

# TIENet<sup>®</sup> 310 Ex Ultrasonic Level Sensor

## Installation and Operation Guide



Manual Body #69-4313-010  
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## Foreword - Water and Wastewater Products

This instruction manual is designed to help you gain a thorough understanding of the operation of the equipment. Teledyne ISCO recommends that you read this manual completely before placing the equipment in service.

Although Teledyne ISCO designs reliability into all equipment, there is always the possibility of a malfunction. This manual may help in diagnosing and repairing the malfunction.

If a problem persists, call or e-mail Teledyne ISCO technical support for assistance. Simple difficulties can often be diagnosed over the phone. For faster service, please have your serial number ready.

If it is necessary to return the equipment to the factory for service, please follow the shipping instructions provided by technical support, including the use of the Return Merchandise Authorization (RMA) specified. Be sure to include a note describing the malfunction. This will aid in the prompt repair and return of the equipment. **No item may be returned for service without a Return Material Authorization (RMA) number issued by Teledyne.**

Teledyne ISCO welcomes suggestions that would improve the information presented in this manual or enhance the operation of the equipment itself.

**Teledyne ISCO is continually improving its products and reserves the right to change product specifications, replacement parts, schematics, and instructions without notice.**

### Contact Information

#### *Customer Service*

Phone: (800) 228-4373 (USA, Canada, Mexico)  
(402) 464-0231 (Outside North America)

Fax: (402) 465-3022

Email: [isco.orders@teledyne.com](mailto:isco.orders@teledyne.com)

#### *Technical Support*

Phone: Toll Free (866) 298-6174 (Samplers and flowmeters)

Email: [iscowatersupport@Teledyne.com](mailto:iscowatersupport@Teledyne.com)

Return equipment to: 4700 Superior Street, Lincoln, NE 68504-1398

#### *Other Correspondence*

Mail to: P.O. Box 82531, Lincoln, NE 68501-2531

**Warranty and Operation Manuals can be found on our website at:**

[www.teledyneisco.com](http://www.teledyneisco.com)



## Safety

### *General Warnings*

Before installing, operating, or maintaining this equipment, it is imperative that all hazards and preventive measures are fully understood. While specific hazards may vary according to location and application, take heed of the following general warnings:

 **WARNING**

**Avoid hazardous practices! If you use this instrument in any way not specified in this manual, the protection provided by the instrument may be impaired.**

 **AVERTISSEMENT**

**Éviter les usages périlleux! Si vous utilisez cet instrument d'une manière autre que celles qui sont spécifiées dans ce manuel, la protection fournie de l'instrument peut être affaiblie; cela augmentera votre risque de blessure.**

### *Hazard Severity Levels*

This manual applies *Hazard Severity Levels* to the safety alerts, These three levels are described in the sample alerts below.

 **CAUTION**

Cautions identify a potential hazard, which if not avoided, may result in minor or moderate injury. This category can also warn you of unsafe practices, or conditions that may cause property damage.

 **WARNING**









**Warnings identify a potentially hazardous condition, which if not avoided, could result in death or serious injury.**

 **DANGER**

**DANGER – limited to the most extreme situations to identify an imminent hazard, which if not avoided, will result in death or serious injury.**

*Hazard Symbols*

The equipment and this manual use symbols used to warn of hazards. The symbols are explained below.

<b>Hazard Symbols</b>	
<b>Warnings and Cautions</b>	
	The exclamation point within the triangle is a warning sign alerting you of important instructions in the instrument's technical reference manual.
	The lightning flash and arrowhead within the triangle is a warning sign alerting you of "dangerous voltage" inside the product.
<b>Symboles de sécurité</b>	
	Ce symbole signale l'existence d'instructions importantes relatives au produit dans ce manuel.
	Ce symbole signale la présence d'un danger d'électocution.
<b>Warnungen und Vorsichtshinweise</b>	
	Das Ausrufezeichen in Dreieck ist ein Warnzeichen, das Sie darauf aufmerksam macht, daß wichtige Anleitungen zu diesem Handbuch gehören.
	Der gepfeilte Blitz im Dreieck ist ein Warnzeichen, das Sei vor "gefährlichen Spannungen" im Inneren des Produkts warnt.
<b>Advertencias y Precauciones</b>	
	Esta señal le advierte sobre la importancia de las instrucciones del manual que acompañan a este producto.
	Esta señal alerta sobre la presencia de alto voltaje en el interior del producto.

# TIENet™ Model 310 Ex Ultrasonic Level Sensor

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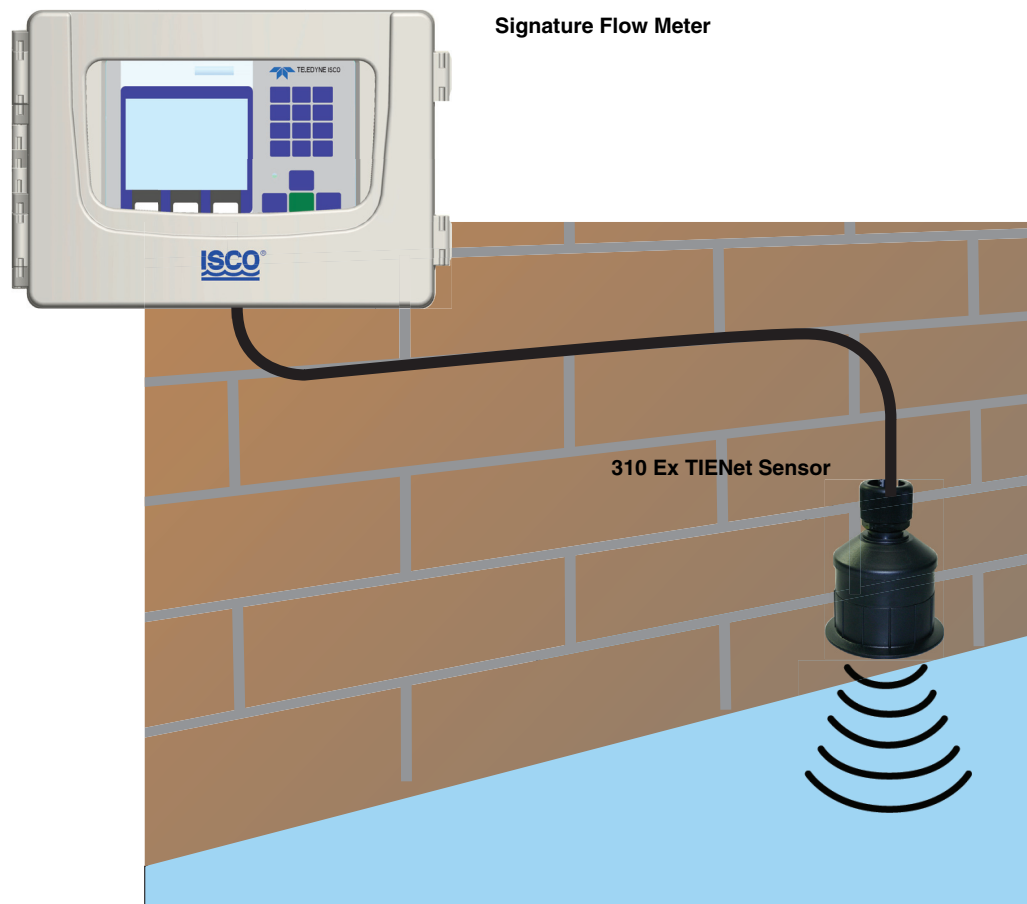
# TIENet® Model 310 Ex Ultrasonic Level Sensor

## *Section 1 Introduction*

The Signature® Flow Meter uses the TIENet 310 Ex Device to provide non-contact liquid level measurement. The flow meter has built-in level-to-flow conversions that cover the majority of open channel flow measurement situations.

### **1.1 Description**

The ultrasonic sensor is mounted over the flow stream. The flow meter measures the time interval between transmission of a sound pulse from the sensor, and receiving its echo off the surface of the liquid, to determine the level of the stream.



*Figure 1-1 Basic Signature monitoring system with 310 Ex (mounting hardware not shown)*

This non-contact measurement method reduces the frequency of maintenance, and is ideal for applications where the flow may contain chemicals, grease, silt, or suspended solids.

## 1.2 310 Ex Sensor Design

The ultrasonic level sensor consists of a housing with a single transducer that is both pulse transmitter and echo receiver. A temperature sensor within the housing measures the ambient temperature, and a microprocessor automatically compensates for speed-of-sound changes due to any changes in air temperature.

The 310 Ex is available with a 10m, 23m, and special order to 150m or less cable lengths with or without connectors. For greater distances, external connection via conduit, and connection of additional TIENet devices, the TIENet Expansion Box is available. Bulk TIENet cable may also be used for greater distances.



Figure 1-2 310 Ex Ultrasonic TIENet Sensor with unterminated leads (l) or TIENet plug (r)

## 1.3 Operation

The sensor emits multiple ultrasonic pulses per second. Between pulses, the transducer switches from transmitter to receiver. When the transducer receives the echo from the water's surface, the sound energy is converted into an electrical signal. The signal is then amplified and processed by the Signature flow meter into an "echo-received" signal. The time between the transmitted pulse and the echo-received signal is proportional to the distance between the transducer and the liquid surface. This distance in turn determines the liquid level used to calculate flow.

## 1.4 Technical Specifications

**Table 1-1 310 Ex TIENet Device Specifications<sup>a</sup>**

Sensor Dimensions	3.63" Ø x 4" tall	(9.1cm Ø x 10.2cm tall)
Cable Length	10 or 23 meters standard	(32.8 or 75.5ft) standard
Mounting Attachment	3/4" NPT Pipe thread nipple w/ Conduit lock nut	
Weight	4 lbs	(1.8 kg)
Body Material	PVDF	
Enclosure	IP68 when connected and properly sealed with cord-grip fitting.	
Temperature Range		
Operating (compensated)	-22 to 140°F	(-30 to 60°C)
Storage	-40 to 158°F	(-40 to 70°C)
Hazardous Locations	-40 to 140°F	(-40 to 60°C)
Measurement Range	Minimum: 1 ft (0.3m) from sensor to liquid surface Maximum: 11 ft (3.3m) from sensor to liquid at minimum level	
Measurement Accuracy at 72 °F (22 °C)	±0.02ft (0.006m) at 1ft level change or less; ±0.03ft (0.009m) at greater than 1ft level change	
Temperature Coefficient within compensated range	± 0.0002 x D (m) per degree C ± 0.00011 x D (ft) per degree F (Where D is the distance from the transducer to the liquid surface)	
Beam Angle	10°	5° From center line
Ultrasonic Signal	50KHz	
Certifications	Group II, Category 1G (zone 0), T4, [ATEX and IECEx] Class I, Division 1 (and Zone 0), T4	

a. All specifications are subject to change without notice.

## 1.5 Accessories

Accessories used in sensor installation are briefly described below. Refer to the next section for ordering information.

 <b>Note</b>
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Only the Wall Mount Bracket is approved for use in classified hazardous locations. Other accessories must undergo a hazardous location evaluation in order to fulfill safe installation requirements.

**Spreader Bar** – The Spreader Bar is an expandable pipe for suspending equipment inside a manhole. Outward spring pressure secures it against the manhole walls, like a shower curtain rod. Depending on your application, you can then suspend the 310 Ex TIENet Device, or the Signature Flow Meter itself, from the bar.

**Cable Straightener** – The cable straightener is designed for use in installations where the transducer is suspended by its cable only, such as from the Spreader Bar. The straightener helps hold the transducer vertically plumb, thereby stabilizing alignment.

**Cable Clamp** – The cable clamp is used with the Spreader Bar to secure the mounting of the sensor.

**Wall Mount Bracket** – This device lets you install the ultrasonic level sensor on a convenient nearby wall over a flow stream, such as the side of a bridge, or other structure.

**Floor Mount** – The Ultrasonic Floor Mount is a collapsible metal stand attached to the floor, for extending the sensor out over a flow stream.

**Ultrasonic Calibration Target** – This option is designed to make calibration of the level sensor more accurate during the installation process by letting you calibrate the level sensor from outside the manhole.

**Sunshade** – The ultrasonic sunshade is a white plastic cap that fits over the top of the ultrasonic transducer. Its purpose is to keep sunlight from heating the body of the level transducer and introducing temperature errors to the internal temperature compensation.

### 1.5.1 Ordering Information

Options and accessories can be purchased by contacting Teledyne ISCO's Customer Service Department.

**Teledyne ISCO**

Customer Service Dept.

P.O. Box 82531

Lincoln, NE 68501 USA

Phone: 800 228-4373 or 402 464-0231

FAX: 402 465-3022

E-mail: [isco.orders@teledyne.com](mailto:isco.orders@teledyne.com)

**1.5.2 TIENet 310 Ex  
Ultrasonic Level  
Sensor**

**310 Ex Ultrasonic Level Sensor with unterminated leads. For use with barrier screw terminals or Signature 6 position plug-in (green) terminal strip.**

*Includes cord grip and sensor with cable. (See cable lengths below).*

310 Ex Ultrasonic sensor w/ 10m cable.....	60-4314-005
310 Ex Ultrasonic sensor w/ 23m cable.....	60-4314-006
310 Ex Ultrasonic sensor Cut-to-length.....	60-4314-014
Cut to length cable up to 999 ft* .....	60-4304-050

\*Cable lengths can go up to 150 m with an expansion box.

**310 Ex Ultrasonic Level Sensor with Signature connection ending in TIENet plug. For use with portable Signature TIENet receptacle.**

*Includes cord grip and sensor with cable. (See cable lengths below).*

310 Ex Ultrasonic sensor w/ connector and 10m cable .....	60-4314-009
310 Ex Ultrasonic sensor w/ connector and 23m cable .....	60-4314-011
310 Ex Ultrasonic sensor w/ connector Cut-to-length* .....	60-4314-013
Cable Assembly with TIENet Y w/ connector .....	60-4304-066

\*Cable lengths can go up to 150 m with an expansion box.

Sunshade for ultrasonic sensor .....	60-3004-142
Spreader bar for suspension of sensor or flow meter in manhole shaft .....	60-3004-110
Cable clamp .....	60-3004-129
Sensor Mounting Bracket U/S .....	60-2003-615
Floor mount for horizontal surfaces .....	60-2004-611

Cable straightener for suspension over stream.....	60-4313-009
TIENet Expansion Box .....	60-4307-023

*Kit includes 10ft TIENet cable*

Cord grip fitting, 3/4" NPT, for TIENet cable .....	209-0073-12
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**1.5.3 1.5.3 TIENet Barrier for  
Hazardous Locations**

**TIENet Barrier (DIN-rail Mountable)**

TIENet Barrier .....	60-4364-112
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**TIENet Barrier with Enclosure**

TIENet Barrier w/ enclosure and 10m cable .....	60-4364-120
TIENet Barrier w/ enclosure and 23m cable .....	60-4364-121
TIENet Barrier w/ enclosure and cut-to-length cable .....	60-4364-122

<b>Note</b>
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Teledyne ISCO uses FreeRTOS version 5.4.2 in its TIENet devices. In accordance with the FreeRTOS license, FreeRTOS source code is available on request. For more information, visit [www.FreeRTOS.org](http://www.FreeRTOS.org).



# TIENet® Model 310 Ex Ultrasonic Level Sensor

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## *Section 2 Installation and Setup for Signature*

The Signature Flow Meter does not have to be mounted near the flow stream. You can install the flow meter itself at a convenient, protected location and route the sensor cable to the measurement point. Proper installation of the 310 Ex sensor is critical for accurate measurement.

### **2.1 Sensor Installation Considerations**

Measurement accuracy can be affected by a number of site factors that should be taken into consideration when selecting the location for the sensor. If the sensor cannot obtain a valid reading, an asterisk (\*) will appear next to the displayed level, indicating there is an error.

#### **2.1.1 Beam Angle**

The 310 Ex sensor has a 10° beam angle, forming a cone whose apex is the ultrasonic transducer. The sensor can only detect surfaces within this cone. Narrow channels can result in false echoes and incorrect level readings off the walls and sides of the channel. For preventive measures, see Section 2.5.2 *Measurement Setup*, and the programming steps in Figure 2-14.

The beam becomes narrower at shorter distances, which can increase difficulty in detecting the return echo. If the beam is too wide, the sensor may pick up signals from unwanted surfaces, such as the walls of the channel.

Sensor elevation is highly specific to the particular site.

#### **2.1.2 Humidity**

Conditions of extremely high or low humidity can cause detection to occur either earlier or later than under normal conditions. A drop in water level, normally compensated for by the sensor's interval-based amplifier, may produce errors in echo detection.

Additionally, water droplet condensation on the bottom surface of the sensor can cause measurement errors.

#### **2.1.3 Surface**

Solids, foam, oil, and turbulence can all absorb or weaken the ultrasonic pulses, causing errors in detection. Foam or oil on the surface of the stream can produce false level readings.

#### **2.1.4 Temperature**

Changes in ambient temperature significantly affect the velocity of sound. If ambient temperature changes rapidly, there may be a delay before the 310 Ex's temperature sensor can activate temperature compensation.

If the sensor will be installed outdoors in direct sunlight, use a sunshade to prevent heating of the sensor housing.

- 2.1.5 Waves** Waves on the surface of the flow stream can deflect the ultrasonic signal, causing erroneous readings or total loss of signal. The Signature Flow Meter software is able to reject occasional readings that deviate substantially from normal.
- 2.1.6 Wind** Strong winds can significantly reduce the strength of the return echo. Narrow beams can result in the sound being blown away; likewise, greater distances to the flow stream surface are more subject to distortion in strong winds.
- 2.1.7 Hazardous Locations** Installation in classified hazardous locations must meet specific conditions in order to fulfill safety requirements. Installation must be performed only by trained, qualified personnel. Refer to Section 2.4 *Installation in Hazardous Locations* for complete information.

## 2.2 Connecting the Cable

External TIENet devices such as the 310 Ex are all connected to the Signature flow meter in the same manner. These connections usually use conduit or cord-grip cable fittings for permanent mounted meter or with TIENet receptacle for portable meters. Multiple external TIENet devices can be connected simultaneously.

Refer to your Signature flow meter manual for instructions on accessing the instrument's interior components.

### **Note**

The steps that follow include instructions for installing cord-grip fittings. Some applications will require cables to be routed through user-supplied conduit. Conduit with a minimum  $\frac{3}{4}$ " ID is suggested for unterminated sensor cables and conduit with minimum  $1\text{-}\frac{1}{2}$ " ID is suggested for straight runs for sensor cables with connectors.

### 2.2.1 Permanent Meters

#### **Note**

Before proceeding, ensure that the flow meter has been disconnected from mains power.



1. Remove one of the 6-position plug-in terminal strip connectors from the case board.

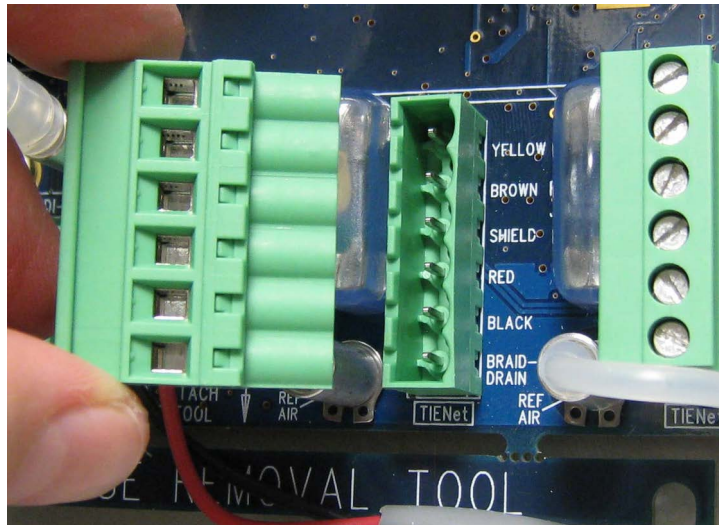


Figure 2-1 TIENet Device terminal strips

2. If using a cord-grip fitting, install the cable nut in the appropriate opening on the bottom of the Signature enclosure, securing it to the wall with the lock nut (concave side facing wall).
3. Feed the TIENet device cable end through the sealing nut and seal, and through the cable nut. Lightly tighten the sealing nut, just enough to hold the cable in place while installing the connector.

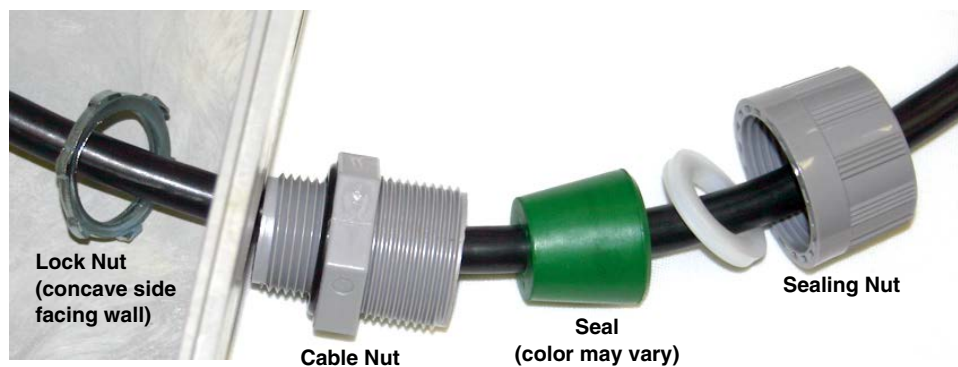


Figure 2-2 Installing cable with a cord-grip fitting

4. Attach the wire ends to the terminal strip as shown in Figure 2-3, then press the terminal strip back down into its socket on the case board, as shown in Figure 2-4, taking care not to strain any wire connections. Gently tug each wire when finished, to verify secure connection to the screw terminals.

**✓ Note**

The SHIELD wire is the bare drain emerging from the foil shield around the YELLOW and BROWN wires. The BRAID-DRAIN wire is the bare drain emerging from the surrounding braided shield inside the cable jacket. It is not necessary to prevent the two braids from coming into contact with each other. The drain wires need to be kept very short.

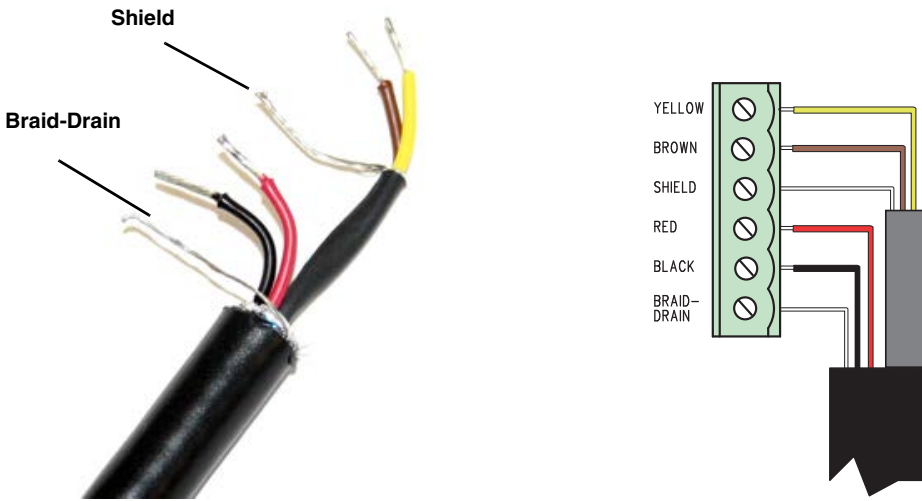


Figure 2-3 TIENet Device terminal connections

5. Press the terminal strip back down into its socket on the case board, as shown in Figure 2-5, taking care not to strain any wire connections. The 310 Ex sensor cable does not include a reference air connection (Figure 2-4).

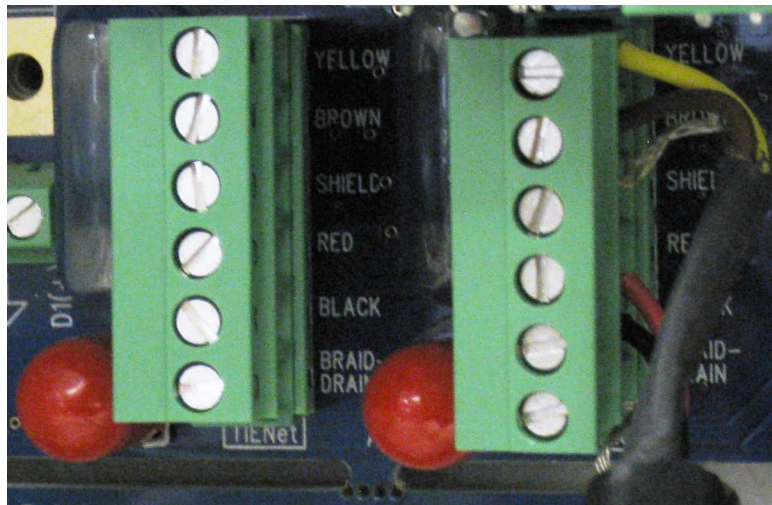


Figure 2-4 Attach wired terminal strip to case board socket

6. Gently tug the cable downward, to remove any slack within the enclosure, taking care not to put any stress on the connection.
7. Tighten the cord grip sealing nut.

**⚠ CAUTION**

If you are using conduit instead of the cord-grip fitting, the conduit must be sealed to prevent harmful gases and moisture from entering the Signature enclosure. Failure to seal conduit could reduce equipment life.

8. Close the front panel and fasten it shut with the two Philips screws.

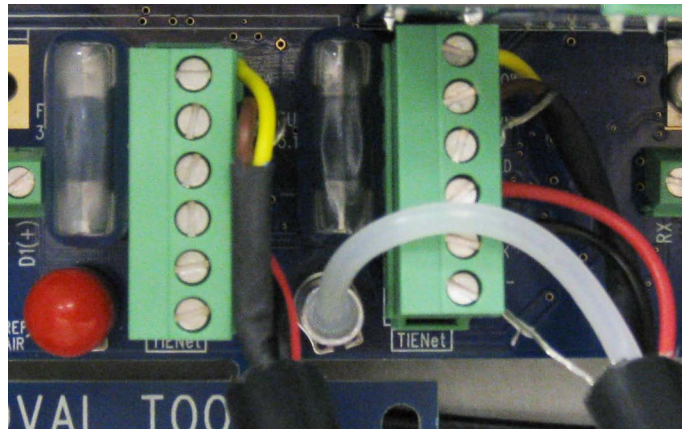


Figure 2-5 Position and secure the cable

### 2.2.2 Connecting to Signature Portable via a TIENet Receptacle

The optional external TIENet devices compatible with the Signature Portable (and Signature) all scan into the hardware in the same manner. A scan is required anytime a new TIENet device is added.

Multiple TIENet devices can be connected simultaneously to the same Signature Portable Flow Meter. The following TIENet devices will attach to the TIENet receptacle:

- Ultrasonic Level Sensor

- Area Velocity Sensor
- 301 pH Interface
- LaserFlow
- 306 Sampler Interface

*Connecting a TIENet plug to the Signature Portable*

To connect the TIENet plug from the sensor to the TIENet Receptacle:

1. Align the connectors and push together (Figure 2-6).
2. After the physical connection is made, a scan must be performed for the device to be recognized.

For additional TIENet connections, use the TIENet Y-cable or alternately an Expansion Box.

1. Coat the O-ring's sealing surface with a silicone lubricant.

*O-Ring and Lubrication for the TIENet receptacle*

**CAUTION**

Do not use petroleum-based lubricants. Petroleum-based lubricants will cause the O-ring to swell and eventually deteriorate. Aerosol silicone lubricant sprays often use petroleum-based propellents. If you are using an aerosol spray, allow a few minutes for the propellant to evaporate before proceeding.

2. Align and insert the connector. The sensor release will "click" when the sensor connector is fully seated.
3. Connect the two caps together.



Figure 2-6 How to connect a TIENet plug to the Signature Portable

### 2.2.3 Connecting to TIENet Barrier

1. Refer to the TIENet Barrier Installation Guide section 2 for connecting the 310 Ex TIENet cable to the "hazardous" side of the barrier.
2. If the installation utilizes a Signature flow meter refer to section 2.2.1 *Permanent Meters* for the installation of the TIENet cable on the "safe" side of the barrier to the meter.
3. Refer to section 2.4 *Installation in Hazardous Locations* for installation requirements.

## 2.3 Sensor Installation

The mounting location of the ultrasonic level sensor depends on the type of primary measuring device (such as a weir or flume), and on the method of level-to-flow conversion used. Refer to the *Isco Open Channel Flow Measurement Handbook* included with your Signature flow meter, or to instructions provided by the manufacturer of the primary device, for detailed information about locating the measuring point.

If you intend to measure flow by some other means, such as a gravity flow equation (Manning) or by calibrating a section of the flow channel, you must locate the measuring point based on the hydraulic characteristics of the channel, as well as the level-to-flow conversion method.

In most open channel installations where the level may exceed one-half of full pipe, mount the sensor as near as possible to the midpoint between the entrance and exit to measure over the least turbulent flow.

### 2.3.1 Dead Band

Mount the sensor as close as possible to **one foot** (0.3 m) above maximum expected level. The sensor cannot measure within the foot of space directly below it, called the *dead band*.

### 2.3.2 Submersion and Fouling

Fouling by grease or solids can cause the sensor to malfunction. The sensor is sealed, so unless it was exposed to corrosive substances, temporary accidental submersion should not harm it. Upon retrieval, ensure that the sensor's surface is clean. Clean the bottom surface very gently with running water and a soft cloth.

### 2.3.3 Mounting Options

The 310 Ex sensor can be mounted over the flow stream in various ways, depending on which method best fits the application.

Optional equipment is available from Teledyne ISCO for wall, floor, suspension, and horizontal mounting (see Section 1.5 *Accessories*). The sensor has a  $\frac{3}{4}$ " NPT male pipe thread with a conduit lock nut to connect it to a mounting bracket or cable stiffener. The sensor cable can be routed through user-provided conduit back to the Signature Flow Meter.

Regardless of the mounting method you select, always place the sensor over the center of the stream, and always use a circular bubble level for vertical alignment.

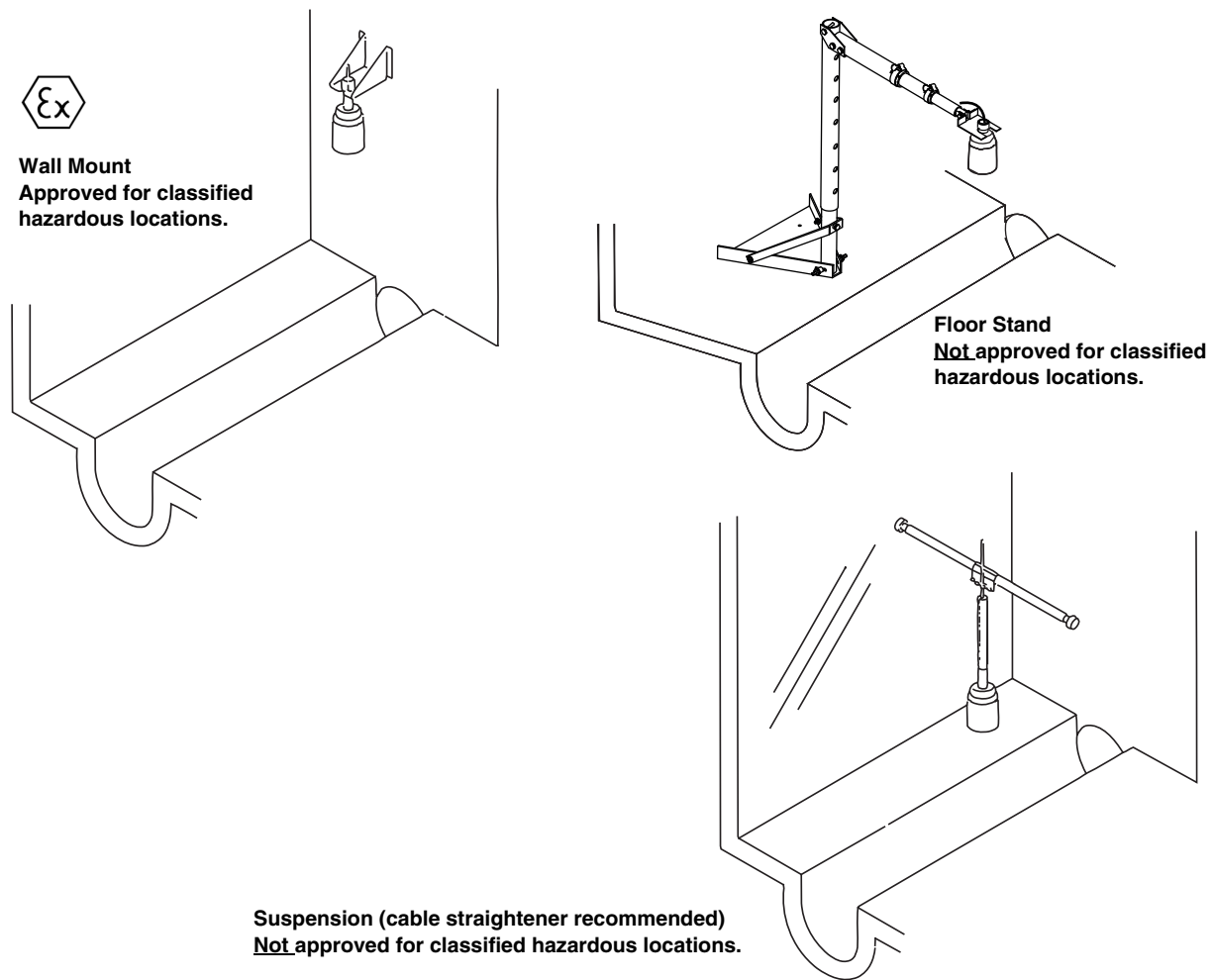


Figure 2-7 Sensor mounting options

## 2.4 Installation in Hazardous Locations

Read all labels carefully before installing the equipment!

The TIENet Model 310 Ex device is IECEx and ATEX-approved for use in potentially explosive atmospheres when specific conditions are met, as described in this section in reference to “X” Marking.

The 310 Ex is Group II, Category 1G equipment for use in gas hazard zones 0, 1, and 2 (IECEx and European standards), or Class I Division 1 (North American standards).

The braid-drain lead depicted in Figure 2-8 *Sensor labeling regarding hazloc installations* is normally bonded to earth through the Signature connector case terminals or conduit; it is also electrically connected to the anti-static conductive housing of the 310 Ex sensor.

Installation must be performed only by trained, qualified personnel.

Barriers or isolators required for certifiable safe installation are the responsibility of the user. Refer to the control drawings provided in Figures 2-9 and 2-10.

 **Note**

There is a TIENet barrier (a weatherproof box with terminals and power supply) available for hazardous locations. Refer to section 1.5.3.

 **Note**

Only the Wall Mount Bracket is approved for use in classified hazardous locations. Non-ISCO hardware must undergo a hazardous location evaluation in order to fulfill safe installation requirements.

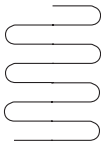
 **WARNING**

**The mounting bracket is a potential isolated charge carrier. For classified hazardous locations, your installation MUST satisfy earthing requirements. Refer to IEC 60079-14 section 12.2.4 and IEC 60079-11.**

 **WARNING**

**Do not coil the sensor cable; this will form an inductor and create a hazard. The cable should be kept as short as is practical. If necessary, use a serpentine loop (see figure at left) instead.**

*Serpentine loop*



**2.4.1 Important Information Regarding “X” Marking**

The ATEX labeling on the serial tag of the 310 Ex device includes a number ending in “X.” The X marking indicates that there are specific conditions that must be met in order for the equipment to comply with intrinsic safety requirements. Refer to Figure 2-8 on the following page.

These specific conditions are as follows for ATEX and IECEx:

- The integral cable must be terminated in a manner suitable for the zone of installation and providing at least degree of protection IP20.
- Any extension to the integral 310 Ex sensor cable must utilize a cable with parameters  $\leq 108\text{pF/m}$ ,  $\leq 1\mu\text{H/m}$ ,  $\leq 19\mu\text{H}/\Omega$ . The total length of cable must not exceed 150m.
- A maximum of three 310 Ultrasonic sensors may be connected together in parallel.
- The Li and Ci of the associated apparatus must be negligible.

**2.4.2 Electrical Requirements**

Always refer to the electrical values listed at the bottom of the 310 Ex serial tag when connecting associated apparatus (i.e., power supply, network interface, etc.).

This labeling indicates the maximum input voltage (Ui), maximum input current (Ii), and maximum power (Pi) that can be present at the specified terminals without invalidating intrinsic safety.

The power supply parameter allowances *must exceed* maximum internal capacitance (Ci) and either the maximum internal inductance (Li), or the maximum internal inductance-to-resistance ratio (Li/Ri) of the 310 Ex device and integral cable. These parameters are established on the third party certification report and are available by contacting Teledyne ISCO.

**2.4.3 Ambient Environment**

Installation in designated hazardous areas must fall within the temperature range of -40 to +60°C, as specified on the serial tag labeling.

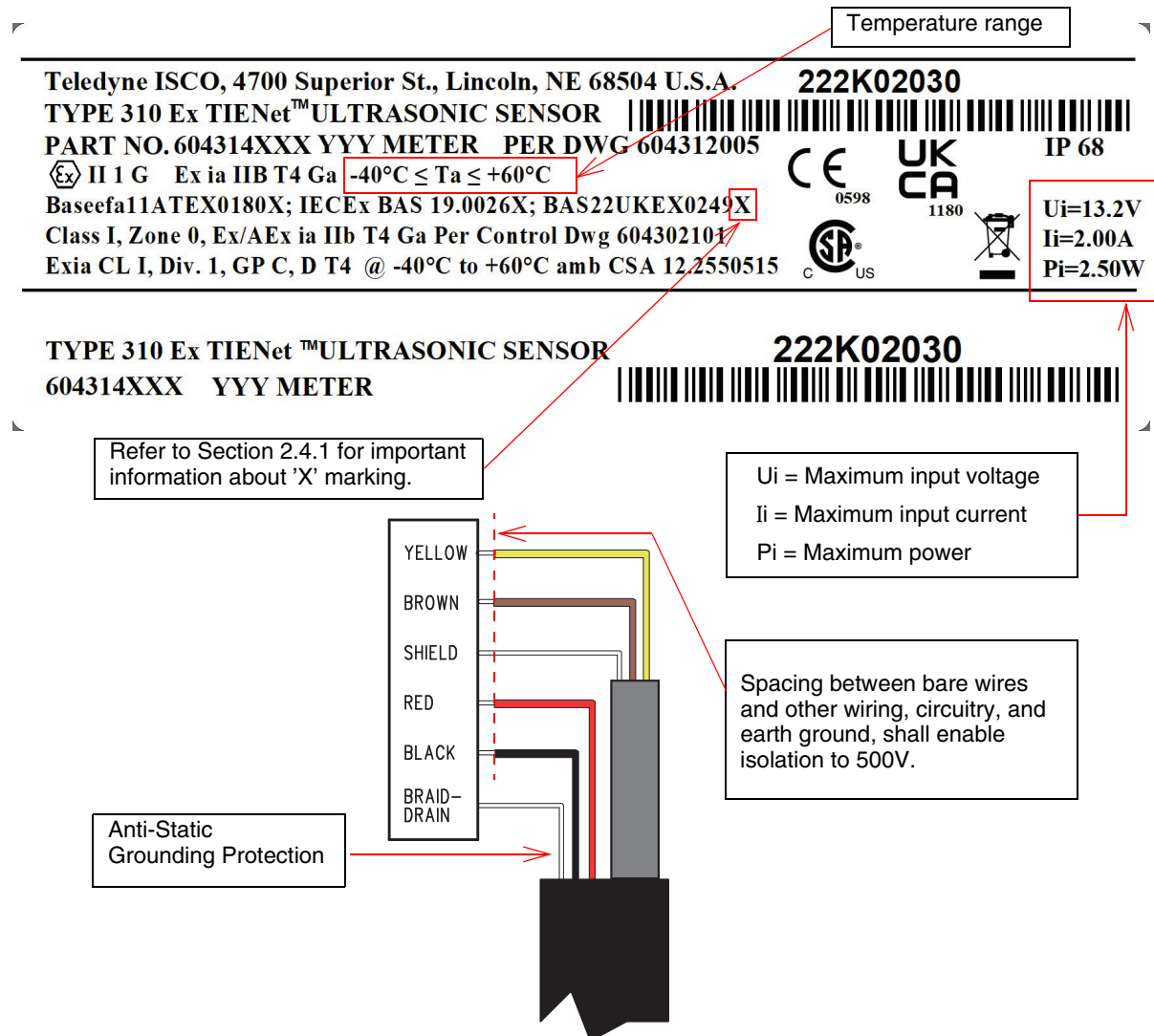


Figure 2-8 Sensor labeling regarding hazloc installations





TIENet® Model 310 Ex Ultrasonic Level Sensor  
Section 2 Installation and Setup for Signature

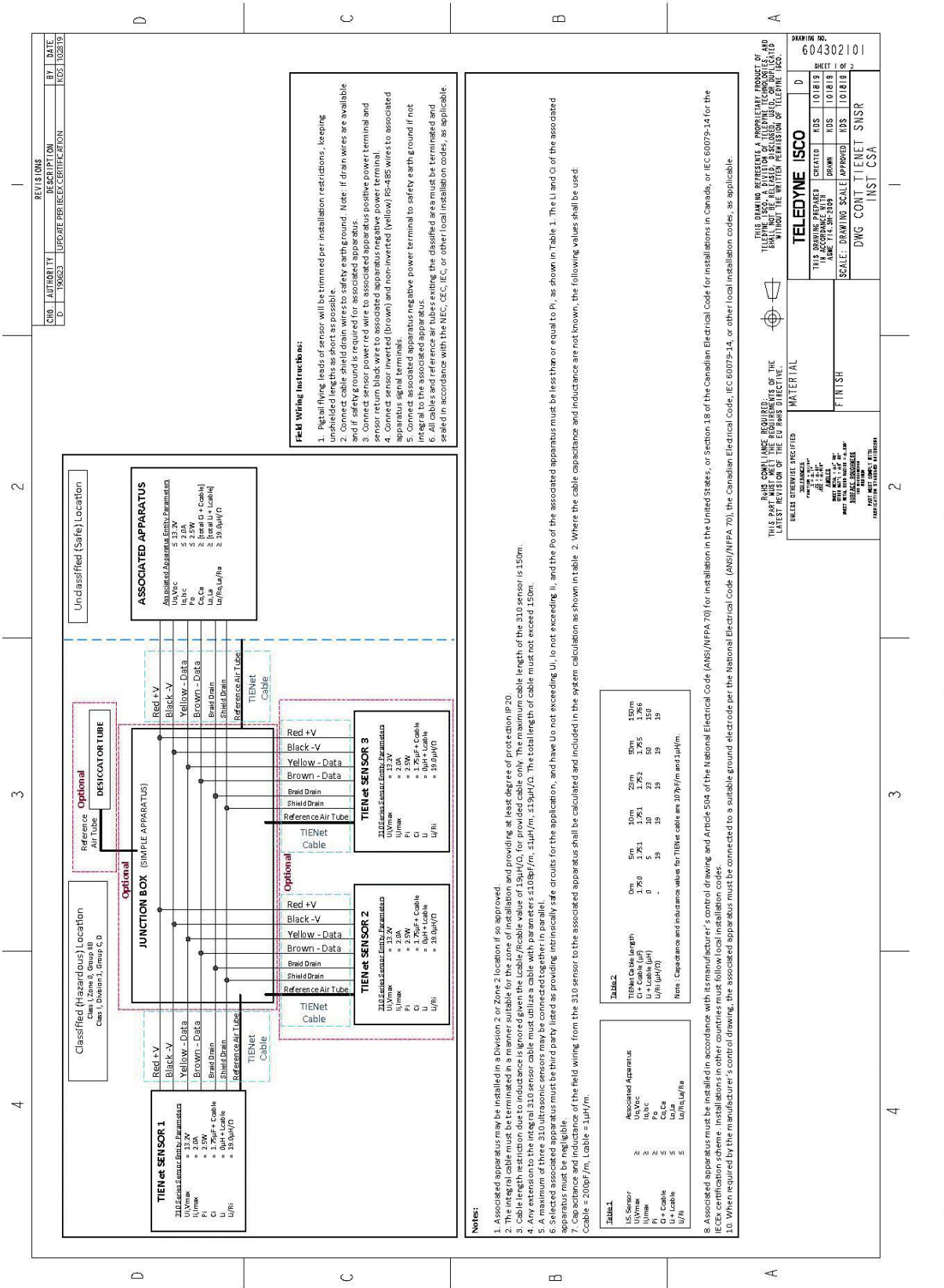
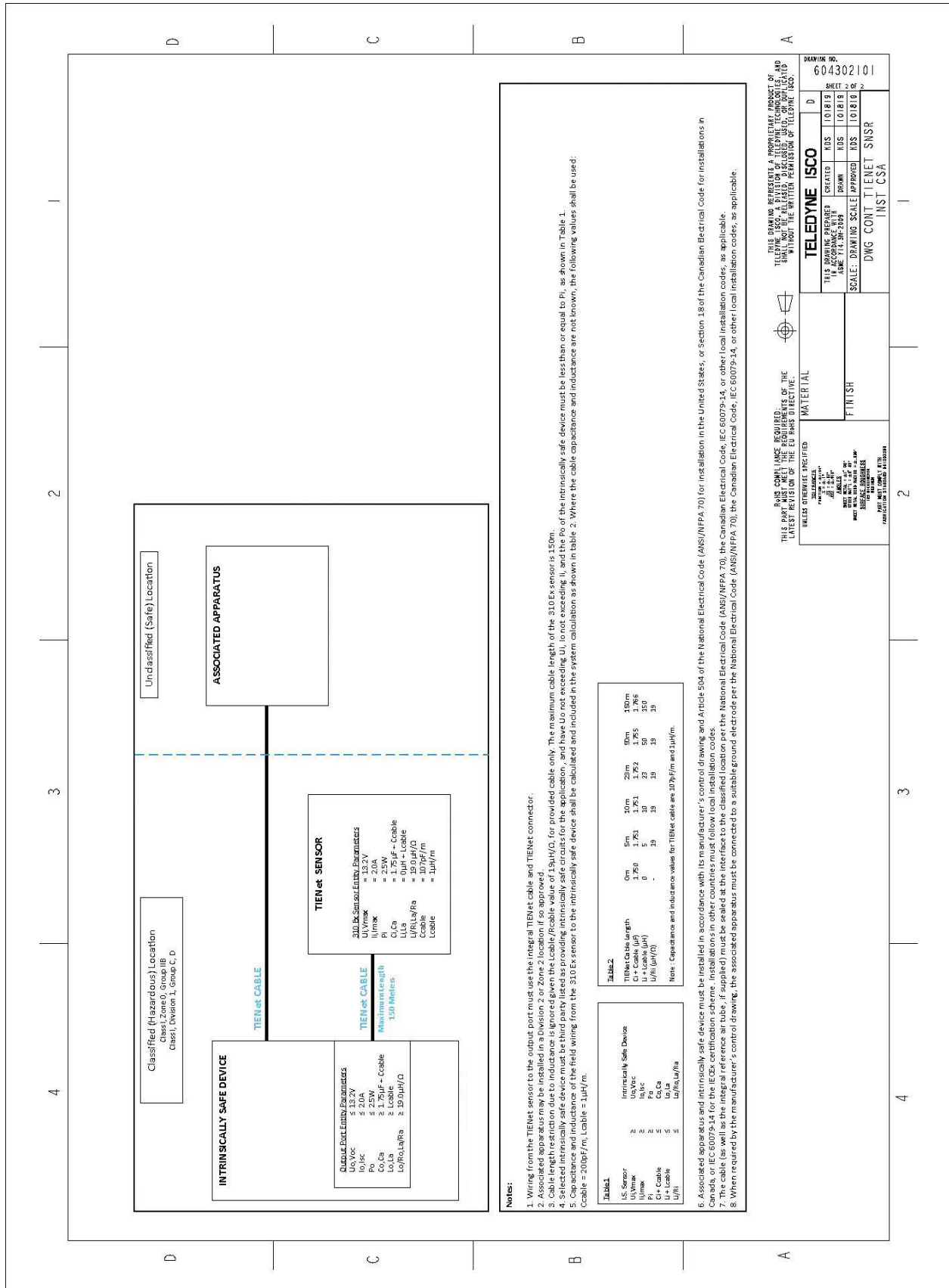


Figure 2-10 Hazardous Location Installation Control Drawing-CSA



**Notes:**

- Wiring from the TIENet sensor to the output point must use the integral TIENet cable and TIENet connector.
- Associated apparatus must be cables in Zone 0 or Zone 1.
- Cable length restriction due to inductance is ignored given the cable R cable value of 19µH/Ω. The maximum cable length of the 310 Ex sensor is 150m.
- Selected intrinsically safe device must be third party listed as providing intrinsically safe circuits for the application, and have Uo not exceeding U<sub>i</sub> and the P<sub>o</sub> of the intrinsically safe device must be less than or equal to P<sub>i</sub>, as shown in Table 1.
- Capacitance and inductance of the field wiring from the 310 Ex sensor to the intrinsically safe device shall be calculated and included in the system calculation as shown in table 2. Where the cable capacitance and inductance are not known, the following values shall be used:  
 Cable = 200pF/m, Cable = 4µH/m.

**TABLE 1**

IS Sensor	Intrinsic Safe Device
UL/Voc	U <sub>o</sub> /Voc
Io/Isc	I <sub>o</sub> /Isc
Co/Co	Co/Co
Lo/La	Lo/La
Lo/Ro/La/Ra	Lo/Ro/La/Ra

**TABLE 2**

TIENet Cable Length	Cap	Ind	20m	50m	100m	150m
Lo + Cable (µH)	1.750	1.750	1.750	1.750	1.750	1.750
Lo + Cable (pF)	0	5	10	15	20	25
Lo (µH/Ω)	-	19	19	19	19	19

Note: Capacitance and inductance values for TIENet cable are 200pF/m and 4µH/m.

6. Associated apparatus and intrinsically safe device must be installed in accordance with its manufacturer's control drawing and Article 504 of the National Electrical Code (ANSI/NFPA 70) for installation in the United States, or Section 18 of the Canadian Electrical Code for installations in Canada, or IEC 60079-14 for the IECEx certification scheme. Installations in other countries must follow local installation codes.

7. Associated apparatus and intrinsically safe device must be installed in accordance with its manufacturer's control drawing and Article 504 of the National Electrical Code (ANSI/NFPA 70), the Canadian Electrical Code (ANSI/NFPA 70), the Canadian Electrical Code, IEC 60079-14, or other local installation codes, as applicable.

8. When required by the manufacturer's control drawing, the associated apparatus must be connected to a suitable ground electrode per the National Electrical Code (ANSI/NFPA 70), the Canadian Electrical Code, IEC 60079-14, or other local installation codes, as applicable.

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DWG CONT: TIENET SNBR

INST: CSA

## 2.5 Configuring the System

To configure the Signature flow meter for operation with the TIENet 310 Ex device, press MENU (  ) to access the top menu, and select Hardware Setup. For all TIENet devices including the 310 Ex, select Smart Sensor Setup (TIENet).

### 2.5.1 Updating the Device List

When the 310 Ex is physically added to the system, select Perform Scan so that the flow meter detects it. When the scan is complete, the 310 Ex appears in the list of connected devices, ready to be configured with the steps shown in Figure 2-12 on the following page.

 **Note**

From the Hardware Setup menu, “Configure” refers to defining and selecting the parameters for each connected device.



The four parameters that will appear for the 310 Ex device are:

**310 Distance** – Distance between the bottom of the sensor and the surface of the flow stream.

**310 Air Temperature** – Temperature of surrounding (ambient) air

**310 Level** – Level of the flow stream surface

**310 Signal** – Strength of the return echo

The name of any parameter can be customized by highlighting it and pressing Enter (  ) to display the character grid. Navigate the grid using the arrow keys. Select characters with Enter and clear characters with Delete (  ).

310 Distance														
Done				Cancel										
<b>A</b>	B	C	D	E	F	G	H	I	J	K	L	M	N	↑
O	P	Q	R	S	T	U	V	W	X	Y	Z	a	b	
c	d	e	f	g	h	i	j	k	l	m	n	o	p	
q	r	s	t	u	v	w	x	y	z	/	:	!		
@	#	\$	%	^	&	*	(	)	-	_	+	=	<	
>	?	,	.											↓

Figure 2-11 Character grid

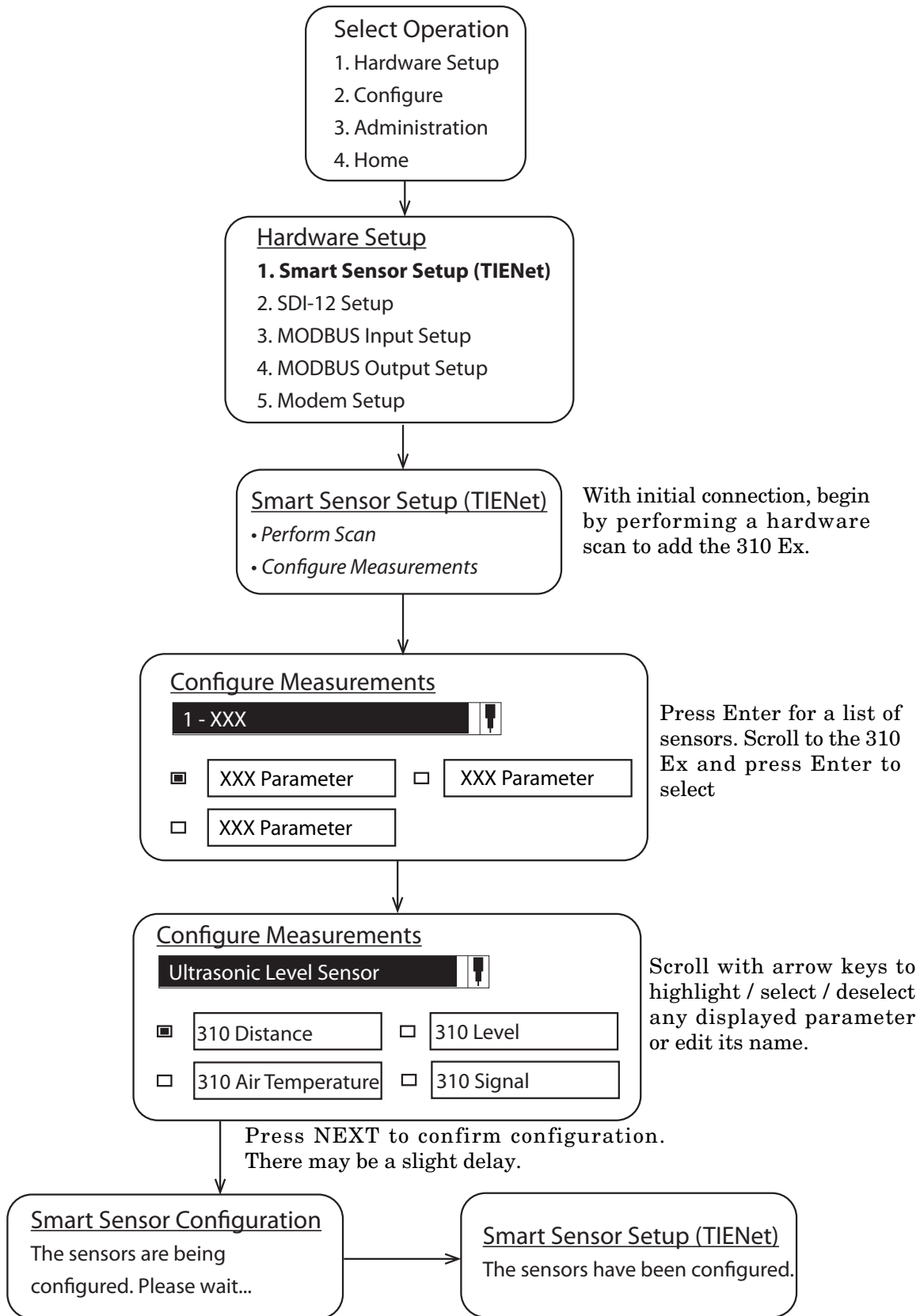


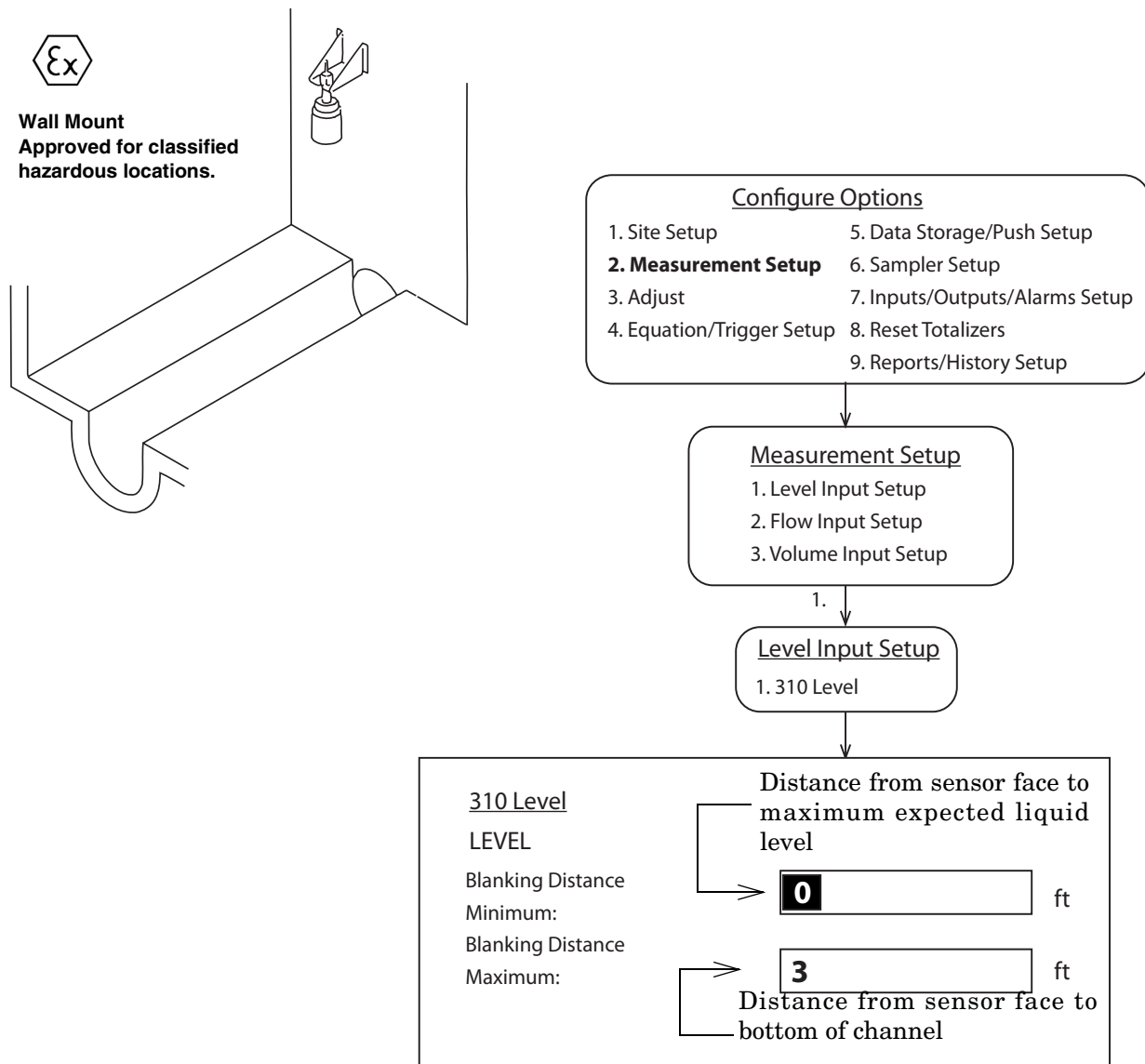
Figure 2-12 Menu Tree: 310 Ex Configuration

### 2.5.2 Measurement Setup

From Measurement Setup (Figure 2-13 below), select Level Input Setup to define the measurement range.

The **Minimum Blanking Distance** is the shortest distance from the sensor face (highest expected liquid level). Because of the dead band, this value can never be less than one foot. Depending on the elevation of your sensor, this value may be increased to help ensure that echoes read by the flow meter come only from the surface of the flow stream, and not off the walls or sides of the channel.

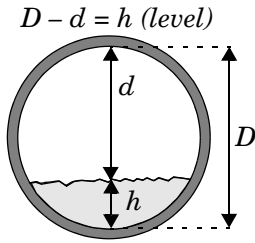
The **Maximum Blanking Distance** is the distance between the sensor face and the bottom of the channel, or zero level. You can enter a slightly larger value than calculated, if you prefer.



Press Next 2x.

Figure 2-13 Configuring ultrasonic level measurement

## 2.6 Level Calibration



Although all other programming steps can be performed off-site, level must be set at the measurement site following installation, at ambient temperature.

Once the sensor is installed over the flow stream, measure the present liquid level (see figure at left) and enter this value for Level, under Adjust Options. Then highlight “Adjust” and press Enter to confirm.

From this screen, you can also update the display to show the current level of the stream.

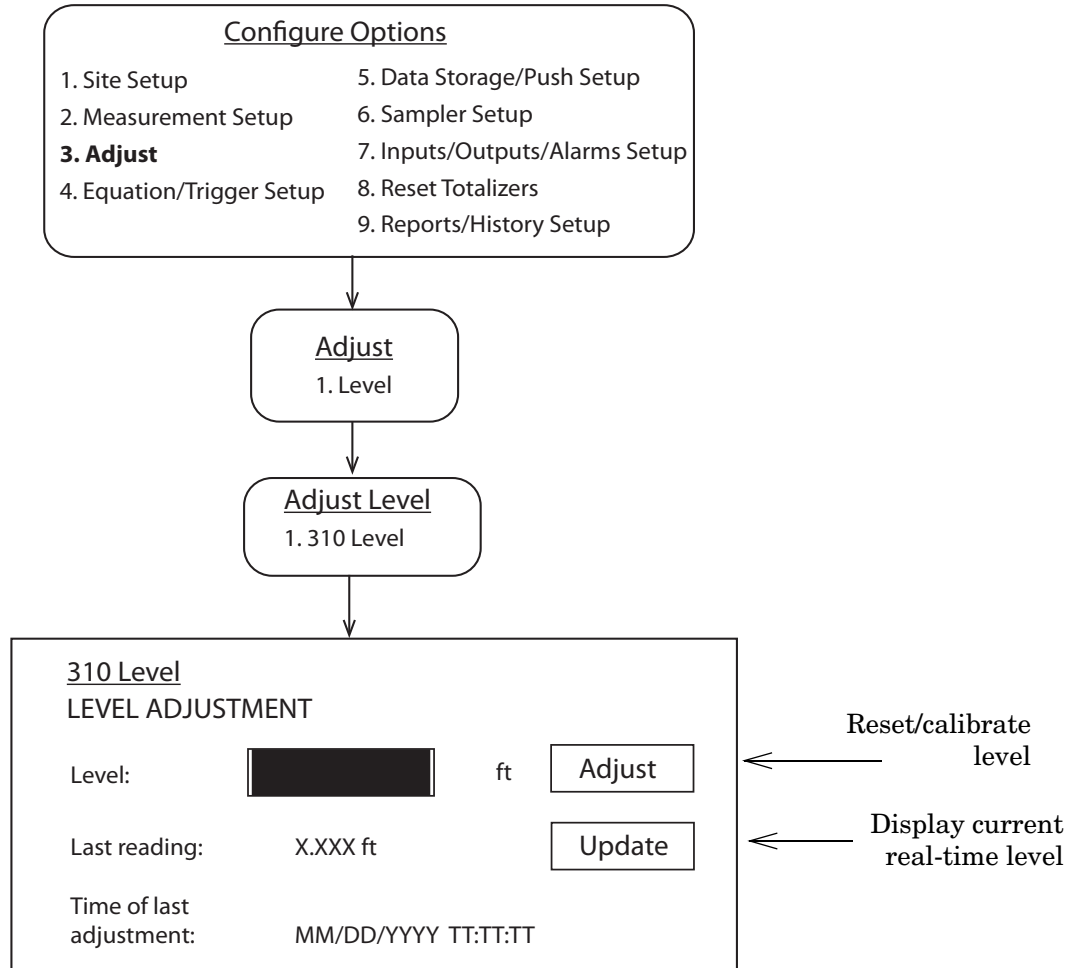


Figure 2-14 Ultrasonic level adjustment and calibration

## 2.7 Firmware Updates

The TIENet device's firmware is updated via the USB port on the front panel of the Signature Flow Meter. Step-by-step instructions for updating the firmware can be found in Section 2 of the Signature user manual.

## 2.8 Troubleshooting TIENet 310 Ex USLS

Table 2-1 Troubleshooting: TIENet 310 Ex Ultrasonic Level Sensor		
Symptom	Cause	Action
Invalid level, display has asterisk (*) by level reading	Not scanned	Perform a smart sensor scan
	Not able to achieve signal lock (misalignment, loose mounting, turbulence, foam, or debris in the water)	Adjust mounting or place over a solid surface.
	Level outside of the Blanking distances	Adjust min/max blanking distances
	Not wired correctly	Check/repair wiring
	Open fuse	Replace fuse FU-T 3.15A and rescan. Part #411-0212-70. Refer to Figure 3-2 Item K.
	Failed sensor	Replace with known good sensor
No level reading on the display	Parameter not selected to be displayed on Home Display	Add the parameter to the Home Display. Refer to Section
Incorrect level reading	Level not adjusted properly	Readjust level
	Sensor misaligned	Realign sensor
	Objects in the path of the signal	Adjust min/max blanking distances and/or reposition sensor.
	Sensor exposed to direct sunlight	Install sunshade. Refer to <i>Appendix Appendix B Options and Accessories</i> .

## 2.9 Contact Teledyne ISCO

If you have further questions about the installation, operation, and maintenance of your TIENet device, please contact our service department at:

Teledyne ISCO  
 4700 Superior St.  
 Lincoln, NE 68504  
 Phone: 866 298-6174 or 402 464-0231  
 Fax: 402 465-3022  
 E-mail: IscoService@teledyne.com



# TIENet® Model 310 Ex Ultrasonic Level Sensor

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## *Appendix A Replacement Parts*

### **A.1 Replacement Parts**

Replacement parts can be purchased by contacting Teledyne ISCO's Customer Service Department.

**Teledyne ISCO**  
Customer Service Department  
P.O. Box 82531  
Lincoln, NE 68501 USA

Phone: (800) 228-4373  
(402) 464-0231  
FAX:(402) 465-3022

E-mail:[Isco.orders@teledyne.com](mailto:Isco.orders@teledyne.com)

**A.1.1 TIENet 310 Ex  
Ultrasonic Level  
Sensor Replacement  
Parts**

Split mounting Nut .....	60-4313-007
Cap Sensor Connector .....	60-4313-011
310 Ex Ultrasonic sensor w/ 10m cable.....	60-4314-005
310 Ex Ultrasonic sensor w/ 23m cable.....	60-4314-006
310 Ex Ultrasonic sensor w/ Cut-to-length .....	60-4314-014
310 Ex Ultrasonic sensor w/ connector and 10m cable .....	60-4314-009
310 Ex Ultrasonic sensor w/ connector and 23m cable .....	60-4314-011
310 Ex Ultrasonic sensor w/ connector and Cut-to-length .....	60-4314-013
O-Ring Sensor Connector .....	20-2100-669