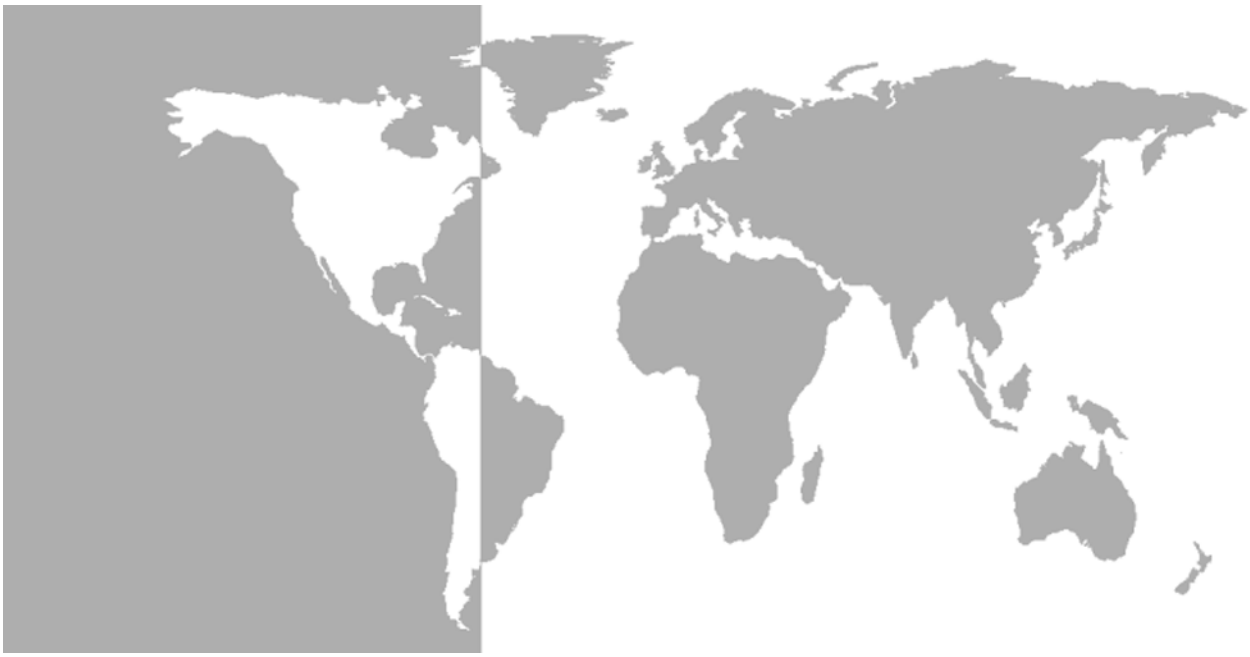
GE
Sensing



DigitalFlow™ ISX878

Panametrics Ultrasonic Liquid Flow Transmitter

User's Manual

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DigitalFlow™ ISX878

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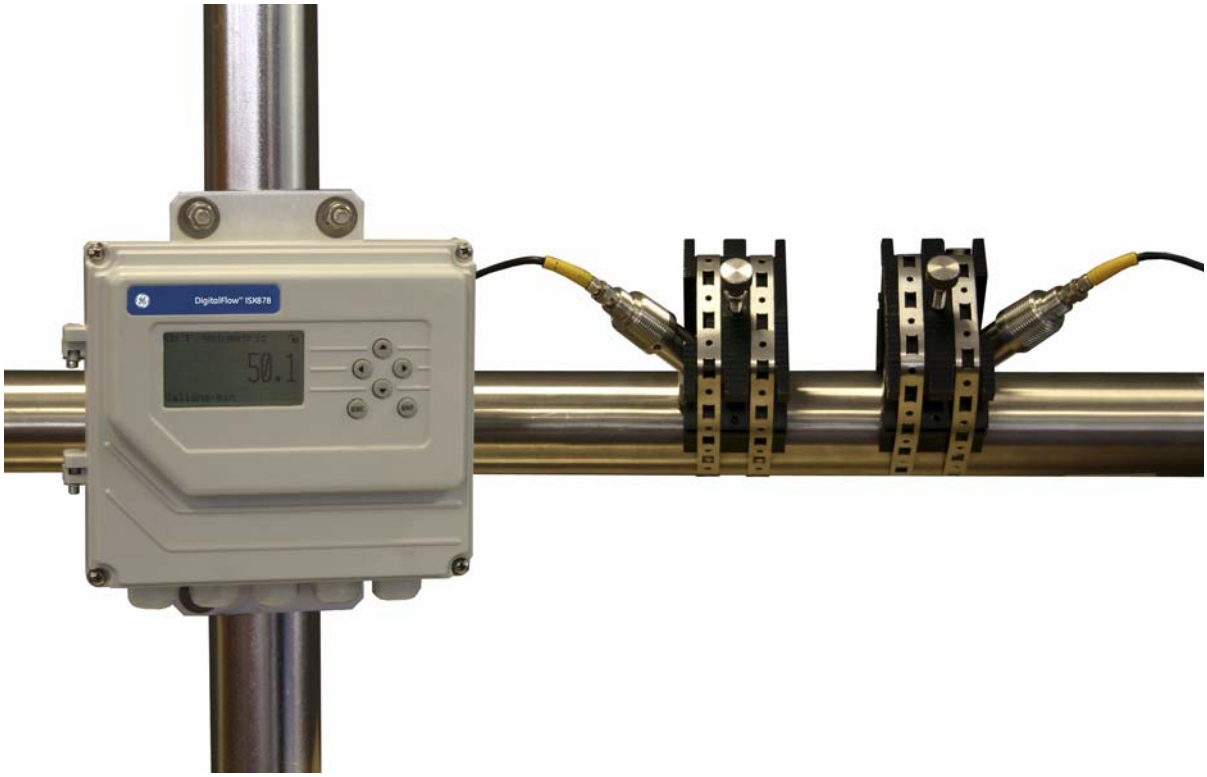

User's Manual

910-270A
July 2006

DigitalFlow™ is a GE Panametrics product. GE Panametrics has joined other GE high-technology sensing businesses under a new name—GE Industrial, Sensing.

Warranty

Each instrument manufactured by GE Sensing, Inc. is warranted to be free from defects in material and workmanship. Liability under this warranty is limited to restoring the instrument to normal operation or replacing the instrument, at the sole discretion of GE. Fuses and batteries are specifically excluded from any liability. This warranty is effective from the date of delivery to the original purchaser. If GE determines that the equipment was defective, the warranty period is:

- one year for general electronic failures of the instrument
- one year for mechanical failures of the sensor

If GE determines that the equipment was damaged by misuse, improper installation, the use of unauthorized replacement parts, or operating conditions outside the guidelines specified by GE, the repairs are not covered under this warranty.

The warranties set forth herein are exclusive and are in lieu of all other warranties whether statutory, express or implied (including warranties of merchantability and fitness for a particular purpose, and warranties arising from course of dealing or usage or trade).

Return Policy

If a GE Sensing, Inc. instrument malfunctions within the warranty period, the following procedure must be completed:

1. Notify GE, giving full details of the problem, and provide the model number and serial number of the instrument. If the nature of the problem indicates the need for factory service, GE will issue a RETURN AUTHORIZATION number (RA), and shipping instructions for the return of the instrument to a service center will be provided.
2. If GE instructs you to send your instrument to a service center, it must be shipped prepaid to the authorized repair station indicated in the shipping instructions.
3. Upon receipt, GE will evaluate the instrument to determine the cause of the malfunction.

Then, one of the following courses of action will then be taken:

- If the damage is covered under the terms of the warranty, the instrument will be repaired at no cost to the owner and returned.
- If GE determines that the damage is not covered under the terms of the warranty, or if the warranty has expired, an estimate for the cost of the repairs at standard rates will be provided. Upon receipt of the owner's approval to proceed, the instrument will be repaired and returned.

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Chapter 1

Installation

Introduction

To ensure safe and reliable operation of the Model ISX878 Ultrasonic Flowmeter, the system must be installed and programmed in accordance with the guidelines established by GE Sensing's engineers. Those guidelines, explained in detail in this chapter, include the following topics:

- Unpacking the Model ISX878 system
- Selecting suitable sites for the electronics enclosure and the transducers
- Installing the transducers
- Installing the electronics enclosure
- Wiring the electronics enclosure

!WARNING!
Be sure to follow all applicable local safety codes and regulations for installing electrical equipment. Consult company safety personnel or local safety authorities to verify the safety of any procedure or practice.

!ATTENTION EUROPEAN CUSTOMERS!
To meet CE Mark requirements, all cables must be installed as described in Appendix B, *CE Mark Compliance*.

ISXDR Transducers

The *ISXDR ultrasonic flow transducer*s are used exclusively with the ISX878 ultrasonic flowmeter. These transducers measure the flow rate of sonically-conductive liquids through pipes having diameters between 1/2 in. (1.27 cm) and 16 in. (40.64 cm). Such measurements are typically independent of the pipe material. The transducers operate in process temperatures from -40 to 194^{o}F (-40 to 90^{o}C)*. Each transducer assembly consists of the following components (see Figure 1-1 on the next page):

- a stainless steel adapter with 3/4" NPT male thread for attaching a junction box
- a transducer that consists of a piezoelectric element mounted on a wedge and wired to the connector
- a connector for use in connecting the transducer to the flowmeter.

*This temperature is for ATEX certified designs. Consult factory for higher temperatures.

ISXDR Transducers (cont.)

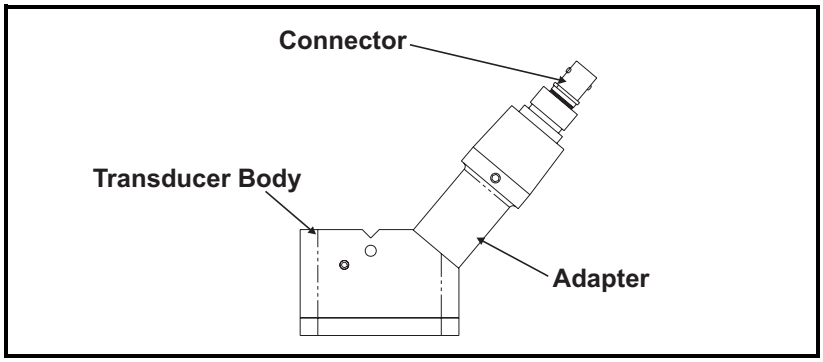


Figure 1-1: ISXDR Transducer Components

Unpacking

Carefully remove the electronics enclosure and the transducer/cable assembly from the shipping containers. Before discarding any of the packing materials, account for all components and documentation listed on the packing slip. The discarding of an important item along with the packing materials is all too common. If anything is missing or damaged, contact the factory immediately for assistance.

Site Considerations

Because the relative location of the transducers and the electronics enclosure is important, use the guidelines in this section to plan the ISX878 installation.

Electronics Enclosure Location

The standard ISX878 electronics enclosure is epoxy-coated aluminum rated for weatherproof NEMA Type 4X, IP67 applications. Typically, the enclosure is mounted as close as possible to the transducers. When choosing a site, make sure the location permits easy access to the electronics enclosure for programming, maintenance and service.

Transducer Location

Caution!

The Model ISX878's accuracy and performance depends primarily on the location, spacing and alignment of the transducers. The transducer spacing is unique to your installation.

In addition to accessibility, when planning for transducer location, adhere to the following procedure:

1. Locate the transducer measurement point at least 3 ft (1 m) or more from any butt welds or flanges, ideally in the center of a 20 ft (6 m) length of straight run of pipe. Keep appropriate clearance on either side of the pipe for easy transducer installation:
   - 6 in. (15 cm) if you are not using a junction box, or
   - 9 in. (22.5 cm) if you are using a junction box.

Transducer Location (cont.)

Note: *To guarantee the specified accuracy of the flowmeter there is no substitute for a straight run pipe and fully-developed flow profile. However, if straight run is not available, the transducer location should be in a position such that the acoustic signal travels through the full distribution of the under-developed flow profile for best repeatability.*

2. Place the transducers as close as possible to the horizontal plane. (see Figure 1-2 below). Locate the transducers on opposite sides of the pipe 180^{o} apart, ideally at the 3 and 9 o'clock positions. **Do not place transducers on the top or bottom of the pipe.**

Note: *For best profile identification in limited straight run, place transducers at 1 and 7 o'clock.*

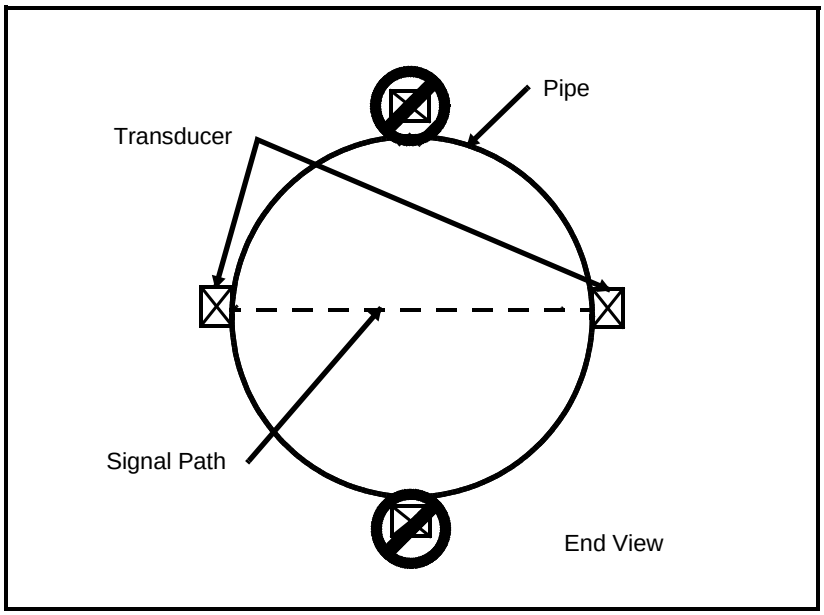


Figure 1-2: Transducer Placement

Cable Lengths

Locate the electronics enclosure as close as possible to the transducers. GE Sensing can supply ISX878 transducer cables in fixed lengths up to 100 ft (30 m) in length for remote location of the electronics enclosure.

Transducer Cables

When installing the transducer cables, always observe established standard practices for the installation of electrical cables. Do not route transducer cables alongside high amperage AC power lines or any other cables that could cause electrical interference. Also, protect the transducer cables and connections from the weather and corrosive atmospheres. Do not run the transducer cables along a pipe with a surface temperature over 75°C (167°F) for models ISXDR-407 and ISXDR-408.

IMPORTANT: *Use only the cables and transducers that have been supplied with the ISX878.*

Mounting the ISX878 Electronics Enclosure

The standard Model ISX878 electronics package is housed in a epoxy-coated aluminum weatherproof NEMA4X, IP67 enclosure suitable for indoor or outdoor use. Figure 1-27 on page 1-29 shows the outline and installation drawing. Refer to Chapter 7, *Specifications*, for the mounting dimensions and the weight of this enclosure.

Making the Electrical Connections

This section contains instructions for making all the necessary electrical connections to the Model ISX878 flow transmitter. Refer to Figure 1-31 on page 1-33 for a complete wiring diagram.

!ATTENTION EUROPEAN CUSTOMERS!
To meet CE Mark requirements, all cables must be installed as described in Appendix B, *CE Mark Compliance.*

!WARNING!
Always disconnect the input power from the Model ISX878 before removing the front cover.

Preparing the Unit Before Making Electrical Connections

Prepare the unit as described below before making any electrical connections.

1. Disconnect any previously wired power line from the unit.
2. Remove the screws on the front cover.
3. Install any required cable clamps on the appropriate conduit holes on the bottom of the enclosure.

Proceed to the next section to make the desired wiring connections.

Intrinsic Safety

The ISX878 flowmeter is listed as “Intrinsically Safe” for hazardous locations. “Intrinsically Safe” means that the circuits within this flowmeter are designed to be incapable of producing a spark or thermal effect that could ignite a mixture of flammable or combustible gases when properly installed in a hazardous location. However, it does **not** mean that the ISX878 is “Explosion-Proof.” If proper safety precautions are not followed, or if the equipment is not installed properly, there is a serious potential for possible explosion. Be sure to review all safety precaution, installation, and wiring directions throughout this manual prior to installing the ISX878 flowmeter. The ISX878 provides intrinsically safe outputs to the transducers, allowing the transducers to be located in a hazardous (Classified) location. The ISX878 electronics can be mounted in a hazardous (classified) location when appropriate safety barriers are used. See “Safety Barriers” on the next page.

Intrinsically Safe Installation Requirements

Where possible, mount the associated apparatus in a non-hazardous location as near as possible to the hazardous location. This will minimize the length of intrinsically safe conductors within the non-hazardous location, thus decreasing the possibility of inadvertent connection of non-intrinsically safe energy to the protected circuit.

!WARNING!
Intrinsically safe wiring must be separated from non-intrinsically safe wiring to prevent the transfer of unsafe levels of energy to the hazardous area. Consult local codes and authorities having jurisdiction over the area.

Safety Barriers

The Model ISX878 requires the use of a safety barrier(s). Refer to Table 1-1 below for the required safety barrier specifications for use with the Model ISX878.

Note: *Safety barriers must be installed in accordance with the barrier manufacturer's specifications.*

Table 1-1: Safety Barrier Specifications

	Loop Power	Totalizer Output	Alarm Switch Output
	MTL-7706 or equivalent	MTL-7787 or equivalent	MTL-7741 or equivalent
Umax	28 VDC	28 VDC	10 VDC
Imax	93 mA	93 mA	19 mA
Rmax	300 ohm	300 ohm	
Pmax	0.65 W	0.65 W	0.19 W

Wiring the Input Power

Note: *If the input voltage needs to be adjusted, select "Voltage Adjust" from the Service Menu and press [ENT]. Then adjust the input voltage and press [ESC]. This procedure allows the meter to correctly read the input voltage to adjust the power management algorithm.*

Refer to Figure 1-31 on page 1-33 to locate the power terminal block and connect the input power as follows:

1. Follow the instructions on page 1-4 to prepare the unit before you connect power.

!ATTENTION EUROPEAN CUSTOMERS!
To meet CE Mark requirements, all cables must be installed as described in Appendix B, *CE Mark Compliance.*

2. Connect the ISX878 case to the earth ground with a grounding cable to the external ground screw found on either side of the enclosure.
3. Strip 1/4-in. of insulation from the end of each of the two input power leads.
4. Route the shielded cable through the conduit hole and connect the power leads to the power terminal block as shown in Figure 1-31 on page 1-33. Tie the shield drain wire to the ground bus bar inside the ISX878, but leave the shield wire open on the power supply end (to avoid AC ground loops and for CE certification).
5. Leaving a small amount of slack, secure the power line with the cable clamp.
6. Connect the two power leads to the safety barrier, as shown in Figure 1-3 on the next page. Barriers must be installed in accordance with the barrier manufacturer's specifications.

Wiring the Input Power (cont.)

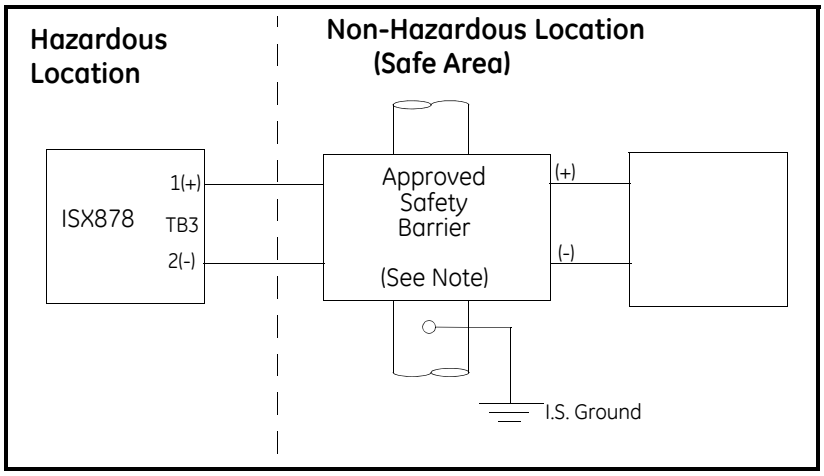


Figure 1-3: Power Lead Connection to Safety Barrier

7. If you are installing the ISX878 for the first time, refer to Chapter 2, *Programming Site Data*, and program the sections from page 2-4 to 2-14 (the *Status*, *Transducer*, *Pipe*, *Fluid* and *Path* options) to determine the appropriate transducer spacing to position the transducers (see page 1-9).

Determining the Number of Traverses

The next step in installation is to determine the number of traverses. The transducers can be mounted using one of two methods (shown in Figure 1-4 on the next page:

- Double-traverse method ("V" method) - transducers are mounted on the same side of the pipe and the ultrasonic signal is bounced from one transducer to the other, off the opposite pipe wall.
- Single-traverse method ("Z" method) - transducers are mounted diagonally across from each other. The ultrasonic signal is transmitted directly from one transducer to the other, across the pipe.

You should always try the double-traverse method first, since it easier to install and yields greater accuracy. Otherwise, the single-traverse method is best for pipes with the following:

- poor inside surface conditions
- highly attenuating fluid

Note: *You may want to try both configurations to see which yields more accurate results.*

Determining the Number of Traverses (cont.)

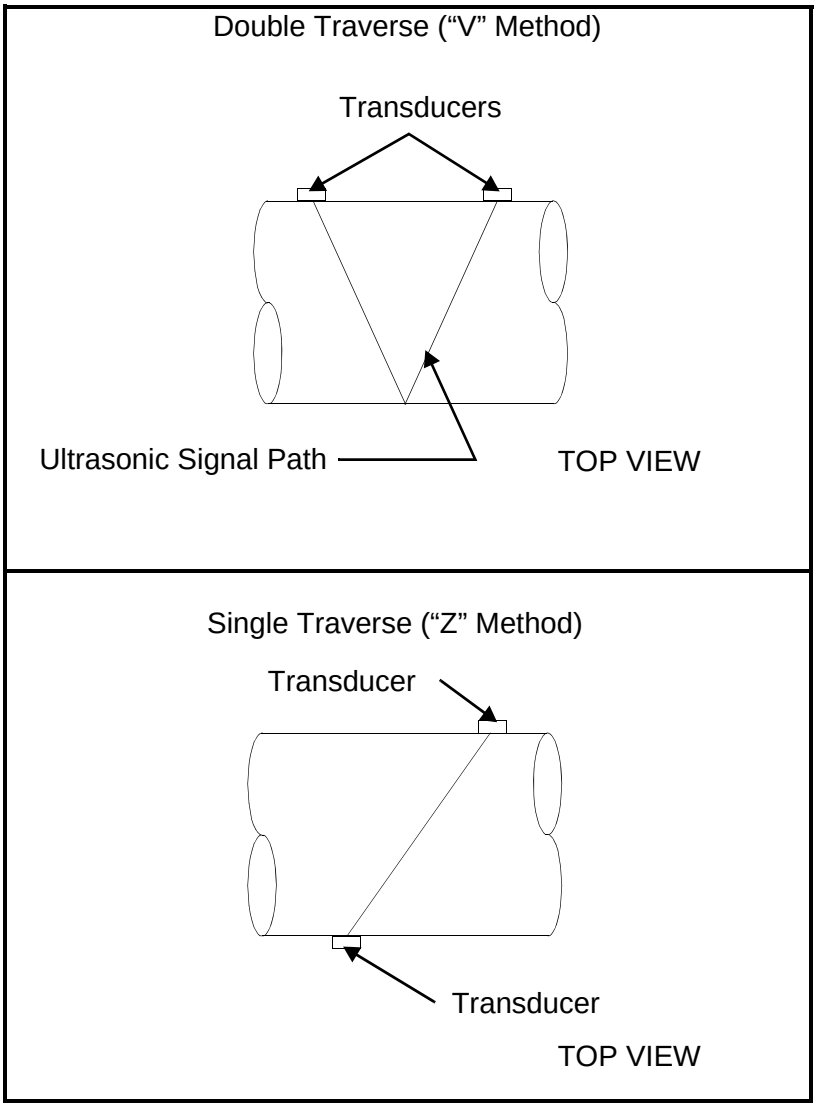


Figure 1-4: Double- and Single-Traverse Installations

Installing the Transducers

The transducers that have been specially designed for use with the ISX878 are available in four models: 4 MHz for 1/2 to 2 in. pipes; 2 MHz for 1/2 to 8 in.; 1 MHz for 2 to 16 in.; and 500 kHz for 6 to 16 in. They typically support 2-traverse applications. Two styles of transducer are available; one style, intended for smaller pipes, integrates the cable and clamping fixture, while the other style accommodates larger pipes. The preattached cables come in lengths from 6 to 25 ft. (Longer lengths are available by special order. Please consult the factory.) Figure 1-5 below shows a typical ISX878 transducer, while the outline and installation drawing for the clamping fixture appears in Figure 1-30 on page 1-32.

Small Pipe Transducer Installation

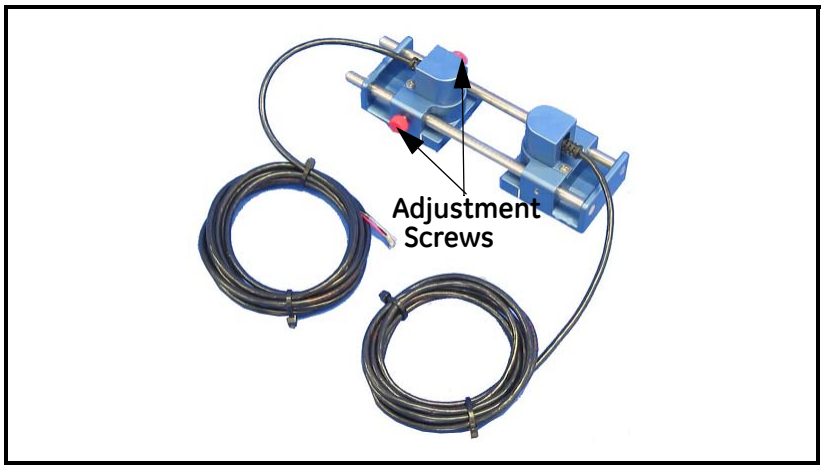


Figure 1-5: ISX878 Transducer/Cable Assembly

Setting Transducer Spacing

Note: *If the calculated spacing exceeds the minimum allowed by the transducers, set the transducers to minimum spacing, and override the calculated value to the values measured on the transducers*

If you have not already obtained the transducer spacing, you must program the *Status, Transducer, Pipe, Fluid* and *Path* options of the *Program* menu (pages 2-4 to 2-14) to calculate the appropriate setting. To set the desired transducer spacing:

1. Loosen the red screws on the adjustable transducer (shown in Figure 1-5 above).
2. Slide the adjustable transducer on the rails until you have positioned it at the desired spacing. Use the ruler on the rails and the white tick mark on the transducer housing to assist in setting the correct spacing.
3. Tighten the red screws to secure the transducer to the rails.

Setting Transducer Spacing (cont.)

Note: *If your application requires one or three traverses, you can remove the adjustable transducer from the rails and use it as a separate transducer at a 180° angle from the stationary transducer, as shown in Figure 1-6 below.*

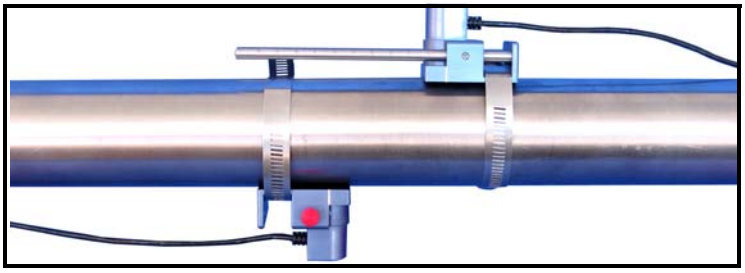


Figure 1-6: Positioning for 1 or 3-Traverse Applications

Installing the Transducers on the Pipe

Note: *Some pipe preparation may be required before securing the transducers to the pipe. Remove any paint or coating from the surface in contact with the transducers. A flat, smooth surface is ideal.*

1. Apply the supplied couplant to the transducer faces, as shown in Figure 1-7 below.

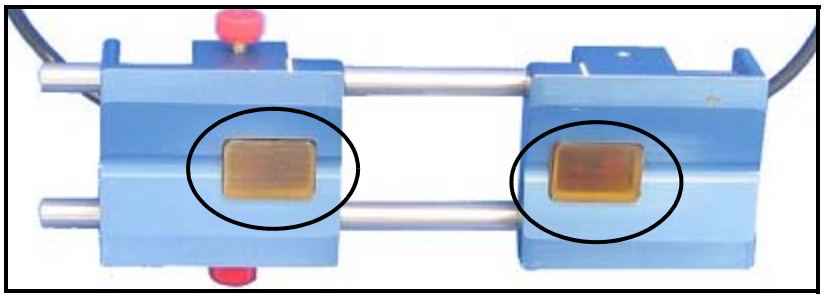


Figure 1-7: The Transducer Faces

2. Put the transducer fixture at the desired location on the pipe. Secure it with the supplied stainless steel clamps. Figure 1-8 on the next page illustrates a typical installation.

Note: *Installation on the sides (at 3 and 9 o'clock) of the pipe is ideal. The top of the pipe might contain bubbles, while the bottom might contain sediment.*

Installing the Transducers on the Pipe

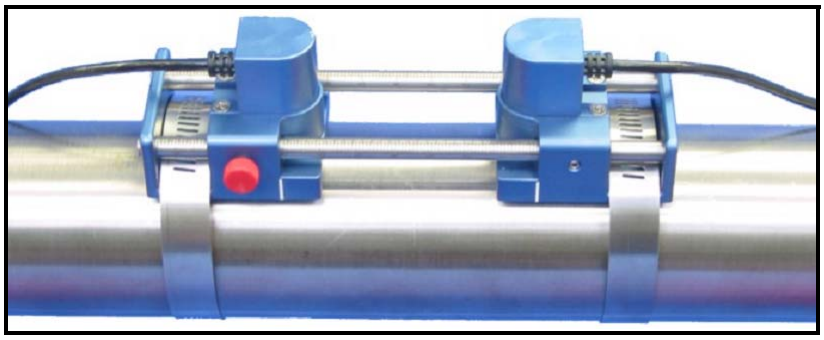


Figure 1-8: A Typical Transducer Installation

Once on the pipe, an internal spring mechanism ensures proper mechanical pressure by "pressing" the transducer face against the pipe surface. Refer to the next page to wire the transducer cables to the ISX878.

Large Pipe Fixture and Transducer Installation

The CF-ES clamping fixture acts as a permanent transducer holder. The fixture has two blocks that are used for double- and single-traverse methods. Steel straps secure the blocks to the pipe for a permanent installation.

The blocks are positioned properly using the spacing dimension calculated by the flowmeter. Then the transducers are mounted into the blocks. Figure 1-9 below shows a long block.

The transducer installation consists of mounting the CF-ES to the pipe and then mounting the transducers into the blocks. Refer to the appropriate section that follows for instructions:

- Double-traverse Method - see the next page
- Single-traverse Method - see page 1-16.

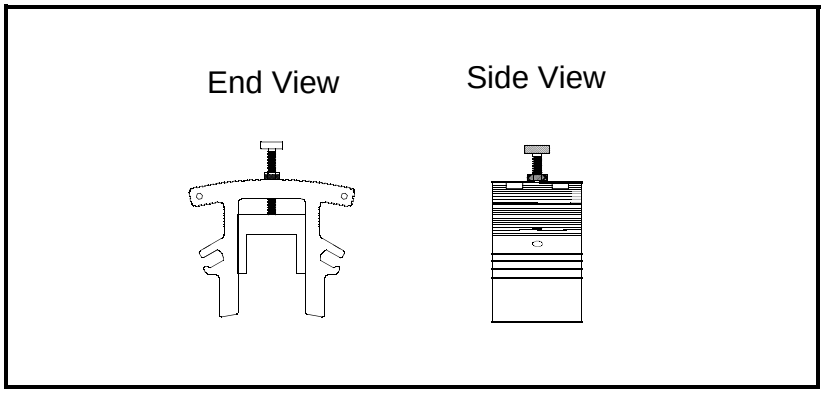


Figure 1-9: CF-ES Clamping Fixture Block

The Double-Traverse Method - CF-ES

Note: *The instructions in this section can also be used for a multiple-traverse method. However, you must use an EVEN number of traverses. The distance the signal travels from one side of the pipe wall to the opposite side of the pipe wall is considered one traverse. For more than two traverses, consult the factory.*

There are three advantages in using the double-traverse method:

- Accuracy is improved because the signal is in the fluid longer than with a single-traverse.
- This configuration can reduce some effects of an underdeveloped flow profile.
- If there is enough pipe length available, the double-traverse fixture is easier to install.

The procedure for mounting the CF-ES involves marking the pipe for the desired spacing, fastening the clamping fixture on the pipe and then mounting the transducers into the fixture.

Procedure:

You will need a level and a marker or scribe to locate and mark the transducer locations on the pipe.

1. Obtain the transducer spacing dimension S.
2. Be sure the location you have chosen for the installation has at least 10 pipe diameters of straight, undisturbed flow upstream and 5 pipe diameters downstream of the measurement point.
3. Prepare the pipe where you intend to place the clamping fixture by making sure it is clean and free of loose material. Sanding, though usually not required, may be necessary to take off any high spots. Be careful to preserve the original curvature of the pipe.
4. Find the top of the pipe and use a level to draw a line parallel to the pipe's axis, as shown in Figure 1-10 below.

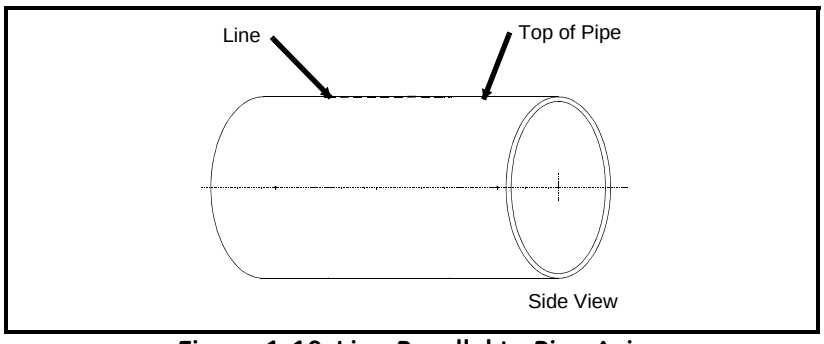


Figure 1-10: Line Parallel to Pipe Axis

The Double-Traverse Method - CF-ES (cont.)

5. Make two marks (shown in Figure 1-11 below) on the line equal to the transducer spacing distance S, as calculated by the meter.

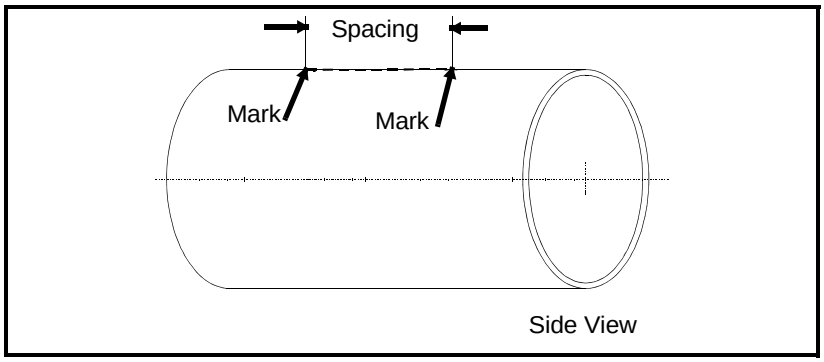


Figure 1-11: Marks for Transducer Spacing on Inscribed Line

6. From each of the marks, measure around the circumference of the pipe in the same direction a distance equal to one quarter the pipe's circumference, as shown in Figure 1-12 below. Make a crossmark with a marker or scribe.

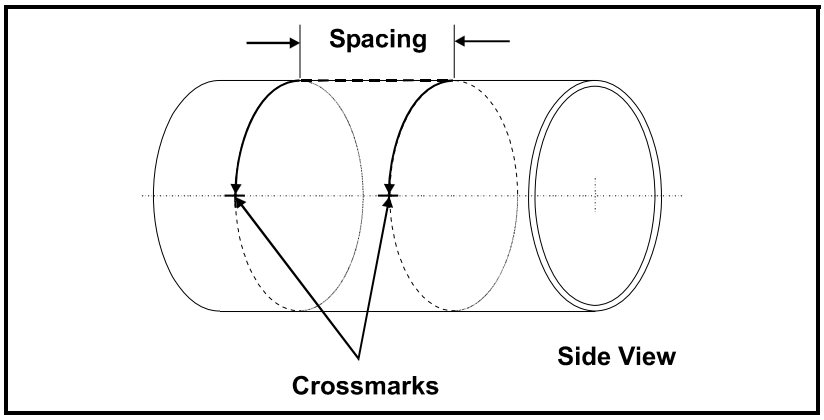


Figure 1-12: Measuring a Quarter-Circumference

The Double-Traverse Method - CF-ES (cont.)

7. Center one of the blocks over one of the crossmarks on the pipe. Align the block so that the pressure bolt is over the center of the mark. Secure the block by wrapping the two straps around the block and pipe and tightening them. Make sure the turnbuckles are at least 1/2 pipe diameter away from the block, as shown in Figure 1-13 below.

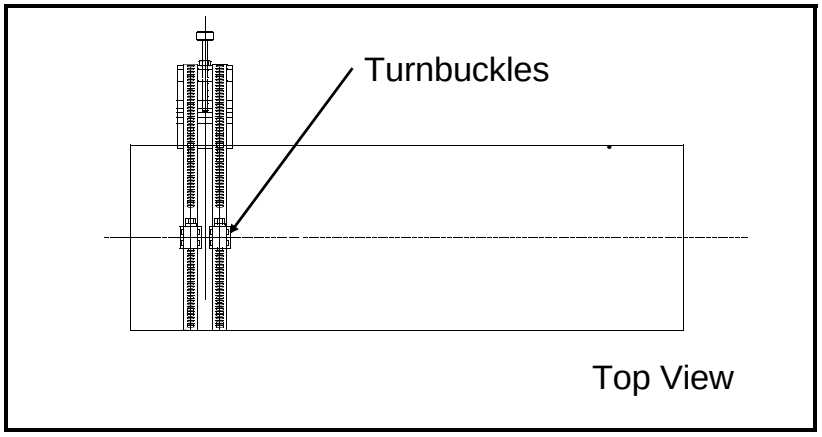


Figure 1-13: Positioning Turnbuckles 1/2 Pipe Diameter from Block

8. Repeat Step 7 to install the other block over the other crossmark (Figure 1-14 below).

Note: *Make sure both straps are perpendicular to the bottom of the block. If the straps are slanted, the slack will cause the block to slide. The slack may also change the transducer spacing after the transducers are mounted.*

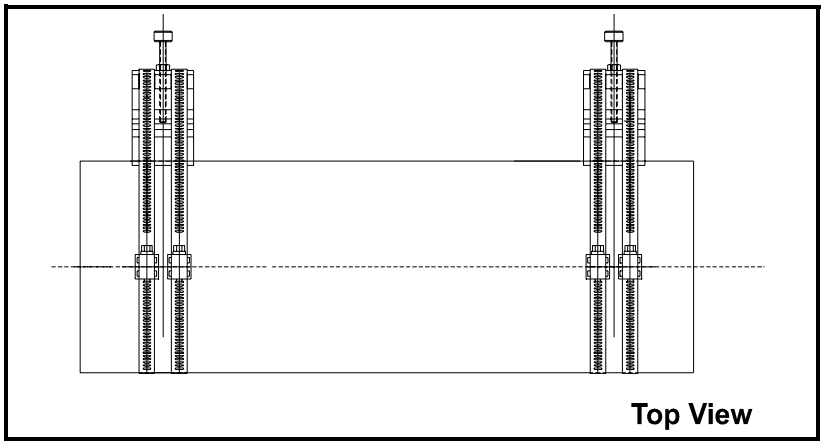


Figure 1-14: Positioning Both Blocks

Figure 1-15 on the next page shows a double-traverse installation without transducers. Proceed to *Mounting Transducers into the CF-ES* on page 1-20.

The Double-Traverse Method - CF-ES (cont.)

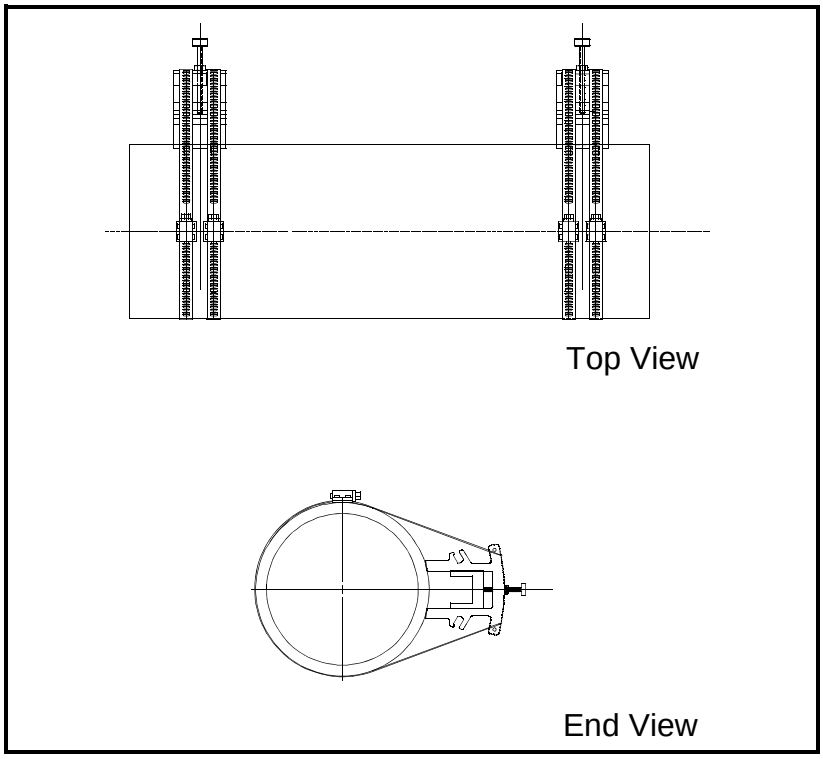


Figure 1-15: A Double-Traverse CF-ES Installation without Transducers

The Single-Traverse Method - CF-ES

Note: *The instructions in this section can also be used for a multiple-traverse method. However, you must use an ODD number of traverses. The distance the signal travels from one side of the pipe wall to the opposite side of the pipe wall is considered one traverse.*

The procedure for mounting the CF-ES involves marking the pipe for the desired spacing, fastening the fixture to the pipe and then mounting the transducers into the fixture.

Procedure:

You will need a level and marker or scribe to locate the transducers on the pipe.

1. Obtain the transducer spacing dimension S, as described on pages 2-4 to 2-14.
2. Be sure the location you have chosen for the installation has at least 10 pipe diameters of straight, undisturbed flow upstream and 5 pipe diameters downstream of the measurement point.
3. Prepare the pipe where you intend to place the CF-ES by making sure it is clean and free of loose material. Sanding, though usually not required, may be necessary to take off any high spots. Be careful to preserve the original curvature of the pipe and not to eradicate the marks on the pipe.
4. Find the top of the pipe and use a level to draw a line parallel to the pipe's axis, as shown in Figure 1-16 below.

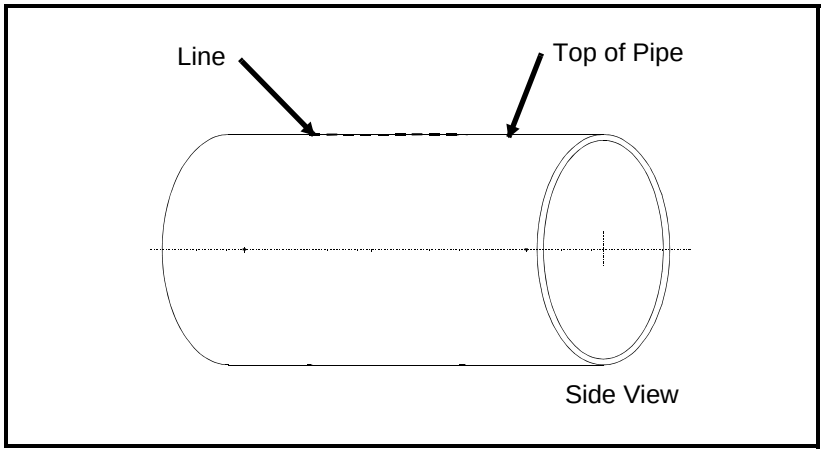


Figure 1-16: Drawing Line Parallel to Pipe Axis

The Single-Traverse Method - CF-ES (cont.)

5. Make two marks (shown in Figure 1-17 below) on the line equal to the transducer spacing distance S, as calculated by the meter.

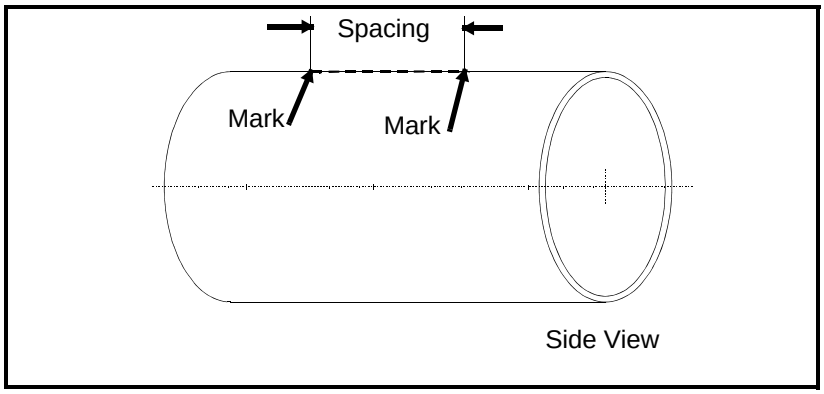


Figure 1-17: Marking Transducer Spacing

6. From one of the marks, measure around the circumference of the pipe a distance equal to one quarter the pipe's circumference, as shown in Figure 1-18 below. Make a crossmark with a marker or scribe.

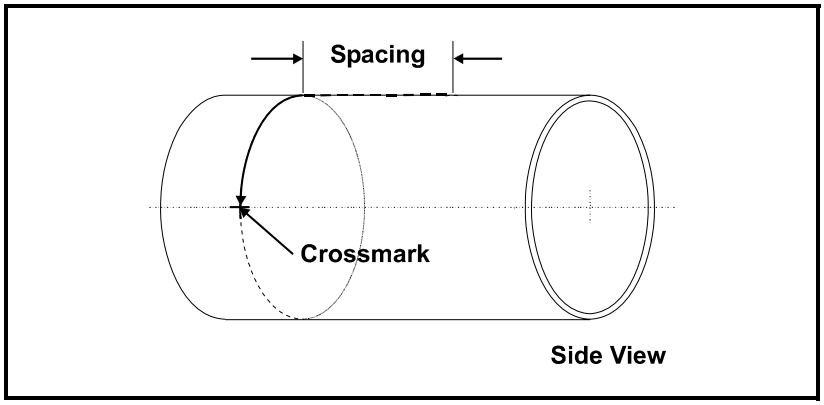


Figure 1-18: Measuring a Quarter of the Pipe's Circumference

7. From the other mark, go in the opposite direction around the pipe for one quarter the circumference and make another crossmark, as shown in Figure 1-19 below.

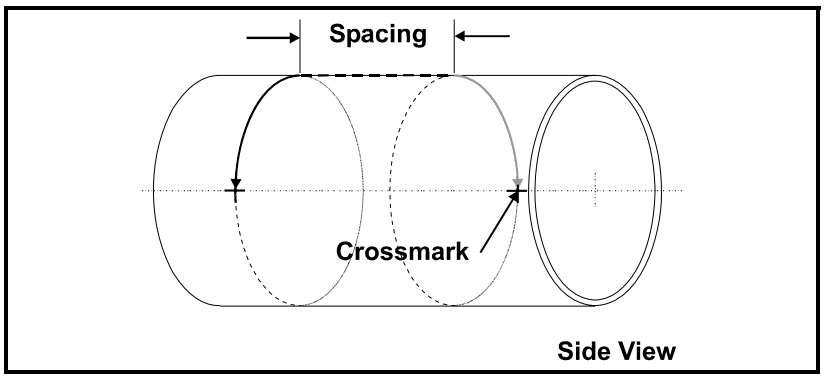


Figure 1-19: Measuring the Second Quarter Circumference

The Single-Traverse Method — CF-ES (cont.)

8. Center one of the blocks over one of the crossmarks on the pipe. Align the block so that the pressure bolt is over the center of the crossmark. Secure the block by wrapping two straps around the block and pipe and tightening them. Make sure the turnbuckles are at least 1/2 pipe diameter away from the block, as shown in Figure 1-20 below.

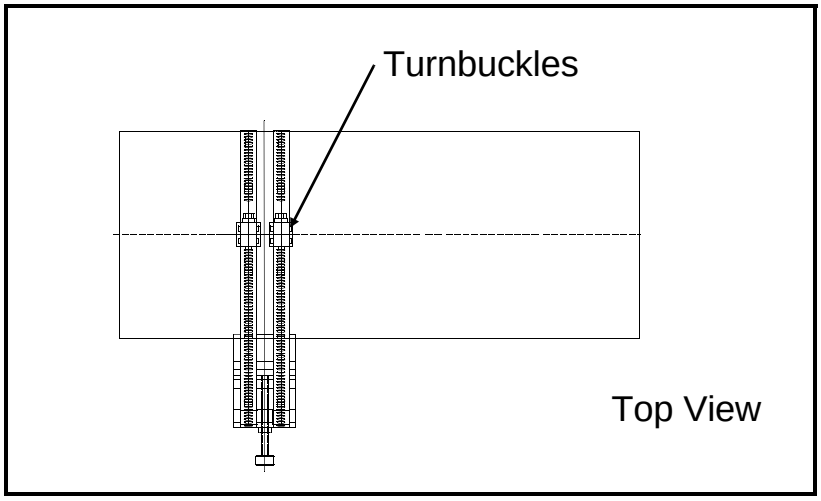


Figure 1-20: Positioning Turnbuckles

9. Repeat Step 8 to install the other block over the other punch mark.

Note: *Make sure both straps are perpendicular to the bottom of the block (Figure 1-21 below). If the straps are slanted, the slack will cause the block to slide. The slack may also change the transducer spacing after the transducers are mounted.*

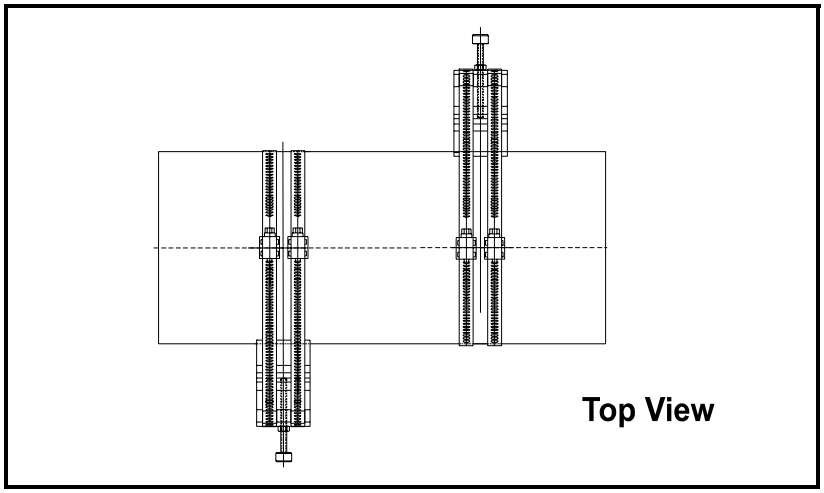


Figure 1-21: Correct Strap Positioning

The Single-Traverse Method -CF-ES (cont.)

Figure 1-22 below shows a single-traverse installation without transducers. Proceed to *Mounting Transducers into the CF-ES* on the next page.

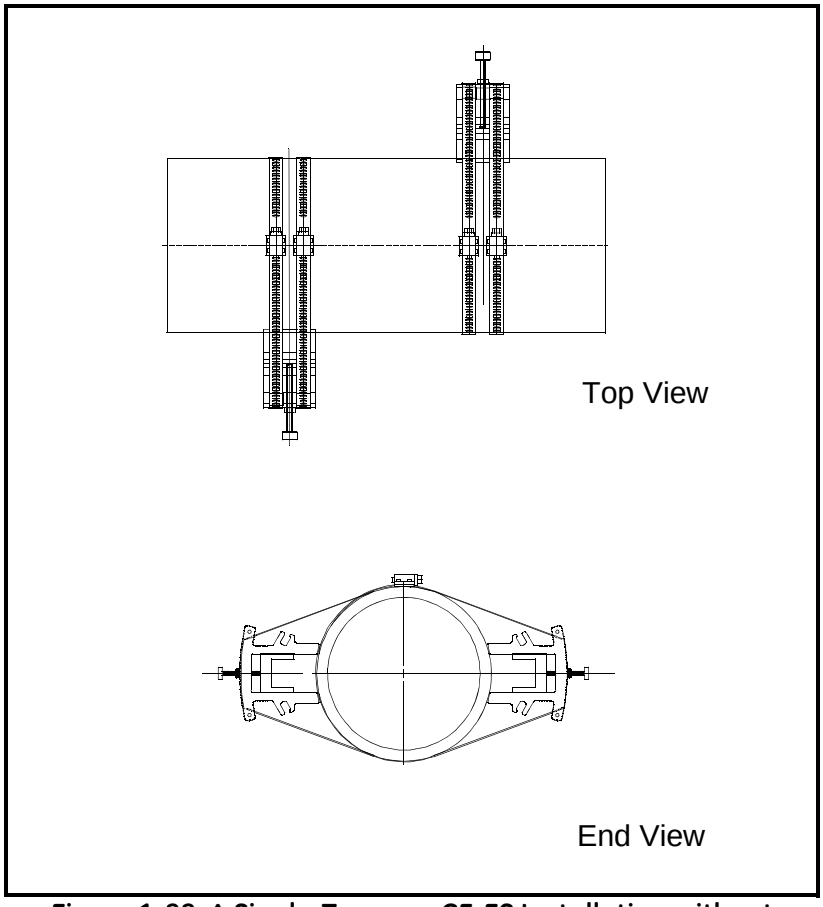


Figure 1-22: A Single-Traverse CF-ES Installation without Transducers

Mounting Transducers into the CF-ES

The last step of installation is mounting the transducers into the clamping fixture.

IMPORTANT: *To maintain ATEX certification, the transducer face must be protected against impact. This is provided by properly installing the transducer into the clamping fixture. All care must be taken during installation to ensure all protection is afforded.*

Procedure for Mounting Transducers

To mount the transducers into the CF-ES, use the following steps:

1. Apply a thread sealant to the transducer threads. A sealant is not required within the US; however, a sealant must be used in the European Community.
2. Before mounting the transducers, thread the junction box onto the end of the transducer with the connector, as shown in Figure 1-23 below. Ensure that at least five full threads are engaged. Make sure to orient the cover of the junction box so it is accessible to make cable connections once the box is installed.

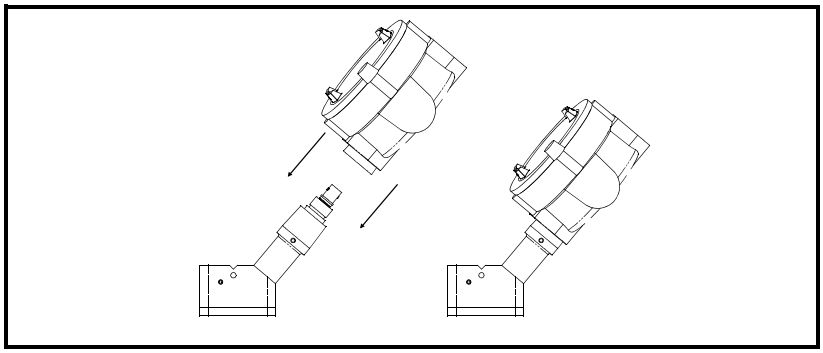


Figure 1-23: Threading the Junction Box

3. Take one of the transducers and apply a thin bead of couplant down the center of its face approximately the size of a toothpaste bead (Figure 1-24 below).

IMPORTANT: *To prevent the loss of couplant, do not slide the transducer with couplant along the surface of the pipe when mounting.*

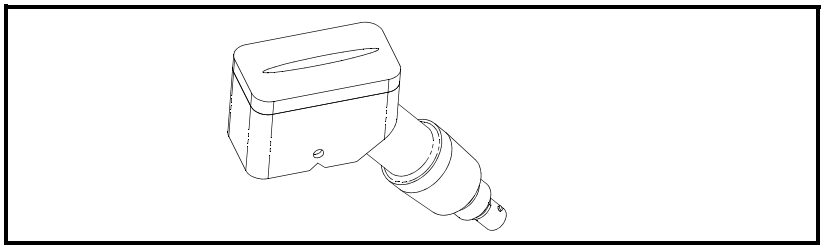


Figure 1-24: Applying Couplant to Transducer

Mounting Transducers into the CF-ES (cont.)

4. Place the transducers in the appropriate blocks. Make sure the transducers are oriented as shown in Figure 1-25 below.

Note: *If the transducer cables are already connected, you must determine the upstream and downstream directions of the pipe and place the transducers into the appropriate blocks.*

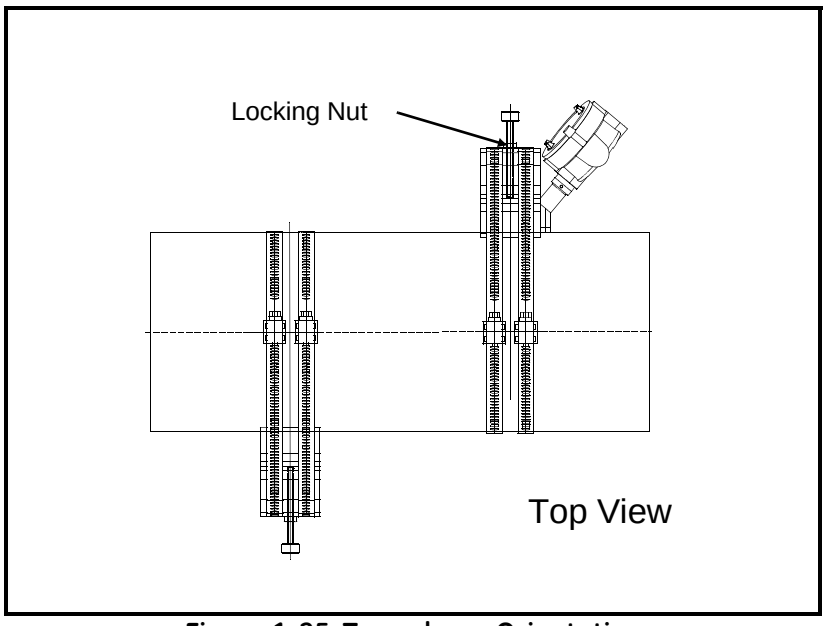


Figure 1-25: Transducer Orientation

5. Use the pressure bolt to secure the transducer in place. The pressure bolt should fit into the dimple. Hand-tighten enough to hold the transducer in place. Do not overtighten so that the fixture lifts off the pipe.
6. Tighten the locking nut on the pressure bolt (see above).

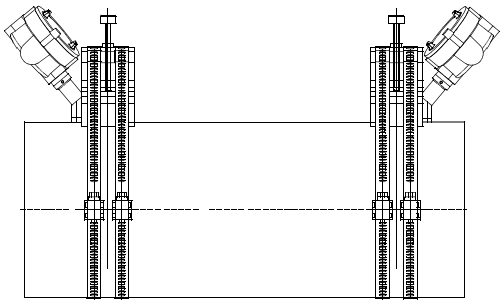
IMPORTANT: *When using the CF-ES in a pipe location with possible mechanical vibration, the locking nut must be used to secure the position of the pressure bolt on the transducer after the bolt has been hand-tightened into the transducer dimple. For additional resistance to vibration a thread lock compound or a stainless steel washer and lock washer may also be used. These items can be ordered from GE by requesting a "special" clamping fixture and specifying either the thread lock or the washers.*

7. Repeat Steps 1 to 6 to mount the other transducer in the remaining block. See Figure 1-26 on the next page for completed installations.

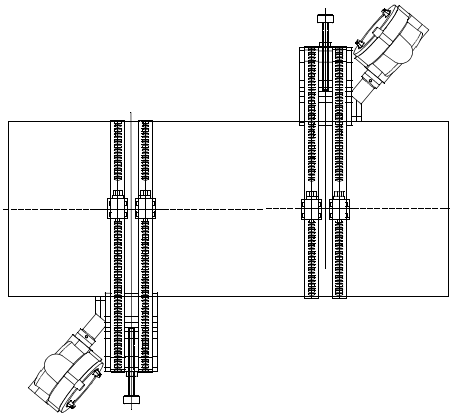
Mounting Transducers into the CF-ES (cont.)

!WARNING!
Before performing the next step make sure power to the flowmeter electronics has been disconnected.

8. Make transducer cable connections as described on the next page.



Double-Traverse Installation (Top View)



Single-Traverse Installation (Top View)

Figure 1-26: Completed CF-ES Installations with Transducers

Note: *If you have mounted the transducers into the CF-ES properly, the two transducer cable connectors will face away from each other as shown in the above figure.*

Wiring the Transducers

Follow the instructions on page 1-4 before wiring the transducers.

!WARNING!
Before connecting the transducers, discharge any static buildup by shorting the twisted pairs of the transducer cables to the metal shield on the cable connector.

1. Refer to the wiring diagram in Figure 1-31 on page 1-33 and connect the transducer cables to the terminal block (TB-1) for Channel 1. Then, secure the cable clamp.

Note: *The RED (or BLUE) cable leads are the SIG (+) leads and the BLACK (or BROWN) cable leads are the RTN (-) leads. The shield cable leads are connected to the ground bus.*

!ATTENTION EUROPEAN CUSTOMERS!
To meet CE Mark requirements, all cables must be installed as described in Appendix B, *CE Mark Compliance.*

2. For a 2-path averaging ISX878, repeat step 1 to connect the CH2 transducers to the terminal block for Channel 2. It is not required that both channels/paths of a 2-Channel unit be connected.

Note: *The ISX878 uses two channels or paths to make more accurate flow measurement by averaging, subtracting or adding the channels/paths together.*

3. Connect the transducer shield wires to the ISX878 ground bus.
4. Do one of the following:
   - Proceed to the next page to wire the ISX878 option cards, if desired.
   - Proceed to page 1-26 to wire the ISX878 RS232 serial port, if desired.
   - Replace the front cover on the enclosure and tighten the screws.

!WARNING!
Use RS232 connections only in the safe area.

Note: *A channel must be activated before it can begin taking measurements. See Chapter 2,* Programming Site Data*, for instructions.*

Wiring the Option Cards

Follow the instructions on page 1-4 before wiring the option cards.

Wiring the Totalizer Option

Refer to Figure 1-31 on page 1-33 to locate the totalizer terminal block and connect the totalizer option card as follows:

1. Follow the instructions on page 1-4 to prepare the unit before you connect power.

!ATTENTION EUROPEAN CUSTOMERS!
To meet CE Mark requirements, all cables must be installed as described in Appendix B, *CE Mark Compliance.*

2. Connect the ISX878 case to the earth ground with a grounding cable.
3. Strip 1/4-in. of insulation from the end of each of the two option card leads.
4. Route the shielded cable through the conduit hole and connect the totalizer card to the totalizer card terminal block as shown in Figure 1-31 on page 1-33. Tie the shield drain wire to the ground bus bar inside the ISX878, but leave the shield wire open on the power supply end (to avoid AC ground loops and for CE certification).
5. Leaving a small amount of slack, secure the totalizer option card line with the cable clamp.
6. Connect the two totalizer option cards leads to the safety barrier. Barriers must be installed in accordance with the barrier manufacturer's specifications.

Wiring the Alarm Switch Option

Refer to Figure 1-31 on page 1-33 to locate the alarm terminal block and connect the alarm option card as follows:

1. Follow the instructions on page 1-4 to prepare the unit before you connect the card.

!ATTENTION EUROPEAN CUSTOMERS!
To meet CE Mark requirements, all cables must be installed as described in Appendix B, *CE Mark Compliance.*

2. Connect the ISX878 case to the earth ground with a grounding cable.
3. Strip 1/4-in. of insulation from the end of each of the two option card leads.
4. Route the shielded cable through the conduit hole and connect the alarm card to the alarm card terminal block as shown in Figure 1-31 on page 1-33. Tie the shield drain wire to the ground bus bar inside the ISX878 to the closest grounding screw, but leave the shield wire open on the other power supply end (to avoid AC ground loops and for CE certification).
5. Leaving a small amount of slack, secure the totalizer alarm switch output option card line with the cable clamp.
6. Connect the two totalizer alarm switch output option cards leads to the safety barrier. Barriers must be installed in accordance with the barrier manufacturer's specifications.

Wiring the RS232 Serial Port

!WARNING!
Use RS232 connections only in the safe area.

The Model ISX878 flow transmitter is equipped with a built-in RS232 serial communications port. Proceed to the section below for wiring instructions. For more information on serial communications, refer to the *EIA-RS Serial Communications* manual (916-054).

Use the serial port to connect the Model ISX878 flow transmitter to an ANSI terminal or a personal computer. The RS232 interface is wired as Data Terminal Equipment (DTE), and the signals available at the COMMUNICATION terminal block are shown in Table 1-1 below.

1. Follow the instructions on page 1-4 to prepare the unit before you connect power.
2. Use the information in Table 1-2 below to construct a suitable shielded cable for connecting the Model ISX878 to the external device. If desired, an appropriate cable may be purchased from GE Sensing.

Note: *The DTR and RTS signals power the ISX878 communication circuit and are required for proper operation. Consult the factory if you have additional questions.*

Note: *Signal names that imply direction (e.g., transmit and receive) are named from the point of view of the DTE device (the GE Sensing meter is usually considered the DTE device). When the RS232 standard is strictly followed, these signals are labeled with the same name and pin # on the DCE device side as well. Unfortunately, the convention is not followed because the DTE and DCE side get confused. Therefore, connections that imply direction are changed to reflect their direction on the DCE side.*

Table 1-2: RS232 Connection to DCE or DTE Device

Communication TB4	Colors for GE Cable 704-845	Signal Description	DCE DB25 Pin #	DCE DB9 Pin #	DTE DB25 Pin #	DTE DB9 Pin #
1	White	DTR	20	4	20	4
2	Yellow	RTS	4	7	4	7
3	Green	Signal Ground	7	5	7	5
4	Black	ISX878 (Transmit)	2	3	3	2
5	Red	ISX878 (Receive)	3	2	2	3

Wiring the RS232 Serial Port (cont.)

3. Feed the flying leads end of the cable through the conduit hole and wire the leads to the COMMUNICATION terminal block (TB4) as shown in Figure 1-31 on page 1-33. Connect the other end of the cable to the ANSI terminal or personal computer, and secure the cable clamp.
4. Tie the shield drain wire to the ISX878 ground bus bar.

!ATTENTION EUROPEAN CUSTOMERS!
To meet CE Mark requirements, all cables must be installed as described in Appendix B, *CE Mark Compliance*.

After the wiring has been completed, replace the front cover on the enclosure and tighten the screws. Consult the user's manual for the external device to configure it for use with the ISX878.

Service Requirements

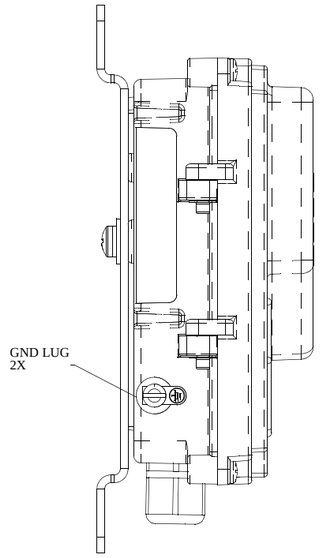
In the event of equipment malfunction, all repairs should be performed by an authorized agent. It is the responsibility of users requiring service to contact the factory for repair or service:

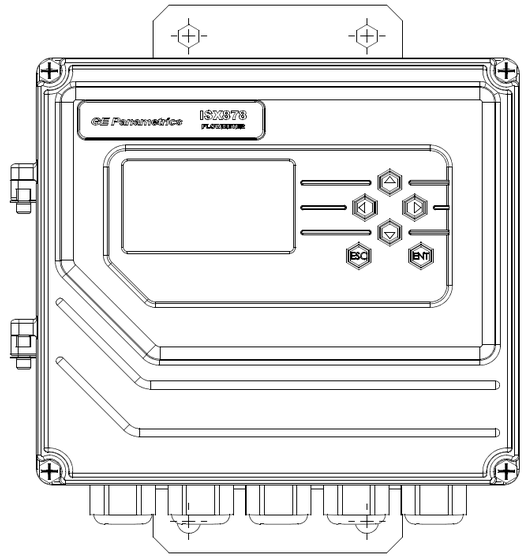
GE Industrial Sensing
1100 Technology Park Dr.,
Billerica, MA 01821 USA
Telephone: (978) 437-1000 or
Toll-free: (800) 833-9438
http://gesensing.com/contact/contactus.htm

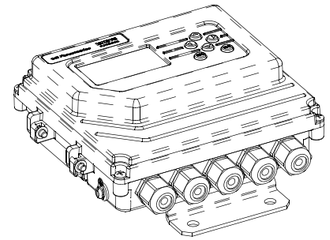
What's Next?

After the ISX878 has been completely installed and wired, reconnect input power.

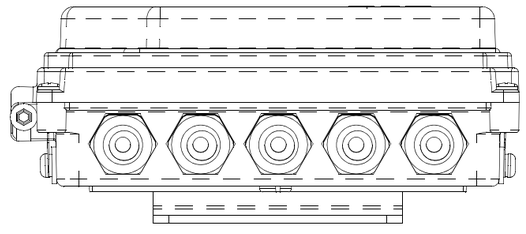
- Check the diagnostics (discussed in Chapter 6, *Error Codes and Diagnostics*) to ensure that the ISX878 has been properly set up.
- Refer to Chapter 2, *Programming Site Data*, to program the meter for taking flow rate measurements.







LOW PROFILE



NOTES:

1. ALL DIMENSIONS ARE REFERENCE.
2. ALL DIMENSIONS IN INCHES [MM].

Figure 1-27: ISX878 Outline and Installation (Dwg. #712-1195, rev. 2)

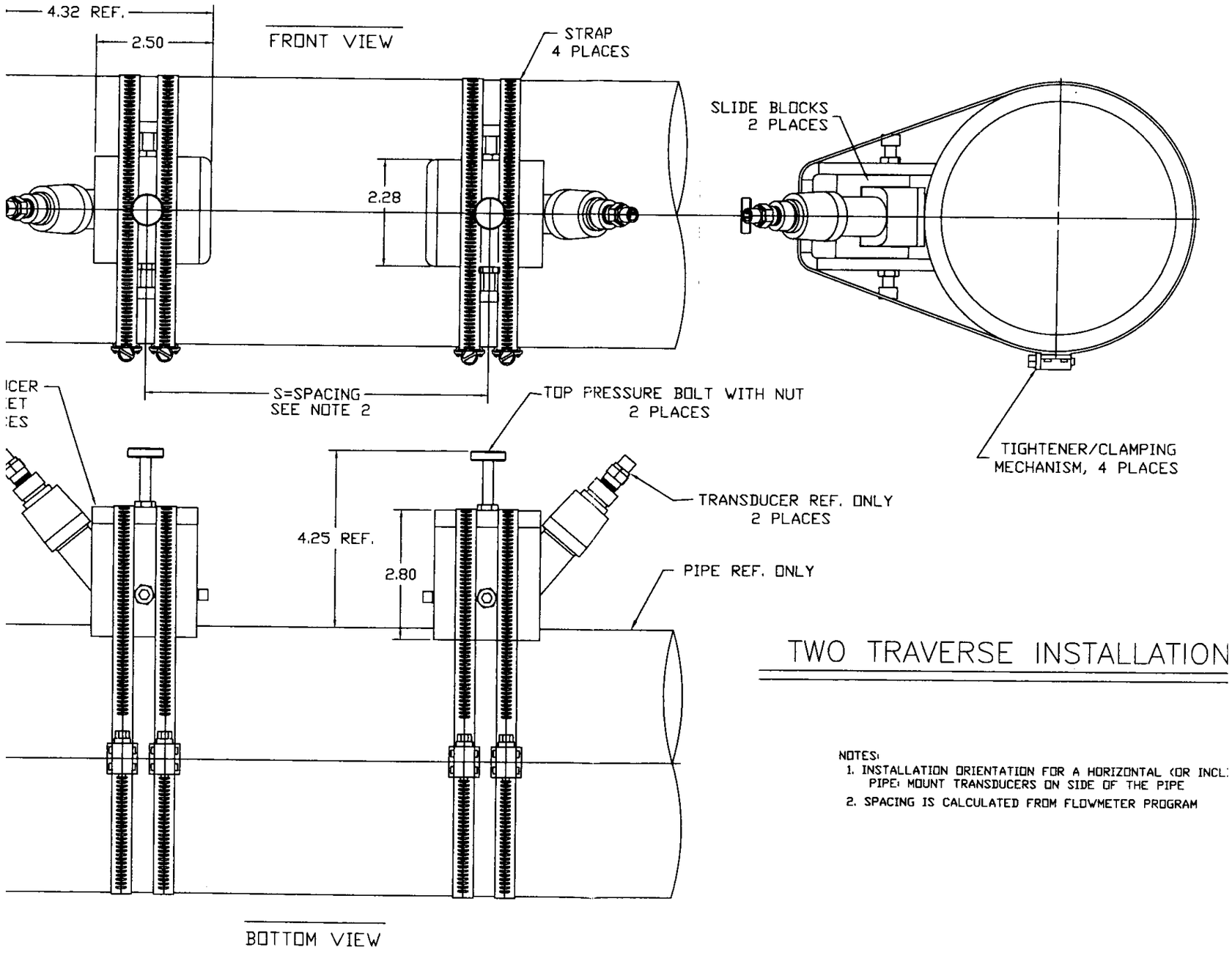


Figure 1-28: Two-Traverse Installation (Dwg. 570-095, sh. 1)

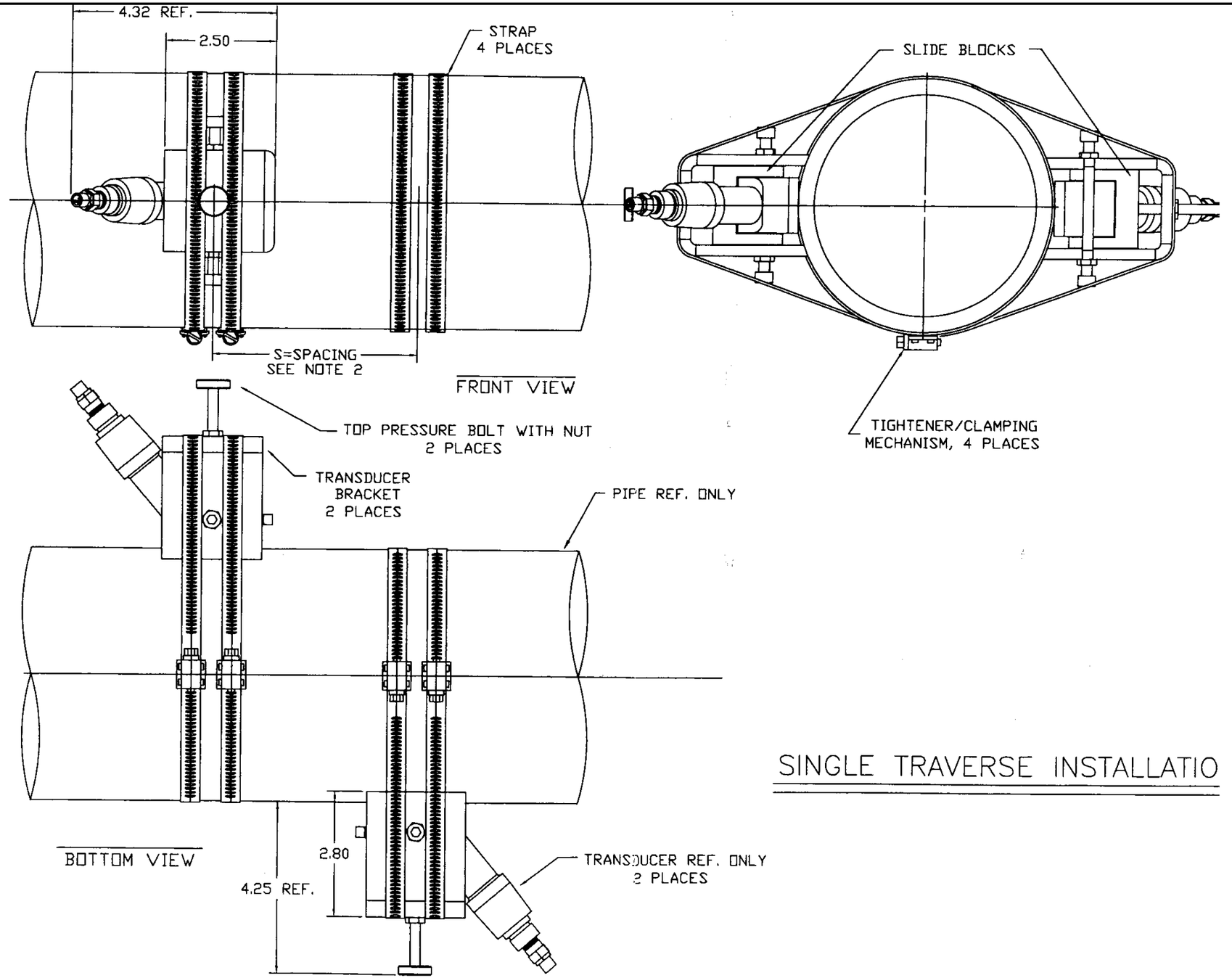
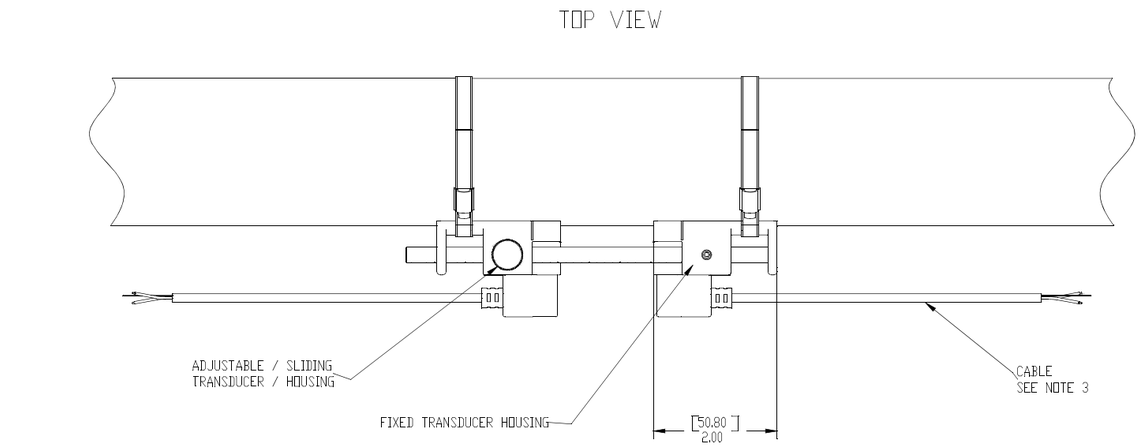


Figure 1-29: Single-Traverse Installation (Dwg. 570-095, sh. 2)



NOTES:

1. SHOWN WITH 6" ENGLISH / METRIC SCALE FOR PIPE RANGE SIZE OF 1/2" (12.7MM) TO 3" (101.6MM) OPTIONAL 11" ENGLISH / METRIC SCALE FOR PIPE RANGE SIZE 1/2" (12.7MM) TO 8" (203.2MM) NOT SHOWN
2. SPACING IS CALCULATED FROM FLOWMETER PROGRAM
3. FOR CABLE LENGTH OPTIONS REFER TO BILL OF MATERIALS 573-030
4. DIMENSIONS ARE IN [MM] INCH. ALL DIMENSIONS ARE FOR REF. ONLY

Figure 1-30: Clamping Fixture Outline and Installation (Dwg. #570-076, rev. 1)

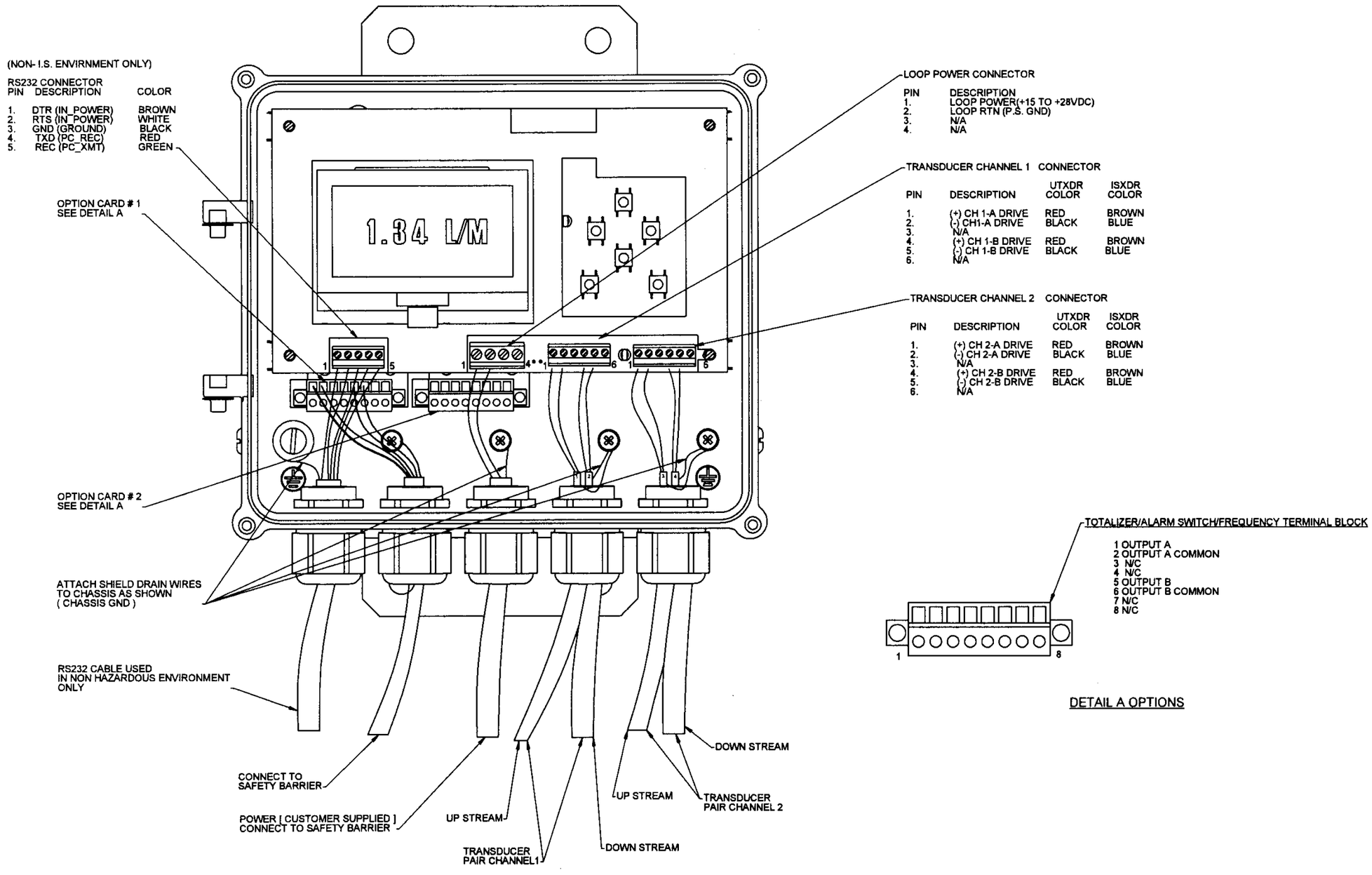


Figure 1-31: ISX878 Wiring Diagram (Dwg. #702-528, rev. 4)

Chapter 2

Programming Site Data

Introduction

The Model ISX878 flow transmitter includes a *User Program* that provides access to the various programmable features of the instrument.This chapter describes step-by-step programming instructions using the internal keypad, shown below in Figure 2-1.

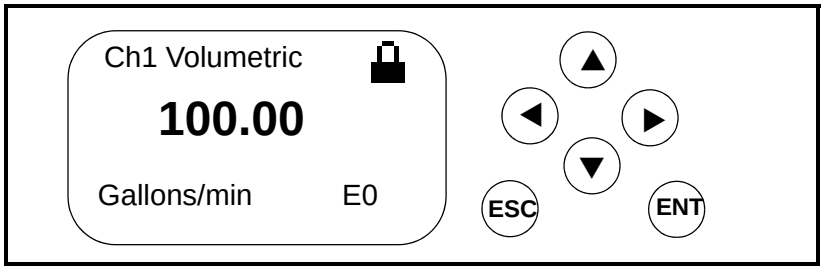


Figure 2-1: An ISX878 Display and Keypad

Refer to the appropriate section for a discussion of the following PROG menu options:

- Status - activate or deactivate one or both channels/paths

Note: *The ISX878 can use two channels or paths to make more accurate flow measurement by averaging, subtracting or adding the channels/paths together.*

- Transducer - enter data for preprogrammed or special clamp-on transducers
- Pipe - enter pipe parameters
- Fluid - enter fluid type and Reynolds Correction data
- Path - enter number of traverses and transducer spacing (for clamp-on transducers)
- Signal - entering signal parameters such as Delta-T offset, zero cutoff and velocity averaging
- K Factor - entering the Meter Correction (K) Factor as a single value or as a table of values
- Error Limits - entering minimum and maximum signal, velocity, amplitude and soundspeed.

To measure flow rate with the ISX878 you must, at a minimum, activate the channel/path(s), and enter transducer, pipe and fluid parameters. As a programming aid, Appendix A includes a complete set of menu maps for the user program, and Figure A-1 on page A-1 offers the menu map for the *PROG* menu.

Note: *This manual will describe only the programming of Channel 1. To program Channel 2 of a 2-channel/path meter, simply repeat the same procedures presented for Channel 1.*

Unlocking and Locking the ISX878

To prevent unauthorized tampering with either the display or the user program, the ISX878 offers a pair of security codes. Once you have set the security level, an operator requires one of these codes to change either the display (Prog Lock) or the display and the user program (Full Lock).

Note: *To speed up the key response of the ISX878, deactivate CH1 (and CH2), as described on page 2-4. Remember to reactivate the channels when programming is complete.*

Unlocking the ISX878

To unlock the display and/or the user program:

1. Press [ESC], [ENT], [ESC]. A Security Check window, similar to Figure 2-2 below, opens.

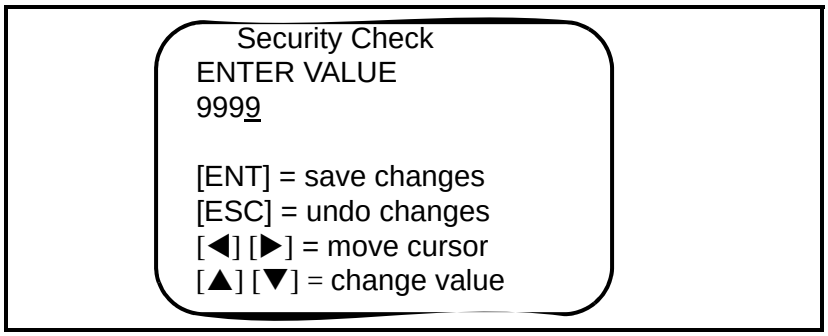


Figure 2-2: Security Check Window

2. Using the arrow keys, change the code number to the value desired for your security level.
   - For Prog Lock (granting access only to the display), the number is **2719.**
   - For Full Lock (granting access to the display and user program), the number is **7378.**
3. Press [ENT]. The display screen reappears, with the lock removed or partially unlocked. Security will remain at this level until you change the level in the user program, as described on the next page.

Locking the ISX878

You can access the security level in two ways.

From the display screen:

1. Press the [▶] key three times, until the lock in the upper right corner is highlighted.
2. Press [ENT], and proceed to step 4 below.

From the User Program:

1. Press [ESC]. The ISX878 enters the User Program.
2. Press the [▶] key until *USER* is bracketed.
3. The menu highlights *Set Security.* Press [ENT].
4. The screen shows three options:
   - *Full Lock*, which prevents a user from changing any part of the display or user program without the appropriate code:
   - *Prog Lock*, which allows a user to change the display but not to enter the user program:
   - *Unlocked*, which allows access to both the display and the user program.

   Scroll to the desired option and press [ENT] twice.
5. Press [ESC] to return to the User Program, or continue pressing [ESC] to return to the display screen. If you have chosen to fully lock the ISX878, the screen appears similar to Figure 2-3 below, with a solid lock in the upper right corner. (For a meter with only the user program locked, the lock shows a keyhole in the center.)

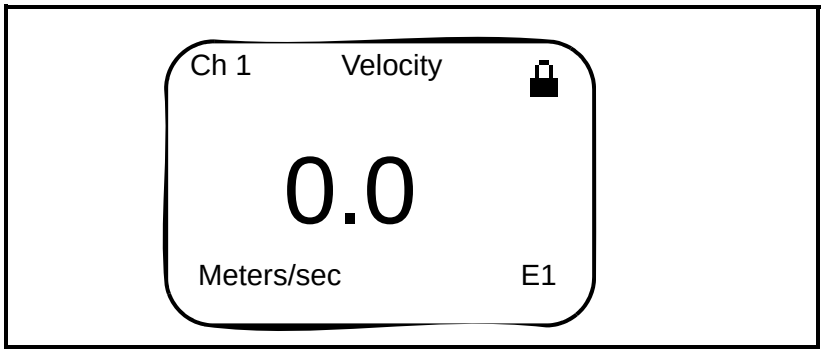


Figure 2-3: ISX878 Screen with Locked Program

Activating a Channel/ Path (Status)

In the *Status* submenu of the *PROG* menu, you can activate or deactivate a channel/path. While the channel/path should be activated when you receive your unit, you should verify that the channel/path is active before you begin programming. When following the programming instructions, refer to Figure A-1 on page A-1 of Appendix A, *Menu Maps*. Remember to record all programmed data in Appendix C, *Data Records.*

Note: *If you are not using Channel 2 of a two-channel ISX878, disable it to increase the response time.*

To access the *Status* submenu:

1. Press [ESC]. The ISX878 enters the *User Program*.
2. Press the [▶] key until PROG is bracketed in the top left corner and press [ENT].
3. Use the [▲] and [▼] keys to scroll to the desired channel and press [ENT]. The screen appears similar to Figure 2-4 below.

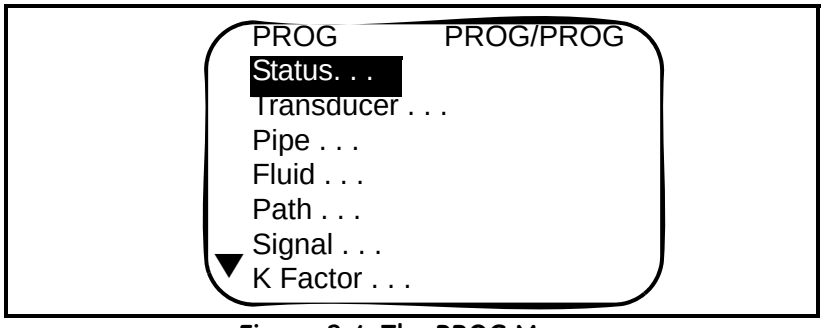


Figure 2-4: The PROG Menu

4. Press [ENT] to open the *Status* submenu.
5. The screen offers two options, ON and OFF. Use the [▲] and [▼] keys to scroll to the desired selection and press [ENT].

IMPORTANT: *On any menu, if you scroll to a different option, press* [ENT] *twice to select that option (once to enter and again to confirm the selection).*

6. Press [ESC] (or [ENT] twice if you have selected the other option) to return to the channel menu.

What's Next?

After completing the above steps, the user program returns to the *PROG* menu. Do one of the following:

- To enter transducer data, press the [▼] key to highlight the *Transducer* listing and press [ENT].
- To program in other menus, refer to Appendix A, *Menu Maps*, to navigate to the desired menu.
- To leave the User Program, press [ESC] three times.

Entering Transducer Parameters

The *Transducer* submenu enables you to enter parameters for preprogrammed or special clamp-on transducers. Remember to record all programmed data in Appendix C, *Data Records.*

Note: *If you have programmed the* Status *submenu, proceed directly to Step 4. If you scroll to a different option, press* [ENT] *twice to select that option (once to enter and again to confirm the selection).*

To access the *Transducer* submenu:

1. Press [ESC]. The ISX878 enters the User Program.
2. Press the [▶] key until PROG is bracketed in the top left corner and press [ENT].
3. Use the [▲] and [▼] keys to scroll to the desired *Channel* and press [ENT].
4. Scroll to the *Transducer* submenu and press [ENT].
5. Scroll to *Clamp-on* and press [ENT].
6. Scroll to either *Preprogrammed* (for the standard transducers) or *Other* (for special transducers), and press [ENT].
7. The program also asks for the Wedge Temperature. Scroll to the *Wedge TMP* option and press [ENT]. Then use the [▲] and [▼] keys to enter the temperature, and press [ENT].

Note: *The wedge temperature of the transducer can be approximated by inputting an average value for the surface temperature of the outside pipe wall.*

8. Do one of the following:
   - For preprogrammed transducers, scroll to the desired *Transducer Number* (either 407 (2 MHz), 408 (4 MHz), 409 (500 kHz) or 410 (1 MHz)) and press [ENT]. Then press [ESC] three times to return to the PROG menu.
   - For other transducers, proceed to *Other Transducers* on the next page.

IMPORTANT: *Other (special) transducers have no engraved number on the housing and are rarely used. Examine the transducer housing carefully for a number.*

Other Transducers

1. The first required parameter is the *Frequency.* Press [ENT] to open the Frequency window. Then scroll to the frequency of your transducer (from 0.25 to 4.00 MHz) and press [ENT].
2. The meter next asks for the *Time Delay (Tw).* Scroll to the *Tw* option and press [ENT]. Then use the arrow keys to enter the time provided by GE Sensing (in microseconds), and press [ENT].
3. The next parameter is the *Wedge Angle,* the angle of the transducer's ultrasonic transmission in the transducer wedge. Scroll to the *Wedge Ang* option and press [ENT]. Use the arrow keys to enter the provided angle (in degrees), and press [ENT].
4. To enter the *Wedge Soundspeed,* scroll to the *Wedge SS* option and press [ENT]. Use the arrow keys to enter the provided soundspeed (in m/s or ft/s), and press [ENT].
5. The final parameter is the Temperature Coefficient. Scroll to the *TempCo* option and press [ENT]. Use the arrow keys to enter the provided coefficient, and press [ENT]. Set the coefficient to 0 if you are unsure of the value.

You have completed entering parameters for other transducers. Press [ESC] until you reach the PROG menu to continue programming, or continue pressing [ESC] to resume displaying data.

Entering Pipe Parameters

In the *Pipe* submenu, you can specify preprogrammed or special pipe parameters. While following the programming instructions, refer to Figure A-1 on page A-1 of Appendix A, *Menu Maps*. Remember to record all programmed data in Appendix C, *Data Records.*

Note: *If you are in the* PROG *menu, proceed directly to Step 4. If you scroll to a different option, press* [ENT] *twice to select that option (once to enter and again to confirm the selection).*

To access the *Pipe* submenu:

1. Press [ESC]. The ISX878 enters the User Program.
2. Press the [▶] key until PROG is bracketed and press [ENT].
3. Use the [▲] and [▼] keys to scroll to the desired *Channel* and press [ENT].
4. Scroll to the *Pipe* submenu and press [ENT].

Entering the Pipe Material

1. The menu offers two options, *Material* and *Lining*. Be sure the *Material* option is highlighted, and press [ENT].
2. Two other options now appear, *Preprogrammed* and *Other.* Scroll to the desired option, and press [ENT].
3. The menu now varies with your choice in Step 2.

- For preprogrammed materials, a list of materials opens. Table 2-1 on the next page covers the available preprogrammed materials on the list. Press the [▼] or [▲] keys to scroll to the appropriate material. Press [ENT] to confirm the choice.
- For other materials, the meter asks for the material *Soundspeed*. Press [ENT] to open the window. Then use the arrow keys to enter the known soundspeed, and press [ENT].

Entering the Pipe Material (cont.)

Table 2-1: Preprogrammed Pipe Materials

Pipe Material Category	Specific Material
Al - Aluminum	Rolled or None
Brass	None
Cu - Copper	Annealed, Rolled or None
CuNi - Copper/Nickel	70% Cu 30% Ni or 90% Cu 10% Ni
Glass	Pyrex, Flint, or Crown
Gold	Hard-drawn
Inconel	None
Iron	Armco, Ductile, Cast, Electrolytic
Monel	None
Nickel	None
Plastic	Nylon, Polyethylene, Polypropylene, PVC (CPVC), or Acrylic
Steel	Carbon Steel, Mild or Stainless Steel
Tin	Rolled
Titanium	None
Tungsten	Annealed, Carbide, Drawn
Zinc	Rolled

4. The next required parameter is either the outside diameter *(OD)* or the circumference *(OD x* π*)*. Scroll to the measured parameter and press [ENT]. For either measurement, enter the desired value and press [ENT].

Note: *Obtain the required information by measuring either the pipe outside diameter (OD) or circumference at the transducer installation site. The data may also be obtained from standard pipe size tables found in* Sound Speeds and Pipe Size Data *(914-004).*

5. The meter also requires the *Wall Thickness (WT)*. Scroll to the WT option, and press [ENT]. Use the arrow keys to enter the known thickness, and press [ENT].

Note: *To obtain an accurate pipe wall thickness measurement, use an ultrasonic thickness gauge.*

Entering the Pipe Material (cont.)

6. If you have selected certain materials (such as carbon or stainless steel, cast iron, PVC and CPVC), the ISX878 offers the option of entering the pipe dimensions by a standardized schedule. (This option does not appear unless you have selected one of these materials; if you have, proceed to step a below.) Once you enter the nominal pipe size and schedule number, the ISX878 determines the OD and wall thickness from an internal table.

   a. Scroll to the *Schedule* option, and press [ENT].

   b. A list of pipe sizes opens, from 15 to 200 mm (0.5 to 8 in.). Scroll to the desired pipe size, and press [ENT].

   c. A list of schedules opens. Scroll to the desired schedule, and press [ENT].

You have finished entering the pipe parameters. Press [ESC] until you return to the *Pipe Material/Lining* window, or continue pressing [ESC] to return to the data display window.

Entering Pipe Lining Data

To access the *Lining* option:

1. From the *Pipe* submenu, scroll to the *Lining* option, and press [ENT].
2. Two options appear, *Material* and *Thickness*. Be sure *Material* is highlighted, and press [ENT].
3. Two other options now appear, *Preprogrammed* and *Other.* Scroll to the desired option, and press [ENT].
4. The menu now varies with your choice in Step 3.

- For preprogrammed linings, the screen shows a list of *Lining Materials*, listed in Table 2-2 below. Scroll to the appropriate material. If the pipe has no lining, select "None." Press [ENT] to confirm the choice.
- For other materials, the next screen asks for the lining *Soundspeed*. Press [ENT] to open the soundspeed window. Use the arrow keys to enter the known soundspeed, and press [ENT].

Table 2-2: Preprogrammed Lining Materials

Lining Material Options
None
Tar/Epoxy
Glass (Pyrex)
Asbestos Cement
Mortar
Rubber
PTFE

Note: *If your pipe lining is not on the drop-down list, consult GE Sensing for further information.*

What's Next?

You have finished entering data in the *Pipe* submenu. Do one of the following:

- To program in other options, press [ESC] until you return to the PROG menu.
- To program in other menus, refer to Appendix A, *Menu Maps*, to navigate to the desired menu.
- To leave the User Program, press [ESC] until the display screen reappears.

Entering Fluid Data

The *Fluid* submenu allows you to specify the fluid you are measuring, as well as the Reynolds Correction factor and tracking windows. While following the programming instructions, refer to Figure A-1 on page A-1 of Appendix A, *Menu Maps*. Remember to record all programmed data in Appendix C, *Data Records.*

Note: *If you are in the* PROG *menu, proceed directly to Step 4. If you scroll to a different option, press* [ENT] *twice to select that option (once to enter and again to confirm the selection).*

To access the *Fluid* submenu:

1. Press [ESC]. The ISX878 enters the User Program.
2. Press the [▶] key until PROG is bracketed in the top left corner and press [ENT].
3. Use the [▲] and [▼] keys to scroll to the desired *Channel* and press [ENT].
4. Scroll to the *Fluid* submenu and press [ENT].

Entering Fluid Type

5. Two options appear, *Fluid Type* and *Reynolds*. Scroll to *Fluid Type* and press [ENT].
6. Two other options appear, *Normal* and *Tracking*. Tracking refers to Tracking Windows, which are used to detect the receive signal when you are unsure of the fluid sound speed, or when the fluid sound speed changes drastically under process conditions. Scroll to the desired option and press [ENT].
7. You can now select between *Preprogrammed* and *Other* fluids. Scroll to the desired option, and press [ENT].

   - For Normal fluids, you can program the expected fluid *Temperature*. Scroll to the *Temperature* option and press [ENT]. Then use the arrow keys to enter the process temperature, and press [ENT].
   - For fluids monitored with a Tracking Window, the meter offers the selections of *Water* (up to either 100 or 260°C) or *Oil*. Scroll to the desired listing and press [ENT].

Entering Fluid Data (cont.)

8. The menu now varies, depending on your selections in steps 6 and 7.

- If you have selected Preprogrammed fluids, the ISX878 supplies a list of preprogrammed fluids. As shown in Table 2-3 below, the list varies, depending on whether you have selected normal or tracking window fluid types. In either case, scroll to the desired fluid and press [ENT].

- If you selected Other, the ISX878 asks for the fluid soundspeed (for Normal fluids) or minimum and maximum soundspeed (for Tracking Window fluids). In either case, scroll to the soundspeed option and press [ENT]. Use the arrow keys to enter the appropriate soundspeed, and press [ENT].

Table 2-3: Preprogrammed Fluid Types

Tracking Windows Off	Tracking Windows On
Water (0-260°C)	Water (0-100°C)
Sea Water	Water (0-260°C)
Oil (22°C)	Oil
Crude Oil	
Lube Oil (X200)	
Methanol (20°C)	
Ethanol	
LN2 (-199°C)	
Freon (R-12)	
Diesel	
Gasoline	

9. Press the [ESC] key until you return to the Fluid Type window discussed in Step 5.

Entering Reynolds Correction Data

Reynolds Correction is a correction factor based on the Kinematic Viscosity and flow rate of the fluid. It is necessary, as the velocity of the fluid measured along a diametrical path must be related to the total area average velocity over the entire pipe cross-section. This factor should be ON in most applications, including all those that use clamp-on transducers. To access Reynolds Correction data:

1. From the Fluid Type window (described in step 5 on the previous page), scroll to *Reynolds* and press [ENT].
2. The screen shows three options: *Off, Single* and *Table*. Scroll to the desired option, and press [ENT].

Entering Reynolds Correction Data (cont.)

3. The menu varies, depending on your selection in Step 2.

- If you select *Off*, no further choices are available.
- If you select *Single*, the ISX878 will select and automatically display the *Kinematic Viscosity.* To change the value, press [ENT]. Use the arrow keys to change the value (available in document #914-004, *Sound Speeds and Pipe Size Data*), and press [ENT].
- If you select *Table*, the screen displays three options: *Units, Rows Used* and *Edit Table.*

  a. If you scroll to *Units* and press [ENT], the screen displays three more options: *Velocity, Soundspeed* and *Diagnostic*. If you select either *Velocity* or *Soundspeed* and press [ENT], the screen displays the measurement units (either metric or English). Press [ESC] or [ENT] to return to the previous screen. But if you scroll to *Diagnostic* and press [ENT], the meter asks for the type of signal to be used, Signal Strength *Up* or Signal Strength *Dn*. Scroll to the appropriate signal, and press [ENT].

  b. If you select *Rows Used*, the program asks for the number of *rows* you wish to use. Enter the desired number (from 2 to 20) and press [ENT].

  c. If you select *Edit Table*, the table opens with a series of *rows*. Scroll to the desired row, and press [ENT].

  d. For each row, the screen displays the Reynolds Correction number (X) and the Kinematic Viscosity (KV). If you wish to change either value, scroll to the value and press [ENT]. Use the arrow keys to change the value (available in document #914-004, *Sound Speeds and Pipe Size Data*), and press [ENT].

  e. Repeat steps c and d until you have programmed all of your available data (from 2 to 20 rows).

Press [ESC] until you return to the PROG menu, or continue pressing [ESC] until the display screen reappears.

Entering Path Data

In the *Path* submenu, you can specify and check the path taken by the transducer signal. Remember to record all programmed data in Appendix C, *Data Records.*

Note: *If you are in the PROG menu, proceed directly to Step 4. If you scroll to a different option, press* [ENT] *twice to select that option (once to enter and again to confirm the selection).*

To access the *Path* submenu:

1. Press [ESC]. The ISX878 enters the User Program.
2. Press the [▶] key until *PROG* is bracketed and press [ENT].
3. Use the [▲] and [▼] keys to scroll to the desired *Channel* and press [ENT].
4. Scroll to the *Path* submenu and press [ENT].
5. The meter first asks for the number of *Traverses*, or times the signal crosses the pipe. Press [ENT], scroll to the number of traverses for your installation, and press [ENT] to confirm the entry.

Note: *The great majority of ISX applications call for two traverses. Figure 2-5 below illustrates signal paths for a typical two-traverse installation.*

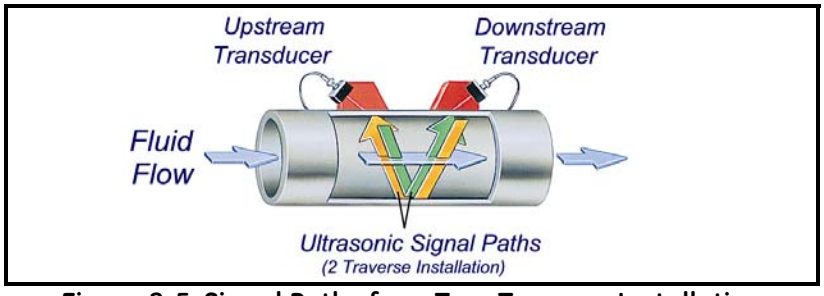


Figure 2-5: Signal Paths for a Two-Traverse Installation

6. The remaining prompt displays the *Transducer Spacing*, as calculated from the information entered. Use this number to set the spacing of the transducers. (The minimum spacing is 0.9 in.) If necessary, you can overwrite the spacing to match the actual physical spacing of the transducers. Press [ENT] to open the Spacing window, and use the arrow keys to change the value. Then press [ENT] to confirm the value.

IMPORTANT: *It is recommended that you do not use a spacing other than the one calculated by the ISX878. However, if you do use a different spacing, do not change the spacing by more than ±10% from that calculated by the ISX878.*

Press [ESC] until you return to the *PROG* menu, or continue pressing [ESC] until the display screen reappears.

Entering Signal Parameters

In the *Signal* submenu, you can set parameters that affect the transducer signal:

Caution!
The SIGNAL default settings are suitable for most applications. Consult GE Sensing before changing any of these applications.

- Delta-T Offset
- Zero Cutoff
- Errors Allowed
- Peak Detection Method and Thresholds
- Transmit Sample Size
- Velocity Averaging

While following the programming instructions, refer to Figure A-1 on page A-1 of Appendix A, *Menu Maps*.

Note: *If you are in the PROG menu, proceed directly to Step 4. If you scroll to a different option, press* [ENT] *twice to select that option (once to enter and again to confirm the selection).*

To enter the *Signal* submenu:

1. Press [ESC]. The ISX878 enters the User Program.
2. Press the [▶] key until *PROG* is bracketed and press [ENT].
3. Use the [▲] and [▼] keys to scroll to the desired *Channel* and press [ENT].
4. Scroll to the *Signal* option and press [ENT].
5. The first prompt, *Delta-T Offset*, is the difference between the upstream and downstream transit times of the transducer signals. It should normally be set to 0. Press [ENT], use the arrow keys to enter the new value, and press [ENT] to confirm your entry.
6. The next prompt asks for the *Zero Cutoff*. Near “zero” flow, the ISX878 may have fluctuating readings due to small offsets (caused by factors such as thermal drift in the fluid). The zero cutoff causes velocity measurements less than the cutoff to be reported as zero. To set the cutoff, press [ENT], and use the arrow keys to enter the new value. Press [ENT] to confirm your entry.

Entering Signal Parameters (cont.)

7. The *Errors Allowed* prompt specifies the number of errors the ISX878 can record before displaying an error message. Press [ENT], and use the [▲] and [▼] keys to scroll to the appropriate number of errors (from 0 to 16). Press [ENT] to confirm your entry.

8. The next prompt asks for the *Peak Detection* method. In the "Peak" method, the peak is identified by testing a derivative of the signal. In the "Threshold" method, the peak is identified as the point where the signal crosses a threshold that is a percentage of the maximum signal detected. The peak method is more reliable in identifying the signal in dynamic conditions, while the threshold method is more reliable in marginal signal conditions.

Note: *Do not change the peak detection method or values unless recommended by GE Sensing.*

   a. Press [ENT]. The screen shows the two display options, *Peak* and *Threshold.* Scroll to the desired option, and press [ENT].

   b. The next screen depends on your selection in Step a.

   - If you select *Peak*, no further options are available. Press [ESC] to return to the Signal menu.

   - If you select *Threshold* and press [ENT], the screen shows three parameters: *Min Threshold, Max Threshold* and *Percent of Peak.* For each parameter, press [ENT]. Use the arrow keys to enter the new value, and press [ENT].

9. The next parameter is the *Transmit Sample Size*, the number of pulses each transducer (upstream and downstream) emits. It is set to 8 by default. Press [ENT], and use the [▲] and [▼] keys to scroll to the new number (from 1 to 32). Press [ENT] to confirm the entry.

10. The final prompt asks for *Velocity Averaging*, in which users select a certain number of velocity measurements to average together to smooth out noise in the signal. Press [ENT], and use the [▲] and [▼] keys to scroll to the desired number. (Selections include none, 2, 5, 10, 30, 60 and Statistics. The Statistics option increases averaging under steady flow conditions, but allows for a rapid response to step changes in flow rate.) Press [ENT] to confirm your entry.

You have completed entering parameters in the *Signal* option. Press [ESC] until you return to the PROG menu, or continue pressing [ESC] until the display screen reappears.

Entering the Meter Correction (K) Factor

With the *K Factor* submenu, you can calibrate or adjust the ISX878 readings to another flow reference. While following the programming instructions, refer to Figure A-1 on page A-1 of Appendix A, *Menu Maps*.To enter K Factor data:

Note: *If you are in the* PROG *menu, proceed directly to Step 4. If you scroll to a different option, press* [ENT] *twice to select that option (once to enter and again to confirm the selection).*

1. Press [ESC]. The ISX878 enters the *User Program*.
2. Press the [▶] key until PROG is bracketed in the top left corner and press [ENT].
3. Use the [▲] and [▼] keys to scroll to the desired *Channel* and press [ENT].
4. Scroll to the *K Factor* submenu and press [ENT].
5. The screen shows three options: *Off, Single* and *Table*. Scroll to the desired option, and press [ENT].
6. The menu varies, depending on your selection in Step 5.

- If you select *Off*, no further choices are available.
- If you select *Single*, the ISX878 displays the *K Factor.* To change the value, press [ENT]. Use the arrow keys to change the value and press [ENT].

IMPORTANT: *If you have enabled the Reynolds Correction factor in the Fluid option, the K factor should be set to 1.00. Otherwise, the typical factor is between 0.5 and 2.00.*

- If you select *Table*, the screen displays three options: *Units, Rows Used* and *Edit Table*.
  a. If you scroll to *Units* and press [ENT], the screen displays the selected measurement units (either metric or English). Press [ESC] or [ENT] to return to the previous screen.
  b. If you select *Rows Used*, the program asks for the number of *rows* you wish to use. Enter the desired number (from 2 to 20) and press [ENT].
  c. If you select *Edit Table*, the table opens with a series of *rows*. Scroll to the desired row, and press [ENT].
  d. For each row, the screen displays the X (velocity) value and the K Factor. If you wish to change either value, scroll to the value and press [ENT]. Use the arrow keys to change the value and press [ENT].
  e. Repeat steps c and d until you have programmed all available data (from 2 to 20 rows).

Press [ESC] until you return to the PROG menu, or continue pressing [ESC] until the display screen reappears.

Entering Error Limits

The Error Limits option enables you to set limits for an incoming signal. When the signal falls outside the programmed limits, an error indication appears on the display screen. To set error limits, follow the steps below.

Note: *If you are in the* PROG *menu, proceed directly to Step 4. If you scroll to a different option, press* [ENT] *twice to select that option (once to enter and again to confirm the selection).*

1. Press [ESC]. The ISX878 enters the *User Program*.
2. Press the [▶] key until PROG is bracketed in the upper left corner and press [ENT].
3. Use the [▲] and [▼] keys to scroll to the desired *Channel* and press [ENT].
4. Scroll to the *Error Limits* option and press [ENT].
5. The first prompt asks for the *Minimum Signal* limit for the transducer signal received by the ISX878. The E1:LOW SIGNAL error message appears if the signal strength falls below the limit programmed here. Press [ENT]. Use the arrow keys to change the value and press [ENT].
6. Repeat the steps above for the *Maximum Signal* limit.
7. The next prompt calls for the *Minimum Velocity* limit. Press [ENT]. Use the arrow keys to change the value and press [ENT].
8. Repeat the steps above to change the *Maximum Velocity* limit. (The E3: VELOCITY RANGE error message appears if the velocity falls outside the minimum and maximum limits.)
9. The meter now asks for the *Min Amplitude*, the lower limit for the amplitude discriminator. The discriminator measures the size of the transducer signal sent from the ISX878. If the signal falls outside these limits, the E5: AMPLITUDE error message appears. Press [ENT]. Use the arrow keys to change the value and press [ENT].
10. Repeat these steps for the *Max Amplitude*, the upper limit for the discriminator.
11. The next prompt asks for the acceptable limits for the sound speed, based on conditions in your particular system. The E2: SOUND SPEED error message appears if the fluid sound speed exceeds that entered in the Fluid submenu by more than this percentage. Press [ENT]. Use the arrow keys to change the percentage and press [ENT].

Entering Error Limits (cont.)

12. The final prompt asks for the acceleration limit for detecting cycle skipping. The E6: ACCELERATION error message appears if the velocity changes by more than this limit from one reading to the next. Press [ENT]. Use the arrow keys to change the value and press [ENT].

What's Next?

You have finished entering data in the PROG menu. Do one of the following:

- To program in other menus, refer to Appendix A, *Menu Maps*, to navigate to the desired menu.
- To return to the display screen, press [ESC] until the display screen reappears.
- To configure the display, proceed to the next chapter.

Chapter 3

Displaying Data

Introduction

The Model ISX878 flow transmitter includes a Liquid Crystal Display (LCD) that can display up to two variables simultaneously. Users can change the number of variables, the displayed measurements and units, and the contrast level of the LCD.

Setting Up the Display

You can configure either of two channels for your particular requirements. When you first power up the installed ISX878, the display screen appears similar to Figure 3-1 below.

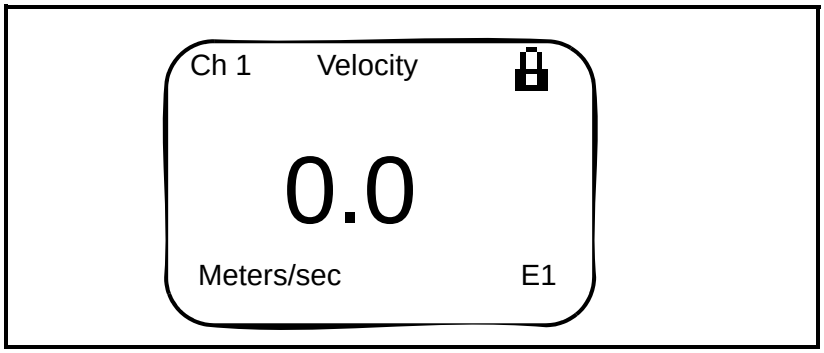


Figure 3-1: A Typical Display Screen

To change the display screen, press either the [◀] or [▶] keys. The screen will highlight one of the parameters, as shown in Figure 3-2 below.

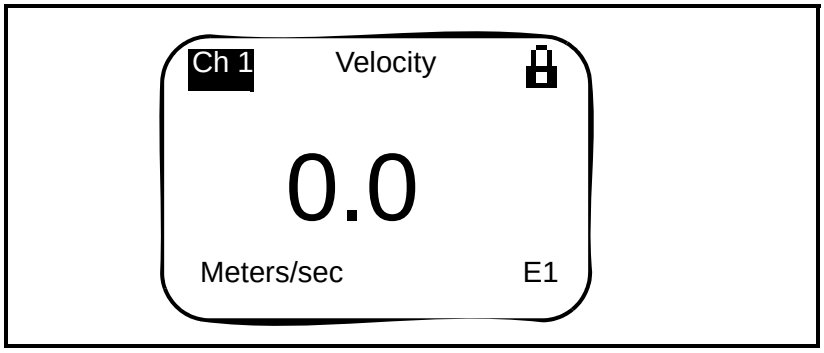


Figure 3-2: Display Screen with Highlighted Parameter

If you press the [▶] key, the ISX878 highlights the channel parameter in the upper left; if you press the [◀] key, it highlights the error code parameter in the lower right. Continue pressing the [◀] or [▶] key to reach the desired parameter. When you have highlighted that parameter, press [ENT].

IMPORTANT: *On any menu, if you scroll to a different option, press* [ENT] *twice to select that option (once to enter and again to confirm the selection).*

Changing the Channel

Note: *This option is available only for 2-channel versions of the ISX878.*

The first parameter on the screen in the upper left is the *Channel Number.* You can change the display to show either of the two channels, or the average, sum or difference of the channels.

1. When you have highlighted the channel number, press [ENT].
2. The screen displays a list of options:
   - Channel 1
   - Channel 2
   - AVG (2-Path)
   - SUM
   - DIFF
   - AVG ((Ch1 + Ch2)/2)

Note: *The 2-Path Avg option is intended for applications where two sets of transducers are installed in the same location in the same pipe to improve accuracy and the ISX878 operates in AVE 2-Path mode. With this function enabled, the ISX878 performs error handling only if both channels/paths are in error. If this function is disabled, error handling occurs when either channel/path goes into error.*

Scroll to the desired option, and press [ENT]. The display screen reappears with the new channel.

Changing the Measurement Parameter

The next parameter, in the center, is the measurement parameter (velocity, volumetric, forward or reverse total, soundspeed and diagnostic parameters). To change the measurement parameter:

1. Use the [◀] or [▶] key to highlight the measurement parameter, and press [ENT].
2. The screen displays a list of parameters:
   - Velocity
   - Volumetric
   - Fwd Total
   - Rev Total
   - Soundspeed
   - Diagnostic

Changing the Measurement Parameter (cont.)

Scroll to the desired parameter, and press [ENT]. The display screen reappears with the new measurement.

Note: *To select a particular diagnostic parameter or unit, select* Diagnostic *and proceed to* Changing the Measurement Units *on the next page.*

Adjusting the Numeric Display Format

When you highlight the numeric display, you can control both its positioning and the number of decimal places displayed to the right of the decimal point.

1. Use the [◀] or [▶] key to highlight the numeric display, and press [ENT].
2. The Format window opens, with four options: Width (the width of the numeric display), Decimal (the number of decimal places), Min and Max (the respective minimum and maximum values displayed). Use the [▲] or [▼] key to scroll to the desired option, and press [ENT].
3. The menu now varies with your choice in Step 2.

- *If you select Width:*

The program offers a choice of widths from 0 (least wide) to 8 (widest). Use the [▲] and [▼] keys to enter the desired width and press [ENT].

- *If you select Decimal:*

The program offers a choice of decimal places from 0 (no places) to 4. Use the [▲] and [▼] keys to enter the desired number of places and press [ENT].

- *If you select Min or Max:*

The program displays the programmed minimum or maximum value.

4. After making your selection, press [ESC] twice to return to the display screen with the changed parameter.

Changing the Measurement Units

In addition to changing the measurement parameter, you can select (for some parameters) the particular units in which that parameter will be displayed. (For a list of output measurement units, see Chapter 7, *Specifications.*)

Note: *To choose between metric and English units, refer to Chapter 4,* Configuring Meter Data.

1. Use the [◀] or [▶] key to highlight the measurement units, and press [ENT].
2. The screen displays a list of measurement units (or, for Diagnostic, a list of diagnostic parameters). Scroll to the desired unit, and press [ENT]. The display screen reappears with the new measurement units.
3. Press [ESC]. The display screen returns with the changed measurement unit.

Note: *For the velocity and soundspeed parameters, it is not possible to change the display unit.*

Interpreting the Error Message

The parameter in the lower right corner, represented by E and a number (E1, E2, etc.) is an error message that signals a particular problem with the measurement. To access an explanation of the error, use the [◀] or [▶] key to highlight the error code and press [ENT]. The screen appears similar to Figure 3-3 below.

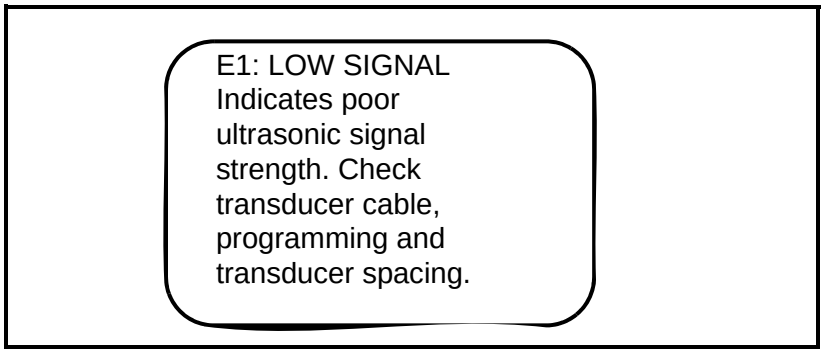


Figure 3-3: A Typical Error Message Explanation

Press [ESC] to return to the display screen. For an explanation of all error codes, refer to Chapter 6, *Error Codes and Diagnostics.*

Setting Screen Contrast

For viewer convenience, you can reset the contrast level of the display screen. To change the contrast:

1. Press [ESC]. The ISX878 enters the *User Program*.
2. Press the [▶] key until *DISP* is bracketed in the upper left corner.
3. The menu highlights the *Contrast* option. Press [ENT].
4. Use the [▲] and [▼] keys to enter the desired contrast level from 0 to 100%. (The default value is 30%.) As you scroll, the screen visibly changes contrast. When you have reached the desired contrast level, press [ENT].

Note: *The display is visible over the entire ISX878 temperature range without contrast adjustment.*

5. Press [ESC] to return to the *User Program*, or continue pressing [ESC] to return to the display screen.

Setting the Number of Screen Views

You can also choose to display either one or two measurement parameters, on the same or different channels. To select the number of views:

1. Press [ESC]. The ISX878 enters the *User Program*.
2. Press the [▶] key until *DISP* is bracketed.
3. Scroll to the *Views* option, and press [ENT].
4. Scroll to the desired number of views, and press [ENT].
5. Press [ESC] to return to the *User Program*, or continue pressing [ESC] to return to the display screen.

Chapter 4

Configuring Meter Data

Introduction

The CONFIG menu in the ISX878 *User Program* enables you to set global parameters for the meter that suit your individual preferences. The available parameters include:

- Metric or English units
- 4-20 Loop Settings (low and high values)
- Communication settings
- Resetting totals
- Totalizer error handling

To enter the CONFIG menu from the display screen, press [ESC] (to enter the *User Program*) and press the [▶] key once. While following the programming instructions, refer to Figure A-2 on page A-2 of Appendix A, *Menu Maps*.

Note: *If the program is locked, follow the directions on page 2-2 to unlock the user program.*

Entering Global Units

In the *Units* submenu, you can choose to display all measurements in either metric or English formats.

Note: *You cannot choose to display some measurements in English formats and others in metric.*

To access the *Units* submenu:

1. Press [ESC]. The ISX878 enters the *User Program.*
2. Press the [▶] key until CONFIG is bracketed and press [ENT].
3. Press [ENT] to enter the *Units* submenu.
4. Use the [▲] and [▼] keys to scroll to the desired selection (metric or English) and press [ENT]. The ISX878 returns to the CONFIG menu.

IMPORTANT: *On any menu, if you scroll to a different option, press* [ENT] *twice to select that option (once to enter and again to confirm the selection).*

Entering Base (Zero) and Span Output Values

The *4-20 Loop* submenu enables you to enter the information needed to set up output parameters: unit type, base (zero) and span values, and error handling. To enter data in the *4-20 Loop* submenu:

1. Press [ESC]. The ISX878 enters the *User Program.*
2. Press the [▶] key until CONFIG is bracketed and press [ENT].
3. Press [▼] to reach the *4-20 Loop* submenu, and press [ENT].

Entering Output Type and Units

1. In the *Loop* submenu, press [ENT] to enter the *Units* option.
2. The menu displays five options: Channel 1, Channel 2, AVG 2Path, SUM, DIFF and AVG. Use the [▲] and [▼] keys to scroll to the desired option, and press [ENT].

Note: *Channel 2, AVG (2-Path), AVG, SUM and DIFF are only available for a two-channel ISX878.*

3. The screen now displays three measurement parameters: velocity, volumetric, and soundspeed. Scroll to the desired selection and press [ENT].
4. The menu now asks for the unit type.
   - For velocity or soundspeed measurements, the menu offers a single selection (either feet/sec or meters/sec, depending on your choice of units). Press [ENT] to confirm the entry and return to the previous menu.
   - For volumetric, the menu offers a list of output units (either metric or English). Scroll to the desired units and press [ENT].

Press [ESC] until you return to the CONFIG menu.

Entering Base and Span Values

1. In the *Loop* option, press [▼] and [ENT] to enter the *Base* option.
2. The Base window opens. Use the arrow keys to enter the desired base (4 mA) value for the analog output, and press [ENT].
3. The ISX878 returns to the Loop menu. Press [▼] and [ENT] to enter the *Span* option.
4. The *Span* window opens. Use the arrow keys to enter the desired span (20 mA) value for the analog output, and press [ENT].

Entering Error Handling

1. The ISX878 returns to the *Loop* option. Press [▼] and [ENT] to enter the *Error Level* option.
2. The screen displays a list of error options as defined in Tables 4-1 and 4-2 below, and Table 4-3 on the next page. Scroll to the desired option and press [ENT].

Table 4-1: Error Options and Responses for a 1-Channel Path/Meter

Option	Output Response
Hold Value	Holds the last "good" reading.
Force HI (20 mA)	Forces the outputs to the high set point.
Force LO (4 mA)	Forces the outputs to the low set point.
Force HH (22 mA)	Forces the outputs ≈10% above the high set point.
Force LL (3.8 mA)	Forces the outputs ≈10% below the low set point.
Force Value	Forces the outputs to a preprogrammed value.

- If you select Force Value (as shown in Table 4-1 above), the meter asks for a specific value. Use the arrow keys to enter the desired value, and press [ENT].

AVG 2PATH is an independent totalizer, which uses the AVG 2PATH volumetric to calculate the totalizer value. Composite channels (AVG, SUM and DIFF) continue to calculate when either channel goes into error, and will display if either channel is in error.

Table 4-2: Non-Totalizer Two-Path Averaging Truth Table

CH1	CH2	AVG 2PATH Calculation (Non-Total Values)
OK	OK	(CH1 + CH2)/2
OK	ERR	CH1
ERR	OK	CH2
ERR	ERR	Hold Last Value

Entering Error Handling (cont.)

Table 4-3: Error Options and Responses for a 2-Channel/Path Meter

When Measuring	Display Response	Totalizer Response When Error Handling is	
		Totalize on Error? (YES)	Totalize on Error? (NO)
CH1 or CH2 (vel, vol, etc.)	Holds last "good" reading.	Holds last "good" reading and continues to totalize based on that "good" reading.	Stops totalizing.
AVE (2-Path)	See Table 4-2		
SUM	Adds two channels/paths using the last "good" reading.		
DIF	Subtracts two channels/paths using the last "good" reading.		
AVE	Adds two channels/paths using the last "good" reading.		

Note: *Forward and reverse totalizers persist on a 3 minute interval. If the ISX878 loses power, you might lose data.*

Press [ESC] until you return to the CONFIG menu, or continue pressing [ESC] until the display screen reappears.

Entering RS232 Communication Settings

!WARNING!
Use RS232 connections only in the safe area.

With the *Communication* submenu, you can set the parameters by which the ISX878 communicates to a PC or terminal over the RS232 interface. You can set the Node ID as well as the baud rate, parity, stop bits and data bits. To access the *Communication* submenu:

1. Press [ESC]. The ISX878 enters the *User Program.*
2. Press the [▶] key until *CONFIG* is bracketed and press [ENT].
3. Press the [▼] key until *Communication* is highlighted. Then press [ENT].
4. The next window offers a selection between Node ID and RS232. Use the [▲] and [▼] keys to scroll to the desired option and press [ENT].

   - If you select Node ID:
     The meter asks for a specific ID number. Use the arrow keys to enter the desired number (from 1 to over 255) and press [ENT].
   - If you select RS232, a list of six options appears. Scroll to the desired option and press [ENT].

   a. The first option asks for the RS232 *Status*. Scroll to the desired selection (ON or OFF), and press [ENT]. (If you are not using RS232, selecting OFF increases response time at lower power settings.)

   b. The next option asks for the *Baud Rate*. The available choices extend from 300 to 115,200 baud. Scroll to the desired selection and press [ENT].

   c. The next option is *Parity.* Scroll to the desired selection (none, even, or odd) and press [ENT].

   d. The next prompt asks you to select one or two *Stop Bits*. Scroll to the desired selection and press [ENT].

   e. The next option asks you to select either seven or eight *Data Bits*. Scroll to the desired selection and press [ENT].

   f. The final option asks for the interface type. Scroll to *HyperTer* (for Hyperterminal) and press [ENT].

Press [ESC] twice to return to the CONFIG menu, or continue pressing [ESC] until the display screen reappears.

Resetting Forward and Reverse Totals

On occasion, you may need to clear and reset the forward and reverse totals computed by the Forward and Reverse Totalizers. To reset the totals:

1. Press [ESC]. The ISX878 enters the *User Program.*
2. Press the [▶] key until CONFIG is bracketed and press [ENT].
3. Press the [▼] key until *Reset Totals* is highlighted. Then press [ENT].
4. The next window asks you to choose the *Channel* (1 or 2), *AVG 2PATH*, or *All.* Use the [▲] and [▼] keys to scroll to the desired channel and press [ENT].
5. The next screen displays three choices: *Reset Fwd Total*, *Reset Rev Total* or *Reset Both*. Scroll to the desired choice and press [ENT].

Handling Totalizer Errors

In the *Totalizer Errors* option, you can program each channel (Channel 1, Channel 2, or AVG 2-Path) to totalize on an error or not. The AVG 2-Path is an independent totalizer which uses the AVG 2-Path volumetric to calculate the totalizer value. To determine whether the ISX878 totalizes when it encounters an error:

1. Press [ESC]. The ISX878 enters the *User Program.*
2. Press the [▶] key until CONFIG is bracketed and press [ENT].
3. Press the [▼] key until *Totalizer Errors* is highlighted. Then press [ENT].
4. The next window asks you to choose the *Channel* (1 or 2) or *AVG 2PATH*. Use the [▲] and [▼] keys to scroll to the desired option and press [ENT].
5. The final window asks whether the UTX should *Totalize on Error?* Use the [▲] and [▼] keys to scroll to *Yes* or *No* and press [ENT]. The totalizer response appears in Table 4-4 below.

Table 4-4: Totalizer Error Handling (CH1, CH2, AVG-2Path)

Totalize on Error?	Totalizer Response
Yes	Holds last “good” reading and continues to totalize, based on that “good” reading.
No	Stops totalizing.

Note: *Totalizers are stored within 3 minutes of a power-down.*

Configuring the Option Cards

Configuring the Totalizer Option

1. Press [ESC]. The ISX878 enters the *User Program*.
2. Press the [▶] key until CONFIG is bracketed and press [ENT]. The screen appears similar to Figure 4-1 below.

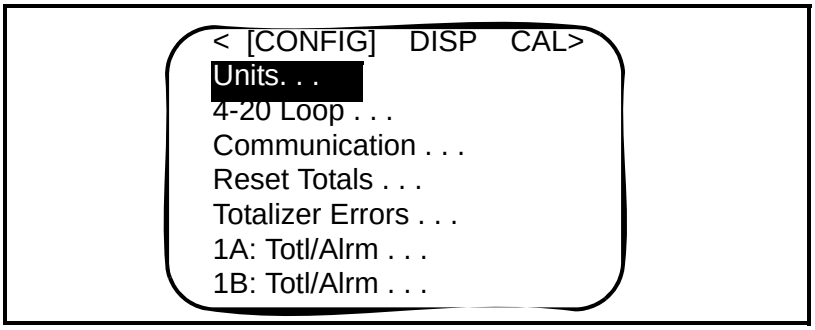


Figure 4-1: The CONFIG Menu

3. Use the [▲] and [▼] keys to scroll to the desired option (1A or 1B, 2A or 2B) and press [ENT].
4. Use the [▲] and [▼] keys to scroll to the *Totalizer* option and press [ENT]. The screen now appears similar to Figure 4-2 below.

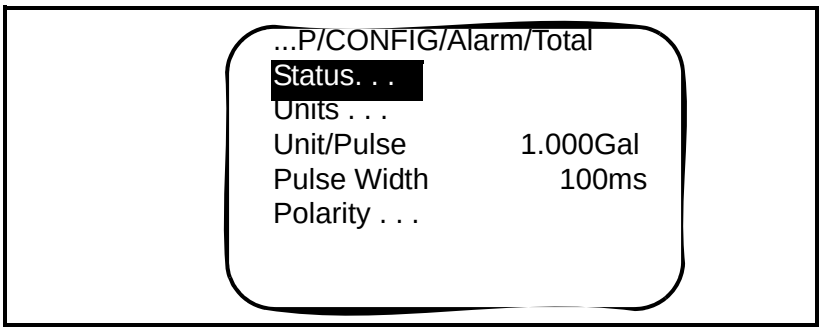


Figure 4-2: The Totalizer Option

Entering Output Status

1. In the *Totalizer* option, select *Status* and press [ENT].
2. Use the [▲] and [▼] keys to scroll to the desired option (ON or OFF) and press [ENT].

Entering Output Type and Units

1. In the *Totalizer* option, press [ENT] to enter the *Units* option.
2. The menu displays five options: Channel 1, Channel 2, AVG 2Path, SUM, DIFF and AVG. Use the [▲] and [▼] keys to scroll to the desired option, and press [ENT].

Note: *Channel 2, AVG (2-Path), AVG, SUM and DIFF are only available for a two-channel ISX878.*

3. The screen now displays two measurements: Fwd Total and Rev Total. Scroll to the desired option, and press [ENT].
4. The menu now asks for the *Unit Type*. For both Fwd Total and Rev Total, the menu offers a list of output units (either metric or English). Scroll to the desired unit and press [ENT].
5. Press [ESC] until you return to the *Totalizer* submenu.

Entering Pulse Width

1. In the *Totalizer* option, select *Pulse Width* and press [ENT].
2. Use the [▲] and [▼] keys to change the numeric value, and the [◀] and [▶] keys to change the digit selection. Adjust to the desired value, and press [ENT].

Entering Pulse Polarity

1. In the *Totalizer* option, select *Polarity* and press [ENT].
2. Use the [▲] and [▼] keys to scroll to the desired option (POSITIVE or NEGATIVE), and press [ENT].

Configuring the Alarm Option

1. Press [ESC]. The ISX878 enters the *User Program.*
2. Press the [▶] key until CONFIG is bracketed and press [ENT]. The screen appears similar to Figure 4-1 on page 4-7.
3. Use the [▲] and [▼] keys to scroll to the desired option (1A or 1B, 2A or 2B) and press [ENT].
4. Use the [▲] and [▼] keys to scroll to the *Alarm* option and press [ENT]. The screen now appears similar to Figure 4-3 below.

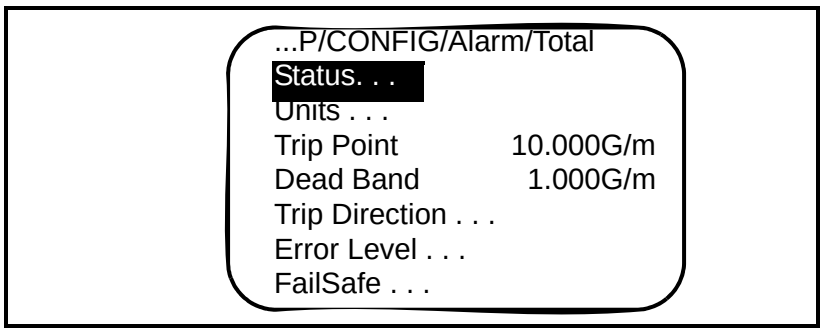


Figure 4-3: The Alarm Option

Entering Output Status

Note: *By default, all options are disabled.*

1. In the *Alarm* option, select *Status* and press [ENT].
2. Use the [▲] and [▼] keys to scroll to the desired option (ON or OFF) and press [ENT].

Entering Output Type and Units

1. In the *Alarm* option, press [ENT] to enter the *Units* option.
2. The menu displays five options: Channel 1, Channel 2, AVG 2Path, SUM, DIFF and AVG. Use the [▲] and [▼] keys to scroll to the desired option, and press [ENT].

Note: *Channel 2, AVG (2-Path), AVG, SUM and DIFF are only available for a two-channel ISX878.*

3. The screen now displays three measurements: Velocity, Volumetric and Sound Speed. Scroll to the desired selection and press [ENT].
   - For velocity or sound speed measurements, the menu offers a single selection (either in feet/sec or meters/sec, depending on your choice of units). Press [ENT] to confirm the entry and return to the previous menu.
   - For volumetric, the menu offers a list of output units (either metric or English). Scroll to the desired units and press [ENT].

Entering Output Type and Units (cont.)

4. The menu now asks for the *Unit Type*, and offers a list of output units (either metric or English). Scroll to the desired units and press [ENT].
5. Press [ESC] until you return to the *Alarm* submenu.

Entering Trip Point

1. In the *Alarm* option, select *Trip Point* and press [ENT].
2. Use the [▲] and [▼] keys to change the numeric value, and the [◀] and [▶] keys to change the digit selection. Adjust to the desired value, and press [ENT].

Entering Dead Band

1. In the *Alarm* option, select *Dead Band* and press [ENT].
2. Use the [▲] and [▼] keys to change the numeric value, and the [◀] and [▶] keys to change the digit selection. Adjust to the desired value, and press [ENT].

Entering Trip Direction

1. In the *Alarm* option, select *Trip Direction* and press [ENT].
2. Use the [▲] and [▼] keys to scroll to the desired option (ABOVE or BELOW), and press [ENT].

Entering Error Level

1. In the *Alarm* option, select *Error Level* and press [ENT].
2. Use the [▲] and [▼] keys to scroll to the desired option (HOLD, TRIP or RESET), and press [ENT].

Entering FailSafe

1. In the *Alarm* option, select *FailSafe* and press [ENT].
2. Use the [▲] and [▼] keys to scroll to the desired option (YES or NO), and press [ENT].

What's Next?

You have finished entering data in the CONFIG menu. Do one of the following:

- To program in other menus, refer to Appendix A, *Menu Maps*, to navigate to the desired menu.
- To return to the display screen, press [ESC] until the display screen reappears.

Chapter 5

Calibration

Introduction

In the CALIB menu, you can calibrate and trim the analog outputs and inputs and check other meter functions. This chapter also covers updating ISX878 software over the RS232 interface.

Before performing calibration of the ISX878, be sure the following equipment is available:

- 0-30 VDC, 100 mA variable power supply
- Current meter capable of precisely measuring 4 to 20 mA current levels
- PC with RS232 Cable and *Hyperterminal* software (available on Windows operating systems)

While following the programming instructions, refer to Figure A-3 on page A-3 of Appendix A, *Menu Maps*.

Updating ISX878 Instrument Software

1. To set up the RS232, connect one end of a 9-pin RS232 cable to the COM-1 serial port on a PC and the other end to terminal block TB4 on the ISX878, as described in Chapter 1, *Installation.*

!WARNING!
Use RS232 connections only in the safe area.

Note: *The RS232 cable connection is not limited to the COM-1 serial port of your PC. You can connect the RS232 cable to any available RS232 serial port on the PC, and follow the same instructions as for the COM-1 port.*

2. On your PC, set up the *Hyperterminal* program.

Note: *The use of* Hyperterminal *is shown here as an example. If you are using a different communications software, see its manual for detailed instructions.*

   a. From the PC Start Menu, click *Programs/Accessories/ Communications/Hyperterminal* to open the Hyperterminal window.

   b. If the call is not connected, click on *New Connection* and enter a name. Click OK.

   c. In the *Connect To* window, select COM 1 as the desired port.

Updating ISX878 Instrument Software (cont.)

d. In the *Properties* window, set the following parameters:

- Bits per second: 19200
- Data bits: 8
- Parity: None.
- Stop Bits: 1
- Flow control: None

3. From the ISX878 FACTORY menu, scroll to the *Upgrade* option and press [ENT] twice. When the ISX878 prompts you to confirm, select Yes and press [ENT],

or

With the ISX878 powered off, press and hold the left arrow key ([◀]) on the keypad. Turn the power on, and release the key after about two seconds. The UTX screen should appear as follows:

```
Loader vX.X
Boot is flash.
Load by Software.

Load: via Comm?
Y=[ENT], N=[ESC].
```

The Hyperterminal window on your PC should appear as follows:

```
GE Panametrics Loader vX.X XX/XX/XX
Load requested by Software.
Load Flash via RS232 (Y/N)?
```

Press “Y” on the PC keyboard to load the software, or press “N” to abort the process.

4. If you press “Y,” the following screen appears on the PC:

```
GE Panametrics Loader vX.X XX/XX/XX
Load requested by Software.
Load Flash via RS232 (Y/N)?

Ready to receive update via XMODEM-CRC.
Start upload now, or CTRL-X to cancel:C
```

Updating ISX878 Instrument Software (cont.)

In Hyperterminal, select *Transfer*, and then *Send File*. (The protocol should be Xmodem.) Use *Browse* to locate the file, which will have a .cod extension. Double click on this file and click the *Send* button. The screens on the ISX878 and on Hyperterminal should both display the status of the transfer. The Hyperterminal screen should appear as follows:

```
Update complete.
Program CRC valid.

Writing Signature Block . . .OK

System will restart in 10 seconds.
```

Note: *If you have another file to update, press and hold the left arrow key ([◀]) when the ISX878 displays "Restart in 10 sec." The meter will enter the reload mode immediately.*

5. Repeat steps 3 and 4 for each file that needs to be loaded.
6. To ensure the ISX878 operates correctly, GE recommends defaulting the meter after software updates. Press and hold the [ENT] and [ESC] keys when the ISX878 displays the following screen:

```
GE Panametrics

Ultrasonic
Flow Transmitter

Loading FPGA . . .
```

7. After several seconds, release the keys when the following screen appears:

```
GE Panametrics

Ultrasonic
Flow Transmitter

Loading FPGA . . .Done.
Default Meter?
[UP] = YES, [DOWN] - NO
```

Press the up arrow key ([▲]) to default the meter, or the down arrow key ([▼]) to cancel the default.

Note: *After the ISX878 has been defaulted, it restarts in the locked mode. See page 2-2 for instructions on unlocking the meter. Also, remove the RS232 cable after updating the program.*

8. To check that the software has been loaded correctly, proceed to the next section.

Checking the Meter Software

1. Turn power on. The display should boot up with a typical cycling procedure. After initialization, the display should show Ch 1 Velocity, 0.00, Meters/Sec and EX.
2. To verify which version of software has been loaded:
   a. Press [ESC] to enter the *User Program.*
   b. Press the [▶] key until FACTORY is highlighted. Scroll to the *Versions* option and press [ENT].
   c. Press [ENT] again to enter *Main*. The display should appear similar to the screen below.

```
2006 GE SENSING
S/N: A000000
PCI: P000000
b: BOOT.XXX.X
p: BETAX.XXX.X
f: FPGA.XXX.X
X: XML.XXX.X
```

Checking Option Card Version Information

To verify which option card version has been loaded:

1. Press [ESC] to enter the *User Program.*
2. Press the [▶] key until FACTORY is highlighted. Scroll to the *Versions* option and press [ENT].
3. Press [ENT] again to enter *Option Cards*. The display should appear similar to the screen below.

```
OPTION CARD VER INFO

1: TOTAL+ TOTAL          vX.X.X
```

Trimming 4-20 mA via the Keypad

1. In the *User Program*, scroll to CAL with *4-20 Loop* highlighted. Press [ENT].
2. Scroll to *Mode* and press [ENT]. In the *Mode* window, scroll to *Test[Trim]* and press [ENT].
3. Return to the *Loop* window, and scroll to *Percent*.
4. In the *Percent* window, use the arrow keys to set the percentage to 100%. Press [ENT]. Record the value shown on the current meter.
5. Now use the arrow keys to set the percentage to 0%. Press [ENT]. Record the value shown on the current meter.
6. Return to the *Loop* window, and scroll to *Base Trim*. Press [ENT].
7. Use the arrow keys to enter the base trim value, the value recorded in step 5. (The loop current should now be the same as the current meter. It should read 4.0 +/-0.01 mA.) Press [ENT].
8. Repeat steps 3 and 4.
9. Return to the *Loop* window, and scroll to *Span Trim*. Press [ENT].
10. Use the arrow keys to enter the span trim value, the value recorded in step 4. (The loop current should now be the same as the current meter. It should read 20.0 +/-0.01 mA.) Press [ENT].
11. Return to the *Loop* window, and scroll to *Mode*. Press [ENT]. Scroll to *Normal*, and press [ENT].

Note: *The difference between "Test" and "Test [TRIM]" is that "Test" is the raw output current without the trim applied. "Test [TRIM]" is the output current with trim applied.*

Chapter 6

Error Codes and Diagnostics

Introduction

The Model ISX878 flow transmitter is a reliable, easy to maintain instrument. When properly installed and operated, as described in Chapter 1, *Installation*, the meter provides accurate flow rate measurements with minimal user intervention. However, if a problem should arise with the electronics enclosure or transducers, this chapter explains how to troubleshoot the Model ISX878. Indications of a possible problem include:

- display of an error message on the LCD screen
- erratic flow readings
- readings of doubtful accuracy (i.e., readings that are not consistent with readings from another flow measuring device connected to the same process).

If any of the above conditions occurs, proceed with the instructions presented in this chapter.

Error Codes

If a problem occurs with the electronics or transducers, a built-in error code message system greatly simplifies the troubleshooting process.

All of the possible ISX878 error code messages are discussed in this chapter, along with the possible causes and the recommended actions. When an error code is generated, it will appear in the lower right corner of the LCD screen, as discussed in Chapter 3.

If an error message appears on the display screen during operation of the Model ISX878, refer to the appropriate section of this chapter for instructions on how to proceed.

E0: No Error

Problem: No error condition currently exists.

Cause: This message appears briefly to confirm that the response to another error message has corrected the problem.

Action: No action is required.

E1: Low Signal

Problem: Poor ultrasonic signal strength or the signal exceeds the limits entered via the *User Program*.

Cause: Poor signal strength may be caused by a defective cable, a flowcell problem, a defective transducer or a problem in the electronics console. A signal that exceeds the programmed limits is probably caused by the entry of an improper value in the Error Limits option of the *User Program*.

Action: Using the procedures in Chapter 1, check the components listed above. Also, check the value entered into the Signal Strength *Error Limits* option, as described on page 2-19.

E2: Sound Speed Error

Problem: The sound speed exceeds the limits programmed in the Error Limits option of the *User Program*.

Cause: The error may be caused by incorrect programming, poor flow conditions or poor transducer orientation.

Action: Compare the measured sound speed to tabulated nominal values for the process fluid and correct any programming errors. Refer to the sections on *Fluid and Pipe Problems* (page 6-6) and on *Transducer Problems* (page 6-8) to correct any problems.

E3: Velocity Range

Problem: The velocity exceeds the limits programmed in the *Error Limits* option of the *User Program*.

Cause: This error may be caused by the entry of improper programming data or by poor flow conditions and/or excessive turbulence.

Action: Make sure the actual flow rate is within the programmed limits. Also, check the value entered into the *Error Limits* option, as described on page 2-18. Refer to the sections on *Fluid and Pipe Problems* (page 6-6) and on *Transducer Problems* (page 6-8) to correct any problems.

E4: Signal Quality

Problem: The signal quality is outside the limits programmed in the *Error Limits* option of the *User Program*.

Cause: The peak of the upstream or downstream correlation signals has fallen below the correlation peak limit, as set in the *Error Limits* option on page 2-18. This may be caused by a flowcell or electrical problem.

Action: Check for sources of electrical interference and verify the integrity of the electronics console by temporarily substituting a test flowcell that is known to be good. Check the transducers and relocate them, if necessary.

E5: Amplitude Error

Problem: The signal amplitude exceeds the limits programmed in the *Error Limits* option of the *User Program*.

Cause: Solid or gas particulates may be present in the flowcell. The error could also be caused by poor coupling for clamp-on transducers.

Action: Refer to the section on *Fluid and Pipe Problems* (page 6-6) to correct any flowcell problems.

E6: Cycle Skip, Accel.

Problem: The acceleration exceeds the limits programmed in the *Error Limits* option of the *User Program*.

Cause: This condition is usually caused by poor flow conditions or improper transducer alignment.

Action: Refer to the sections on *Fluid and Pipe Problems* (page 6-6) and on *Transducer Problems* (page 6-8) to correct any problems.

E7: Analog Out Error

Problem: The current setting is outside the programmed limits.

Cause: The calculated output value exceeds the programmed limits.

Action: Verify that the 4-20 loop configuration base and span settings are correct for your process.

E30: Channel Disabled

Problem: The channel is not available.

Cause: The channel has been turned off.

Action: Enter the PROGRAM menu and enable the channel (see page 2-4).

E31: Invalid Calibration

Problem: The calibration is invalid.

Cause: Improper calibration for the application has been entered.

Action: Consult GE Sensing.

Displaying Diagnostic Parameters

The Model ISX878 offers built-in *Diagnostic Parameters* to aid in the troubleshooting of transducer and/or electrical problems. To access these parameters, do the following:

1. From the display screen, press [ESC].

Note: *If the display screen is locked, you will need to enter* [ESC], [ENT], [ESC] *and the security code. Refer to page 2-2 for details.*

2. Press the [▶] key. The screen will highlight the *channel* you wish to check. Be sure the desired channel appears on the screen (or change it, as discussed in Chapter 3).
3. Press the [▶] key to scroll to the *measurement* entry in the upper right. Press [ENT]. Be sure *Diagnostic* is highlighted, and press [ENT].
4. Press the [▶] key twice to access the *units* parameter. Press [ENT]. Scroll to the desired Diagnostic unit (as described in Table 6-1 on the next page) and press [ENT].
5. If desired, repeat steps 1-4 for the other channel.

Table 6-1: Available Diagnostic Parameters

Option Bar	Description	Good	Bad
Delta-T[ns]	Displays the transit time difference between the upstream and downstream signals.	≤1 nsec	>1 nsec
Amp Up	Displays the value for the signal amplitude of the upstream transducer.	24 ± 5	<19 or >29
Amp Dn	Displays the value for the signal amplitude of the downstream transducer.	24 ± 5	<19 or >29
T Up [µs]	Displays the upstream ultrasonic signal transit time.	N.A.	N.A.
T Dn [µs]	Displays the downstream ultrasonic signal transit time.	N.A.	N.A.
Gain Up [dB]	Displays upstream gain in dB.	N.A.	N.A.
Gain Dn [dB]	Displays downstream gain in dB.	N.A.	N.A.
Signal Up	Displays the signal strength for the upstream transducer.	50-75	<50 or >75
Signal Dn	Displays the signal strength for the downstream transducer.	50-75	<50 or >75
Thresh Up [%]	Displays the value at which the ISX878 detects the signal arrival time for the upstream transducer.	-100 - +100	<-100 or >100
Thresh Dn [%]	Displays the value at which the ISX878 detects the signal arrival time for the downstream transducer.	-100 - +100	<-100 or >100
Norm Factor	Displays the normalization factor.	0.85 - 1.0	<0.85
P# Up	Displays signal peaks for the upstream transducer.	100-924	<100 or >924
P# Dn	Displays signal peaks for the downstream transducer.	100-924	<100 or >924
Quality Up	Displays the signal quality for the upstream transducer.	≥ 1200	–400 to +400
Quality Down	Displays the signal quality for the downstream transducer.	≥ 1200	–400 to +400
Reynolds #	Displays the Reynolds number.	N.A.	N.A.
k(Re)	K factor, based on the Reynolds number.	N.A.	N.A.
Cycle Time [ms]	Time for the reading cycle to complete.	N.A.	N.A.
KFactor	Meter K calibration factor	0.5-2.0	<0.5 or >2.0
#Errors	Number of errors present.	0<Programmed Error Limit	≥Programmed Error Limit

Fluid and Pipe Problems

If preliminary troubleshooting with the *Error Code Messages* and/or the *Diagnostic Parameters* indicates a possible problem, proceed with this section. Measurement problems fall into two categories:

- fluid problems
- pipe problems.

Read the following sections carefully to determine if the problem is indeed related to the fluid or the pipe. If the instructions in this section fail to resolve the problem, contact GE Sensing for assistance.

Fluid Problems

Most fluid-related problems result from a failure to observe the flowmeter system installation instructions, as described in Chapter 1, *Installation*. Refer to Chapter 1, *Installation*, to correct any installation problems.

If the physical installation of the system meets the recommended specifications, it is possible that the fluid itself may be preventing accurate flow rate measurements. The fluid being measured must meet the following requirements:

1. *The fluid must be homogeneous, single-phase, relatively clean and flowing steadily.* Although a low level of entrained particles may have little effect on the operation of the Model ISX878, excessive amounts of solid or gas particles will absorb or disperse the ultrasound signals. This interference with the ultrasound transmissions through the fluid will cause inaccurate flow rate measurements. In addition, temperature gradients in the fluid flow may result in erratic or inaccurate flow rate readings.
2. *The fluid must not cavitate near the measurement point.* Fluids with a high vapor pressure may cavitate near the measurement point. This causes problems resulting from gas bubbles in the fluid. Cavitation can usually be controlled through proper system design.
3. *The fluid must not excessively attenuate ultrasound signals.* Some fluids, particularly those that are very viscous, readily absorb ultrasound energy. In such a case, an `E1` error code message will appear on the display screen to indicate that the ultrasonic signal strength is insufficient for reliable measurements.
4. *The fluid sound speed must not vary excessively.* The Model ISX878 will tolerate relatively large changes in the fluid sound speed, as may be caused by variations in fluid composition and/or temperature. However, such changes must occur slowly. Rapid fluctuations in the fluid sound speed, to a value that is considerably different from that programmed into the ISX878, will result in erratic or inaccurate flow rate readings. Refer to Chapter 2, *Programming Site Data*, to make sure that the appropriate sound speed is programmed into the meter.

Pipe Problems

Pipe-related problems may result either from a failure to observe the installation instructions, as described in Chapter 1, *Installation*, or from improper programming of the meter. By far, the most common pipe problems are the following:

1. *The collection of material at the transducer location(s).* Accumulated debris at the transducer location(s) will interfere with transmission of the ultrasound signals. As a result, accurate flow rate measurements are not possible. Realignment of the measurement point or transducers often cures such problems. Refer to Chapter 1, *Installation*, for more details on proper installation practices.
2. *Inaccurate pipe measurements.* The accuracy of the flow rate measurements is no better than the accuracy of the programmed pipe dimensions. Measure the pipe wall thickness and diameter with the same accuracy desired in the flow rate readings. Also, check the pipe for dents, eccentricity, weld deformity, straightness and other factors that may cause inaccurate readings. Refer to Chapter 2, *Programming Site Data*, for instructions on programming the pipe data.
3. *The inside of the pipe must be relatively clean.* Excessive build up of scale, rust or debris will interfere with flow measurement. Generally, a thin coating or a solid well-adhered build up on the pipe wall will not cause problems. Loose scale and thick coatings (such as tar or oil) will interfere with ultrasound transmission and may result in incorrect or unreliable measurements.

Maintaining the ISXDR Transducers

Transducers, couplant, the clamping fixture and dampening material are provided by GE Sensing. Once you have completed installation little maintenance is required. Refer to Table 6-2 below for maintenance information.

Table 6-2: Maintenance Checks

Component	Interval	Maintenance Check	Comments
Transducer	N/A	No additional adjustments or maintenance needed. If you suspect something is wrong with a transducer or need to replace a transducer, simply loosen the pressure bolt that secures the transducer in place and remove it. If necessary, loosen the locking nut with a wrench. Refer to *Installing the Transducers* to insert a new transducers.	No cleaning required.
Couplant	Verify every 6 months in dry areas (e.g. the desert). Verify every 12 months in other areas.	Measure the signal strength using diagnostics and compare to the value taken at the time of installation.	No cleaning required.
Dampening Material	N/A	Life of 25 years. Consult factory for additional information if needed.	No cleaning required.
Clamping Fixture	Determined by user.	Periodic inspection and tightening of clamping fixture nuts is required to ensure clamping fixture does not become loose and fall, possibly causing injury.	No cleaning required.

Transducer Problems

Ultrasonic transducers are rugged, reliable devices. However, they are subject to physical damage from mishandling and chemical attack. Clamp-on transducers are also subject to installation variables such as physical misalignment and faulty coupling to the pipe on which they are mounted.

Because the ISX878 uses clamp-on transducers, the following list concerns potential clamp-on problems. Contact GE Sensing if you cannot solve a transducer-related problem.

Clamp-on Transducer Problems

1. **POOR COUPLING TO PIPE:** Clamp-on transducers must be in close contact with the pipe. Make sure the pipe wall is smooth and generally free of paint. The couplant material must fill voids between the transducer and the pipe, and must be firmly coupled or bonded to both the pipe and the transducer. The pipe and transducer must be clean and dry for permanent couplant, such as grease or epoxy, to adhere properly. Enough pressure must be applied to the transducer by its clamp to hold it firmly against the pipe.
2. **MISALIGNMENT:** The transducer transmits relatively narrow beams of ultrasound; therefore; transducer alignment is critical to assure that the beam can travel from one transducer to the other without undue attenuation. Be sure to exactly follow the instructions that came with your transducers and clamping fixtures. Also, be sure that the actual transducer spacing agrees with the calculated spacing (S).
3. **INTERNAL DAMAGE:** Ultrasonic transducers consist of a ceramic "crystal" bonded to the transducer case. The bond between the crystal and the case may be damaged by extreme shock and by temperature extremes. The crystal itself can also be damaged by the same conditions. The internal wiring can be corroded or shorted if contaminants enter the transducer housing.
4. **PHYSICAL DAMAGE:** Transducers may be physically damaged by dropping them onto a hard surface or striking them against another object.

IMPORTANT: *Transducers must be replaced in pairs. Refer to Chapter 2,* Programming Site Data, *to program the new transducer data into the meter.*

5. **CYCLE SKIP CONDITION:** A cycle skip is usually caused by a distorted or altered signal due to poor couplant, bad pipe wall or unusual fluid disturbances. To resolve a cycle skip, recouple both transducers with proper couplant. Check your couplant for temperature ranges. In addition, make sure the pipe wall is free of paint and rust.

Contact GE Sensing if you cannot solve a transducer-related problem.

Chapter 7

Specifications

General Specifications

The general specifications for the Model ISX878 flow transmitter are divided into the following categories:

Hardware Configuration

Channel Options:
Standard: 1-Channel/Path
Optional: 2-Channel/Path (for 2-path averaging).

Enclosure:
Epoxy-coated aluminum, weatherproof, Type 4X, IP67

Dimensions:
Weight 3.9 lb (2 kg)
Size (h x w x d) 8.8 x 8.2 x 3.6 in. (220 x 210 x 90 mm)

Environmental

Ambient Operating Temperature:
-4° to +140°F (-20° to +60°C)

Storage Temperature:
-40° to +158°F (-20° to +70°C)

Measurement Parameters

Volumetric flow, totalized flow, and flow velocity

Keypad

Six-button external keypad

Flow Accuracy (% of Reading)

Pipe Diameter (ID) > 6 in. (150 mm):
±1% to 2% of reading typical

Pipe Diameter (ID) ≤ 6 in. (150 mm):
±2% to 5% of reading typical

Note: *Accuracy depends on pipe size and whether measurement is one-path or two-path. Accuracy to ±0.5% of reading may be achievable with process calibration.*

Range

-40 to +40 ft/s (-12.2 to +12.2 m/s)

Rangeability

400:1

Repeatability

±0.1% to 0.3% of reading

Note: *Specifications assume a fully developed flow profile, with a straight run of pipe 10 diameters upstream and 5 diameters downstream, and flow velocity greater than 1 ft/s (0.3 m/s).*

Fluid Types

Acoustically conductive fluids, including water and most hydrocarbon liquids. Maximum void fraction depends on transducers, interrogation carrier frequency, path length and pipe configuration.

Electrical Specifications

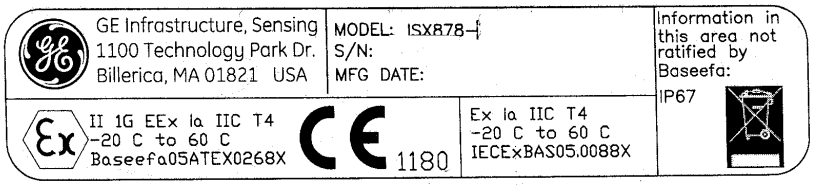
The electrical specifications for the Model ISX878 flow transmitter are divided into the following categories:

Electrical Classification/ Certification

	ATEX	IECEx
Marking	<Ex> II 1G EEx ia IIC T4 (-20 C ≤ Ta ≤60 C)	Ex ia IIC T4 (-20 C ≤ Ta ≤60 C)
Certificate No.	Baseefa05ATEX0268X	IECExBAS05.0088X
Additional Info.	CE 1180	

Special Conditions for Safe Use (X):

The apparatus is not capable of withstanding the 500 V rms test as defined in Clause 6.4.12 of EN50020. This must be taken into account on any installation in which it is used, for example, by assuring that the supply to the apparatus is galvanically isolated.



Power Requirements

15-30 VDC loop powered, 2 W max

Output Drive Capability:

$$\text{Max. load (ohms)} = [50 \times (PSV - 15)] - Rc$$

where PSV = power supply voltage in volts DC
and Rc = cable resistance, 22 AWG cable has 0.04 ohm/ft

For example:
Given a 24-VDC power supply and a 1,000-ft cable (22 AWG, 0.04 ohm/ft),

$$Rc = 1000 \text{ ft} \times 0.04 \text{ ohm/ft} = 40 \text{ ohms}$$

$$\text{Max. load} = [50 \times (24 - 15)] - 40$$
$$= [50 \times 9] - 40$$
$$= 410 \text{ ohms}$$

Note: *The maximum load the ISX878 can drive is 500 ohms.*

Power Consumption:
700 mW, depending on the loop voltage and current.
In a loop-powered configuration,

Power Consumption = Loop current × Input power supply voltage

Memory	FLASH memory, field-upgradable
Operating Mode	Correlation Transit-Time™ Mode with clamp-on transducers
Input/Output Specifications	**Digital Display:** 128 X 64 LCD, configurable to display up to 2 measurement parameters. **Digital Communications:** Standard: RS232 serial port for PC or terminal (safe area only). **Analog Output:** 4-20 mA on power loop **Cable and Length:** Transducer: 10-ft, 25-ft, 50-ft, 100-ft integral with transducer Power: Shielded 2-wire, twisted pair, 24 gauge **Environmental:** System complies with EMC Directive 89/336/EEC, and wetted transducers comply with PED 97/23/EC for DN<25.

Transducer Specifications

Clamp-on Transducers

Temperature Range:
Standard: -40° to 194°F (-40° to 90°C)

Cable Temperature Rating:
ISXDR-407, -408: -40° to 167°F (-40°C to 75°C)
ISXDR-409, -410: -40° to 221°F (-40°C to 105°C)

Frequency:
500 kHz, 1 MHz, 2 MHz, 4 MHz

Mounting:
ISXDR-407, -408: Fixture with stainless steel strap.
ISXDR-409, -410: CF-ES clamping fixture with stainless steel strap

Certifications:
ISXDR-407, -408: Type 4X, IP65
ISXDR-409, -410: Type 4X, IP66

Pipe Size and Materials

Clamp-on Transducers

Pipe Materials:
Can clamp to all metals and most plastics. (Consult GE Sensing for concrete, composite materials and highly corroded or lined pipes.)

Pipe Sizes:
ISXDR-407, -408: 0.5 to 8 in. (12 mm to 200 mm)
ISXDR-407, -408, -409, -410: 2.0 to 16 in. (50.8 mm to 406.4 mm)

Pipe Wall Thickness:
Up to 0.5 in. (12 mm)

Area Classifications: Standard general-purpose. Hazardous area classification Zone 0.

Appendix A

Menu Maps

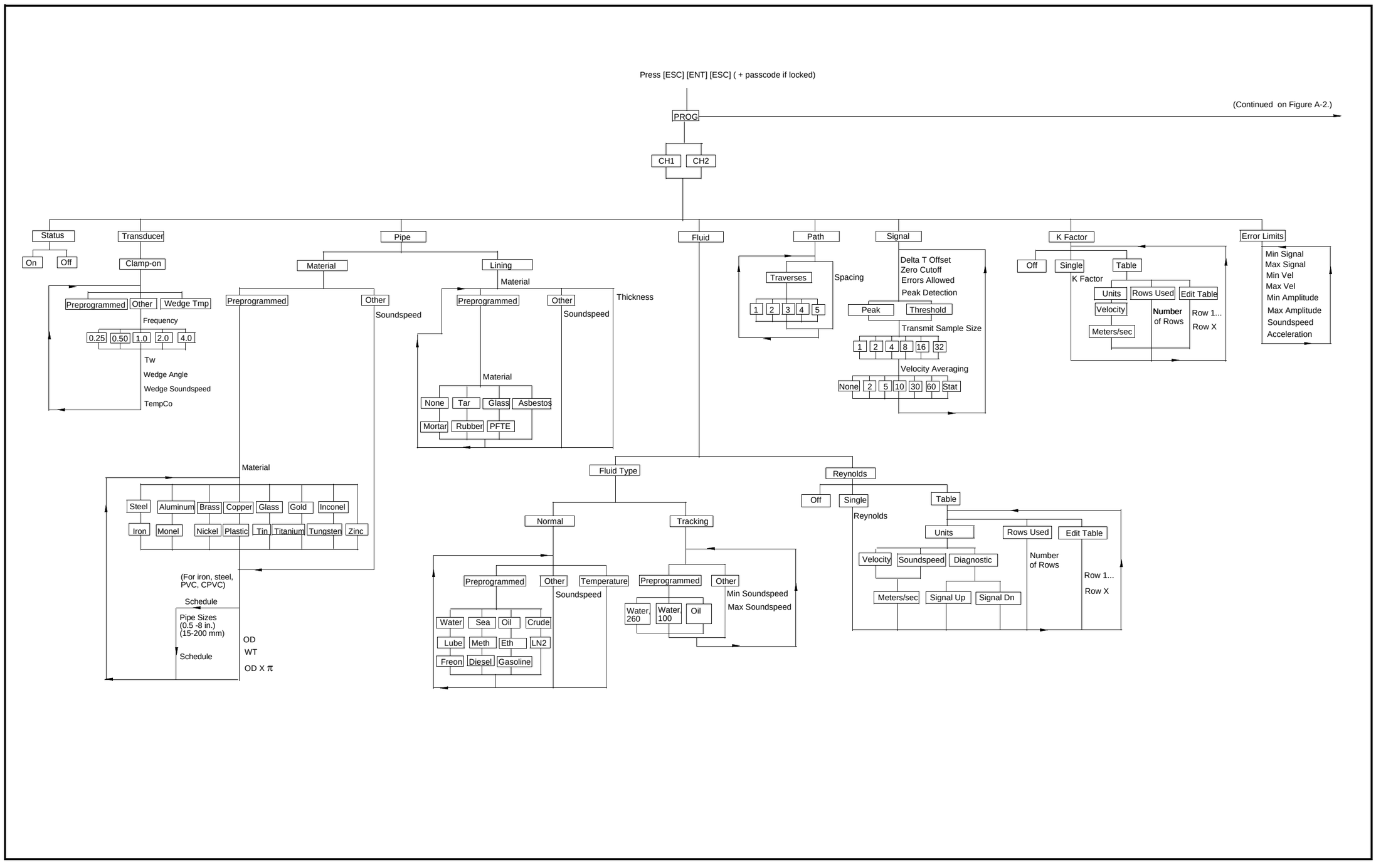


Figure A-1: The ISX878 PROG Menu

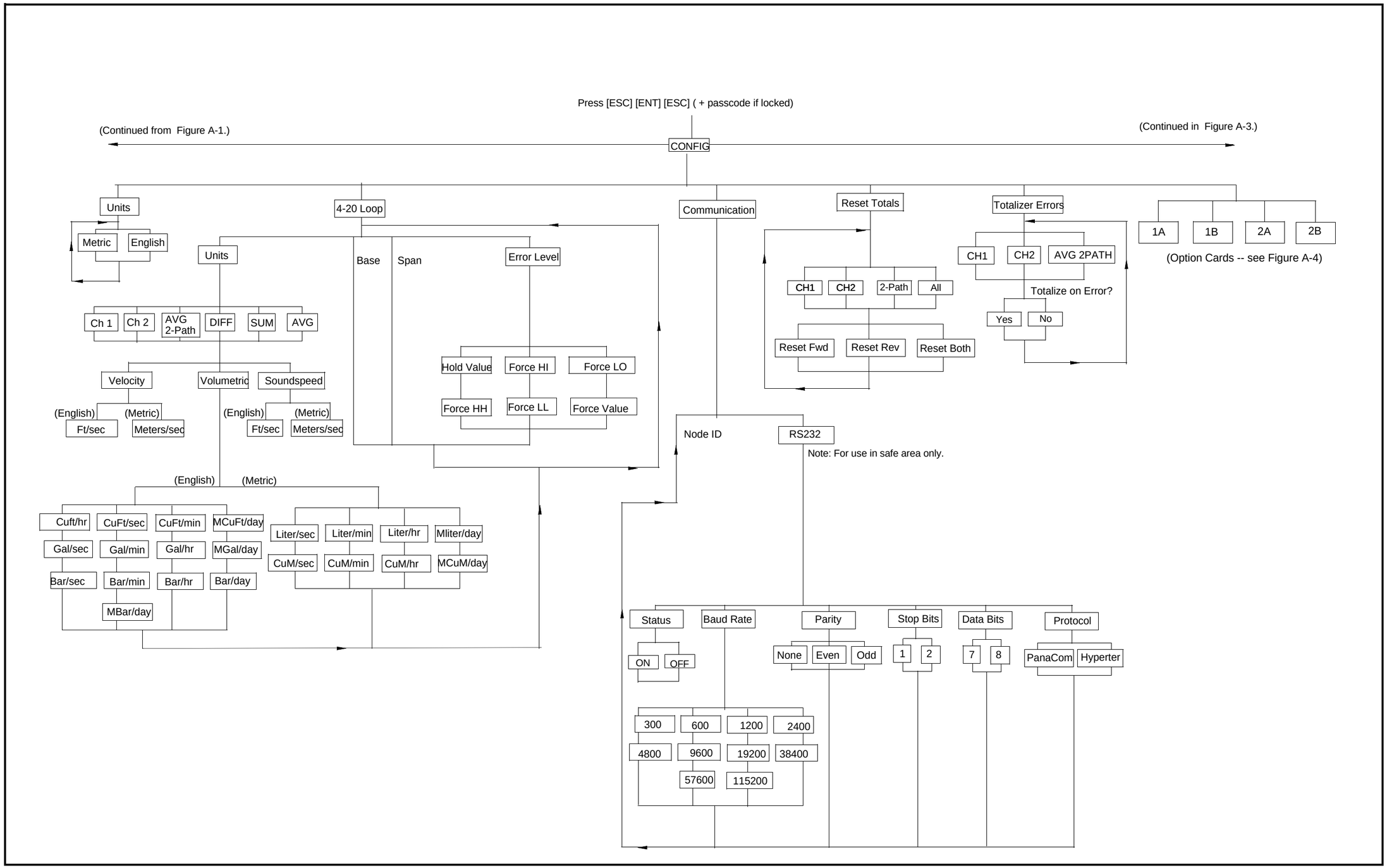


Figure A-2: The ISX878 CONFIG Menu

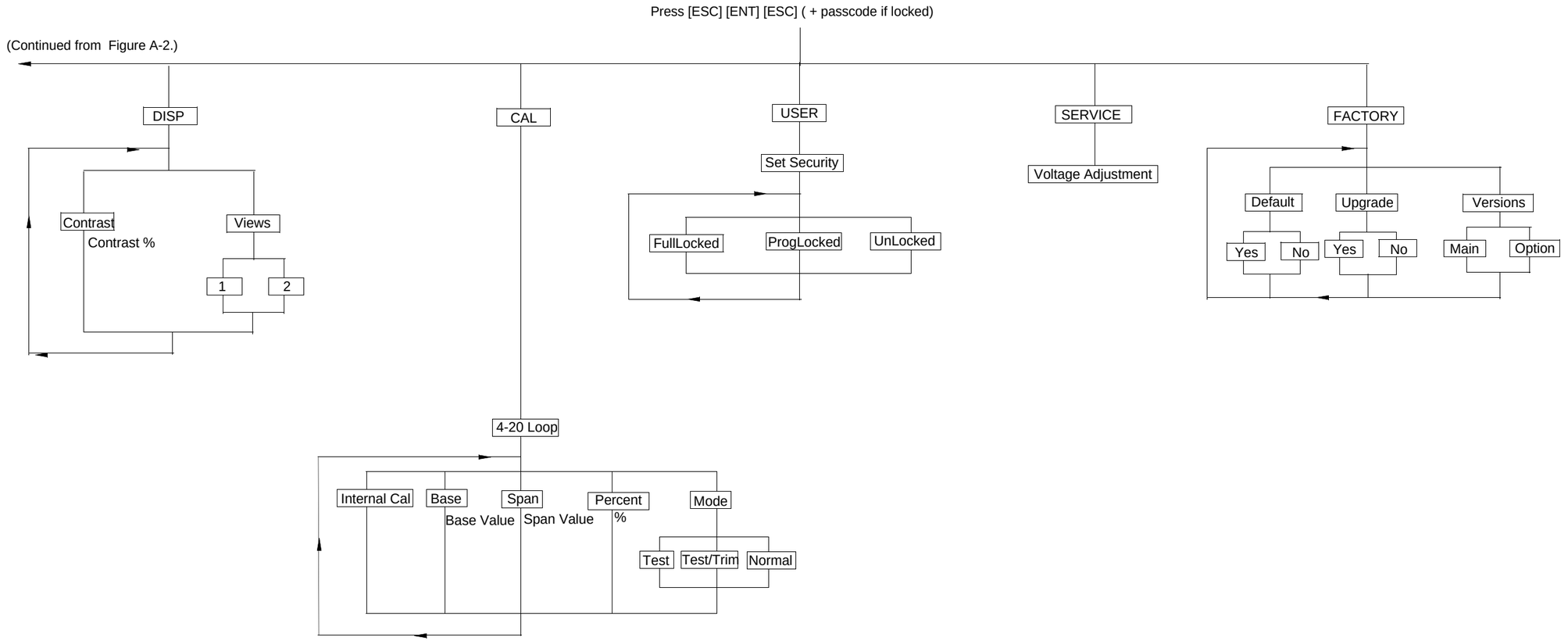


Figure A-3: The ISX878 DISP, CAL, USER, SERVICE and FACTORY Menus

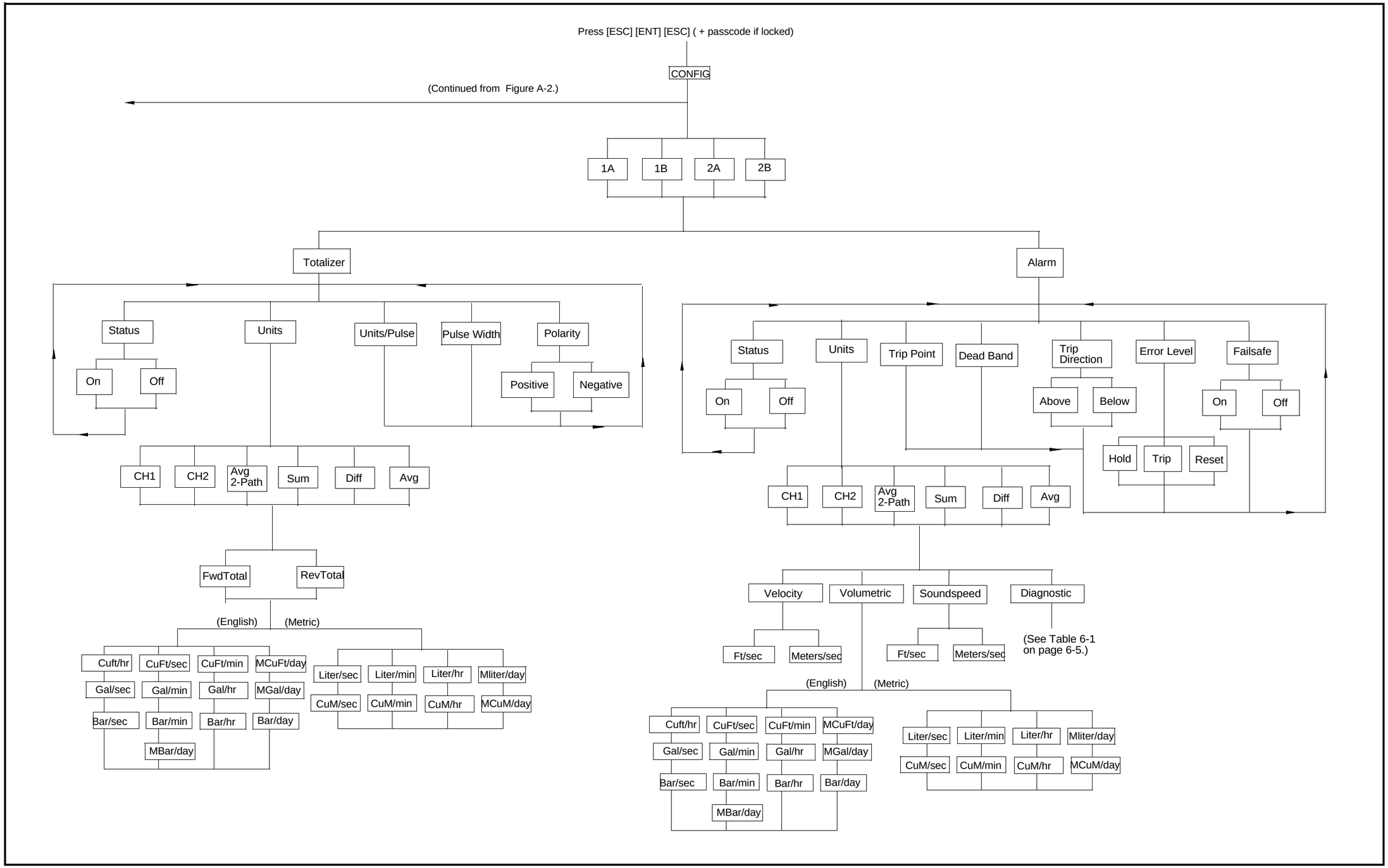


Figure A-4: Option Card Programming (CONFIG Menu)

Appendix B

CE Mark Compliance

Introduction

For CE Mark compliance, the Model ISX878 flow transmitter must meet the EMC directive.

IMPORTANT: *CE Mark compliance is required only for units intended for use in EEC countries.*

EMC Compliance

In addition to the standard wiring requirements, the electrical connections must be shielded and grounded as in Table B-1 below for EMC compliance. After all the necessary electrical connections have been made, seal any unused cable entry holes.

Note: *If the instructions in this appendix are followed, the unit will comply with the EMC Directive 89/336/EEC.*

Table B-1: Wiring Modifications

Connection	Cable Type	Termination Modification
Transducer	Shielded cable	Terminate shield to case
Power	Shields, twisted pair	Terminate shield to case
Shielding	Wires enclosed in a properly-grounded metal conduit do not require additional shielding.	
Options: Alarm/ Totalizer	Shielded cable	Terminate shield to case

Note: *Make sure to connect the ISX878 case to the earth ground with a grounding cable, using the external ground screws found on either side of the enclosure.Terminate the cable shields to the closest screw on the bus bar inside the enclosure.*

Appendix C

Data Records

Site Data

After the Model ISX878 flow transmitter has been installed, specific site data must be entered via the *User Program*, prior to operation. Record that information in Table C-1 below.

Table C-1: Site Data

General Information					
Model #			Serial #		
Software Vers.			Setup Date		
Channelx-Status					
Channel 1			Channel 2 (if applicable)		
Channel Status	Off[1] On		Channel Status	Off[1] On	
Channelx-Pipe Parameters					
Channel 1			Channel 2 (if applicable)		
Trans. Type	Clamp-On		Trans. Type	Clamp-On	
Transducer #			Transducer #		
Other Transducers			***Other Transducers***		
Wedge Temp			Wedge Temp		
Frequency (Hz)			Frequency (Hz)		
Tw (µs)			Tw (µs)		
Wedge Angle (°)			Wedge Angle (°)		
Wedge Sndspd			Wedge Sndspd		
Pipe Material			Pipe Material		
All Clamp-On Transducers			***All Clamp-On Transducers***		
Pipe O.D.			Pipe O.D.		
Pipe Wall			Pipe Wall		
Path Length (P)			Path Length (P)		
Axial Length (L)			Axial Length (L)		
Lining	Yes	No	Lining	Yes	No
Lining Material			Lining Material		
Lining Sndspd			Lining Sndspd		
Lining Thickness			Lining Thickness		
Track. Window.	Yes	No	Track. Window.	Yes	No
Fluid Type			Fluid Type		
Other/Sndspd			Other/Sndspd		
Reynolds Corr.	Off	Active	Reynolds Corr.	Off	Active
KV Input Sel.	Table	Static	KV Input Sel.	Table	Static
Kin. Visc.			Kin. Visc.		
Cal. Factor			Cal. Factor		
# of Traverses			# of Traverses		
Trans. Spacing			Trans. Spacing		

Table C-1: Site Data (cont.)

Channelx-Error Limits					
Channel 1				Channel 2 (if applicable)	
Min. Signal				Min. Signal	
Max. Signal				Max. Signal	
Min.Velocity				Min.Velocity	
Max. Velocity				Max. Velocity	
Min. Amplitude				Min. Amplitude	
Max. Amplitude				Max. Amplitude	
Soundspeed				Soundspeed	
Acceleration				Acceleration	
Channelx-Signal					
Channel 1				Channel 2 (if applicable)	
Delta T Offset				Delta T Offset	
Zero Cutoff				Zero Cutoff	
# of Errors				# of Errors	
Detection	Peak	Threshold		Detection	Peak	Threshold
Min. Thresh%	N/A			Min. Thresh%	N/A	
Max. Thresh%	N/A			Max. Thresh%	N/A	
Xmit Sam. Size	N/A			Xmit Sam. Size	N/A	
Vel. Averaging				Vel. Averaging		
Global-CONFIG					
System Units	English	Metric		Node ID	
4/20 Units				Baud Rate	
4/20 Base				Parity	
4/20 Span				Stop Bits	
Error Level				Data Bits	
Channelx-Display					
Channel 1				Channel 2 (if applicable)	
Vol. Units				Vol. Units	
Totalizer Units				Totalizer Units	
Channelx- KFACTOR Table					
K-Factor Table				**K-Factor Table**	
Channel 1				Channel 2 (if applicable)	
K-Factor Row #	Velocity	K Factor		K-Factor Row #	Velocity	K Factor
1				1		
2				2		
3				3		
4				4		
5				5		

Table C-1: Site Data (cont.)

Channelx- KFACTOR Table (cont.)						
6				6		
7				7		
8				8		
9				9		
10				10		
11				11		
12				12		
13				13		
14				14		
15				15		
16				16		
17				17		
18				18		
19				19		
20				20		
Channelx- Reynolds Number Table						
Channel 1				Channel 2 (if applicable)		
Reynolds Row #	Units	kRe		K-Factor Row #	Units	kRe
1				1		
2				2		
3				3		
4				4		
5				5		
6				6		
7				7		
8				8		
9				9		
10				10		
11				11		
12				12		
13				13		
14				14		
15				15		
16				16		
17				17		
18				18		
19				19		
20				20		

Appendix D

Service Record

Introduction

Whenever any service procedure is performed on the Model ISX878 flow transmitter, the details of the service should be recorded in this appendix. An accurate service history of the meter can prove very helpful in troubleshooting any future problems.

Data Entry

Record complete and detailed service data for the Model ISX878 in Table D-1 below. Make additional copies of the table as needed.

Table D-1: Service Record

Table D-1: Service Record (cont.)

Diagnostic Parameters

After a successful initial installation of the Model UTX868 and whenever any system malfunction is noticed, the values for the diagnostic parameters should be entered in Table D-2 below.

Table D-2: Diagnostic Parameters

Channel 1			*Channel 2*		
Delta-T[ns]			Delta-T[ns]		
Amp Up			Amp Up		
Amp Dn			Amp Dn		
T Up [µs]			T Up [µs]		
T Dn [µs]			T Dn [µs]		
Gain Up [dB]			Gain Up [dB]		
Gain Dn [dB]			Gain Dn [dB]		
Signal Up			Signal Up		
Signal Dn			Signal Dn		
Thresh Up [%]			Thresh Up [%]		
Thresh Dn [%]			Thresh Dn [%]		
Norm Factor			Norm Factor		
P# Up			P# Up		
P# Dn			P# Dn		
Quality Up			Quality Up		
Quality Down			Quality Down		
Reynolds #			Reynolds #		
k(Re)			k(Re)		
Cycle Time [ms]			Cycle Time [ms]		

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GE
Sensing

DECLARATION OF CONFORMITY

We,

GE Sensing
1100 Technology Park Drive
Billerica, MA 01821
USA

declare under our sole responsibility that the

DigitalFlow™ ISX878 Liquid Flow Ultrasonic Transmitter

to which this declaration relates, is in conformity with the following standards:

- EN50014:1997+A1+A2:1999
  EN50020:2002
  EN60079-26
  as specified in: Baseefa05ATEX0268X
  Baseefa
  Buxton, Derbyshire, UK
- EN61326:1998, Class A, Annex A, Continuous Unmonitored Operation
- EN60529:1991+A1:2000
  IP66
- IEC 60079-0:2000
  IEC 60079-11:1999
  as specified in: IECEx BAS 050088X

following the provisions of the 89/336/EEC EMC Directive and the 94/9/EC ATEX Directive.

The *units listed above and any transducers supplied with them (spoolpieces are addressed under a separate declaration of conformity)* do not bear CE marking for the Pressure Equipment Directive, as they are supplied in accordance with Article 3, Section 3 (sound engineering practices and codes of good workmanship) of the Pressure Equipment Directive 97/23/EC for DN<25.

June 30, 2006
Date of Issue

Mr. Gary Kozinski
Certification & Standards, Lead Engineer

CE

I.S. EN ISO 9002
Shannon

TÜV ESSEN
ISO 9001
U.S.

GE
Sensing

DECLARATION DE CONFORMITE

Nous,

GE Sensing
1100 Technology Park Drive
Billerica, MA 01821
USA

déclarons sous notre propre responsabilité que les

DigitalFlow™ ISX878 Liquid Flow Ultrasonic Transmitter

rélatif á cette déclaration, sont en conformité avec les documents suivants:

- EN50014:1997+A1+A2:1999
  EN50020:2002
  EN60079-26
  as specified in: Baseefa05ATEX0268X
  Baseefa
  Buxton, Derbyshire, UK
- EN61326:1998, Class A, Annex A, Continuous Unmonitored Operation
- EN60529:1991+A1:2000
  IP66
- IEC 60079-0:2000
  IEC 60079-11:1999
  as specified in: IECEx BAS 050088X

suivant les régles de la Directive de Compatibilité Electromagnétique 89/336/EEC et d'ATEX 94/9/EC.

Les *matériels listés ci-dessus ainsi que les transducteurs pouvant être livrés avec (les manchettes faisant l'objet d'une déclaration de conformité séparée)* ne portent pas le marquage CE de la directive des équipements sous pression, car ils sont fournis en accord avec la directive 97/23/EC des équipements sous pression pour les DN<25, Article 3, section 3 qui concerne les pratiques et les codes de bonne fabrication pour l'ingénierie du son.

30 juin 2006
Date d'émission

Mr. Gary Kozinski
Certification et normes, ingénieur de fil

CE

NSAI I.S. EN ISO 9002 Shannon

TÜV ESSEN ISO 9001 U.S.

GE
Sensing

KONFORMITÄTS-ERKLÄRUNG

Wir,

GE Sensing
1100 Technology Park Drive
Billerica, MA 01821
USA

erklären, in alleiniger Verantwortung, daß die Produkte

DigitalFlow™ ISX878 Liquid Flow Ultrasonic Transmitter

folgende Normen erfüllen:

- EN50014:1997+A1+A2:1999
  EN50020:2002
  EN60079-26
  as specified in: Baseefa05ATEX0268X
  Baseefa
  Buxton, Derbyshire, UK
- EN61326:1998, Class A, Annex A, Continuous Unmonitored Operation
- EN60529:1991+A1:2000
  IP66
- IEC 60079-0:2000
  IEC 60079-11:1999
  as specified in: IECEx BAS 050088X

gemäß den Europäischen Richtlinien, EMV-Richtlinie Nr.: 89/336/EG und ATEX Richtlinie Nr. 94/9/EG.

Die *oben aufgeführten Geräte und zugehörige, mitgelieferte Schallwandler (Messrohre werden in einer separaten Konformitätserklärung behandelt)* tragen keine CE-Kennzeichnung gemäß der Druckgeräte-Richtlinie, da sie in Übereinstimmung mit Artikel 3, Absatz 3 (gute Ingenieurpraxis) der Druckgeräte-Richtlinie 97/23/EG für DN<25 geliefert werden.

30. Juni 2006
Außtellungsdatum

Hr. Gary Kozinski
Bescheinigung und Normen, Leitungsingenieur

CE

I.S. EN ISO 9002
Shannon

TÜV
TÜV ESSEN
ISO 9001
U.S.

GE
Sensing

ATEX COMPLIANCE

We,

GE Sensing
1100 Technology Park Drive
Billerica, MA 01821-4111
U.S.A.

as the manufacturer, declare under our sole responsibility that the product

DigitalFlow™ ISX878 Liquid Flow Ultrasonic Transmitter

to which this document relates, in accordance with the provisions of ATEX Directive 94/9/EC Annex II, meets the following specifications:

CE 1180 Ex **II 1 G EEx ia IIC T4 (-20°C to +60°C)**
Baseefa05ATEX0268X

Furthermore, the following additional requirements and specifications apply to the product:

- Having been designed in accordance with EN 50014, EN 50020, and EN 60079-26, the product meets the fault tolerance requirements of electrical apparatus for category “ia”.
- The product is an electrical apparatus and must be installed in the hazardous area in accordance with the requirements of the EC Type Examination Certificate. The installation must be carried out in accordance with all appropriate international, national and local standard codes and practices and site regulations for flameproof apparatus and in accordance with the instructions contained in the manual. Access to the circuitry must not be made during operation.
- Only trained, competent personnel may install, operate and maintain the equipment.
- The product has been designed so that the protection afforded will not be reduced due to the effects of corrosion of materials, electrical conductivity, impact strength, aging resistance or the effects of temperature variations.
- The product cannot be repaired by the user; it must be replaced by an equivalent certified product. Repairs should only be carried out by the manufacturer or by an approved repairer.
- The product must not be subjected to mechanical or thermal stresses in excess of those permitted in the certification documentation and the instruction manual.
- The product contains no exposed parts which produce surface temperature infrared, electromagnetic ionizing, or non-electrical dangers.

USA

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