

Rigid In-Tank Mounted Model "KTR" Magnetostrictive Transmitter Operation Manual



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1. Introduction

1.1 Purpose and use of this manual

Important:

Before starting the operation of the equipment, read this documentation thoroughly and follow the safety information.

The content of this technical documentation and of its various annexes is intended to provide information on mounting, installation and commissioning by qualified service personnel according to IEC 60079-14 and local regulations or factory trained service technicians.

1.2 Used symbols and warnings

Warnings are intended for your personal safety and for avoidance of damage to the described product or connected devices. In this documentation, safety information and warnings to avoid dangers that might affect the life and health of personnel or cause material damage are highlighted by the preceding pictogram, which is defined below.

Symbol Meaning

Notice

This symbol is used to point to situations that may lead to material damage and/or personal injury.

2. Safety instructions

2.1 Intended use

The liquid level transmitter is intended to be used to measure the level of liquid(s) contained by a structure as well as the temperature of the liquid. The product may only be used for the applications defined under item 1 to item 4 below and only in conjunction with third-party devices and components recommended or approved by manufacturer. As a prerequisite of proper and safe operation, the product requires correct transport, storage, mounting and commissioning and must be operated with utmost care.

1. Application does not exceed product's performance specification in Section 4.6.
2. Product may only be installed in hazardous areas as specified by approval certifications in Section 10 following special conditions of safe use outlined in Section 10 or in safe areas.
3. The liquid(s) being measured are compatible with the selected wetted parts of the product.
4. Factory supplied floats should be used for proper functionality and safety approval.

2.2 Foreseeable misuse

Foreseeable misuse	Consequence
Wrong sensor connection	Possible damage to electronics. See Section 5 for electrical connections.
Improper installation	Physical damage to packaging. See Section 4 for installation.

Foreseeable misuse	Consequence
Installation in unapproved hazardous area	Potential spark. See Section 10 for agency information.
Process temperature out of range	Signal degradation. Possible damage to sensor. See Section 4.6 for specifications.
Power supply out of range	No communication. Possible damage to sensor. See Section 4.6 for specifications.
Process pressure out of range	Possible damage to sensor. See Section 4.6 for specifications.
Improper chemical compatibility	Possible damage to sensor. Customer must select wetted material that is compatible with liquid(s) in tank.
Modifying sensor	Warranty void. Hazardous approval void. Customer should contact factory for custom unit.
Improper grounding	Possible damage to sensor. Full protection compromised. See Section 5.6 for grounding.

Table 1: Foreseeable misuse

2.3 Installation, commissioning and operation

1. Wear proper personal protection equipment such as a hard hat, safety shoes, flame resistant clothing, safety glasses, gloves and hearing protection.
2. Follow the specifications given in the technical documentation.
3. Two (2) individuals are recommended to conduct proper installation, commissioning and repair of the level transmitter.
4. Ensure the equipment used in a hazardous environment is selected and installed in compliance with regulations governing the geographical installation and facility. Only install equipment that complies with the types of protection relevant to the applicable classes, division, zones, category, gas group and temperature code.
5. Protect the sensor against mechanical damage during installation and operation.
6. Do not use damaged products and secure them against unintentional use. Mark damaged products as being defective.
7. Connect the sensor very carefully and pay attention to the polarity of connections. Do not make connections while power is live.
8. Before turning on power, ensure that nobody's safety is jeopardized by starting level transmitter and/or process.
9. Regularly follow preventative maintenance to prevent safety risks.
10. Make sure that no wire strands are loose or sticking out of the terminal block connection which could short and cause a problem.
11. Make sure that no wire strands, including shield, are in contact with the electronic module enclosure.

3. Product overview

The "KTR" liquid level transmitter is a continuous multi-functional magnetostrictive transmitter that provides product level, interface level and temperature to the user via Analog (4-20mA) with HART®, Modbus RTU (Remote Terminal Unit) or DDA (Direct Digital Access). Magnetostrictive technology is one of the most accurate and repeatable level technologies available to date.

3.1 Components

The "KTR" liquid level transmitter consists of four main components: a housing, internal electronics, outer pipe and float(s). Varying the components of the transmitter allows the transmitter to be customized to almost any application.

Housings

The "KTR" transmitters are available in three different housing configurations; (2) explosion-proof single cavity housings and (1) explosion-proof dual cavity housing as shown below:

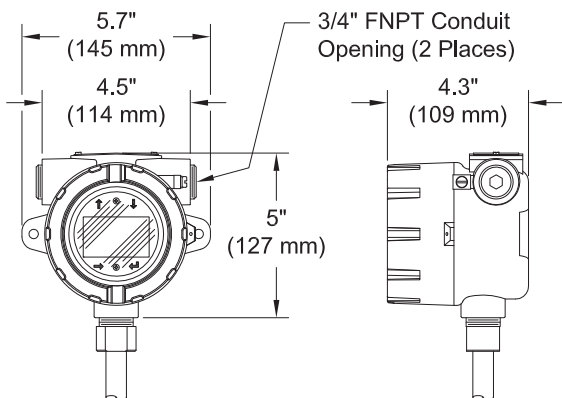


Figure 1: Single Cavity Explosion-Proof Housing

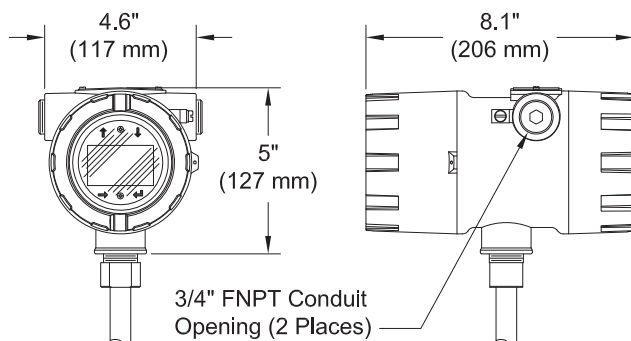


Figure 2: Dual Cavity Explosion-Proof Housing

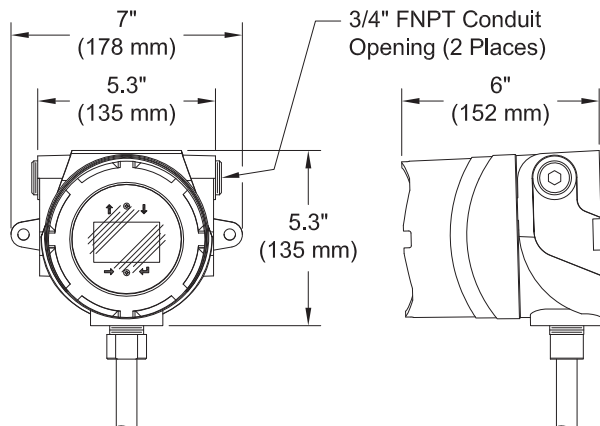


Figure 3: Stainless Steel Single Cavity Housing

Internal electronics

All transmitters come with two electronic components: a sensing element and a board set. The sensing element on the model "KTR" is rigid. The board set consists of up to three electronic boards and an LCD display. The display is password protected and is capable of displaying the product level, interface level and temperature. The product level and interface level measurement unit options are length, current, percent and volume. The temperature unit options are degrees Fahrenheit and degrees Celsius. Designed into the display are five buttons for local setup of the level transmitter. Each transmitter is supplied with a menu stylus used to activate the display buttons during local setup to allow programming without removing the transmitter housing cover. The factory default password is 27513. A temperature sensing function is optional with the transmitter. The temperature sensing device is a digital thermometer mounted inside the transmitter outer pipe assembly and can be ordered with 1, 5, 12 or 16 temperature points depending on the output option chosen.

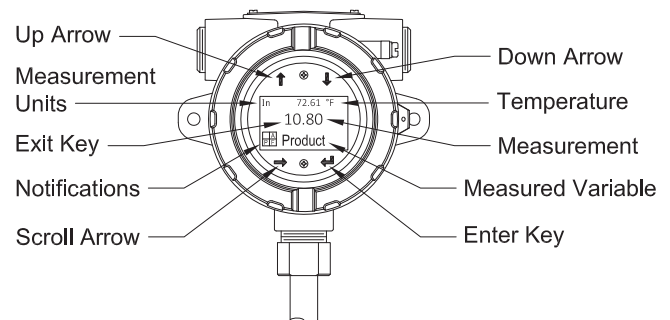
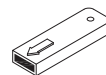


Figure 4: LCD Display

Menu stylus (Part Number 79857)

Used to activate the display buttons during local setup to allow programming without removing the transmitter housing cover.



Use Menu Stylus and factory default password 27513 to access transmitter Program Mode.

Figure 5: Menu Stylus

Outer pipe configuration

The outer pipe is constructed of rigid Ø5/8" (Ø16 mm) tubing.

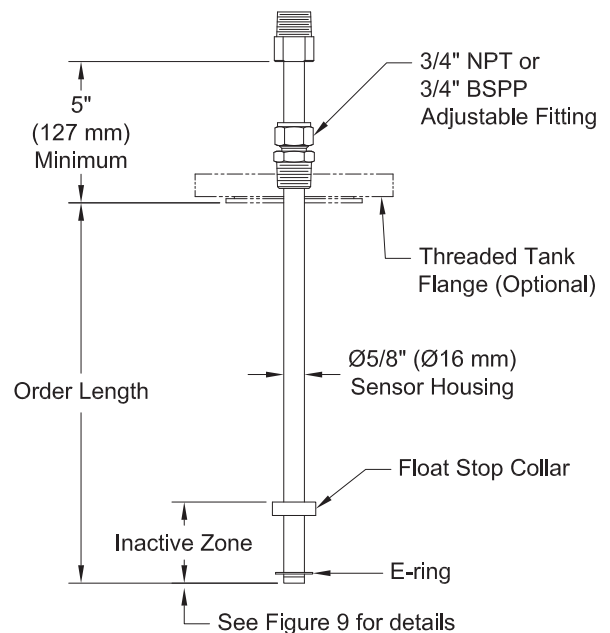


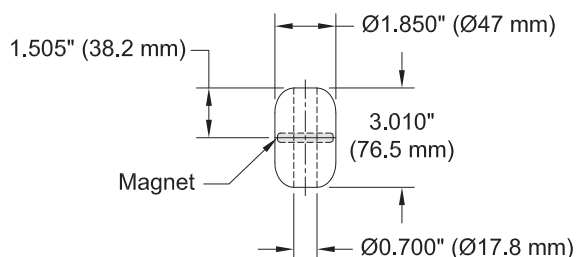
Figure 6: Outer Pipe Configuration

Floats

Numerous floats for different applications such as stainless steel, Hastelloy C, Teflon® and Nitrophyl® are available for both total product level measurement and interface level measurement. To be able to accurately detect the interface level, there needs to be a difference of at least 0.05 in specific gravities between the product and interface liquids. For assistance with selecting a specific float for your application, please contact technical support with the following information:

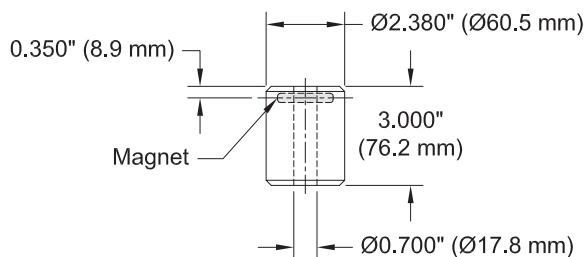
- Specific gravity of liquid(s) being measured
- Process temperature
- Process opening size
- Vessel pressure

Transmitters should be used with a float having an offset weight and made of stainless steel or Hastelloy C. This allows the float to stay in contact with the pipe to prevent the buildup of an electrostatic charge. Non-metallic floats with a projected surface area of less than 5,000 mm² should only be used in Zone 0, Gas group IIA. All other non-metallic floats should not be used in a hazardous area application. Consult factory for details. Below are specifications on a few of the more frequently used floats:



Part Number	Specific Gravity	Float Material	Maximum Pressure	Maximum Temperature
76562	0.67	316L SS	425 PSIG (29.3 Bar)	300° F (149° C)
76563	0.71	Hastelloy C		
76564	0.93	316L SS		
76565	0.93	Hastelloy C		

Figure 7: 316L Stainless Steel / Hastelloy "C" Floats



Part Number	Specific Gravity	Float Material	Maximum Pressure	Maximum Temperature
76566	0.86	Teflon®	25 PSIG (1.7 Bar)	100° F (38° C)
76567	0.93			
76568	1.06			

Figure 8: Teflon® Floats

Accessories

A series of displays, housings, converters, and other accessories are available. Please contact factory for details.

3.2 Accuracy

For magnetostrictive transmitters, inherent accuracy is measured in terms of non-linearity. Non-linearity is a measurement of any imperfections in the waveguide that are reflected in the linearity of the transmitter's output. Tolerances reflect a maximum non-linearity of $\pm 0.039"$ (± 1 mm). Strict tolerances are achieved by the proprietary waveguide alloy and 100% testing of each transmitter before shipment.

3.3 Warranty

Important:

Contact Technical Support or Customer Service for assistance if you suspect that the transmitter is not working correctly. Technical Support can assist you with troubleshooting, part replacement, and Return Materials Authorization (RMA) information if required.

All transmitters come with a two year limited warranty from the factory shipment date. An additional extended warranty can be purchased. A Return Materials Authorization (RMA) number is required and must accompany any transmitter returns. Any unit that was used in a process must be properly cleaned in accordance with OSHA standards before it is returned to the factory. A Material Safety Data Sheet (MSDS) must also accompany the transmitter that was used in any process.

3.4 Storage

If storage is required prior to installation, store indoors in a dry environment at ambient temperature range not to exceed -40° F (-40° C) to 160° F (71° C).

4. Installation and mounting

4.1 Training

Warning:

When the pipe of the level transmitter is installed or removed from the tank, the release of flammable vapors will occur. Take all necessary precautions when installing or removing the level transmitter due to the release of flammable vapors.

Installation should only be conducted by qualified service personnel according to IEC 60079-14 and local regulations or factory trained service technicians. Factory offers web based and in person training for installation, commissioning, maintenance, and repair. Factory also offers factory direct services for these same functions. Contact factory to discuss training or factory direct services before starting.

4.2 Stilling wells and guide poles

Transmitters can be mounted in slotted or unslotted stilling wells, but a slotted stilling well is always preferred. Using an unslotted stilling well will negatively affect performance of any level device as the level in the stilling well can differ from the level in the tank. The transmitter can also be installed to one side of the stilling well to also allow for sampling and manual gauging from the same opening as the automatic tank gauging. Contact Technical Support for details.

Transmitters do not require a stilling well for installation. They are installed in numerous tanks without stilling wells with no loss in performance. A stilling well is highly recommended for agitated, turbulent, and/or fast filling tanks.

4.3 Tools

- Adjustable Pliers
- 9/64" Hex Key (Allen Wrench)
- 3/4" Open End Wrench
- Common Head Screwdriver, Slotted Screwdriver

4.4 Installation steps

Caution:

It is recommended that assembly and mounting of this transmitter should not be done alone. To ensure proper and safe assembly, a minimum of two individuals are recommended. Personal protective equipment such as safety shoes, safety glasses, hard hat, and fire resistant clothing is recommended for work areas. Gloves are also recommended.

1. Consult Section 2.3 before starting.
2. Perform Commissioning Steps in Section 6.4.
3. Remove the float stop collar and E-ring. With assistance, feed the pipe through the hole of the removed tank flange until the flange is positioned at the top of the pipe. Using applicable pipe thread sealant, insert the threaded portion of the adjustable fitting into the tank flange and tighten. Be careful not to drop flange on the pipe as damage may result.
4. Slide the product float onto the pipe. Slide the interface float (optional) onto the pipe. Install float stop collar 3" (76.2 mm) from the bottom of the rigid section (see 'Note' below). Install E-ring. Do not drop float(s) or allow them to free fall along the pipe as damage may result.

Note:

The float stop collar can be removed or adjusted based on the float selected for the application. Please consult the factory for more information.

5. Slide float(s) back down to the float stop collar to prevent them from free falling during installation into the tank. Insert the pipe and floats through the tank riser pipe and lower the transmitter/float assembly into the tank until it rests on the bottom.
6. Secure the flange onto the tank riser pipe.
7. Pull the transmitter upward to straighten the pipe. Tighten the compression nut on the adjustable fitting to hold the transmitter in place.
8. Terminate the field wire cables noting proper wire orientation.

4.5 Mounting

The method of mounting the transmitter is dependent on the vessel or tank in which it is being used and what type of transmitter is being mounted. In most applications, the transmitter can be mounted directly to the tank or flange via a 3/4" NPT or 3/4" BSPP threaded fitting, assuming there is a proper threaded connection available. If the float will not fit through the flange opening when the flange is removed, there must be some alternative means to mount the float on the transmitter from inside the vessel. This may require an access port near the entry point of the transmitter as shown in Figure 9.

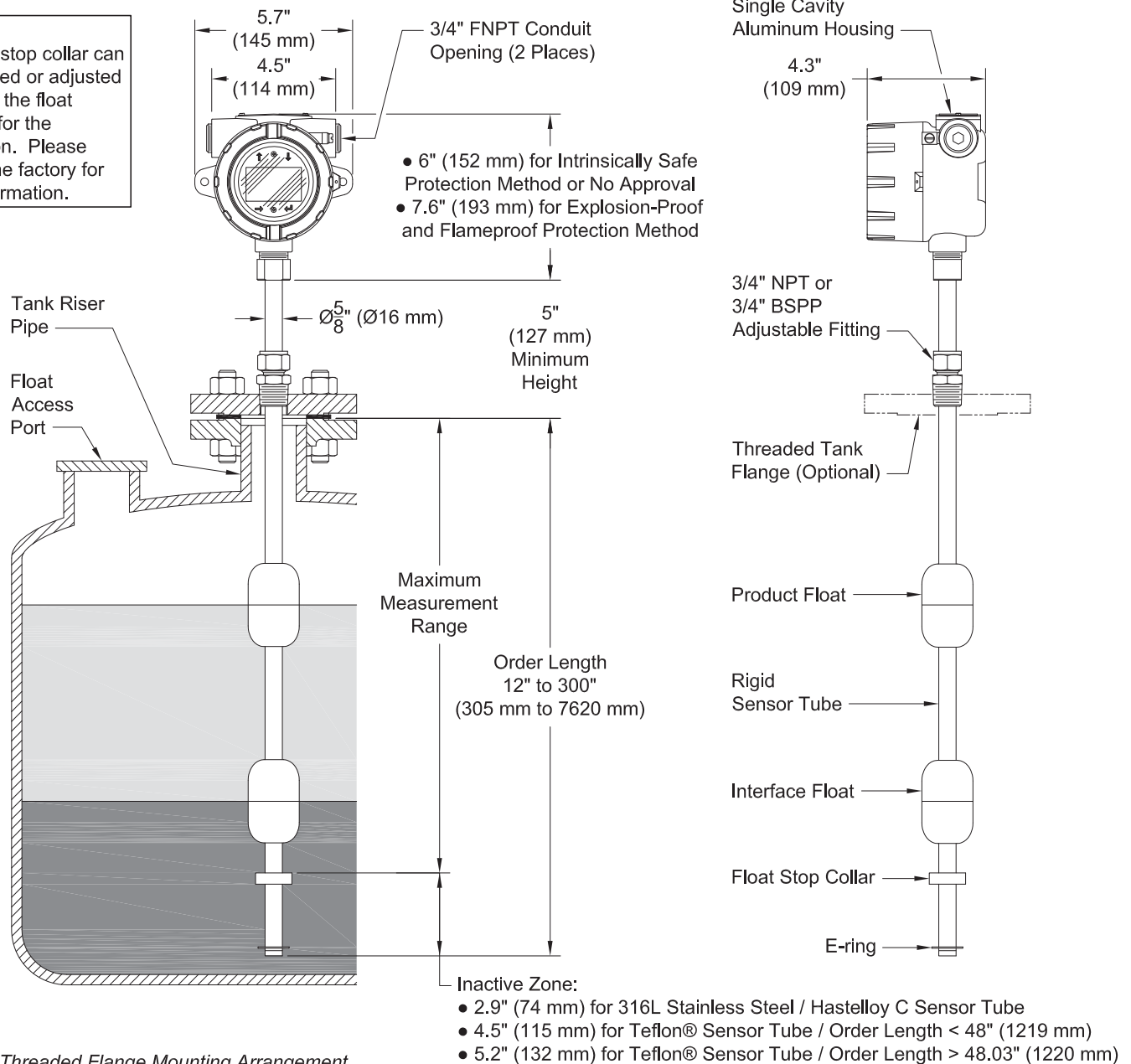


Figure 9: Threaded Flange Mounting Arrangement

4.6 Product specifications (Technical data)

Level Output		Specifications
Measured Variable		Product level and Interface level
Output Signal / Protocol		Analog (4-20mA) with HART® / Modbus RTU / DDA
Order Length (Measurement Range plus Inactive Zone)		12" to 300" (305 mm to 7620 mm); Contact factory for longer lengths.
Inherent Accuracy		±0.039" (±1 mm)
Repeatability (Any Direction)		0.001% F.S. or 0.015" (0.381 mm); whichever is greater.

Temperature Output		Specifications
Measured Variable	Analog (4-20mA), HART®	Single point temperature
	Modbus RTU / DDA	Average and multipoint temperatures
Temperature Accuracy	Analog (4-20mA), HART®	±0.5° F from -40° F to 221° F (±0.28° C from -40° C to 105° C)
	Modbus RTU / DDA	±0.4° F from -40° F to -4° F (±0.2° C from -40° C to -20° C)
		±0.2° F from -4° F to 158° F (±0.1° C from -20° C to 70° C)
		±0.3° F from 158° F to 212° F (±0.15° C from 70° C to 100° C)
		±0.9° F from 212° F to 221° F (±0.5° C from 100° C to 105° C)

Electronics		Specifications
Input Voltage		10.5 to 28 Vdc
Fail Safe	Analog (4-20mA), HART®	Low (3.5 mA default) or High (22.8 mA)
	Modbus RTU / DDA	High, Full scale
Reverse Polarity Protection		Series diode
EMC (Electromagnetic Compatibility)		EN 61326-1, EN 61326-2-3, EN 61326-3-2, EN 61000-6-2, EN 61000-6-3, EN 61000-4-2, EN 61000-4-3, EN 61000-4-4, EN 61000-4-5, EN 61000-4-6, EN 61000-4-8, EN 61000-4-11

Environmental		Specifications
Enclosure Rating		IP65
Humidity		0 to 100% relative humidity, non-condensing
Operating Temperatures	Electronics	-40° F to 160° F (-40° C to 71° C)
	Sensing Element	-40° F to 257° F (-40° C to 125° C); Contact factory for specific temp. ranges.
	Temperature Element	-40° F to 221° F (-40° C to 105° C)
Vessel Pressure	Metal Sensor Tube	1000 psi (69 Bar)
	Teflon® Sensor Tube	25 psi (1.75 Bar)
Materials	Wetted Parts	316L stainless steel, Hastelloy C, Teflon®; Contact factory for other materials.
	Non-Wetted Parts	Epoxy coated aluminum or 316 stainless steel

Electrical Housing Dimensions		Specifications
Single Cavity (Epoxy Coated Aluminum)		5.7" W x 5" D x 4.3" H (145 mm W x 127 mm D x 109 mm H)
Dual Cavity (Epoxy Coated Aluminum)		4.6" W x 5" D x 8.1" H (117 mm W x 127 mm D x 206 mm H)
Single Cavity (316 Stainless Steel)		7" W x 5.3" D x 6" H (178 mm W x 135 mm D x 152 mm H)

Mounting Connections		Specifications
Rigid Sensor Tube		3/4" NPT adjustable fitting, 3/4" BSPP adjustable fitting or pipe flange

Wiring		Specifications
Connections		4-wire shielded cable or twisted pair, Daniel Woodhead 6-pin male connector, 180" (4570 mm) integral cable with pigtail

Electrical Housing Connections		Specifications
Single and Dual Cavity		3/4" FNPT conduit opening

Electrical Housing LCD Display		Specifications
Measured Variables		Product level, interface level and temperature

4.7 Product ordering guide

KTR	-		-		-	1	-
Kenco Transmitter Style: KTR = Rigid In-Tank Mounted Sensor Housing		Output: 1 = 1 Loop with HART® 2 = 2 Loop with HART® 5 = 1 Loop with HART® and SIL2 7 = 2 Loop with HART® and SIL2 Loop 1 only M = Modbus RTU D = DDA (Direct Digital Access)		Housing Type: D = Single Cavity with Display (Epoxy Coated Aluminum) E = Dual Cavity with Display (Epoxy Coated Aluminum) L = Single Cavity with Display (316 Stainless Steel)		Electronics Mounting: 1 = Standard	
B	-		-		-		-
Sensor Housing: B = Rigid Ø5/8" (Ø16 mm) Tube		*Wetted Materials: 1 = 316L Stainless Steel 3 = Hastelloy C A = Teflon® C = CRN-Canadian Registration Number (FMC approval only) *Contact factory for other materials.		*Mounting Connection Type: 1 = NPT Adjustable Fitting 2 = BSPP Adjustable Fitting X = None *Flanged Mounting Connection available upon request. See Ordering Notes below.		*Mounting Connection Size: A = 3/4" X = None *See Ordering Notes below for Flanged Mounting Connection.	
	-		-		-		-
Digital Thermometer Quantity: 0 = None 1 = One 5 = Five (Modbus / DDA only) K = Twelve (Modbus only) M = Sixteen (Modbus only)		Digital Thermometer Placement: F = Evenly Spaced per API *C = Custom X = None *Location to be specified by customer.		*Notified Body: C = CEC (FMC) F = NEC (FM) X = None *Other certifications available upon request.		Protection Method: F = Explosion-Proof and Flameproof I = Intrinsically Safe X = No Approval	
	-		-		-		-
Gas Group: A = Group A (Not available with Notified Body "C" and Protection Method "F") B = Group B C = Group C D = Group D 3 = IIC (Intrinsically Safe only) 4 = IIB+H2 (Explosion-Proof and Flameproof only) X = None		Order Length Unit of Measure: U = US Customary (Inches) M = Metric (Millimeters)		*Order Length: XXXXXX = Inches (12 to 300) Enter Length Code as 01200 to 30000 XXXXXX = mm (305 to 7620) Enter Length Code as 00305 to 07620 *Order Length equals measurement range plus inactive zone.		S Special: S = Standard Product	

Example Model No.: KTR-1-D-1-B-1-1-A-0-X-X-X-U-01200-S

Ordering Notes: Accessories such as cables, remote displays, float(s) and mounting connection flange to be ordered as separate line items. Information below will need to be filled out by customer when requesting a quote:

		PSIG		
Specific Gravity of Upper Liquid in Tank	Specific Gravity of Lower Liquid in Tank	Max. Working Pressure	*Mounting Connection Flange Size: 2.00 = 2" 4.00 = 4" 2.50 = 2-1/2" 5.00 = 5" 3.00 = 3" 6.00 = 6" X = None	*Mounting Connection Flange Rating / Type: 150 = 150 Lb. R.F. ANSI 300 = 300 Lb. R.F. ANSI 600 = 600 Lb. R.F. ANSI X = None
<ul style="list-style-type: none"> Float will be designed for lower liquid in all interface applications unless otherwise specified. Two floats can only be used with 2 Loop Analog, Modbus RTU or DDA outputs. 		Max. Operating Temperature °F	*Other flange sizes available upon request.	*Other flange ratings & types available upon request.

Note: Contact factory for desired options not shown.

5. Electrical connections

5.1 Basic information

A typical intrinsically safe connection for the transmitter includes protective safety barriers, a power supply and a reading or monitoring device. Refer to agency information in Section 10.

A typical explosion-proof / flameproof connection for the transmitter includes a power supply and a reading or monitoring device. All cabling is in approved conduit with sealoffs as specified by local electrical code. Refer to agency information in Section 10.

5.2 Safety recommendations

Be sure to:

1. Always follow applicable local and national electrical codes and observe polarity when making electrical connections.
2. Never make electrical connections to the transmitter with power turned on.
3. Make sure that no wire strands are loose or sticking out of the terminal block connection which could short and cause a problem.
4. Make sure that no wire strands, including shield, are in contact with the electronic module enclosure.
5. The electronics module enclosure is grounded through internal circuitry and is electronically isolated from the explosion-proof housing.

5.3 Industrial topologies

There are four topologies described and illustrated below. However, the daisy-chain topology is not recommended.

Point-to-point

The point-to-point topology consists of having only one device on the loop as shown in Figure 10. This topology is not usually used with a bus network since it does not take advantage of placing multiple devices on a loop.

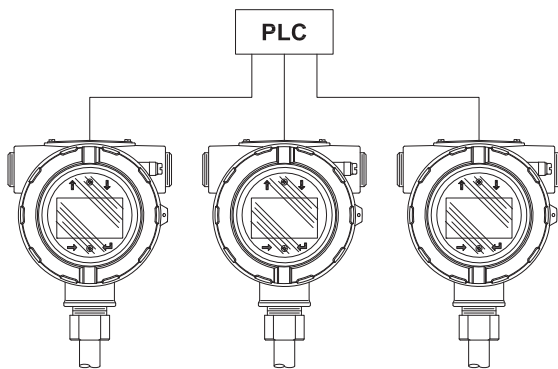


Figure 10: Point-to-Point Topology

Bus with spurs

The bus with spurs topology has a main trunk cable that has each device connected via its own spur at a junction box as shown in Figure 11. The bus with spurs and tree topologies can also be used together to form a hybrid topology.

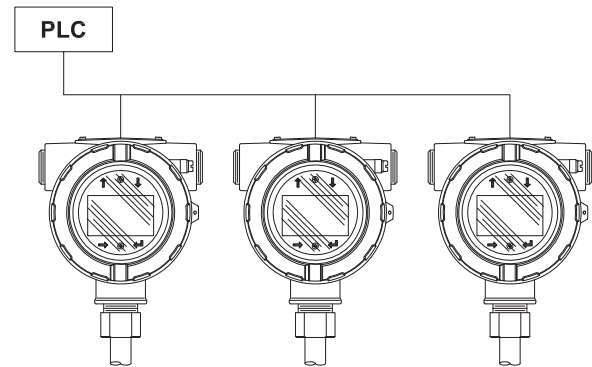


Figure 11: Bus with Spurs Topology

Tree alignment

The tree topology is very similar to the bus with spurs topology with the main difference of having a common junction box for all of the transmitters as shown in Figure 12. Bus with spurs and tree topologies can also be used together to form a hybrid topology.

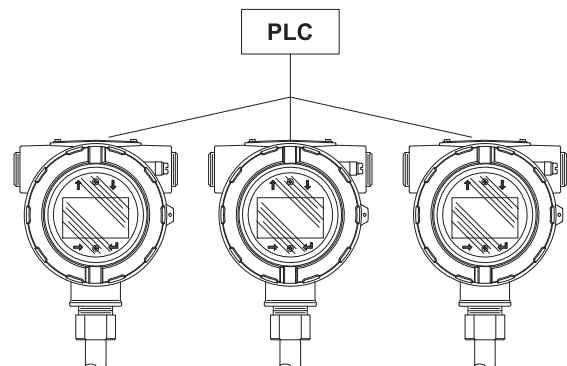


Figure 12: Tree Topology

Daisy-chain

The daisy-chain topology utilizes a single cable that is connected to all of the transmitters with the cable being interconnected at each field device. When using this topology, make sure that the wiring practice allows for one transmitter to be disconnected without disconnecting the entire loop as shown in Figure 13. Factory does not suggest using the daisy-chain topology.

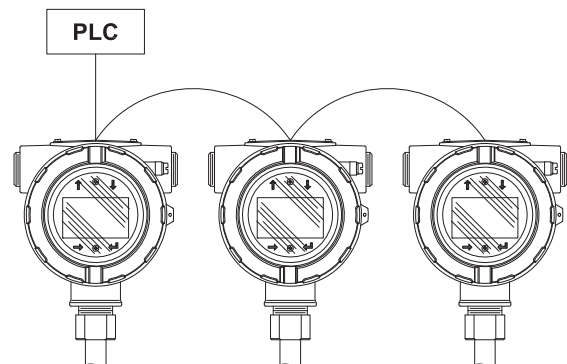


Figure 13: Daisy-Chain Topology

5.4 Cable recommendations

Refer to Table 2 below for general requirements of cable types for the transmitter.

Cable specifications

Parameter	Specification
Minimum cable size	24 to 14 AWG (0.51 to 1.6 mm diameter)
Cable type	Single pair shielded or multiple pair with overall shield; minimum 0.010" (0.25 mm) insulation thickness
Capacitance	Less than 30 pF/ft (98 pF/m)

Table 2: Cable specifications and parameters

5.5 Electrical conduit

Notes:

1. Tighten housing cover (both front and back covers if dual cavity) to full stop against the o-ring.

2. Do not over-tighten compression fittings.

3. Use side conduit entry only.

4. In high humidity areas, use a breather drain type conduit sealing fitting to minimize moisture intrusion.

5. For Division installations, an approved conduit seal is required within 18" (457 mm) of the enclosure.

6. For Zone installations, an approved conduit seal is required within 2" (50 mm) of the enclosure.

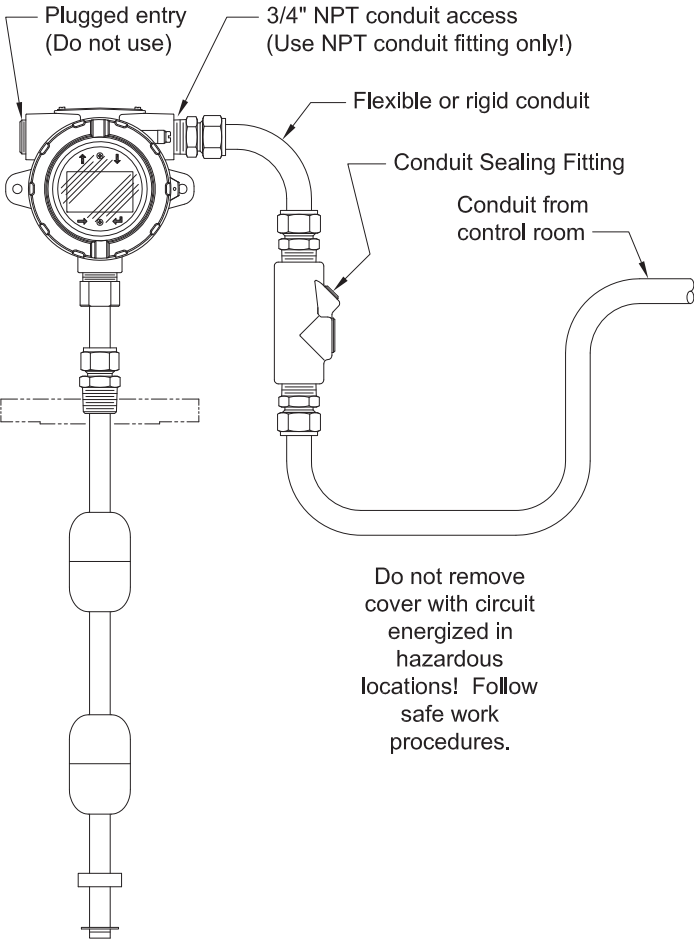


Figure 14: Electrical Conduit Installation

5.6 Grounding

5.6.1 Safety grounding

Warning:

Grounding the transmitter through a threaded conduit connection does not meet the requirements as a grounding of the sensor for safety.

There are two methods to provide an earth ground connection to the earth ground of the electronics. Either method must result in a resistance of less than 1 ohm.

- Run an earth ground through the conduit and connect directly to the earth ground lug inside the housing.
- Run an earth ground directly to the ground lug on the outside of the housing.

5.6.2 Shield grounding

Warning:

The shield ground does not meet the requirements as grounding of the sensor for safety.

Immunity performance of the sensor from external sources of surge, burst, RF, radiated emissions and other noise is dependent on a proper ground for the shield of the communications cable.

The communications cable shield should be of a braided type and connected to the internal ground lug of the sensor housing.

Runs in a continuous metallic conduit

When installed inside a dedicated continuous metallic conduit, the conduit provides a level of shielding protection from external interference and a level of ground to the sensor housing. In this case, a foil type shielded cable with a drain wire connected to the internal ground lug may be sufficient.

Sharing of the metallic conduit with other cables will result in loss of effective shielding performance of the communication cable and possible degradation in performance of the sensor. In this case, a braided type shielded cable connected to the sensor internal ground lug would be recommended.

In all cases, paralleling the communications cable with any noise generating cable inside of a conduit or with noise generating cables in close proximity to the conduit may degrade the performance of the sensor.

Runs without a conduit

In some rare applications, or where safety may not be required, a metallic conduit may not exist. The communications cable shield should be of a braided type and connected to the internal ground lug of the sensor housing.

Alternatively, a safety approved EMC Cable Gland can be used for grounding the shield. Contact factory for information before using one of these cable glands.

NEC (National Electrical Code)

Undesirable currents (ground loops) is a violation of the NEC and is a safety hazard.

5.7 Safety barriers

Refer to Table 3 for entity parameters and Table 4 for example safety barriers.

Entity Parameters	
Digital supply (1 per LT)	Ui = 28 Vdc
	Ii = 100 mA
	Ci = 0.0 µF
	Li = 0 mH
	Pi = 700 mW
Digital communication (2 per LT)	Ui = 8.6 Vdc
	Ii = 10 mA
	Ci = 0.0 µF
	Li = 0.0 mH
	Pi = 21.5 mW
Analog (1 per loop)	Ui = 28 Vdc
	Ii = 120 mA
	Ci = 0 µF
	Li = 5 µH
	Pi = 840 mW

Table 3: Safety barrier entity parameter references

Supplier	STAHL	STAHL	STAHL
Type	9001/01-280-100-101	9001/51-280-110-141	9001/01-086-010-101
Maximum voltage	28 Vdc	28 Vdc	8.6 Vdc
Maximum current (each channel)	100 mA	110 mA	10 mA
Maximum power (each channel)	700 mW	770 mW	21.5 mW
Number of channels	1	1	1
Interface	Modbus/DDA	Hart®	Modbus/DDA

Table 4: Example safety barriers

6. Commissioning

6.1 Training

Commissioning should only be conducted by qualified service personnel according to IEC 60079-14 and local regulations or factory trained service technicians. Factory offers web based and in person training for installation, commissioning, maintenance, and repair. Factory also offers factory direct services for these same functions. Contact factory to discuss training or factory direct services before starting.

6.2 Tools

- Adjustable Pliers
- 9/64" Hex Key (Allen Wrench)
- 3/4" Open End Wrench
- RS485 to USB Converter (Modbus and DDA)
- Windows Based PC
- Linear Regulated Power Supply
- Setup Software
- HART® to USB Converter (HART®)

6.3 Setup software

Factory offers setup software that is shipped with the level transmitter and is also available for download from website. The setup software is to be used for installation, commissioning, and troubleshooting. For further details on how to use the setup software, consult the Modbus Interface Manual, the DDA Interface Manual, and the HART® Interface Manual.

6.4 Commissioning steps

Note:

For additional details, consult the protocol specific Modbus Interface Manual, DDA Interface Manual and HART® Interface Manual.

6.4.1 Modbus or DDA

1. Consult Section 2.3 before starting.
2. Remove level transmitter from shipping container.
3. Remove E-ring and float stop collar.
4. Insert pipe into float(s) making sure float(s) are in the active range. Install product float first.
5. Connect power, RS485 to USB converter, and PC.
6. Open Setup Software.
7. Establish Communication.
8. For DDA Interface - Set Address.
9. For Modbus Interface - Set Address, Enter Strap Table and Setup Volume Correction Method.
10. Disconnect Power and Communication. Remove float(s). Prepare level transmitter for transport to the top of the tank.
11. Complete installation in Section 4.4.
12. Have qualified technician perform hand measurement. Enter hand measurement into Setup Software and calibrate.
13. Store all settings as backup file according to site name and tank number.

6.4.2 HART®

1. Consult Section 2.3 before starting.
2. Remove level transmitter from shipping container.
3. Remove E-ring and float stop collar.
4. Insert pipe into float(s) making sure float(s) are in the active range.
5. Connect power, HART® to USB converter, and PC.
6. Open Setup Software.
7. Establish Communication.
8. Set/Update 4 and 20 mA setpoints.
9. Disconnect Power and Communication. Remove float(s). Prepare level transmitter for transport to the top of the tank.
10. Complete Installation in Section 4.4.
11. Have qualified technician perform hand measurement. Enter hand measurement into Setup Software and calibrate.
12. Store all settings as backup file according to site name and tank number.

7. Maintenance

7.1 Training

Maintenance should only be conducted by qualified service personnel according to IEC 60079-14 and local regulations or factory trained service technicians. Factory offers web based and in person training for installation, commissioning, maintenance, and repair. Factory also offers factory direct services for these same functions. Contact factory to discuss training or factory direct services before starting.

7.2 Tools

- Adjustable Pliers
- 9/64" Hex Key (Allen Wrench)
- 3/4" Open End Wrench

7.3 Inspection

Below are some standard items that should be inspected on a regular basis to make sure that the level transmitter and surrounding environment are in operating condition.

- Hazardous area label is present and legible
- Hazardous area approval is correct for installation
- There are no visible unauthorized modifications
- Electrical connections are tight
- Condition of enclosure o-ring is satisfactory
- No water ingress (white powder)
- No obvious damage to cable
- Sealing of conduit or cable gland is satisfactory
- Earth ground is satisfactory
- Single or dual cavity enclosure threads are not damaged
- Housing is not damaged or cracked
- No corrosion on visible parts
- Printed circuit boards are clean and undamaged

7.4 Preventative maintenance

Transmitters do not typically require preventative maintenance, but may require preventative maintenance dependent on the application. For general purpose applications where there is no potential for buildup on the pipe and/or float, there is no need for preventative maintenance, but routine inspection is still suggested. For severe service applications where there is potential for buildup on the pipe and/or float, then preventative maintenance is required.

7.4.1 General purpose applications

7.4.1.1

Perform inspection suggested in Section 7.3.

7.4.1.2

No additional preventative maintenance is necessary. Preventative maintenance suggested for severe service applications may be performed.

7.4.2 Severe service applications

7.4.2.1

Perform inspection suggested in Section 7.3.

7.4.2.2

Disconnect power.

7.4.2.3

Disconnect process connection from tank. Remove pipe from tank.

Note:

It is best to clean the pipe as it is removed from the tank to minimize the amount of product that is removed from the tank. The user should take caution and abide by all regulations so that product is not spilled and the environment is not contaminated.

7.4.2.4

When the bottom of the pipe is reached, inspect the floats.

7.4.2.4.1

If the floats are highly contaminated, remove the assembly from the tank and remove the floats from the pipe.

7.4.2.4.2

If the floats are slightly contaminated, clean the floats without removing them from the pipe.

7.4.2.5

Replace pipe and floats in tank.

7.4.2.6

Connect process connection to tank.

7.4.2.7

Connect power.

7.4.2.8

The process should be carried out regularly until a consistent pattern has been established as to how long the intervals between cleanings should be.

8. Repair

8.1 RMA policy

Important:

Contact Technical Support or Customer Service for assistance if you suspect that the transmitter is not working correctly. Technical Support can assist you with troubleshooting, part replacement, and Return Materials Authorization (RMA) information if required.

All transmitters come with a two year limited warranty from the factory shipment date. A Return Materials Authorization (RMA) number is required and must accompany any transmitter returns. Any unit that was used in a process must be properly cleaned in accordance with OSHA standards before it is returned to the factory. A Material Safety Data Sheet (MSDS) must also accompany the transmitter that was used in any process.

8.2 Training

Repair should only be conducted by qualified service personnel according to IEC 60079-14 and local regulations or factory trained service technicians. Factory offers web based and in person training for installation, commissioning, maintenance, and repair. Factory also offers factory direct services for these same functions. Contact factory to discuss training or factory direct services before starting.

8.3 Tools

- Adjustable Pliers
- 9/64" Hex Key (Allen Wrench)
- 3/4" Open End Wrench
- Phillips Head Screwdriver
- Common Head Screwdriver, Slotted Screwdriver
- RS485 to USB Converter (Modbus and DDA)
- Windows Based PC
- Linear Regulated Power Supply
- HART® to USB Converter (HART®)

8.4 Troubleshooting

Symptom	Possible cause	Action
No communication with transmitter	No power	Check voltage at transmitter
	Wiring incorrect	Reference installation drawing Section 10
	Wrong address	DDA factory default is '192' Modbus factory default is '247'
	Wrong software	Confirm correct software
	Wrong protocol	Confirm software and transmitter are same protocol
Missing magnet error or alarm output	Float not recognized	Confirm that the float is attached
	Float is in the dead zone	Raise float to see if the error stops
	Wrong number of floats selected	Confirm that the number of floats on the transmitter and the number of floats the transmitter is attempting to verify are the same
Trigger level error	Gain needs to be adjusted	Consult Factory
	SE is damaged	Consult Factory
	Minimum trigger level too high	Consult Factory
Volume calculation error	No strap table entered	Enter strap table
	Level outside range of strap table	Enter additional points in strap table
	Strap table incorrect	Check value entries
VCF error	No VCF table entered	Enter VCF table
	VCF table incorrect	Check VCF value entries

Table 5: Troubleshooting reference

8.5 Setup software

Factory offers setup software that is shipped with the level transmitter and is also available for download from website. The setup software is to be used for installation, commissioning, and troubleshooting. For further details on how to use the setup software, consult the Modbus Interface Manual, the DDA Interface Manual, and the HART® Interface Manual.

9. Interface

Transmitter is available with multiple outputs including Modbus, DDA and HART®. This operation and installation manual includes all of these outputs. Each output has its own specialized interface manual that should be consulted for additional information on the specific output. For SIL, consult the SIL Safety Manual.

9.1 Modbus

Factory offers Modbus RTU (Remote Terminal Unit) over a RS485 half-duplex network. For additional information, consult Modbus Interface Manual.

9.2 DDA

Factory offers DDA (Direct Digital Access) over a RS485 half-duplex network. For additional information, consult DDA Interface Manual.

9.3 HART®

Factory offers HART® over a 4 to 20 mA signal. For additional information, consult HART® Interface Manual.

10. Agency information

10.1 Approvals overview

The Notified Body is designated in the 13th digit of the model number and the Protection Method is designated in the 14th digit of the model number. These two digits of the model number specify the hazardous area approval that is provided with the selected level transmitter.

Notified Body	Protection Method	Classifications	Standards
C = CEC Canadian Electrical Code	I = Intrinsic Safety	Class I, Division 1, Groups A,B,C,D T4; Class I, Zone 0/1; Ex ia IIC T4; Ta = -50° C to +71° C; IP65	CAN C22.2 No. 157-92: 2012; CSA C22.2 No. 1010.1: 2004; CAN/CSA C22.2 No. 60079-0: 2011; CAN/CSA C22.2 No. 60079-11: 2014; CAN/CSA C22.2 No. 60529: 2005
	F = Explosion- Proof and Flameproof	Class I, Division 1, Groups B,C,D T6...T3; Ex db IIB+H2 T6...T3 Ga/Gb; Ta = -40° C to +71° C; IP65	CSA C22.2 No. 0.4-04: R2013; CSA C22.2 No. 0.5: R2012; CSA C22.2 No. 0-10: R2015; CSA C22.2 No. 30: R2012; CAN/CSA C22.2 No. 60079-0: 2015; CAN/CSA C22.2 No. 60079-1: 2016; CAN/CSA C22.2 No. 60079-26: 2016; CAN/CSA C22.2 No. 61010.1: 2012; CSA C22.2 No. 60529: R2010
F = NEC National Electrical Code	I = Intrinsic Safety	Class I, Division 1, Groups A,B,C,D T4; Class I, Zone 0/1; AEx ia IIC T4; Ta = -50° C to +71° C; IP65	FM 3600: 2011; FM 3610: 2010; FM 3810: 2005; ANSI/ISA 60079-0: 2013; ANSI/ISA 60079-11: 2014; ANSI/IEC 60529: 2004
	F = Explosion- Proof and Flameproof	Class I, Division 1, Groups A,B,C,D T6...T3; Class I, Division 1, Groups B,C,D T6...T3; Class I, Zone 0/1; AEx db IIB+H2 T6...T3 Ga/Gb; Ta = -40° C to +71° C; IP65	FM 3600: 2011; FM 3615: 2006; FM 3810: 2005; ANSI/ISA 60079-0: 2013; ANSI/UL 60079-1: 2015; ANSI/UL 60079-26: 2017; ANSI/IEC 60529: 2004

Table 6: Agency approvals

10.2 Certificates

Downloadable copies of all certificates are located on the Kenco website at www.kenco-eng.com and can be downloaded on the product specific landing page. If there is any difficulty in obtaining the certificates from the web, contact the factory and they will be sent electronically.

10.3 FM (NEC) / FMC (CEC)

10.3.1 Intrinsically Safe

• Intrinsically Safe Analog Output:

Refer to Section 10.3.1.3 for wiring notes, Figure 19 for wiring schematic, Figure 31 for single cavity housing and Figure 32 for dual cavity housing.

Note: Agency controlled installation drawings can be found on the Kenco website at www.kenco-eng.com.

- >For (U.S.) Intrinsically Safe Analog Output installation drawings, refer to 651544-11.
- >For (Canada) Intrinsically Safe Analog Output installation drawings, refer to 651544-12.

• Intrinsically Safe Digital Output:

Refer to Section 10.3.1.4 for wiring notes, Figure 20 for wiring schematic, Figure 33 for single cavity housing and Figure 34 for dual cavity housing.

Note: Agency controlled installation drawings can be found on the Kenco website at www.kenco-eng.com.

- >For (U.S.) Intrinsically Safe Digital Output installation drawings, refer to 651543-11.
- >For (Canada) Intrinsically Safe Digital Output installation drawings, refer to 651543-12.

10.3.1.1 Special conditions for safe use

1. The apparatus enclosure contains aluminum and is considered to constitute a potential risk of ignition by impact or friction. Care must be taken into account during installation and use to prevent impact or friction (when installed in a Ga Approval).
2. The maximum permitted ambient temperature of the transmitter is 160° F (71° C). To avoid the effects of process temperature and other thermal effects, care shall be taken to ensure the surrounding ambient and the ambient inside the transmitter housing does not exceed 160° F (71° C).
3. Some models contain non-metallic enclosure parts. To prevent the risk of electrostatic sparking, the non-metallic surface should only be cleaned with a damp cloth.

10.3.1.2 Intrinsically Safe Labels

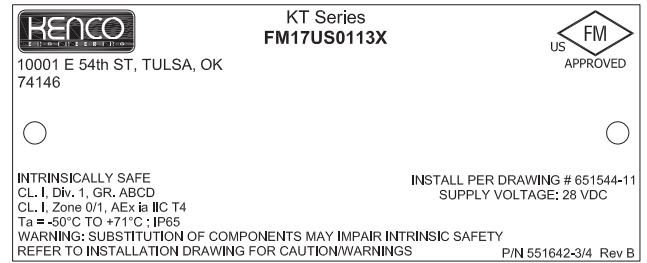


Figure 15: Intrinsically Safe Analog Output Label (U.S.)



Figure 16: Intrinsically Safe Analog Output Label (Canada)

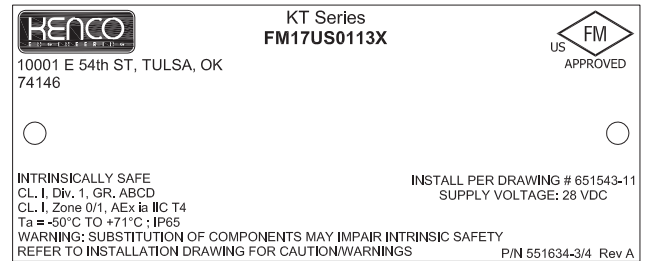


Figure 17: Intrinsically Safe Digital Output Label (U.S.)

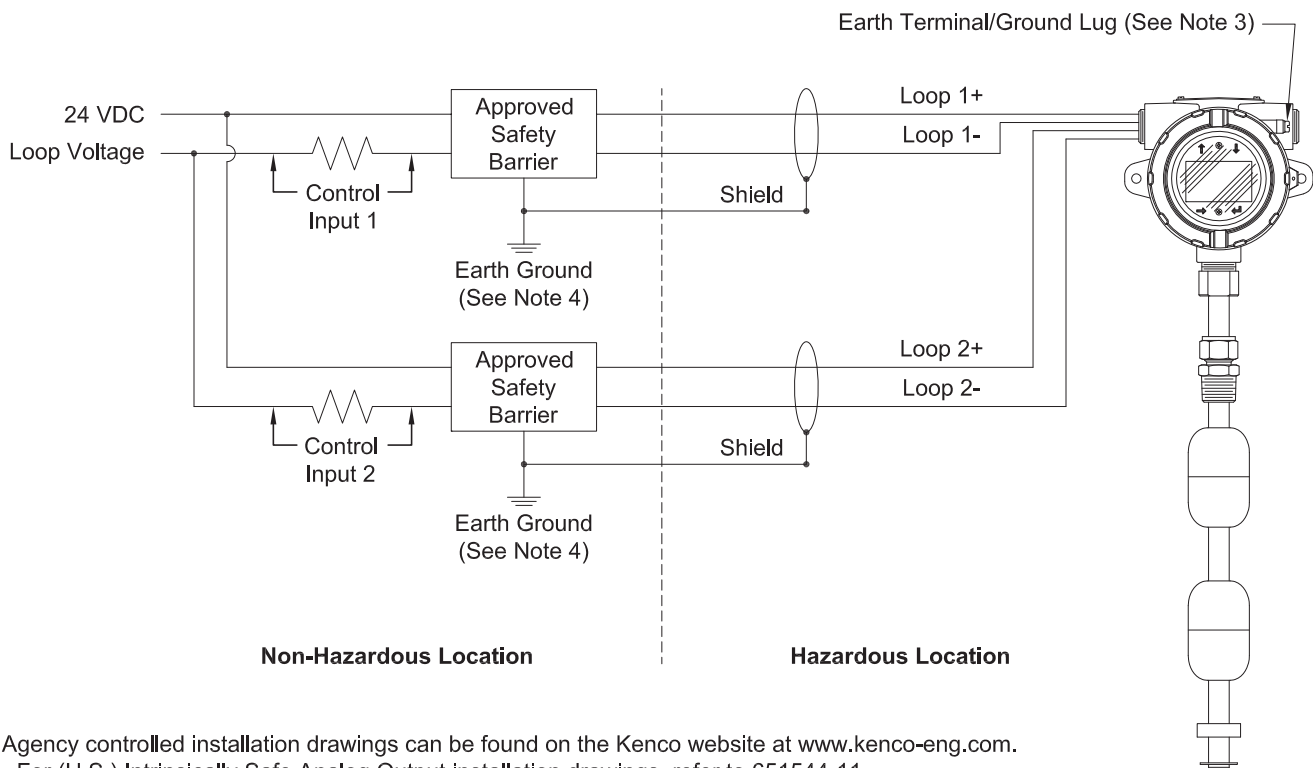


Figure 18: Intrinsically Safe Digital Output Label (Canada)

10.3.1.3 Intrinsically Safe Analog Output Wiring Notes

1. All national and local codes and regulations must be adhered to when installing the level sensor in hazardous environments. Seal all conduits within 18" (457 mm).
2. Loop cable must be 24 AWG to 14 AWG (0.511 mm² to 1.6 mm²) shielded twisted pair cable with shield. Cable capacitance must be less than 30 pF per foot (98 pF per m). Cable shield is connected to system ground in non-hazardous area. See installation manual for additional cable information.
3. The resistance between earth ground and the intrinsically safe ground must be less than 1 ohm.
4. The transducer frame shall be grounded to earth ground directly or through the equipment on which it is mounted.
5. Control equipment connected to associated apparatus must not use or generate more than 250 VRMS or VDC.
6. Associated apparatus manufacturer's installation drawing must be followed when installing this equipment.
7. Approved barriers:
 - In the U.S., only use NEC (e.g. FM) approved barriers.
 - In Canada, only use CEC approved barriers.
8. Approved loop separation methods:
 - Run loops in separate cables.
 - Run loops in separate grounded shields.
9. Entity parameters each loop:
 - U_i = 28 VDC
 - I_i = 120 mA
 - C_i = 0 µF
 - L_i = 5 µH
 - P_i = 840 mW
10. Dual-cavity enclosures: Customer connections will be made at terminal block on power side of housing (not to terminal block on interconnect board).
11. Installation codes:
 - In the U.S., installation should be in accordance with ANSI/ISA RP12.06.01 "Installation of intrinsically safe systems for hazardous (classified) locations" and the National Electrical Code (ANSI/NFPA 70).
 - In Canada, See Canadian Electrical Code, CSA No. C22.1.
12. The maximum permitted ambient temperature of the digital/analog level transmitter is 160° F (71° C). To avoid the effects of process temperature and other thermal effects, care shall be taken to ensure the surrounding ambient and the ambient inside the transmitter housing does not exceed 160° F (71° C).
13. **Caution:** Flexible gauges have a minimum bend radius of 15" (381 mm).
14. **Warning:** The apparatus enclosure contains aluminum and is considered to constitute a potential risk of ignition by impact or friction. Care must be taken into account during installation and use to prevent impact or friction.
15. **Warning:** Substitution of components may impair intrinsic safety.
16. **Warning:** To prevent ignition of flammable or combustible atmospheres, disconnect power before servicing.
17. **Warning:** The equipment contains non-metallic enclosure parts. To prevent the risk of electrostatic sparking, the non-metallic surface should only be cleaned with a damp cloth.

Intrinsically Safe Analog Output



Note: Agency controlled installation drawings can be found on the Kenco website at www.kenco-eng.com.

- For (U.S.) Intrinsically Safe Analog Output installation drawings, refer to 651544-11.
- For (Canada) Intrinsically Safe Analog Output installation drawings, refer to 651544-12.

Figure 19: Intrinsically Safe Analog Output Wiring Schematic

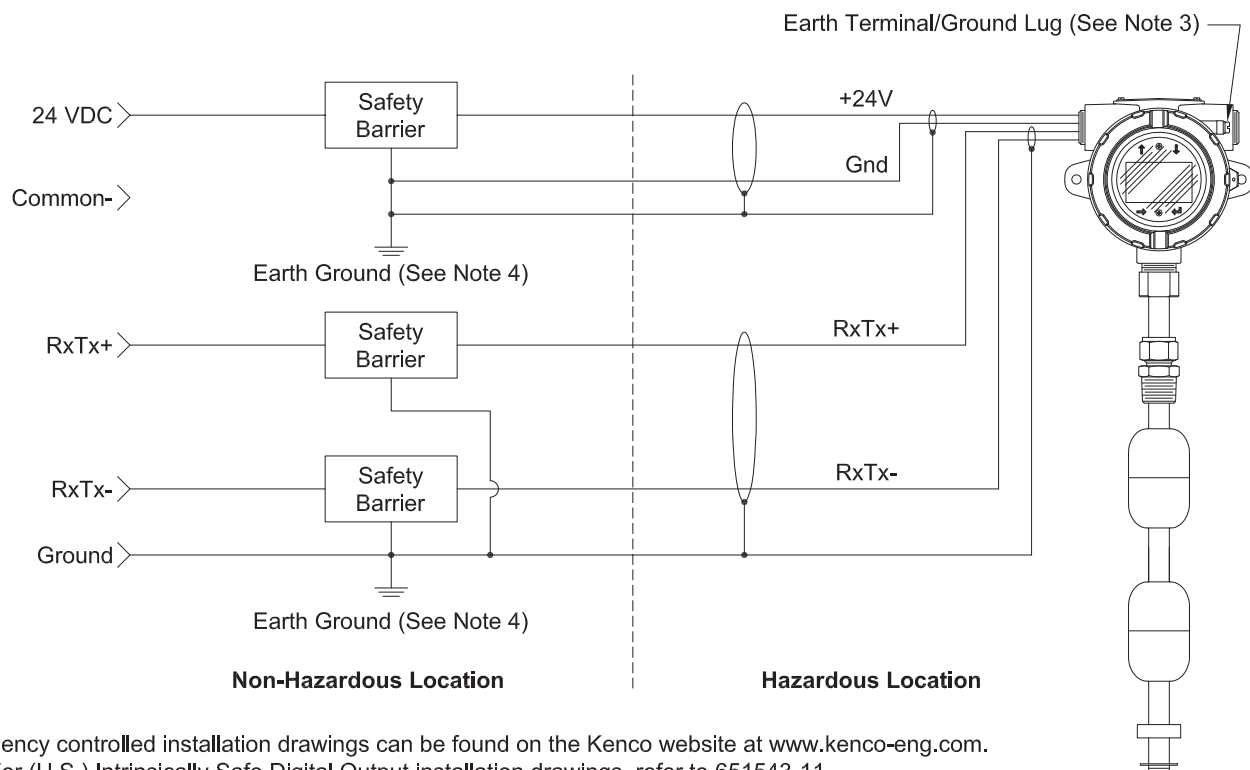
10.3.1.4 Intrinsically Safe Digital Output Wiring Notes

1. All national and local codes and regulations must be adhered to when installing the level sensor in hazardous environments. Seal all conduits within 18" (457 mm).
2. Loop cable must be 24 AWG to 14 AWG (0.511 mm² to 1.6 mm²) shielded twisted pair cable with shield. Cable capacitance must be less than 30 pF per foot (98 pF per m). Cable shield is connected to system ground in non-hazardous area. See installation manual for additional cable information.
3. The resistance between earth ground and the intrinsically safe ground must be less than 1 ohm.
4. The transducer frame shall be grounded to earth ground directly or through the equipment on which it is mounted.
5. Control equipment connected to associated apparatus must not use or generate more than 250 VRMS or VDC.
6. Associated apparatus manufacturer's installation drawing must be followed when installing this equipment.
7. Approved barriers:
 - In the U.S., only use NEC (e.g. FM) approved barriers.
 - In Canada, only use CEC approved barriers.
8. Entity parameters:

Supply:	Rx/Tx-:	Rx/Tx+:
Ui = 28 VDC	Ui = 8.6 V	Ui = 8.6 V
Ii = 100 mA	Ii = 10 mA	Ii = 10 mA
Ci = 0 µF	Ci = 0 µF	Ci = 0 µF
Li = 0 µH	Li = 0 µH	Li = 0 µH
Pi = 0.7 W	Pi = 0.0215 W	Pi = 0.0215 W
9. The entity concept allows interconnection of intrinsically safe apparatus with associated apparatus when the following is true:
 - Vmax or Ui ≥ Voc, Vt or Uo;
 - I_{max} or Ii ≥ Isc, It or Io;
 - Pmax or Pi ≥ Po;
 - Ca ≥ Ci + Ccable;
 - La ≥ Li + Lcable.

10. Dual-cavity enclosures:
Customer connections will be made at terminal block on power side of housing (not to terminal block on interconnect board).
11. Installation codes:
 - In the U.S., installation should be in accordance with ANSI/ISA RP12.06.01 "Installation of intrinsically safe systems for hazardous (classified) locations" and the National Electrical Code (ANSI/NFPA 70).
 - In Canada, See Canadian Electrical Code, CSA No. C22.1.
12. The maximum permitted ambient temperature of the digital/analog level transmitter is 160° F (71° C). To avoid the effects of process temperature and other thermal effects, care shall be taken to ensure the surrounding ambient and the ambient inside the transmitter housing does not exceed 160° F (71° C).
13. **Caution:** Flexible gauges have a minimum bend radius of 15" (381 mm).
14. **Warning:** The apparatus enclosure contains aluminum and is considered to constitute a potential risk of ignition by impact or friction. Care must be taken into account during installation and use to prevent impact or friction.
15. **Warning:** Substitution of components may impair intrinsic safety.
16. **Warning:** To prevent ignition of flammable or combustible atmospheres, disconnect power before servicing.
17. **Warning:** The equipment contains non-metallic enclosure parts. To prevent the risk of electrostatic sparking, the non-metallic surface should only be cleaned with a damp cloth.

Intrinsically Safe Digital Output



Note: Agency controlled installation drawings can be found on the Kenco website at www.kenco-eng.com.

- For (U.S.) Intrinsically Safe Digital Output installation drawings, refer to 651543-11.
- For (Canada) Intrinsically Safe Digital Output installation drawings, refer to 651543-12.

Figure 20: Intrinsically Safe Digital Output Wiring Schematic

10.3.2 Explosion-Proof / Flameproof

• Explosion-Proof / Flameproof Analog Output:

Refer to Section 10.3.2.3 for wiring notes, Figure 29 for wiring schematic, Figure 31 for single cavity housing and Figure 32 for dual cavity housing.

Note: Agency controlled installation drawings can be found on the Kenco website at www.kenco-eng.com.

>For (U.S.) Explosion-Proof / Flameproof Analog Output installation drawings, refer to 651553-11.

>For (Canada) Explosion-Proof / Flameproof Analog Output installation drawings, refer to 651553-12.

• Explosion-Proof / Flameproof Digital Output:

Refer to Section 10.3.2.4 for wiring notes, Figure 30 for wiring schematic, Figure 33 for single cavity housing and Figure 34 for dual cavity housing.

Note: Agency controlled installation drawings can be found on the Kenco website at www.kenco-eng.com.

>For (U.S.) Explosion-Proof / Flameproof Digital Output installation drawings, refer to 651552-11.

>For (Canada) Explosion-Proof / Flameproof Digital Output installation drawings, refer to 651552-12.

10.3.2.1 Specific conditions for safe use

- Warning:** The equipment contains non-metallic enclosure and process parts. To prevent the risk of electrostatic sparking, the non-metallic surface should be cleaned with a damp cloth. Painted surfaces of the equipment may store an electrostatic charge and become a source of ignition in applications with a low relative humidity (<~30%) when the painted surface is somewhat free of surface contamination such as dirt, dust or oil. Cleaning of the painted surfaces should only be done with a damp cloth.
- Cables shall be rated >9° F (>5° C) above maximum ambient temperature.
- To maintain the ingress protection rating of IP65, PTFE tape (3 wraps) or pipe dope shall be used. Refer to installation instructions.
- In the U.S., the equipment can be installed in the boundary wall between a Zone 0 area and the less hazardous Zone 1 area. In this configuration, the process connection is installed in Zone 0, while the transmitter housing is installed in Zone 1. Refer to installation instructions.
In Canada, the equipment can be installed in the boundary wall between an EPL Ga area and the less hazardous EPL Gb area. In this configuration, the process connection is installed in EPL Ga, while the transmitter housing is installed in EPL Gb. Refer to installation instructions.
- Flexible gauges have a minimum bend radius of 15" (381 mm).
- Flamepaths not for repair.
- The applicable temperature class, process temperature range and ambient temperature range of the equipment is as follows:
 - T3 Process range = -40° F to +302° F (-40° C to +150° C)
 - T4 Process range = -40° F to +275° F (-40° C to +135° C)
 - T5 Process range = -40° F to +212° F (-40° C to +100° C)
 - T6 Process range = -40° F to +185° F (-40° C to +85° C)
 - Ambient range = -40° F ≤ Ta ≤ +160° F (-40° C ≤ Ta ≤ +71° C)
- When mounting on a magnetic level gauge housing, make sure the electronic head and pressure barrier have a minimum spacing of 5" (127 mm). See installation manual for detail.

10.3.2.2 Explosion-Proof / Flameproof Labels

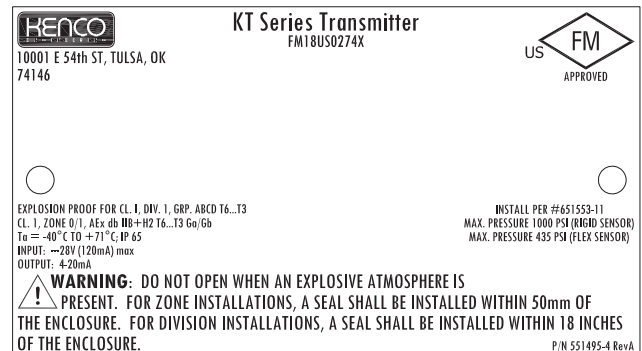


Figure 21: Analog Output Label (U.S.) for Epoxy Coated Aluminum Single Cavity and Dual Cavity Housings

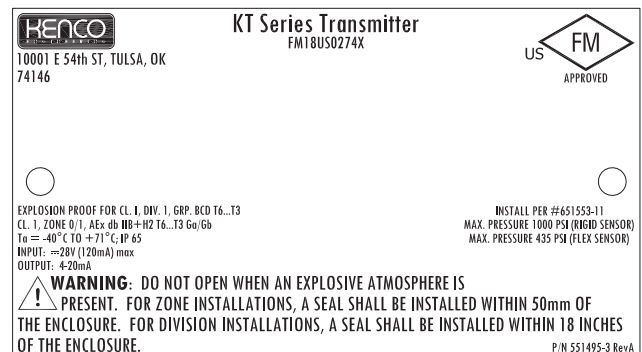


Figure 22: Analog Output Label (U.S.) for 316 Stainless Steel Single Cavity Housing

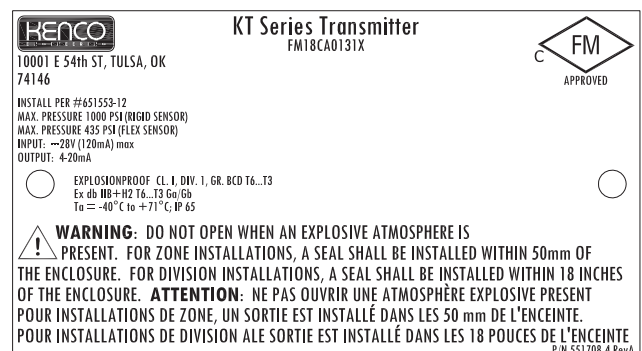


Figure 23: Analog Output Label (Canada) for Epoxy Coated Aluminum Single Cavity and Dual Cavity Housings

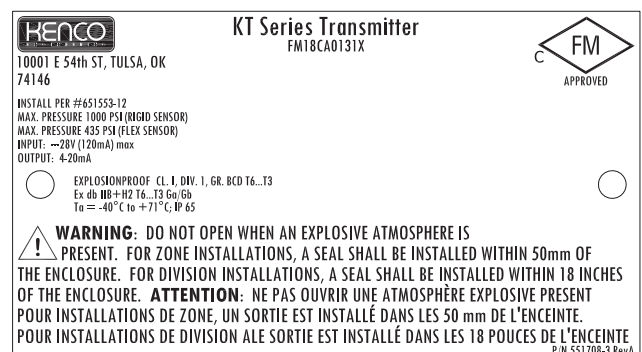


Figure 24: Analog Output Label (Canada) for 316 Stainless Steel Single Cavity Housing

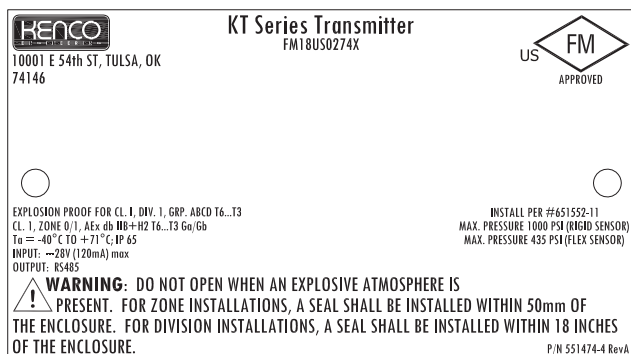


Figure 25: Digital Output Label (U.S.) for Epoxy Coated Aluminum Single Cavity and Dual Cavity Housings

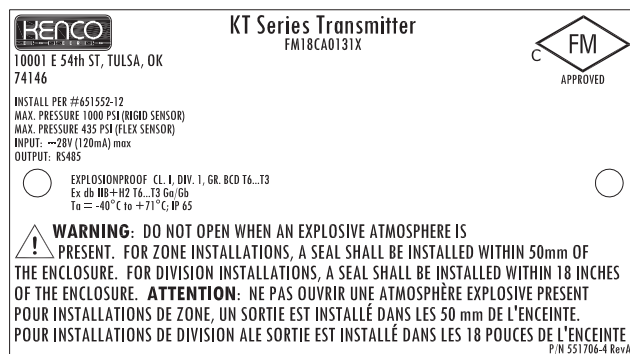


Figure 27: Digital Output Label (Canada) for Epoxy Coated Aluminum Single Cavity and Dual Cavity Housings

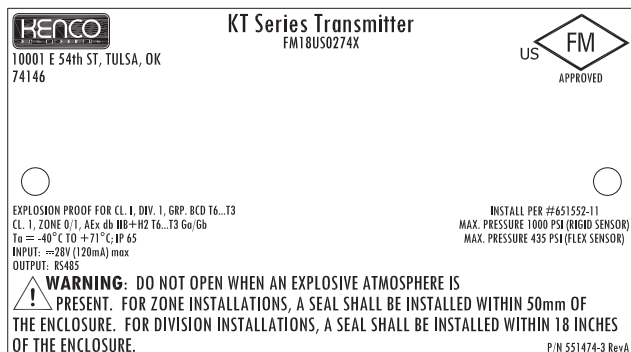


Figure 26: Digital Output Label (U.S.) for 316 Stainless Steel Single Cavity Housing

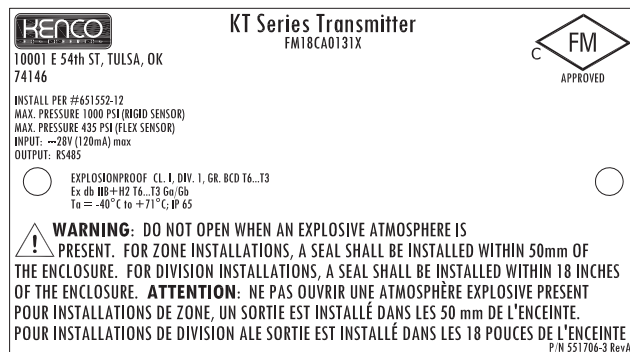
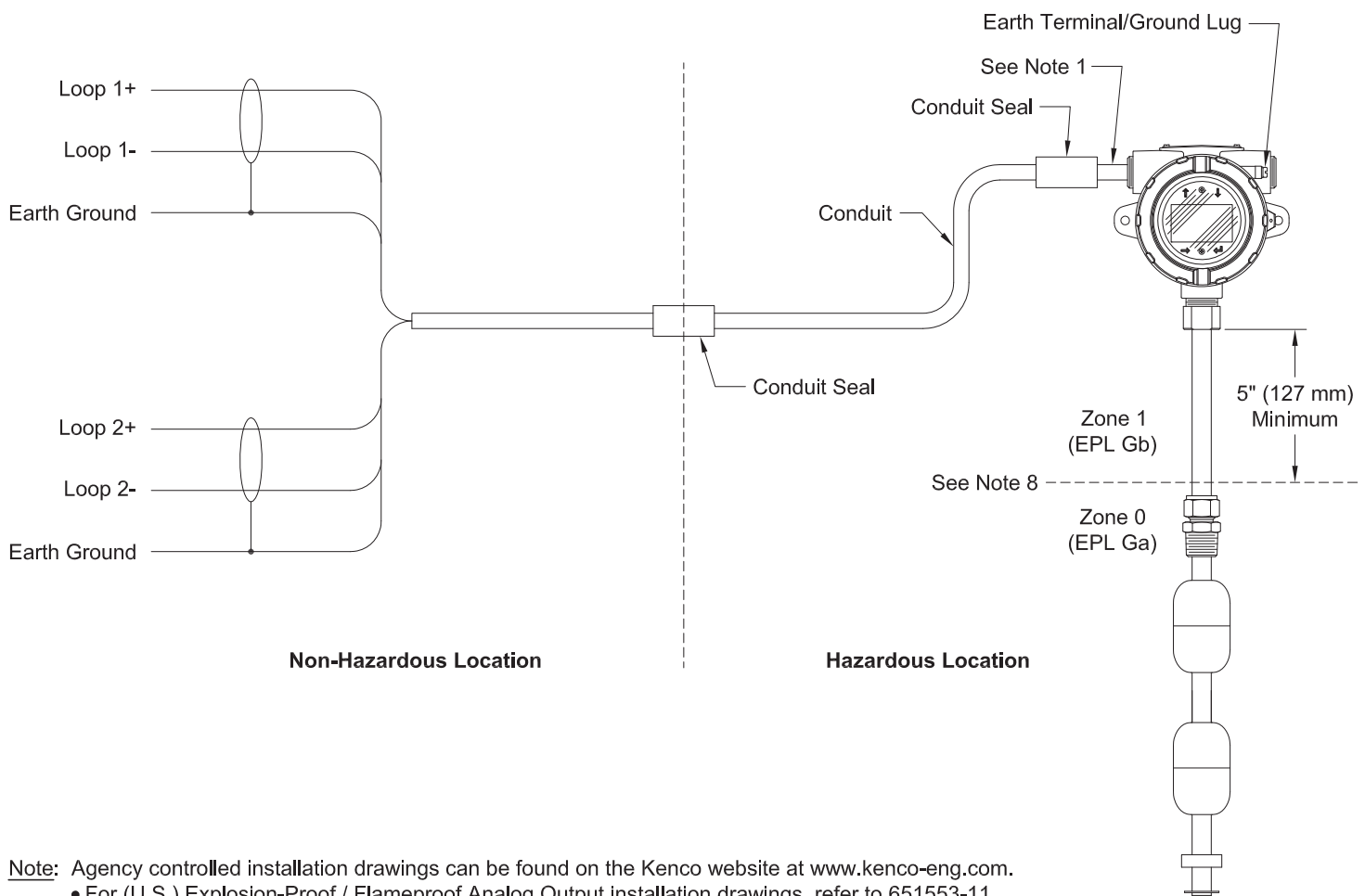


Figure 28: Digital Output Label (Canada) for 316 Stainless Steel Single Cavity Housing

10.3.2.3 Explosion-Proof / Flameproof Analog Output Wiring Notes

1. All national and local codes and regulations must be adhered to when installing the level sensor in hazardous environments. For Zone installations, a seal shall be installed within 2" (50 mm) of the enclosure. For Division installations, a seal shall be installed within 18" (457 mm) of the enclosure.
2. Dual cavity enclosures:
Customer connections will be made at terminal block on power side of housing (not to terminal block on interconnect board). See Figure 20.
3. **Caution:** Flexible gauges have a minimum bend radius of 15" (381 mm).
4. **Warning:** To prevent ignition of flammable or combustible atmospheres, disconnect power before servicing.
5. **Warning:** The equipment contains non-metallic enclosure and process parts. To prevent the risk of electrostatic sparking, the non-metallic surface and process parts should only be cleaned with a damp cloth. Painted surfaces of the equipment may store an electrostatic charge and become a source of ignition in applications with a low relative humidity (<~30%) when the painted surface is somewhat free of surface contamination such as dirt, dust or oil. Cleaning of the painted surfaces should only be done with a damp cloth.
6. Cables shall be rated >9° F (>5° C) above maximum ambient temperature.
7. To maintain the ingress protection rating of IP65, PTFE tape (3 wraps) or pipe dope shall be used. Refer to the installation instructions.
8. In the U.S., the equipment can be installed in the boundary wall between a Zone 0 area and the less hazardous Zone 1 area. In this configuration, the process connection is installed in a Zone 0 area, while the transmitter housing is installed in a Zone 1 area.
In Canada, the equipment can be installed in the boundary wall between an EPL Ga area and the less hazardous EPL Gb area. In this configuration, the process connection is installed in EPL Ga, while the transmitter housing is installed in EPL Gb.
9. The applicable temperature class, process temperature range and ambient temperature range of the equipment is as follows:
 - T3 Process range = -40° F to +302° F (-40° C to +150° C)
 - T4 Process range = -40° F to +275° F (-40° C to +135° C)
 - T5 Process range = -40° F to +212° F (-40° C to +100° C)
 - T6 Process range = -40° F to +185° F (-40° C to +85° C)
 - Ambient range = -40° F ≤ Ta ≤ +160° F (-40° C ≤ Ta ≤ +71° C)
10. When mounting on a magnetic level gauge housing, make sure the electronic head and pressure barrier have a minimum spacing of 5" (127 mm). See installation manual for detail.
11. Flamepaths are not for repair.

Explosion-Proof / Flameproof Analog Output



Note: Agency controlled installation drawings can be found on the Kenco website at www.kenco-eng.com.

- For (U.S.) Explosion-Proof / Flameproof Analog Output installation drawings, refer to 651553-11.
- For (Canada) Explosion-Proof / Flameproof Analog Output installation drawings, refer to 651553-12.

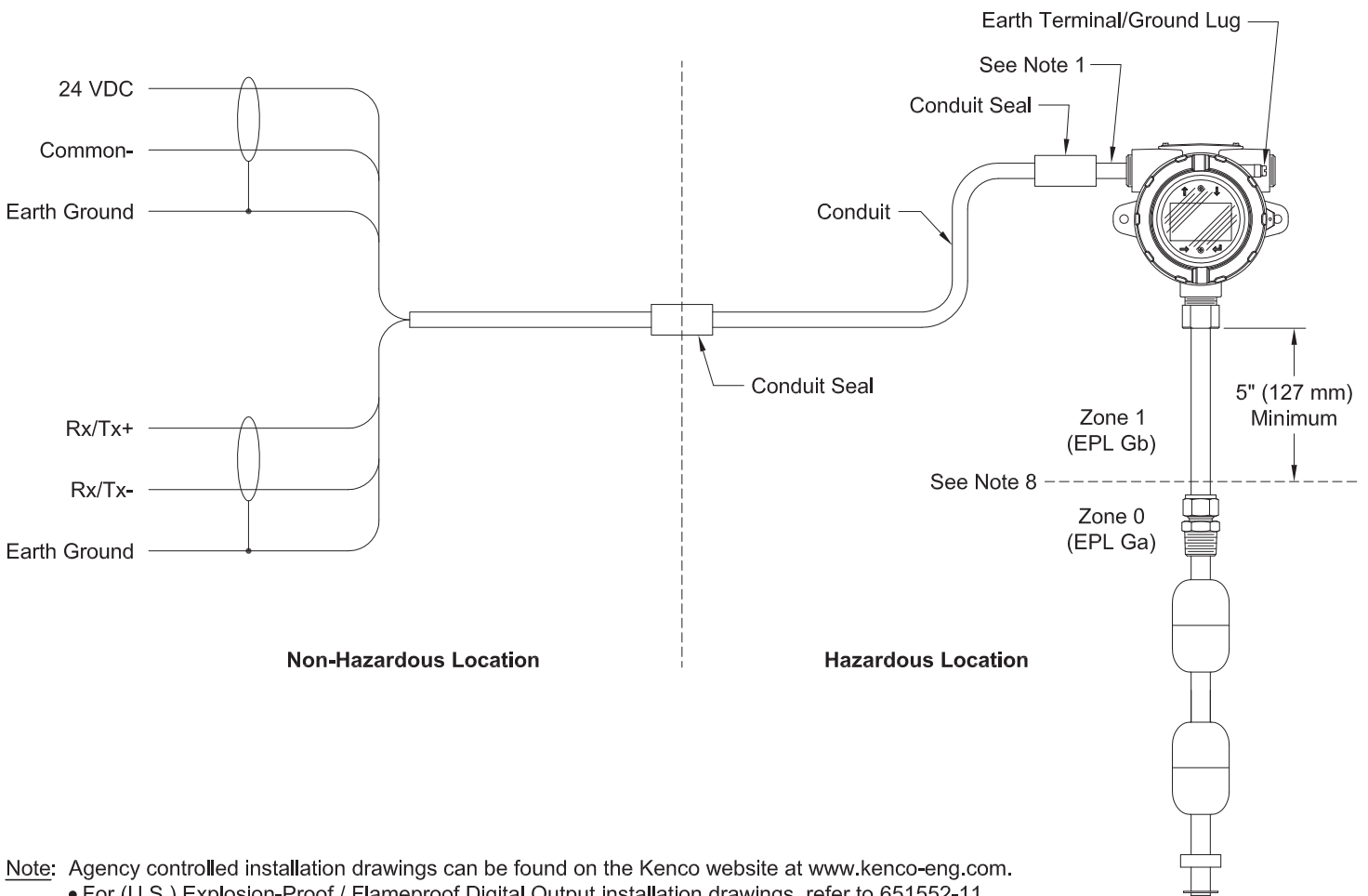
Figure 29: Explosion-Proof / Flameproof Analog Output Wiring Schematic

10.3.2.4 Explosion-Proof / Flameproof Digital Output Wiring Notes

1. All national and local codes and regulations must be adhered to when installing the level sensor in hazardous environments. For Zone installations, a seal shall be installed within 2" (50 mm) of the enclosure. For Division installations, a seal shall be installed within 18" (457 mm) of the enclosure.
2. Dual cavity enclosures:
Customer connections will be made at terminal block on power side of housing (not to terminal block on interconnect board). See Figure 22.
3. **Caution:** Flexible gauges have a minimum bend radius of 15" (381 mm).
4. **Warning:** To prevent ignition of flammable or combustible atmospheres, disconnect power before servicing.
5. **Warning:** The equipment contains non-metallic enclosure and process parts. To prevent the risk of electrostatic sparking, the non-metallic surface and process parts should only be cleaned with a damp cloth. Painted surfaces of the equipment may store an electrostatic charge and become a source of ignition in applications with a low relative humidity (<~30%) when the painted surface is somewhat free of surface contamination such as dirt, dust or oil. Cleaning of the painted surfaces should only be done with a damp cloth.

6. Cables shall be rated $>9^{\circ}\text{F}$ ($>5^{\circ}\text{C}$) above maximum ambient temperature.
7. To maintain the ingress protection rating of IP65, PTFE tape (3 wraps) or pipe dope shall be used. Refer to the installation instructions.
8. In the U.S., the equipment can be installed in the boundary wall between a Zone 0 area and the less hazardous Zone 1 area. In this configuration, the process connection is installed in a Zone 0 area, while the transmitter housing is installed in a Zone 1 area.
In Canada, the equipment can be installed in the boundary wall between an EPL Ga area and the less hazardous EPL Gb area. In this configuration, the process connection is installed in EPL Ga, while the transmitter housing is installed in EPL Gb.
9. The applicable temperature class, process temperature range and ambient temperature range of the equipment is as follows:
 - T3 Process range = -40°F to $+302^{\circ}\text{F}$ (-40°C to $+150^{\circ}\text{C}$)
 - T4 Process range = -40°F to $+275^{\circ}\text{F}$ (-40°C to $+135^{\circ}\text{C}$)
 - T5 Process range = -40°F to $+212^{\circ}\text{F}$ (-40°C to $+100^{\circ}\text{C}$)
 - T6 Process range = -40°F to $+185^{\circ}\text{F}$ (-40°C to $+85^{\circ}\text{C}$)
 - Ambient range = $-40^{\circ}\text{F} \leq \text{Ta} \leq +160^{\circ}\text{F}$ ($-40^{\circ}\text{C} \leq \text{Ta} \leq +71^{\circ}\text{C}$)
10. When mounting on a magnetic level gauge housing, make sure the electronic head and pressure barrier have a minimum spacing of 5" (127 mm). See installation manual for detail.
11. Flamepaths are not for repair.

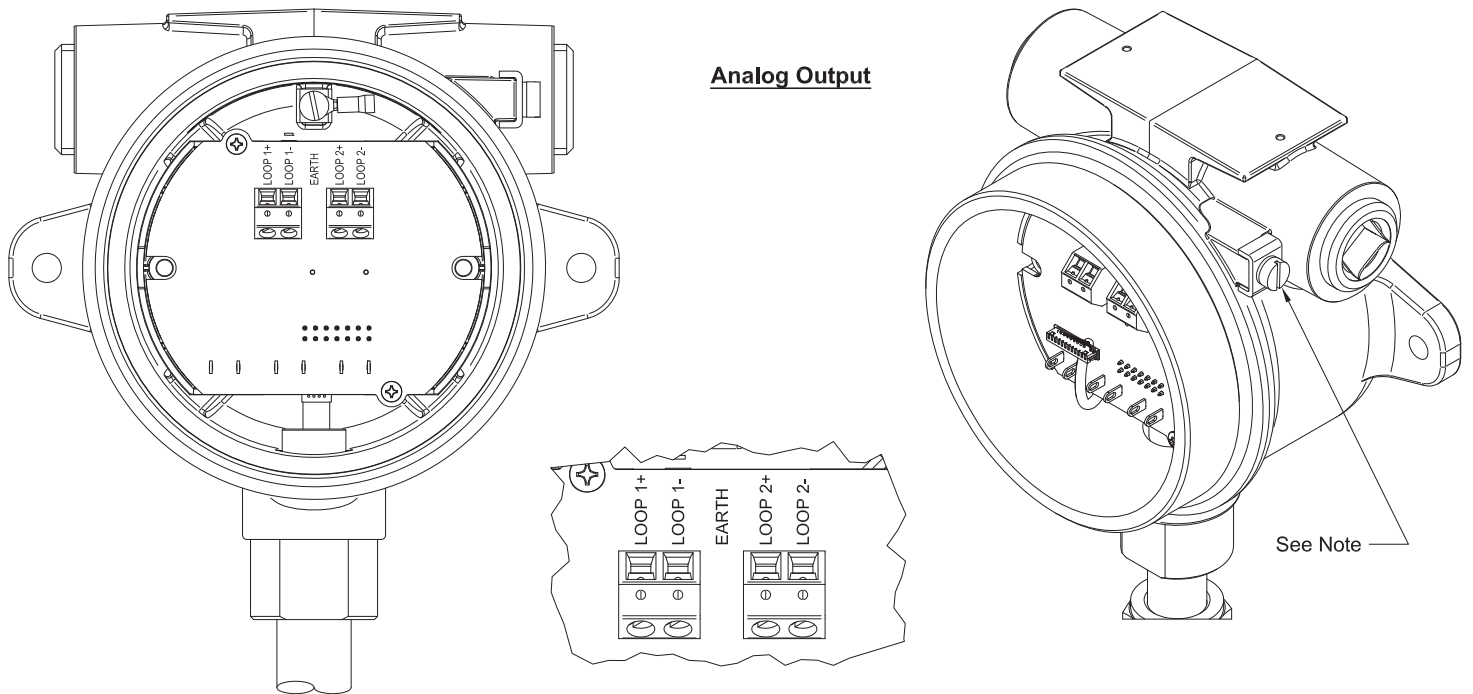
Explosion-Proof / Flameproof Digital Output



Note: Agency controlled installation drawings can be found on the Kenco website at www.kenco-eng.com.

- For (U.S.) Explosion-Proof / Flameproof Digital Output installation drawings, refer to 651552-11.
- For (Canada) Explosion-Proof / Flameproof Digital Output installation drawings, refer to 651552-12.

Figure 30: Explosion-Proof / Flameproof Digital Output Wiring Schematic

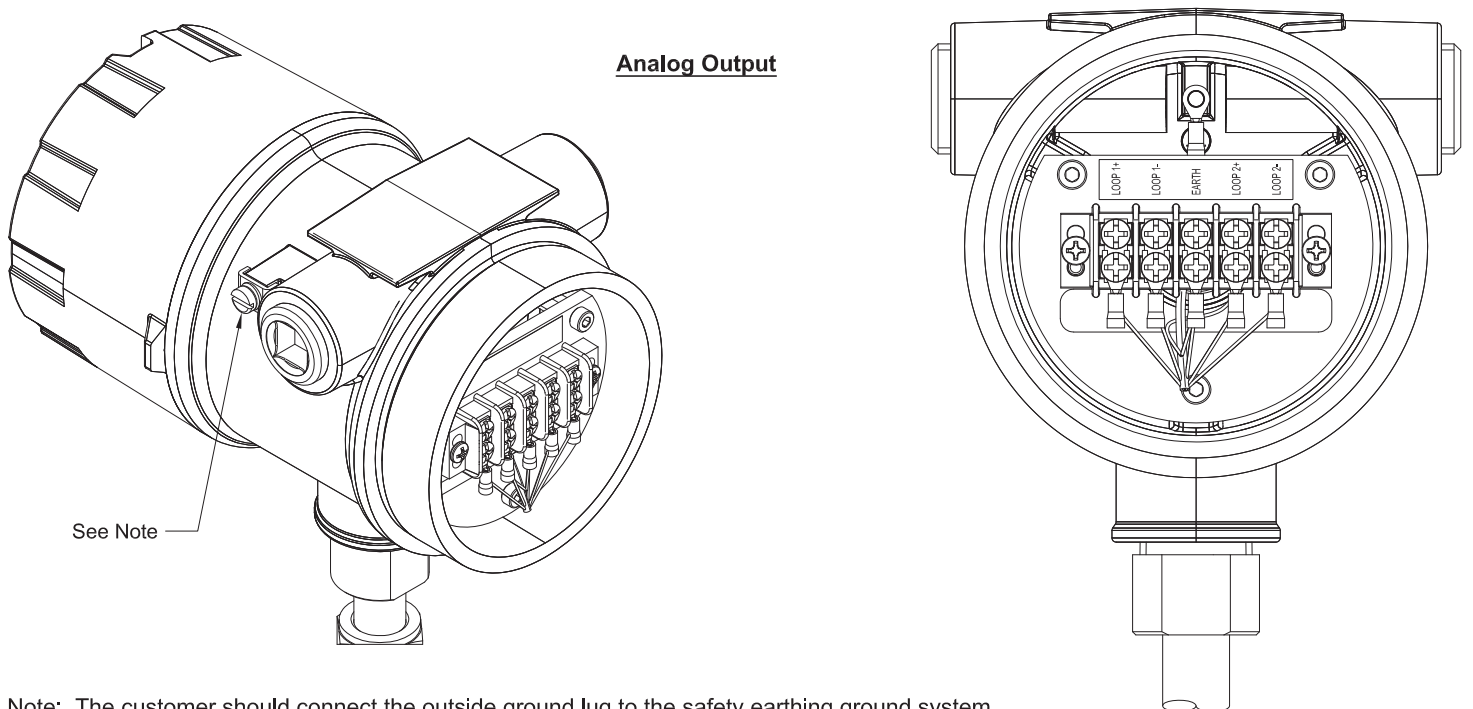


Note: The customer should connect the outside ground lug to the safety earthing ground system.

Warnings:

- Intrinsically Safe applications: Conduit seals are required within 18" (457 mm) of housing.
- Explosion-Proof / Flameproof applications: For Zone installations, a seal shall be installed within 2" (50 mm) of the enclosure. For Division installations, a seal shall be installed within 18" (457 mm) of the closure.

Figure 31: Single Cavity Housing (Analog Output)

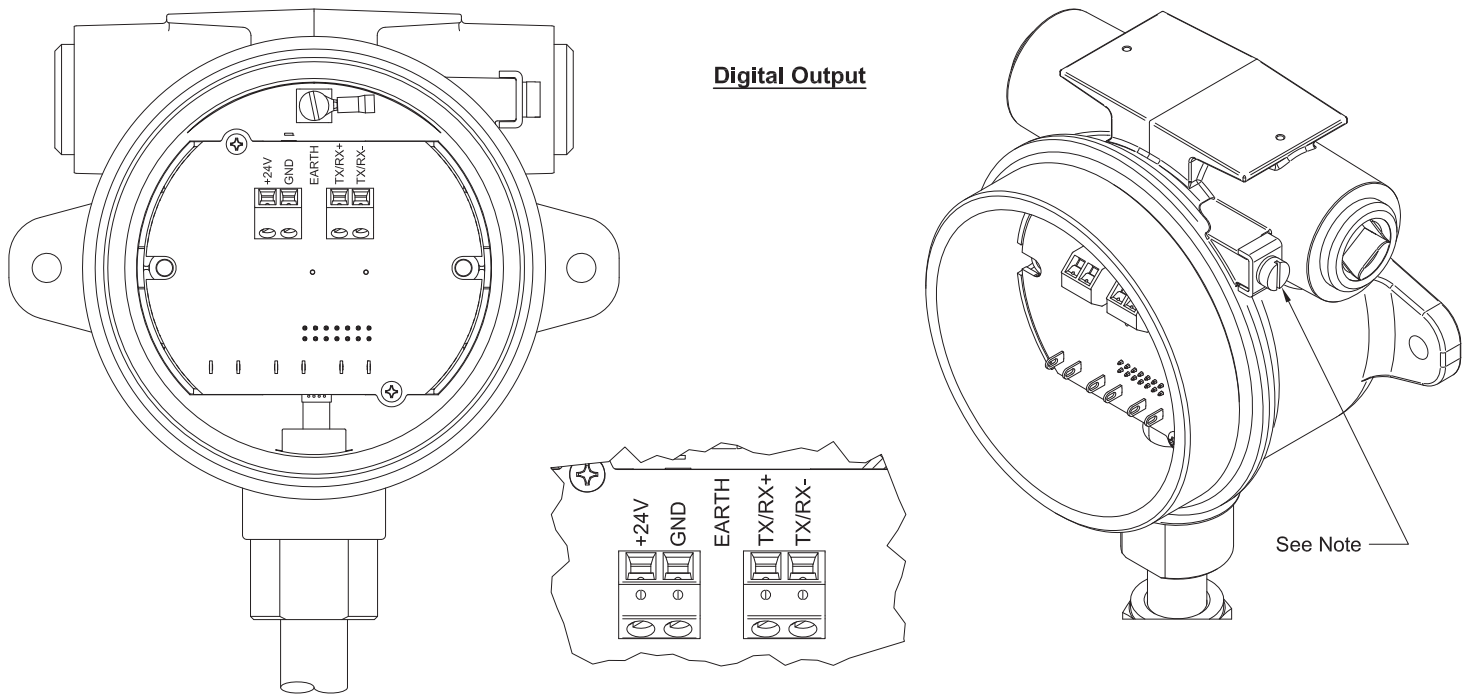


Note: The customer should connect the outside ground lug to the safety earthing ground system.

Warnings:

- Intrinsically Safe applications: Conduit seals are required within 18" (457 mm) of housing.
- Explosion-Proof / Flameproof applications: For Zone installations, a seal shall be installed within 2" (50 mm) of the enclosure. For Division installations, a seal shall be installed within 18" (457 mm) of the closure.

Figure 32: Dual Cavity Housing (Analog Output)

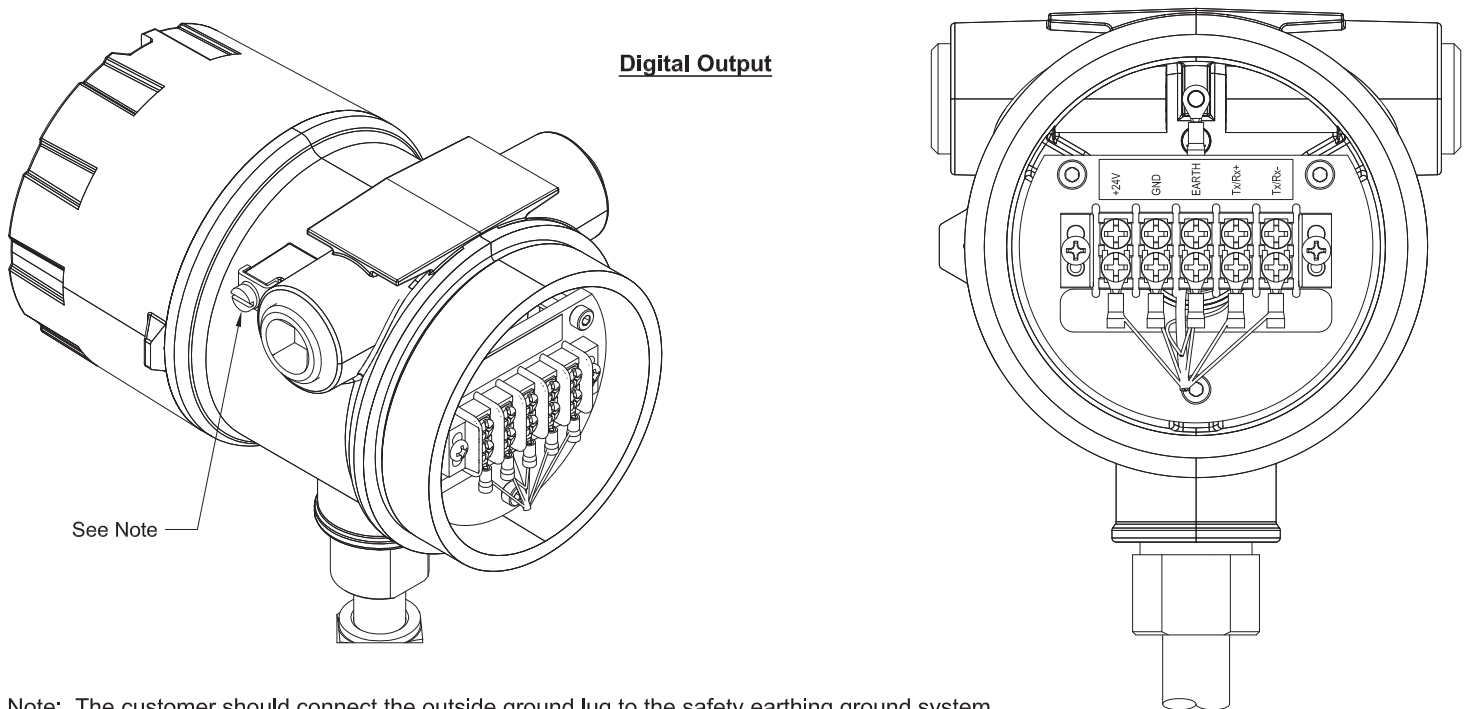


Note: The customer should connect the outside ground lug to the safety earthing ground system.

Warnings:

- **Intrinsically Safe applications:** Conduit seals are required within 18" (457 mm) of housing.
- **Explosion-Proof / Flameproof applications:** For Zone installations, a seal shall be installed within 2" (50 mm) of the enclosure. For Division installations, a seal shall be installed within 18" (457 mm) of the closure.

Figure 33: Single Cavity Housing (Digital Output)



Note: The customer should connect the outside ground lug to the safety earthing ground system.

Warnings:

- **Intrinsically Safe applications:** Conduit seals are required within 18" (457 mm) of housing.
- **Explosion-Proof / Flameproof applications:** For Zone installations, a seal shall be installed within 2" (50 mm) of the enclosure. For Division installations, a seal shall be installed within 18" (457 mm) of the closure.

Figure 34: Dual Cavity Housing (Digital Output)