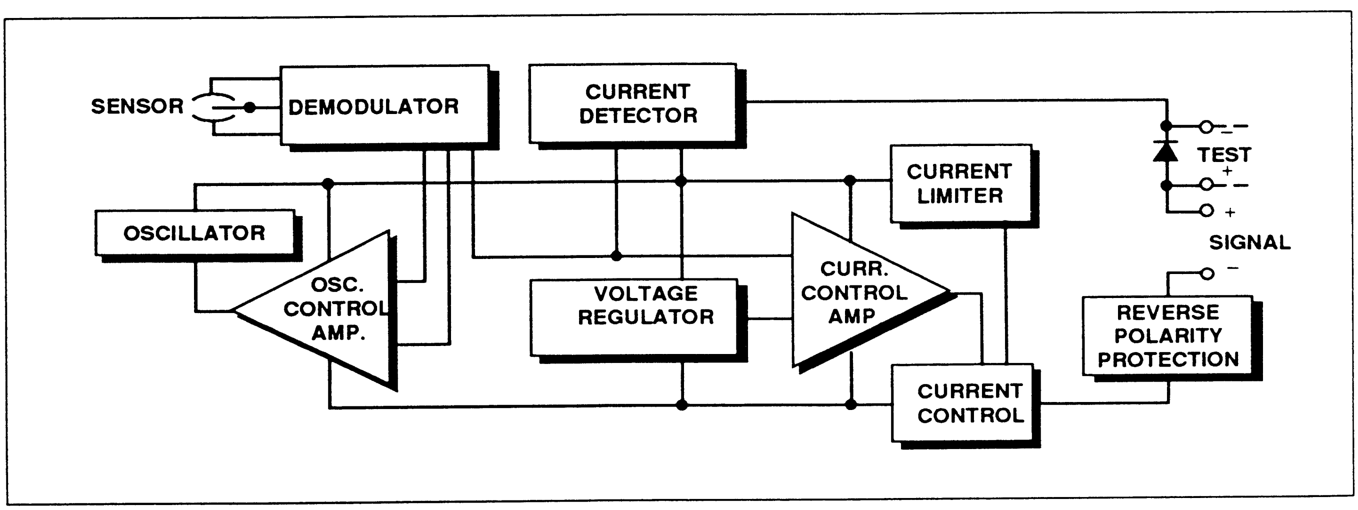


FIGURE 2-1. Model 1151LT Block Diagram.

This approach is based on the following concepts:

1. $P = K_1 \dfrac{C_1 - C_2}{C_1 + C_2}$

   Where:

   - P is the process differential pressure.
   - K_1 is a constant.
   - C_1 is the capacitance between the high pressure side and the sensing diaphragm.
   - C_2 is the capacitance between the low pressure side and the sensing diaphragm.

2. $fV_{p\text{-}p} = \dfrac{I_{ref}}{C_1 + C_2}$

   Where:

   - I_{ref} is the current source.
   - $V_{p\text{-}p}$ is the peak-to-peak oscillation voltage.
   - f is the oscillation frequency.

3. $I_{diff} = fV_{p\text{-}p}(C_1 - C_2)$

   Where:

   - I_{diff} is the difference in current between C_1 and C_2.

4. $I_{sig} = K_2 \times I_{diff}$

   Where:

   - I_{sig} is the signal current.
   - K_2 is a constant.

   Therefore:

$$I_{sig} = K_2 I_{ref} \frac{C_1 - C_2}{C_1 + C_2} = \text{Constant} \times P.$$

Process pressure is transmitted through an isolating diaphragm and oil fill fluid to a sensing diaphragm located in the center of the δ-Cell. The reference pressure is transmitted similarly to the other side of the sensing diaphragm. The sensing diaphragm moves to a position which is proportional to the difference in pressure.

The position of the sensing diaphragm is detected by the capacitance plates on both sides of the sensing diaphragm. The capacitance between the sensing diaphragm and either capacitor plate is approximately 150 pf. The sensor is driven by an oscillator, at roughly 32 kHz and 30 Vp-p. It is then rectified through a demodulator.

DEMODULATOR

The demodulator consists of a diode bridge D1-D8, which rectifies the ac signal. See Figure 4-3 or 4-4 in the Specifications and Reference Data Section of this manual.

The dc currents through transformer windings 1–12 and 3–10 are summed and controlled to be a constant by IC1 in the oscillator control amplifier. The net dc current through transformer winding 2–11 is directly proportional to pressure as shown in the following equation:

$$I_{diff} = fV_{p\text{-}p}(C_1 - C_2)$$

The diode bridge and span temperature compensating thermistor are located inside the sensor module. The effect of the thermistor is controlled by resistors R4 and R5 located in the electronics housing.

OSCILLATOR CONTROL AMPLIFIER

A differential amplifier functioning as the oscillator control amplifier supplies a variable voltage to the oscillator. The amplifier's output voltage must be adjusted to ensure a proper excitation voltage on the sensor's capacitor plates.

IC1 is used in a feedback control circuit and controls the oscillator drive voltage such that:

$$fV_{p\text{-}p} = \frac{I_{ref}}{C_1 + C_2}$$

OSCILLATOR

The oscillator has a frequency determined by the capacitance of the sensing element and the inductance of the transformer windings. The oscillator consists of components Q1, T1, C19, C20, R29 and R30. The sensing element capacitance varies with pressure. Therefore, the frequency varies about a nominal value of 32 kHz. IC1 is used as a feedback control circuit and controls the oscillator drive voltage such that:

$$fV_{p\text{-}p} = \frac{I_{ref}}{C_1 + C_2}$$

CURRENT CONTROL AMPLIFIER

The E option current control amplifier consists of IC3, Q3, Q4, and associated components. The G option current control amplifier consists of IC2, Q3, Q4, and associated components.

The E option IC reference voltage is established at the junction of R10 and R13. The G option IC reference voltage is established by voltage dividers for 6.4 V dc.

CURRENT CONTROL AND CURRENT DETECTOR

The current control amplifier drives the current control to a level that causes the current detector to feed back a signal through R34 equal to the sum of the zero current and the variable sensor current.

The current control consists of Q3, Q4, Q5, and associated components. The Q5 portion of the circuit assures sufficient current flow during start-up. The current detector consists of R31, R32, and R33.

CURRENT LIMITER

The current limiter prevents excessively high output currents in case of overpressure. The components and maximum outputs for E and G options follow:

E Option: The current limiter consists of R18, D13, and Q2. Maximum output is approximately 30 mA.

G Option: The current limiter consists of R15, D14, D15, and Q2. Maximum output is approximately 90 mA.

REVERSE POLARITY PROTECTION

Reverse polarity protection is provided by diode D14 except when an integral meter is connected across the test terminals. In this case, diode D13 provides limited protection for the E output option. Diode D15 provides reverse polarity protection for the G output option.

VOLTAGE REGULATOR

The voltage regulator circuits provide a supply voltage and a constant reference voltage. Specific E and G option circuit descriptions follow:

E Option: A 4–20 mA (E) output transmitter uses zener diode D11, transistor Q2, and resistors R15, R43, and R16 to provide a constant voltage of 6.4 V dc for the reference and 7 V dc to supply the oscillator, IC1, IC2, and IC3.

G Option: A 10–50 mA (G) output transmitter uses zener diode IC3, IC1 (section C), transistors Q6 and Q7, and resistors R42 through R48 to provide a constant voltage of 6.4 V dc for the reference and to supply the oscillator, IC1 and IC2. Diode D12 establishes an approximate operating point for IC1. Diode D16 provides reverse bias protection for Q6.

ZERO ELEVATION AND SUPPRESSION

Zero adjustment components consist of potentiometer R35 and resistor R36, which develop a separate adjustable current that sums with the sensor current.

Resistors R20 or R21 may be switched in by SW1 to add another fixed zero current, shifting the range of zero adjustment to allow larger amounts of suppression or elevation.

DAMPING ADJUSTMENT

A signal that is proportional to the output current's rate of change is fed from the damping circuit back to the current control amplifier. This feedback is provided by capacitor C22 and potentiometer R12. The setting of R12 determines the amount of feedback and, consequently, the amount of damping. As the amount of resistance between pins one and two of R12 increases, so do the damping and the time constant of the output response to a change in input pressure.

SPAN ADJUSTMENT

Span adjustment is performed with potentiometer R32, which determines the amount of sensed output current that is sensed and fed back to the current control amplifier IC3.

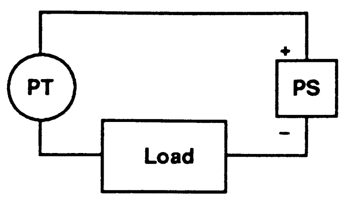
LINEARITY ADJUSTMENT

Linearity is adjusted by a variable resistance network (R20, R22, and R23), diodes D9 and D10, and capacitor C3. The currents generated through this part of the circuit are summed into the inputs of the oscillator control circuit. This provides a programmed correction which raises the oscillator peak-to-peak voltage to compensate for first order nonlinearity of capacitance as a function of pressure.

FILTER FOR FAST SAMPLE COMPUTERS

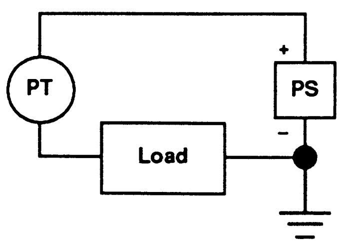
The sensor requires alternating current to generate a capacitance signal. Alternating current is developed in an oscillator circuit with a frequency of approximately 32 kHz. This signal is capacitor-coupled to transmitter-case ground through the sensor. Because of this coupling, a voltage may be imposed across the load, depending on choice of grounding. See Figure 2-3.

This impressed voltage, which is seen as high frequency noise, will not affect most instruments. However, computers with short sampling times may respond to this noise. If the current loop circuit is wired and grounded as shown in Figures 2-3a through 2-3c, the noise effects should be negligible. Current loop circuits as in Figure 2-3d could detect a significant noise signal. In this case, use a large capacitor (1 μF) or a 32 kHz LC filter across the load to filter out noise.



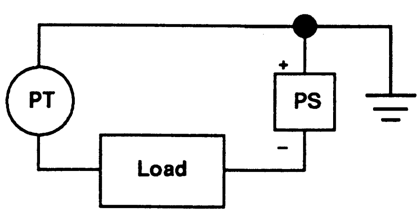
2-3a. Ungrounded System

Impressed Voltage: 12 to 22 mV_{p-p}
32 kHz
Effect: 0.01% of span, max.



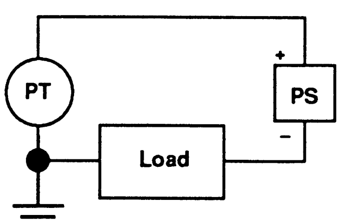
2-3b. Ground Between Negative Side of Power Supply and Load

Impressed Voltage: 35 to 60 mV_{p-p}
32 kHz
Effect: 0.03% of span, max.



2-3c. Ground Between Positive Side of Transmitter and Power Supply

Impressed Voltage: 35 to 60 mV_{p-p}
32 kHz
Effect: 0.03% of span, max.



2-3d. Ground Between Negative Terminal of Transmitter and Load

Impressed Voltage: 500 to 600 mV_{p-p}
32 kHz
Effect: 0.27% of span, max.

*The effect caused by the impressed voltage on a computer with a sampling time of 100 microseconds using a 2 to 10 volt signal.

FIGURE 2-3. Effects of Grounding on Accuracy for Fast Sample Computers.*

Section 3
MAINTENANCE

INTRODUCTION

The Model 1151 Series has no moving parts and requires little maintenance. Calibration procedures for adjusting and changing ranges are outlined in the calibration information of Section 1.

Test terminals are available for in-process checks. For bench checks, the transmitter can be divided into three active physical components: the sensor module, amplifier board, and the calibration board.

This section outlines a technique for checking components, disassembly instructions, and a troubleshooting guide.

WARNING
Use only the procedures and new parts specifically referenced in this manual to ensure specification performance and certification compliance. Unauthorized procedures or parts can render the instrument dangerous to life, limb, or property.

Section 4 includes dimensional drawings, an exploded view drawing, schematic diagrams, and a parts list. Figure 4-2 illustrates the locations of parts with numbers in parentheses.

TEST TERMINALS

Test terminals are connected across a diode through which the loop signal current passes. A plug-in meter or test equipment shunts the diode when connected to the test terminals. No current passes through the diode if voltage across the terminals is kept below the diode threshold voltage.

To avoid leakage current through the diode when making a test reading, or when a meter is connected, keep the resistance of the test connection or meter below 10 ohms on 4–20 mA dc units, or 4 ohms on 10–50 mA dc units. Resistance values three times greater than these will cause less than 1% error, however. The test terminals are bored to accept a miniature banana plug (Pomona 2944, 3690, or equivalent).

SENSOR MODULE CHECKOUT

The sensor module is not field repairable and must be replaced if found to be defective. If no obvious defect is observed (such as a punctured process diaphragm or fill fluid loss) the sensor module can be checked as follows. Refer to Figure 4-2 for part references in parentheses.

1. Carefully pull the header assembly board (16) off of the post connectors. Rotate the board 180 degrees about the axis formed by the connecting leads. The sensor module and electronics housing can remain attached for checkout.
2. Check internal diode loops, forward and reverse bias: one loop is on pins one and two, the other is on pins three and four. See Figure 3-1.

NOTE
Do not touch the transmitter housing when checking resistances or a faulty reading will result.

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3. Check the resistance between the sensor module housing and pins 1 through 4. This checks the resistance between both capacitor plates and the sensing diaphragm, which is grounded to the housing. This resistance should be greater than 10 megohms.
4. Check the resistance between pin 8 and the sensor module to ensure that the module is grounded. Resistance should be zero.

NOTE
The above procedure does not completely test the sensor module. If circuit board replacement does not correct the abnormal condition, and no other problems are obvious, replace the sensor module.

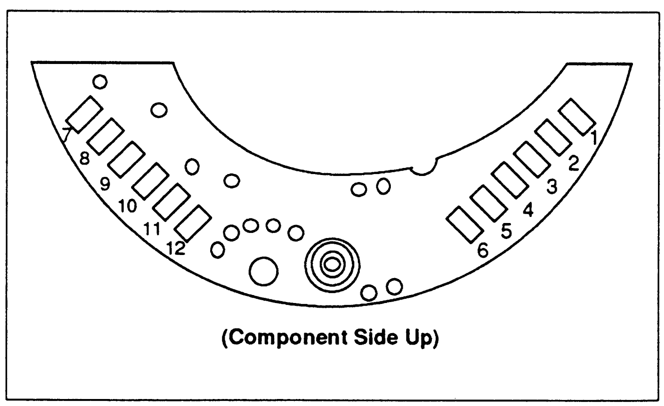


FIGURE 3-1. Header Board Connections.

CIRCUIT BOARD CHECKOUT

The printed circuit boards (11 and 13) can most easily be tested by substituting a spare into the circuit.

The schematic diagram and parts list in Section 4 may be referenced to isolate a failure on the board. A functional block diagram and a discussion of each function is included in the preceding Theory of Operation information of Section 2.

DISASSEMBLY PROCEDURE

Read the following information carefully before you disassemble the transmitter. Numbers in parentheses refer to item numbers in Figure 4-2.

CAUTION
The Model 1151LT process flanges cannot be removed. Attempting to remove them will result in fill fluid loss, transmitter failure, and loss of warranty. If a problem is suspected with the diaphragm and sensor module assembly (24) please return complete transmitter to the nearest Rosemount service location for troubleshooting and maintenance.

ELECTRONICS HOUSING DISASSEMBLY

Electrical connections are located in a compartment identified as TERMINAL SIDE on the nameplate. The signal and test terminals are accessible by unscrewing the cover (1) on the terminal side. The terminals are permanently attached to the housing and must not be removed. Terminal removal will break the housing seal between compartments.

CAUTION
Do not break the housing seal. Doing so will invalidate the explosion-proof housing rating.

Circuit boards are located in a separate compartment identified as CIRCUIT SIDE on the nameplate. Circuit boards are accessible by removing transmitter power and unscrewing the cover (1) on the circuit side.

CAUTION
Remove transmitter power when changing circuit boards.

The 4–20 mA dc amplifier board (13) may be disconnected by removing three holding screws (14). The 10–50 mA dc board has one additional screw that is captive to it and is removed last.

The header assembly board (16) is permanently attached to the sensor module (24) and contains temperature compensating resistors. There is enough slack wire to pull this board off of the post connectors and out off the way for access to the calibration board (11).

The calibration board (11) may be disconnected by removing the three standoffs (12) and aligning the zero and span adjustment screws so that they are perpendicular to the board. The board may be removed by pulling up on the board's interference pin.

The zero and range adjustment screws (4) may be removed by removing the nameplate (8) and detaching the snap rings (6). The connection board is soldered to the terminal posts.

REMOVING SENSOR MODULE FROM ELECTRICAL HOUSING

The diaphragm and sensor module assembly (24) can be removed directly from the electronics housing (3) by the following procedure:

1. Remove transmitter from service.
2. Remove the amplifier board (13) and calibration board (11) as described in the preceding electronic housing disassembly instructions.
3. Loosen the lock nut (17).
4. Carefully unscrew the sensor module (24) from the electronic housing (3), without damaging the sensor leads. The threaded connection has a sealing compound that must be broken loose.
5. Carefully pull the header assembly board through the housing connection hole.

CAUTION
Do not scratch or puncture the process diaphragm when unscrewing the sensor module.

NOTE
The process diaphragm may be cleaned with a soft rag, mild cleaning solution, and clear water rinse. Do not use chlorine or acid solutions.

REASSEMBLY PROCEDURE

Follow these procedures carefully to ensure proper reassembly. Refer to Figure 4-2 for part references.

PRELIMINARY

Inspect all O-rings and replace if necessary. Lightly grease with silicone oil to ensure a good seal. Use an inert grease for inert fill options.

Inspect threaded connections to ensure five undamaged threads will fully engage for explosion-proof requirements.

SENSOR MODULE CONNECTION

1. Insert header assembly board (16) through the small hole in the electronic housing.
2. Apply a sealing compound such as Loctite 222—Small Screw Threadlocker, Rosemount P/N C12728-0202 to the diaphragm and sensor module assembly threads (24) to ensure a watertight housing seal.
3. Screw the diaphragm and sensor module assembly (24) into the electronic housing (3). Ensure that five full threads are engaged.
4. Tighten the lock nut (17).

ELECTRONICS HOUSING ASSEMBLY

1. Make sure that the circuit boards are clean.
2. Make sure that O-rings and snap rings are secure on the zero and span adjustment screws (4).

WARNING
Snap rings must be in place for explosion-proof operation.

3. Make sure that the post connectors on the connection board are clean.
4. Align the zero and span adjustment screws with the potentiometers on the calibration board (11) and push the calibration board onto the post connectors. Secure the calibration board with the three standoffs (12). The upper right-hand standoff grounds the electronics to the case and must be firmly in place.
5. Slide the header assembly board (16) onto the post connectors with the component side toward the pins. Slide excess wire behind the calibration board (11).
6. Push the amplifier circuit board (6) onto the post connectors and secure with the three holding screws (14).

OPTIONAL PLUG-IN METER

An optional indicating meter is available for Model 1151LT transmitters. Be aware of the following information during meter assembly. See Figure 4-6 for meter illustration.

- The meter may be rotated in 90-degree increments for convenient reading.
- If the meter is removed, ensure that the O-ring (2) is in place between the cover and housing before reattachment. To maintain an explosion-proof condition, the glass in the meter cover should not be disassembled.

WARNING
Disassembling the meter cover glass will invalidate the explosion-proof meter rating.

NOTE
The meter needle may not rest on the zero index when power is removed. This does not indicate a faulty meter.

INTERCHANGE OF PARTS

Mechanical hardware such as electronics housings and covers are interchangeable among Model 1151LT units without regard to range or calibration.

CAUTION
The Model 1151LT process flanges cannot be removed. Attempting to remove them will result in fill fluid loss, transmitter failure, and loss of warranty. If a problem is suspected with the diaphragm and sensor module assembly (24) please return complete transmitter to the nearest Rosemount service location for troubleshooting and maintenance.

Interchange of electronics and sensors is subject to the following conditions:

- Plug-in meters may be added to units or interchanged among units without regard to range, but cannot be interchanged between 4–20 and 10–50 mA dc units.
- Amplifier boards (13) and calibration boards (11) are interchangeable among units without regard to range for Models 115HP, 1151DP, 1151GP, 1151AP, and 1151LT. The amplifier and calibration boards determine the output signal of the transmitter; therefore, output may be changed by changing board sets. Recalibration will be required after interchanging boards.
- The header assembly board (16) is permanently attached to the sensor module and is not interchangeable.

RETURN OF MATERIAL

To expedite the return process, call the Rosemount National Response Center using the 800-654-RSMT (7768) toll-free number. This center, available 24 hours a day, will assist you with any needed information or materials.

The center will ask for product model and serial numbers, and will provide a Return Material Authorization (RMA) number. The center will also ask for the name of the process material the product was last exposed to.

CAUTION
People who handle products exposed to a hazardous substance can avoid injury if they are informed and understand the hazard. If the product being returned was exposed to a hazardous substance as defined by OSHA, a copy of the required Material Safety Data Sheet (MSDS) for each hazardous substance identified must be included with the returned goods.

The Rosemount National Response Center will detail the additional information and procedures necessary to return goods exposed to hazardous substances.

TROUBLESHOOTING

In case of a transmitter malfunction, the troubleshooting procedures in Table 3-1 will help isolate the problem and its source. These procedures will also allow you to determine if the transmitter can be repaired on-site. This information is intended to help diagnose and repair problems related to three primary malfunction symptoms. Under each symptom are procedures for checking conditions that could be causing the symptom. Select the symptom most closely resembling the symptom displayed by your unit. Always deal with the most likely and easiest-to-check conditions first.

WARNING
Isolate a failed transmitter from its pressure source as soon as possible. Pressure that may be present could cause serious injury to personnel if the transmitter is disassembled or ruptured under pressure.

Return defective transmitters to Rosemount Inc. See the Return of Material information in this section for instructions.

TABLE 3-1. Troubleshooting.

Symptom	Potential Source	Corrective Action
High Output	Primary Element	Check for restrictions at primary element.
	Impulse Piping	Check for leaks or blockage. Check that blocking valves are fully open. Check for entrapped gas in liquid lines and for liquid in dry lines. Check that density of fluid in impulse lines is unchanged. Check for sediment in transmitter process flanges.
	Transmitter Electronics Connections	Check for shorts in sensor leads. Make sure post connectors are clean and check the sensor connections. Check that post connector #8 is properly grounded to the case. See Figure 3-1.
	Transmitter Electronics Failure	Determine faulty circuit board by trying spare boards. Replace faulty circuit board.
	Sensor Module	See Sensor Module Checkout information in this section.
	Power Supply	Check output of power supply.
Erratic Output	Loop Wiring	**CAUTION: Do not use over 100 volts to check the loop.** Check for adequate voltage to the transmitter. Check for intermittent shorts, open circuits, and multiple grounds. E output: 12 to 45 V dc. G output: 30 to 85 V dc.
	Process Fluid Pulsation	Adjust electronic damping pot.
	Impulse Piping	Check for entrapped gas in liquid lines and for liquid in dry lines.
	Transmitter Electronics Connections	Check for intermittent shorts or open circuits. Make sure post connectors are clean and check the sensor connections. Check that post connector #8 is properly grounded to the case. See Figure 3-1.
	Transmitter Electronics Failure	Isolate faulty circuit board by trying spare boards. Replace faulty circuit board.
Low Output or No Output	Primary Element	Check installation and condition of element. Note any changes in process fluid properties which may affect output.
	Loop Wiring	**CAUTION: Do not use over 100 volts to check the loop.** Check for adequate voltage to transmitter. Check for shorts and multiple grounds. Check polarity of connections. Check loop impedance. E output: 12 to 45 V dc. G output: 30 to 85 V dc.

TABLE 3-1. Troubleshooting - Continued.

Symptom	Potential Source	Corrective Action
Low Output or No Output (continued)	Impulse Piping	Check that pressure connection is correct. Check for leaks or blockage. Check for entrapped gas in liquid lines. Check for sediment in transmitter process flange. Check that blocking valves are fully open and that bypass valves are tightly closed. Check that density of fluid in impulse lines is unchanged.
	Transmitter Electronics Connections	Check to see that calibration adjustments are in control range. Check for shorts in sensor leads. Make sure post connectors are clean and check the sensor connections. Check that post connector #8 is properly grounded to the case. See Figure 3-1.
	Transmitter Electronics Failure	Isolate faulty circuit board by trying spare boards. Replace faulty circuit board.
	Test Diode Failure	Replace test diode or jumper terminals.
	Sensor Module	See Sensor Module Checkout information in this section.

Section 4

SPECIFICATIONS AND REFERENCE DATA

INTRODUCTION

This section contains specifications, option ordering information, schematics, parts lists, and CSA Intrinsic Safety Approvals for the Rosemount Model 1151LT Transmitter.

SPECIFICATIONS

FUNCTIONAL SPECIFICATIONS

Service

Liquid in open or closed tanks.

Ranges

0–25 to 0–150 inH_2O (0–635 to 0–3,810 mmH_2O).

0–125 to 0–750 inH_2O (0–3,175 to 0–19,050 mmH_2O).

0–471 to 0–2,770 inH_2O (0–11.96 to 0–70.36 mH_2O).

Outputs

4–20 or 10–50 mA dc.

Smart 4–20 mA dc. (See Product Data Sheet PDS 4593).

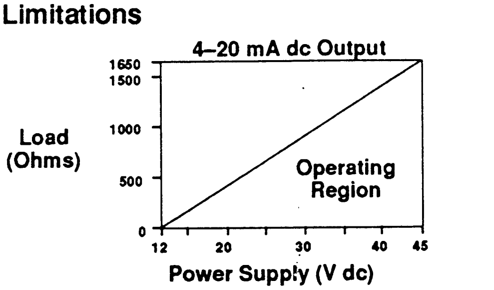
Power Supply

External power supply required.

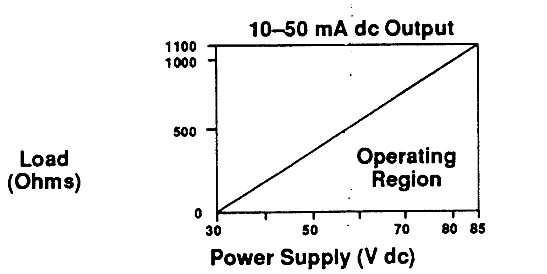
4–20 mA dc transmitter operates on 12–45 V dc with no load.

10–50 mA dc transmitter operates on 30–85 V dc with no load.

Load Limitations



Maximum Load = 50 (Power Supply Voltage –12)



Maximum Load = 20 (Power Supply Voltage –30)

Indication Options

Analog Meter, 2-in. scale (50.8 mm):
Indication accuracy is ±2% of calibration.

Digital Meter, 4-digit:
Indication accuracy is 0.25% of calibrated range ±1 digit. Display resolution is 0.05% of calibrated range ±1 digit.

Approvals

Factory Mutual (FM) Approvals, Standard

FM Explosion Proof tag standard. Appropriate tag will be substituted if optional certification is selected.

Explosion Proof: Class I, Division 1, Groups B, C, and D. Dust-Ignition Proof: Class II, Division 1, Groups E, F, and G. Suitable for use in: Class III, Division 1. Indoor and outdoor use. NEMA 4X.

I5 Intrinsic Safety Approvals FM certifications optional for specific Classes, Divisions, and Groups when connected with approved barrier systems. See summary in PDS 2360.

Canadian Standards Association (CSA) Approvals

E6 Certified for Class I, Division 2, Groups A, B, C, and D. Class I, Division 1, Groups C and D; Class II, Divisions 1 and 2, Groups E, F, and G; Class III hazardous locations; CSA enclosure 4, factory sealed.

I6 Intrinsic Safety Approvals CSA certifications optional for specific Classes, Divisions, and Groups when connected with approved barrier systems. See summary in PDS 4360.

Span and Zero

Continuously adjustable externally.

Zero Elevation and Suppression

Regardless of output specified, zero elevation and suppression must be such that neither the span nor the upper or lower range value exceeds 100% of the upper range limit.

Maximum zero elevation: 600% of calibrated span.

Maximum zero suppression: 500% of calibrated span.

High-Side Temperature Limits

(at atmospheric pressure and above)

–20 to 200 °F (–29 to 93 °C) Amplifier operating.

–40 to 300 °F (–40 to 149 °C) With silicone oil fill.

–50 to 400 °F (–45.6 to 204 °C) With inert fill.

–50 to 400 °F (–45.6 to 204 °C) With Syltherm 800® fill (100 °F or 37.8 °C ambient).

0 to 200 °F (–17.7 to 93 °C) With glycerin and water.

32 to 400 °F (0 to 204 °C) With Neobee M-20®.

20 to 200 °F (–7 to 93 °C) with propylene glycol and water.

Static Pressure Limits

Class 150 Flanges

6 psia to 275 psi at 100 °F (41.37 kPa to 1.89 MPa at 37.8 °C); except atmospheric to 275 psi at 100 °F (38 °C) with glycerin and water, and propylene glycol and water.* Below 6 psia, see Option W5.

Class 300 Flanges

6 psia to 720 psi at 100 °F (41.37 kPa to 4.96 MPa at 37.8 °C); except atmospheric to 720 psi at 100 °F (38 °C) with glycerin and water, and propylene glycol and water.* Below 6 psia, see Option W5.

*For less than atmospheric, consult factory.

Humidity Limits

0–100% relative humidity.

Volumetric Displacement

Less than 0.01 in^3 (0.16 cm^3).

Damping

Time constant continuously adjustable between 0.4 and 2.2 seconds with silicone oil fill, or 1.1 and 2.7 seconds with inert fill for flush models and electronics codes E or G.

Turn-On Time

Two seconds. No warm-up required.

PERFORMANCE SPECIFICATIONS

(Zero-based spans, reference conditions, silicone oil fill, 316L SST isolating diaphragms)

Accuracy

±0.25% of calibrated span. Includes combined effects of linearity, hysteresis, and repeatability.

Stability

±0.25% of upper range limit for six months.

Temperature Effect

At maximum span for Range 4:

Zero Error: ±0.75% of span per 100 °F (55.6 °C).

Total effect including span and zero errors: ±1.5% of span per 100 °F.

At minimum span for Range 4:

Zero Error: ±4.5% of span per 100 °F (55.6 °C).

Total effect including span and zero errors: ±5.25% of span per 100 °F.

Vibration Effect

±0.05% of upper range limit per g to 200 Hz in any axis.

Power Supply Effect

Less than 0.005% of output span per volt.

Load Effect

No effect other than the change in power supplied to the transmitter.

Mounting Position Effect

With liquid level diaphragm in vertical plane, zero shift of up to 1 inH_2O (25.4 mmH_2O). With diaphragm in horizontal plane, zero shift of up to 5 inH_2O (127 mmH_2O) plus extension length on extended units. All zero shifts can be calibrated out. No effect on span.

PHYSICAL SPECIFICATIONS

Materials of Construction

Process and reference diaphragms, including process gasket surface:

316L SST, Hastelloy C-276, or tantalum.

Extension

316 SST or Hastelloy C®. Fits schedule 40 and 80 pipe.

Drain/Vent Valve

316 SST or Hastelloy C.

Wetted O-Rings

Viton® (other materials also available).

Reference (Low Side) Flange and Adapter

Cadmium- or nickel-plated carbon steel, 316 SST, or Hastelloy C.

Mounting Flange

Zinc-plated carbon steel. Other materials available.

Fill Fluid

Low-pressure side: Silicone oil or inert fill.

High-pressure side: Silicone, inert, glycerin and water, Syltherm 800, Neobee M-20, or propylene glycol and water.

Electronics Housing

Low-copper aluminum (NEMA 4X).

Paint

Epoxy-polyester.

Process Connections

High-pressure side: 3- or 4-in., Class 150 or 300 flange.

Low-pressure side: 1/4–18 NPT on flange. 1/2–14 NPT on adapter.

Electrical Connections

1/2-in. conduit with screw terminals and integral test jacks compatible with miniature banana plugs (Pomona 2944, 3690, or equivalent).

Weight, lb (kg)

Flange	Flush	2-in. Ext.	4-in. Ext.	6-in. Ext.
2-in., Class 150	24 (10.9)	N/A	N/A	N/A
2-in., Class 300	29 (13.1)	N/A	N/A	N/A
3-in., Class 150	23 (10.4)	25 (11.3)	26 (11.7)	27 (12.2)
4-in., Class 150	29 (13.1)	32 (14.4)	34 (15.4)	36 (16.3)
3-in., Class 300	28 (12.6)	30 (13.6)	31 (14.0)	32 (14.4)
4-in., Class 300	38 (17.2)	41 (18.5)	43 (19.5)	45 (20.4)

Meter Option: Add 2 lb (1 kg).

TABLE 4-1. Design Specifications for Model 1151LT Liquid Level Transmitters.

MODEL 1151LT	ALPHALINE FLANGE-MOUNTED LIQUID LEVEL TRANSMITTER

CODE	RANGE
4	0–25 to 0–150 inH_2O (0–635 to 0–3810 mmH_2O)
5	0–125 to 0–750 inH_2O (0–3175 to 0–19050 mmH_2O)
6	0–471 to 0–2770 inH_2O (0–11.96 to 0–70.36 mH_2O)

CODE	OUTPUT
E	4–20 mA dc, with adjustable damping
G	10–50 mA dc, with adjustable damping
S	1151 Smart 4–20 mA dc electronics (See PDS 2593)

CODE	SIZE	EXTENSION LENGTH	HIGH SIDE ISOLATIOR AND EXTENSION MATERIAL
G0	2 in.	Flush	316L SST
H0	2 in.	Flush	*Hastelloy C-276*
J0	2 in.	Flush	Tantalum
A0	3 in.	Flush	316L SST
A2	3 in.	2 inches (50.8 mm)	316L SST
A4	3 in.	4 inches (101.6 mm)	316L SST
A6	3 in.	6 inches (152.4 mm)	316L SST
B0	4 in.	Flush	316L SST
B2	4 in.	2 inches (50.8 mm)	316L SST
B4	4 in.	4 inches (101.6 mm)	316L SST
B6	4 in.	6 inches (152.4 mm)	316L SST
C0	3 in.	Flush	*Hastelloy C-276*
C2	3 in.	2 inches (50.8 mm)	*Hastelloy C-276*
C4	3 in.	4 inches (101.6 mm)	*Hastelloy C-276*
C6	3 in.	6 inches (152.4 mm)	*Hastelloy C-276*
D0	4 in.	Flush	*Hastelloy C-276*
D2	4 in.	2 inches (50.8 mm)	*Hastelloy C-276*
D4	4 in.	4 inches (101.6 mm)	*Hastelloy C-276*
D6	4 in.	6 inches (152.4 mm)	*Hastelloy C-276*
E0	3 in.	Flush	Tantalum
F0	4 in.	Flush	Tantalum

(G0, H0:) A lower housing must be chosen from the flushing code option information.

NOTE
Except for unusual applications, Rosemount Inc. does not recommend using SST material on the high side isolator (Codes A0, A2, A4, A6, B0, B2, B4, B6, or G0) with tantalum or Hastelloy material on the low side isolator (Codes 55, 23, 25, 33, 35, 5D, 2B, 2D, 3B, or 3D).

CODE	MOUNTING FLANGE
A	3-in., class 150 CS, for use with A, C, and E size codes
B	4-in., class 150 CS, for use with B, D, and F size codes
C	3-in., class 300 CS, for use with A, C, and E size codes
D	4-in., class 300 CS, for use with B, D, and F size codes
M	2-in., class 150 CS, for use with G, H, and J size codes
N	2-in., class 300 CS, for use with G, H, and J size codes
F	3-in., class 150 316 SST, for use with A, C, and E size codes
G	4-in., class 150 316 SST, for use with B, D, and F size codes
H	3-in., class 300 316 SST, for use with A, C, and E size codes
J	4-in., class 300 316 SST, for use with B, D, and F size codes
X	2-in., class 150 316 SST, for use with G, H, and J size codes
Y	2-in., class 300 316 SST, for use with G, H, and J size codes

NOTE
Other materials and sizes available, consult factory.

1151LT	4	E	A0	A	22	D	F1	TYPICAL MODEL NUMBER

TABLE 4-1. Design Specifications for Model 1151LT Liquid Level Transmitters (continued).

SENSOR MODULE AND LOW-SIDE MATERIALS OF CONSTRUCTION

CODE	LOW-SIDE FLANGE AND ADAPTER	DRAIN/VENT VALVES	LOW-SIDE ISOLATOR DIAPHRAGM	LOW-SIDE FLUID FILL
12	Cad Plated CS	316 SST	316L SST	Silicone
55	Ni Plated CS	316 SST	Tantalum	Silicone
22	316 SST	316 SST	316L SST	Silicone
23	316 SST	316 SST	*Hastelloy C*	Silicone
25	316 SST	316 SST	Tantalum	Silicone
33	*Hastelloy C*	*Hastelloy C*	*Hastelloy C*	Silicone
35	*Hastelloy C*	*Hastelloy C*	Tantalum	Silicone
1A	Cad Plated CS	316 SST	316L SST	Inert
5D	Ni Plated CS	316 SST	Tantalum	Inert
2A	316 SST	316 SST	316L SST	Inert
2B	316 SST	316 SST	*Hastelloy C*	Inert
2D	316 SST	316 SST	Tantalum	Inert
3B	*Hastelloy C*	*Hastelloy C*	*Hastelloy C*	Inert
3D	*Hastelloy C*	*Hastelloy C*	Tantalum	Inert

CODE	PROCESS FILL - HIGH PRESSURE SIDE
D	Silicone
F	Inert
G	Glycerine and Water
N	*Neobee M-20*
S	*Syltherm 800*
P	Propylene glycol and water

CODE	OPTIONS (See complete Approvals descriptions)
M1	Linear meter, 0–100% scale
M3	Special scale meter, specify range
M4	LCD display, 0–100%
E6	Canadian Standards Association (CSA) Explosion-proof and nonincendive approval
I5❶	Factory Mutual (FM) Intrinsic safety and nonincendive approval
I6❶	Canadian Standards Association (CSA) intrinsic safety approval
--	Insert additional codes selected from options data sheet PDS 2360
W5	Copper O-ring for 0.5 to 6 psia operating pressure
S1	One remote seal selected from data sheet PDS 4394
F_	Select code from Lower Housing Flushing Connection Option Table

NOTE
FM explosion-proof approval is standard

❶Not available with Output Code G.

1151LT 4 E A0 A 22 D F1 TYPICAL MODEL NUMBER

TABLE 4-2. Lower Housing Flushing Connection Options.

Codes	Material	Flushing Connections	2-in.	3-in.	4-in.
F1	SST	1	•	•	•
F2	SST	2	•	•	•
F3	*Hastelloy*	1	•	•	•
F4	*Hastelloy*	2	•	•	•
FA	SST	0	•	N/A	N/A
FB	CS	0	•	N/A	N/A
FC	*Hastelloy*	0	•	N/A	N/A

TABLE 4-3. Option Ordering Information.

CODE	TRANSMITTER MODEL AND PRODUCT DATA SHEET (PDS) NUMBER	1151DP (PDS 4256)	1151DP High Differential (PDS 4257)	1151HP (PDS 4258)	1151DP Square Root (PDS 4259)	1151GP (PDS 4260)	1151GP/DP Remote Seal (PDS 4394)	1151AP (PDS 4261)	1151LT (PDS 4526)	1151DR (PDS 4294)	1151DP Low Power (PDS 4447)	1151Smart (PDS 4593)
CODE	**MOUNTING BRACKETS**											
B1	Right Angle Bracket for 2-in. Pipe Mounting	•	•	•	•	•	•	•	NA	•	•	•
B2	Right Angle Bracket for Panel Mounting	•	•	•	•	•	•	•	NA	•	•	•
B3	Flat Bracket for 2-in. Pipe Mounting	•	•	•	•	•	•	•	NA	•	•	•
B4	Bracket for 2-in. Pipe with Series 300 SST Bolts	•	•	•	•	•	•	•	NA	•	•	•
B5	Bracket for Panel with Series 300 SST Bolts	•	•	•	•	•	•	•	NA	•	•	•
B6	Flat Bracket for 2-in. Pipe with Series 300 SST Bolts	•	•	•	•	•	•	•	NA	•	•	•
B7	Series 300 SST Bracket and Bolts for 2-in. Pipe Mounting	•	•	•	•	•	•	•	NA	•	•	•
B9	Series 300 SST Flat Bracket and Bolts for 2-in. Pipe Mounting	•	•	•	•	•	•	•	NA	•	•	•
CODE	**METERS** (Not available with options V2, V3)											
M1	Integral Linear Meter, 0–100% Scale	•	•	•	•	•	•	•	•	•	NA	•
M2	Integral Square Root Meter, 0–100% Flow	•	•	•	NA	NA	NA	NA	NA	•	NA	•
M3	Special Scale Meter, Specify Range Desired	•	•	•	•	•	•	•	•	•	NA	•
M6	Square Root Meter, 0–10√‾ Scale	•	•	•	•	•	•	•	•	•	NA	•
CODE	**CERTIFICATIONS** (FM explosion-proof approval and tag are standard)											
E6	Explosion Proof, CSA	•	•	•	•	•	•	•	•	•	•	•
I5	Intrinsic Safety, FM with Foxboro, Taylor, Westinghouse, Leeds & Northrup, Honeywell, Measurement Technology, Stahl and Fisher Controls Barriers. (Intrinsic Safety Approval Not Valid With Output Code B)	•	•	•	•	•	•	•	•	•	•	•
I6	Intrinsic Safety, CSA, with Zener barriers and Foxboro converters. (Intrinsic Safety Approval Not Valid With Output Code B)	•	•	•	•	•	•	•	•	•	•	•
CODE	**BOLTS FOR FLANGES AND ADAPTERS**											
L3	ANSI 193-B7	•	•	•	•	•	•	•	•	•	•	•
L4	Austenitic 316 SST	•	•	•	•	•	•	•	•	•	•	•
CODE	**PROCESS CONNECTIONS**											
D1	Side Drain/Vent Top (Material same as flange)	•	•	•	•	•	NA	•	•	•	•	•
D2	Side Drain/Vent Bottom(Material same as flange)	•	•	•	•	•	NA	•	•	•	•	•
D3	1/4–18 NPT Process Connection	•	•	•	•	•	NA	•	•	•	•	•
D6	316 SST Low Side Flange	NA	NA	NA	NA	•	NA	•	NA	NA	NA	NA
K1	1/4–18 NPT *Kynar* Process Flange Insert*	•	•	NA	•	•	NA	•	•	•	•	•
K2	1/2–14 NPT *Kynar* Process Flange Insert*	•	•	NA	•	•	NA	•	•	•	•	•
S1	Assembly of One Remote Diaphragm Seal	•	•	NA	NA	•	•	NA	•	NA	•	•
S2	Assembly of Two Remote Diaphragm Seals	•	•	NA	NA	NA	•	NA	NA	NA	•	•
S4**	Assembly of Model 1195 Integral Orifice	•	NA	•	•	NA	NA	NA	NA	•	•	•
CODE	**WETTED O-RINGS**											
W2	Buna N	•	•	•	•	•	•	•	•	•	•	•
W3	Ethylene - Propylene	•	•	•	•	•	•	•	•	•	•	•
W4	*Aflas*	•	•	•	•	•	NA	•	NA	•	•	•
CODE	**PROCEDURES**											
P1	Hydrostatic Testing	•	•	•	•	•	•	•	•	•	•	•
P2	Cleaning for Special Service	•	•	•	•	•	•	•	•	•	•	•
P4	Calibration at Line Pressure	•	•	•	•	NA	NA	NA	NA	NA	•	•
P5	Calibration at Temperature	•	•	•	•	•	•	•	•	•	•	•
P7	Enhanced Temperature Performance	•	•	•	NA	•	NA	NA	NA	NA	•	•
P8	0.1% Accuracy	•	•	•	NA	NA	NA	NA	•	NA	•	•
CODE	**OUTPUTS**											
V1	Reverse Output	†	†	†	NA	•	•	NA	NA	†	•	•
V2	1 Ω Test Resistor (Test Resistors Not Available with Options M1, M2, M3, M6, I5 or I6)	•	•	•	•	•	•	•	•	•	NA	•
V3	5 Ω Test Resistor (Test Resistors Not Available with Options M1, M2, M3, M6, I5 or I6)	•	•	•	•	•	•	•	•	•	NA	•

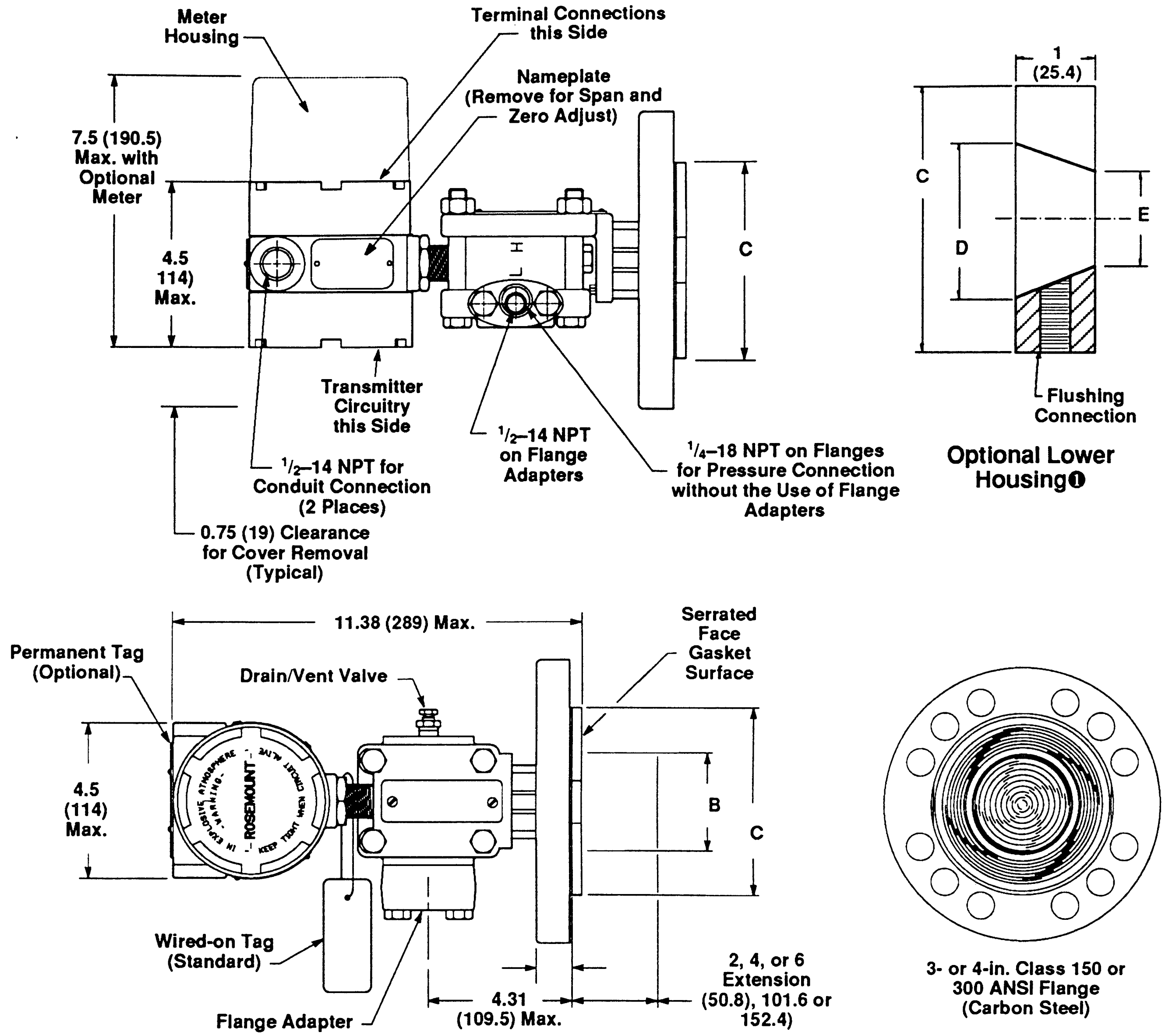
To order the options listed in this product data sheet, add the appropriate code or codes at the end of the transmitter model number.

* Patent Pending

**Applicable only to orifice assemblies without piping.

Example: 1151DP4E12 (Basic Model No.) **B1 M1 D2 P1**

- • - Available
- NA - Not Available
- † - Not Applicable



NOTE
Dimensions are in inches (millimeters).
❶Lower Housing is required for all 3- and 4-in. process connections when the optional flushing connection is specified, and for all 2-in. process connections.

Ordering Codes By Flange Size and Ratings				Diaphragm Assembly Dimensions			Lower Housing Dimensions		Bolt Holes	
Ordering Code	Size (in.)	Rating Class	O.D. (in.)	A (in.)	B (in.)	C (in.)	D (in.)	E (in.)	No.	Dia. (in..)
A	3	150	7.50	1.19	2.58	5	3.11	3.11	4	0.75
B	4	150	9.00	1.19	3.50	6.19	4.06	4.06	8	0.75
C	3	300	8.25	1.38	2.58	5	3.11	3.11	8	0.88
D	4	300	10.00	1.5	3.50	6.19	4.06	4.06	8	0.88
M	2	150	6.00	0.75	N/A	3.75	2.90	2.16	4	0.75
N	2	300	6.50	0.88	N/A	3.75	2.90	2.16	8	0.75

FIGURE 4-1. Dimensional Drawings.

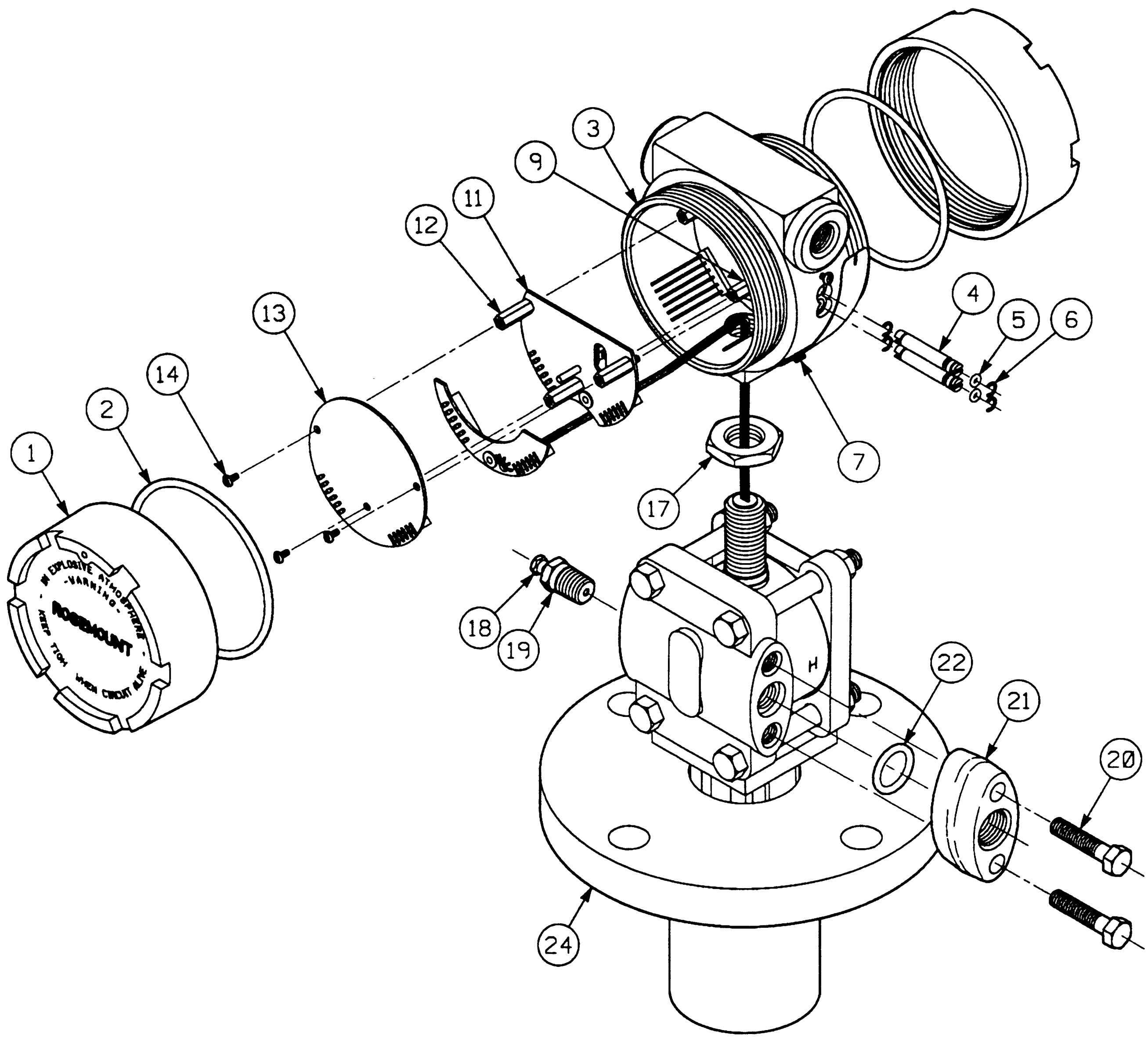


FIGURE 4-2. Exploded Parts Drawing.

TABLE 4-4. Illustrated Parts List for Model 1151LT Liquid Level Transmitter.

Part Description	Item No.	Order Number	Qty. Req. Per Trans.	Spares Category❶
Diaphragm and Sensor Module Assembly	24	Consult Factory		
Cadmium Plated Carbon Steel	21	90001-0033-0001	1	
316 SST		01151-0211-0002	1	
Hastelloy C		01151-0211-0004	1	
Valve Stem, 316 SST❸	18	01151-0028-0012	1	A
Valve Seat, 316 SST❸	19			
Plug, 316 SST (used with side drain/vent)	18A	C50246-0002	1	
Valve Stem, *Hastelloy C* ❸	18	01151-0028-0023	1	A
Valve Seat, *Hastelloy C* ❸	19			
Plug, *Hastelloy C* (used with side drain/vent)	18A	C50246-0202	1	
Bolt for Flange Adapter				
Carbon Steel	20	01151-0031-0002	2	
316 SST	20	01151-0031-0024	2	
ANSIK 193-B7	20	01151-0031-0013	2	
O-ring for Flange Adapter				
Viton	22	01151-0035-0009	1	
BUNA-N	22	01151-0035-0002	1	
Aflas	22	01151-0035-0008	1	
Ethylene-Prop.	22	01151-0035-0004	1	
E OUTPUT Code 4–20 mA dc				
Amplifier Circuit Board	13	01151-0137-0001	1	A
Calibration Circuit Board	11	01151-0139-0001	1	A
G OUTPUT Code 10–50 mA dc				
Amblifier Circuit Board	13	01151-0597-0001	1	A
Calibration Circuit Board	11	01151-0139-0001	1	A
Smart Retrofit Kit❸	—	01151-0770-0001	1	B
Includes smart electronics, extended cover, terminal eyelets, and board spacers				
Electronics Housing	3	01151-0060-0007	1	
Electronics Cover	1	90032-0240-0003	2	
Adjustment Screw	4	01151-0029-0001	1	
Retaining Ring❸	6			
O-ring for Adjustment Screw	5			
O-ring for Adjustment Screw❷	5	01151-0033-0001	2	
O-ring for Electronics Cover (1)❷	2	01151-0033-0003	2	
Electronics Assembly Hardware		01151-0030-0002	1	A
Standoff	9			
Standoff	12			
Screw❸	7			
Screw	14			
Lock Nut	17			

❶Rosemount recommends one spare part for every 25 transmitters in Category A, and one spare part for every 50 transmitters in Category B.
❷Part Number is for package of 12 O-rings–only 2 required per transmitter.
❸Kit containing enough parts for one transmitter.

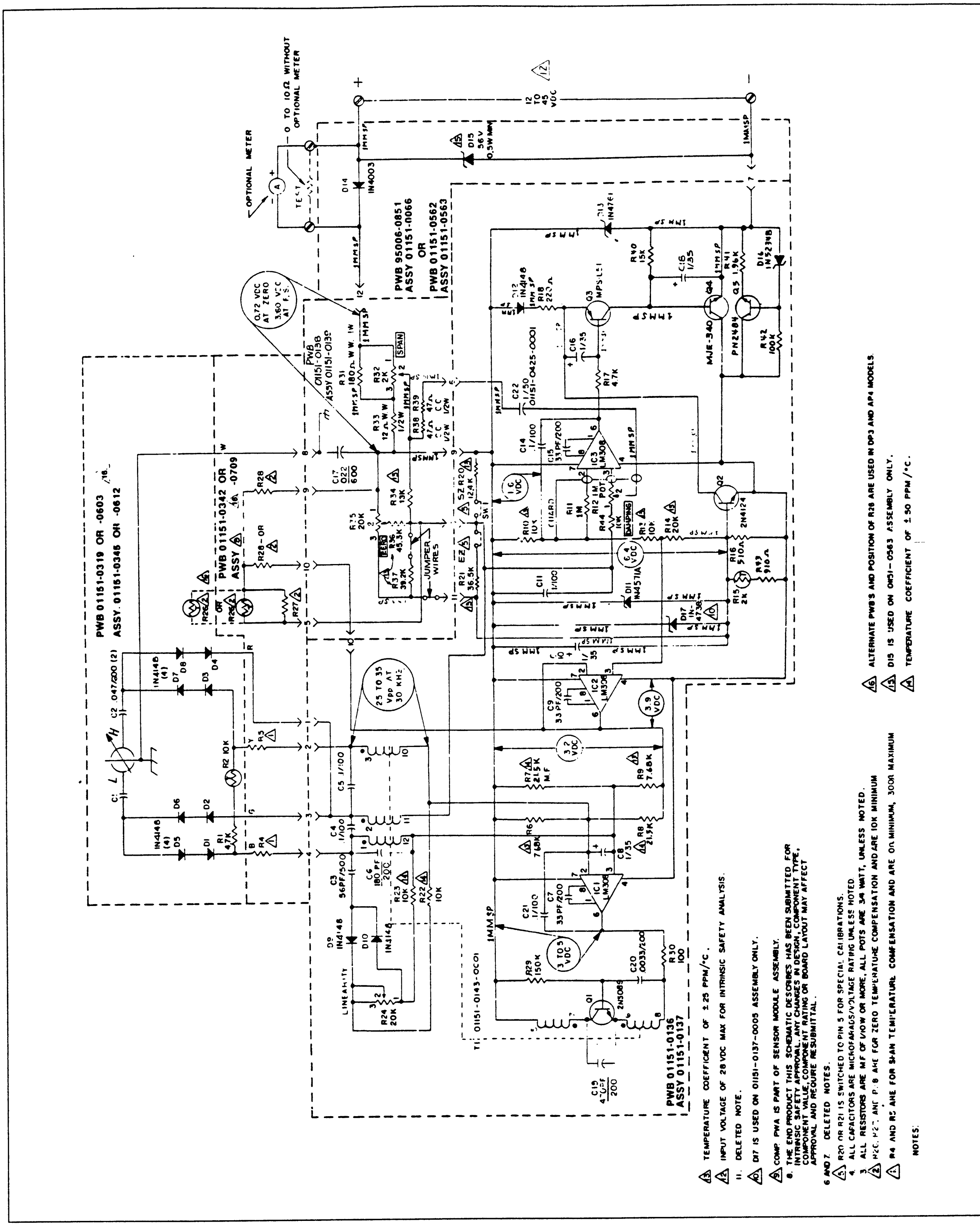


FIGURE 4-3. E OUTPUT Schematic Diagram (Refer to Drawing 01151-0135, Rev. V).

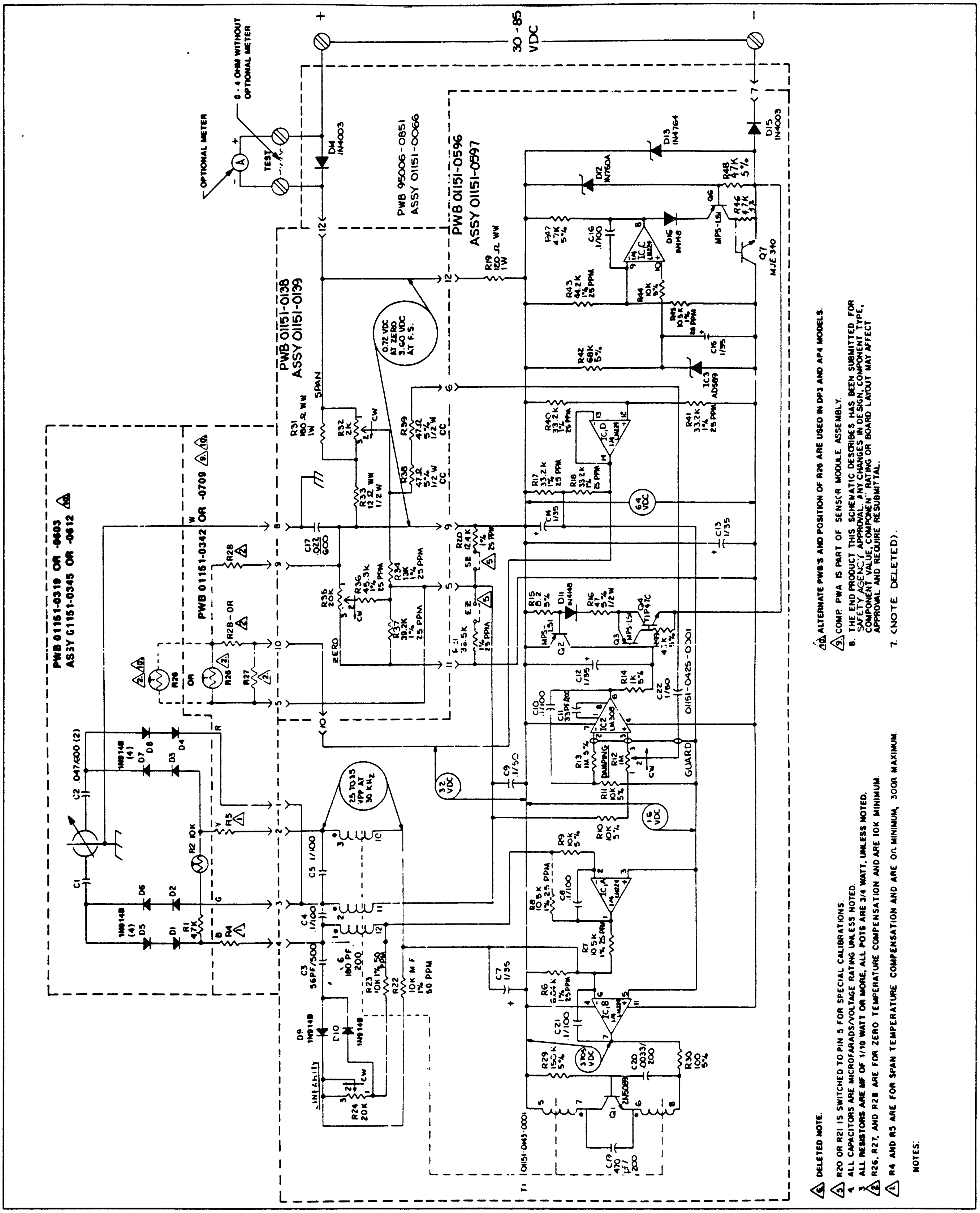
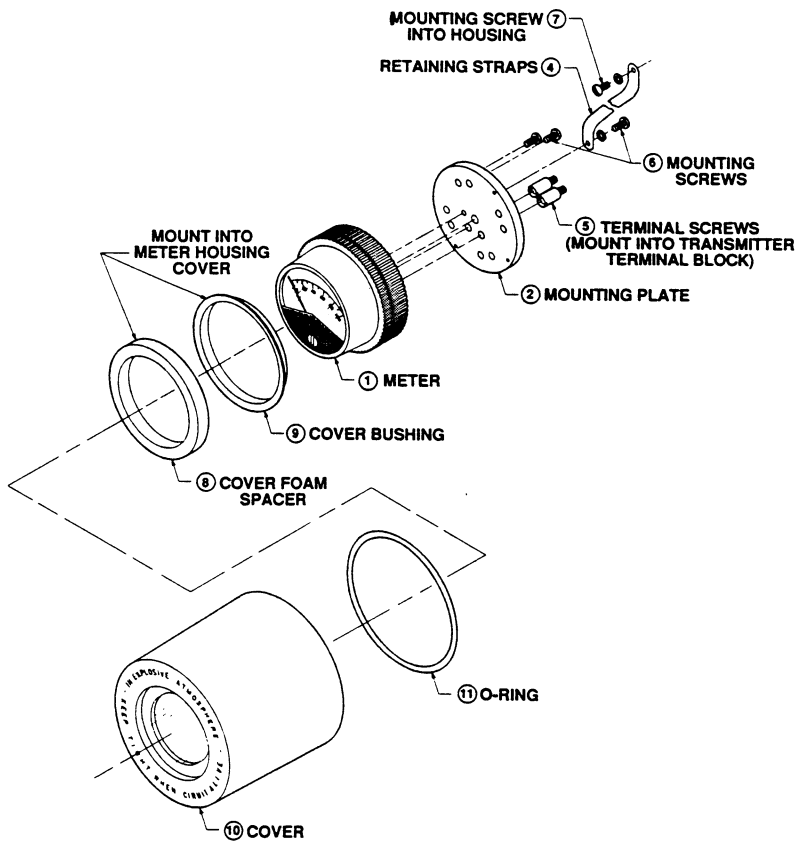


FIGURE 4-4. G OUTPUT Schematic Diagram (Refer to Drawing 01151-0600, Rev. G).



Meter Kit or Part	Item No.	Order No.	Qty. Req'd. Per Trans.
Meter Kit❶, 4–20 mA dc, Linear Scale	—	01151-0728-0007	1
Meter Kit❶, 10–50 mA dc, Linear Scale	—	01151-0728-0011	1
4–20 mA dc Linear Meter	1	01151-0687-0004	1
10–50 mA dc Linear Meter	1	01151-0687-0006	1
Mounting Hardware Kit includes:		01151-0728-0006	
Mounting Plate❷	2		1
Retaining Strap❷	4		1
Terminal Screw❷	5		2
Mounting Screw❷	6		2
Mounting Screw and Washers❷	7		2
Cover Foam Spacer❷	8		1
Cover Bushing❷	9		1
Cover Assembly Kit includes:		01151-0729-0001	
Cover Foam Spacer❸	8		1
Cover Busing❸	9		1
Cover Faceplate Assembly❸	10		1
O-ring for Cover❸	11		1

❶Meter Kit includes meter, mounting hardware, and cover assembly.

NOTE

For meters with special scaling, order the appropriate meter and specify the scale desired. Mounting hardware and cover assembly must be ordered separately.

❷Included in mounting hardware kit.

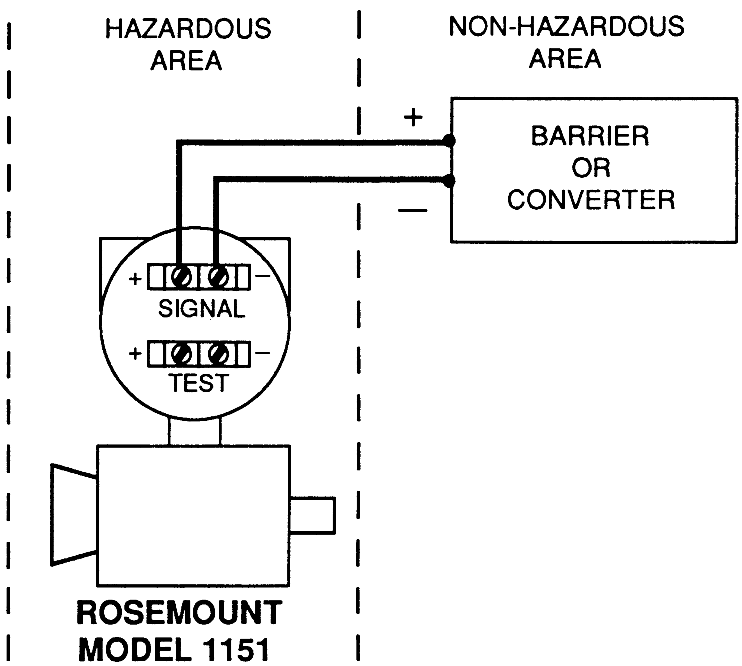
❸Included in cover assembly kit.

FIGURE 4-5. Meter Assembly (Refer to Drawing 01151-0025, Rev. D).

1151 CIRCUIT CONNECTION WITH BARRIER OR CONVERTER

Exia

Intrinsically Safe / Securite Intrinseque



DEVICE	PARAMETERS	APPROVED FOR CLASS I, DIVISION 1
CSA Approved Safety Barrier	30 V or less 330 ohms or more 28 V or less 300 ohms or more 22 V or less 180 ohms or more	Groups A, B, C, D
Foxboro Converter 2AS-I3I-CGB, 2AI-I2V-CGB, 2AI-I3V-CGB, 2AS-I2I-CGB, 3A2-I2D CS-E/CGB-A, 3F4-I2DA1 CS-E/CGB-A, 3AD-I3IA CS-E/CGB-A, 3A2-I3D CS-E/CGB-A, 3A4-I2DA CS-E/CGB-A		Groups B, C, D
CSA Approved Safety Barrier	30 V or less 120 ohms or more	Groups C, D

FIGURE 4-6. CSA Intrinsic Safety Approvals.

Appendix

Index of intrinsically safe barrier systems and entity parameters (refer to document 01151-0214, Rev. T).

REVISIONS					
LTR	DESCRIPTION	ECO NO	REV BY	APPR	DATE
P	Change entity parameters (Fm on re-exam) correct 444 CI	637376	WWR	WCR	9/28/90
R	Add 1151 Low Power Barrier System, Model 751 LI to 0	638105		MCR	4/27/90
T	1135, 1144, 1151 Li TO Ø	639039	SVC	MCR	1/23/91

CONTENTS	
ENTITY APPROVALS	SHEETS 2 THRU 4
APPROVED PARAMETERS	SHEETS 2 THRU 3
CONNECTION DIAGRAMS	SHEET 4

MASTER

APPROVED SOURCES OF SUPPLY	
MFG	MFG PART NO

Material purchased to this Rosemount Specification Control Drawing shall be required to meet all the specifications of this drawing. Any mention of manufacturer's part number within this drawing is for reference only. This is necessary to ensure design control of Rosemount's end product. It is Rosemount's intent to purchase your standard material whenever possible.

SPECIFICATION CONTROL DRAWING

UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE IN INCHES.

TOLERANCES:

DECIMALS	FRACTIONS
.X ±.1	±1/32
.XX ±.02	ANGLES
.XXX ±.010	±2°

PREPARED BY: Nancy Nix — DATE: 9/20/90

CHECKED BY: WCR

APPROVED BY Q.C.

APPROVED BY ENG. N C Ranft — 9/20/90

APPROVED BY PURCH.

FINAL APPROVAL ES

ROSEMOUNT® Measurement Control Analytical Valves

TITLE
INDEX OF INTRINSICALLY SAFE BARRIER SYSTEMS & ENTITY PARAMETERS FOR 444, 1135, 1144, 1151, & 2051TRANSMITTERS AND 751 FIELD INDICATORS

SIZE	CODE IDENT NO	DRAWING NO
A	04274	01151-0214

SCALE None	U/M: Each	SHEET 1 OF 5

ENTITY CONCEPT APPROVALS

The entity concept allows interconnection of intrinsically safe apparatus to associated apparatus not specifically examined in combination as a system. The approved values of maximum open circuit voltage (V_{OC}) and maximum short circuit current (I_{SC}) for the associated apparatus must be less than or equal to the maximum safe input voltage (V_{MAX}) and input current (I_{MAX}) of the intrinsically safe apparatus. In addition, the approved maximum allowable connected capacitance (C_A) and inductance (L_A) of the associated apparatus must be greater than the maximum unprotected internal capacitance (C_I) and inductance (L_I) of the intrinsically safe apparatus. The approved entity concept parameters are as follows:

Model 444

Class 1, Div. 1, Groups A and B

V_{MAX} = 40V	V_{OC} is less than or equal to 40V
I_{MAX} = 165 mA	I_{SC} is less than or equal to 165 mA
C_I = 0.044μF	C_A is greater than 0.044μF
L_I = 0	L_A is greater than 0

Class 1, Div. 1, Groups C and D

V_{MAX} = 40V	V_{OC} is less than or equal to 40V
I_{MAX} = 225 mA	I_{SC} is less than or equal to 225 mA
C_I = 0.044μF	C_A is greater than 0.044μF
L_I = 0	L_A is greater than 0

Model 751

Class 1, Div. 1, Groups A and B

V_{MAX} = 40V	V_{OC} is less than or equal to 40V
I_{MAX} = 165 mA	I_{SC} is less than or equal to 165 mA
C_I = 0	C_A is greater than 0
L_I = 0	L_A is greater than 0

Class 1, Div. 1, Groups C and D

V_{MAX} = 40V	V_{OC} is less than or equal to 40V
I_{MAX} = 225 mA	I_{SC} is less than or equal to 225 mA
C_I = 0	C_A is greater than 0
L_I = 0	L_A is greater than 0

MASTER

SIZE	CODE IDENT NO	DRAWING NO
A	04274	01151-0214
SCALE None	REV T	2 OF 5

Model 1135, 1144, and 1151

Class 1, Div. 1, Groups A and B

V_{MAX} = 40V	V_{OC} is less than or equal to 40V
I_{MAX} = 165 mA	I_{SC} is less than or equal to 165 mA
C_I(Smart 1151 = 0.024μF	C_A is greater than 0.024μF
C_I(1135F) = 0.008μF	C_A is greater than 0.008μF
C_I(1144 & std 1151) = 0	C_A is greater than 0
L_I = 0	L_A is greater than 0

Class 1, Div. 1, Groups C and D

V_{MAX} = 40V	V_{OC} is less than or equal to 40V
I_{MAX} = 225 mA	I_{SC} is less than or equal to 225 mA
C_I(Smart 1151 = 0.024μF	C_A is greater than 0.024μF
C_I(1135F) = 0.008μF	C_A is greater than 0.008μF
C_I(1144 & std 1151) = 0	C_A is greater than 0
L_I = 0	L_A is greater than 0

Model 2051

Class 1, Div. 1, Groups A and B

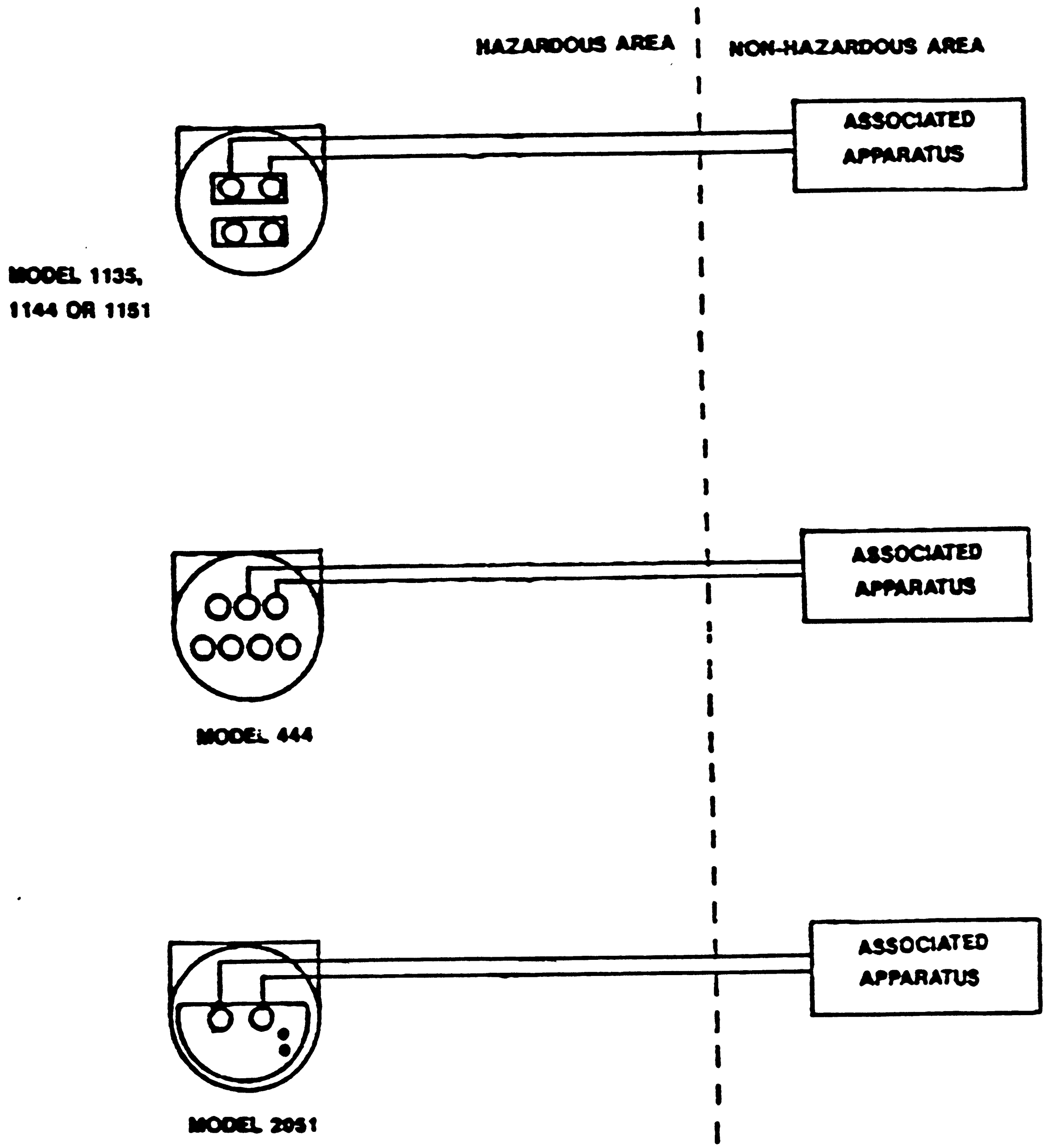
V_{MAX} = 40V	V_{OC} is less than or equal to 40V
I_{MAX} = 165 mA	I_{SC} is less than or equal to 165 mA
C_I = 0.012μF	C_A is greater than 0.012μF
L_I = 480μH	L_A is greater than 480μH

Class 1, Div. 1, Groups C and D

V_{MAX} = 40V	V_{OC} is less than or equal to 40V
I_{MAX} = 225 mA	I_{SC} is less than or equal to 225 mA
C_I = 0.012μF	C_A is greater than 0.012μF
L_I = 480μH	L_A is greater than 480μH

MASTER

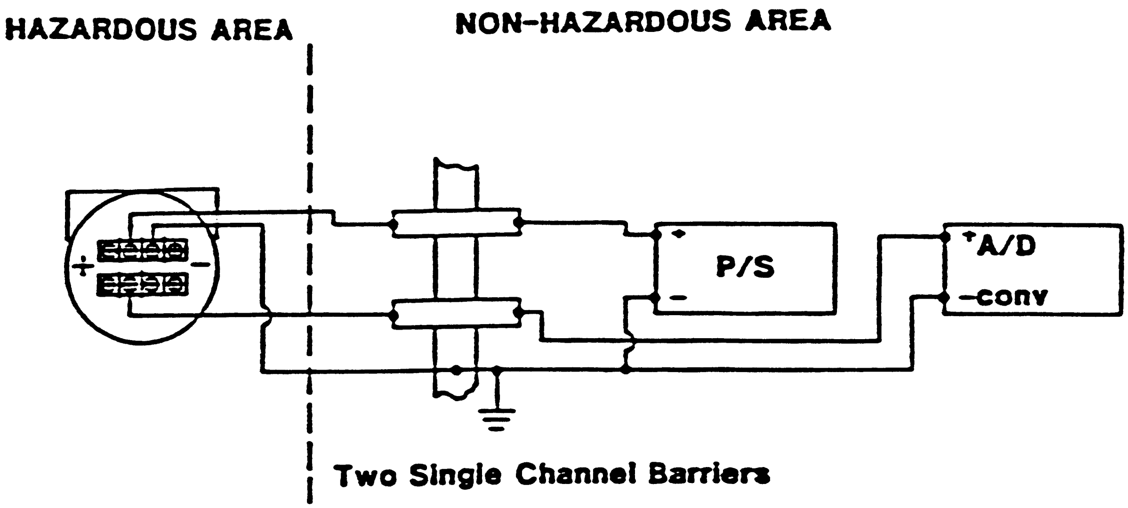
SIZE	CODE IDENT NO	DRAWING NO	
A	04274	01151-0214	
SCALE None	REV T		3 OF 5



MASTER

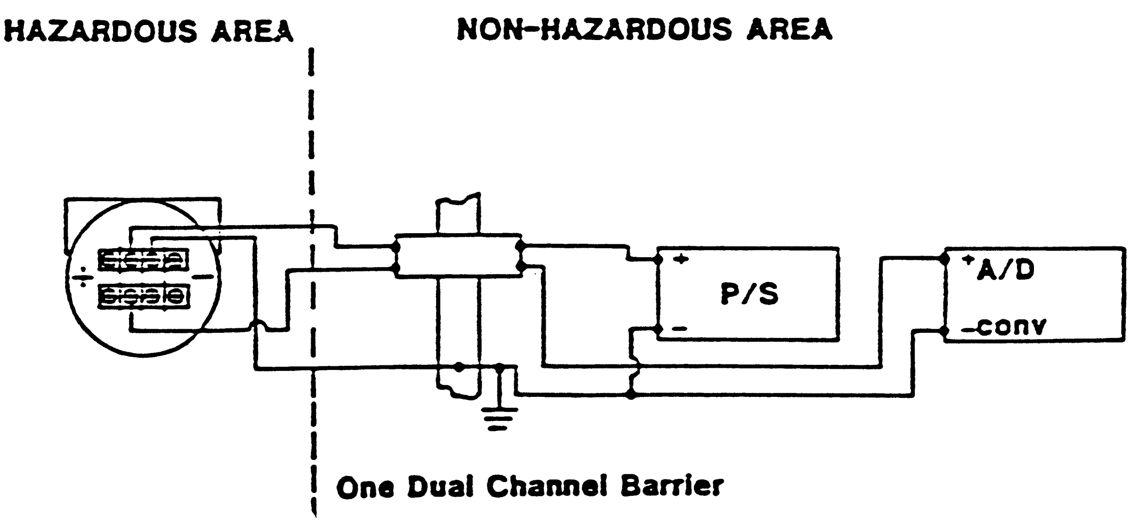
SIZE	CODE IDENT NO	DRAWING NO	
A	04274	01151-0214	
SCALE None	REV T		4 OF 5

1151 — L & M CIRCUIT CONNECTION WITH INTRINSIC SAFETY BARRIERS



Two Single Channel Barriers

CIRCUIT DIAGRAM 1



One Dual Channel Barrier

CIRCUIT DIAGRAM 2

MASTER

SIZE	CODE IDENT NO	DRAWING NO
A	04274	01151-0214
SCALE NONE	REV T	5 OF 5

Index

T

V

W

Z

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