

TRO2E/E6

FLOAT LEVEL TRANSMITTER

INSTALLATION AND OPERATIONS MANUAL

Loop-Powered Float Level Transmitter
For Hazardous Locations



SOLUTIONS WITH INNOVATION

AN INNOVATIVE SENSING COMPANY

ISO 9001:2008 CERTIFIED



READ THIS MANUAL PRIOR TO INSTALLATION

This manual provides information on the **TR02E/E6 Loop-Powered Level Transmitter**. It is important that all instructions are read carefully and followed sequentially. The **QuickStart Installation** instructions are a brief guide to the sequence of steps for experienced technicians to follow when installing the equipment. Detailed instructions are included in the **Complete Installation** section of this manual.

Conventions Used in this Manual

Certain conventions are used in this manual to convey specific types of information. General technical material, support data and safety information are presented in narrative form. The following styles are used for notes, cautions and warnings:



Notes

Notes contain information that augments or clarifies an operating step. Notes do not normally contain actions and often follow the procedural steps to which they refer.



Cautions

Cautions alert the technician to special conditions that could injure personnel, damage equipment, or reduce a component's mechanical integrity. Cautions are also used to alert the technician of unsafe practices, the need for special protective equipment, or specific materials. In this manual, a caution indicates a potentially hazardous situation which, if not avoided, may result in minor to moderate injury.



Warnings

Warnings identify potentially dangerous situations, or serious hazards. In this manual, a warning indicates an imminently hazardous situation which, if not avoided, may result in serious injury or death.

Safety Messages

Follow all standard industry procedures for servicing electrical and computer equipment when working with, or around high voltage. Always shut off the power supply before touching any components. Although high voltage is not present in this system, it may be present in other systems.

Electrical components are sensitive to electrostatic discharge. To prevent equipment damage, observe all safety precautions when working with electrostatic-sensitive components.



WARNING!

DO NOT CONNECT OR DISCONNECT THE TRANSMITTERS UNLESS THE POWER HAS BEEN SWITCHED OFF.

Low Voltage Directive

If the equipment is used in a manner not specified by the manufacturer, protection provided by equipment may be impaired.

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Warranty

All Solutions With Innovation Electronic Level and Flow Controls are warranted free of defects in materials and workmanship for one full year from the date of the original factory shipment. If returned within the warranty period; and, upon factory inspection of the control, the cause of the claim is determined to be covered under the warranty; then, Solutions With Innovation will repair or replace the product at no cost to the purchaser (or owner) other than transportation.

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The Quality Assurance System in place at Solutions With Innovation guarantees the highest level of quality throughout the company. Solutions With Innovation is committed to providing full customer satisfaction; both in quality products and in quality service.

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TR02E/E6

FLOAT LEVEL TRANSMITTER

For Hazardous Locations

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1.0 QUICKSTART INSTALLATION

The Quickstart Installation procedures provide key steps for mounting, wiring and configuring the TR02E/E6 Loop-Powered Level Transmitter for Hazardous Locations. These procedures are intended for experienced installers of electronic level measurement instruments. Refer to **Section 2.0: Complete Installation** for detailed installation instructions.

 **WARNING!** TR02E/E6 TRANSMITTER PROBES SHOULD BE INSTALLED WHERE THE MAXIMUM OVERFILL LEVEL IS AT A MINIMUM OF 1" (24.5 MM) BELOW THE PROCESS CONNECTION. THIS MAY INCLUDE UTILIZING A NOZZLE OR SPOOL PIECE TO RAISE THE PROBE. CONSULT THE MANUFACTURER TO ENSURE PROPER INSTALLATION.

 **CAUTION!** THIS UNIT CONTAINS REED SWITCHES THAT MAY BE PERMANENTLY DAMAGED BY MECHANICAL SHOCK OR VIBRATION. AVOID DROPPING OR HITTING THE DEVICE AGAINST HARD SURFACES.

1.1 GETTING STARTED

Before beginning the Quickstart Installation procedures, have the proper equipment, tools and information readily available.

1.1.1 Equipment and Tools


- Open-End Wrenches or An Adjustable Wrench to Fit the Process Connection Size and Type
- Small Flat Blade Screwdriver
- Cable Cutter & Wire Strippers
- Digital Multimeter or Digital Volt/Ammeter
- 24 VDC Power Supply


1.1.2 Configuration Information

The TR02E/E6 Loop-Powered Level Transmitter for Hazardous Locations is factory-calibrated. Configuration is not required.

2.0 COMPLETE INSTALLATION

This section provides detailed procedures on properly installing and configuring the TR02E/E6 Loop-Powered Level Transmitter for Hazardous Locations.

 **CAUTION!** IF THE EQUIPMENT IS USED IN A MANNER NOT SPECIFIED BY THE MANUFACTURER, PROTECTION PROVIDED BY THE EQUIPMENT MAY BE IMPAIRED.

 **CAUTION!** THIS UNIT CONTAINS REED SWITCHES THAT MAY BE PERMANENTLY DAMAGED BY MECHANICAL SHOCK OR VIBRATION. AVOID DROPPING OR HITTING THE DEVICE AGAINST HARD SURFACES.

2.1 UNPACKING

Unpack the instrument, carefully. Make sure that all components have been removed from the packing material. Inspect all components for damage. Report any concealed damage to the carrier within 24 hours of receiving. Compare the contents with the packing slip and report any discrepancies to the factory immediately. Record the sales order number and/or serial number for future reference when ordering parts.

Before Proceeding to Installation, Complete the Following:

- Inspect all components for damage. Report any damage to the carrier within 24 hours of receiving.
- Verify that the laser marked model number located on the probe and transmitter correspond to the packing slip and purchase order.
- Record the model and serial numbers for future reference when ordering parts.

Model Number _____

Serial Number _____

2.2 INSTALLATION LOCATION

TR02E/E6 Loop-Powered Level Transmitter sensors should be located within easy access for service, calibration and monitoring. Sensors should not be exposed to ambient temperatures below -40° F (-40° C) or above +185° F (+85° C). Special precaution should be made to prevent exposure to corrosive atmospheres, excessive vibration, shock and physical damage.

It is common practice to use the metal tank wall as the reference ground. In such cases, it is required that the probe housing makes a good electrical connection to the tank wall. If there is any doubt about this connection due to the use of PTFE thread tape, gaskets, paint, rust or any other reason, a separate strap should be installed between the probe housing and tank.

 **CAUTION!** THIS UNIT CONTAINS ELECTRONICS WHICH MAY BE DAMAGED BY STATIC ELECTRICITY. DO NOT TOUCH ANY SEMI-CONDUCTOR DEVICES UNLESS YOU ARE PROPERLY GROUNDED.

2.3 ⚠ ELECTROSTATIC DISCHARGE (ESD) HANDLING PROCEDURE



Solutions With Innovation's electronic instruments are manufactured to the highest quality standards. These instruments use electronic components that may be damaged by static electricity present in most work environments.

THE FOLLOWING STEPS ARE RECOMMENDED TO REDUCE THE RISK OF COMPONENT FAILURE DUE TO ELECTROSTATIC DISCHARGE:

- Ship and store circuit boards in anti-static bags. If an anti-static bag is not available, wrap the board in aluminum foil. Do not place boards on foam packing materials.
- Use a grounding wrist strap when installing and removing circuit boards. A grounded workstation is recommended.
- Handle all circuit boards *only* by their edges. Do not touch board components or connector pins.
- Make sure that all electrical connections are completely secure and none are partial or floating. Ground all equipment to a good, earth ground.

2.4 BEFORE YOU BEGIN

2.4.1 Site Preparation

- 1 Each TR02E/E6 Loop-Powered Level Transmitter is built to the specifications indicated during the ordering process. Make sure that the probe connection is correct for the threaded or flanged mounting on the vessel or tank where the transmitter will be placed. Refer to **Section 2.5: Mounting**.
- 2 Ensure that the wiring between the power supply and TR02E/E6 electronics are complete and appropriate for the type of installation. Refer to **Section 3.5: Specifications**.
- 3 When installing the TR02E/E6 Loop-Powered Level Transmitter in a non-incendive, intrinsically safe or hazardous area, all local, state and federal regulations/guidelines must be observed. Refer to **Section 2.6: Wiring**.

2.4.2 Equipment and Tools


No special equipment or tools are required to install the TR02E/E6 Loop-Powered Level Transmitter.

The Following Are Recommended:


- Grounding Wrist Strap and ESD Workstation (*For safety usage with electronic components*)
- Open-End Wrenches or an Adjustable Wrench (*To fit the process connection size and type*)
- 1/8" Wide, Small Flat Blade Screwdriver
- Cable Cutter & Wire Strippers
- Digital Multimeter or Digital Volt/Ammeter
- 24 VDC Power Supply

2.5 MOUNTING

The TR02E/E6 Loop-Powered Level Transmitter for Hazardous Locations is mounted vertically inside a tank using a variety of process connections. Generally, a threaded or flanged connection is used. For information about the sizes and types of connections available, refer to **Section 3.6: Model Configurator**.

 **WARNING!** TR02E/E6 TRANSMITTER PROBES SHOULD BE INSTALLED WHERE THE MAXIMUM OVERFILL LEVEL IS AT A MINIMUM OF 1" (25.4 MM) BELOW THE PROCESS CONNECTION. CONSULT THE MANUFACTURER TO ENSURE PROPER INSTALLATION.

 **WARNING!** DO NOT DISASSEMBLE THE PROBE WHEN IT IS IN SERVICE AND/OR UNDER PRESSURE.

 **CAUTION!** DO NOT ADJUST THE ELECTRICAL ENCLOSURE'S ORIENTATION RELATIVE TO THE MOUNT'S POSITION. DAMAGE TO THE INTERNAL WIRING WILL OCCUR.

2.5.1 TR02E/E6 Probe Installation

Before Installing, Verify:

- The probe has adequate room for installation and has an unobstructed entry to the bottom of the vessel. Refer to **Section 3.5.4: Physical Specifications**.
- The process temperature, pressure and specific gravity are within the probe specifications for the installation. Refer to **Section 3.5: Specifications**.

How To Install The TR02E/E6 Probe:

- 1 Make sure the process connection is **at least** 1 ½" NPT, 2" NPT or a flanged mounting.
- 2 Carefully, place the probe into the vessel. Align the gasket on flanged installations.
- 3 Align the probe process connection with the threaded or flanged mounting on the vessel.
- 4 For *threaded connections*, tighten the hex nut of the probe process connection. For *flanged connections*, tighten and torque the flange bolts.

2.6 WIRING

Within the transmitter enclosure, connections are made to the terminal strip and the ground connections. The instructions for wiring the TR02E/E6 Loop-Powered Level Transmitter depend on the application:

2.6.1 Non-Incendive (Class I, Div. II)

2.6.2 Explosion-Proof

CAUTION! THE TR02E/E6 TRANSMITTER ELECTRONICS OPERATE AT VOLTAGES OF 10 - 30 VDC. A HIGHER VOLTAGE WILL DAMAGE THE TRANSMITTER.

WARNING! DO NOT DISCONNECT THE EQUIPMENT UNLESS THE POWER IS SWITCHED OFF. DO NOT ATTEMPT TO WIRE THE EQUIPMENT UNLESS THE POWER IS SWITCHED OFF.

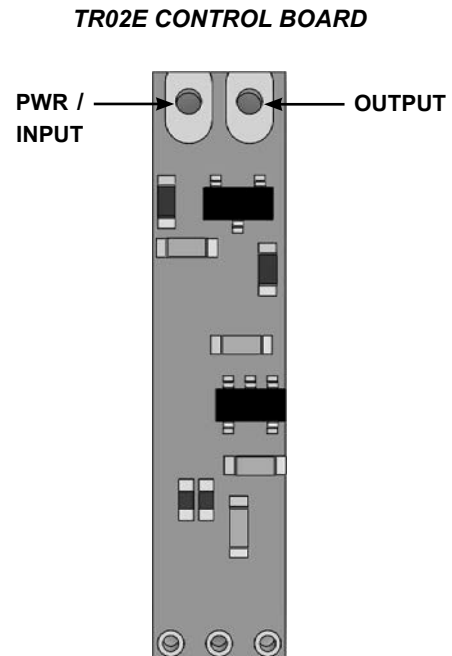
NOTE: WIRING BETWEEN THE POWER SUPPLY AND TR02E/E6 TRANSMITTER SHOULD BE MADE USING 18 - 22 AWG SHIELDED, TWISTED PAIR INSTRUMENT CABLE.

2.6.1 Non-Incendive (Class I, Div. II)

- Areas rated *Non-Incendive* (Class I, Div. II) have flammable media present only under abnormal conditions (no special electrical connections are required).
- If flammable media is contained within the vessel, the transmitter must be installed per the Class I, Div. I standards of area classification.

How To Install Non-Incendive Wiring:

- 1 Remove the cover of the transmitter.
- 2 Install the conduit plug into the unused opening.
- 3 Install a conduit fitting and pull the supply wires through.
- 4 Connect the red positive wire to the **PWR** terminal and the white negative wire to the **OUTPUT** terminal.
- 5 Run the wires to your device to make proper terminations for signal there.
- 6 Re-install the cover of the transmitter.



2.6.3 Explosion-Proof

- An *Explosion-Proof (EP)* installation **HAS** flammable gases or vapors present where their quantities are able to produce explosive or ignitable mixtures.
- The wiring for the transmitter must be contained in an explosion-proof conduit extending into the non-hazardous (safe) area.
- An explosion-proof conduit fitting (**EY seal**) must be installed between the hazardous and non-hazardous areas.



WARNING! BEFORE ATTEMPTING TO WIRE THE DEVICE, VERIFY THE POWER IS OFF.

How To Install Explosion-Proof Wiring:

- 1 Install the explosion-proof conduit from the safe area to the TR02E/E6 Transmitter's conduit connection (refer to local plant or facility procedure).
- 2 Remove the cover of the transmitter.
- 3 Connect the red positive wire to the **PWR** terminal and the white negative wire to the **OUTPUT** terminal.
- 4 Run the wires to your device to make proper terminations for signal there.
- 5 Re-install the cover of the transmitter.

2.7 CALIBRATION

The TR02E/E6 Loop-Powered Level Transmitter for Hazardous Locations requires no initial calibration. The device is shipped from the manufacturer with its 4 mA (0%) point set on empty indication and its 20 mA (100%) point set on full indication.

3.0 REFERENCE INFORMATION

This section illustrates an overview of the TR02E/E6 Loop-Powered Level Transmitter operation, as well as information on troubleshooting common problems, agency approval listings, replacement parts, and detailed physical, functional and performance specifications.

3.1 DESCRIPTION

The vertically-mounted TR02E/E6 Loop-Powered Level Transmitter for Hazardous Locations is equipped with an integral signal conditioner and provides a reliable 4-20 mA proportional electronic output in tank levels up to 15 feet. It is easily adaptable to programmable controllers, meters and other digital receivers for accurate and continuous measurement in many liquid level applications. The TR02E/E6 is FM-approved with an explosion-proof rating for Class I, Div. I, Groups C & D, Class II, Div. I, Groups E, F & G hazardous (classified) locations, indoor/outdoor (Type 4, 4X). Float materials are available in stainless steel with a variety of mounting types. Additional options include high and low level alarms with SPST or SPDT switch contacts. Display outputs are also available.

3.2 THEORY OF OPERATION

3.2.1 Basic Operating Principle

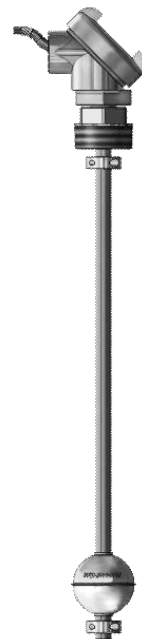
The TR02E/E6 Loop-Powered Level Transmitter for Hazardous Locations contains a series of magnetic reed switches within its vertical sensor stem. As the float travels along the transmitter's stem relative to the fluid level inside the tank, its internal magnets actuate the series of reed switches. Then, a signal is electronically conditioned through the built-in transmitter board to provide a current output.

3.2.2 TR02E/E6 Probe

Each probe segment contains 64 discrete resistors, forming a series circuit. The segments have been configured as a voltage divider where the magnetic reed switches serve as the tapping point to the circuit. As each switch closes, the voltage divider varies in proportion to the switch position. Ultimately, the probe connectors allow the voltage divider to extend the length of the probe.

3.2.3 TR02E/E6 Control Board

The control is a current transmitter that accepts high-level signal inputs from the resistive probe and drives a standard 4-20 mA current loop to enable valves, actuators and other devices commonly used in the process. During the transmission, the input signal is buffered by an input amplifier that is used to scale the input signal. The signal is then divided by voltage and fed back to the input signal. The output is directly proportional to the actual sensing length to ensure accuracy at every measured level.



3.3 TROUBLESHOOTING

The TR02E/E6 Loop-Powered Level Transmitter for Hazardous Locations is designed and manufactured for trouble-free performance across a wide range of operating conditions. Common transmitter problems are discussed in terms of their symptoms and recommended corrective actions. Information on how to handle material build-up on the probe is also provided in this section.


⚠ WARNING! EXPLOSION HAZARD. DO NOT CONNECT OR DISCONNECT THE EQUIPMENT UNLESS POWER HAS BEEN SWITCHED OFF OR THE AREA IS KNOWN TO BE NON-HAZARDOUS.

3.3.1 TR02E/E6 Transmitter Problems

SYMPTOM	PROBLEM	SOLUTION
THE OUTPUT FLUCTUATES.	TURBULENCE.	RELOCATE THE PROBE TO A LESS TURBULENT LOCATION OR PURCHASE A SLOSH SHIELD ASSEMBLY.
THE OUTPUT READING IS LOW VERSUS THE ACTUAL OUTPUT.	COATING OR BUILD-UP IS PRESENT ON THE FLOAT AND STEM.	CLEAR THE FLOAT AND STEM OF ANY CONTAMINANTS.
THERE IS NO OUTPUT.	BAD CONNECTION.	CHECK THE CONNECTION. CONSULT AN ENGINEER AT SWI, IF NECESSARY.
	ELECTRONIC CIRCUIT FAILURE.	REPLACE THE UNIT.

 *If you are still in doubt about the condition or performance of your control, consult the factory for further instructions.*

3.4 AGENCY APPROVALS

AGENCY	APPROVED MODEL(S)	FILE NUMBER	AREA CLASSIFICATION
FM 	TR02E/E6	3031861	EXPLOSION-PROOF: CLASS I, DIV I, GROUPS A, B, C & D DUST IGNITION-PROOF: CLASS II/CLASS III, DIV I GROUPS E, F & G, TYPE 4, 4X

3.5 SPECIFICATIONS

3.5.1 Functional

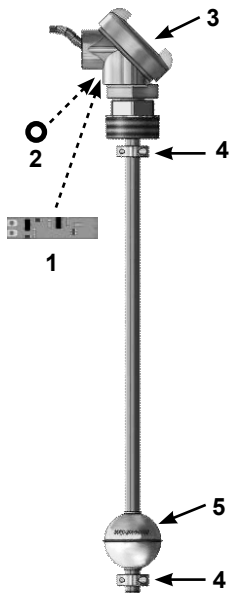
INPUT	
MEASUREMENT PRINCIPLE:	Voltage Divider Network
MEASURED VARIABLE:	Level, Determined by the Float Position Closing Reed Switches and a Proportionally Conditioned Output Signal
INDICATION LENGTH:	6" to 180" (15 cm to 458 cm)
POWER:	10 to 30 VDC (Non-Incendive or Explosion-Proof)
OUTPUT	
SIGNAL:	4-20 mA
RANGE:	4-20 mA
RESOLUTION:	0.01 mA

ENVIRONMENTAL	
OPERATING TEMPERATURE:	-40° to +185° F (-40° to +85° C)
STORAGE TEMPERATURE:	-50° to +185° F (-40° to +85° C)
AMBIENT TEMPERATURE:	Approximately +0.03% of Probe Length/°C
HUMIDITY:	0 to 99%, Non-Condensing
VIBRATION CLASS:	ANSI/ISA-S71.03 Class VC2
SHOCK CLASS:	ANSI/ISA-S71.03 Class SA1
USER INTERFACE	
KEYPAD:	None
INDICATION:	None
DIGITAL COMMUNICATION:	None
PERFORMANCE	
LINEARITY:	± 0.25"
RESOLUTION:	± 0.25" or ± 0.50"
REPEATABILITY:	Less Than 0.25"
RESPONSE TIME:	Less Than 1/2 Second
WARM-UP TIME:	Less Than 3 Seconds
MATERIALS OF CONSTRUCTION	
ENCLOSURE:	None
PROBE MOUNT & STEM:	316 Stainless Steel ≥ 0.50" (12.7 mm) Ø Tube
PROCESS CONNECTION:	See Section 3.7: Model Numbers
FLOATS:	316 Stainless Steel
RETAINING COLLARS:	316 Stainless Steel

3.5.2 Process Conditions

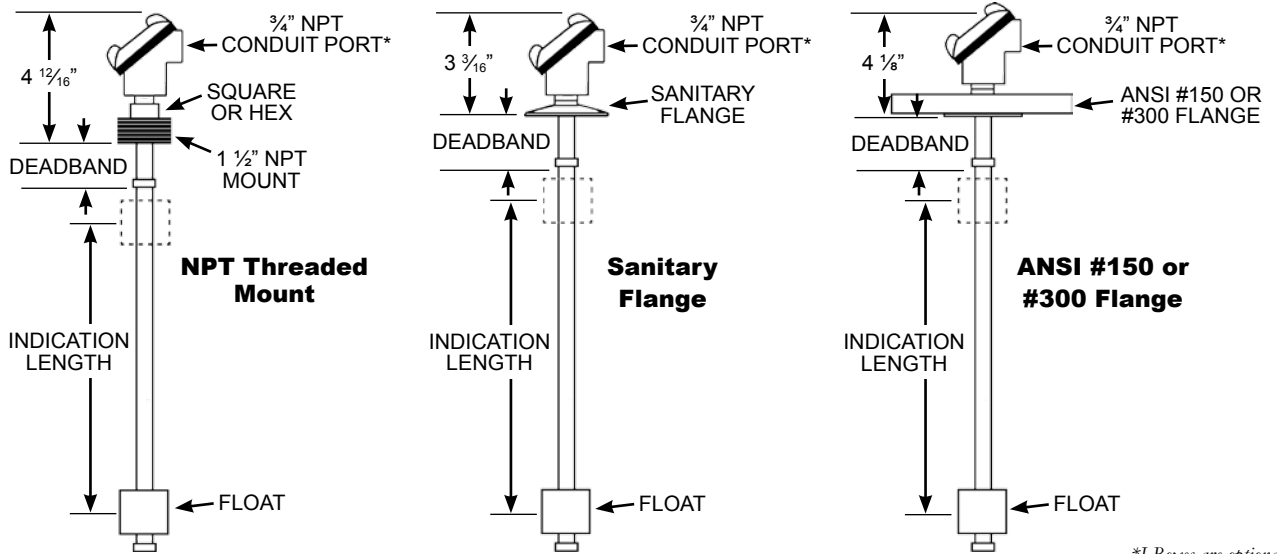
STAINLESS STEEL PROBES	
MAXIMUM PROCESS PRESSURE:	750 PSIG at +70° F (51.7 bar at +20° C)
MINIMUM SPECIFIC GRAVITY:	0.80

3.5.3 Replacement Parts



ITEM	DESCRIPTION	PART NO.
1	Control Board: 24 VDC Input, 4 to 20 mA Output	0953-TR02-0001
2	Standoff (2 Pieces Required)	0785-0018-0250
3	Junction Box: Aluminum Junction Box: Cast Iron	0700-0000-0002 0700-0000-0004
4	Collar: 316 Stainless Steel 1/2" Collar: 316 Stainless Steel 5/8"	0610-0500-0030 0610-0625-0003
5	Float: Stainless Steel for 1 1/2" NPT Mount and Larger Float: Stainless Steel for 2" NPT Mount and Larger Float: Stainless Steel for 2" NPT Mount and Larger Float: Stainless Steel for 2" NPT Mount and Larger Float: Stainless Steel for 2 1/2" NPT Mount and Larger Float: Stainless Steel for 4" NPT Mount and Larger	2000-1513-0054 2000-2000-0052 2000-2026-0054 2000-2000-52XX 2000-2200-0054 2000-3500-0054

3.5.4 Physical



*J-Boxes are optional.

3.6 MODEL CONFIGURATOR

TECHNOLOGY		OUTPUT		CONFIG.		MOUNT MAT'L		FLOAT		INDICATION LENGTH & DEADBAND		MOUNT		MOD.		RES.		J-BOX	
TR	Transmitter	02	4-20 mA	E	Explosion-Proof	08	316 S.S.	08	316 S.S.	XXXY	X" = Full Inches Y" = Deadband	08	1 1/2" NPT	0	None	25	1/4"	0	None
				E6	5/8" Tube	10	Hastelloy	10	Hastelloy			09	2" NPT	1	High-Level Alarm	50	1/2"	2	Cast Alum.
												10	3" NPT	2	Low-Level Alarm			3	Alum.
												11	4" NPT	3	Hi/Lo Level Alarm			5	Cast Iron
												12	2 1/2" NPT						
												64	2 1/2" Sanitary Flg.						
												65	3" Sanitary Flg.						
												66	4" Sanitary Flg.						
												72	1 1/2" #150 ANSI Flg.						
												73	2" #150 ANSI Flg.						
												74	2 1/2" #150 ANSI Flg.						
												75	3" #150 ANSI Flg.						
												76	4" #150 ANSI Flg.						
												83	1 1/2" #300 ANSI Flg.						
												84	2" #300 ANSI Flg.						
												85	2 1/2" #300 ANSI Flg.						
												86	3" #300 ANSI Flg.						
												87	4" #300 ANSI Flg.						

TR	02	E	08	08	12	03	09	1	25	2
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Consult the manufacturer for special configurations, materials, mountings and alarm features: 203-729-6434.

ASSURED QUALITY & SERVICE COST LESS

Service Policy

Owners of Solutions With Innovation products may request a return of the product, or any part of the product for complete rebuilding or replacement. Units will be rebuilt or replaced promptly. Products returned under the SWI Service Policy must be returned by prepaid transportation. Solutions With Innovation will repair or replace the product at no cost to the purchaser (or owner) other than transportation if:

- 1 Returned within the warranty period; and
- 2 Factory Inspection finds the cause of the claim to be covered under the warranty.

If the problem is due to circumstances beyond Solutions With Innovation's liability, or is NOT covered by the warranty, there will be charges for labor in addition to the parts required to rebuild or replace the equipment.

In rare cases, it may be expedient to ship replacement parts; or in extreme cases, an entire product before the damaged product is returned. If a quick replacement service is necessary, notify the manufacturer of the damaged product's model and serial number. In such cases, credit for the returned materials will be determined on the applicability of the warranty.

No claims for misapplication, labor, direct or consequential damage will be allowed.

Return Material Procedure

In order to efficiently process any returned materials, it is essential that a *Return Material Authorization* (RMA) number be obtained from the manufacturer prior to an item's return. RMA's can be issued through local representatives, or by contacting the factory directly.

Please supply the following information:

- 1 The Company's Name
- 2 Description of the Material
- 3 Product Serial Number
- 4 Reason for Return
- 5 Product's Application

Used units must be properly cleaned in accordance with OSHA standards before it is returned to the manufacturer. A *Material Safety Data Sheet* (MSDS) must accompany units or materials that were used in any type of media. All return shipments to the factory must be by done via prepaid transportation. All product replacements will be shipped F.O.B. manufacturer.



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