

# Chamber Mounted Model "KTC" 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) when connected to a Kenco magnetic level gauge (KMLG). In conjunction with third-party devices and components recommended or approved by manufacturer, product may only be used for applications that do not exceed the product performance specifications in Section 4.5 and may only be installed in hazardous areas as specified by approval certifications in Section 10 following special conditions of use outlined in Section 10 or in safe areas. As a prerequisite of proper and safe operation, the product requires correct transport, storage, mounting and commissioning and must be operated with utmost care.

### 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.
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 4.5 for specifications.

Foreseeable misuse	Consequence
Power supply out of range	No communication. Possible damage to sensor. See Section 4.5 for specifications.
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 "KTC" chamber mounted liquid level transmitter is a continuous multi-functional magnetostrictive transmitter that provides product level 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 "KTC" chamber mounted liquid level transmitter consists of three main components: a housing, internal electronics and an outer pipe. Varying the components of the transmitter allows the transmitter to be customized to almost any application.

#### Housings

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

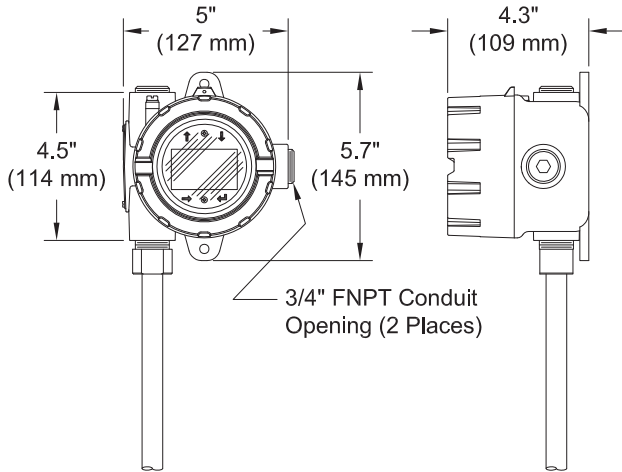


Figure 1: Single Cavity Explosion-Proof Housing

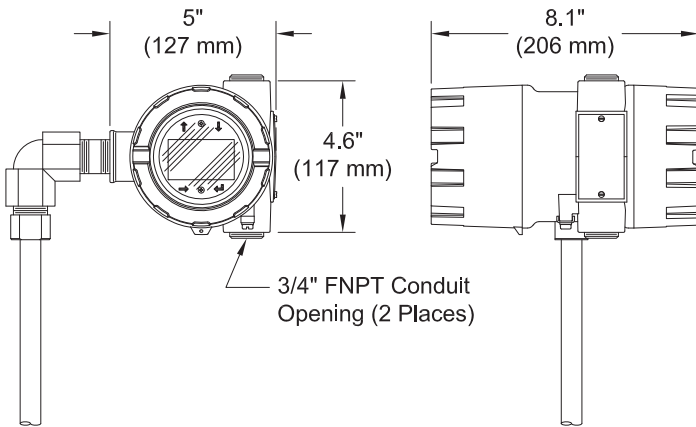


Figure 2: Dual Cavity Explosion-Proof Housing

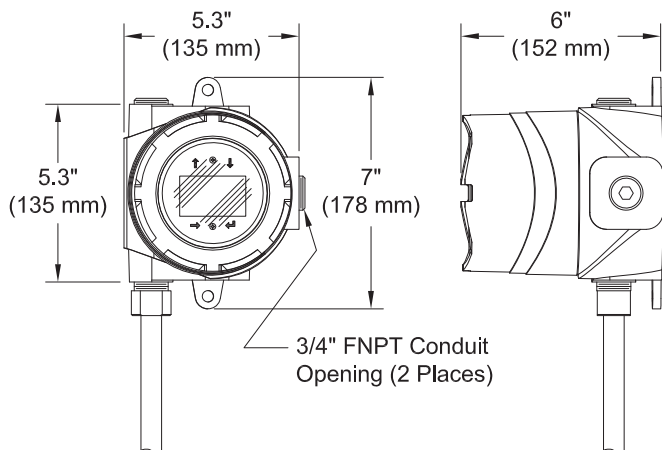


Figure 3: Stainless Steel Single Cavity Housing

#### Internal electronics

All transmitters come with two electronic components: a sensing element and a board set. The sensing element on the model "KTC" 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 and more. The product level measurement unit options are length, current, percent and volume. 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.

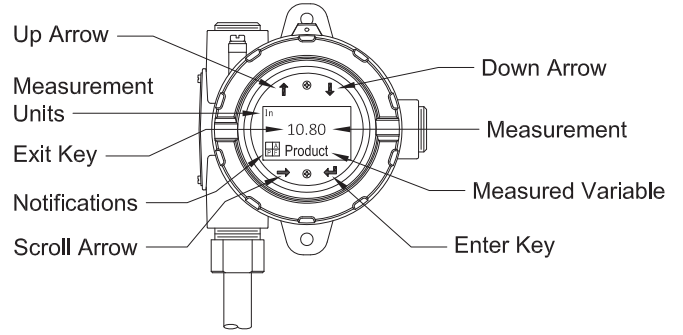
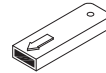


Figure 4: LCD Display

#### 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 Ø5/8" (Ø16 mm) tubing.

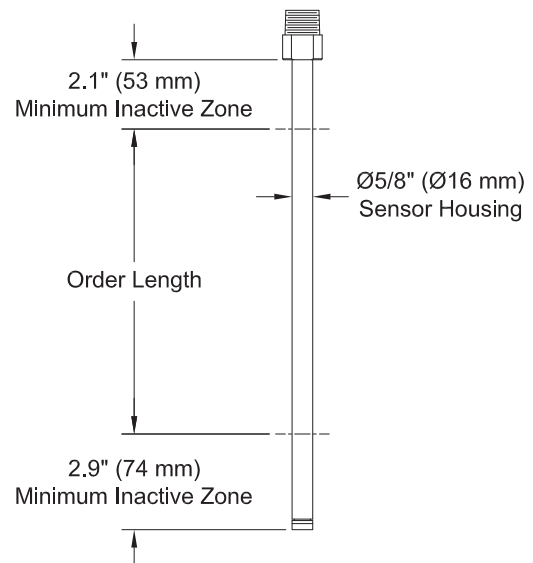


Figure 6: Outer Pipe Configuration

#### Accessories

A series of remote 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  $\pm 0.039$ " ( $\pm 1$  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. 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  $-40^{\circ}$  F ( $-40^{\circ}$  C) to  $160^{\circ}$  F ( $71^{\circ}$  C).

## 4. Installation and mounting

### 4.1 Training

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 Tools

- Adjustable Pliers
- Hexagon Key Wrenches
- Slotted Screwdrivers
- 5/16" Nut Driver, Socket or Adjustable Wrench
- Wire Strippers

### 4.3 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 required for work areas. Gloves are also recommended.

1. Consult Section 2.3 before starting.
2. Perform Commissioning Steps in Section 6.4.

#### Caution:

The ambient temperature rating,  $T_a = -40^{\circ}$  F ( $-40^{\circ}$  C) to  $160^{\circ}$  F ( $71^{\circ}$  C), must not be exceeded due to the mounting of the level transmitter to the magnetic level gauge and exposure to the process temperature.

### 4.4 Mounting

The "KTC" chamber mounted liquid level transmitter is mounted directly to the KMLG magnetic level gauge chamber pipe. The method of mounting the transmitter is dependent on the style of the magnetic level gauge. It can be installed anywhere around the perimeter of the chamber pipe that does not interfere with the level indicator or gauge process connections. A typical installation utilizes the existing KMLG level indicator mounting clamps as shown in Figure 7. If separate mounting clamps are used, it is extremely important to ensure that they are not magnetic, as this will interfere with the magnetic field of the KMLG float. Consult factory for details on ordering separate mounting clamps. Before tightening the mounting clamps around the rigid sensor tube of the transmitter, allow for the minimum inactive zone at the bottom of the rigid sensor tube by placing bottom of the sensor tube at least 2.9" (74 mm) below the centerline of the bottom gauge process connection as shown in Figure 7. Also, when the transmitter housing is located above the top of the KMLG magnetic level gauge as shown, the transmitter sensor tube can be rotated 360° to achieve the desired orientation of the transmitter housing. The transmitter may also be installed with the transmitter housing at the bottom of the KMLG magnetic level gauge. Contact factory for details.

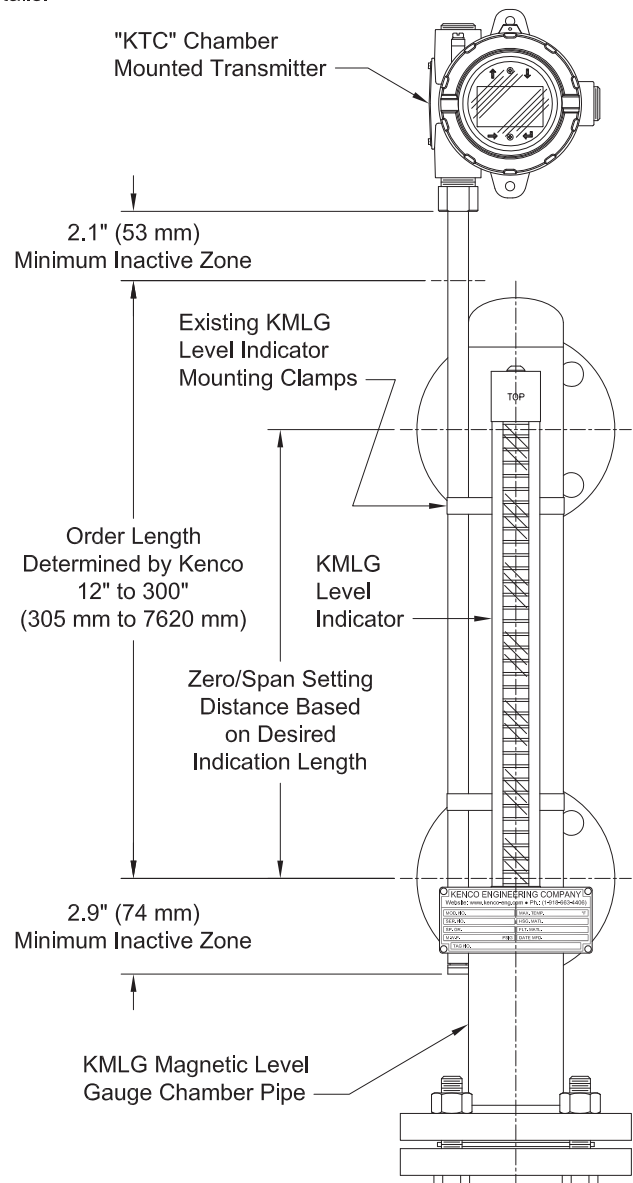


Figure 7: Chamber Mounted Single Cavity Explosion-Proof Housing

#### 4.5 Product specifications (Technical data)

Level Output		Specifications
Measured Variable		Product level
Output Signal / Protocol		Analog (4-20mA) with HART® / Modbus RTU / DDA
Order Length (Not including Inactive Zones)		12" to 300" (305 mm to 7620 mm)
Inherent Accuracy		±0.039" (±1 mm )
Repeatability (Any Direction)		0.001% F.S. or 0.015" (0.381 mm); whichever is greater.

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

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.
Materials	Sensor Housing	316L stainless steel; Contact factory for other materials.
	Electrical Housing	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		Existing non-magnetic stainless steel band clamps on magnetic level gauge. Separate mounting clamps can be provided. Contact factory for details.

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

4.6 Product ordering guide

<b>KTC</b>	-		-		-		-
<p><b>Kenco Transmitter Style:</b>  <b>KTC</b> = Chamber Mounted Sensor Housing</p>		<p><b>Output:</b>  <b>3</b> = 1 Loop with HART®  <b>6</b> = 1 Loop with HART® and SIL2  <b>M</b> = Modbus RTU (Remote Terminal Unit)  <b>D</b> = DDA (Direct Digital Access)</p>		<p><b>Housing Type:</b>  <b>D</b> = Single Cavity with Display (Epoxy Coated Aluminum)  <b>E</b> = Dual Cavity with Display (Epoxy Coated Aluminum)  <b>L</b> = Single Cavity with Display (316 Stainless Steel)</p>		<p><b>Electronics Mounting:</b>  <b>7</b> = Top Mount  <b>8</b> = Bottom Mount</p>	

<b>B</b>	-	<b>1</b>	-	<b>X</b>	-	<b>X</b>	-
<p><b>Sensor Housing:</b>  <b>B</b> = Rigid Ø5/8" (Ø16 mm) Tube</p>		<p><b>* Sensor Housing Material:</b>  <b>1</b> = 316L Stainless Steel</p> <p><i>* Contact factory for other available materials.</i></p>		<p><b>Mounting Connection Type:</b>  <b>X</b> = None</p>		<p><b>Mounting Connection Size:</b>  <b>X</b> = None</p>	

<b>0</b>	-	<b>X</b>	-		-		-
<p><b>Digital Thermometer Quantity:</b>  <b>0</b> = None</p>		<p><b>Digital Thermometer Placement:</b>  <b>X</b> = None</p>		<p><b>*Notified Body:</b>  <b>C</b> = CEC (FMC)  <b>F</b> = NEC (FM)  <b>X</b> = None</p> <p><i>*Other certifications available upon request.</i></p>		<p><b>Protection Method:</b>  <b>F</b> = Explosion-Proof and Flameproof  <b>I</b> = Intrinsically Safe  <b>X</b> = No Approval</p>	

	-		-		-	<b>S</b>	-
<p><b>Gas Group:</b>  <b>A</b> = Group A (Not available with Notified Body "C" and Protection Method "F")  <b>B</b> = Group B  <b>C</b> = Group C  <b>D</b> = Group D  <b>3</b> = IIC (Intrinsically Safe only)  <b>4</b> = IIB+H2 (Explosion-Proof and Flameproof only)  <b>X</b> = None</p>		<p><b>Order Length Unit of Measure:</b>  <b>U</b> = US Customary (Inches)  <b>M</b> = Metric (Millimeters)</p>		<p><b>*Order Length:</b>  <b>XXXXX</b> = Inches (12 to 300)  Enter Length Code as 01200 to 30000  <b>XXXXX</b> = mm (305 to 7620)  Enter Length Code as 00305 to 07620</p> <p><i>*Order Length equals measurement range, but does not include inactive zones.</i></p>		<p><b>Special:</b>  <b>S</b> = Standard Product</p>	

**Example Model Designation:** KTC-3-D-7-B-1-X-X-0-X-X-X-X-U-01200-S

**Ordering Notes:** Accessories such as cables, remote displays, and separate mounting clamps can be provided, but have to be ordered separately. Contact factory for details.



## 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.

### 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 8. This topology is not usually used with a bus network since it does not take advantage of placing multiple devices on a loop.

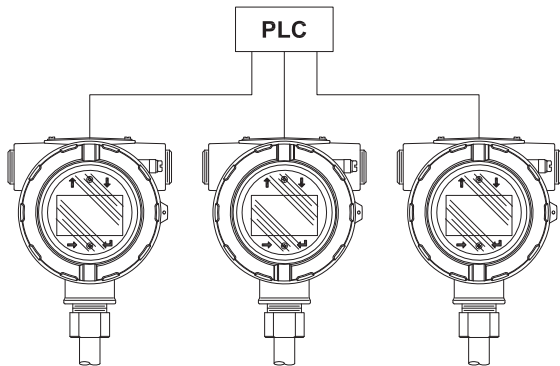


Figure 8: Point-to-Point Topology

#### 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 9. The bus with spurs and tree topologies can also be used together to form a hybrid topology.

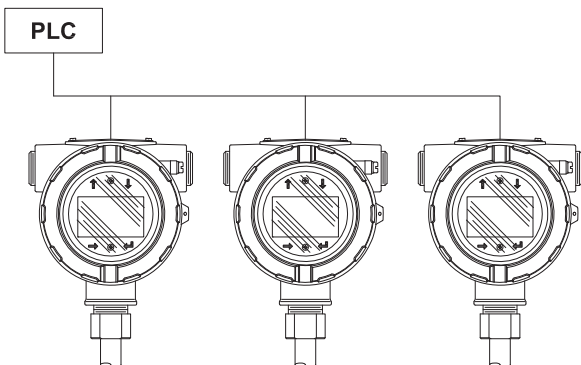


Figure 9: Bus with Spurs Topology

#### 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 10. Bus with spurs and tree topologies can also be used together to form a hybrid topology.

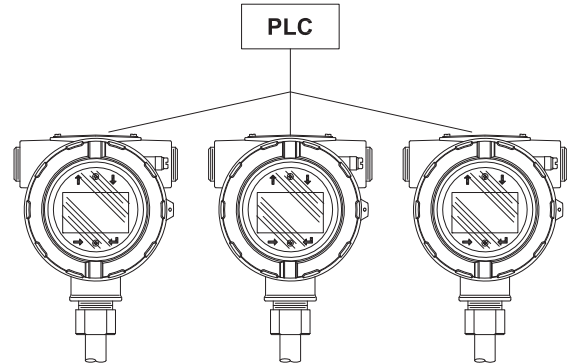


Figure 10: Tree Topology

#### 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 11. Factory does not suggest using the daisy-chain topology.

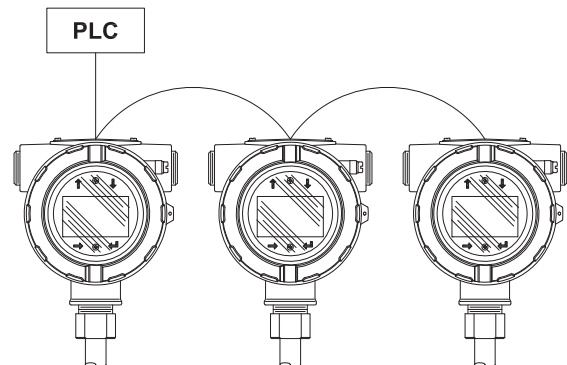


Figure 11: Daisy-Chain Topology

### 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. Use side conduit entry only.
3. In high humidity areas, use a breather drain type conduit sealing fitting to minimize moisture intrusion.
4. For Division Installations, an approved conduit seal is required within 18" (457 mm) of the enclosure.
5. For Zone Installations, an approved conduit seal is required within 2" (50 mm) of the enclosure.

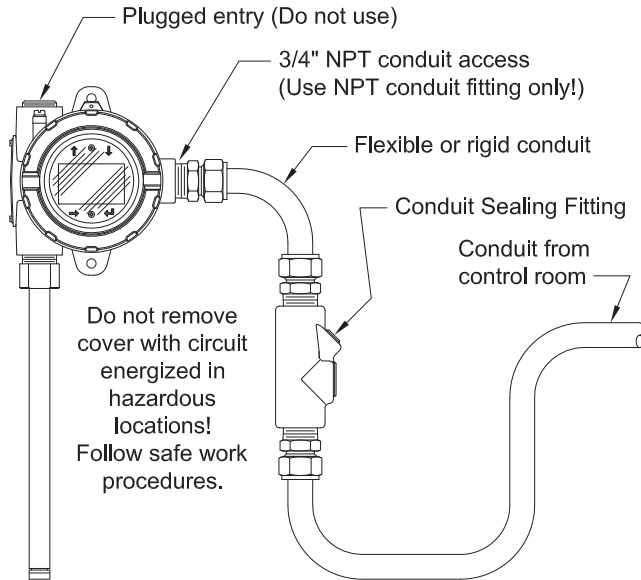


Figure 12: Electrical Conduit Installation

## 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. Refer to Table 3 for safety barrier references.

- 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 $\mu$ F
	Pi = 700 mW
Digital communication (2 per LT)	Ui = 8.6 Vdc
	Ii = 10 mA
	Ci = 0.0 $\mu$ F
	Pi = 21.5 mW
Analog (1 per loop)	Ui = 28 Vdc
	Ii = 120 mA
	Ci = 0 $\mu$ F
	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
- 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. Mount on magnetic level gauge housing and test with float from magnetic level gauge.
4. Connect power, RS485 to USB converter, and PC.
5. Open Setup Software.
6. Establish Communication.
7. For DDA Interface - Set Address. Default 192.
8. For Modbus Interface - Set Address. Default address 247.
9. Disconnect Power and Communication.
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.

#### 6.4.2 HART®

1. Consult Section 2.3 before starting.
2. Remove level transmitter from shipping container.
3. Mount on magnetic level gauge housing and test with float from magnetic level gauge.
4. Connect power, HART® to USB converter, and PC.
5. Open Setup Software.
6. Establish Communication.
7. Set/Update 4 and 20 mA setpoints.
8. Disconnect Power and Communication.
9. Complete Installation in Section 4.4.
10. Have qualified technician perform hand measurement. Enter hand measurement into Setup Software and calibrate.
11. 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
- Common Head Screwdriver, Slotted Screwdriver

### 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 float, there is no need for preventative maintenance, but routine inspection is still suggested. For severe service applications where there is the potential for buildup on the float, then preventative maintenance is required.

## 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
- Phillips Head Screwdriver
- Common Head 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: R2012; CSA C22.2 No. 1010.1: R2004; CAN/CSA C22.2 No. 60079-0: 2011; CAN/CSA C22.2 No. 60079-11: 2014; CAN/CSA C22.2 No. 60529: R2005
	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

Notified Body	Protection Method	Classifications	Standards
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](http://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 17 for wiring schematic, Figure 29 for single cavity housing and Figure 30 for dual cavity housing.

**Note:** Agency controlled installation drawings can be found on the Kenco website at [www.kenco-eng.com](http://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 18 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](http://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

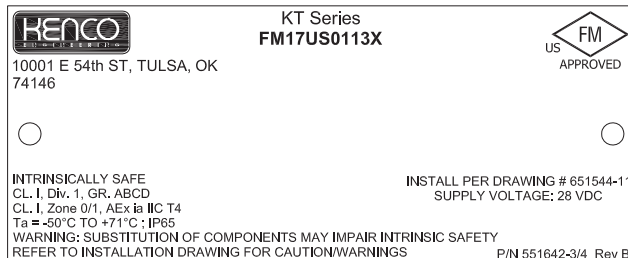


Figure 13: Intrinsically Safe Analog Output Label (U.S.)



Figure 14: Intrinsically Safe Analog Output Label (Canada)

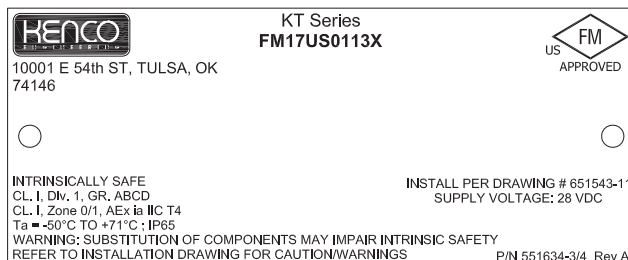


Figure 15: Intrinsically Safe Digital Output Label (U.S.)



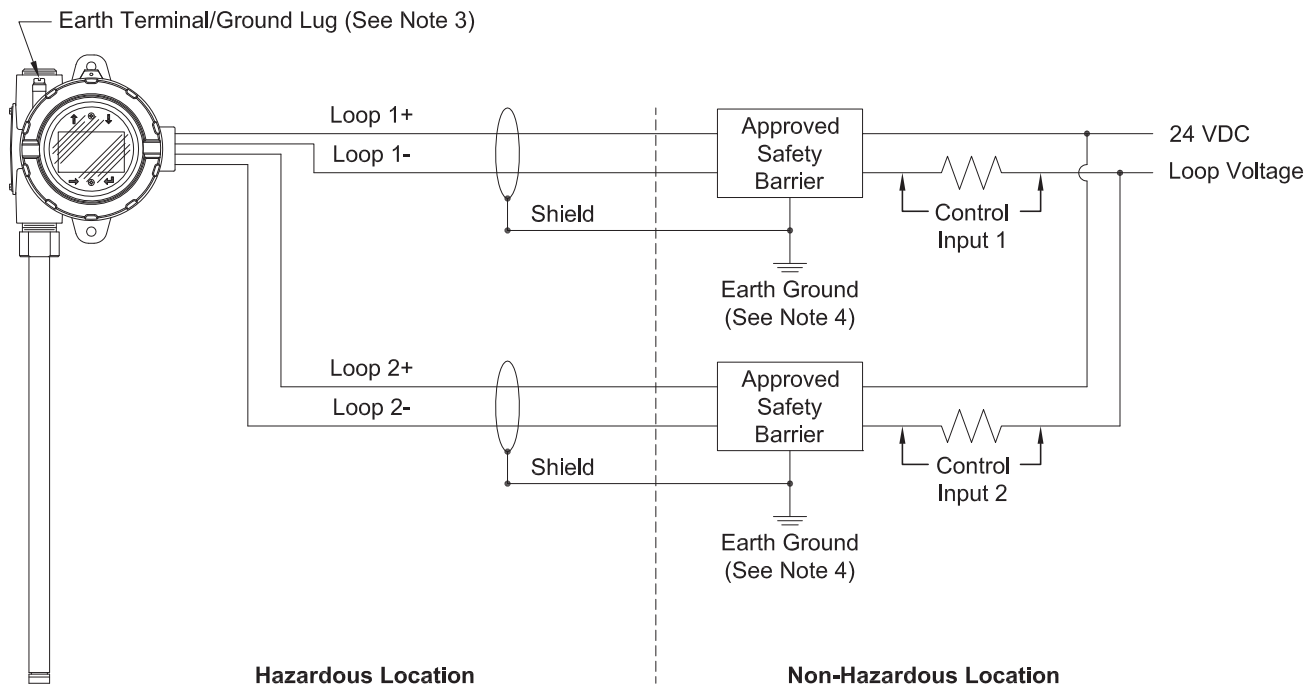
Figure 16: Intrinsically Safe Digital Output Label (Canada)

### 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 mm<sup>2</sup> to 1.6 mm<sup>2</sup>) 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<sub>i</sub> = 28 VDC
  - I<sub>i</sub> = 120 mA
  - C<sub>i</sub> = 0 μF
  - L<sub>i</sub> = 5 μH
  - P<sub>i</sub> = 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](http://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 17: Intrinsically Safe Analog Output Wiring Schematic

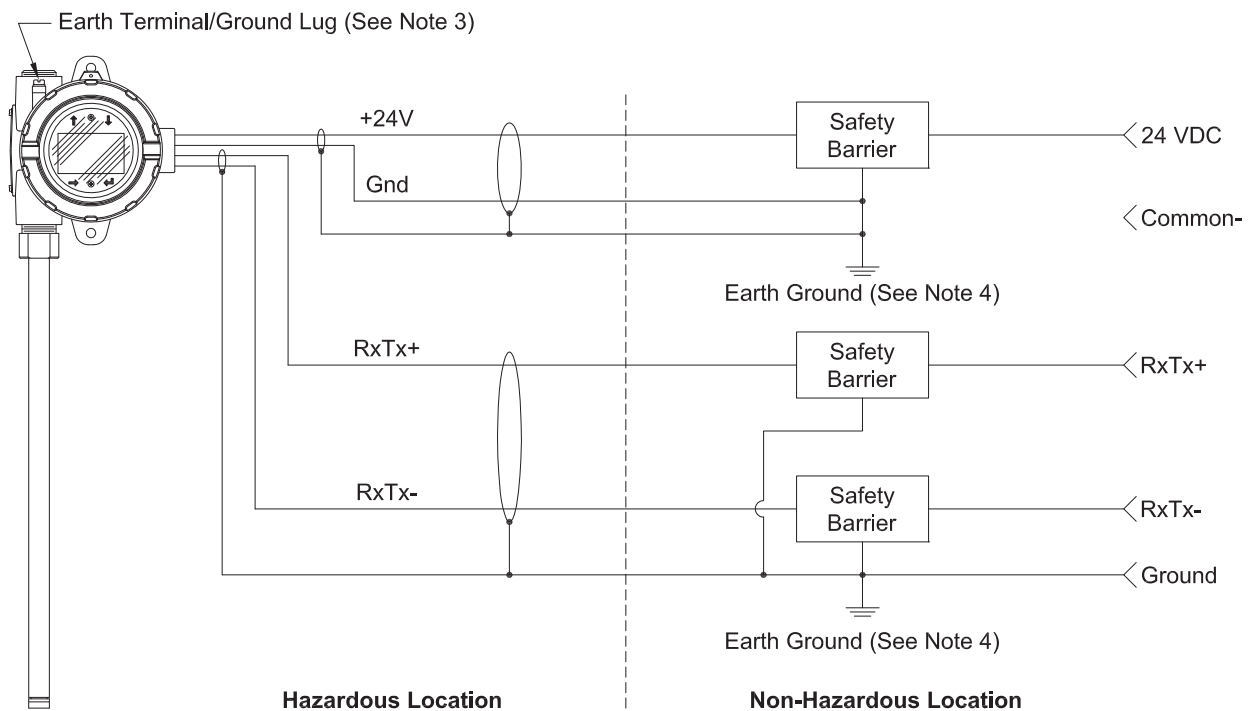
### 10.3.1.4 Intrinsically Safe Digital Output Wiring Notes

- 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).
- Loop cable must be 24 AWG to 14 AWG (0.511 mm<sup>2</sup> to 1.6 mm<sup>2</sup>) 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.
- The resistance between earth ground and the intrinsically safe ground must be less than 1 ohm.
- The transducer frame shall be grounded to earth ground directly or through the equipment on which it is mounted.
- Control equipment connected to associated apparatus must not use or generate more than 250 VRMS or VDC.
- Associated apparatus manufacturer's installation drawing must be followed when installing this equipment.
- Approved barriers:
  - In the U.S., only use NEC (e.g. FM) approved barriers.
  - In Canada, only use CEC approved barriers.
- 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
- 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<sub>max</sub> or Ii ≥ I<sub>sc</sub>, It or Io;
  - Pmax or Pi ≥ Po;
  - Ca ≥ Ci + C<sub>cable</sub>;
  - La ≥ Li + L<sub>cable</sub>.

- Dual-cavity enclosures: Customer connections will be made at terminal block on power side of housing (not to terminal block on interconnect board).
- 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.
- 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).
- Caution:** Flexible gauges have a minimum bend radius of 15" (381 mm).
- 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.
- Warning:** Substitution of components may impair intrinsic safety.
- Warning:** To prevent ignition of flammable or combustible atmospheres, disconnect power before servicing.
- 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](http://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 18: 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 27 for wiring schematic, Figure 29 for single cavity housing and Figure 30 for dual cavity housing.

Note: Agency controlled installation drawings can be found on the Kenco website at [www.kenco-eng.com](http://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 28 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](http://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

1. **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.
2. Cables shall be rated >9° F (>5° C) above maximum ambient temperature.
3. To maintain the ingress protection rating of IP65, PTFE tape (3 wraps) or pipe dope shall be used. Refer to installation instructions.
4. 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.
5. Flexible gauges have a minimum bend radius of 15" (381 mm).
6. Flamepaths not for repair.
7. 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)
8. 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

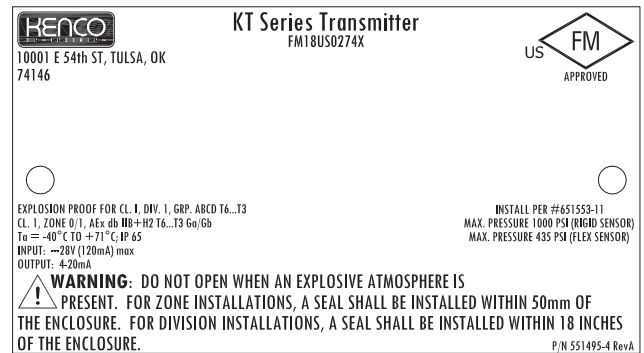


Figure 19: Explosion-Proof Analog Output Label (U.S.) for Epoxy Coated Aluminum Single Cavity and Dual Cavity Housings

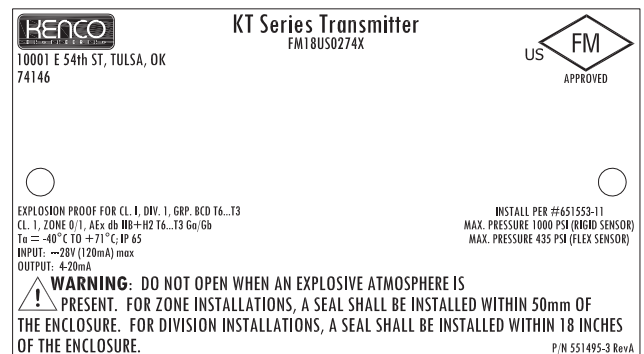


Figure 20: Explosion-Proof Analog Output Label (U.S.) for 316 Stainless Steel Single Cavity Housing

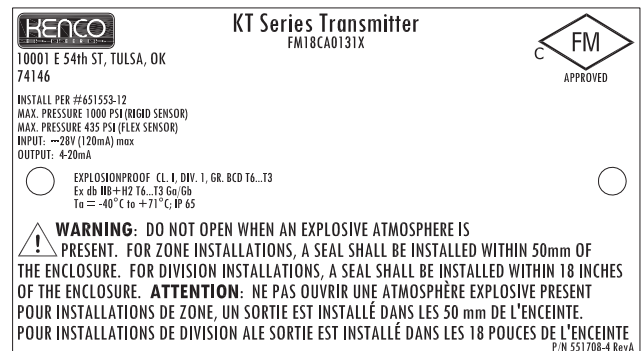


Figure 21: Explosion-Proof Analog Output Label (Canada) for Epoxy Coated Aluminum Single Cavity and Dual Cavity Housings



Figure 22: Explosion-Proof Analog Output Label (Canada) for 316 Stainless Steel Single Cavity Housing



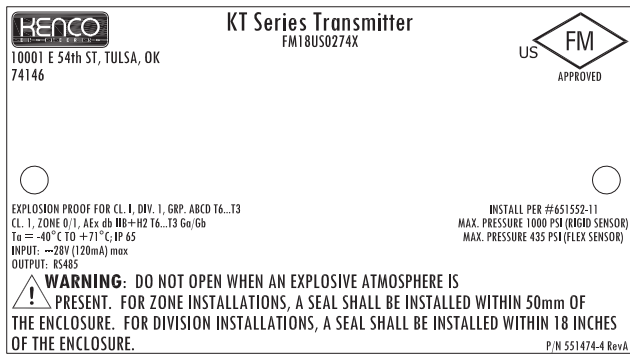


Figure 23: Explosion-Proof Digital Output Label (U.S.) for Epoxy Coated Aluminum Single Cavity and Dual Cavity Housings

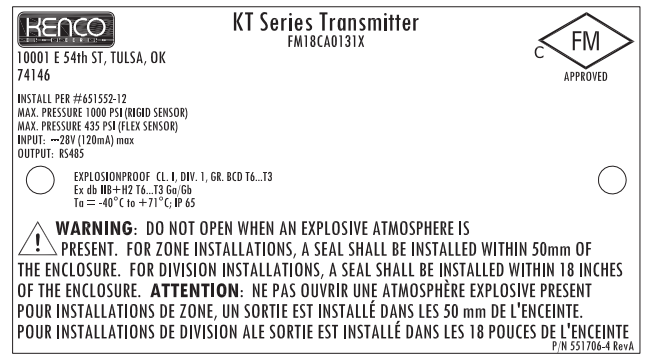


Figure 25: Explosion-Proof Digital Output Label (Canada) for Epoxy Coated Aluminum Single Cavity and Dual Cavity Housings

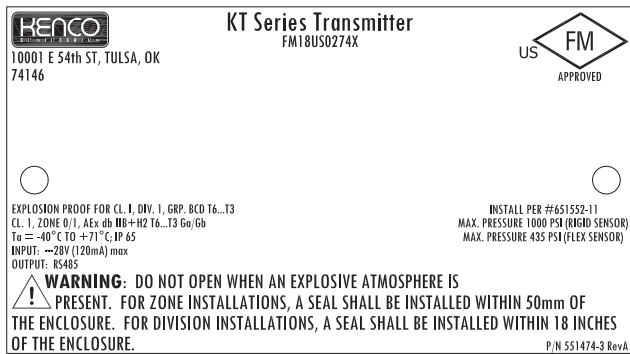


Figure 24: Explosion-Proof Digital Output Label (U.S.) for 316 Stainless Steel Single Cavity Housing

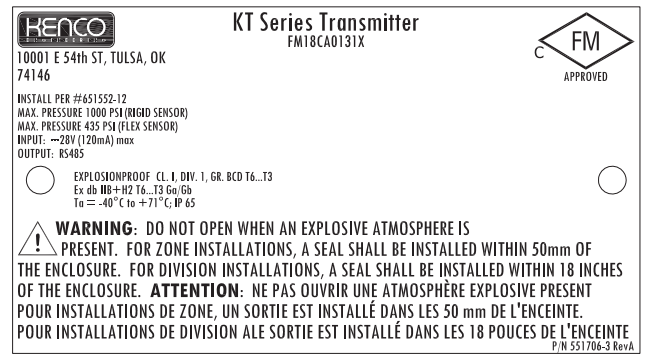
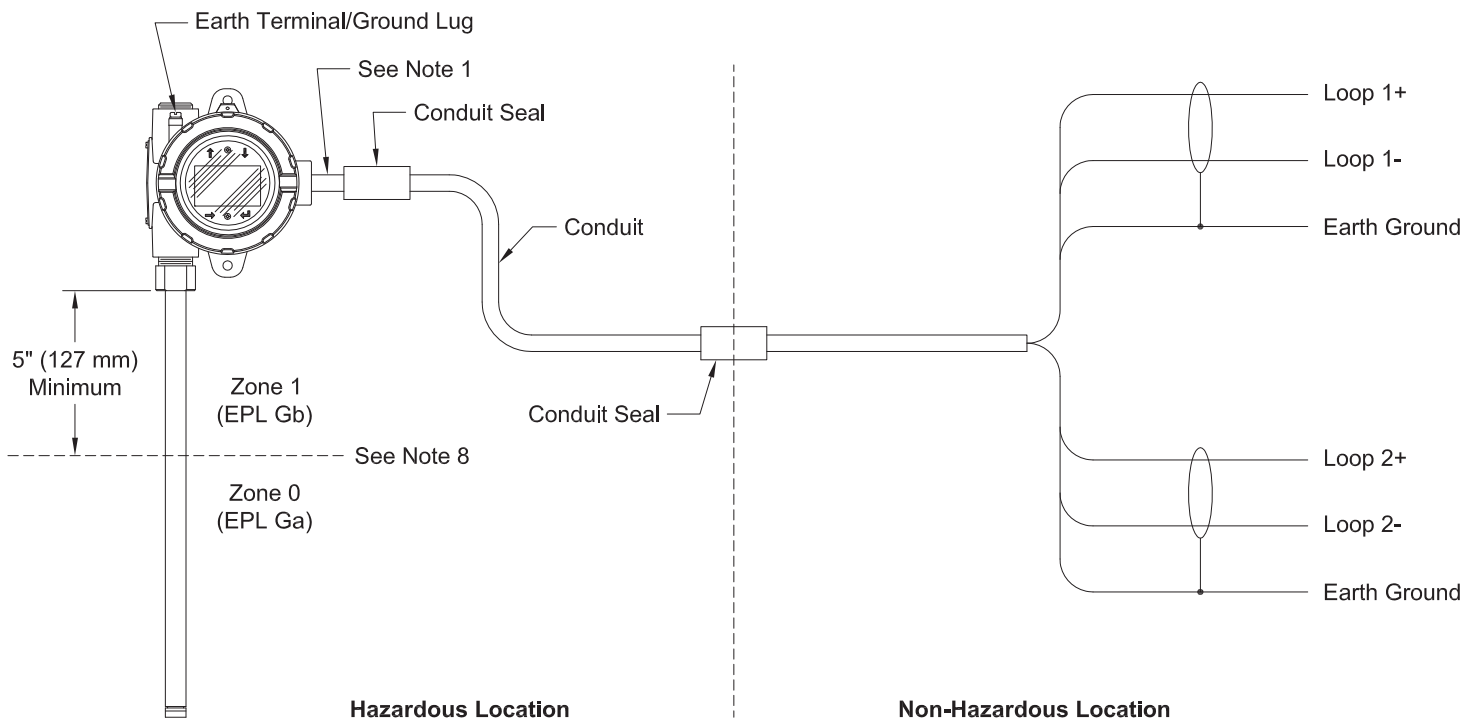


Figure 26: Explosion-Proof Digital Output Label (Canada) for 316 Stainless Steel Single Cavity Housing

### 10.3.2.3 Explosion-Proof / Flameproof Analog Output Wiring Notes

- 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.
- 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 18.
- Caution:** Flexible gauges have a minimum bend radius of 15" (381 mm).
- Warning:** To prevent ignition of flammable or combustible atmospheres, disconnect power before servicing.
- 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.
- 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 the 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 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.
- 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.
- 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](http://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.

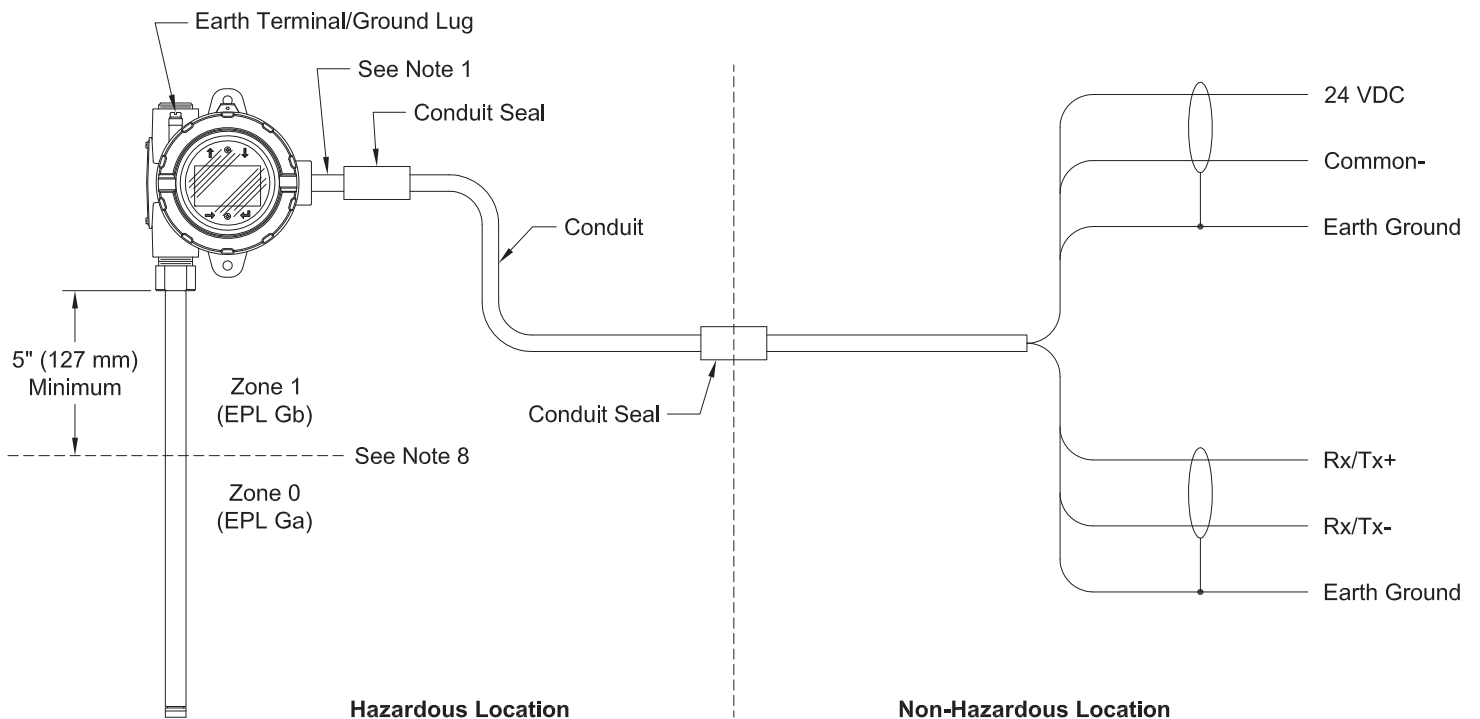
Figure 27: Explosion-Proof / Flameproof Analog Output Wiring Schematic

**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 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.

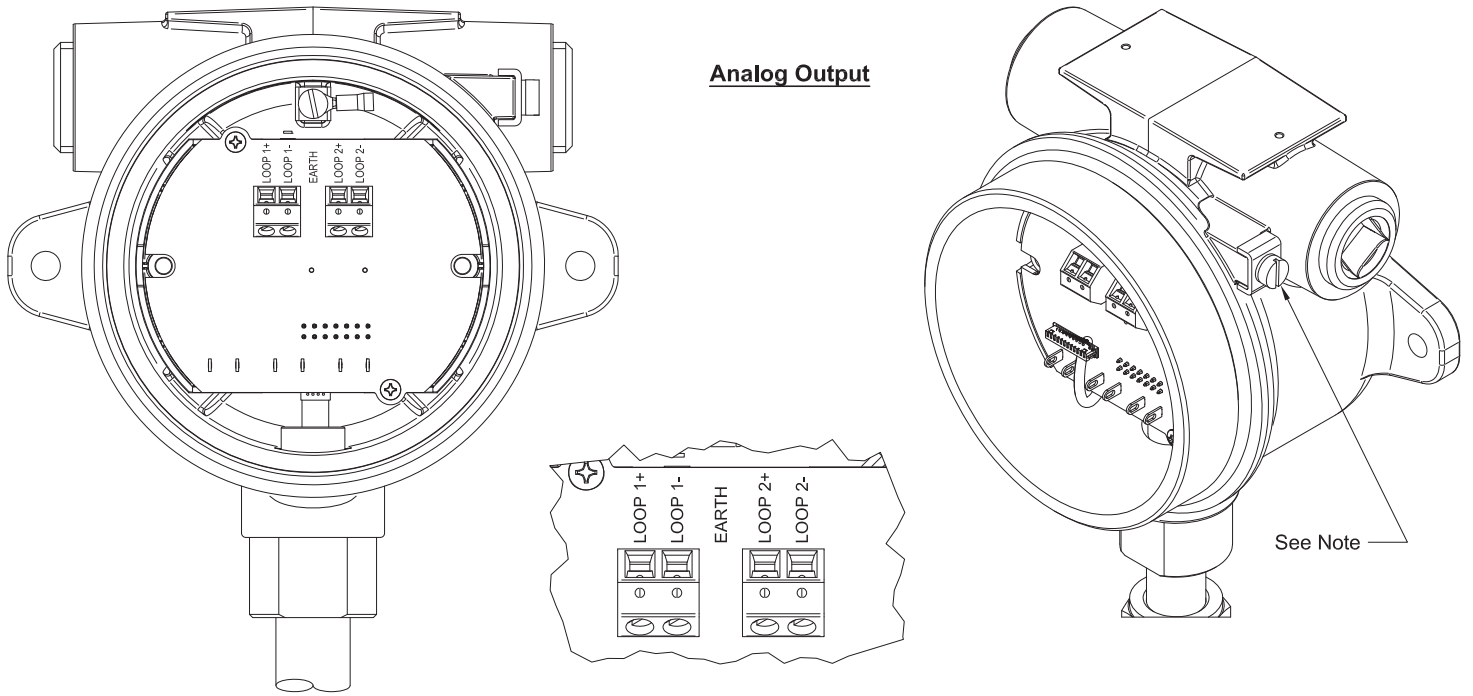
6. Cables shall be rated >9° F (>5° C) above maximum ambient temperature.
7. To maintain the ingress protection rating of IP65, PTFE tape (3 wraps) or pipe dope shall be used. Refer to the installation instructions.
8. In the U.S., the equipment can be installed in the boundary wall between a Zone 0 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 Digital Output**



**Note:** Agency controlled installation drawings can be found on the Kenco website at [www.kenco-eng.com](http://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 28: Explosion-Proof / Flameproof Digital Output Wiring Schematic

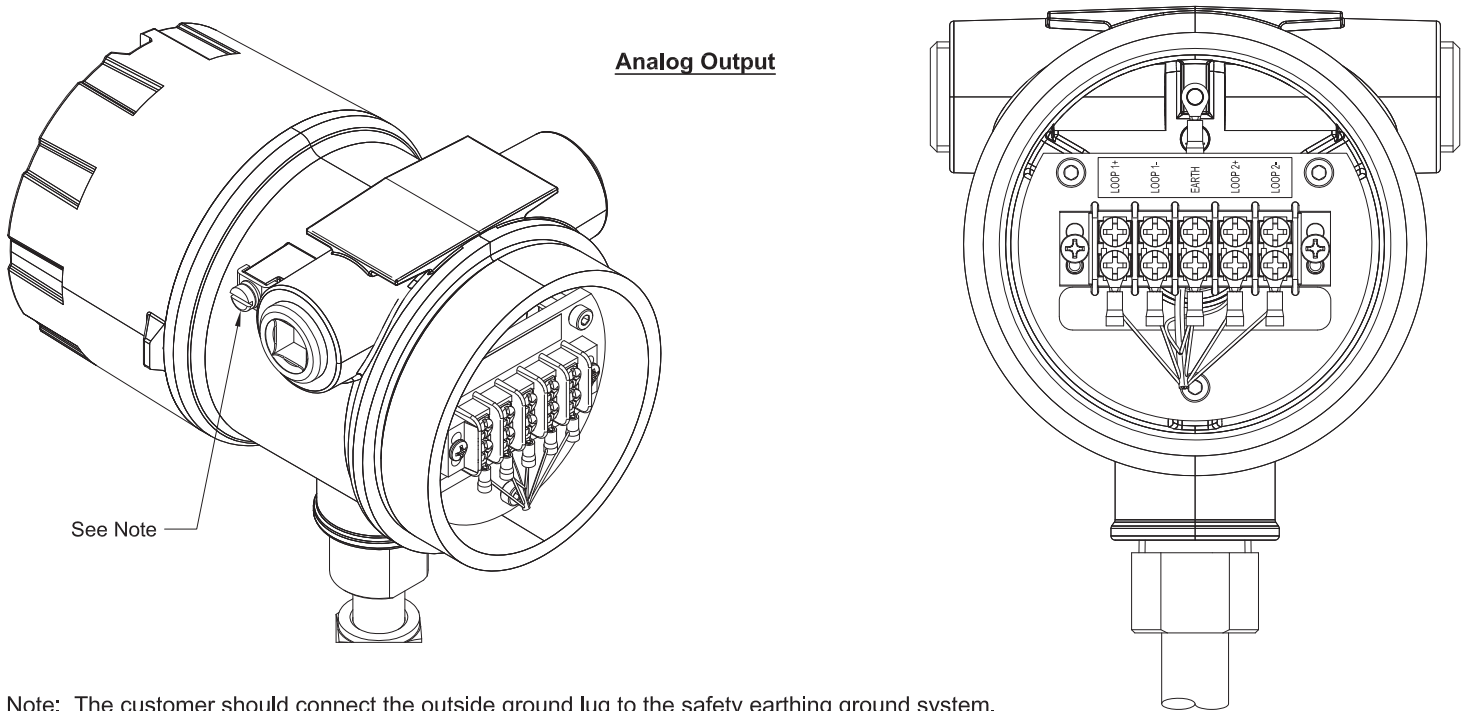


**Note:** The customer should connect the outside ground lug to the safety earthing ground system.

**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 29: Single Cavity Housing (Analog Output)

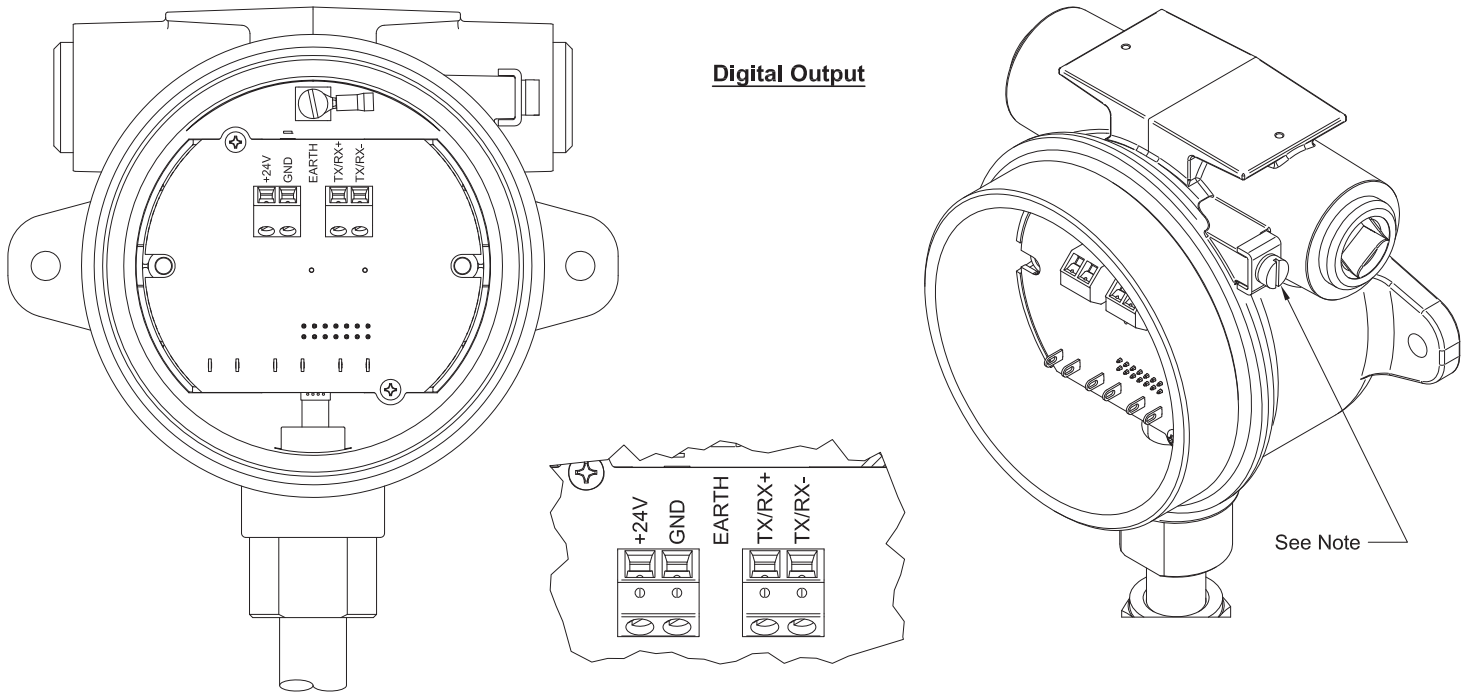


**Note:** The customer should connect the outside ground lug to the safety earthing ground system.

**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 30: Dual Cavity Housing (Analog Output)

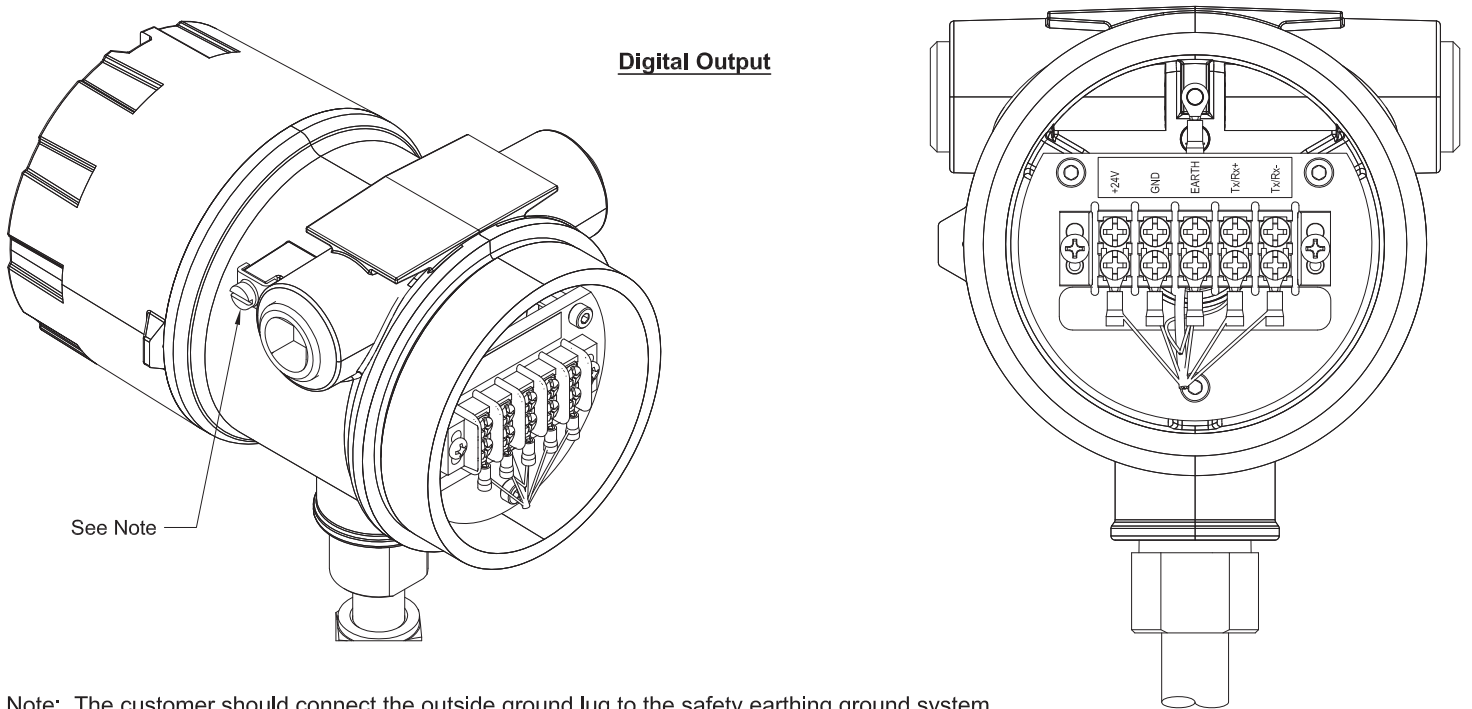


**Note:** The customer should connect the outside ground lug to the safety earthing ground system.

**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 31: 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 32: Dual Cavity Housing (Digital Output)