PanaFlow™ LC

User's manual

910-327 Rev. A

Panametrics
a Baker Hughes business

PanaFlow™ LC

Panametrics liquid ultrasonic flowmeter

User's manual

910-327 Rev. A
Sep 2019

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Contents

Product registration

Thank you for purchasing a model PanaFlow™ LC from Panametrics. Please register your product at https://info.bakerhughes.com/New-Product-Registration-LP.html for product support such as the latest software/firmware upgrades, product information and special promotions.

Services

Panametrics provides customers with an experienced staff of customer support personnel ready to respond to technical inquiries, as well as other remote and on-site support needs. To complement our broad portfolio of industry-leading solutions, we offer several types of flexible and scalable support services including: Training, Product Repairs, Service Agreements and more. Please visit https://www.bakerhughesds.com/panametrics/services for more details.

Typographical conventions

Note: These paragraphs provide information that provides a deeper understanding of the situation, but is not essential to the proper completion of the instructions.

IMPORTANT:

These paragraphs provide information that emphasizes instructions that are essential to proper setup of the equipment. Failure to follow these instructions carefully may cause unreliable performance.

CAUTION!

This symbol indicates a risk of potential minor personal injury and/or severe damage to the equipment, unless these instructions are followed carefully.

WARNING!

This symbol indicates a risk of potential serious personal injury, unless these instructions are followed carefully.

Safety issues

WARNING!

It is the responsibility of the user to make sure all local, county, state and national codes, regulations, rules and laws related to safety and safe operating conditions are met for each installation.

Attention European customers!

To meet CE Mark requirements for all units intended for use in the EU, all electrical cables must be installed as described in this manual.

Auxiliary equipment

Local safety standards

The user must make sure that he operates all auxiliary equipment in accordance with local codes, standards, regulations, or laws applicable to safety.

Working area

WARNING!

Auxiliary equipment may have both manual and automatic modes of operation. As equipment can move suddenly and without warning, do not enter the work cell of this equipment during automatic operation, and do not enter the work envelope of this equipment during manual operation. If you do, serious injury can result.

WARNING!

Make sure that power to the auxiliary equipment is turned OFF and locked out before you perform maintenance procedures on this equipment.

Qualification of personnel

Make sure that all personnel have manufacturer-approved training applicable to the auxiliary equipment. Please make the factory aware of any customer visits so that any further support to the customer can occur immediately.

Personal safety equipment

Make sure that operators and maintenance personnel have all safety equipment applicable to the auxiliary equipment. Examples include safety glasses, protective headgear, safety shoes, etc.

Unauthorized operation

Make sure that unauthorized personnel cannot gain access to the operation of the equipment. Security levels need to be set properly at the completion of any customer visit.

Environmental compliance

RoHS

The PanaFlow™ LC fully complies with RoHS regulations (Directive 2011/65/EU).

Waste Electrical and Electronic Equipment (WEEE) directive

Panametrics is an active participant in Europe's Waste Electrical and Electronic Equipment (WEEE) take-back initiative (Directive 2012/19/EU).

This equipment has required the extraction and use of natural resources for its production. It may contain hazardous substances that could impact health and the environment.

In order to avoid the dissemination of those substances in our environment and to diminish the pressure on the natural resources, we encourage you to use the appropriate take-back systems. Those systems will reuse or recycle most of the materials of your end life equipment in a sound way.

The crossed-out wheeled bin symbol invites you to use those systems.

If you need more information on the collection, reuse and recycling systems, please contact your local or regional waste administration.

Please visit https://www.bakerhughesds.com/health-safetyand-environment-hse for take-back instructions and more information about this initiative.

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Chapter 1. Introduction

Thank you for purchasing a model PanaFlow™ LC from Panametrics. Please register your product at https://info.bakerhughes.com/New-Product-Registration-LP.html for product support such as the latest software/firmware upgrades, product information and special promotions.

1.1 System description

The PanaFlow™ LC flowmeter is a one, two, or three channel ultrasonic transit time flowmeter that utilizes clamp-on transducers on external pipe surfaces to allow for uninterrupted flow operation during flow measurement. The PanaFlow™ LC flowmeter has up to 3 independent channels. These channels are capable of measuring the flow rate of acoustically conductive single-phase liquid, which may have limited amount of second phase. With the 3 channels, the user will have the capability to average them with equal weights, or with different weights that will better suit the flow profile. The meter is designed for pipe sizes ranging from ½ in. (15 mm) to 300 in. (7600 mm) with wall thickness up to 4 in. (102 mm) for flow velocities up to 80 ft/s (25 m/s). For a full list of its capabilities, see Appendix A. This manual will serve as a guide to install the clamping fixture and transducers necessary for accurate flow readings, programming the meter for specific customer needs, error codes and troubleshooting walk through, and maintenance and service procedures.

Figure 1: PanaFlow LC

1.2 Theory of operation

The PanaFlow™ LC uses a procedure called Transit-Time Flow Measurement. In this method, the flowmeter transmits ultrasonic pulses through a moving liquid. The pulses that travel in the same direction as the fluid flow (downstream) travel slightly faster than the pulses that travel against the fluid flow (upstream). The difference in transit times is then used to calculate flow velocity.

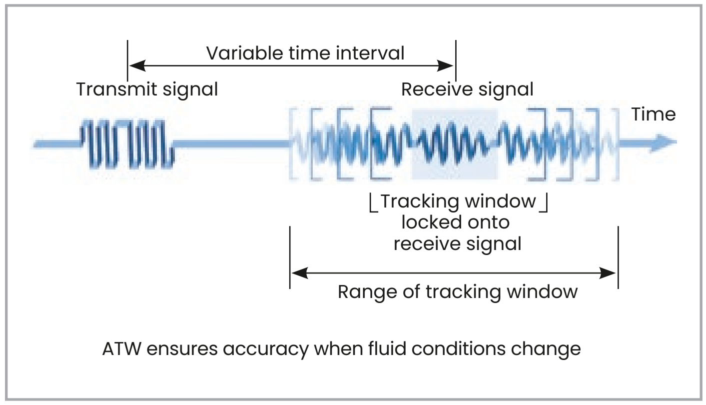


Figure 2: Transit - time flow measurement

Chapter 2. Installation

2.1 Installation guidelines

This section provides general information with respect to the mechanical and electrical installation, and should be thoroughly reviewed before the system is installed. To ensure safe and reliable operation of the PanaFlow™ LC, the system must be installed in accordance with the established guidelines. Those guidelines, explained in detail in this chapter, include the following topics:

- Unpacking the PanaFlow LC System
- Site Considerations
- Making Electrical Connections

WARNING!

The PanaFlow™ LC flow meter can measure the flow rate of many fluids, some potentially hazardous. The importance of proper safety practices cannot be overemphasized.

WARNING!

Be sure to follow all applicable local safety codes and regulations for installing electrical equipment and working with hazardous fluids or flow conditions. 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 D, CE Mark Compliance.

2.2 Unpacking the PanaFlow LC system

Before removing the PanaFlow™ LC from its box, please inspect both the box and the instrument carefully. Each instrument manufactured by Panametrics is warranted to be free from defects in material and workmanship. 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 Panametrics Customer Care immediately for assistance.

The PanaFlow LC flowmeter shall consist of one set of XMT1000 Electronics, a pair of transducer cables, a pair of clamp on transducers and a clamping fixture to mount the transducers to a pipe.

Due to a variety of configurations your kit may include additional cables, clamping fixtures, transducers and junction boxes.

Please refer to your packing slip and ordered parts string and lists for your specific components.

The PanaFlow™ LC is supplied with both a serial number label and a certification label for identification of the instrument (see Figure 3 below and Figure 4 on page 5).

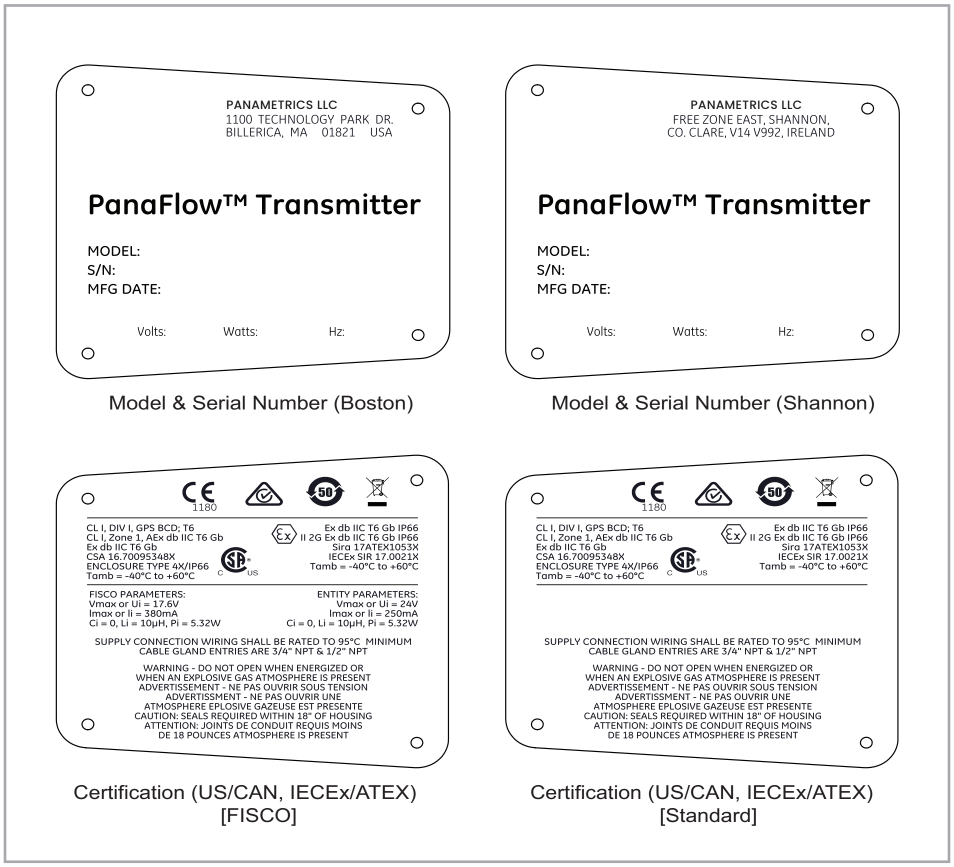


Figure 3: Typical XMT1000 labels (aluminum enclosure)

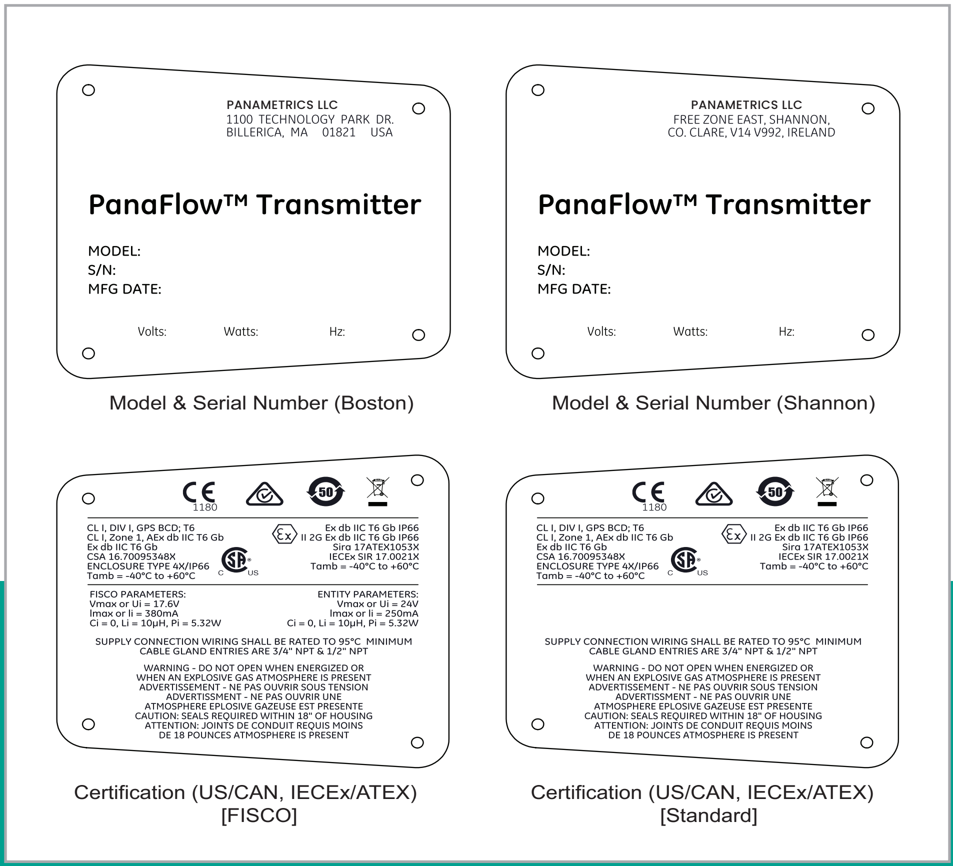


Figure 4: Typical XMT1000 labels

2.3 Site considerations

Proper installation of the PanaFlow™ LC is important to achieve optimum performance from the system. The following installation recommendations provide general guidelines of how this system should be installed. If the following recommendations cannot be met, please consult the factory for a more detailed review of the application to see what performance may be achievable. Following these recommendations may not be the solution for all, since every installation is different.

2.4 Clamping fixtures and Transducer installations

Installation of clamp-on transducers for transit-time measurements consists of mounting the clamping fixture to the pipe and then mounting the transducers into the clamping fixture. When installing transducers in clamp-on applications, you can use one of the following methods to hold the transducer against the pipe wall:

- Strap Clamping Fixture (SCF)
- Universal Clamping Fixture (UCF)
- General Clamping Fixture (GCF, permanent installation)
- Magnetic Clamping Fixture (MCF)
- Small Clamping Fixtures - 6" (150 mm) or 12" (300 mm) long, with Velcro straps (SPCF)

This manual covers the installation for the Strap Clamping Fixture (SCF), while the other fixtures can be found in the Appendix B. Before beginning the transducer installation, you must determine the number of traverses for your configuration.

Note: The accuracy and performance of the flowmeter depends on the location, spacing, and alignment of the transducers. This manual provides general instructions for locating and installing most transducer types. However, the specific spacing of your transducers is unique to your installation.

2.4.1 Strap clamping fixture

The Strap Clamping Fixture (SCF) (see Figure 5 below) acts as a spacing device, a transducer holder, and a transducer aligner. The SCF includes two U-shaped blocks connected by a slotted bar and four hose straps.

The SCF is strapped around the pipe, and the blocks are used to hold the transducers in position for accurate measurements. The blocks must be positioned properly using the spacing dimension calculated by the flowmeter. Then, the transducers are mounted into the blocks.

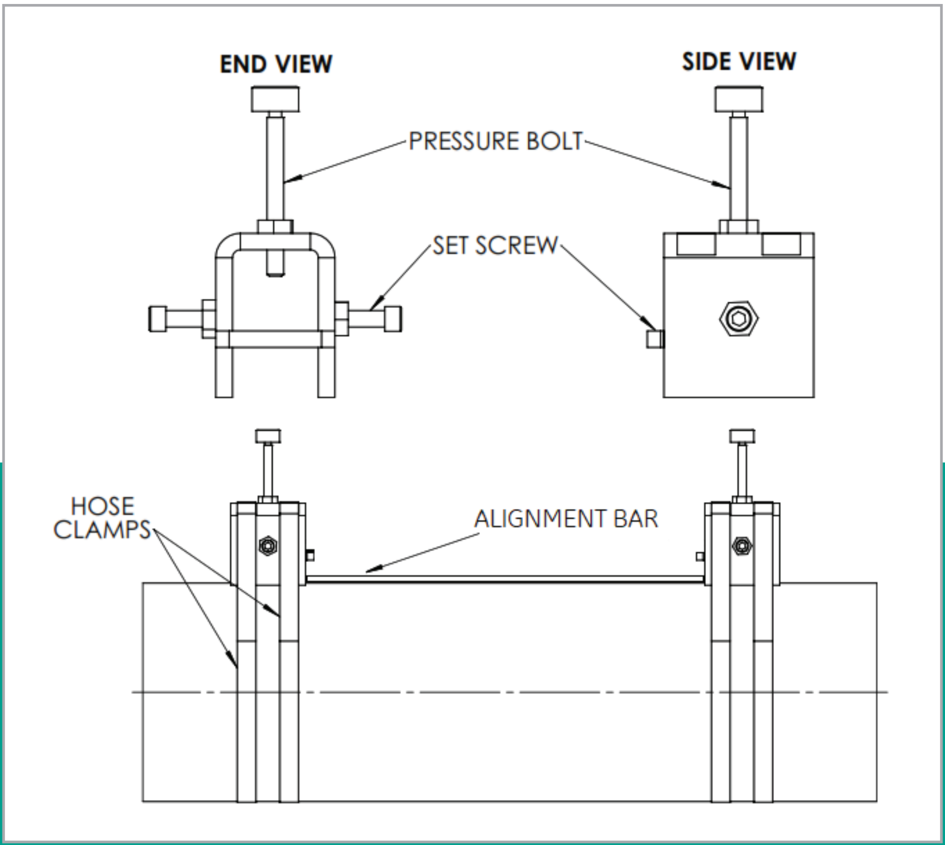


Figure 5: Components of the SCF

2.5 Determining the number of Traverses

The first step in the installation is determining the number of traverses (see Figure 6 below). The transducers can be mounted using one of two methods:

- Even number of-traverse method - the transducers are mounted on the same side of the pipe and the ultrasonic signal is transmitted from one transducer to the other by reflection off the opposite pipe wall.
- Odd number of-traverse method - the transducers are mounted diagonally across from each other. The ultrasonic signal is transmitted across the pipe directly from one transducer to the other.

Always try the even number of-traverse method first because it is easier to configure and yields greater accuracy. However, if the pipe has poor inside surface conditions or the fluid is highly attenuating, you may not be able to obtain a reliable signal. Therefore, you may have to use the Odd number of-traverse method in such applications. The spacing of the transducers is calculated by the system after all the installation parameters have been programmed into the flowmeter.

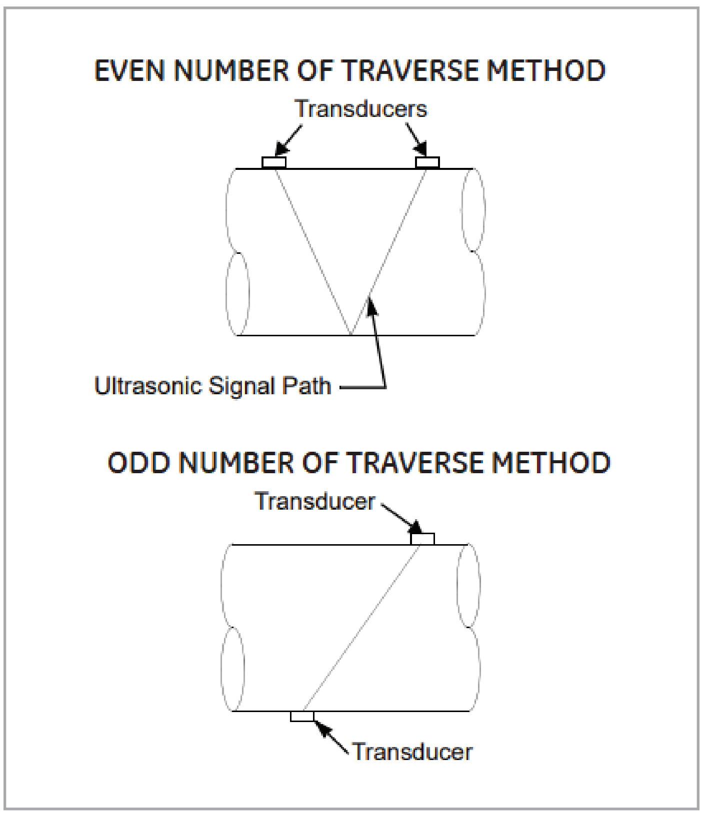


Figure 6: Even and odd number of Traverse installation

2.6 Precautions

Prior to installation the clamping fixture, it is HIGHLY recommended to keep the following in mind:

1. Position the clamp-on fixture(s) and transducer system so that there are at least 10 pipe diameters of straight, undisturbed flow upstream and 5 pipe diameters of straight, undisturbed flow downstream from the measurement point (see Figure 7 below). Undisturbed flow means avoiding sources of turbulence in the fluid such as valves, expansion joints, elbows and other protruded mechanical components. For location after a set of out of plane double elbows, longer upstream length is highly recommended.
2. If the clamping fixture is to be placed downstream of an elbow, the orientation of the clamping fixture must be placed in such a way that the transducer path is perpendicular to the plane of the piping to compensate for swirl.
3. For permanent installations, the clamping fixture should be oriented in a way where the transducer paths are out of the vertical plane. Pipe fouling can produce erroneous meter readings. If this placement contradicts with the placement listed in the previous note, then the fixture can be oriented in the 11-5 o'clock or 1-7 o'clock positions. NEVER orient the transducers in the 12 o'clock or 6 o'clock positions.
4. Once the location has been scoped out, make sure there is enough clearance around the area to install the clamping fixture and transducers.

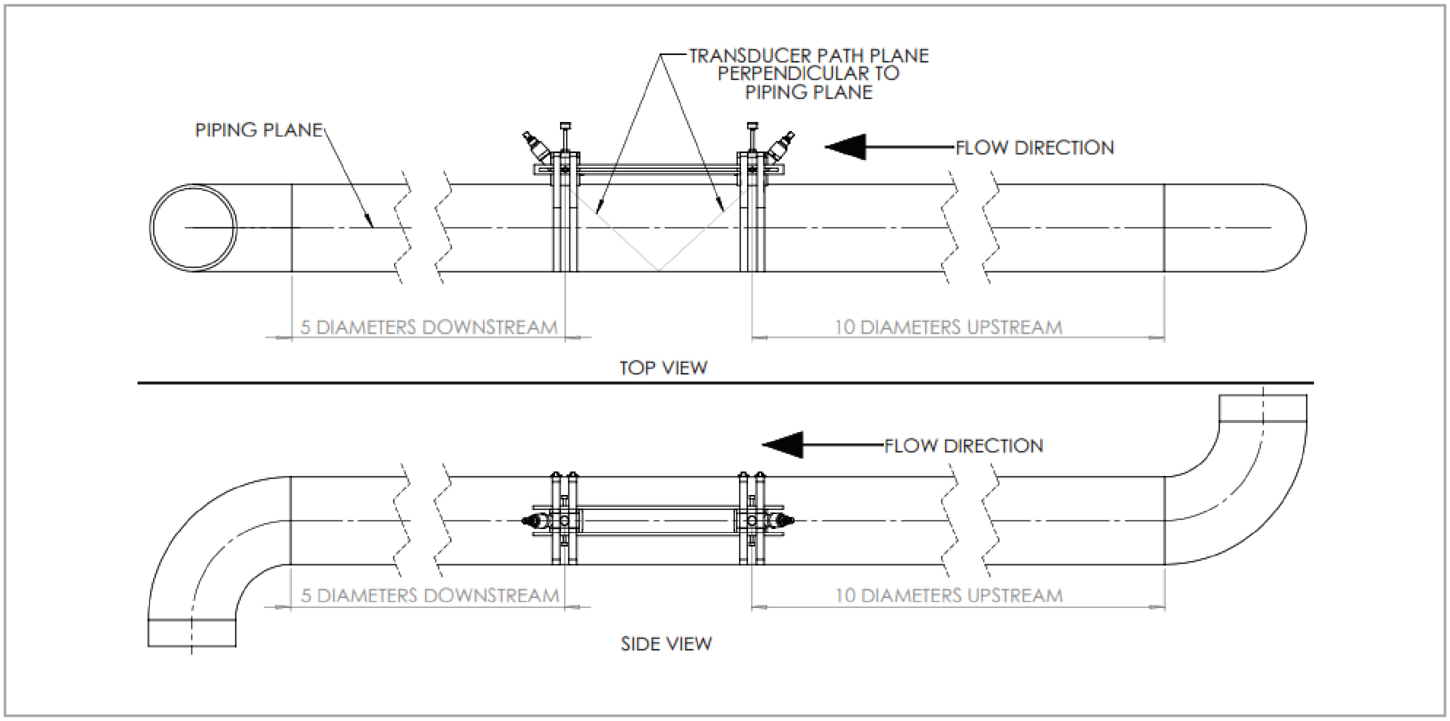


Figure 7: Recommended installation location and orientation

2.6.1 Even number of Traverse method

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 installations with more than two traverses, contact Panametrics for assistance.

The installation procedure for transducers using the even number of-traverse method is as follows:

1. Ensure the location of your clamping fixture has been properly scoped out following the criteria in Section 2.6: Precautions.
2. 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 remove any high spots. However, be careful to preserve the original curvature of the pipe.
3. Secure one of the blocks to the alignment bar by tightening one of the nuts on the block so the block will not be able to slide along the alignment bar's slot.
4. Obtain the transducer spacing dimension (S) after programming the XMT1000 transmitter. Using the alignment bar as a guide, move the second block so that the distance between the blocks equals the S dimension. Use the pressure bolts or the edges of the blocks as reference points, as shown below.

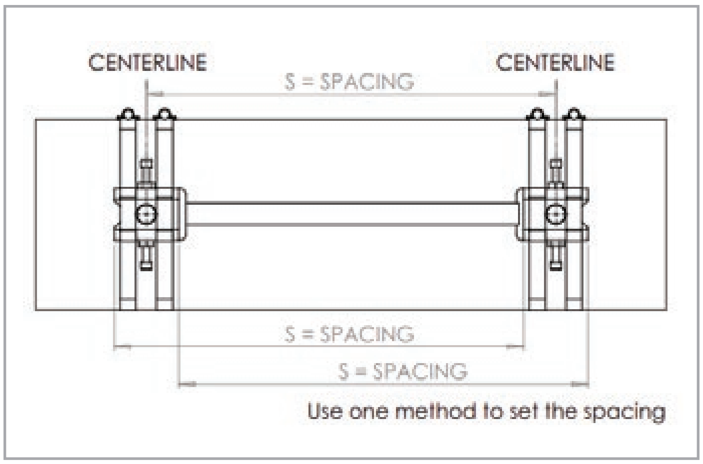


Figure 8: SCF setup, spacing

5. Position the clamping fixture on top of the pipe and wrap the clamping fixture blocks with the hose clamps. Tighten the clamps until the blocks are snug but ensure that they can still be rotated around the pipe.
6. Rotate the blocks so that they are away from the vertical plane and in an orientation that satisfies the criteria listed in Section 2.6: Precautions.
7. Fully tighten the hose clamps so no movement on the fixture will occur.

Figure 9 below shows a completed even-traverse installation without the transducers. Proceed to the section on mounting the transducers later in this chapter.

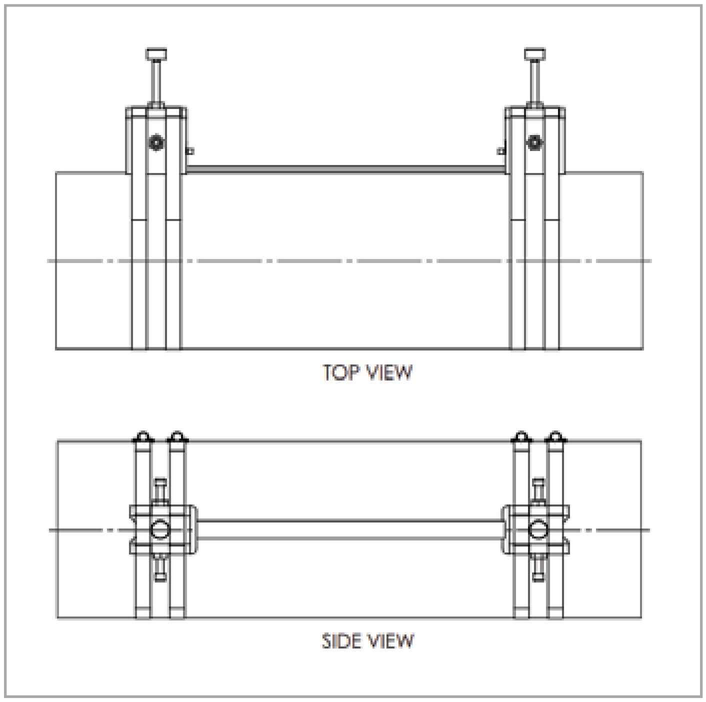


Figure 9: Finished SCF installation without Transducers

2.6.2 Odd number of Traverse method

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. For installations with more than one traverse, contact Panametrics for assistance.

The procedure for mounting the SCF for the odd number of-traverse method includes marking the pipe for the required transducer spacing, fastening the fixture to the pipe, and then mounting the transducers into the fixture.

To install the SCF odd traverse, complete the following steps:

1. Ensure the location of your clamping fixture has been properly scoped out following the criteria in Section 2.6: Precautions.

Note: For simplicity, all figures will show the clamping fixture oriented on the horizontal plane (3 o'clock and 9 o'clock positions). Exact orientation will depend on the piping upstream and downstream of the fixture determined in Section 2.6: Precautions.

2. Prepare the pipe where you intend to place the SCF by making sure it is clean and free of loose material. Sanding, though usually not required, may be necessary to remove any high spots. However, be careful to preserve the original curvature of the pipe.

3. Use a level to find the top of the pipe and then draw a line parallel to the centerline of the pipe.

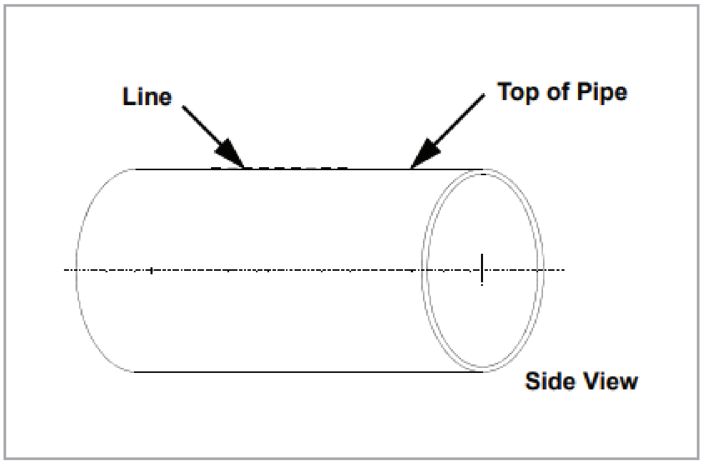


Figure 10: SCF odd number of Traverse installation, step 3

4. Using a level and center punch, make two marks on the line drawn in step 3. These marks must be separated by the transducer spacing distance S, as calculated by the flowmeter.

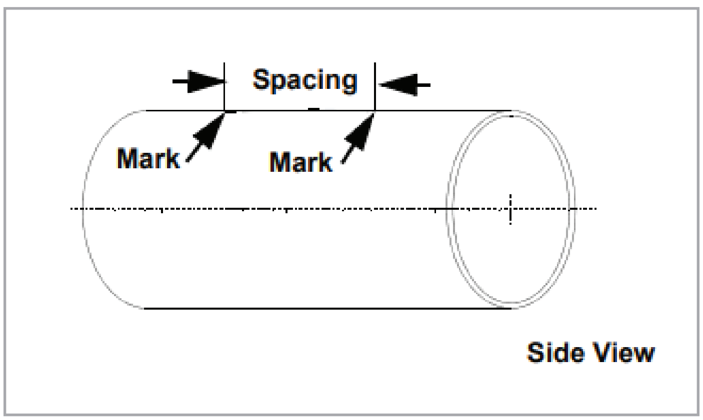


Figure 11: SCF odd number of Traverse installation, step 4

5. From one of the marks on the top of the pipe, measure around the pipe a distance equal to 1/4 of the pipe circumference, or a distance that will satisfy the orientation found in Step 1. Use the center punch to make a mark at this point.

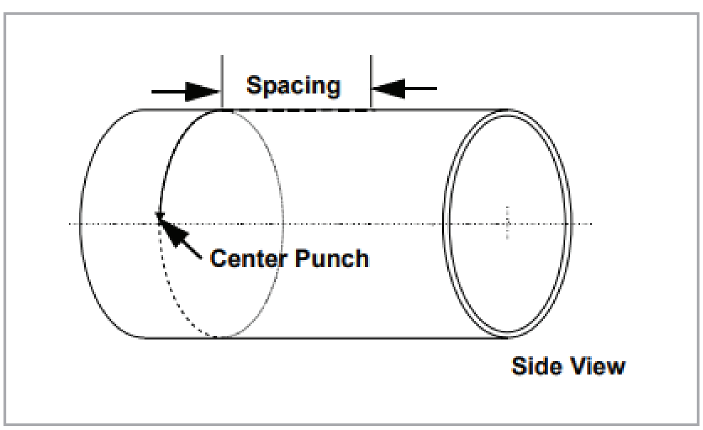


Figure 12: SCF odd number of Traverse installation, step 5

6. From the other mark on the top of the pipe, measure around the pipe in the opposite direction a distance equal to 1/4 of the pipe circumference, or the same distance used in Step 5. Use the center punch to make a mark at this point.

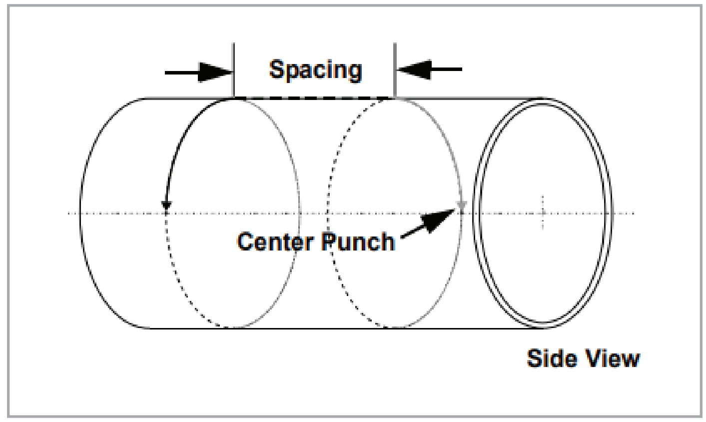


Figure 13: SCF odd number of Traverse installation, step 6

7. Center one of the blocks over one of the center punch marks on the side of the pipe. Align the block so that the pressure bolt is directly over the punch mark. Secure the block by wrapping the two steel straps around both the block and the pipe and tightening the straps.

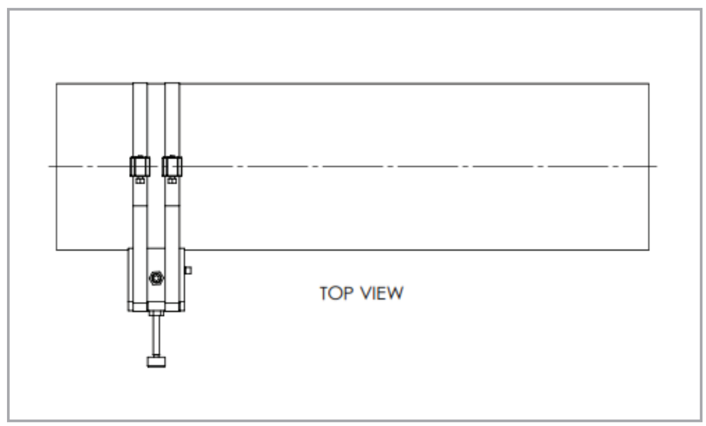


Figure 14: SCF odd number of Traverse installation, step 7

8. Repeat Step 7 to install the other block on the pipe.

IMPORTANT:

Make sure both straps are perpendicular to the bottom of the block. If the straps are slanted, the slack will cause the block to move. Also, the transducer spacing dimension may change after the transducers are mounted.

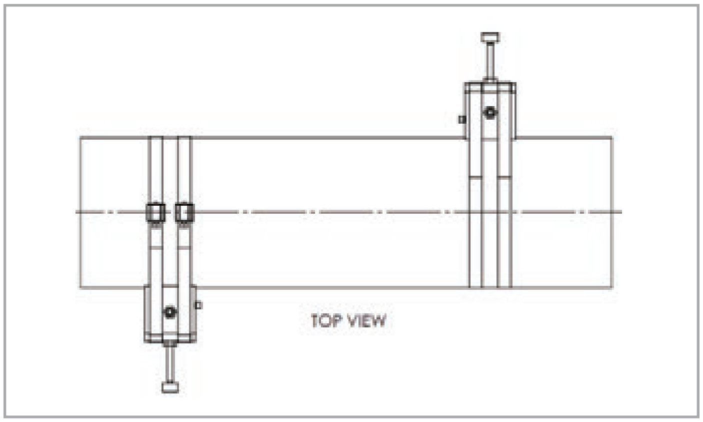


Figure 15: SCF odd number of Traverse installation, step 8

Figure 16 below shows an odd traverse installation without the transducers. Proceed to the section on mounting the transducers later in this chapter.

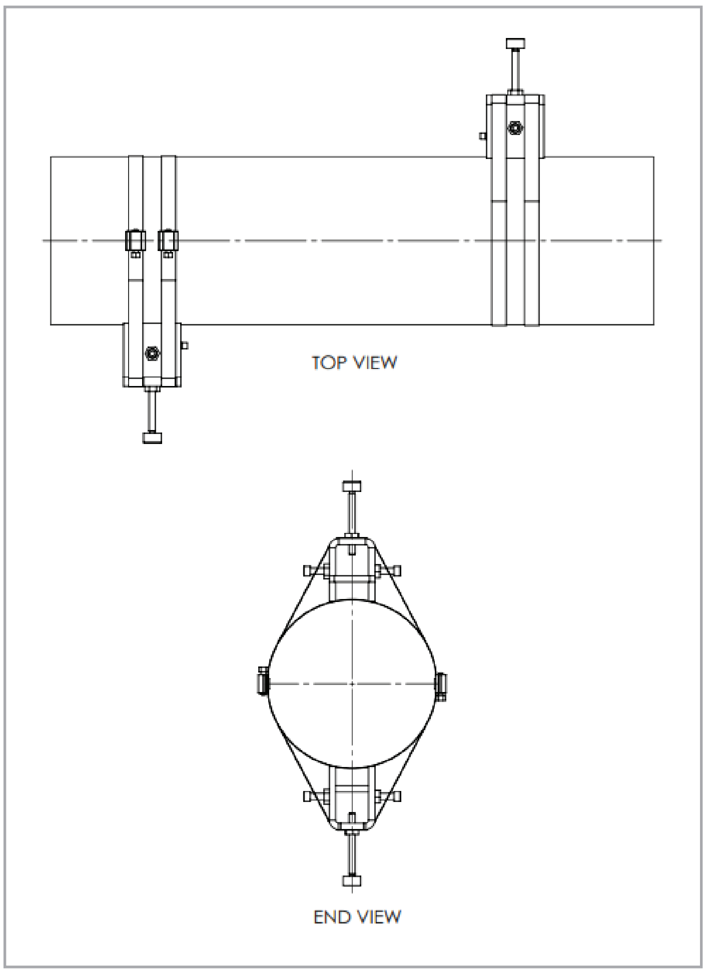


Figure 16: odd number of Traverse SCF installation without Transducer

2.7 Transducer installation

For any of the fixtures above except for the SPCF, the last step in the installation is mounting the transducers into the clamping fixture. Although not all transducer models are installed the same way, the following information provides some general guidelines to help you. The face of the transducer must be in contact with the pipe because this is where the ultrasonic signal is emitted. All Panametrics transducers include a dimple, depression as it is illustrated in Figure 22, drill point or slot on the opposite side of the transducer wedge face, for use as a guide in aligning and securing the transducer. In addition, some transducers have scribe marks on the side to assist in setting the transducer spacing. Figure 17 below shows an example of the dimple and scribe marks on the transducers.

Figure 17: Transducer samples

To mount the transducers into a clamping fixture, complete the following steps:

1. To ensure that the minimum bend radius of the cable is met, the cable adapter is added in series with the transducer cable assembly and the transducer. Connect the transducer cables to the BNC connectors on the transducers, ensuring that the labels on the cables match with the transducers. For example, the cable labeled 'downstream' must be connected to the downstream transducer.

Figure 18: Transducer cable connection with cable jumper, PN133M7313-03

Figure 19: Transducer mounting, step 1

2. Apply a thin bead of couplant to one of the transducers. A bead approximately the size of a toothpaste bead should be placed down the center of the transducer face.

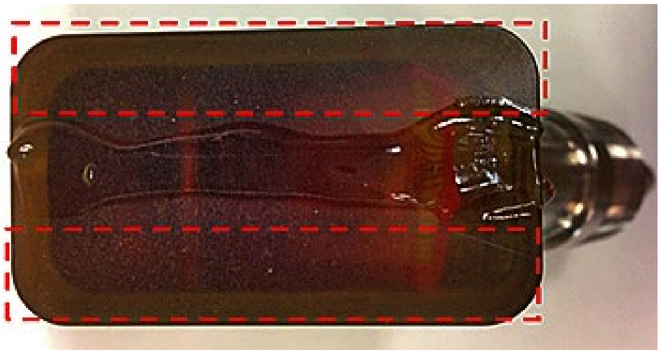


Figure 20: Transducer mounting, step 2

Panametrics supplies an ultrasonic couplant for your clamp-on installation. The purpose of the couplant is to provide reliable transmission of ultrasound between two adjacent solid surfaces. Couplants perform this task by excluding air from the space between the adjacent surfaces. Accordingly, the clamp-on transducers should be pressed tightly against the pipe, using hand pressure on the set screw to squeeze the couplant to as thin a film as practical for the given pipe surface.

Panametrics provides couplants for both permanent and temporary use as well as for high-temperature and low-temperature applications. For long-term installations, make sure the couplant does not dry out or extrude. Standard couplants supplied from Panametrics for the *PanaFlow™ LC* are listed in Table 1 below.

Table 1: Standard Panametrics Couplants

Part No.	Type	Temp. Range	Use
CPL-1	Standard	-40 to +240°C	Semi-Permanent
CPL-8	Solid Sheet	-40 to +260°C	Permanent

3. Determine the upstream and downstream ends of the pipe and place the appropriate transducer into the corresponding block on one of the sub-assemblies. Make sure the transducer cable connector faces away from the center of the installation.

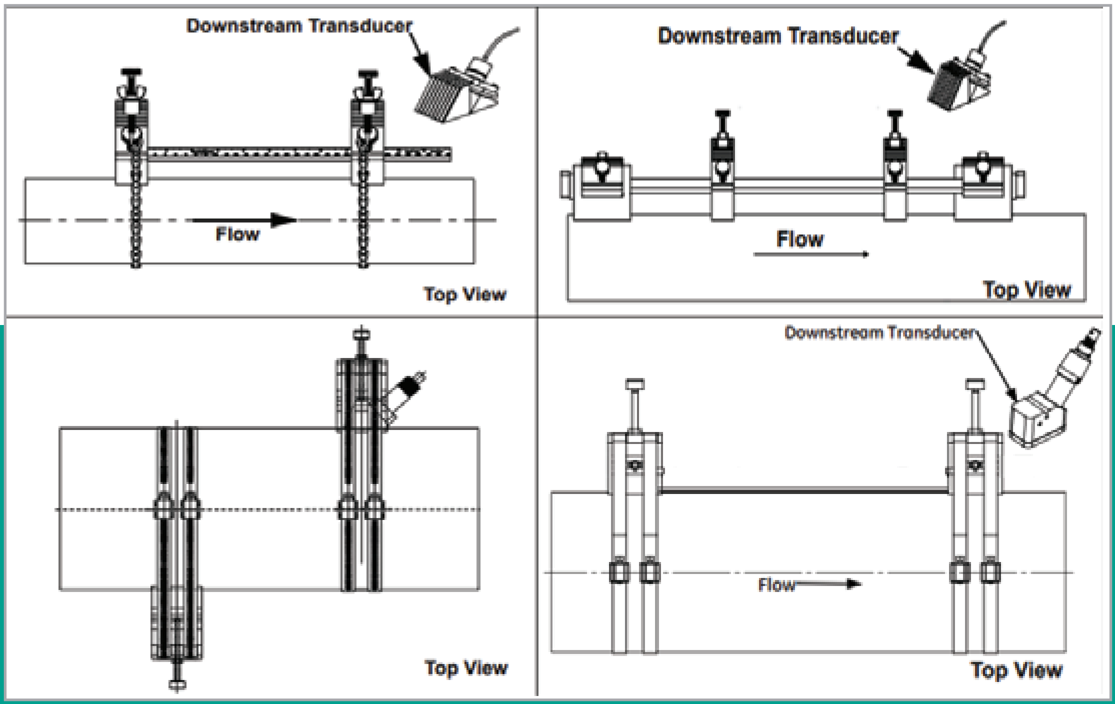


Figure 21: Transducer mounting on UCF (top left), MCF (top right), GCF (bottom left), and SCF (bottom right)

4. Use the pressure bolt to secure the transducer in place. The pressure bolt should fit into the dimple on the transducer. Hand tighten the bolt just enough to hold the transducer in place, but do not overtighten it or the fixture will lift off the pipe.
5. Repeat Steps 1-4 to mount the other transducer in the fixed short block. See Figure 22 below for completed typical clamping fixture installations.
6. Connect the other end of the transducer cables to the junction box in Section 4: Transducer Wiring of this manual.

Note: If the transducers are mounted into the clamping fixtures properly, the two transducer cable connectors will face away from each other as shown above.

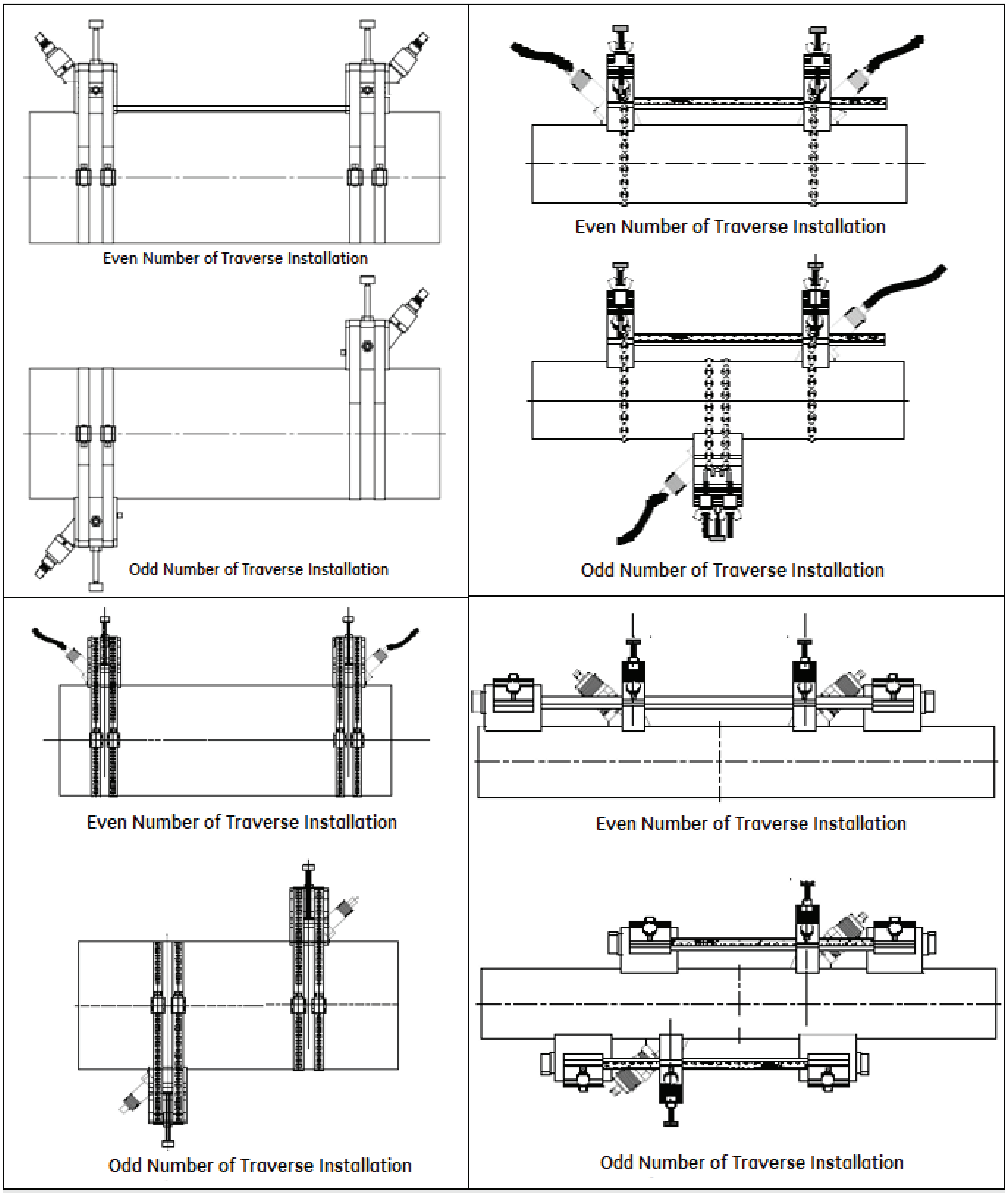


Figure 22: SCF clamping fixture (top left), UCF clamping fixture (top right), GCF clamping fixture (bottom left), MCF clamping fixture (bottom right)

2.8 Installing the V series clamping fixture and transducers

To install the V Series clamping fixture and transducers, complete the following steps:

2.8.1 Installing the fixture

1. Position the half of the clamping fixture with the threaded rods around the pipe, as shown in Figure 23 below. Orient the fixture in the 3 o'clock position on a horizontal pipe.
2. Position the mating half of the fixture over the threaded rods in the 9 o'clock position. Figure 23 below shows the two mounted halves.

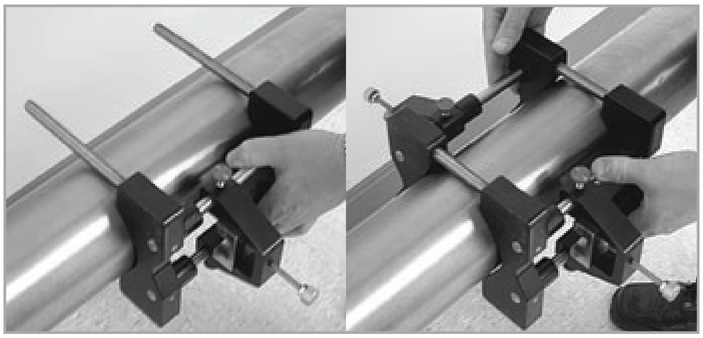


Figure 23: Mounting the two halves of the fixture

The two fixture halves have measuring scales; ensure that the scales are on the same side of the fixture, so that both zeros start at the same origin, as shown in Figure 24 below.

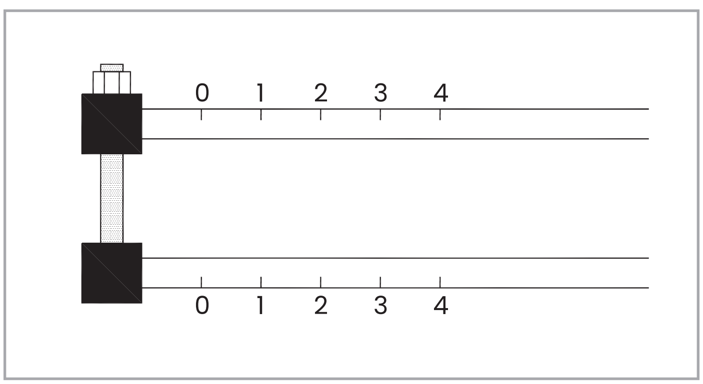


Figure 24: Fixture with scale origins properly aligned

3. Install the four nuts onto the threaded rods with the convex side of the nut facing the fixture. Hand tighten the nuts on each V block evenly, as shown in Figure 25 on the next page. Do not use a cross tightening pattern on the four installation nuts.

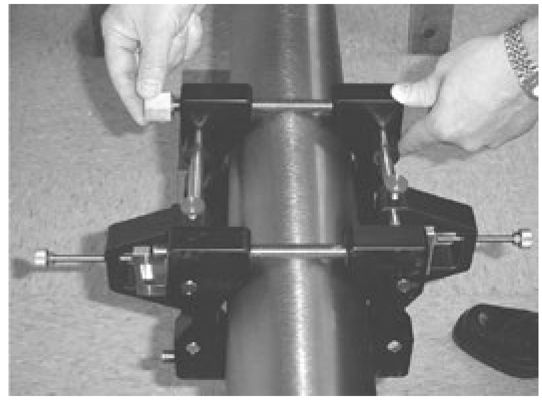


Figure 25: Installing nuts onto the fixture

2.8.2 Installing the Transducers

1. Apply a bead of coupling 6 mm (0.25 in.) wide along the entire length of each transducer face, as shown in Figure 26 below.

Figure 26: Couplant on transducer face

Note: Do not slide the transducer with couplant along the surface of the pipe when mounting the transducer.

2. Set the first mounting block (either left edge or right edge) at a convenient number on the scale, such as 2 in. or 5 cm. Install the first transducer with the BNC connector pointing away from the center of the V block fixture. Tighten the transducer mounting thumbscrew onto the slider, which in turn applies pressure to the transducer. Use a handtight grip to set the transducer in contact with the pipe, as shown in Figure 27 below. Use a wrench to tighten the backing nut to prevent loosening due to vibration and thermal expansion.

IMPORTANT:

Do not use a wrench or pliers on the thumbscrew.

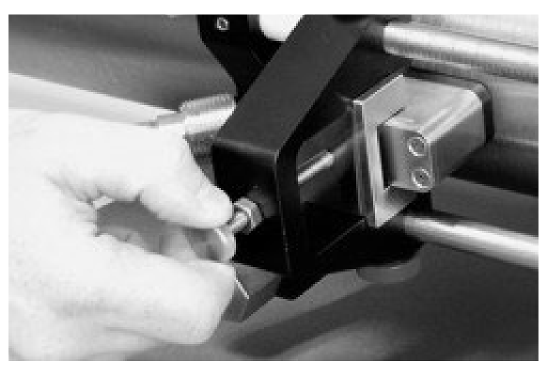


Figure 27: Installing the first transducer

3. Slide the second mounting block to the calculated spacing plus the initial scale number selected for the first mounting block. For example:
   a. Initial convenient number for the first mounting block = 5 cm or 2 in.
   b. Spacing as calculated by the GC868 = 0.5 in. or 12.5 mm
   c. Second mounting block final location = 2 + 0.5 in. = 3.5 in. or 5 cm + 1.25 cm = 6.25 cm

The overall spacing between yokes should be left edge to left edge, or right edge to right edge. Figure 28 below shows typical positioning.

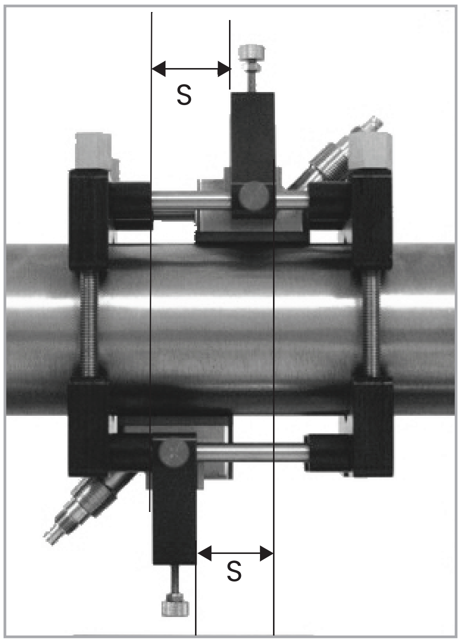


Figure 28: V4 fixture, top view

4. In a similar manner, install the second transducer as shown in Figure 28 above.

2.9 Installing the PI fixture and transducers

The PI clamping fixture holds transducers on pipes from 12 to 24 in. in diameter. It comes with either a chain or strap, depending on the selection made with the initial order from Panametrics. To install the fixture and transducers, complete the following steps:

2.9.1 Surveying the pipe

1. Measure the pipe circumference to an accuracy of ±2 mm (±1/16 in.)

IMPORTANT:

Do not use a calculated value or a nominal value for the circumference.

2. Tightly wrap the layout wrap once around the entire pipe and line up the edges. Using the wrap as a template guide for marks, mark scribe lines around the entire diameter of the pipe, as shown in Figure 29 below.

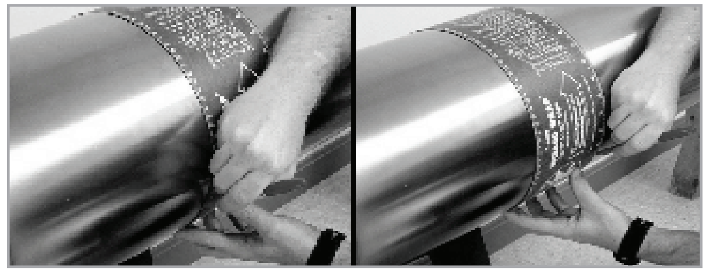


Figure 29: Marking circumferential lines on the pipe

3. Line up the zero scale of the layout tape at the desired location of the first transducer. (For a typical installation, this point will be the 3 o'clock position on a horizontal pipe.) Mark each of the two circumferential lines at the zero point. Connect each of these marks using a straight edge (for example, the edge of the layout tape) as shown in Figure 30 below.

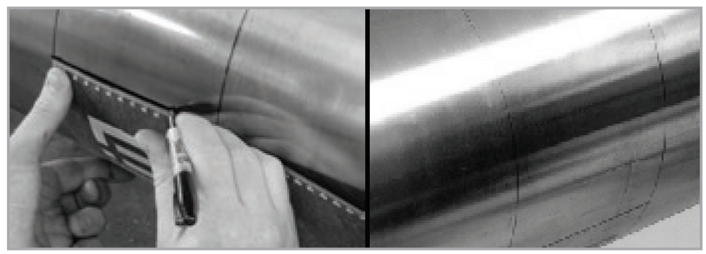


Figure 30: Marking the 3 o'clock position

4. To find the coinciding point on the opposite side of the pipe (180° away from each other), divide the measured circumference by 2 and measure this distance along the circumferential lines from the zero point, as shown in Figure 31 below. Place marks on both sides of the circumferential lines made with the layout wrap and connect the marks.

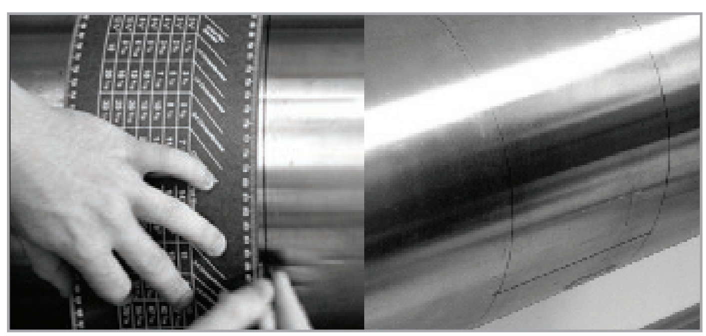


Figure 31: Marking the 9 o'clock position

Make sure to take the 180° point measurement from both over the top of the pipe and under the bottom of the pipe (on a horizontal pipe) to ensure reciprocity of the installation. Figure 32 below shows the appropriate way to measure the 180° point.

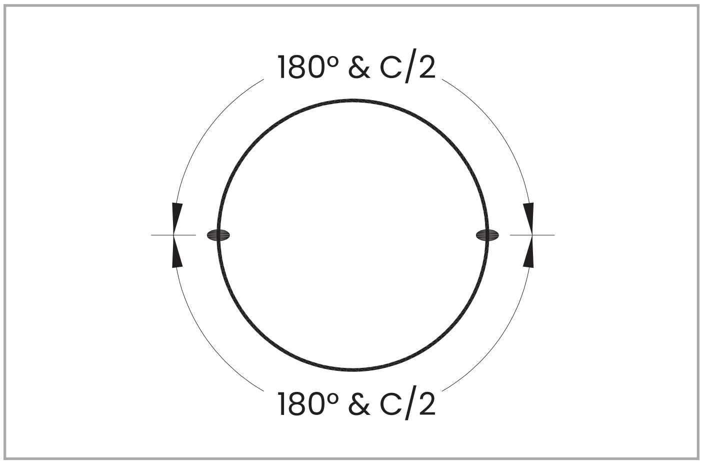


Figure 32: Measuring the 180° point from top and bottom

2.9.2 Installing the first bracket with a chain

The following steps describe how to install the PI fixture with a supplied chain or strap.

1. Carefully wrap the chain or strap around the pipe, taking care not to twist it.
2. Loosen the wing nuts up to the end of the J-hooks. Then hook the chain into the tightest links and loosely hand tighten the wing nuts. If you are using a strap, insert the J-hook into the smaller round hole on the strap.
3. Line up one edge of the CFG-PI holder bracket with the origin scribe line and fully tighten the chain or strap (see Figure 33 and Figure 34 below).

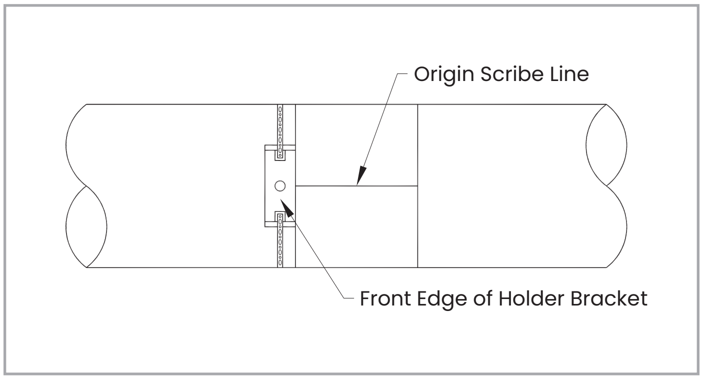


Figure 33: Lining up the first bracket

4. Install the transducer dummy block to verify the circumferential and axial location. Center the indicator line on the block to line up with the scribed mark (see Figure 34 below).

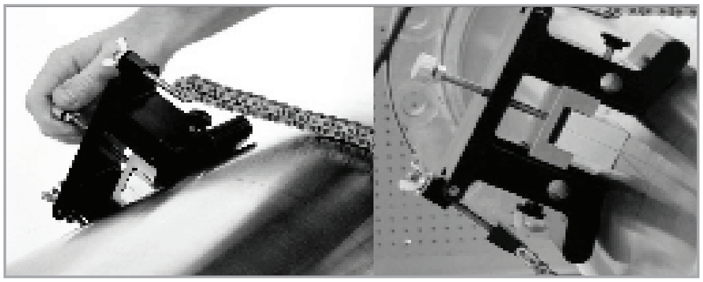


Figure 34: Positioning the CFG-PI holder bracket

5. Loosen the transducer hold-down screw and tighten the J-hooks on the clamping fixture. Be sure the bracket has not moved from its position.

2.9.3 Installing the second bracket with a chain

1. Measure the spacing from the zero point (the point of circumferential origin). Mark the spacing point with a crosshair on the opposite side of the pipe, 180° from the zero point (as shown in Figure 35 below).

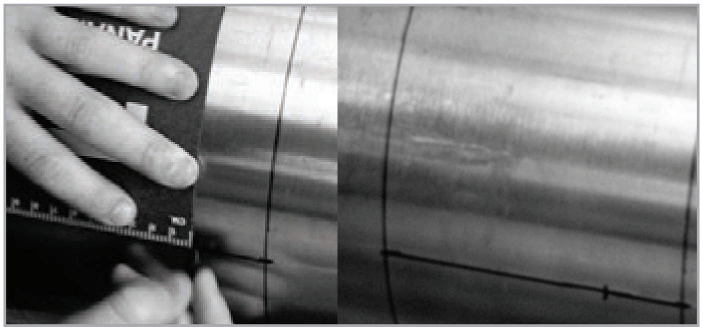


Figure 35: Measuring and marking spacing

2. Carefully wrap the chain or strap around the pipe, taking care not to twist it.
3. Loosen the wing nuts up to the end of the J-hooks. Then hook the chain into the tightest links and firmly hand tighten the wing nuts.
4. Line up the other edge of the CFG-PI holder bracket with the scribe line and tighten the chain or strap, as shown in Figure 36 below.

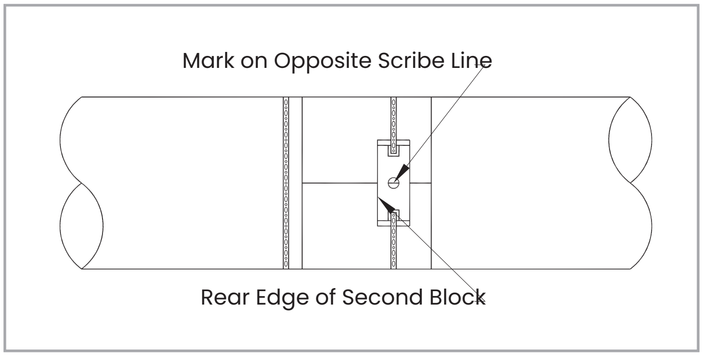


Figure 36: Line up rear edge of bracket with 180° scribe line

The spacing should now appear similar to that in Figure 37 below.

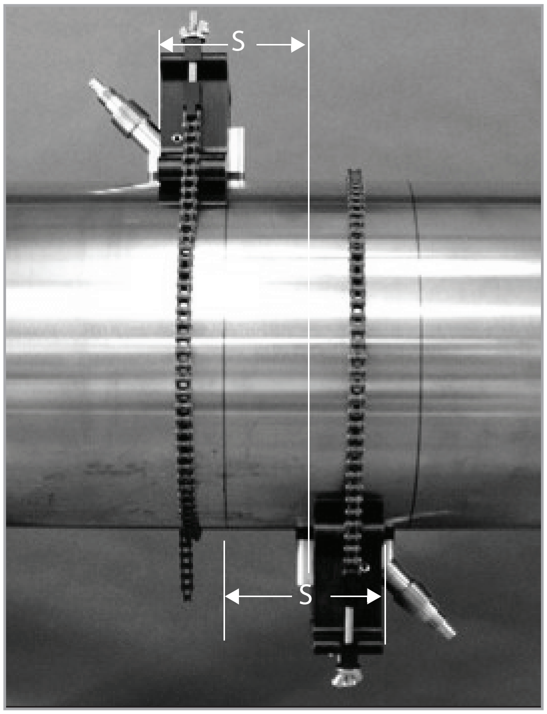


Figure 37: CFG-PI fixture with calculated spacing

2.9.4 Installing the transducers

1. Check to be sure the second CFG-PI holder bracket is correctly positioned.
2. Apply a bead of CPL-16 couplant 6 mm (0.25 in.) wide on each transducer face (see Figure 38 below).

Figure 38: Couplant on transducer face

Note: Do not slide the transducer with couplant along the surface of the pipe when mounting the transducer.

3. With one hand, mount one transducer into the PI fixture. With the other hand, tighten the thumbscrew, gradually pushing the transducer down to the pipe surface. Use a wrench to tighten the backing nut to prevent loosening due to vibration and thermal expansion.

IMPORTANT:

Do not use pliers or a wrench on the thumbscrew.

4. Repeat step 3 for the other transducer.

2.10 Making electrical connections

The PanaFlow LC utilizes the XMT1000 Transmitter module. For information regarding electrical connections required for setup of the XMT1000 Transmitter, please refer to the included PanaFlow LC User's Manual.

WARNING!

Make sure all covers, with their O-ring seals, are installed and the set screws tightened before applying power in a hazardous environment.

Attention European customers!

To meet CE Mark requirements, all cables must be installed as described in Appendix D, CE Mark Compliance.

2.11 Transducer wiring

The PanaFlow™ LC is a 1, 2 or 3 channel clamp-on ultrasonic flowmeter. For three channel applications there will be an additional Aluminum or Stainless-Steel junction box for transducer connections. The transducer wiring installation for either of these junction boxes will be the same. The Figure 39 below shows both boxes:

WARNING!

Make sure that there is no power in the XMT1000 meter and it is not plugged. Failure to do so may result in electrical shock that can cause injury, or death.

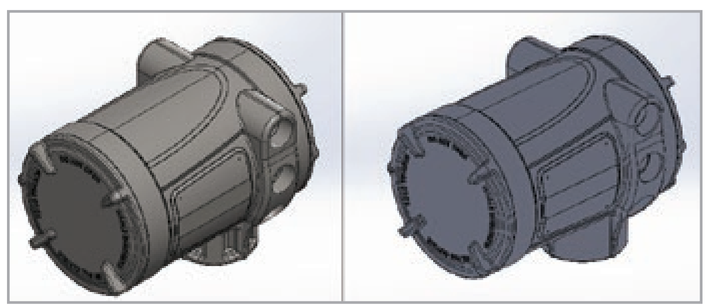


Figure 39: LEFT: stainless steel junction box, RIGHT: aluminum junction box

2.11.1 Installing the Junction Box

Mount the aluminum (5lbs) or stainless steel (15lbs) junction box using the included mounting plate to a wall (hardware supplied by end user) or a 2 inch pipe (hardware supplied with J-box). See Figure 40 for reference.

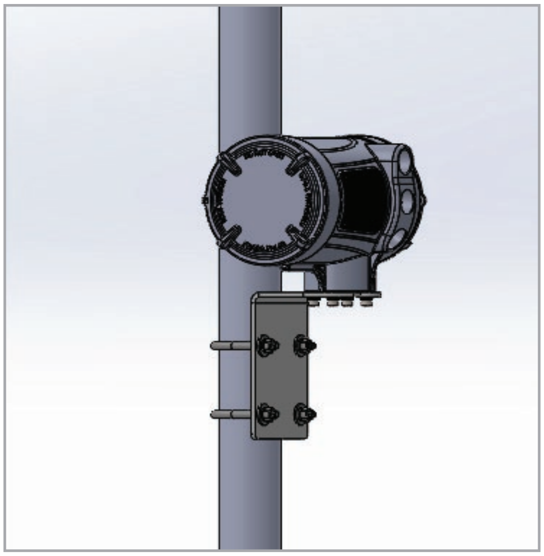


Figure 40: Aluminum J-box mount to 2” pipe using supplied hardware kit (stainless steel install will be identical)

2.11.2 Single channel set up

Components of a single channel PanaFlow LC will be a meter head, two transducer cables and a set of transducers and clamping fixtures. Mount meter head to a two inch post using included hardware or another location following local electrical and building codes.

Install transducers as mentioned in Sections 2.7 through Section 2.9. Prepare to wire transducer cables.

Note: US/ Canada installations will be required to provide conduit per their particular location. European installations will include armored cable.

2.11.2.1 Transducer wiring (ATEX installations)

1. Thread one end of armored cable into the meter head and the other into the junction box on the back of the transducer (see Figure 1 on page 1 for reference).
2. Terminate connections of the transducer end of each cable to each of your clamp on transducers.
3. At the meter end of the cable secure the red wire of channel one downstream RG62 cable to the CH1 (red box in Figure 41) DN terminal of the XMT1000 backplane.
4. Secure Black wire of channel one downstream RG62 cable to the CH1 (red box in Figure 41) RTN terminal directly below the DN terminal of the XMT1000 backplane.
5. Secure red wire of channel one upstream RG62 cable to the CH1 (red box in Figure 41) UP terminal of the XMT1000 backplane.
6. Secure Black wire of channel one upstream RG62 cable to the CH1 (red box in Figure 41) RTN terminal directly above the UP terminal of the XMT1000 backplane.

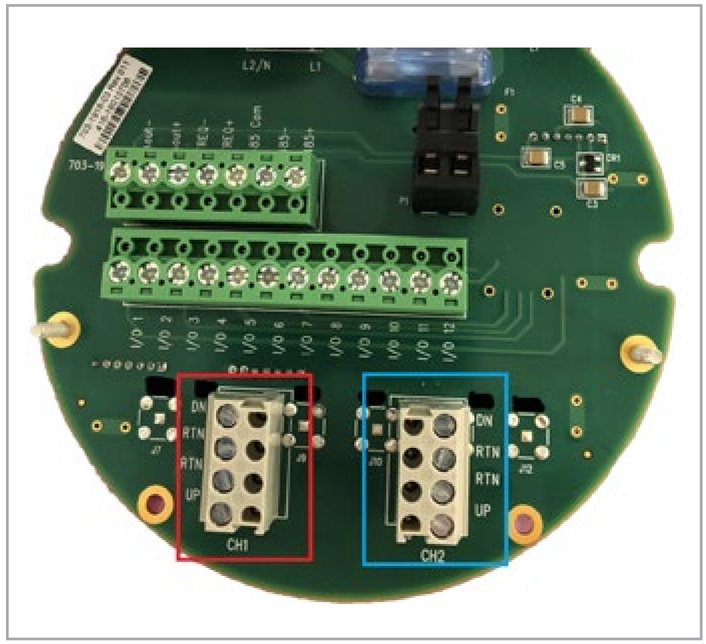


Figure 41: XMT1000, channel back plane

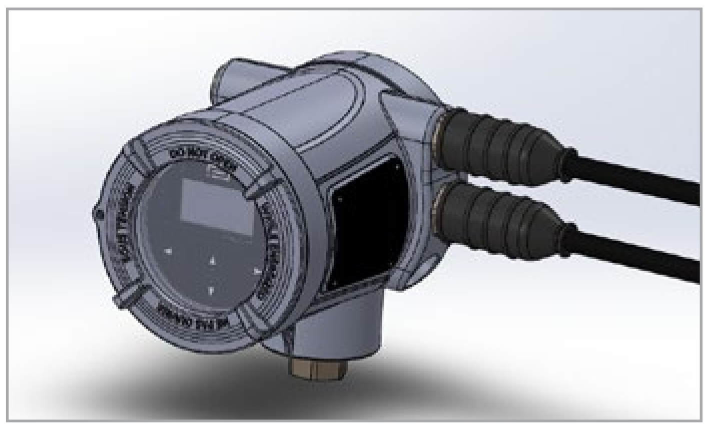


Figure 42: PanaFlow LC single channel set

2.11.3 Two channel set up

Components of a two channel PanaFlow LC will be a meter head, 4 transducer cables and two sets of transducers, 2 channel junction box and clamping fixtures. Mount meter head to a two inch post using included hardware or another location following local electrical and building codes.

Install transducers as mentioned in Section 2.7 through Section 2.9. Prepare to wire transducer cables.

Note: US/ Canada installations will be required to provide conduit per their particular location. European installations will include armored cable.

2.11.3.1 Transducer wiring (ATEX installations)

1. Thread ends of armored cable into the meter head and the other into the junction box on the back of the transducer (see Figure 1 on page 1 for reference).
2. Terminate connections of the transducer end of each cable to each of your clamp on transducers.
3. At the meter end of the cable secure the red wire of channel one downstream RG62 cable to the CH1 (red box in Figure 41) DN terminal of the XMT1000 backplane.
4. Secure Black wire of channel one downstream RG62 cable to the CH1 (red box in Figure 41) RTN terminal directly below the DN terminal of the XMT1000 backplane.
5. Secure red wire of channel one upstream RG62 cable to the CH1 (red box in Figure 41) UP terminal of the XMT1000 backplane.
6. Secure Black wire of channel one upstream RG62 cable to the CH1 (red box in Figure 41) RTN terminal directly above the UP terminal of the XMT1000 backplane.
7. At the meter end of the cable secure the red wire of channel two downstream RG62 cable to the CH2 (blue box in Figure 41) DN terminal of the XMT1000 backplane.
8. Secure Black wire of channel two downstream RG62 cable to the CH2 (blue box in Figure 41) RTN terminal directly below the DN terminal of the XMT1000 backplane.
9. Secure red wire of channel two upstream RG62 cable to the CH2 (blue box in Figure 41) UP terminal of the XMT1000 backplane.
10. Secure Black wire of channel two upstream RG62 cable to the CH2 (blue box in Figure 41) RTN terminal directly above the UP terminal of the XMT1000 backplane.

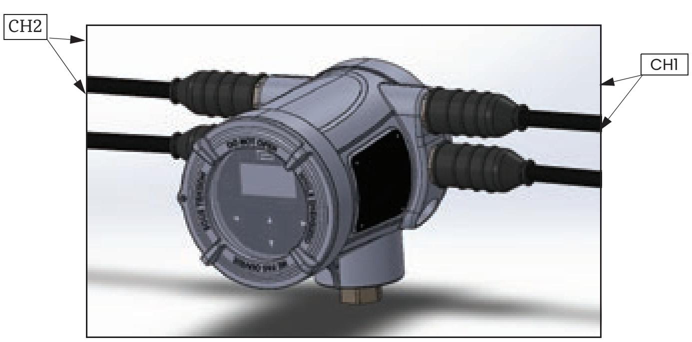


Figure 43: PanaFlow LC2 channel set up

2.11.4 Three channel set up

Components of a three channel PanaFlow LC will be: a meter head, 6 conductor "trunk" cable, 3 channel junction box, 6 transducer cables and 3 sets of transducers and clamping fixtures. Mount meter head and junction box to a two inch post using included hardware or another location following local electrical and building codes.

Install transducers as mentioned in Section 2.7 through Section 2.9. Prepare to wire transducer cables.

Note: US/ Canada installations will be required to provide conduit per their particular location. European installations will include armored cable.

2.11.4.1 Transducer wiring (ATEX installations)

1. Thread MCX end of 6 conductor cable trunk into XMT1000 meter head and the BNC connector end of the cable into the 3 channel Junction box as seen in Figure 44.

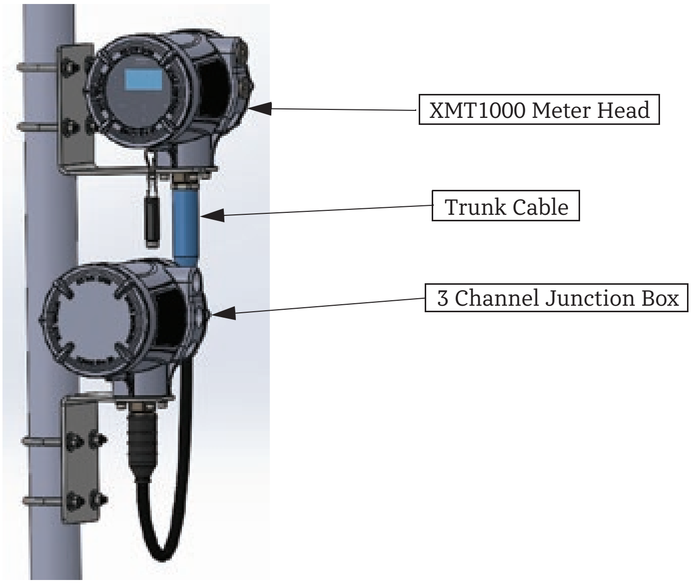


Figure 44: XMT1000 Trunk cable placement

2. Thread one end of transducer cables into 3 channel junction box as shown in Figure 45. (Cable locations in Figure 45 are for reference only. Transducer cables can be placed in any orientation).

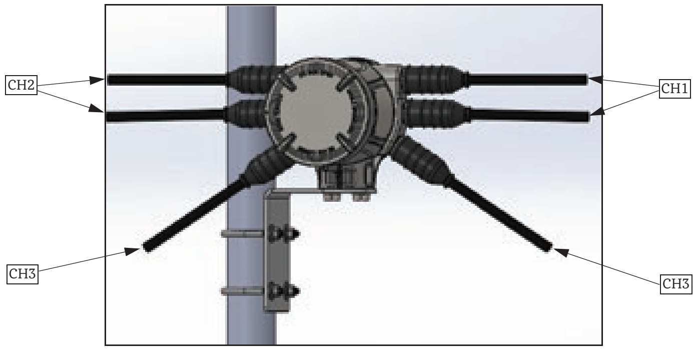


Figure 45: XMT1000, 3 channel junction box

3. Thread CH1 UP transducer cable into upstream junction box of the transducer set you will use for channel one. Repeat for CH1 DN and remaining channels.
4. Remove cover on transducer junction box and terminate BNC end of transducer cable to the BNC on the transducer for each channel. Replace junction box covers.
5. Open cover to 6 channel junction box and make connections between transducer cable BNCs and trunk cable BNCs. Verifying transducer cables have the same channel labels as the trunk cable wires. Replace junction box cover.
6. Open the back lid of the XMT1000 meter to access the wiring connections of the meter.
7. Connect the MCX ends of the 6-connector cable to the corresponding labeled MCX connector in the back of the XMT1000 meter. UP1 must connect to UP1 and so on.

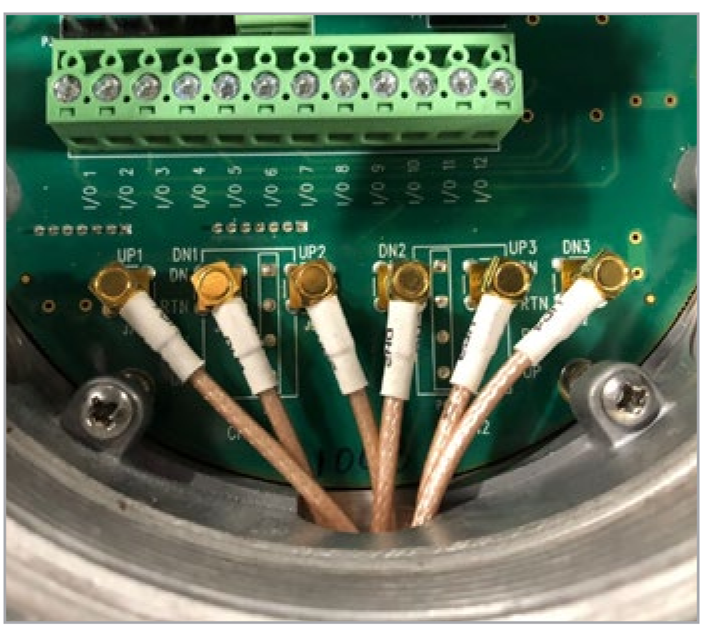


Figure 46: XMT1000 channel backplane

Chapter 3. Programming

3.1 Introduction

This chapter has instructions for programming various features of the PanaFlow™ XMT1000 flow transmitter. In this chapter, we will list all available options. The user can then change the User Preferences and Inputs/Outputs settings, Programming for flow measurements and Calibration to meet their needs.

IMPORTANT:

Not all users will have access to all of the menus. Some menus are restricted to only those users with the proper passcodes.

3.1.1 HMI features

Figure 47: XMT1000 HMI

The six keys on the magnetic keypad are used to program the XMT1000:

Key Symbol	Key Name	Functions
×	Escape Key	To cancel a numeric entry change, exit a menu or as Back key
✓	Enter Key	To accept a numeric entry or select a menu option
◁	Left Arrow Key	To navigate among menu choices, pages or set cursor position
▷	Right Arrow Key	To navigate among menu choices, pages or set cursor position
△	Up Arrow Key	To navigate among menu choices, pages or increase/ decrease numeric entries
▽	Down Arrow Key	To navigate among menu choices, pages or increase/ decrease numeric entries

3.1.2 Indicator lights

- The blue light on the top right above the display is the Power Indicator that is normally lit when the instrument is powered.
- The red light on the top left above the display is the Error Indicator. The Error Indicator light blinks if an instrument error is detected. A short error message will be displayed in the lower left-hand corner of the Measurement View. If the instrument is operating without error, red light is turned OFF.

3.2 Passcodes

IMPORTANT:

Not all users will have access to all of the menus. Some menus are restricted to only those users with the proper passcodes.

The default passcodes for the XMT1000 flow transmitter are:

- Keypad Lockout Password, default (fixed) = 102719 [this password cannot be changed]
- Operator Password, default (changeable) = 111111
- Software Upgrade Password, System Generated specific for the System Serial Number [this password cannot be changed].

IMPORTANT:

Panametrics recommends changing all default (changeable) passwords after commissioning the meter.

3.2.1 Unlock from keypad lockout

After power up, if the meter's Measurement View (Refer Figure 48) shows a lock icon 🔒 on the top right of the display, use the following steps to unlock the meter from keypad lockout mode.

- Press ESC-ENT-ESC [× ✓ ×] followed by either "Operator" password or the "Keypad Lockout" password. The lock icon 🔒 on the top right of the display will show an open lock indicating the meter keypad is unlocked.

3.3 Measurement view, log-in and primary pages

3.3.1 Measurement view

On power up, the XMT1000 meter shows the following screens:

- Panametrics Logo screen
- Meter Initialization screens
- Power-on self-tests and results
- Finally, the Measurement View (Refer Figure 48)

This screen (Refer Figure 48) will be referred to as "Measurement View" throughout this chapter. User can choose the measurement to be displayed in this view from a list of options. The Error indicator at the bottom left of the display will be blank if the meter has no error.

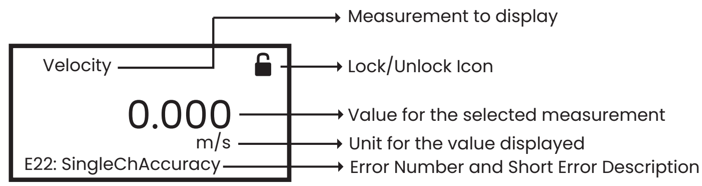


Figure 48: Measurement view

3.3.1a Changing display format

To change Display Format, do the following steps and refer Figure 49.

1. Press [▷] until the lock icon on the meter's Measurement View display is highlighted, and press [ENTER].
2. In the Main Menu select [Display Format], then press [ENTER].
3. Select [One Variable] or [Two Variable] or [Totalizer] format to suit your needs.

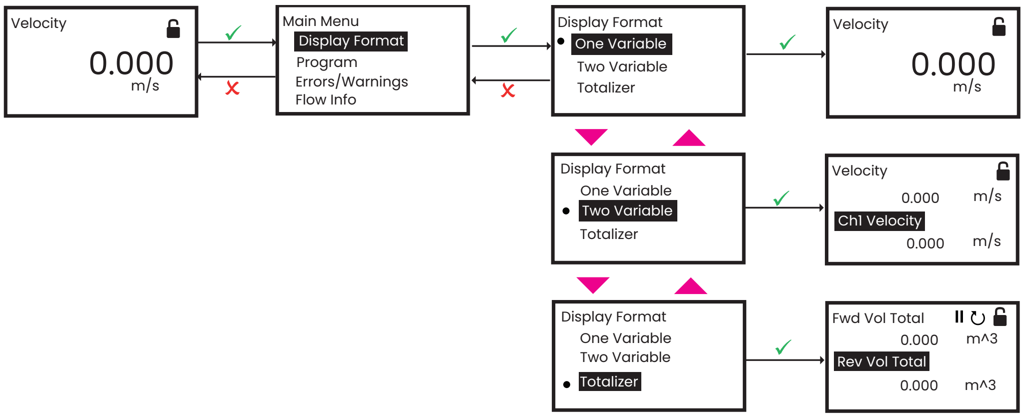


Figure 49: Changing display format

3.3.1b Selecting a composite measurement to display

To select a composite measurement to display on the Measurement View, do the following steps and refer Figure 50.

1. Press [▷] until the Measurement name on the meter's Measurement View display is highlighted, and press [ENTER].
2. In the Display Measurement select [Composite], then press [ENTER].
3. Then, select the measurement you would like to see on the Measurement View and press [ENTER].

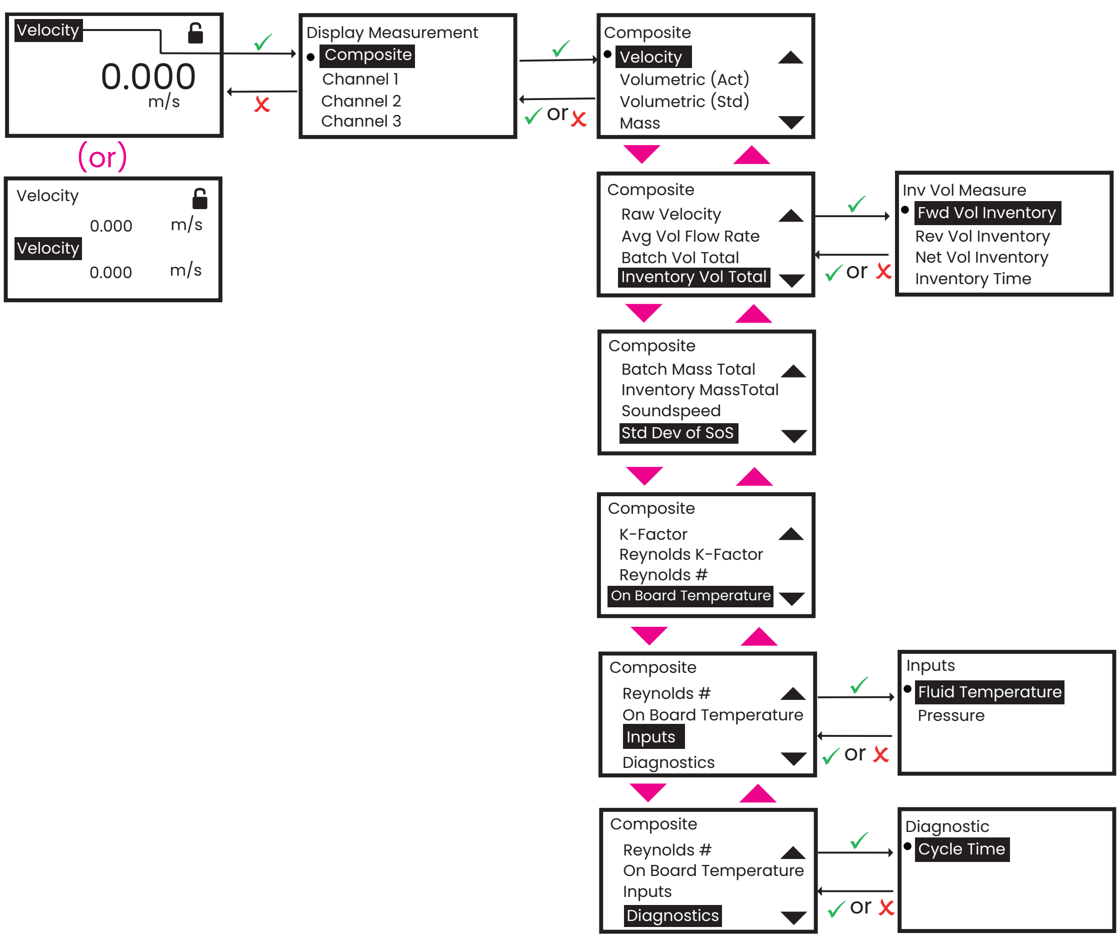


Figure 50: Selecting a composite measurement to display

3.3.1c Selecting a channel measurement to display

To select a Channel measurement to display on the Measurement View, do the following steps and refer Figure 51.

1. Press [▷] until the Measurement name on the meter's Measurement View display is highlighted, then press **[ENTER]**.
2. In the Display Measurement select **[Channel x]**, then press **[ENTER]**.
3. Then, select the measurement you would like to see on the Measurement View and press **[ENTER]**.

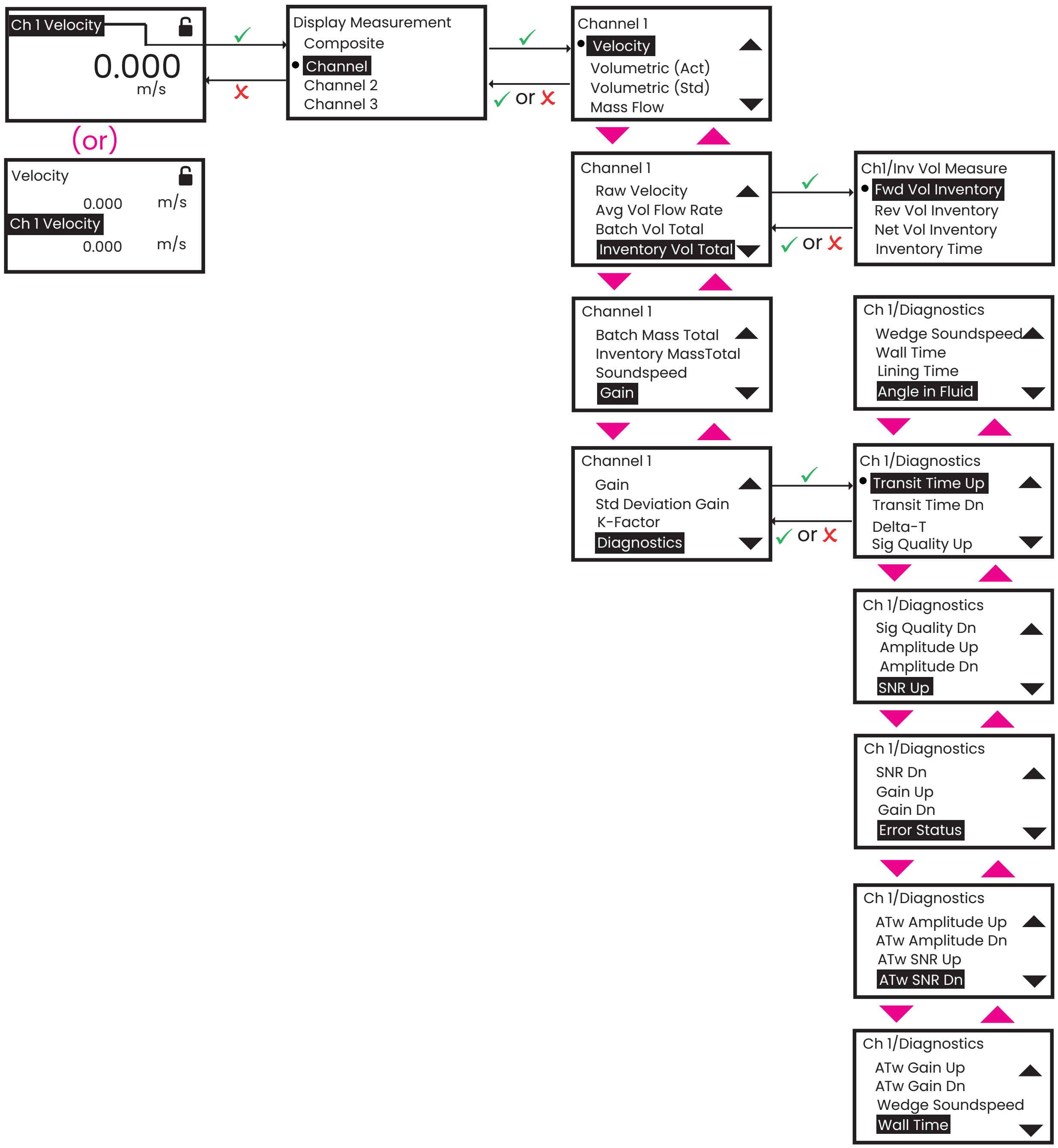


Figure 51: Selecting a channel measurement to display

3.3.1d Totalizer display

The Totalizer display on the Measurement View shows the totalized measurements and provides the ability to start, stop and reset totals. Refer to Figure 49 to set Display format to Totalizer. Do the following steps to select the appropriate Totalizer measurements to view on the Measurement View. Refer to Figure 52.

1. Press [▷] button on the keypad until the Measurement name on the meter's Measurement View display is highlighted, and press [ENTER].
2. In the Display/Totalizer, select [Composite] or [Channel x], then press [ENTER].
3. Then, select the totalizer measurement you would like to see on the Measurement View and press [ENTER].
4. Press [▷] button on the keypad until the [‖ or ▷] is highlighted to stop or start the totalizing respectively.
5. Press [▷] button on the keypad until the [↻] is highlighted to reset/clear the totalized measurements.

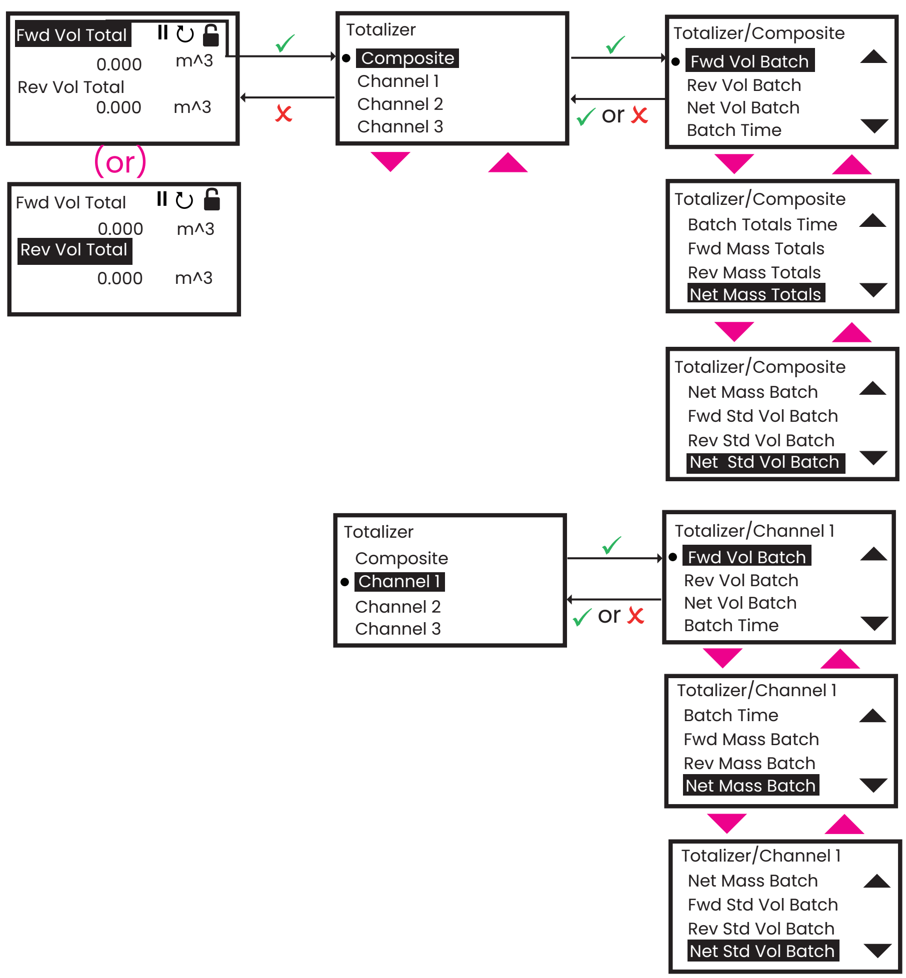


Figure 52: Selecting totalizer measurements for display

3.3.2 Log-in and primary pages

To Log-in into the meter perform the following steps:

1. Press [▷] until the lock icon on the meter's Measurement View display is highlighted, then press **[ENTER]**.
2. In the Main Menu Scroll down and select **[Program]**, then press **[ENTER]**.
3. Scroll and select desired access level **[Operator]**, then press **[ENTER]**.
4. Enter the password Operator access level, and press **[ENTER]**.
5. After completing the log-in steps you will see the primary pages as shown in the Figure 53. To move from one page to the next, press [◁] or [▷] and to scroll to options within a page press [△] and [▽].

Note: For ease of navigation up and down scroll is circular, meaning if you press [△] when the first option is highlighted, then you will be taken to the last option in the page. Similarly, when you press [▽] when the last option is highlighted, then you will be taken to the first option in the page.

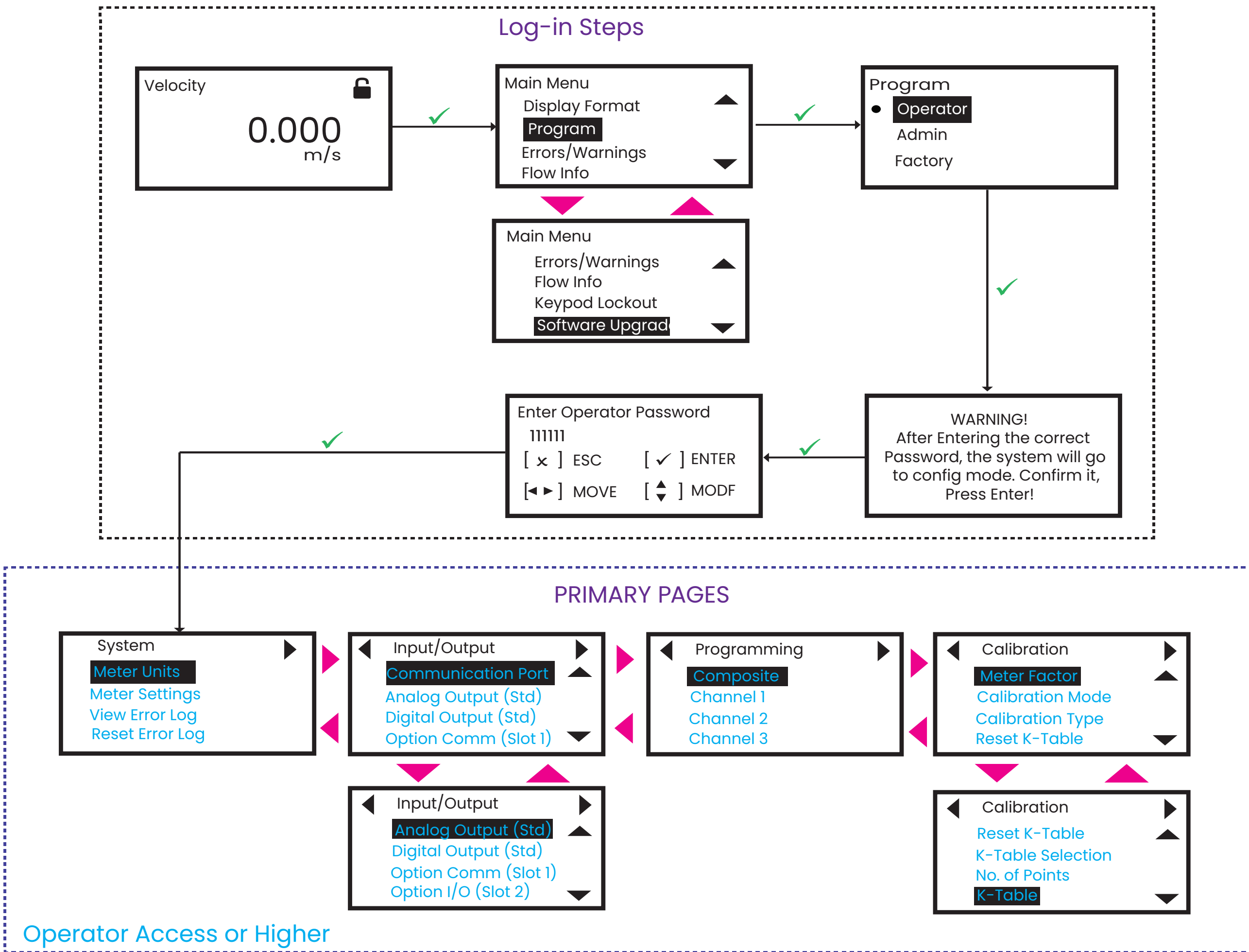


Figure 53: Log-in steps and primary pages

IMPORTANT:

If the keypad has not been pressed for 5 minutes, the XMT1000 exits the Program and returns to displaying measurements. Because changes can only be retained after the user confirms them, the meter discards any unconfirmed configuration changes.

3.4 System settings

3.4.1 Selecting units

The operator can select the preferred units of measurements. Use steps as in section "Log-in and Primary Pages" to navigate to the System settings page. Then highlight [Unit Settings] and press [ENTER], you will now have measurement types listed as in the Figure 54 below, for which you can select your preferred respective units.

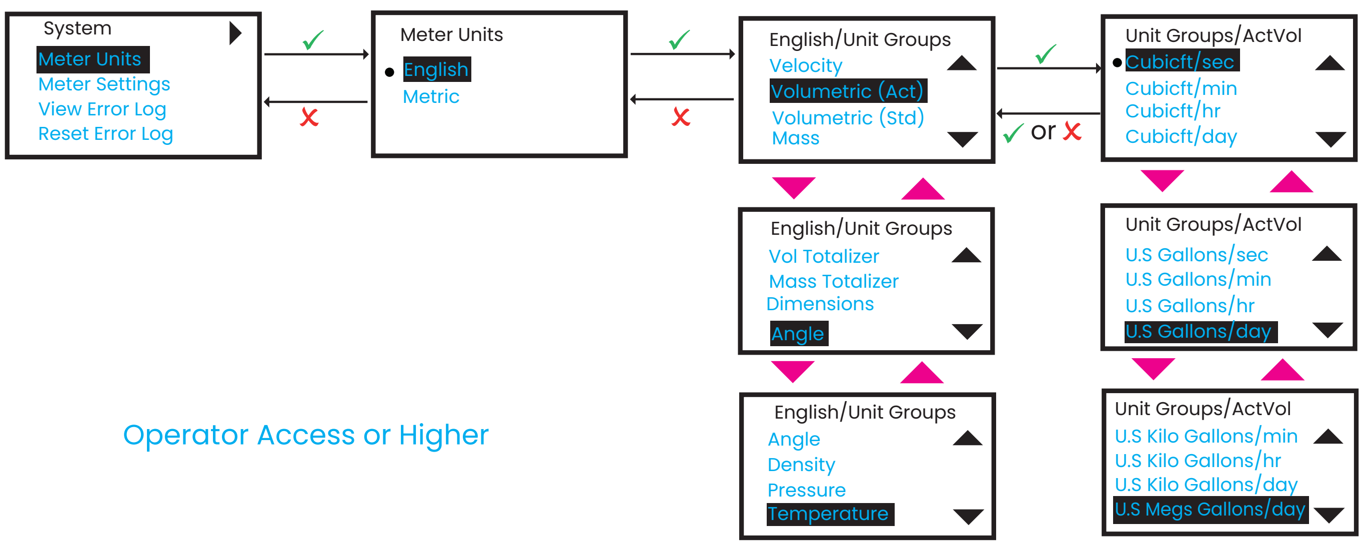


Figure 54: Selecting units

3.4.1a Supported unit groups and units

The Table 2 specifies the unit groups and its respective units supported in XMT1000.

Table 2: Unit groups and supported units

Unit Group	Supported Metric Units	Supported English Units
Velocity Units	m/s	ft/s
Volumetric Units	m³/s, m³/min, m³/h, m³/d, L/s, L/min, L/h, ML/d	ft³/s, ft³/min, ft³/h, ft³/d, gal/s, gal/min, gal/h, gal/d, bbl/s, bbl/min, bbl/h, bbl/d, kgal/min, kgal/h, kgal/d, kbbl/min, kbbl/h, kbbl/d, ac-ft/min, ac-ft/h, ac-ft/d, ac-in/s, ac-in/min, ac-in/h, ac-in/d, impgal/s, impgal/min, impgal/h, impgal/d, Mbbl/d, Mimpgal/d, Mgal/d
Standard Volumetric Units	SL/s, SL/min, SL/hr, SL/d, Sm³/s, Sm³/min, Sm³/hr, Sm³/d	SCFH, SCFM, SBBLD, SBBLH, SBBLM, SBBLS, SCFD, SCFS

Table 2: Unit groups and supported units		
Unit Group	**Supported Metric Units**	**Supported English Units**
Mass Units	kg/s, kg/min, kg/h, kg/d, Ton/s, Ton/min, Ton/h, Ton/d	lb/s, lb/min, lb/h, lb/d, klb/s, klb/min, klb/h, klb/d, STon/s, STon/min, STon/h, STon/d
Volumetric Totals Units	m^3, L, Sm^3, SL, ML, Mm^3	ft^3, Mft^3, gal, Mgal, bbl, Mbbl, ac-ft, ac-in, impgal, Sft^3
Mass Totals Units	kg, MTon	Lb, STon
Dimension Units	mm	in
Density Units	kg/m^3, g/cm^3, Ton/m^3, kg/L, g/mL, kg/dm^3	oz/in^3, lb/in^3, lb/ft^3, lb/gal
Pressure Units	kg/m2, Pa, MPa, KPa, bar, mBar, Torr, atm	Psi-g, Psi-a
Angle Units	Degree, Radians	Degree, Radians
Temperature Units	°C, K, °F, °R	°C, K, °F, °R
Viscosity Units	cSt, m^2/s	ft2/s

3.4.2 Meter settings

In order to change the Language, display settings, System Date, Meter Tag, Label, Change password or view About meter, use steps as in section "Log-in and Primary Pages" to navigate to the System settings page. Then highlight [Meter Settings] and press [ENTER]. Figure 55 below, shows the options available.

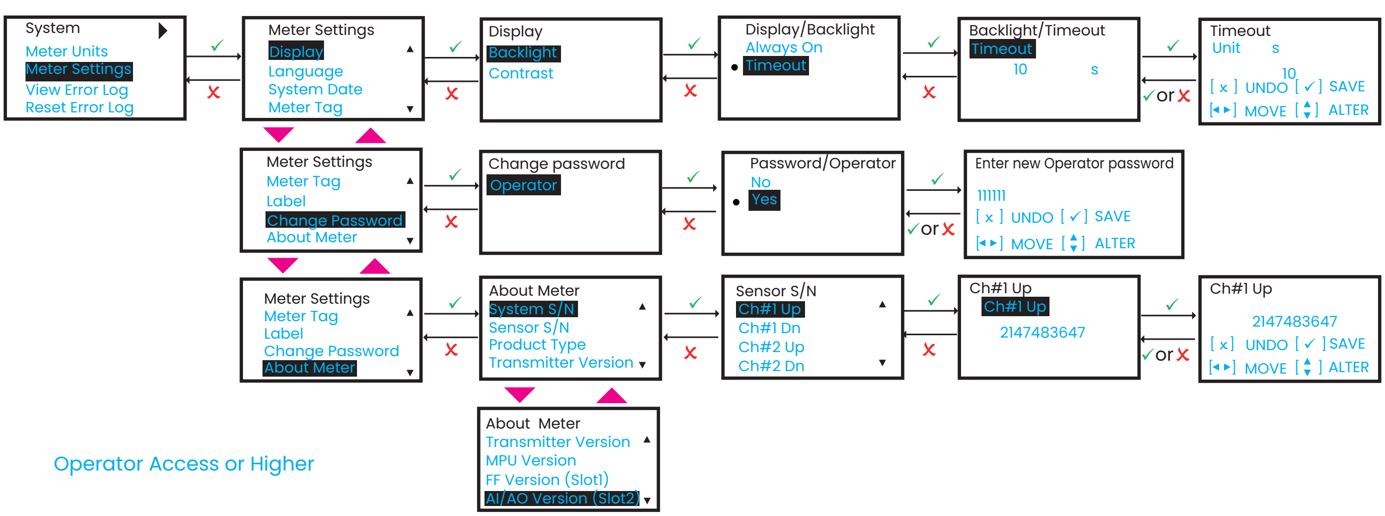


Figure 55: Meter settings

3.5 Inputs and outputs

3.5.1 Modbus port settings

The XMT 1000 meter supports digital communications using the MODBUS/RTU protocol, with 3-wire RS-485 as the physical layer interfaces. Baud rate can be specified from 2400 to 115,200 bits per second (bps), with selectable parity, and number of stop bits (Default = 115200, Even, 1 Stop Bit). Use steps as in section "Log-in and Primary Pages" to navigate to the Input/Output settings page. Then highlight **[Communication Port]** and press **[ENTER]**. Figure 56 below, shows the options available.

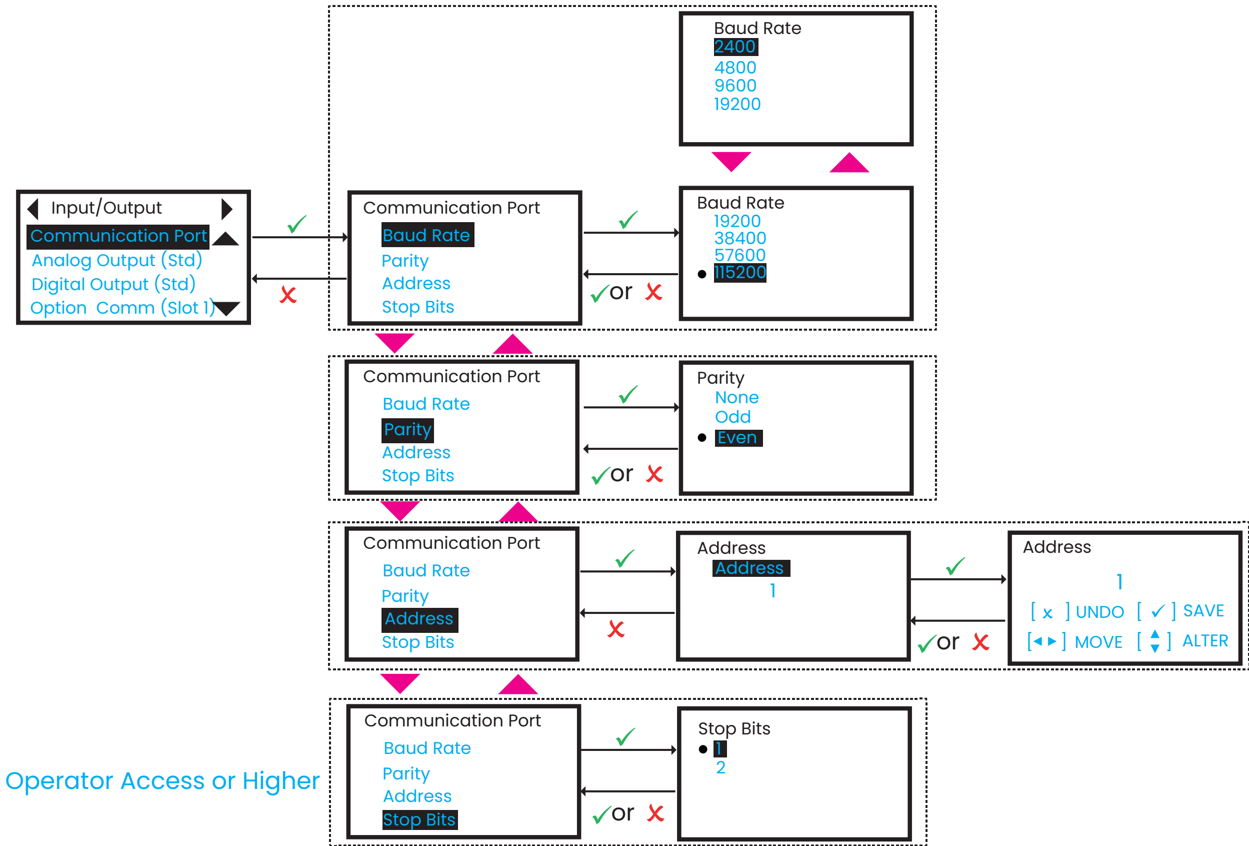


Figure 56: Modbus port setting

3.5.2 Standard analog output

The XMT1000 has one Analog Output and one Digital Output in Standard configuration.

3.5.2a Setting up analog output

The XMT1000 meter has one Analog Output in standard configuration. For additional Analog outputs Optional I/O boards may be purchased. Use steps as in section "Log-in and Primary Pages" to navigate to the Input/Output settings page.

1. Then highlight [Analog Output (Std)] and press [ENTER].
2. If you do not wish to connect an Analog Output, you should turn Analog Output selection to OFF.
3. If you are connecting an Analog Output, choose 4-20mA option. The Figure 57 below, shows the options available.
4. Select the Measurement to be sent out on the 4-20mA output, followed by the [Base Value] and [Full Value] selection. Refer Table 3 to see measurement options available for Analog output.
5. Select [Error Handling]. Refer to section 3.5.2.2 to choose an option that suits your needs.

Table 3: Measurement options for analog output	
Measurement Channel	**Measurement Options for Analog Output**
Composite	Velocity, Actual Volumetric, Standard Volumetric, Mass Flow, Average Volumetric Flow Rate, Sound speed, Reynolds#
Channel x	Velocity, Actual Volumetric, Standard Volumetric, Mass Flow, Average Volumetric Flow rate, Sound speed, Standard Deviation of Gain, Gain and SNR

3.5.2b Understanding the error handling option

The following Table 4 shows the response to each of the Error Handling options. For a multi-channel meter, the **[Path Error Handling]** set to ON (see Figure 70) changes the Output response. See Table 5 for Analog Output response with **[Path Error Handling]** set to ON.

Note: Table 5 assumes Composite Actual Volumetric is chosen as Measurement for Analog Output.

Table 4: Analog output error handling options	
Option	**Output Response**
Low	Forces Output to 4mA on error
High	Forces Output to 20mA on error
Hold	Holds the last “good” reading
Other	Enables the user to enter a value between 4mA and 20mA, to be output during an error

Table 5: Analog Output Error Handling with Path Error Handling set to ON					
Ch1 in Error	**Ch2 in Error**	**Ch3 in Error**	**Error displayed in Meter**	**Expected Composite Volumetric(Act) behavior**	**Analog Output Response**
No	No	No	No Error	Measured Composite Volumetric(Act)	mA proportional to the Measured Composite Volumetric(Act)
Yes	No	No	E22: SingleChAccuracy	Measured Composite Volumetric(Act)	mA proportional to the Measured Composite Volumetric(Act)
No	Yes	No	E22: SingleChAccuracy	Measured Composite Volumetric(Act)	mA proportional to the Measured Composite Volumetric(Act)
No	No	Yes	E22: SingleChAccuracy	Measured Composite Volumetric(Act)	mA proportional to the Measured Composite Volumetric(Act)
Yes	Yes	No	E23: MultiChAccuracy	Measured Composite Volumetric(Act)	mA proportional to the Measured Composite Volumetric(Act)
No	Yes	Yes	E23: MultiChAccuracy	Measured Composite Volumetric(Act)	mA proportional to the Measured Composite Volumetric(Act)
Yes	No	Yes	E23: MultiChAccuracy	Measured Composite Volumetric(Act)	mA proportional to the Measured Composite Volumetric(Act)
Yes	Yes	Yes	E23: MultiChAccuracy	Measured Composite Volumetric(Act) will hold the last good value	mA value based on the [Error Handling] setting

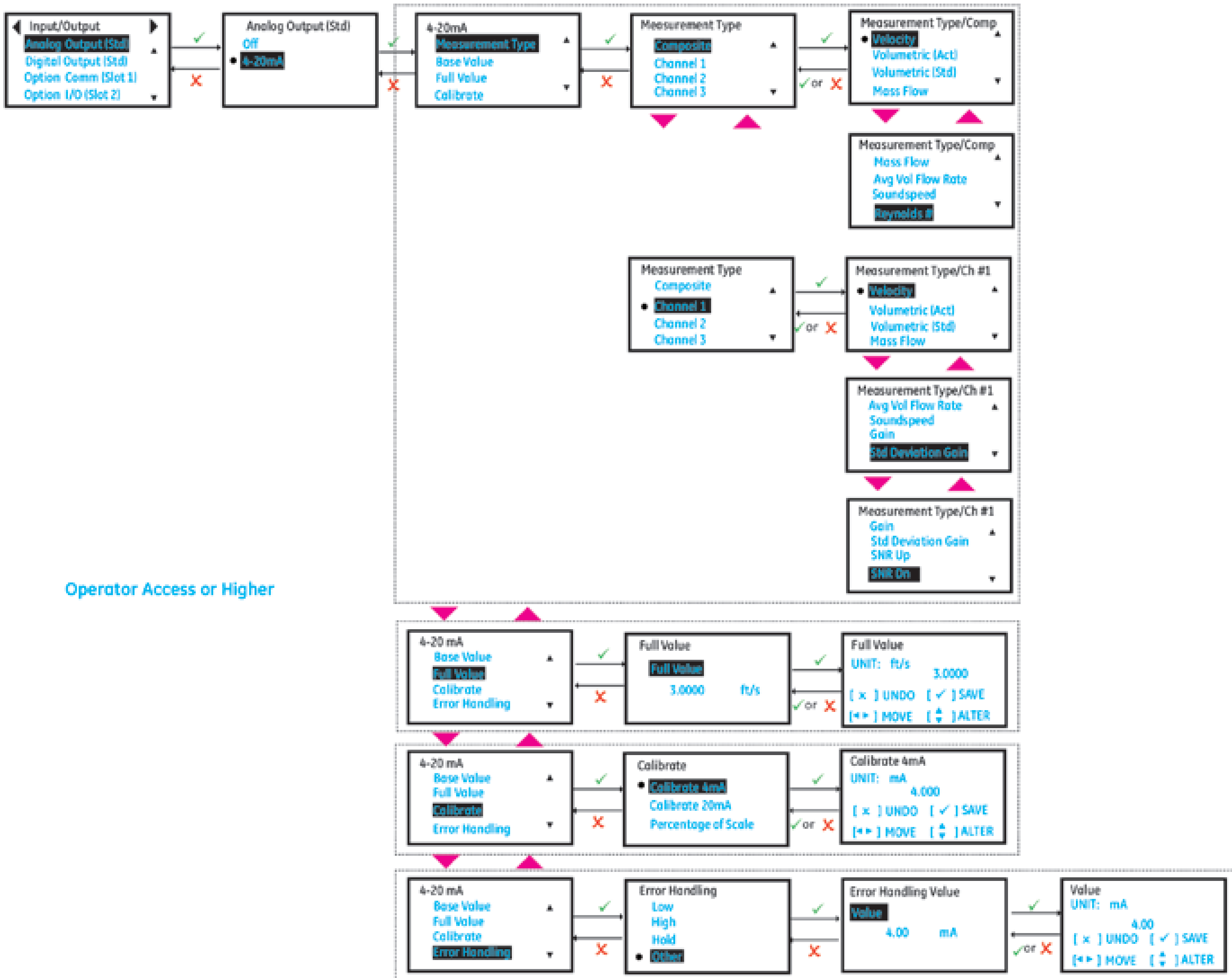


Figure 57: Setting up analog output

3.5.2c Calibrating analog output

To calibrate Analog Output, use steps as in section "Log-in and Primary Pages" to navigate to the Input/Output settings page. You may use a multimeter or DCS/SCADA to calibrate the Analog Output. Regardless of whether multimeter or DCS/SCADA is used, the steps below remain the same. For better readability, the steps below only indicate multimeter and does not repeat multimeter or DCS/SCADA.

1. Turn ON the multimeter (if used), and set it to measure Current (mA) DC. Connect test lead from positive side (Aout+) of the Main Analog Output to the positive terminal of multimeter, and the negative lead to the negative terminal (Aout-).
2. Then in Meter Menu highlight **[Analog Output (std)]** and press **[ENTER]**. Then highlight **[4-20mA]** and press **[ENTER]**.
3. Scroll down and select **[Calibrate]** option.
4. Select **[Calibrate 4mA]** and check if the reading on the multimeter reads 4.00mA ± 0.01mA. If the value on the multimeter is not 4.00mA ± 0.01mA, input the value read on the multimeter into the Calibrate 4mA value and press **[ENTER]**. Check multimeter again verify the Current reads 4.00mA within ±0.01mA.
5. Select **[Calibrate 20mA]** and check if the reading on the multimeter reads 20.00mA ± 0.01mA. If the value on the multimeter is not 20.00mA ± 0.01mA, input the value read on the multimeter into the Calibrate 20mA value and press **[ENTER]**. Check multimeter again verify the Current reads 20.00mA within ±0.01mA.
6. Select **[Percentage of Scale]** and adjust the scale to 0.00% and press **[ENTER]**, then verify the reading on the multimeter is 4.00mA within ±0.01mA. Then adjust the scale to 50.00% and press **[ENTER]**, then verify the reading on the multimeter is 12.00mA within ±0.01mA. Then adjust the scale to 100.00% and press **[ENTER]**, then verify the reading on the multimeter is 20.00mA within ±0.01mA.
7. If Steps 4, 5, and 6 were successfully completed and verified, the Analog output is successfully calibrated.

3.5.3 Standard digital output

3.5.3a Setting up pulse output

To program a Pulse Output, use steps as in section "Log-in and Primary Pages" to navigate to the Input/Output settings page:

In Meter Menu highlight [Digital Output (Std)] and press [ENTER]. Then select [Pulse] option.

Setup the [Polarity], [Measurement], [Pulse Value], [Pulse width] and [Error Handling] options to suit your needs. The Figure 58 below, shows the available options. Also refer to the Table 6 below to understand each option.

Table 6: Pulse output options

Option	Functional Description
Polarity	Choose the Negative or Positive edge of the pulse
Measurement	Choose the channel and Measurement to output
Pulse Value	Choose how many units of the chosen measurement is accumulated before a pulse is output
Pulse Width	Choose the duration of each pulse that is output IMPORTANT: Make sure the meter is not configured to output more than one pulse during this time, as this could lead to missed pulses.
Error Handling	Choose the Pulse output response during an error condition

For measurement options available on Pulse Output refer to Table 7.

Table 7: Measurement options for pulse output

Measurement channel	Measurement options for pulse output
Composite	Forward Volumetric Totals, Reverse Volumetric Totals, Net Volumetric Totals, Forward Mass Totals, Reverse Mass Totals, Net Mass Totals, Forward Std Volumetric Totals, Reverse Std Volumetric Totals, Net Std Volumetric Totals
Channel x	Forward Volumetric Totals, Reverse Volumetric Totals, Net Volumetric Totals, Forward Mass Totals, Reverse Mass Totals, Net Mass Totals, Forward Std Volumetric Totals, Reverse Std Volumetric Totals, Net Std Volumetric Totals

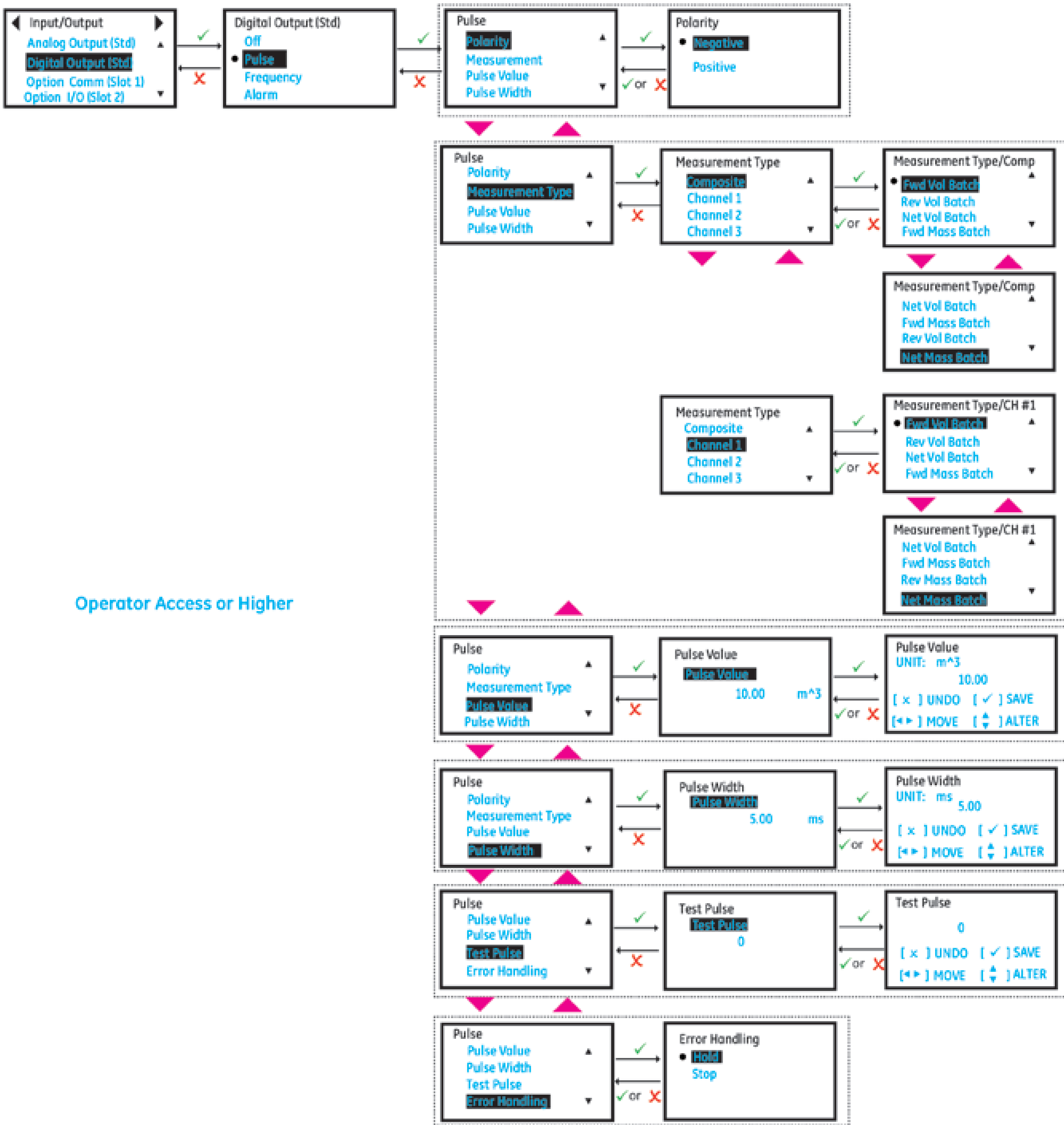


Figure 58: Setting up pulse output

3.5.3b Setting up frequency output

To program a Frequency Output, use steps as in section "Log-in and Primary Pages" to navigate to the Input/Output settings page:

1. In Meter Menu highlight [Digital Output (Std)] and press [ENTER]. Then highlight [Frequency] option and press [ENTER].
2. Setup the [Measurement], [Base Value], [Full Value], [Full Frequency] and [Error Handling] options to suit your needs. The Figure 59 below, shows the available options. Also refer to the Table 9 below to understand each option.

For measurement options available on Frequency Output refer to Table 8.

Table 8: Measurement options for frequency output

Measurement Channel	Measurement Options for Frequency Output
Composite	Velocity, Actual Volumetric, Standard Volumetric, Mass Flow, Average Volumetric Flow Rate, Sound speed, Reynolds #
Channel x	Velocity, Actual Volumetric, Standard Volumetric, Mass Flow, Average Volumetric Flow rate, Sound speed, Standard Deviation of Gain, Gain and SNR

Table 9: Frequency output options

Option	Functional Description
Measurement	Choose the channel and Measurement to output
Base Value	Enter measurement value that should correspond to the min. value of the frequency range
Full Value	Enter measurement value that should correspond to the max. value of the frequency range
Fspan	Enter the highest value of the Frequency range you want to output
Error Handling	Choose the Frequency output response during an error condition: Low, High, Hold, or Other Value. During a meter error, the chosen Error Handling value will be sent to the Frequency Output.

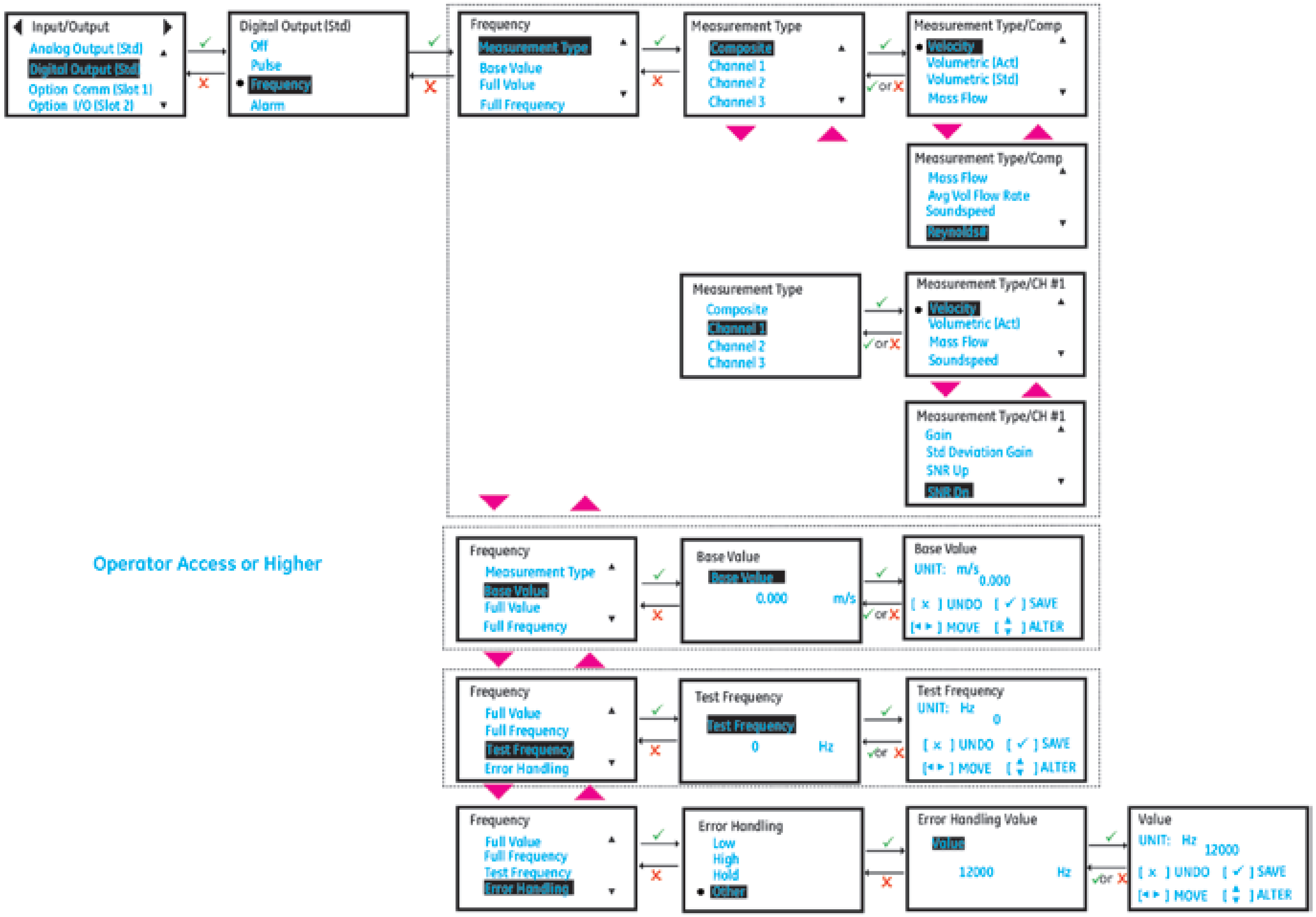


Figure 59: Setting up frequency output

3.5.3c Understanding the error handling option

The Table 10 shows the response to each of the Frequency Output Error Handling options. For a multi-path meter, the [Path Error Handling] set to ON (see Figure 70) changes the Output response. See Table 11 for Analog Output response with [Path Error Handling] set to ON.

Note: Table 11 assumes Composite Actual Volumetric is chosen as Measurement for Frequency Output and the Path configuration is 3 paths.

Table 10: Frequency Output Error Handling options	
Option	**Output Response**
Low	Forces Output to 0Hz on error
High	Forces Output to 10000Hz on error
Hold	Holds the last "good" Hz reading
Other	Enables the user to enter a value between 0Hz and 12000Hz to be output during an error

Table 11: Frequency output error handling with path error handling set to ON					
Ch1 in Error	**Ch2 in Error**	**Ch3 in Error**	**Error displayed in Meter**	**Expected Composite Volumetric(Act) behavior**	**Analog Output Response**
No	No	No	No Error	Measured Composite Volumetric(Act)	Frequency proportional to the Measured Composite Volumetric(Act)
Yes	No	No	E22: SingleChAccuracy	Measured Composite Volumetric(Act)	Frequency proportional to the Measured Composite Volumetric(Act)
No	Yes	No	E22: SingleChAccuracy	Measured Composite Volumetric(Act)	Frequency proportional to the Measured Composite Volumetric(Act)
No	No	Yes	E22: SingleChAccuracy	Measured Composite Volumetric(Act)	Frequency proportional to the Measured Composite Volumetric(Act)
Yes	Yes	No	E23: MultiChAccuracy	Measured Composite Volumetric(Act)	Frequency proportional to the Measured Composite Volumetric(Act)
No	Yes	Yes	E23: MultiChAccuracy	Measured Composite Volumetric(Act)	Frequency proportional to the Measured Composite Volumetric(Act)
Yes	No	Yes	E23: MultiChAccuracy	Measured Composite Volumetric(Act)	Frequency proportional to the Measured Composite Volumetric(Act)
Yes	Yes	Yes	E23: MultiChAccuracy	Measured Composite Volumetric(Act) will hold the last good value	Frequency value based on the [Error Handling] setting

3.5.3d Setting up alarm output

To program an Alarm Output, use steps as in section "Log-in and Primary Pages" to navigate to the Input/Output settings page:

1. In Meter Menu highlight [Digital Output (Std)] and press [ENTER]. Then select [Alarm] option.
2. Select the [Alarm State], [Alarm type], [Measurement] and [Alarm Value] options to suit your needs. The Figure 60 below, shows the available options. Also refer to the Table 13 below to understand each option.

For measurement options available on Alarm Output refer to Table 12.

Table 12: Measurement options for Alarm output

Measurement Channel	Measurement Options for Frequency Output
Composite	Velocity, Actual Volumetric, Standard Volumetric, Mass Flow, Average Volumetric Flow Rate, Sound speed, Reynolds #
Channel x	Velocity, Actual Volumetric, Standard Volumetric, Mass Flow, Average Volumetric Flow rate, Sound speed, Standard Deviation of Gain, Gain and SNR

Table 13: Alarm Output Options

Option	Functional Description
Alarm State	Choose if the Alarm State should be Normally Open, Normally Closed or Failsafe
Alarm Type	For Alarm State selected as Normally Open or Normally Closed, Alarm Type can be set to High or Low. If set to high, Alarm will be triggered if the selected Measurement goes above the programmed Alarm Value
Measurement	Choose the channel and Measurement that is monitored for Alarm Trigger
Alarm Value	Enter measurement value that should be a trigger point

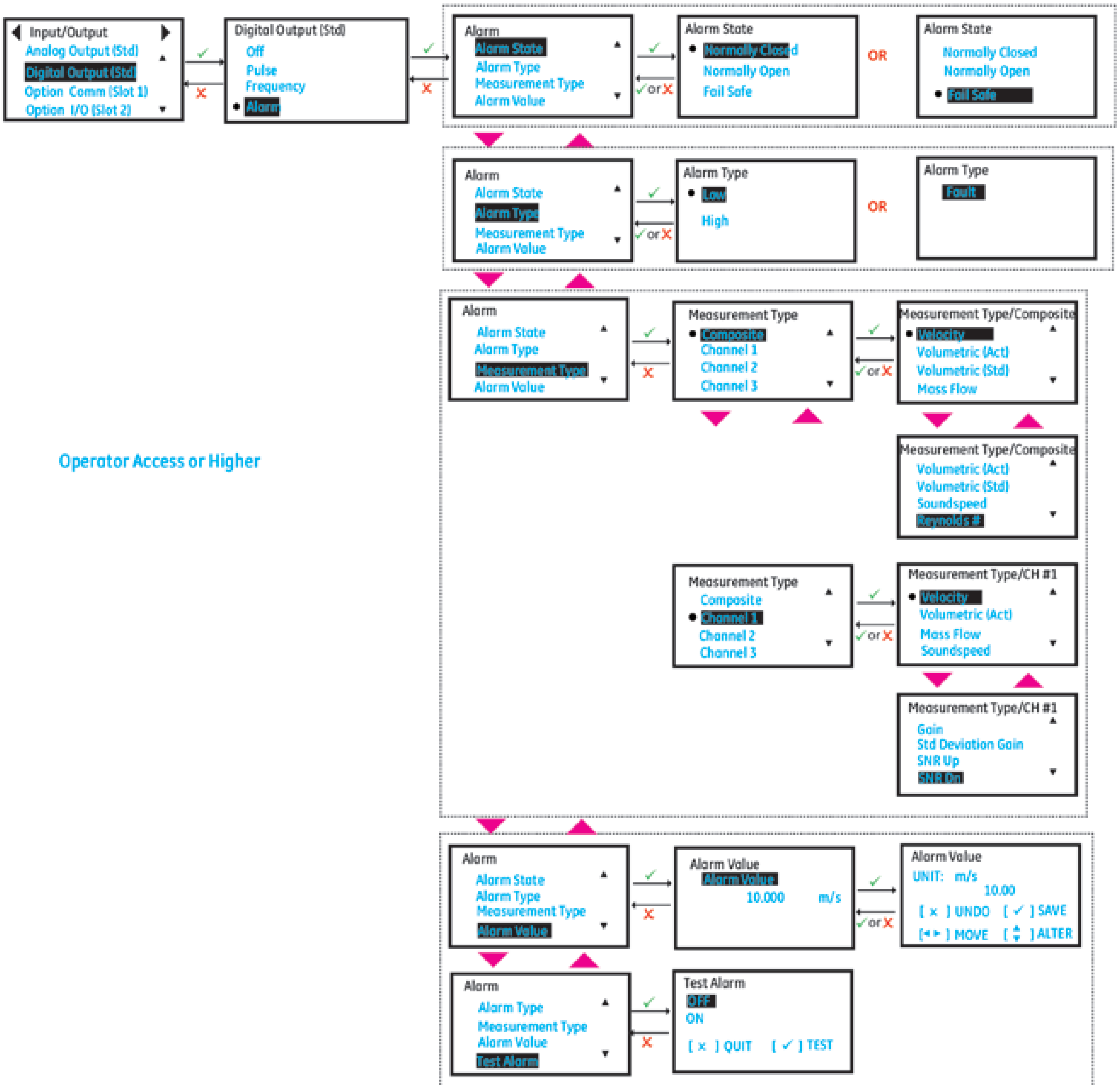


Figure 60: Setting up alarm output

3.5.4 Option comm slot-1 (optional)

3.5.4a Option slot-1 configured as HART

Use steps as in section "Log-in and Primary Pages" to navigate to the Input/Output settings page.

1. Then highlight [Option Comm (Slot 1)] and press [ENTER]. Then highlight [HART] and press [ENTER].
2. You can set Analog Output with HART option. Refer to Figure 61 and Figure 57.
3. You can also view the HART hardware and software revision numbers in About HART option.

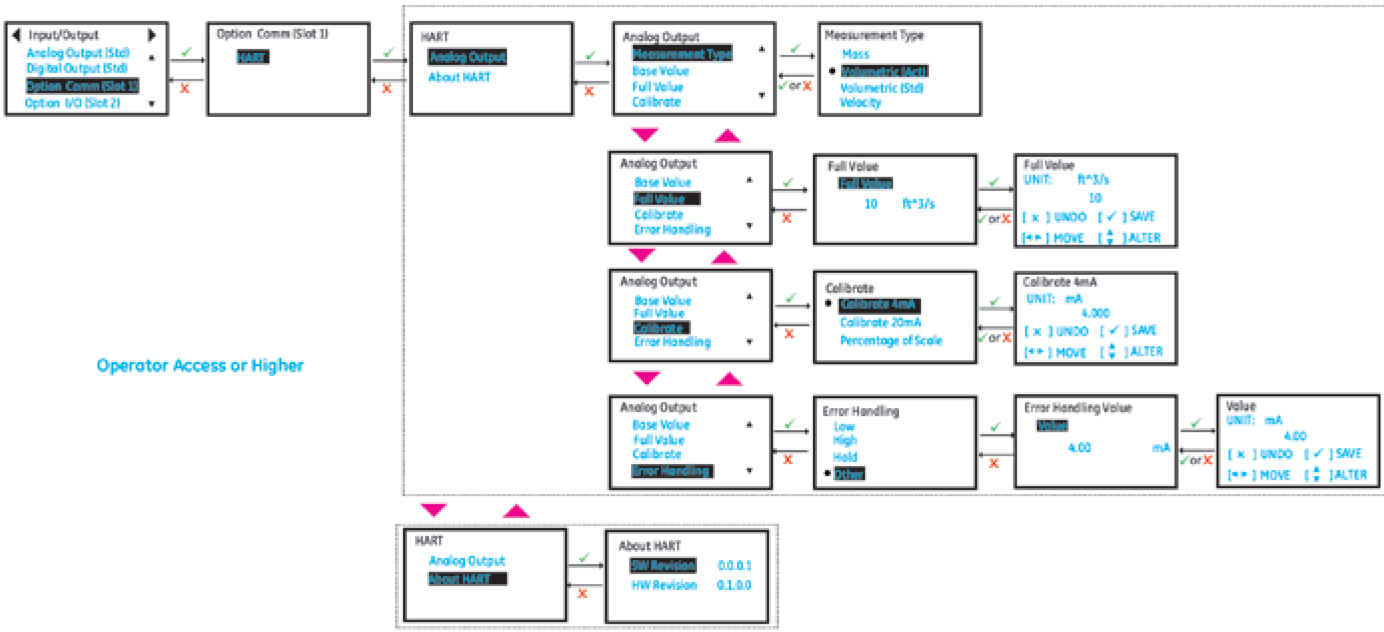


Figure 61: Option slot-1 configured as HART

3.5.4b Option slot-1 configured as FF

Use steps as in section "Log-in and Primary Pages" to navigate to the Input/Output settings page.

1. Highlight [Option Comm (Slot 1)] and press [ENTER]. Then highlight [FF] and press [ENTER].
2. You can view the FF hardware and software revision numbers in About FF option.

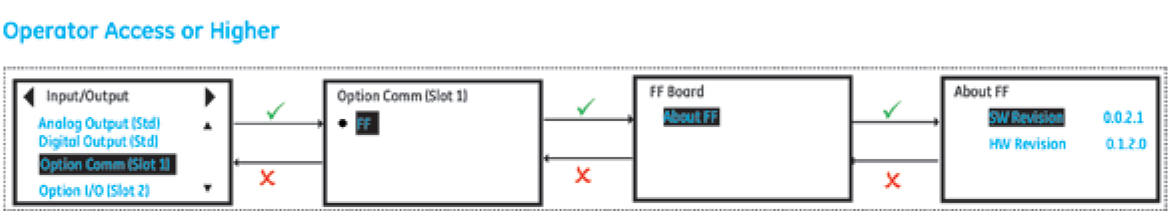


Figure 62: Option slot-1 configured as FF

3.5.5 Option I/O slot-2 (optional)

For extended I/O capability XMT1000 supports an Optional I/O that provides 2 additional Analog Outputs (AO-AO), with up to 2 Analog Inputs (AI-AI) or 2 RTD (R-R) inputs. See Table 14 for all available options.

Table 14: Optional I/O available options

Board Option #	Input / Output Options Available
1	AO-AO-AI-AI
2	AO-AO-AI-R 3 Wire, 100 Ohm
3	AO-AO-R-R 3 Wire, 100 Ohm
4	AO-AO-AI-R 4 Wire, 100 Ohm
5	AO-AO-R-R 4 Wire, 100 Ohm
6	AO-AO-AI-R 3 Wire,1000 Ohm
7	AO-AO-R-R 3 Wire, 1000 Ohm
8	AO-AO-AI-R 4 Wire, 1000 Ohm
9	AO-AO-R-R 4 Wire, 1000 Ohm

In this chapter AO-AO-AI-R 3 Wire,1000 Ohm option will be used as an example. Other options have similar capabilities and menu map.

3.5.5a Option IO (slot2): setting up analog output

Use steps as in section "Log-in and Primary Pages" to navigate to the Input/Output settings page.

1. Highlight [Option I/O (Slot 2)] and press [ENTER].
2. Then highlight [AO-AO-AI-R-1000-3W] and press [ENTER]. Then highlight [Analog Output(S2:1)] or [Analog Output(S2:2)] and press [ENTER].
3. If you do not wish to connect an Analog Output, you should turn Analog Output selection to OFF.
4. If you are connecting an Analog Output, choose 4-20mA option. Figure 63 below, shows the options available.
5. Select the Measurement to be sent out on the 4-20mA output, followed by the [Base Value] and [Full Value] selection. Refer to Table 3 to see measurement options available for Analog output.
6. Select [Error handling]. Refer to Section 3.5.5b to choose an option that suits your needs.

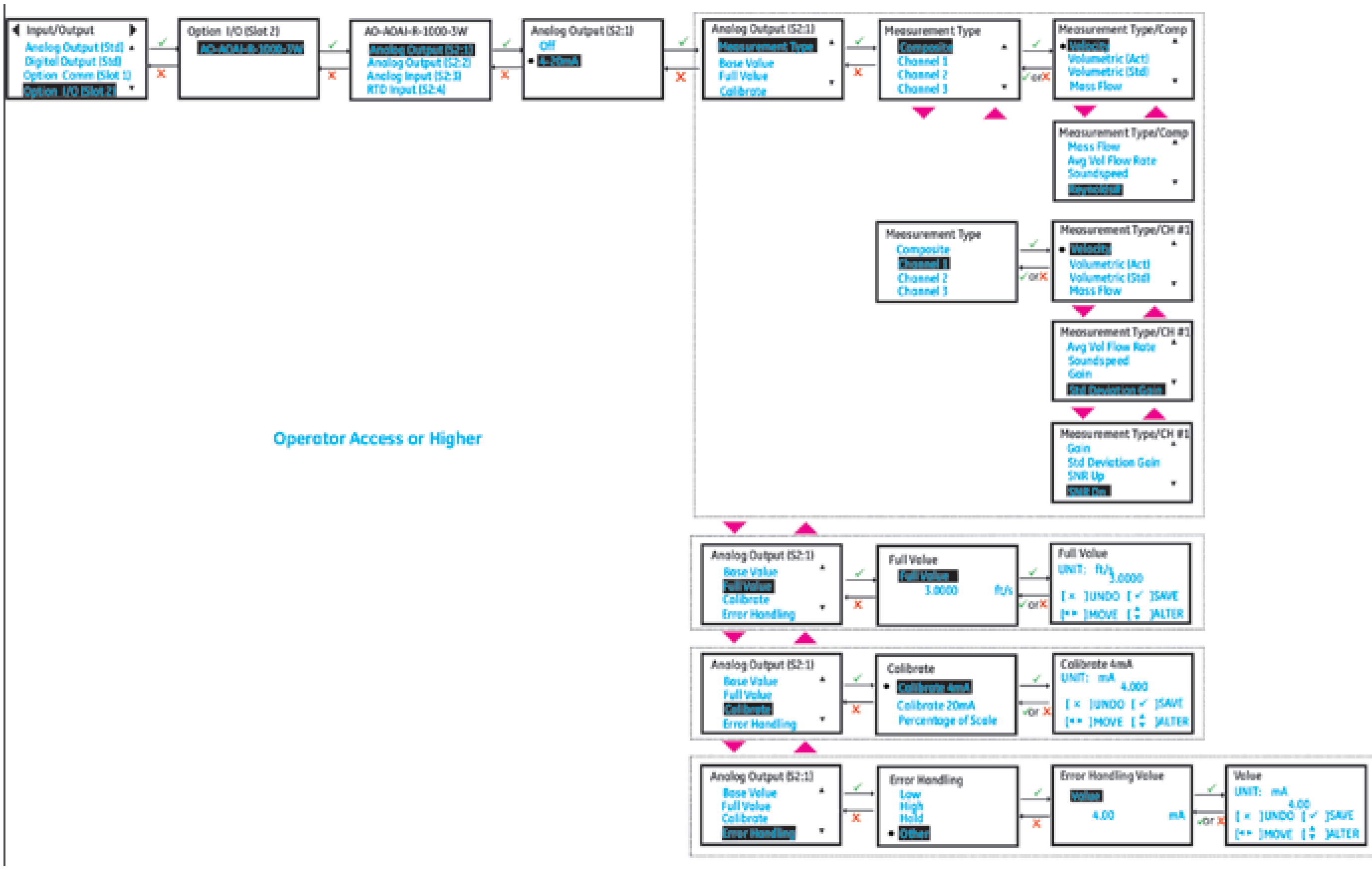


Figure 63: Setting up option I/O analog output

3.5.5b 3Option IO (slot2): calibrating analog output

To calibrate Option I/O Analog Output, use steps as in section “Log-in and Primary Pages” to navigate to the Input/Output settings page. You may use a multimeter or DCS/SCADA to calibrate the Analog Output. Regardless of whether multimeter or DCS/SCADA is used, the steps below remain the same. For better readability, the steps below only indicate multimeter and does not repeat multimeter or DCS/SCADA.

Note: Optional I/O menu uses Slot:Channel convention for clarity. For Example, Analog Output(S2:1) indicates Analog Output on Slot 2, Channel 1. Optional I/O is installed in the Slot2 of the electronics stack.

1. Connect the Analog Output as in Figure 64.
2. Turn ON the multimeter (if used) and set it to measure Current (mA) DC. Connect test lead from positive side (Analog Output Channel 1: I/O 1) or (Analog Output Channel 2: I/O 3) of the optional I/O Analog Output to the positive terminal of multimeter, and the negative lead to the negative terminal (Analog Output Channel 1: I/O 2) or (Analog Output Channel 2: I/O 4).
3. Highlight [Option I/O (Slot 2)] and press [ENTER].
4. Then highlight [AO-AO-AI-R-1000-3W] and press [ENTER]. Then highlight [Analog Output(S2:1)] or [Analog Output(S2:2)] and press [ENTER].
5. Then highlight [4-20mA] and press [ENTER].
6. Scroll down and select [Calibrate] option.
7. Select [Calibrate 4mA] and check if the reading on the multimeter reads 4.00mA ± 0.01mA. If the value on the multimeter is not 4.00mA ± 0.01mA, input the value read on the multimeter into the Calibrate 4mA value and press [ENTER]. Check the multimeter again verify that the Current reads 4.00mA within ±0.01mA.
8. Select [Calibrate 20mA] and check if the reading on the multimeter reads 20.00mA ± 0.01mA. If the value on the multimeter is not 20.00mA ± 0.01mA, input the value read on the multimeter into the Calibrate 20mA value and press [ENTER]. Check the multimeter again verify that the Current reads 20.00mA within ±0.01mA.
9. Select [Percentage of Scale] and adjust the scale to 0.00% and press [ENTER], then verify the reading on the multimeter is 4.00mA within ±0.01mA. Adjust the scale to 50.00% and press [ENTER], then verify the reading on the multimeter is 12.00mA within ±0.01mA. Adjust the scale to 100.00% and press [ENTER], then verify the reading on the multimeter is 20.00mA within ±0.01mA.

10. If Steps 4, 5 and 6 were successfully completed and verified, the Analog output is successfully calibrated.
11. Once calibration is complete, select either [Save] or [Save and Logout] option to save calibration data.

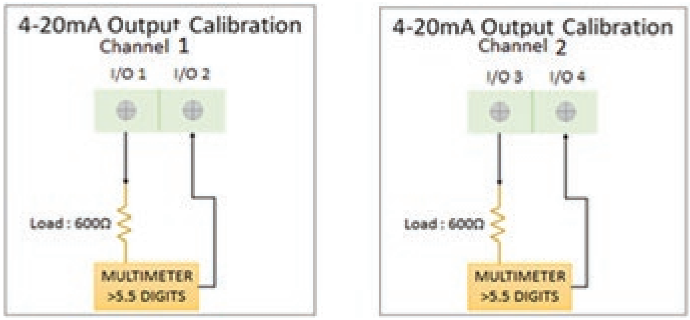


Figure 64: Optional I/O Analog Output Channel 1 and Channel 2 connections

3.5.5c Option IO (slot2): setting up analog input

Use steps as in section "Log-in and Primary Pages" to navigate to the Input/Output settings page.

1. Highlight [Option I/O (Slot 2)] and press [ENTER].

2. Then highlight [AO-AO-AI-R-1000-3W] and press [ENTER]. Then highlight [Analog Input(S2:3)] and press [ENTER].

3. If you do not wish to connect an Analog Input, you should turn Analog Input selection to OFF.

4. If you are connecting an Analog Input, choose [4-20mA] option. Figure 65 below, shows the options available.

5. Select the Measurement to input over 4-20mA input, followed by the [Base Value] and [Full Value] selection. Refer to Table 3 to see measurement options available for Analog output.

Table 15: Analog input measurement types
Measurement Options for Analog Input
Temperature, Pressure

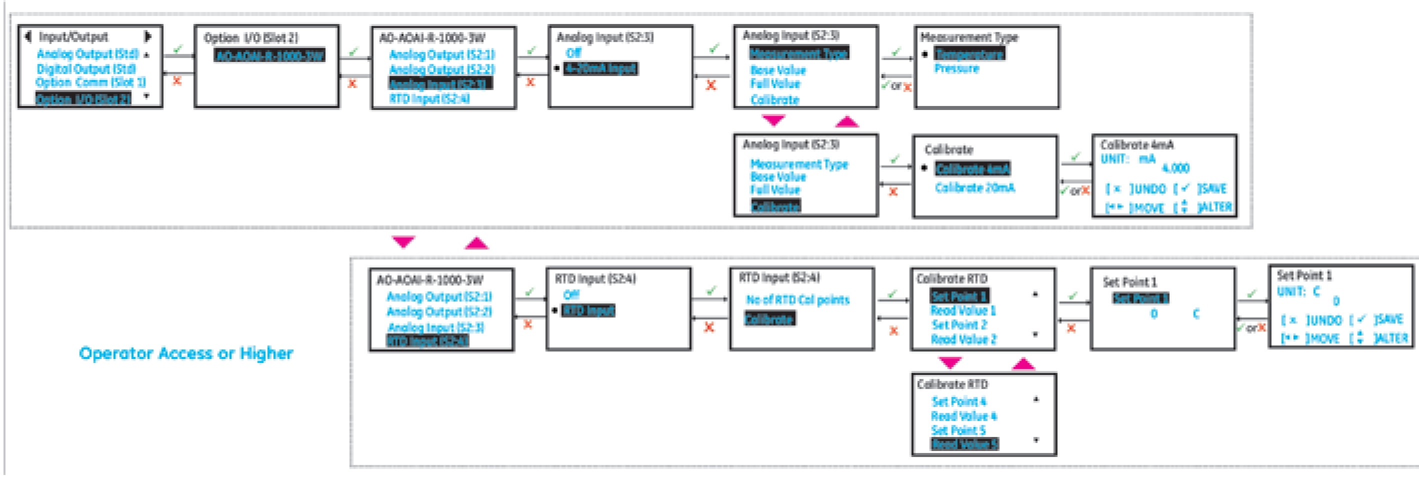


Figure 65: Setting up option I/O analog input/RTD input

3.5.5d Option IO (slot2): calibrating analog input

To calibrate Option I/O Analog Input, use steps as in section "Log-in and Primary Pages" to navigate to the Input/Output settings page.

Note: Optional I/O menu uses Slot:Channel convention for clarity. For Example, Analog Input(S2:3) indicates Analog Input on Slot 2, Channel 3. Optional I/O is installed in the Slot2 of the electronics stack.

1. Connect the Analog Input as in Figure 66.
2. Turn ON the calibrator and set it to measure Current (mA) DC. Connect test lead from positive side (Analog Input Channel 3: I/O 7) of the optional I/O Analog Input to the positive terminal of multimeter, and the negative lead to the negative terminal (Analog Output Channel 3: I/O 8).
3. Highlight [Option I/O (Slot 2)] and press [ENTER].
4. Then highlight [AO-AO-AI-R-1000-3W] and press [ENTER]. Then highlight [Analog Input(S2:3)] and press [ENTER].
5. Then highlight [4-20mA] and press [ENTER].
6. Scroll down and select [Calibrate] option.
7. Select [Calibrate 4mA] in the meter Menu. Set [4mA] current on calibrated current source and check the reading on the XMT1000 is 4.00mA ±0.01mA. Once reading is stabilized on the LCD, Press [ENTER] to accept the current 4 mA value or Press [ESCAPE] to cancel the calibration.
8. Select [Calibrate 20mA] in the meter Menu. Set [20mA] current on calibrated current source and check the reading on the XMT1000 is 20.00mA ±0.01mA. Once reading is stabilized on the LCD, Press [ENTER] to accept the current 20 mA value or Press [ESCAPE] to cancel the calibration.
9. Once calibration is complete, select either [Save] or [Save and Logout] option to save calibration data.

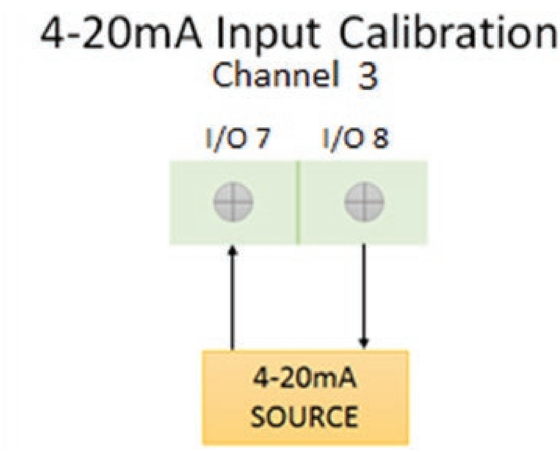


Figure 66: Option I/O analog input connections

3.5.5e Option IO (slot2): calibrating RTD input

1. Insert RTD sensor and master RTD in temperature bath and turn ON, and set it to desired temperature set point.
2. Use steps as in section "Log-in and Primary Pages" to navigate to the Input/Output settings page. Refer to Figure 65 above, highlight [Option I/O (Slot 2)] and press [ENTER].
3. Highlight [AO-AO-AI-R-1000-3W] and press [ENTER]. Then highlight [RTD Input(S2:4)] and press [ENTER].
4. Highlight [RTD Input] and press [ENTER].
5. Set the number of Calibration points by selecting [No. of RTD Cal points].
6. Scroll down and select [Calibrate] option.

7. Select [Set point 1], press [ENTER] and set [Set point 1] to the temperature value selected on the calibrator. Press [ESCAPE].
8. Select [Read Value 1], press [ENTER], and check the [Read Value 1] reads [Set point 1] value. Once reading is stabilized on the [Read Value 1], Press [ENTER] to accept the value or Press [ESCAPE] to cancel the calibration.
9. Repeat steps 7 and 8 for other set points.
10. Once all set points are calibrated, select either [Save] or [Save and Logout] option to save calibration data.

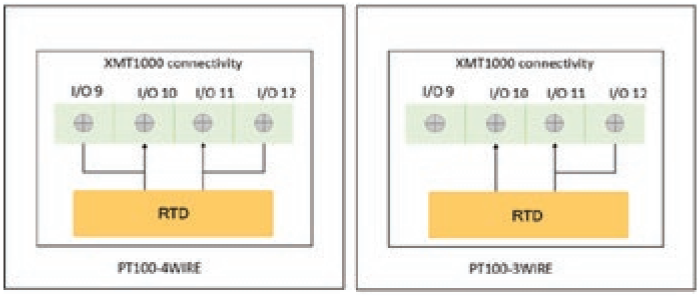


Figure 67: Option I/O RTD connection

3.6 Programming menu options

The options in the Programming Page should be selected to best suit your application. The configurations selected in programming page are critical for accurate flow measurements. Incorrect programming settings can give erroneous measurements and impact accuracy.

Note: Consult the factory or Panametrics Services if you are unsure of the appropriate settings for your application.

3.6.1 Programming the pipe

The Pipe menu allows the user to specify all pipe parameters that are required to ensure accurate ultrasonic flow rate measurements. Use steps as in section “Log-in and Primary Pages” to navigate to the Programming page.

1. Highlight [Composite] and press [ENTER]. Then Select [Pipe] and press [ENTER].
2. Pipe dimensions like [Outer Diameter] (OD), [Wall Thickness] and [Inner Diameter] (ID), [Pipe Material], [Lining Material] and [Lining Thickness] can be programmed in this menu. The meter supports a list of standard pipe materials as in Table 16. If a standard pipe material is selected, the pipe sound speed is automatically updated. If the pipe material is not in the standard list, choose Other for pipe material. Be sure to enter the correct pipe sound speed for your specific pipe material. The meter supports a list of standard lining materials as in Table 17. If Lining is not present, choose None. If a standard lining material is selected, the lining sound speed is automatically updated. If the lining material is not in the standard list, choose Other for lining material. Be sure to enter the correct lining sound speed for your specific lining material.

Note: The measurement units used for pipe size parameters depend on the choices made in the “Selecting Units” on page 40.

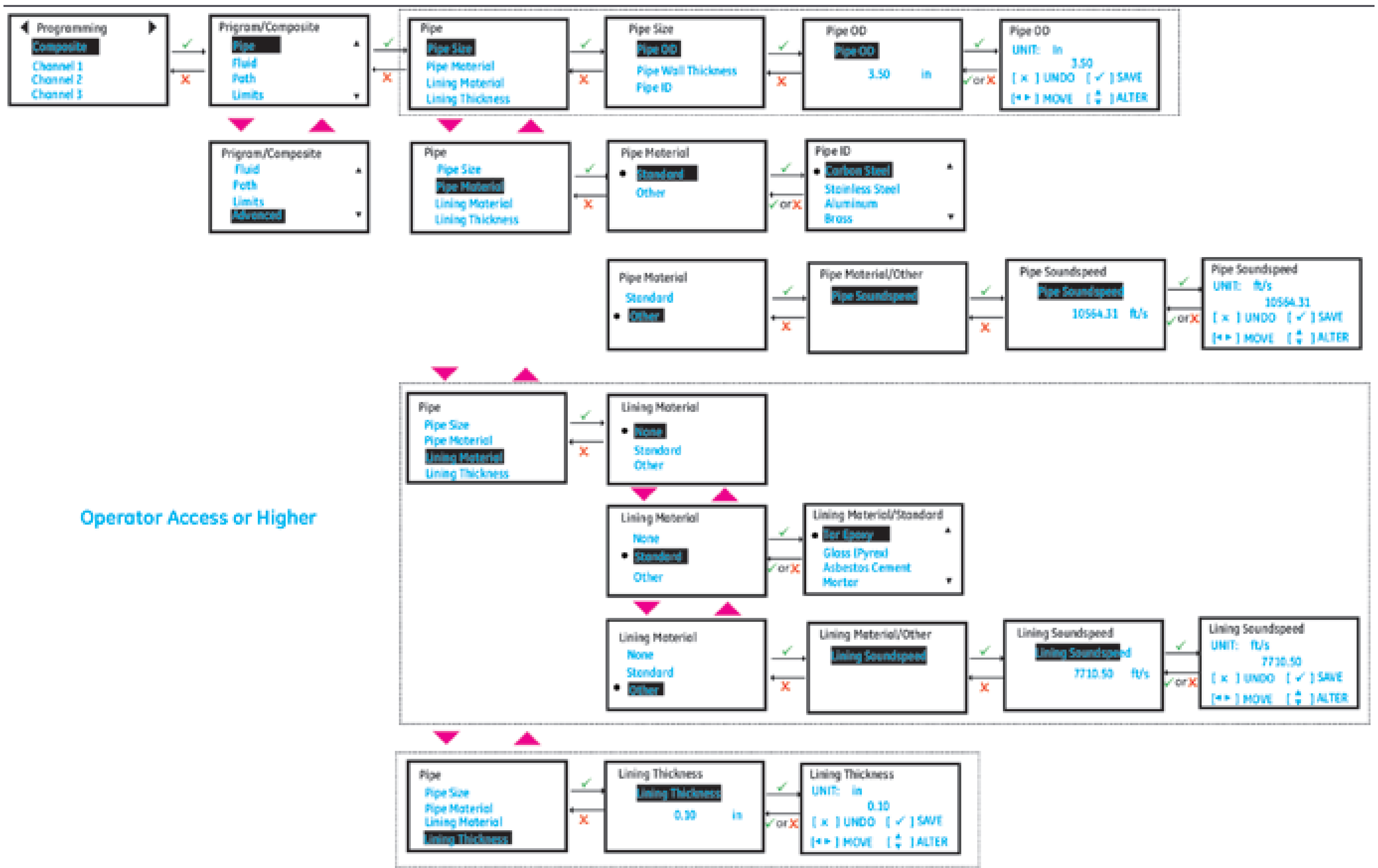


Figure 68: Pipe programming

Table 16: Pipe Materials			
Pipe Material	**Description**	**Pipe Material**	**Description**
Other	Any material	Iron Ductile	Ductile Iron
Carbon Steel	Carbon Steel	Iron Cast	Cast Iron
Stainless Steel	Stainless Steel	Monel	Monel
Aluminum	Aluminum	Nickel	Nickel
Brass	Brass	Plastic Nylon	Nylon
Copper	Copper	Plastic Polye	Polyethylene
Copper/Nickel 10	10% Ni/Cu alloy	Plastic Polyp	Polypropylene
Copper/Nickel 30	30% Ni/Cu alloy	Plastic PVC	Polyvinyl chloride
Glass Pyrex	Pyrex Glass	Plastic Acryl	Acrylic plastics
Glass Flint	Flint Glass	Tin	
Glass Crown	Crown Glass	Titanium	
GRP	Glass reinforced plastic	Tungsten (annealed)	
Gold	Gold	Zinc	
Inconel	Inconel		

Table 17: Lining Materials
Lining Material
Other
Tar Epoxy
Glass Pyrex
Asbestos Cement
Mortar
Rubber
Teflon

3.6.2 Programming the Fluid

The Fluid menu (see Figure 69) allows the user to specify all the parameters of the fluid flowing through the pipe that is required to ensure accurate ultrasonic flow rate measurements. Use steps as in section "Log-in and Primary Pages" to navigate to the Programming page.

1. Highlight [Composite] and press [ENTER]. Scroll down, highlight [Fluid] and press [ENTER].
2. Highlight [Density], press [ENTER] and program the actual density [Density (Act)] and reference density [Density (Ref)] of the process fluid.
3. Then highlight [Kinematic Viscosity], press [ENTER] and program the kinematic viscosity of the process fluid.
4. Then highlight the [Tracking] option. The tracking window is used to scan through the speed of sound range programmed to detect the signal when the user is unsure of the fluid sound speed. The meter also supports a list of standard fluid types. If the process fluid is not listed in standard fluids list and if you are unsure of the fluid sound speed, set tracking window to On and program the minimum and maximum sound speed range to scan.
5. For standard fluids list (see Table 18) supported in the meter, the minimum, maximum and nominal sound speeds are automatically selected.
6. Also program the process [Fluid Temperature] and [Ambient Temperature] see Advanced programming section.

Table 18: Standard Fluid List	
Tracking On	**Tracking Off**
Other	Other
Water (0 to 260 C)	Water (0 to 260C)
LNG	LNG
Oil 22C	Oil 22 C
	Sea Water
	Lube Oil
	Crude Oil
	Methanol (20 C)
	Ethanol
	Freon R12
	Diesel
	Gasoline
	Liquid Nitrogen (-199C)

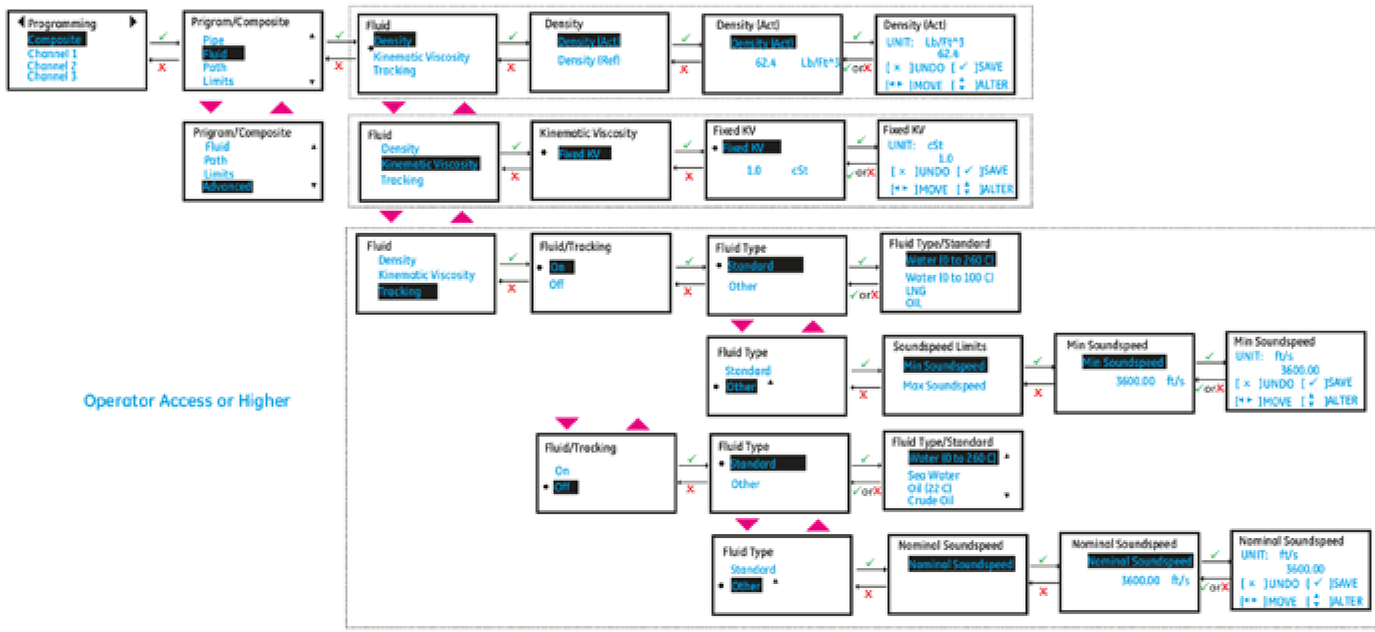


Figure 69: Fluid programming

3.6.3 Programming the Path Configuration

Use steps as in section “Log-in and Primary Pages” to navigate to the Programming page. Refer to Figure 70 for the Path configuration options.

1. Highlight [Composite] and press [ENTER]. Scroll down and select [Path] and press [ENTER].
2. Select [Path Configuration], [Path Weights] and [Path Error Handling].
3. Path Weights are used in Composite flow velocity calculations as in the following equation:

$$Velocity_{Composite} = \frac{((Velocity_{Ch1} \times PathWeight_{Ch1}) + (Velocity_{Ch2} \times PathWeight_{Ch2}) + (Velocity_{Ch3} \times PathWeight_{Ch3}))}{(PathWeight_{Ch1} + PathWeight_{Ch2} + PathWeight_{Ch3})}$$

4. If [Path Error Handling] is set to On, the meter will continue to provide measurements even if one or two channels are in error. Unless, all three channels (for 3 Path (TD-TD-TD)) are in error the flow measurement continues.

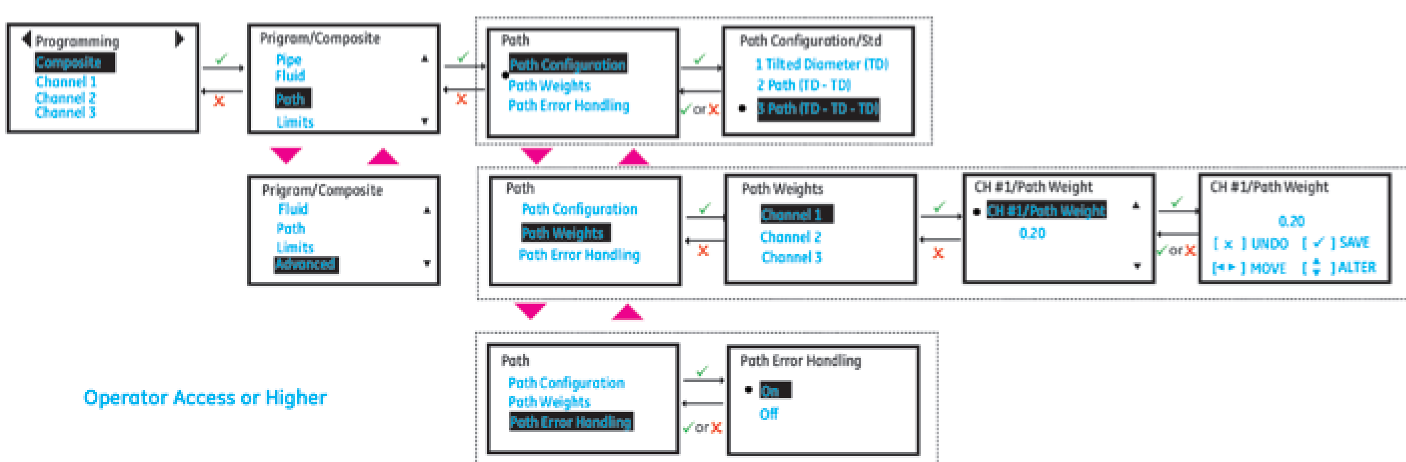


Figure 70: Path configuration

3.6.4 Programming the flow and diagnostic limits

Use steps as in section "Log-in and Primary Pages" to navigate to the Programming page. Refer to Figure 71 for the Path configuration options.

1. Highlight [Composite] and press [ENTER]. Scroll down and select [Limits] and press [ENTER].
2. Program the minimum flow velocity in [Min Velocity] and maximum flow velocity in [Max Velocity].
3. Program the appropriate velocity warning limits in [Min Vel Warn Limit] and [Max Vel Warn Limit]. The values programmed in the warning limits should be tighter than those programmed in
   [Min Velocity] and [Max Velocity] for early warning indications on the LCD and Errors.
4. To cutoff the near zero measurements program an appropriate value in [Zero Cutoff].

d. In order to see stable averaged flow, program the time window for which flow should be averaged in [Flow Averaging]. For example if a value 16 is programmed in for [Flow Averaging], the flow value will have the average of the last 16s of flow values. This allows the flow values on the display and the outputs to be less noisy.

5. If in section "Programming the Fluid" on page 62, Tracking was selected as OFF, program the [Soundspeed Error %]. This configuration will be used to validate if the measured sound speed is within the programmed range of the nominal sound speed. In case the measured sound speed is outside the [Soundspeed Error %] of the nominal sound speed a E2: Soundspeed Error is reported.

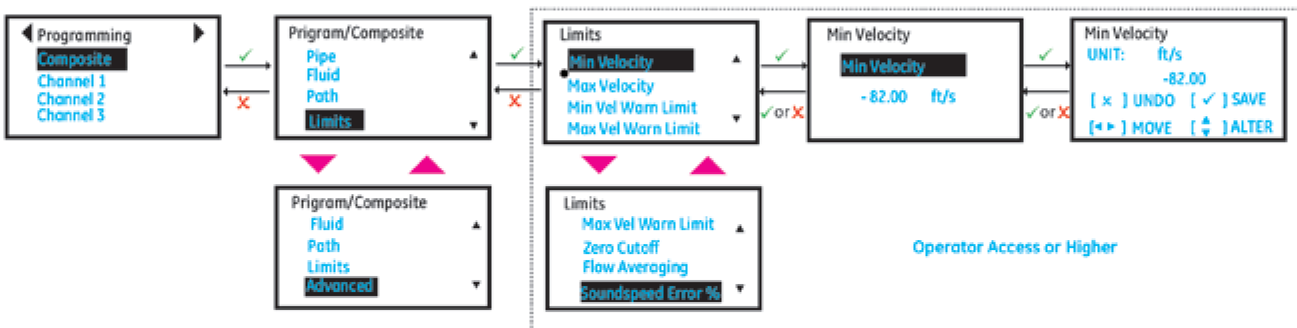


Figure 71: Flow and diagnostic limits

3.6.5 Programming advanced settings

Use steps as in section "Log-in and Primary Pages" to navigate to the Programming page. Refer to Figure 72 for the Path configuration options.

1. Highlight [Composite] and press [ENTER]. Scroll down and select [Advanced] and press [ENTER].
2. Select [Inputs] and set the process [Fluid Temperature]. The Fluid temperature can be either fixed/static (average process fluid temperature) or can be live values read from an Analog input or RTD (available as an option).
3. Also set the [Ambient Temperature].
4. The [Transmit Voltage] should be set based on the viscosity of the process fluid and Pipe size. High viscous fluids or large pipe sizes may need high voltage setting for signals to pass through.
5. Choose the [Refresh Rate] based on how fast you want the meter should make a measurement. The refresh rate selection will not change the update rate on the Analog or Digital outputs. The Analog output and Digital outputs are always updated at 4Hz.

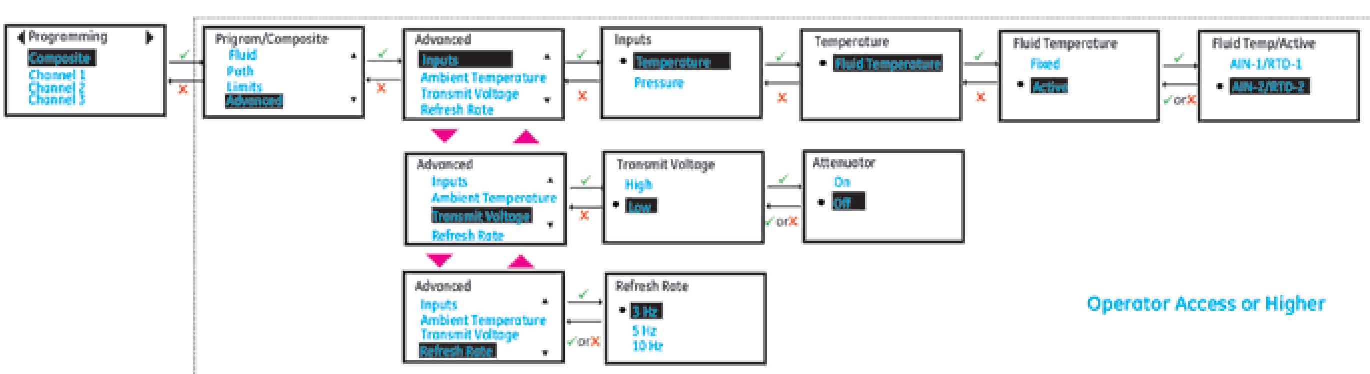


Figure 72: Advanced setting

3.6.6 Channel X programming

This menu is used to setup Channels' Transducers, Placement and Advanced channel settings. Use steps as in section "Log-in and Primary Pages" to navigate to the Programming page.

1. Then highlight [Channel x] and press [ENTER].

3.6.6a Programming the transducer

Note: The Panametrics Transducer Installation Guide for your transducer model provides more detailed information on transducer mounting configurations.

1. Scroll and highlight [Transducer] and press [ENTER].
2. The meter supports a list of Standard transducers. For standard transducers (see Table 19) supported in the meter, the [Transducer Frequency], [Static Tw], [Wedge Angle] and [Wedge Soundspeed] are automatically selected.
3. If you have a special transducer that is not listed in Table 19, then select [Transducer] as Special and program the Transducer Frequency, Static Tw, Wedge Angle and Wedge Sound speed. Contact the factory or Panametrics Services for values suitable for your transducers.

Table 19: Standard Transducers

Transducer Number	Transducer Model Number
15	(#15/115) C-PT-05-H
16	(#16/116) C-PT-10-H
17	(#17/117) C-PT-20-H
23	C-LP-40-HM
24	C-LP-40-NM
312	C-RW-312
318	C-RW-318
401	C-RS-401
402	C-RS-402
403	C-RS-403
407	UTXDR-407
408	UTXDR-408
505	C-RR-505
510	C-RR-510
520	C-RR-520
591	C-RR-591
592	C-RR-592
595	C-RR-H-595
596	C-RR-H-596
597	C-RR-H-597
601	C-AT-601
602	C-AT-602
603	C-AT-603

3.6.6b Programming the placement

The Placement menu allows the user to configure the mounting method of the transducers, based on the Transducer and Pipe programming done as specified in sections "Programming Menu Options" on page 60 and "Programming the Transducer" on page 65.

1. Refer to Figure 75, select [Placement] and press [ENTER].
2. Program the [No. of Traverses] based on your transducer installation and transducer configuration. Refer to Figure 73 for possible Traverse configurations supported in the meter. Typically, a two-traverse installation is used.
3. The [Spacing] shows the value calculated by the XMT1000 for the correct distance between the upstream and downstream transducers, based on your programmed transducer, fluid and pipe data. This is the physical spacing value that should be used when installing your transducer clamping fixture on the pipe (see Figure 74). When exiting from the [Channel x] menu, the meter will display a message indicating that the Physical spacing of the transducers need to be adjusted to the value calculated by the XMT1000.
4. Adjust the physical spacing to value calculated by the XMT1000.
5. Repeat section "Channel X Programming" on page 65 for all channels.
6. This completes the programming for flow measurements. All further steps involve calibrating meter for accurate velocity and sound speed measurements. Exit programming by pressing [ESC] until Save options are displayed on the menu. Highlight [Save] or [Save and Logout] and Press [ENTER] to save settings. The meter will not use the changed setting to make measurements until the settings are explicitly saved.
7. Make sure your pipe is full and there is no flow. Before you proceed to next section "Programming Advanced Channel Settings" on page 69, allow for a 5-minute zero flow stabilization time.

Note: If your transducers need to be installed with a spacing different than that calculated by the XMT1000, make sure it is within 10% of the calculated value. Overwrite the meter calculated [Spacing] value with installed Physical spacing.

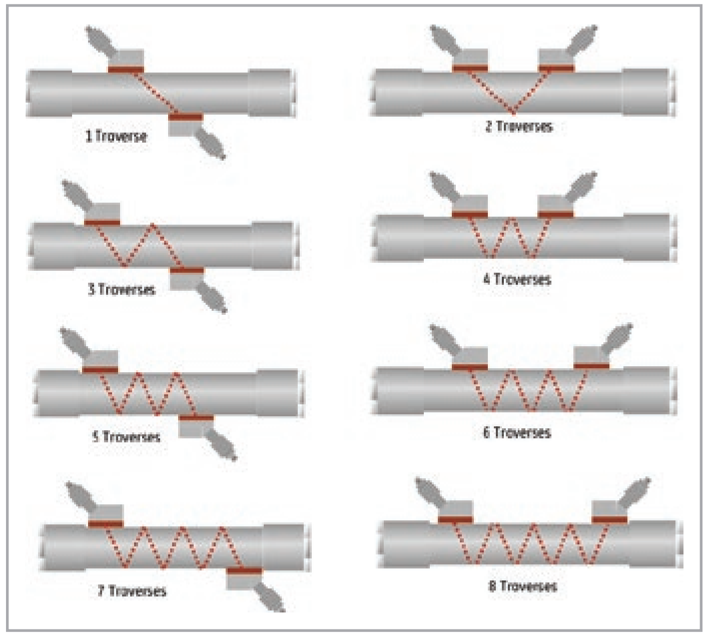


Figure 73: Traverse configurations

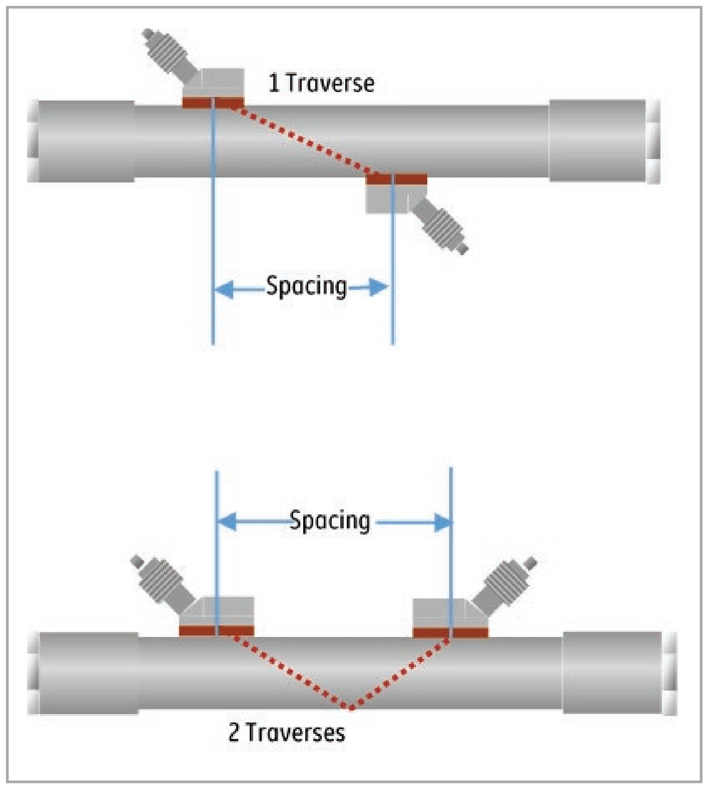


Figure 74: Spacing

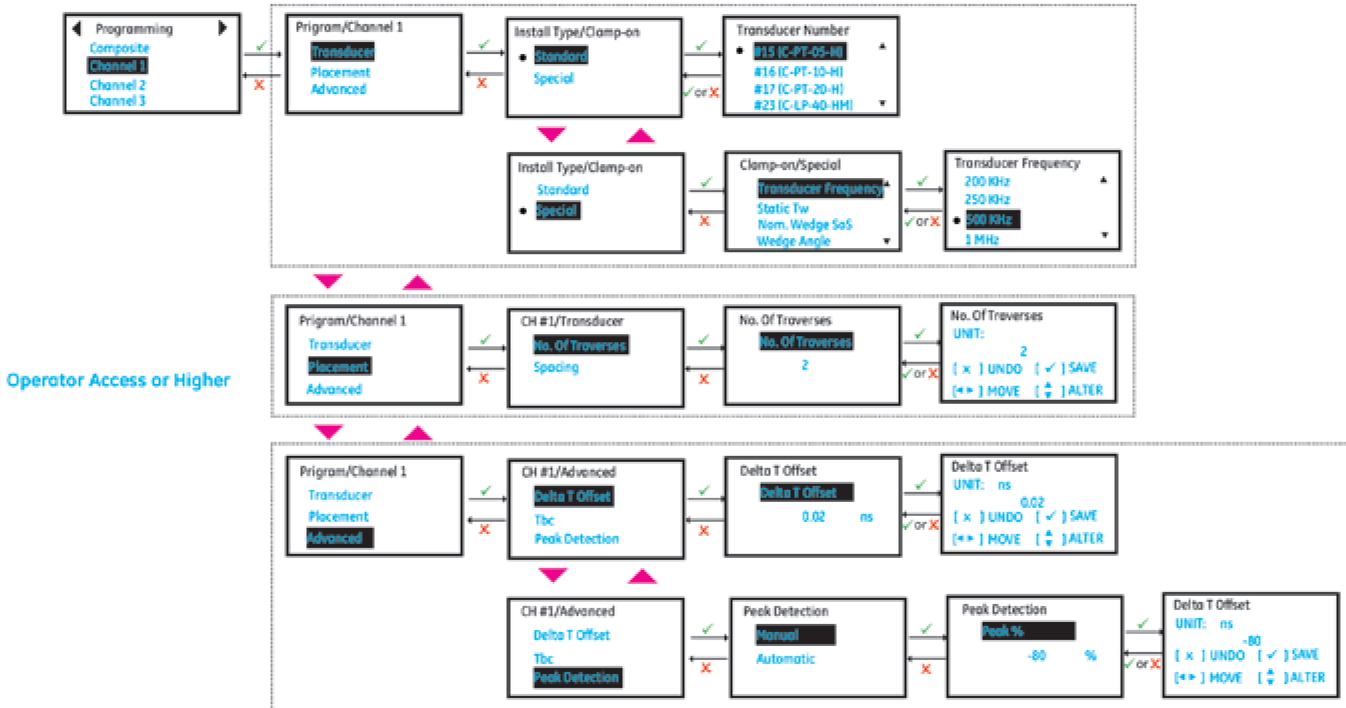


Figure 75: Channel programming (transducer, placement and advanced)

3.6.6c Programming advanced channel settings

1. Refer to Clamp-on Calibration procedure for calibrating zero flow [Delta-T Offset].
2. Refer to Section 3.6.7a Fluid Speed of Sound Calibration for Calibrating sound speed.
3. Scroll and highlight [Peak Detection] and press [ENTER]. Select [Automatic] for the meter to automatically pick the [Peak %]. If you frequently see E6: Cycle Skip errors, please contact Factory.

3.6.7 Fluid speed of sound calibration

In order to perform Speed of sound (SOS) calibration it's necessary to install VitalityTM PC Software application ver. 1.5.0 or later. SOS calibration procedure is described in the CAL-TRIM-TEST section of Vitality Help manual which can be launched from application's main menu.

The XMT1000 can calibrate the fluid speed of sound (SOS) after installation, provided the operator knows the fluid SOS under the current flow conditions. The measured fluid SOS should be within the accuracy specification after following the standard installation procedures. This SOS calibration is for fine-tuning of the XMT1000 meter under the on-site installation conditions and maintaining the high accuracy performance.

3.6.7a Fluid SOS calibration procedure

SOS calibration will be done on each channel. After calibration, the measured SOS from each channel, and the composite channel, shall read within ±1 ft/s (or 0.3 m/s) of expected value. Calibrate the fluid SOS as per below procedure.

Calibration Procedure:

1. Open Panametrics Vitality. Click on [Connect].
2. Select instrument model and communication Port.

Figure 76: Vitality screen

3. Click on [CONNECT TO INSTRUMENT].
4. Change Access Level to Operator and enter respective [Password]. Click on [Change Access Level].

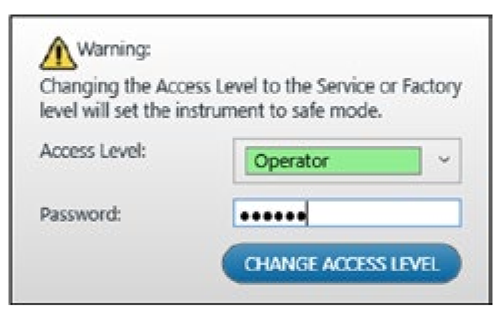


Figure 77: Vitality screen - Warning

5. Click on [Cal-Trim-Test]. Expand the [SOS calibration] parameter.

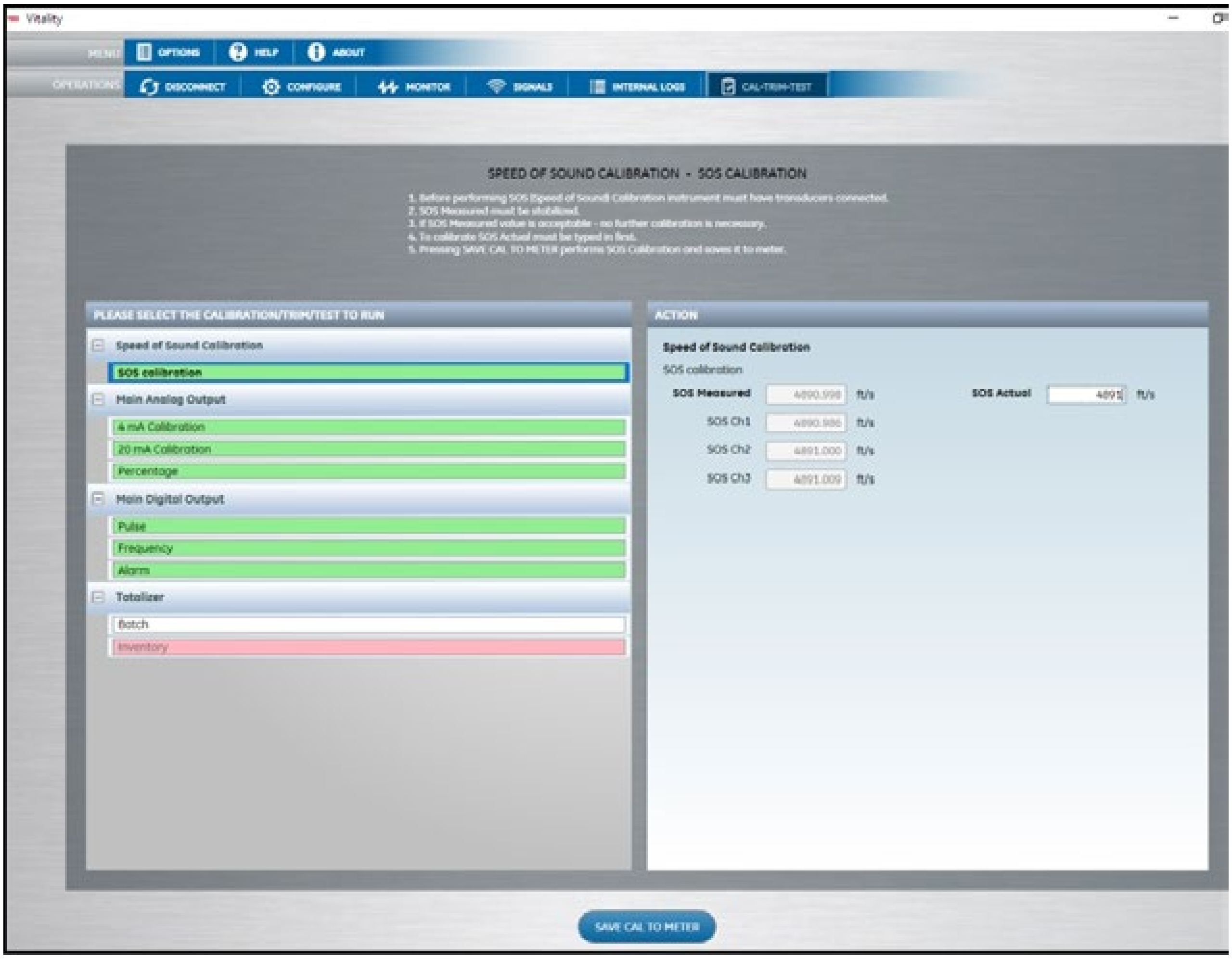


Figure 78: SOS calibrations

Depending on the path configuration, the SOS values for SOS Measured (composite), SOS Ch1, SOS Ch2, SOS Ch3 will be displayed and dynamically updated.

6. Enter the expected SOS value for your specific flow conditions in [SOS Actual] to fine-tune the meter for all its channels.
7. Click on [Save CAL TO METER], the displayed SOS values shall be updated accordingly.
8. Acceptance Criteria: ± 1 ft/s or 0.3 m/s.

3.7 Calibration

This menu is used to Calibrate the XMT1000 meter to another flow rate reference. Use steps as in section “Log-in and Primary Pages” to navigate to the Calibration page.

Note: Use either [Meter Factor] or [K-Table], do not use both at the same time.

1. Scroll and highlight [Meter Factor] and press [ENTER]. Meter Factor is a single multiplier that is applied to the Composite Velocity measurement. The default value is 1.0 and if a single factor would suffice to bring the velocity range measured towards another flow rate reference, this option is used. If a single factor is insufficient to cover the flow velocity range or viscosity range use K-Table option.
2. If using [Meter Factor], skip the following steps, otherwise Scroll and highlight [Calibration Mode] and press [ENTER]. The meter supports Gate(Totalizer) or Frequency Output Calibration methods.

a. If Gate(Totalizer) is chosen, connect the Gate inputs to E1 and E2 test points found on the bottom left front side of the main PCB once the front cover is removed.

b. If Frequency Output is used for calibration, set the [Measurement Type], its corresponding [Base Value], [Full Value], and respective [Base Frequency], [Full Frequency]. Set a [Test Frequency] value to test the Frequency Output connection before starting Calibration.

3. Scroll and highlight [Calibration Type] and press [ENTER]. The calibration type can be set to either Velocity or Reynolds number. Depending on the selection the K-Table points will be updated to accept Velocity or Reynolds number entries.
4. Scroll and highlight [Reset K-Table] and press [ENTER]. Select the table to reset. You can choose to reset all tables, or composite K-Table or any specific channel K-Table.
5. Scroll and highlight [K-Table Selection] and press [ENTER]. The default option is Off. For “as found” calibration leave the [K-Table Selection] as OFF. After

completion of the "as found" calibration and identifying the K-Factor values for each calibration point, select [Composite] table or [Channel] table option.

6. Scroll and highlight [No. of Points] and press [ENTER]. Enter the number of points to enter in the K-Table.
7. Scroll and highlight [K-Table] and press [ENTER]. Select each point and update the [Velocity] or [Reynolds Number] and its corresponding [K-Factor]. These points define a calibration curve for the XMT1000.

Note: [K-Table] Velocity or Reynolds number (Point #1 to Point #20) should be entered in ascending order for the meter to function correctly.

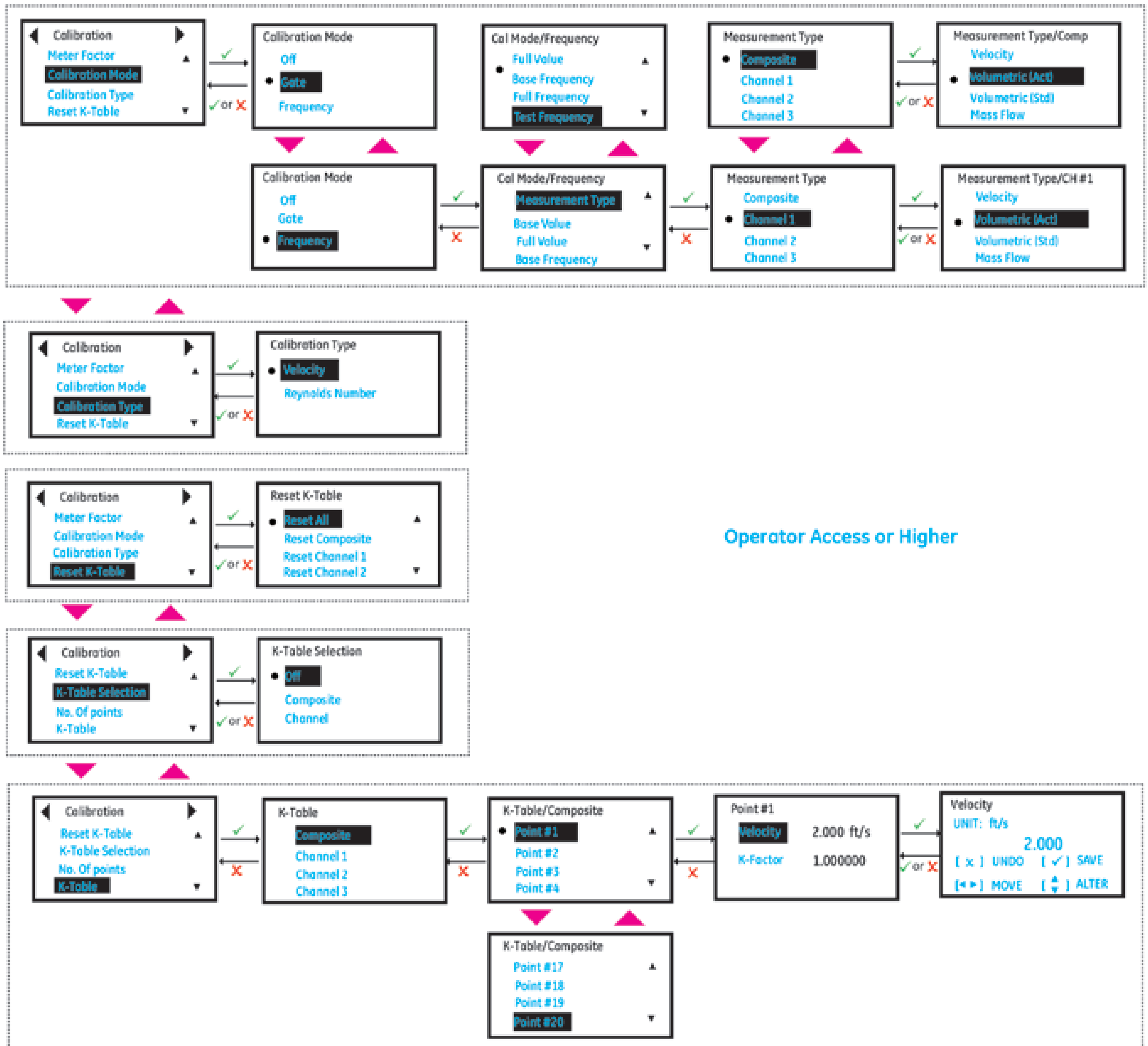


Figure 79: Calibration menu

Chapter 4. Error codes and troubleshooting

4.1 Introduction

The XMT1000 flow transmitter is a reliable, easy to maintain instrument. When properly installed and operated, as described in Chapter: 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 XMT1000 flow meter. Indications of a possible problem include

- Display of an error message on the LCD screen, Vitality PC software, or HART
- Erratic flow readings
- Readings of doubtful accuracy (e.g., readings that are not consistent with readings from another flow measuring device connected to the same process).

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

Note: For high electrical noise areas, it is recommended that you use the CE Installation methods in Appendix B.

4.2 Error classification and error codes

The XMT1000 electronics includes two or more subsystems. The Transmitter, Flow Measurement unit and/or Option I/O. The purpose of the Error codes and string is to convey to the operator about the issues in the specific subsystem. The communication error indicates that the Transmitter subsystem has lost communication with Flow measurement sub-system or the Option I/O sub-system.

Errors in XMT1000 are classified into 5 types as indicated in the table below:

Table 20: XMT1000 error classification

Error Classification	Error Number	Subsystem
Communication Errors	C_n where n is the Error number	Transmitter to Flow or Option I/O
Flow Errors	E_n where n is the Error number	Flow subsystem
System Errors	S_n where n is the Error number	Transmitter or Flow subsystem
Transmitter Errors	X_n where n is the Error number	Transmitter subsystem
Option I/O Errors	A_n where n is the Error number	Option I/O subsystem

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

All the possible XMT1000 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 left corner of the LCD screen, as discussed in Programming Chapter.

If an error message appears on the display screen during operation of the XMT1000, refer to the appropriate section of this chapter for instructions on how to proceed. You may be asked to contact Panametrics. Providing all of the diagnostic data and parameter information as in the Diagnostics Data Table prior to calling your local sales or service center will help to speed up the issue resolution.

4.3 Flow errors (E-errors)

4.3.1 General Guidelines for troubleshooting flow errors with error codes

If the Error code on the LCD or Vitality PC software indicate E22: SingleChAccuracy or E23: MultiChAccuracy, refer to the appropriate section below. Also, refer to Table 21 below for causes and recommended actions for each Error code.

4.3.1a Single channel error

If only one channel is in error, the most likely causes are:

1. Incorrect programming on Error Limits or flow condition changes that now make previous programming invalid.
2. Defective/Damaged cables, transducers, incorrect physical spacing, couplant, buffer or electronics.

After you have tried eliminating/correcting for any most likely causes mentioned above, if error still exists, also check Process/flow conditions such as:

1. Excessive turbulence.
2. Discontinuities in fluid characteristics such as multi-phase flow, flashing, pockets of gas, presence of bubbles or solid particles, cavitation or rapidly changing fluid type.
3. Extreme fluid properties, such as pressure or temperature.
4. Wax build-up inside the pipe.
5. Half-full pipe.

4.3.1b Multi-channel error

If more than one channel is in error, the most likely cause is changes in process/flow conditions such as:

1. Excessive turbulence.
2. Discontinuities in fluid characteristics such as multi-phase flow, flashing, pockets of gas, presence of bubbles or solid particles, cavitation or rapidly changing fluid type.
3. Extreme fluid properties, such as pressure or temperature.
4. Wax build-up inside the pipe.
5. Partially filled pipe.

After you have tried eliminating/correcting for any most likely causes mentioned above, if error still exists, also check:

1. Incorrect programming on Error Limits or flow condition changes that now make previous programming invalid.
2. Defective/Damaged cables, transducers, incorrect physical spacing, couplant, buffer or electronics.

In case you are unable to clear the errors, collect diagnostic data and parameter information for each channel in the Diagnostics Data Table prior to calling your local sales or service center.

4.3.1c Viewing channel specific error/warnings

To indicate the health of the meter, PanaFlow™ LC has built-in Error codes. The Channel specific errors are very critical in determining the corrective actions required. Figure 80 below shows the steps to view current channel specific errors/ warnings. The description of the Error Codes and the recommended actions are provided in Table 21 below.

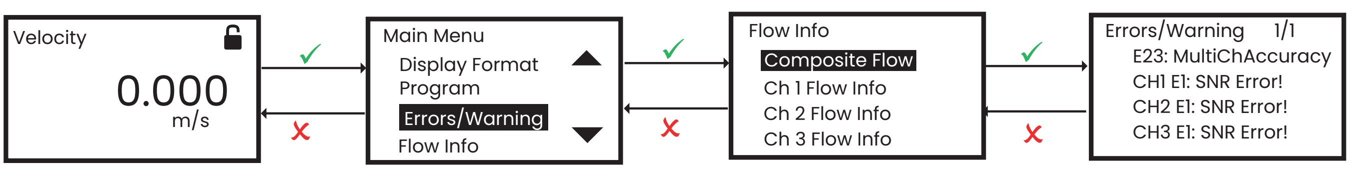


Figure 80: Viewing current channel specific errors

Table 21: Flow error description and recommended actions			
Error Code	**Problem**	**Cause**	**Recommended Action**
E1: SNR	The Signal to Noise ratio is low	The acoustic signal from the process is very weak. This could be due to bubbles, other fluid conditions, an empty pipe, broken cables, transducers, couplant or buffers	Check if the Active Tw measurement on upstream and downstream transducers is valid. If Active Tw measurement is valid then this error is an indication of the problem with the process conditions. If Active Tw measurement is not valid then check the value entered in SNR Min Error Limits option (Refer Programming Chapter). Also, refer to "Fluid and Pipe Problems" and "Transducer Problems" sections to correct for any issues
E2: Soundspeed	The measured sound speed exceeds programmed limits	The error may be caused by incorrect programming, poor flow conditions or poor transducer orientation. It may also occur if signal quality is poor	Compare the measured sound speed to programmed nominal values for the process fluid and correct any programming errors. Refer to "Fluid and Pipe Problems" and "Transducer Problems" sections to correct for any issues. In case you are unable to clear the errors, gather the required diagnostics before contacting Panametrics
E3: Velocity Range	The measured velocity exceeds programmed limits	This error may be caused by incorrect programming, poor flow conditions and/or excessive turbulence	Make sure the actual flow rate is within the programmed Error limits (Refer Programming Chapter). Refer to "Fluid and Pipe Problems" and "Transducer Problems" sections to correct any issues
E4: Signal Quality	The signal quality is lower than the programmed limits	This means the signal shape, upstream to downstream reciprocity, or signal correlation value has fallen below the correlation peak limit. The cause is usually the same as E6 or E5	Make sure the Signal Quality is greater than the programmed Error limits (Refer Programming Chapter). Refer to "Fluid and Pipe Problems" and "Transducer Problems" sections to correct any issues. Gather required diagnostics data before contacting Panametrics

Table 21: Flow error description and recommended actions

Error Code	Problem	Cause	Recommended Action
E5: Amplitude	The signal amplitude exceeds the programmed limits	This error may occur due to high signal attenuation or amplification due to changes in fluid properties, transducer, buffer and/or couplant issues	Make sure the amplitude is within the programmed limits. If the gain is negative and Amplitude > 32, change the Transmit Voltage to “Low”. If it is still negative, enable Attenuator. Do not enable Attenuator if the Transmit Voltage is high. If the gain is greater than 35 dB, change the Transmit Voltage to “High” (Refer Programming Chapter). Refer to “Fluid and Pipe Problems” and “Transducer Problems” sections to correct any issues. Gather required diagnostics data before contacting Panametrics
E6: Cycle Skip	A cycle skip is detected while processing the signal for measurement	This is usually due to poor signal integrity, possibly because of bubbles in the pipeline, sound absorption by very viscous fluids, or cavitation	If this error is caused by changes in flow rate, this error will be auto corrected when flow rate stabilizes after initial acceleration. But, if the error stays refer to “Fluid and Pipe Problems” section to correct any issues. Check Threshold Peak percentage, and gather required diagnostics data before contacting Panametrics
E15: Active Tw	The Active Tw measurement is invalid	A transducer, cable is damaged, or a transducer needs to be re-coupled. This may also be due to incorrect programming, or extreme process temperatures	Refer to “Transducer Problems” sections to correct any issues. In case you are unable to clear the errors, gather required diagnostics before contacting Panametrics
E22: Single Channel Accuracy	One of the measurement channels is in error	One measurement channel is in error; accuracy of the measurement may be compromised because the meter might be using a sister chord substitution	Check individual channel errors, refer to this table for recommended actions to correct channel errors

table 21: flow error description and recommended actions			
Error Code	**Problem**	**Cause**	**Recommended Action**
E23: Multi Channel Accuracy	Two or more measurement channels are in error	Two or more measurement channels are in error; accuracy of the measurement may be compromised because the meter is using a sister chord substitution	Check individual channel errors, refer to this table for recommended actions to correct channel errors
E27: Invalid K-Table	K-Table is invalid	The entered K-table is invalid	Check the K-table values and ensure the Velocity or Reynolds Number in the table is in ascending order
E28: Software Fault	Software malfunction	This is a Software malfunction.	This condition is not self-recovering and will not automatically correct itself. Try power cycling the meter. If error persists after power cycle, contact Panametrics factory.
E29: Velocity Warning	The measured velocity exceeds programmed warning limits	This error may be caused by incorrect programming, poor flow conditions and/or excessive turbulence	Make sure the actual flow rate is within the programmed Warning limits (Refer Programming Chapter). Refer to "Fluid and Pipe Problems" and "Transducer Problems" sections to correct any issues
E31: Not Calibrated	The flow meter has not been calibrated	The flow meter has not been calibrated at the factory and hence not making measurements. Please contact Panametrics factory	The condition is not self-recovering and will not automatically correct itself. Contact Panametrics factory to get more information on the meter setup

4.4 Fluid and pipe problems

If preliminary troubleshooting with the Error Code Messages and 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 related to the fluid or the pipe. If the instructions in this section fail to resolve the problem, contact Panametrics for assistance.

4.4.1 Fluid problems

Most fluid-related problems result from a failure to observe the flow meter system installation instructions, as described in Chapter: Installation.

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:

- 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 XMT1000, excessive amounts of solid 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.
- The fluid must not cavitate near the measurement point.
  Fluids with a vapor pressure relatively close to process pressure may cavitate near the measurement point. Cavitation can usually be controlled through proper system design.
- The fluid must not excessively attenuate ultrasound signals.
  Some fluids, particularly those that are very viscous, readily absorb ultrasound energy. In such a case, signal warning and error message will appear on the display screen to indicate that the ultrasonic signal strength is insufficient for reliable measurements.
- The fluid soundspeed must not vary excessively.
  The XMT1000 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. Also, fluctuations in fluid sound speed due to changes in temperature will likely recover independently. Rapid fluctuations in the fluid sound speed, to a value that is beyond ± 20% from that programmed into the XMT1000, will result in erratic or inaccurate flow rate readings. This may occur when changing batch fluids.

Note: Refer to Chapter 3: Programming, to make sure the appropriate soundspeed is programmed into the meter.

4.4.2 Pipe problems

Pipe-related problems may result from improper choice in meter location or errors in programming. The following may result in problematic installations:

- *The collection of material at the transducer location(s).*
  Accumulated debris at the transducer locations will interfere with the transmission of the ultrasound signals. As a result, accurate flow rate measurements are not possible. Realignment of the transducers often corrects these problems but, in some cases, wetted transducers must be used. Refer to
  Chapter: Installation for more details on proper installation practices.
- *Inaccurate pipe measurements.*
  The flow rate measurement accuracy relies greatly on 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, pitting or rough surfaces, eccentricity, weld deformity, straightness and other factors that may cause inaccurate readings. Refer to the Chapter: Programming, for instructions on entering the pipe data.
- *The inside of the pipe or pipe is not sufficiently clean.*
  Excessive buildup of scale, rust or debris inside the pipe will interfere with flow measurements. 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 flow rate measurements.

4.5 Transducer problems

Ultrasonic transducers are rugged, reliable devices. However, they are subject to physical damage from mishandling and chemical attack. The following list of potential problems is grouped according to transducer type. Contact Panametrics if you cannot solve a transducer-related problem.

4.5.1 Transducer problems

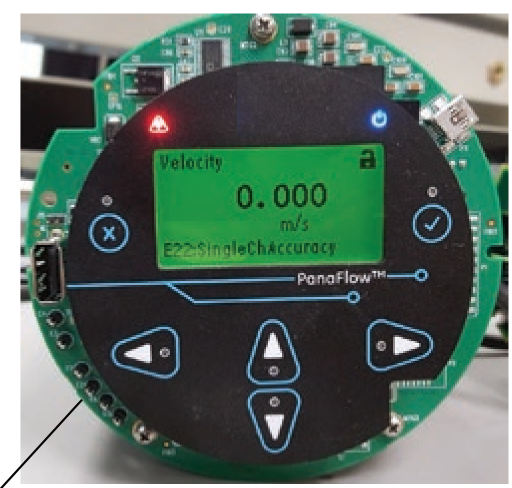
- Internal Damage: An ultrasonic transducer consists of a ceramic crystal bonded to the transducer case. The bond between the crystal and the case or the crystal itself may be damaged by extreme mechanical shock and/or temperature extremes. Also, the internal wiring can be corroded or shorted if contaminants enter the transducer housing.
- Physical Damage: Transducers may be physically damaged by dropping them onto a hard surface or striking them against another object. The transducer connector is the most fragile part and is most subject to damage. Minor damage may be repaired by carefully bending the connector back into shape. If the connector can not be repaired, the transducer must be replaced.

IMPORTANT:

Transducers must be replaced in pairs. Refer to Chapter 3, Programming, to enter the new transducer data into the meter.

4.6 Service test points

Service tests points can be found on the XMT1000 Main board just inside the front cover. There are 6 pins found on the bottom left front side of the main PCB that are accessible to service personnel. These test points are easily connected by standard oscilloscope probes and allow the service person to look at critical signals.



Service Test Points

Figure 81: Service test points

The test points are:

Table 22: Test points	
E1	DRTN
E2	Gate
E3	TWIND
E4	RWIND
E5	ARTN
E6	RCV

GATE: Gate connection is input to start and stop flow calibration process. This input detects an outside source contact closure. A closure can be programmed to stop totals or clear totals. Use DRTN along with GATE.

Table 23: Gate connections	
TWIND: Transmit Window	use DRTN with TWIND
RWIND: Receive Window	use DRTN with RWIND

RCV: Receive signal allows the user to look at the receive signal before it is processed by the meter. It is usually looked at along with the TWIND and RWIND. Use ARTN with RCV signal.

4.7 System errors (S-errors)

These errors are from the Flow subsystem. The system errors have 4 types of information.

1. Indicator
2. Warning
3. Error
4. Fault

The indicator is just a notification to the operator, no action is needed. The warnings are usually indicative of an operator error. Errors indicate failures that need attention. Operator should perform recommended actions to recover from these errors. Faults are usually indicative of more serious failures related to background hardware / software integrity checks performed by XMT1000 meter. See the table below for error codes, error messages, error type and recommended actions.

Table 24: System error description and recommended actions		
Error Code	**Error Message**	**Description / Recommended Action**
S1: In Config Mode	In configuration mode indicator	**Indicator:** This is displayed when a user has logged in to either Operator, Admin or Factory access level. The indicator will clear automatically when the user logs out or saves the configuration changes
S2: Invalid User	Invalid user warning	**Warning:** The passcode entered for access level is incorrect. Please log in with the correct access level and passcode
S3: Invalid Request	Invalid request warning	**Warning:** An invalid communication packet was received and discarded. Or, the requested operation is invalid. Please send a valid packet or operation request
S4: Invalid Param Range	Invalid parameter range warning	**Warning:** The value programmed for the parameter was out of range and hence discarded. Please enter a valid range
S5: Unsupported Parameter	This parameter is not supported	**Warning:** A read or write request to an unsupported parameter was received
S6: Flow Measurement	One or more flow measurement channels are in error	**Error:** One or more flow measurement channels are in error; accuracy of the measurement may be compromised. For more details please check flow(E) errors
S7: Persistent Param CRC	Persistent parameter CRC fault	**Fault:** Persistent parameter CRC failed. Try power cycling the meter. If error persists after power cycle, contact Panametrics factory
S11: Clock Frequency	Clock frequency error	**Fault:** Input clock frequency failure. Try power cycling the meter. If error persists after power cycle, contact Panametrics factory
S12: CPU	CPU error	**Fault:** CPU registers have stuck bits. Try power cycling the meter. If error persists after power cycle, contact Panametrics factory
S13: Invariable Flash Memory	Flash memory fault	**Fault:** Flash memory test failed. Try power cycling the meter. If error persists after power cycle, contact Panametrics factory

Table 24: System error description and recommended actions		
Error Code	**Error Message**	**Description / Recommended Action**
S14: Invariable SRAM	Invariable SRAM fault	**Fault:** Invariable SRAM memory test failed. Try power cycling the meter. If error persists after power cycle, contact Panametrics factory
S15: Variable Memory	Variable SRAM fault	**Fault:** Variable SRAM test failed. Try power cycling the meter. If error persists after power cycle, contact Panametrics factory
S16: FPGA Config	FPGA configuration error	**Fault:** FPGA configuration validation failure. Try power cycling the meter. If error persists after power cycle, contact Panametrics factory
S17: Temperature	Temperature error	**Error:** Temperature of the electronics is outside the pre-defined operating range. Make sure that the ambient temperature is not outside the meter operating range
S18: Driver Fault	Driver failure	**Fault:** Driver failure. Try power cycling the meter. If error persists after power cycle, contact Panametrics factory
S19: Watch Dog Failure	Watch dog failure	**Fault:** Watch dog test failed. Try power cycling the meter. If error persists after power cycle, contact Panametrics factory
S21: Stack Overflow	Stack overflow	**Fault:** Stack overflow. Try power cycling the meter. If error persists after power cycle, contact Panametrics factory
S22: Sequence or Window Watchdog	Sequence failed	**Fault:** Sequence failure detected. Try power cycling the meter. If error persists after power cycle, contact Panametrics factory
S23: Initialization Failed	Initialization failed	**Error:** Initialization failed. Please verify all the configuration parameters. If error persists, contact Panametrics factory
S24: DSP Hardware Errors	DSP hardware failed	**Fault:** DSP hardware failure detected. Try power cycling the meter. If error persists after power cycle, contact Panametrics factory
S25: DSP Exception	DSP exception	**Fault:** DSP exception. Try power cycling the meter. If error persists after power cycle, contact Panametrics factory

Table 24: System error description and recommended actions		
Error Code	**Error Message**	**Description / Recommended Action**
S26: Default ISR	Exception within the ISR	**Fault:** Exception within the ISR. Try power cycling the meter. If error persists after power cycle, contact Panametrics factory
S27: DSP Reset ISR	Exception within the DSP ISR	**Fault:** Exception within the DSP ISR. Try power cycling the meter. If error persists after power cycle, contact Panametrics factory
S28: Software Fault	Software malfunction	**Error:** Software malfunction. Try power cycling the meter. If error persists after power cycle, contact Panametrics factory
S30: Flash Save Failed	Save to Flash Failed	**Error:** Request to Save failed. Try again. If error persists, contact Panametrics factory.

4.8 Communication errors (C-errors)

The communication error indicates that the Transmitter subsystem has lost communication with Flow measurement sub-system or the Option I/O sub-system.

Table 25: Communication error description and recommended actions		
Error Code	**Error Message**	**Description / Recommended Action**
C1: Flow COMM Error	Flow board communication error	Transmitter cannot communicate to the flow measurement unit. Try power cycling the meter. If error persists after power cycle, contact Panametrics factory
C3: Option I/O COMM Error	Optional I/O subsystem communication error	Transmitter cannot communicate to the Optional I/O in Slot-2. Try power cycling the meter. If error persists after power cycle, contact Panametrics factory

4.9 Transmitter errors

These errors are from the Transmitter subsystem. Should you encounter one of the Transmitter Errors, follow recommended actions as indicated in Table 26 and contact Panametrics factory.

Table 26: Transmitter error description and recommended actions

Error Code	Error Message	Description / Recommended Action
X1: MCU RAM Error	Transmitter RAM Fail	Memory test on transmitter RAM failed. Try power cycling the meter. If error persists after power cycle, contact Panametrics factory
X2: MCU Flash CRC Error	Flash memory test failed	Flash memory test failed. Try power cycling the meter. If error persists after power cycle, contact Panametrics factory
X7: MPU not Detected	No flow board detected	Flow board is not detected by the transmitter. Try power cycling the meter. If error persists after power cycle, contact Panametrics factory
X12: System Command Fail	System command failed	System command failed. Try power cycling the meter. If error persists after power cycle, contact Panametrics factory
X13: Get GUI Node Fail	Failed to generate GUI	Failed to generate GUI. Try power cycling the meter. If error persists after power cycle, contact Panametrics factory
X14: Node Memory Fail	GUI node memory failed	GUI node memory failed. Try power cycling the meter. If error persists after power cycle, contact Panametrics factory
X15: Font API Initialize Fail	Failed to generate font	Failed to generate font. Try power cycling the meter. If error persists after power cycle, contact Panametrics factory
X16: XML File Initialize Fail	XML file initialization failed	XML file initialization failed. Try power cycling the meter. If error persists after power cycle, contact Panametrics factory

4.10 Option I/O errors

Table 27: Option I/O errors description		
Error Code	**Error Message**	**Description**
A1:AnalogCh(S2:3) Error!	ADC Channel(S2:3) is not responding	Analog input /RTD input is not working. If error persists after power cycle, contact Panametrics factory
A2:AnalogCh (S2:4) Error!	ADC Channel(S2:4) is not responding	Analog input /RTD is not working. If error persists after power cycle, contact Panametrics factory
A3:AnalogCh (S2:1) Error!	DAQ Channel (S2:1) is not responding	Analog output (4-20mA) is not working. If error persists after power cycle, contact Panametrics factory
A4:AnalogCh (S2:2) Error!	DAQ Channel (S2:2) is not responding	Analog output (4-20mA) is not working. If error persists after power cycle, contact Panametrics factory
A6:(S2:3)Ch Not Calibrated	Error occurs when Analog Input/ RTD(S2:3) are not calibrated	Calibrate the Analog Input/RTD input. If error persists after calibration, contact Panametrics factory
A7:(S2:4)Ch Not Calibrated	Error occurs when Analog Input/RTD (S2:4) are not calibrated	Calibrate the Analog Input/RTD input. If error persists after calibration, contact Panametrics factory
A10:(S2:3)Input NotConnect!	Analog Input: Error occurs when (4-20mA) input is not connected at Channel (S2:3). RTD Input: Error occurs when RTD input is not connected or temp greater than 390 deg C at Channel (S2:3)	Check connectivity for Analog Input/ RTD input and RTD temperature. Try power cycling the meter. If error persists after power cycle, contact Panametrics factory
A11:(S2:4)Input NotConnect!	Analog Input: Error occurs when (4-20mA) input is not connected at Channel (S2:4). RTD Input: Error occurs when RTD input is not connected or temp greater than 390 deg C at Channel (S2:4)	Check connectivity for Analog Input/ RTD input and RTD temperature. Try power cycling the meter. If error persists after power cycle, contact Panametrics factory
A12:(S2:3)Ch OverRange Err!	Exceeds input values. For analog input (S2:3) greater than 21mA	Ensure analog input current less than 21mA. Try power cycling the meter. If error persists after power cycle, contact Panametrics factory
A13:(S2:4)Ch OverRange Err!	Analog input(S2:4) greater than 21mA	Ensure analog input current less than 21mA. Try power cycling the meter. If error persists after power cycle, contact Panametrics factory

Table 27: Option I/O errors description		
Error Code	**Error Message**	**Description**
A24:Aout(S2:1)OutOfRa nge!	When output from analog output(S2:1) exceeds 21 mA or less than 3.6 mA	Check the flow velocity. If velocity is within limits and error still persists, contact Panametrics factory
A25:Aout(S2:2)OutOfRa nge!	When output from analog output(S2:2) exceeds 21 mA or less than 3.6 mA	Check the flow velocity. If velocity is within limits and error still persists, contact Panametrics factory
A31:(S2:3)Ch UnderRange!	Lesser input values. For analog input(S2:3) between 3.6 mA to 0.25mA	Check input analog current is between 3.6 mA to 21mA. If error persists, contact Panametrics factory
A32:(S2:4)Ch UnderRange!	Lesser input values. For analog input(S2:4) between 3.6 mA to 0.25mA.	Check input analog current is between 3.6 mA to 21mA. If error persists, contact Panametrics factory

4.11 Diagnostics data

To determine the health of the meter, PanaFlow™ LC has built-in diagnostic parameters. Please refer to Table 28 below for diagnosing any problems with the system. If the meter shows errors and the diagnostics data indicate issues, fill in the User/Service record appendix before contacting Panametrics factory.

Table 28: Diagnostic Parameter Description and Health Indicators			
Parameter	**Description**	**Good**	**Bad**
Sound Speed	Measured speed of sound of the fluid	• Under ideal conditions sound speed should be within 5 ft/s (1.5 m/s) between channels. • Depending on flow viscosity, flow rate, there can be slightly different sound speed showing on different channels. This could be normal due to different signal path.	• Under ideal conditions, sound speed spread of 30 ft/s (9 m/s) or more between the sound speed measurement of the channels can be an indication of a problem with the pipe installation or any other different local pipe condition.
SNR Up	Signal to noise ratio of the upstream transducer	>5	<2 SNR value between 2 and 5 shall provide valid measurements but can be an indication of a problem with the pipe installation or any other different local pipe condition. Verify the clamping fixture alignment, transducer spacing, transducers, couplant, all the other connections.

Table 28: Diagnostic Parameter Description and Health Indicators			
Parameter	**Description**	**Good**	**Bad**
SNR Down	Signal to noise ratio of the downstream transducer	>5	<2 SNR value between 2 and 5 shall provide valid measurements but can be an indication of a problem with the pipe installation or any other different local pipe condition. Verify the clamping fixture alignment, transducer spacing, transducers, couplant, all the other connections.
Gain Up / Gain Down	Gain setting	<0 dB and <35 dB • In water applications, under ideal conditions, gain should be greater than 0 dB and less than 20 dB. • For higher viscous liquids, gain between 20dB and 35 dB is acceptable.	<35 dB or <0 dB • Gain spreads of 10dB or more between the channels can be an indication of a problem with the pipe installation or any other different local pipe condition. • If the gain is negative, change the Transmit Voltage to "Low". If it is still negative, enable Attenuator. Do not enable Attenuator if the Transmit Voltage is high. • If the gain is greater than 35 dB, change the Transmit Voltage to "High".
Peak Index Up	Threshold peak of the upstream transmit correlation signal	• For pipe sizes greater than 1 inch, index should be between 400 - 700. • For pipe sizes less than 1 inch, the index should be between 150 - 350.	• For pipe sizes greater than 1 inch, if the index <400 or >700 then there is an indication of problem with receive window location. • For pipe sizes less than 1 inch, if the index <150 or >350 then there is an indication of problem with receive window location.
Peak Index Down	Threshold peak of the downstream transmit correlation signal	• For pipe sizes greater than 1 inch, index should be between 400 - 700. • For pipe sizes less than 1 inch, the index should be between 150 - 350.	• For pipe sizes greater than 1 inch, if the index <400 or >700 then there is an indication of problem with receive window location. • For pipe sizes less than 1 inch, if the index <150 or >350 then there is an indication of problem with receive window location.
Wall Time	Transit time inside the pipe wall	N.A	If the value is negative, then there is an indication of problem with the configuration parameters.

Table 28: Diagnostic Parameter Description and Health Indicators

Parameter	Description	Good	Bad
Lining Time	Transit time inside the pipe lining	N.A	If the value is negative, then there is an indication of problem with the configuration parametersw
Signal Quality Up	Signal quality of the upstream transducer	>1000	<1000
Signal Quality Down	Signal quality of the downstream transducer	>1000	<1000
Amplitude Up	Signal amplitude of the upstream transducer	>14 and <32	>32 or <14
Amplitude Down	Signal amplitude of the downstream transducer	>14 and <32	>32 or <14

[no content intended for this page]

Chapter 5. Maintenance and Service

5.1 Transducer maintenance and inspection

WARNING!

All equipment should be de-energized prior to servicing!

PanaFlow™ LC shows low signal strength upon couplant dry out or extrude.

Refer Couplant in “Transducer Installation” on page 15, Step 2 and “Transducer Installation” on page 15 for servicing couplant for proper operation of PanaFlow LC.

[no content intended for this page]

Appendix A. Specifications and model configurations

A.1 Operation and performance

Fluid Types

Liquids: acoustically conductive fluids, including most clean liquids, and many liquids with small amounts of entrained solids or gas bubbles. Maximum void fraction depends on transducer, interrogation carrier frequency, path length, and pipe configuration.

Flow Measurement

Correlation transit time technique

Accuracy

- ±1%: >=2 in pipe; greater than 1 ft/s velocity
- ±2%: <=2 in pipe; greater than 1 ft/s velocity

Accuracy statement assumes measurement of a single phase homogenous liquid with a fully developed symmetrical flow profile passing through the meter (typically 10 diameters upstream and 5 diameters downstream of straight pipe run). Applications with piping arrangements (e.g. two out of plane elbow at upstream) that create an asymmetrical flow profile may require extended piping straight runs and/ or flow conditioning for the meter to perform to this specification.

Calibration

All meters are water calibrated and include a calibration certificate.

Repeatability

±0.15% of reading

Range (Bidirectional)

-82 to 82 ft/s (-25 to 25 m/s)

Rangeability (Overall)

50:1

Transducers supported

- UTXDR 4 and 2 MHz
- CF-LP 4 and 2 MHz
- CRS 0.5, 1.0 and 2.0 MHz
- CPT HT 0.5, 1.0 and 2.0 MHz
- CET
- CRR 0.5, 1.0, and 2.0 MHz
- CAT 0.5, 1.0, and 2.0 MHz

Process Fluid Temperature Range

Local mount: -40°F to 185°F (-40°C to 85°C)

A.2 Electronics

Enclosures

Powder coated aluminum or stainless steel (SS316)

Classifications

US/CAN: Class I, Division 1,
Groups B, C, D; Class I, Zone 1, Ex
d IIB+H2 T6...150C;
ATEX/IECEx: Ex d IIB+H2 T6...150C
FISCO outputs Ta = -40°C to +60°C,
Type 4X
SINGLE SEAL

Electronics Mounting

Local or remote mounting Paths Three paths

Display

English
128 x 64 mono-color LCD display, configurable for single or dual measurement parameters

Keypad

Built-in magnetic, six-button, lockable keypad

Standard Inputs/Outputs

One 4 to 20 mA isolated output, 600-ohm maximum load
One additional output, may be configured as either a pulse or frequency

Additonal Inputs/Outputs

Two 4 to 20 mA isolated output, 600-ohm maximum load
Two 4 to 20 mA isolated input or RTD sensor input (Supports PT100: 3 and 4 Wire, PT1000: 3 and 4 Wire)

Digital Interfaces

Standard: RS485/Modbus® Optional: HART® 7.0 protocol, with 4 dynamic variables, includes one additional 4 to 20 mA analog output NAMUR NE43

Optional: Foundation Fieldbus® FISCO, LAS capable NAMUR NE107 with 5 AI blocks and a PID block

Power Supplies

Universal 100-240 VAC 50/60 Hz ±10% or 12 to 28 VDC

Cable Entries

¾" NPT As-Standard
M20 Via Adapters

Temperature Range

Operating: -40°F to 140°F (-40°C to +60°C)
Storage: -40°F to 158°F (-40°C to 70°C)

Power Consumption

15 Watts maximum

Wiring Connections

Cable entries include 6 × ¾" NPT, consult Panametrics for available adapters

Data Logging

Storage standard on the meter, up to 10,000 flow data points with up to 25 parameters per data point (requires Vitality™ software)

A.3 Part number information

A — B C D - E F G H - I - PREPRO - REPOR PMI Z

	A - MODEL:
XMT1000LC	XMT1000 LC TRANSMITTER
	B - PATHS:
1	Single path with w/ MCX Connectors
2	Two or three path with w/ MCX Connectors
3	Single path with Flying Leads
4	Two path with Flying Leads
	C - POWER:
AC	100-240 VAC power supply
DC	12-28 VDC power supply
	D - CONFORMAL COATING:
0	No Conformal coating
1	With Conformal coating
	E: ENCLOSURE:
AL	Powder coated AL enclosure
SS	316 st Current inputnless steel enclosure
	F - INPUT/OUTPUT:
00	No additional input/output
01	2 Current Outputs, 2 Current inputs
02	2 Current Outputs,1 Current input,1 RTD input-PT100, 3 Wire
03	2 Current Outputs,2 RTD inputs-PT100, 3 Wire
04	2 Current Outputs,1 Current input,1 RTD input-PT100, 4 Wire
05	2 Current Outputs,2 RTD inputs-PT100, 4 Wire
06	2 Current Outputs,1 Current input,1 RTD input-PT1000, 3 Wire
07	2 Current Outputs,2 RTD inputs-PT1000, 3 Wire
08	2 Current Outputs,1 Current input,1 RTD input-PT1000, 4 Wire
09	2 Current Outputs,2 RTD inputs-PT1000, 4 Wire
	G - CERTIFICATIONS:
1	US/CAN Cl 1, Div 1, Grp BCD T6
2	IECEx/ATEX Exd IIC T6 Gb IP66
	H - DIGITAL COMMUNICATIONS:
0	No additional comm.
1	HART with 4 dynamic variables
2	Foundation Fieldbus
	I - FREQUENCY:
0	Standard Frequency
	PREPRO - PREPROGRAMING:
PREPRO	Preprogramming
	REPOR - TEST REPORT:
RPT	Test Report
	Z - SPECIAL:
0	None
S	SPECIAL Consult Factory

XMT1000LC -2 -AC -01 -SS -01 -1 -0 -0 -PREPRO -RPT -S (EXAMPLE PART NUMBER STRING)

A —	B	-C	-D - E	-Z	

Code	Description
	A - MODEL:
XMTXP	XMT1000 LC TRANSDUCER SYSTEM
	B - CHANNELS:
R05	0.5MHz C-RS with SCF fixture
R10	1MHz C-RS with SCF fixture
R20	2MHz C-RS with SCF fixture
P05	0.5MHz C-PT with SCF fixture
P10	1MHz C-PT with SCF ixture
P20	2MHz C-PT with SCF ixture
R20S	2MHz C-RS with CFG ixture
	C - JUNCTION BOX:
0	No Junction Box
AX	N American jct xox (CSA/FM)
EX	European junction box (ATEX)
AXSS	SS NA jct xox (CSA/FM)
EXSS	SS European jct box (ATEX)
	D - EXACT PIPE OUTER DIAMETER:
Textual	<> Pipe size
	E: PIPE UNIT OF MEASUREMENT:
IN	Pipe Size - Inches
MM	Pipe Size - Millimeters
	Z - SPECIAL:
0	No special parts
S	Clamp-on Xdcr & Mounting Sys

XMTXP -W02 -AXSS -Textual -MM -S (EXAMPLE PART NUMBER STRING)

[no content intended for this page]

Appendix B. Using the clamping fixtures

B.1 Using the universal clamping fixture - UCF

This section of the manual provides installation instructions for other clamping fixtures offered by Panametrics.

The Universal Clamping Fixture (UCF) (see Figure 82 below) acts as a spacing device and a transducer holder. The UCF includes one fixed short block and one adjustable short block Two slide tracks are included to connect the two short blocks. A ruler attached to one of these slide tracks helps to set the transducer spacing. For even traverse installations, a long block is also used.

The UCF is chained or strapped around the pipe, and the blocks are used to hold the transducers in position for accurate measurements. The blocks must be positioned properly using the spacing dimension calculated by the flowmeter. Then, the transducers are mounted into the blocks.

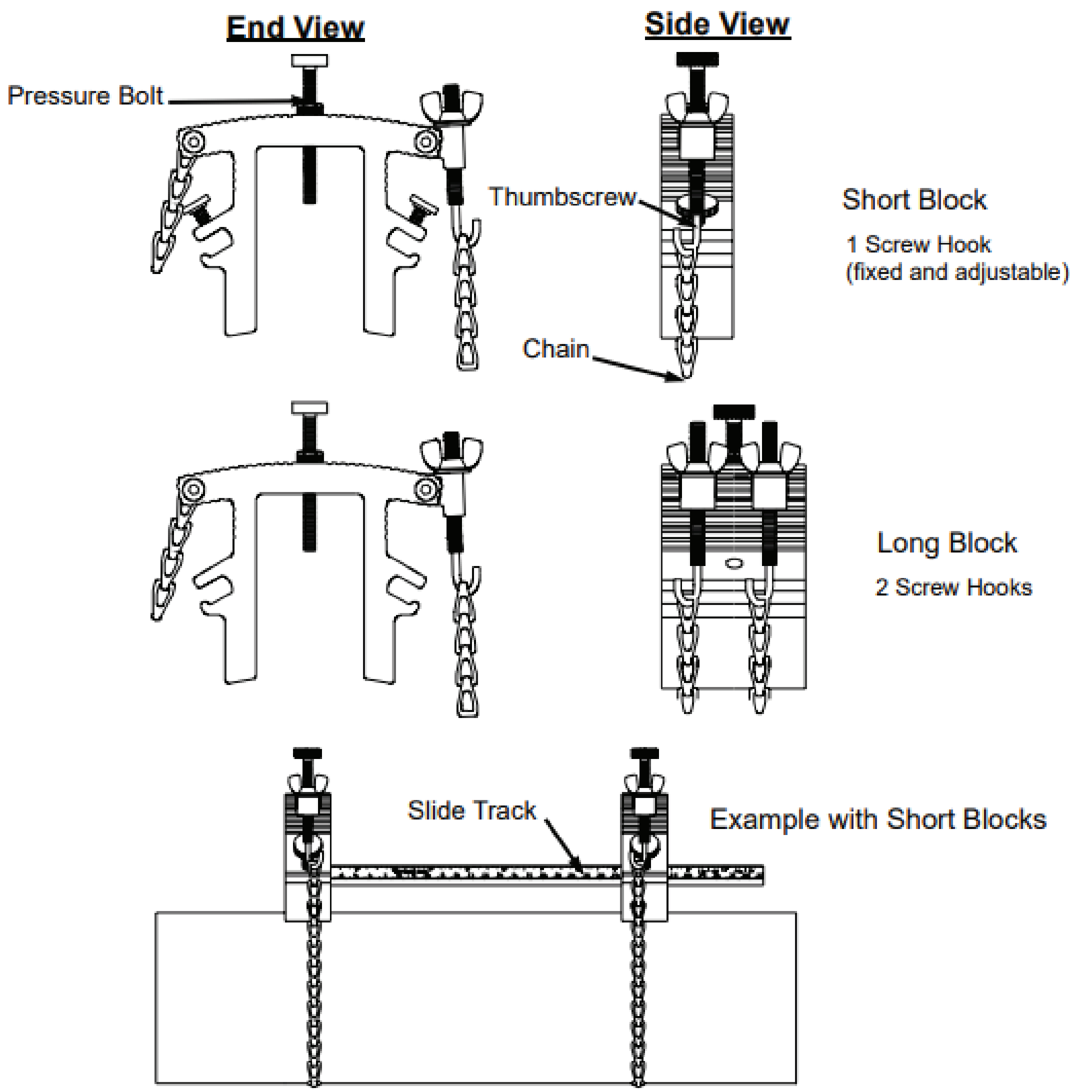


Figure 82: Components of the UCF

Before you begin the installation, make sure you note the application information in Table 2 below for your clamping fixture. The UCF is available in 12” (300 mm) and 24” (600 mm) lengths. Both lengths can be used for either odd traverse or even-traverse installations, but you must observe the pipe size ranges shown.

Table 29: UCF Pipe size ranges

Fixture Length	Odd Traverse Pipe Diameter	Even Traverse Pipe Diameter
12” (300 mm)	2-24” (50-600mm)	2-12” (50-300 mm)
24” (600 mm)	24-48” (600-1200mm)	12-24” (300-600mm)

The transducer installation consists of mounting the UCF to the pipe and then mounting the transducers into the fixture. Refer to the appropriate section for instructions on either the even-traverse or odd number of-traverse methods.

B.1.1 Even traverse method

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 installations with more than two traverses, contact Panametrics for assistance.

There are two advantages to using the even number of-traverse method:

- Measurement accuracy is improved because the ultrasonic signal is in the fluid longer than with an odd number of-traverse method.
- If there is enough pipe length available, the even-traverse fixture is easier to install.

The procedure for mounting the UCF involves setting the transducer spacing and fastening the fixture on the pipe.

Note: For a even-traverse installation, you will only need the short block assembly - the long block is not used.

The installation procedure for transducers using the even number of-traverse method is as follows:

1. Ensure the location of your clamping fixture has been properly scoped out following the criteria in Section 2.6: Precautions.
2. 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 remove any high spots. However, be careful to preserve the original curvature of the pipe.
3. Obtain the transducer spacing dimension (S) after programming the XMT1000 transmitter. Using the attached ruler on the slide bar as a guide, move the adjustable block so that the distance between the blocks equals the S dimension. Use the pressure bolts or the edges of the blocks as reference points, as shown below.

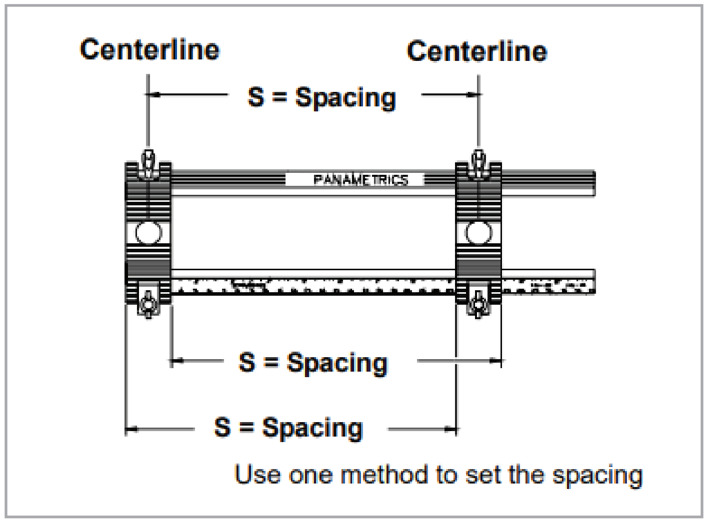


Figure 83: UCF setup, spacing

4. Position the clamping fixture along the horizontal plane of the pipe. It must not be on the top or bottom of the pipe. Make sure the chains on both blocks are on the side of the fixture opposite from the slide bar with the ruler.

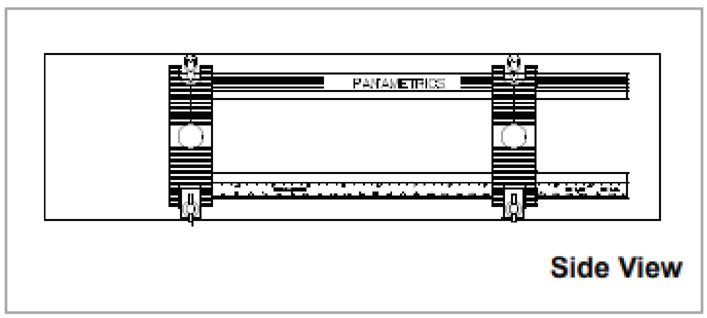


Figure 84: UCF setup, side view

5. Wrap one of the chains around the pipe and fasten it on the J screw hook on the opposite side of the block. Repeat this for the other chain.

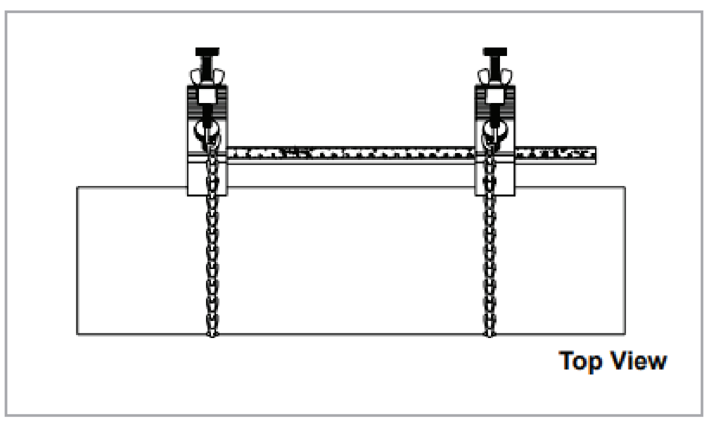


Figure 85: UCF setup, top view

6. Using the screw hook on the blocks, tighten both chains until the fixture is secured snugly to the side of the pipe.

IMPORTANT:

Make sure the chains are perpendicular to the clamping fixture and are not twisted. If the chains are slanted, the slack may cause the fixture to move. Also, the transducer spacing dimension may change after the transducers are mounted.

Figure 86 below shows a completed even-traverse installation without the transducers. Proceed to the section on mounting the transducers later in this chapter.

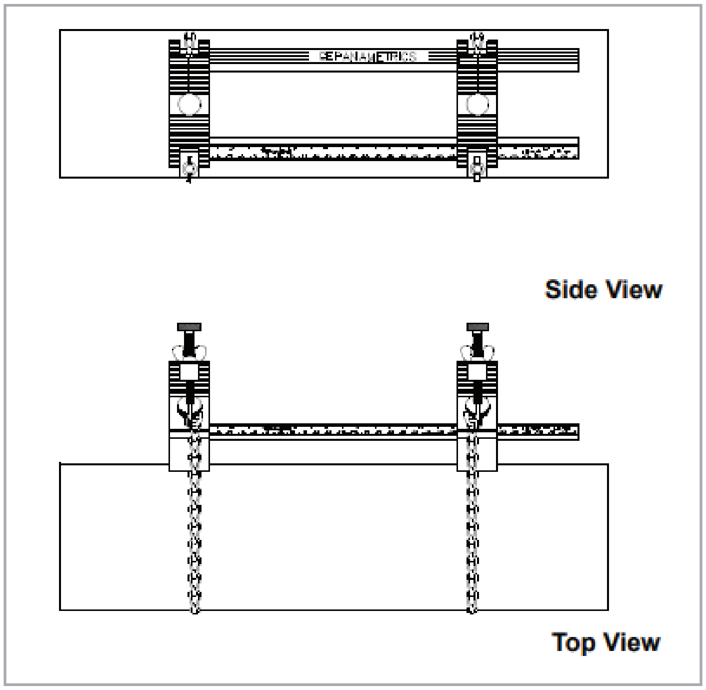


Figure 86: Finished UCF installation without transducers

B.1.2 Odd number of-traverse method

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. For installations with more than one traverse, contact Panametrics for assistance.

The procedure for mounting the UCF for the odd number of-traverse method requires one long block and two short blocks. The long block is fastened to the pipe first and then the short block assembly is properly aligned and fastened 180° around the pipe from the long block.

To install the UCF, complete the following steps:

1. Choose a location for the installation that has at least 10 pipe diameters of straight, undisturbed flow upstream and at least 5 pipe diameters of straight, undisturbed flow downstream from the measurement point.
2. Prepare the pipe where you intend to place the UCF by making sure it is clean and free of loose material. Sanding, though usually not required, may be necessary to remove any high spots. However, be careful to preserve the original curvature of the pipe.
3. Use a level to find the top of the pipe and then draw a line parallel to the centerline of the pipe.

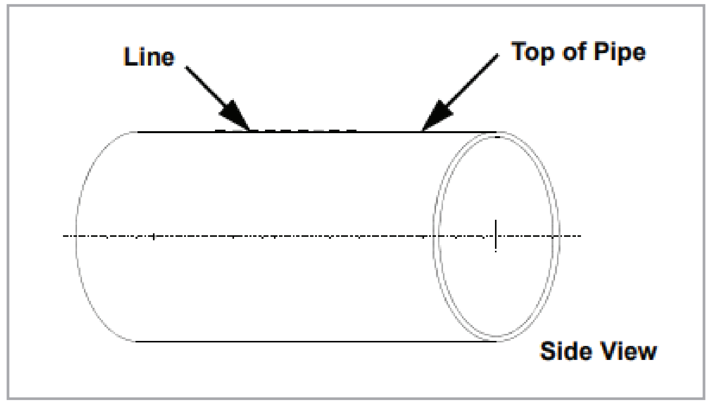


Figure 87: UCF setup, odd traverse, step 3

4. Using a level and center punch, make two marks on the line drawn in step 3. These marks must be separated by the transducer spacing distance S, as calculated by the flowmeter.

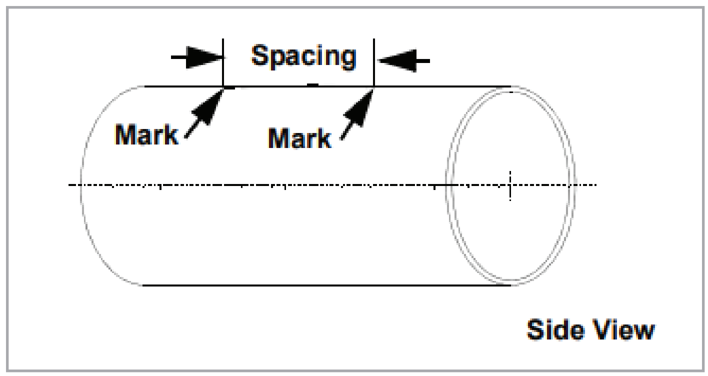


Figure 88: UCF setup, odd traverse, step 4

5. From one of the marks on the top of the pipe, measure around the pipe a distance equal to 1/4 of the pipe circumference, or a distance that will satisfy the orientation found in Step 1. Use the center punch to make a mark at this point.

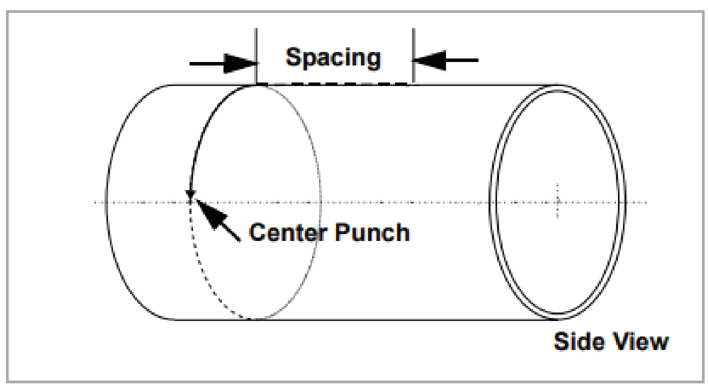


Figure 89: UCF setup, odd traverse, step 5

6. From the other mark on the top of the pipe, measure around the pipe in the opposite direction a distance equal to 1/4 of the pipe circumference, or the same distance used in Step 5. Use the center punch to make a mark at this point.

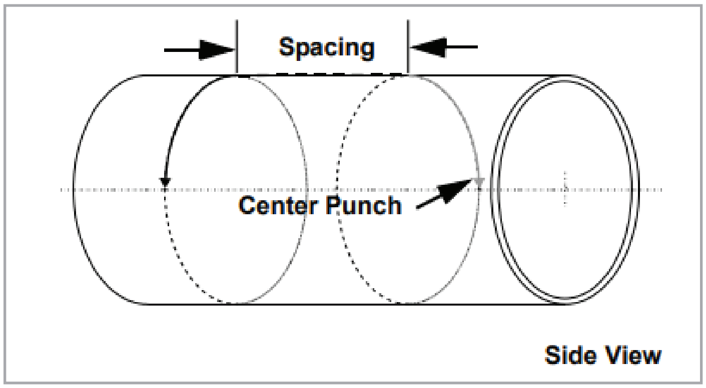


Figure 90: UCF setup, odd traverse, step 6

7. Center the long block over one of the center punch marks on the side of the pipe. Align the long block so that the pressure bolt is directly over the punch mark. Fasten the block to the pipe by wrapping both chains around the pipe and fastening the chains to the screw hooks on the opposite side of the block.

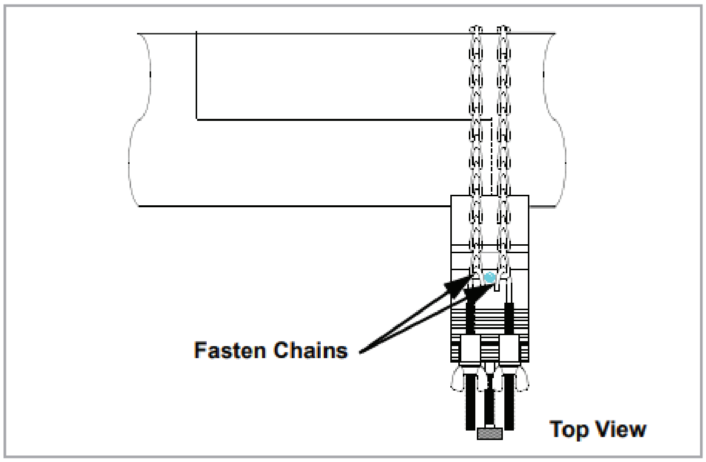


Figure 91: UCF setup, odd traverse, step 7

8. Use the wing nuts to tighten the chains on the long block until the block is tightly secured to the pipe.

IMPORTANT:

Make sure both chains are perpendicular to the bottom of the block and are not twisted. If the chains are slanted, the slack may cause the block to move.

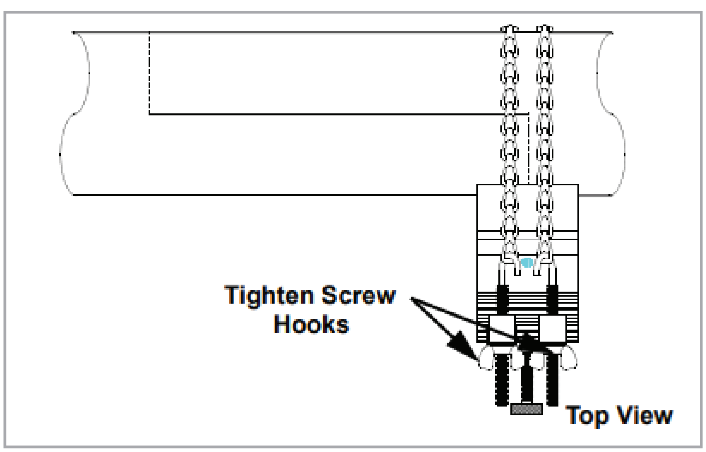


Figure 92: UCF setup, odd traverse, step 8

9. Position the clamping fixture rails so that the fixed short block is placed over the remaining center punch mark on the opposite side of the pipe and the pressure bolt is directly over the punch mark. Make sure the fixed short block is not positioned on top of the chains of the long block. The adjustable short block may be placed on either side of the long block chains.

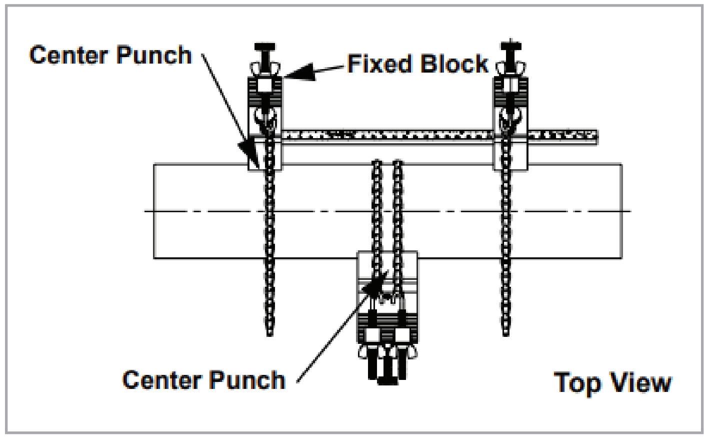


Figure 93: UCF setup, odd traverse, step 9

10. Wrap one short block chain around the pipe and fasten the chain to the screw hook on the opposite side of the block. Repeat this for the other short block.

Note: Make sure the chains on both blocks are on the same side of the fixture and are opposite the slide rail with the ruler.

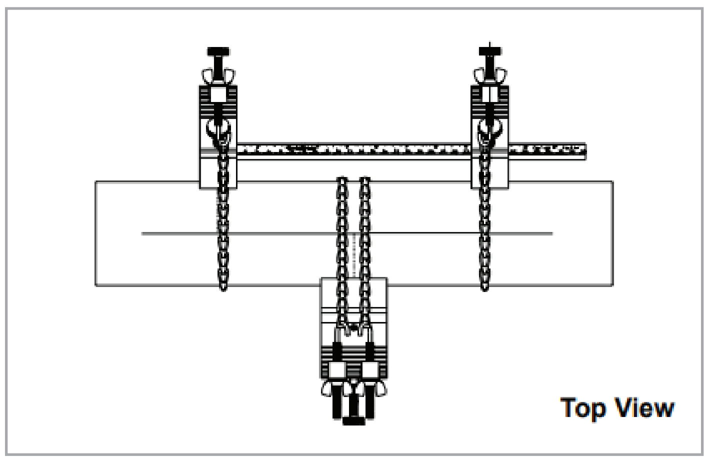


Figure 94: UCF setup, odd traverse, step 9

11. Use the screw hooks to tighten the chains on both the fixed and adjustable short blocks until both blocks are tightly secured to the pipe.

IMPORTANT:

Make sure the chains are perpendicular to the clamping fixture and are not twisted. If the chains are slanted, the slack may cause the fixture to move. Also, the transducer spacing dimension may change after the transducers are mounted.

Figure 95 below shows a completed odd traverse installation without the transducers. Proceed to the section on mounting the transducers later in this chapter.

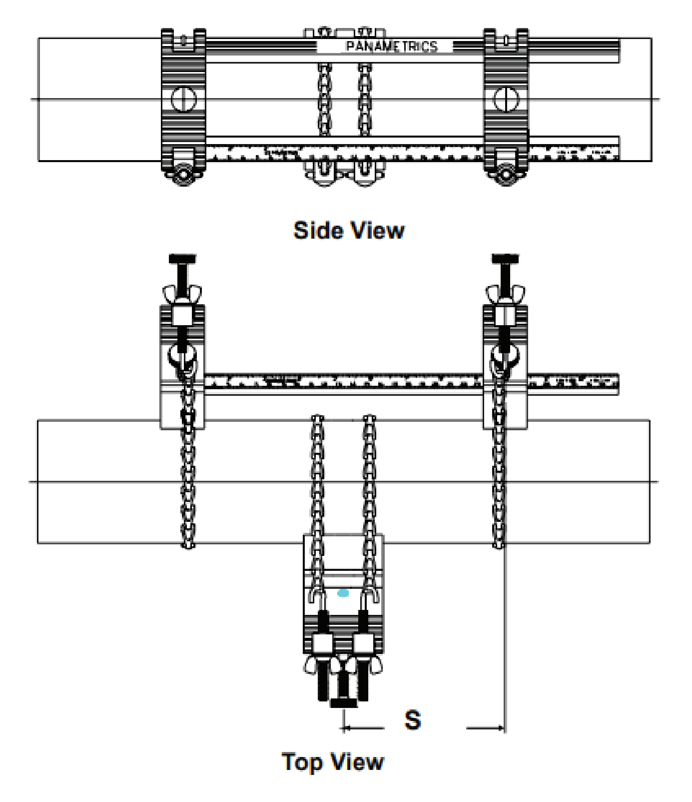


Figure 95: A odd traverse clamping fixture installation without transducers

B.2 Using the General Clamping Fixture - GCF

The General Clamping Fixture (GCF) acts as a permanent transducer holder. The fixture has two blocks (see Figure 96 below) that are used for both even-traverse and odd number of-traverse methods. Steel straps secure the blocks to the pipe for a permanent installation. To install the GCF, the blocks must first be positioned using the spacing dimension (S) calculated by the flowmeter. Then, the transducers are mounted into the blocks.

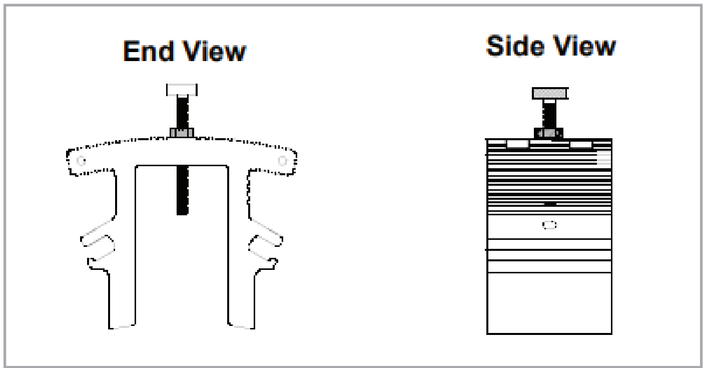


Figure 96: General clamping fixture block

Proceed to the appropriate section for instructions on either the even-traverse or odd number of-traverse method.

B.2.1 Even traverse method

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 installations with more than two traverses, contact Panametrics for assistance.

There are two advantages to using the even number of-traverse method:

- Measurement accuracy is improved because the ultrasonic signal is in the fluid longer than with a odd number of-traverse method.
- If there is enough pipe length available, the even-traverse fixture is easier to install.

The procedure for mounting the GCF involves setting the transducer spacing and fastening the fixture on the pipe.

The installation procedure for transducers using the even number of-traverse method is as follows:

1. Ensure the location of your clamping fixture has been properly scoped out following the criteria in Section 2.6: Precautions.
2. 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 remove any high spots. However, be careful to preserve the original curvature of the pipe.
3. Use a level to find the top of the pipe and then draw a line parallel to the centerline of the pipe.

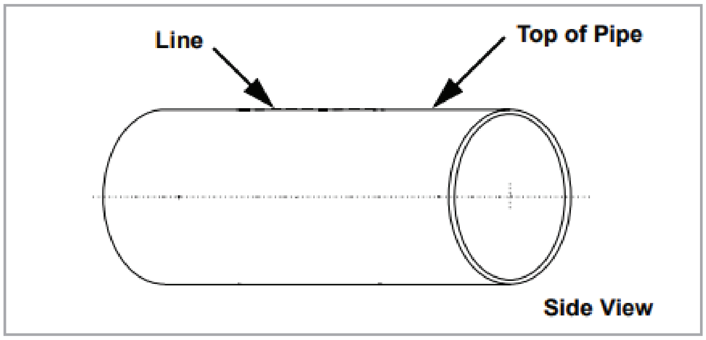


Figure 97: GCF even traverse installation, step 3

4. Using a level and center punch, make two marks on the line drawn in step 3. These marks must be separated by the transducer spacing distance S, as calculated by the flowmeter.

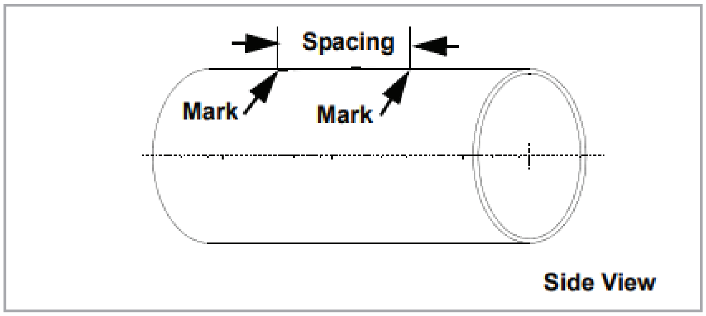


Figure 98: GCF even traverse installation, step 4

5. From each of the marks on the top of the pipe, measure around the pipe in the same direction a distance equal to 1/4 the pipe circumference. Use the center punch to make a mark at each location.

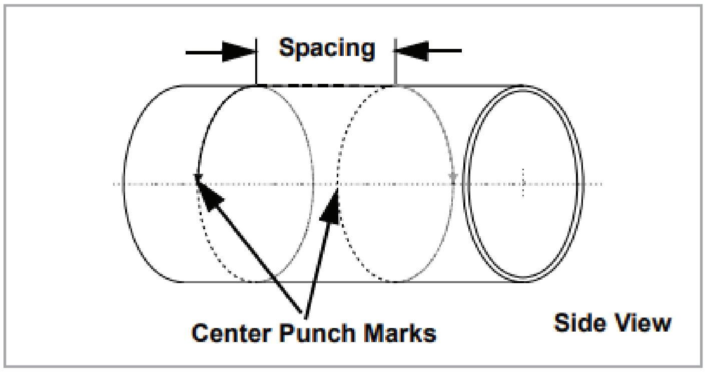


Figure 99: GCF even traverse installation, step 5

6. Center one of the blocks over one of the center punch marks on the side of the pipe. Align the block so that the pressure bolt is directly over the punch mark. Secure the block by wrapping the two steel straps around both the block and the pipe and tightening the straps.

IMPORTANT:

Make sure both straps are perpendicular to the bottom of the block. If the straps are slanted, the slack will cause the block to move. Also, the transducer spacing dimension may change after the transducers are mounted.

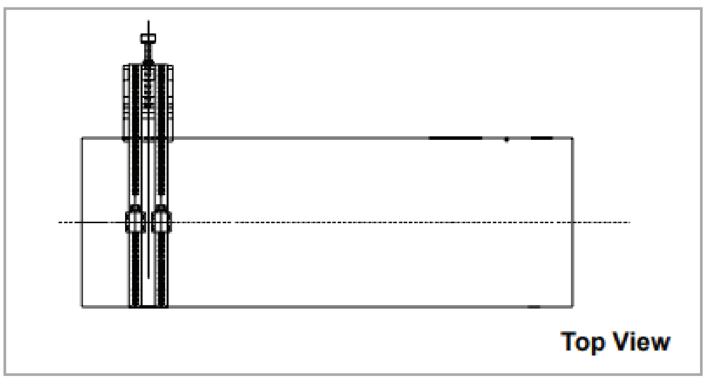


Figure 100: GCF even traverse installation, step 6

7. Repeat Step 6 to install the other block.

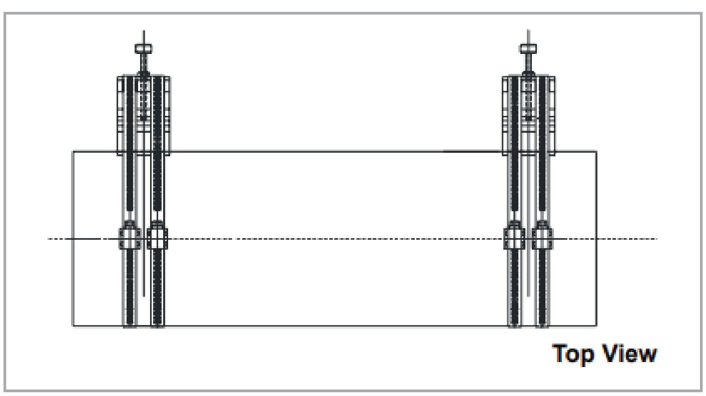


Figure 101: GCF even traverse installation, step 7

Figure 102 below shows a completed even-traverse installation without the transducers. Proceed to the section on mounting the transducers later in this chapter.

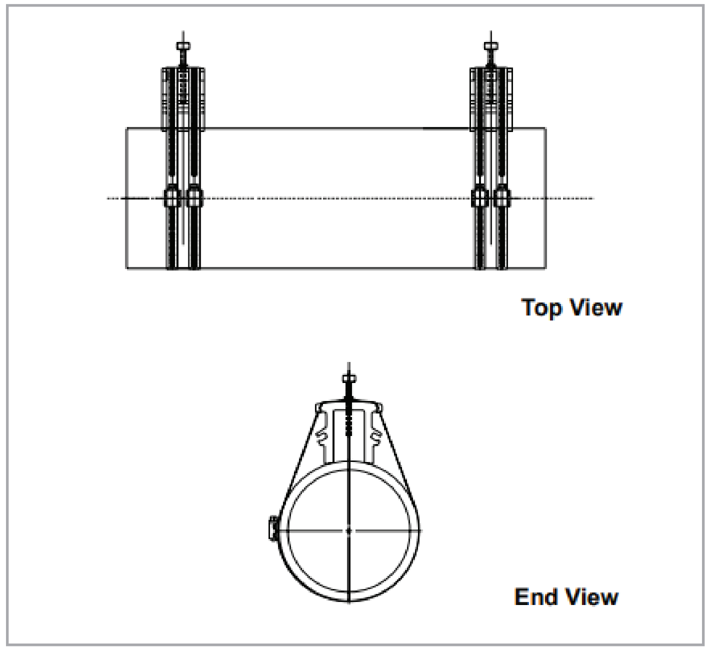


Figure 102: Even traverse GCF Installation without transducers

B.2.2 Odd number of-traverse method

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. For installations with more than one traverse, contact Panametrics for assistance.

The procedure for mounting the GCF for the odd number of-traverse method includes marking the pipe for the required transducer spacing, fastening the fixture to the pipe, and then mounting the transducers into the fixture.

To install the GCF odd traverse, complete the following steps:

1. Ensure the location of your clamping fixture has been properly scoped out following the criteria in Section 2.6: Precautions.
2. Prepare the pipe where you intend to place the GCF by making sure it is clean and free of loose material. Sanding, though usually not required, may be necessary to remove any high spots. However, be careful to preserve the original curvature of the pipe.
3. Use a level to find the top of the pipe and then draw a line parallel to the centerline of the pipe.

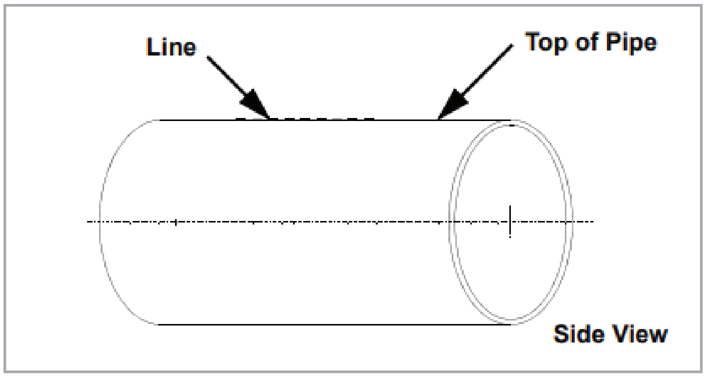


Figure 103: GCF odd traverse installation, step 3

4. Using a level and center punch, make two marks on the line drawn in step 3. These marks must be separated by the transducer spacing distance S, as calculated by the flowmeter.

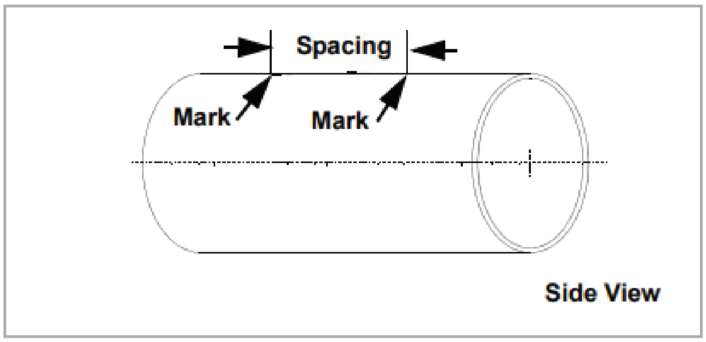


Figure 104: GCF odd traverse installation, step 4

5. From one of the marks on the top of the pipe, measure around the pipe a distance equal to 1/4 of the pipe circumference, or a distance that will satisfy the orientation found in Step 1. Use the center punch to make a mark at this point.

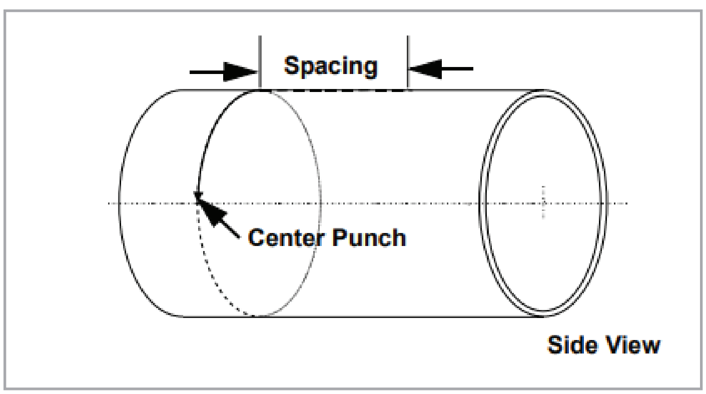


Figure 105: GCF odd traverse installation, step 5

6. From the other mark on the top of the pipe, measure around the pipe in the opposite direction a distance equal to 1/4 of the pipe circumference, or the same distance used in Step 5. Use the center punch to make a mark at this point.

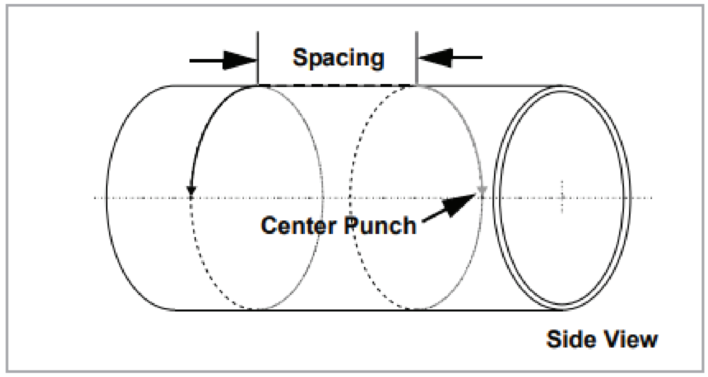


Figure 106: GCF odd traverse installation, step 6

7. Center one of the blocks over one of the center punch marks on the side of the pipe. Align the block so that the pressure bolt is directly over the punch mark. Secure the block by wrapping the two steel straps around both the block and the pipe and tightening the straps.

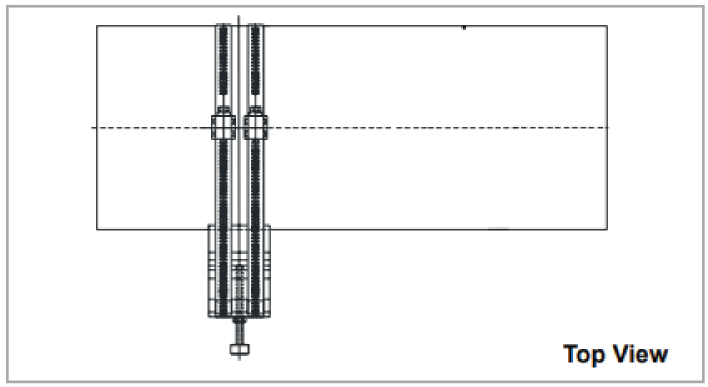


Figure 107: GCF odd traverse installation, step 7

8. Repeat Step 7 to install the other block on the pipe.

IMPORTANT:

Make sure both straps are perpendicular to the bottom of the block. If the straps are slanted, the slack will cause the block to move. Also, the transducer spacing dimension may change after the transducers are mounted.

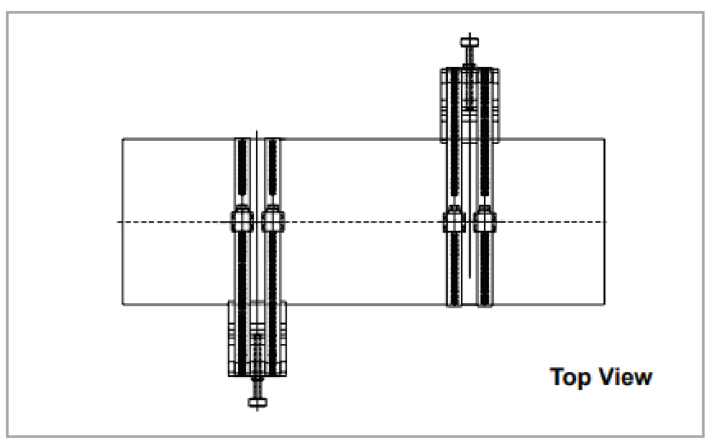


Figure 108: GCF odd traverse installation, step 8

Figure 109 below shows an odd traverse installation without the transducers. Proceed to the section on mounting the transducers later in this chapter.

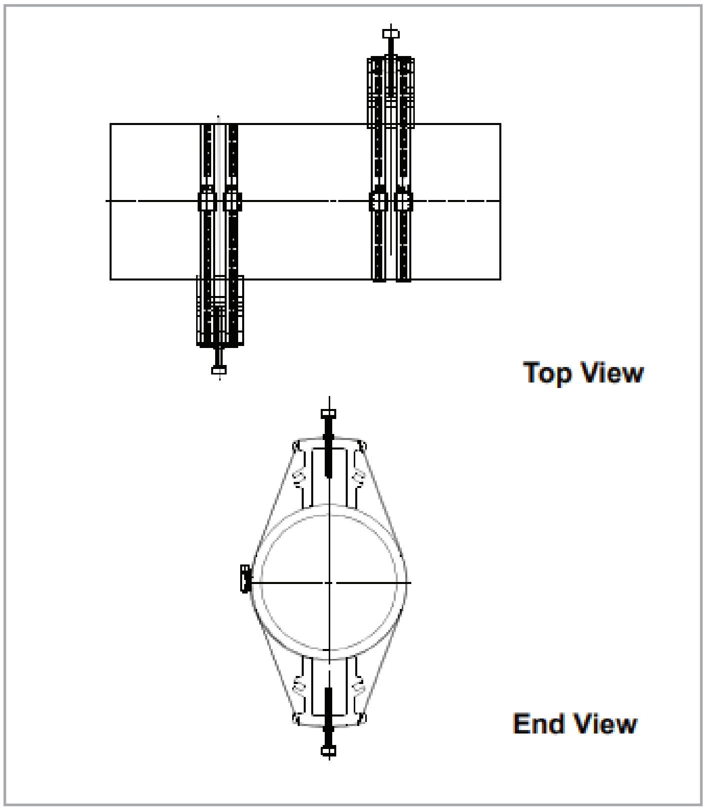


Figure 109: A odd traverse GCF installation without transducers

B.3 Using the magnetic clamping fixture - MCF

The Magnetic Clamping Fixture (MCF) is used to fasten transducers to the pipe at the proper spacing without chains or straps. Different fixtures are used for the odd traverse and even number of-traverse methods. Each type of MCF has magnets located in the two blocks at the ends of the fixture. When the magnets are turned ON, the fixture is magnetically clamped to the pipe wall.

WARNING!

Do not use the MCF at temperatures that exceed 120°F (49°C) - the fixture will fall off the pipe.

The transducer installation consists of mounting the MCF to the pipe and then mounting the transducers into the fixture. To properly mount the MCF, you should first become familiar with the components of the fixture (see Figure 110 below). Then, refer to the appropriate section for instructions on either the even traverse or odd number of-traverse method.

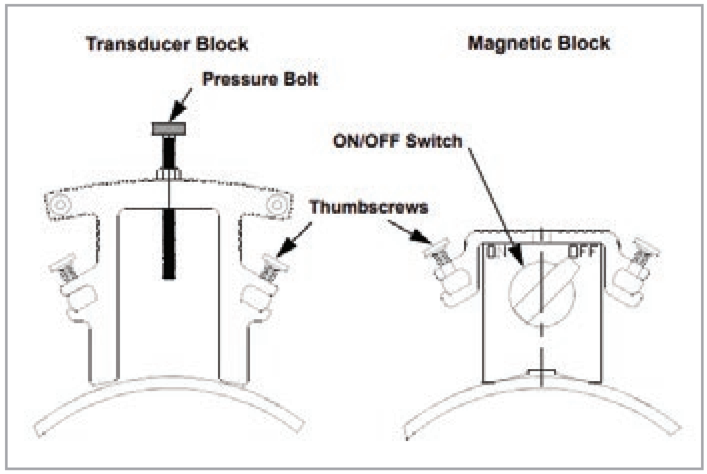


Figure 110: MCF transducer block and magnetic block

B.3.1 Even traverse method

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 installations with more than two traverses, contact Panametrics for assistance.

The even-traverse MCF consists of a fixed magnetic block and an adjustable magnetic block, which are connected by two rods (one of the rods acts as a scale to help you properly space the transducers). In addition, a fixed transducer block and an adjustable transducer block are included. To install the MCF in a even-traverse configuration, complete the following steps:

1. 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 of straight, undisturbed flow downstream from the measurement point.
2. 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 remove any high spots. However, be careful to preserve the original curvature of the pipe.
3. Obtain the transducer spacing dimension (S) after programming the XMT1000 transmitter. Using the ruler on the MCF rod as a guide, loosen the red thumbscrews and move the transducer blocks so that the distance between them equals the S dimension. Then, tighten the thumbscrews. Use the pressure bolts or the edges of the blocks as reference points, as shown below.

IMPORTANT:

Make sure there is at least 4" (100 mm) of clearance between the fixed magnetic block and the nearest transducer block.

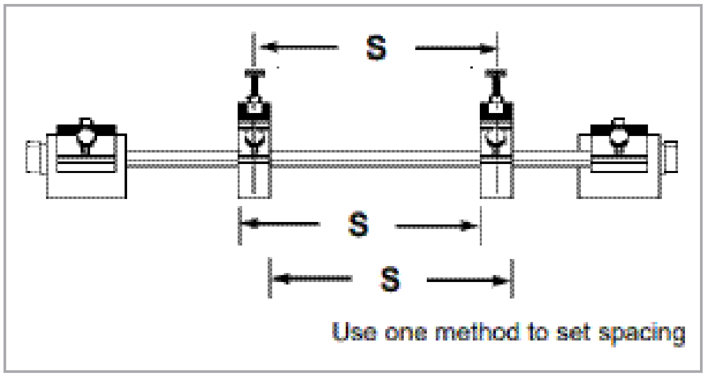


Figure 111: MCF even traverse installation, step 3

4. To ensure that there is enough clearance to mount the transducers in the blocks, move the adjustable magnetic block so that it is at least 4” (100 mm) away from the nearest transducer block. Then, secure the block to the rods with the thumbscrews.

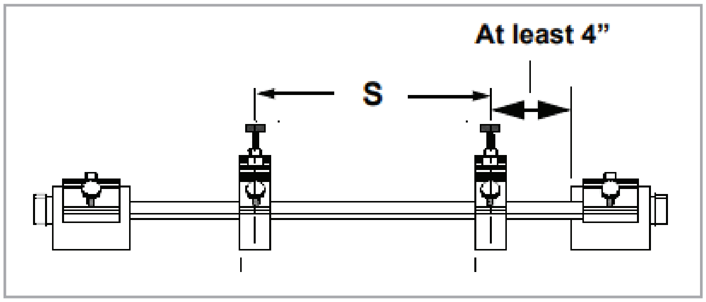


Figure 112: MCF even traverse installation, step 4

5. Position the clamping fixture along the horizontal plane of the pipe. It must not be on the top or bottom of the pipe.

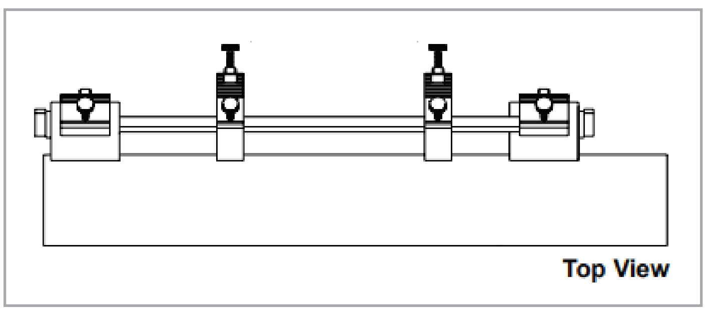


Figure 113: MCF even traverse installation, step 5

6. Turn the switches on both magnets to the ON position.

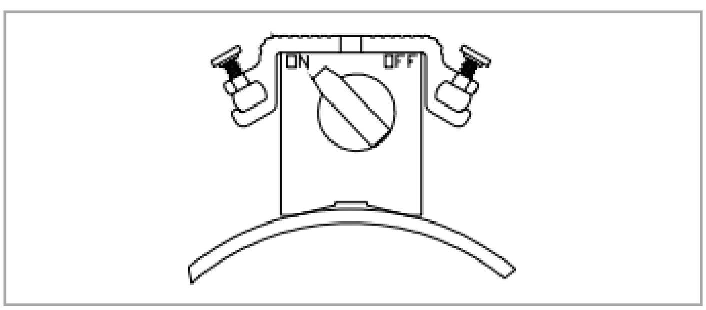


Figure 114: MCF even traverse installation, step 6

Proceed to the section on mounting the transducers later in this chapter.

B.3.2 Odd number of-traverse method

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. For installations with more than one traverse, contact Panametrics for assistance.

The odd traverse MCF consists of two sub-assemblies. Each subassembly is made up of one adjustable transducer block, two magnetic blocks and two connecting rods. The two sub-assemblies must be installed on opposite sides of the pipe. To install the MCF in an odd traverse configuration, complete the following steps:

1. Choose a location for the installation that has at least 10 pipe diameters of straight, undisturbed flow upstream and at least 5 pipe diameters of straight, undisturbed flow downstream from the measurement point.
2. Prepare the pipe where you intend to place the GCF by making sure it is clean and free of loose material. Sanding, though usually not required, may be necessary to remove any high spots. However, be careful to preserve the original curvature of the pipe.
3. Use a level to find the top of the pipe and then draw a line parallel to the centerline of the pipe.

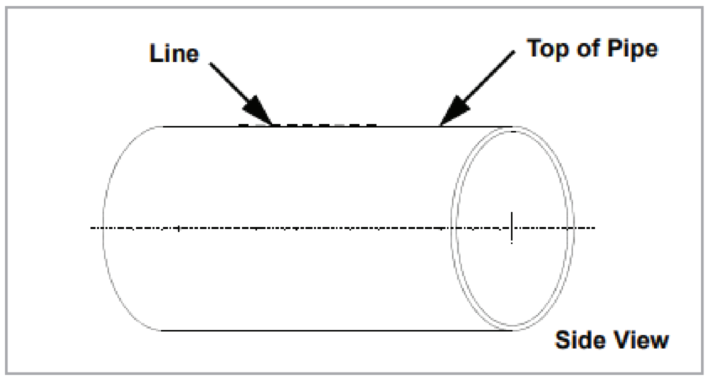


Figure 115: MCF odd traverse installation, step 3

4. Using a level and center punch, make two marks on the line drawn in step 3. These marks must be separated by the transducer spacing distance S, as calculated by the flowmeter.

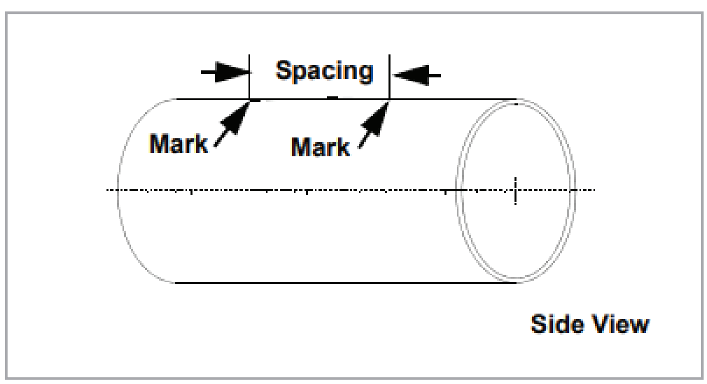


Figure 116: MCF odd traverse installation, step 4

5. From one of the marks on the top of the pipe, measure around the pipe a distance equal to 1/4 of the pipe circumference, or a distance that will satisfy the orientation found in Step 1. Use the center punch to make a mark at this point.

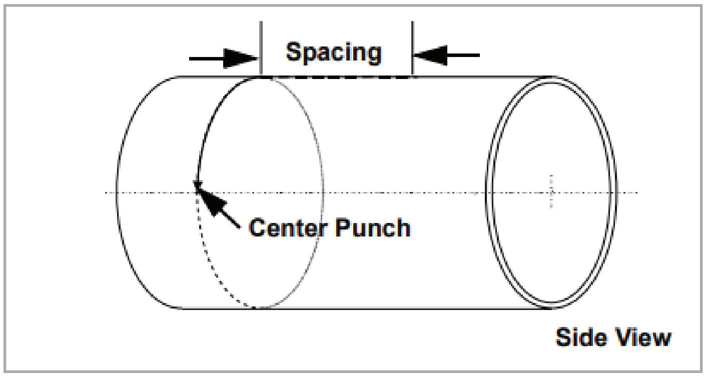


Figure 117: MCF odd traverse installation, step 5

6. From the other mark on the top of the pipe, measure around the pipe in the opposite direction a distance equal to 1/4 of the pipe circumference, or the same distance used in Step 5. Use the center punch to make a mark at this point.

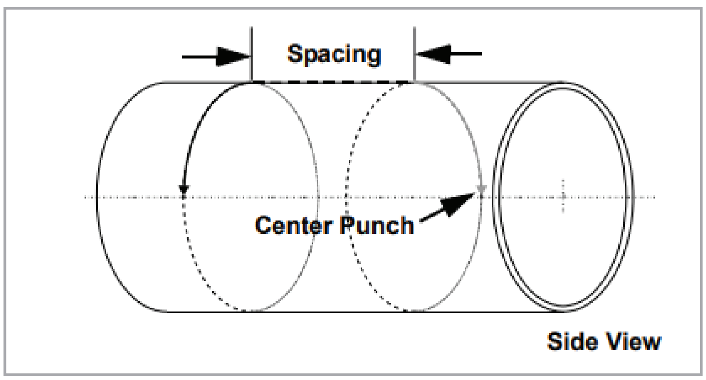


Figure 118: MCF odd traverse installation, step 6

7. On one of the MCF sub-assemblies, position the adjustable transducer block anywhere along the rods, being sure to leave enough room on both sides to easily insert the transducer. To move the block, loosen the red thumbscrews, slide the block to the desired location and tighten the thumbscrews. Use the pressure bolt and the scale on the rod to position the block at the desired location. Repeat the procedure for the other sub-assembly.

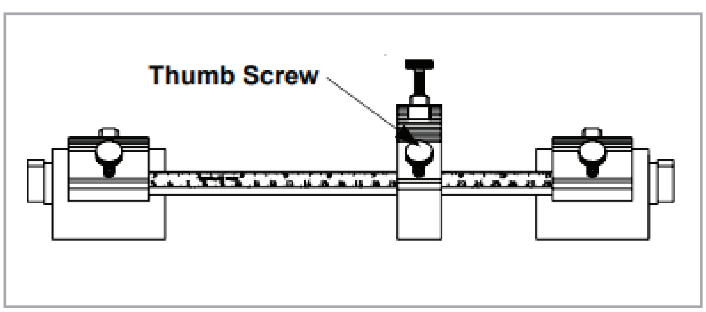


Figure 119: MCF odd traverse installation, step 7

8. Center the transducer block of one sub-assembly over one of the center punch marks on the side of the pipe. Align the block so that the pressure bolt is directly over the punch mark.

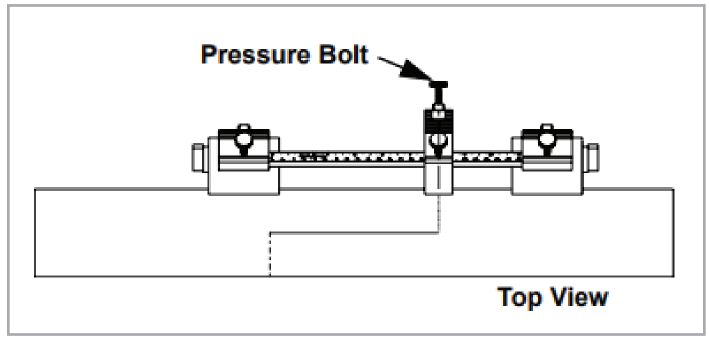


Figure 120: MCF odd traverse installation, step 8

9. Turn the switches on both magnets to the ON position.

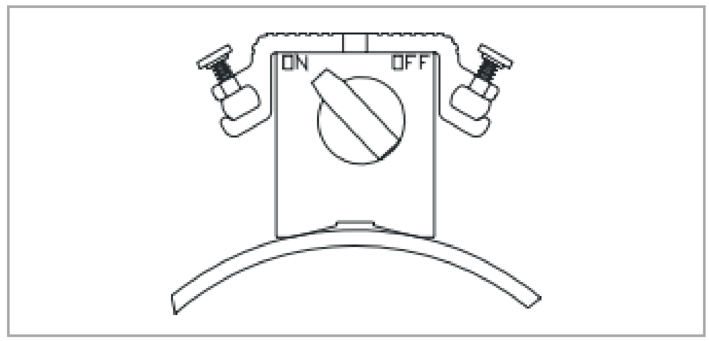


Figure 121: MCF odd traverse installation, step 9

10. Repeat Steps 8 and 9 to mount the other sub-assembly on the opposite side of the pipe.

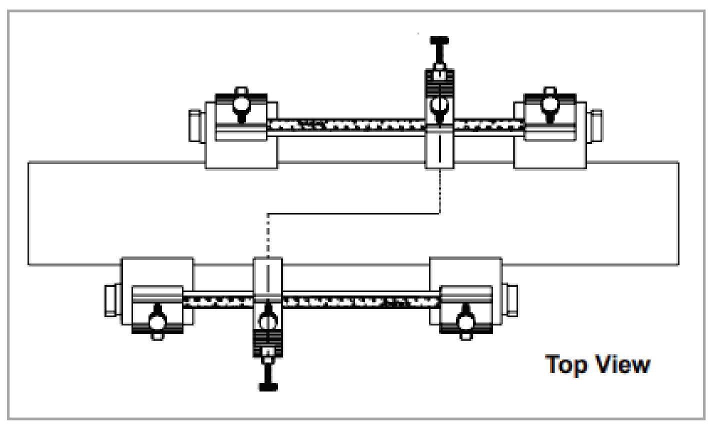


Figure 122: A odd traverse MCF installation without transducers

Proceed to the section on mounting the transducers later in this chapter.

Appendix C. Data records

C.1 Electronics

C.1.1 Data entry

Record complete and detailed service data for the PanaFlow™ LC in Table 30 below. Make additional copies of the table as needed.

Table 30: Service Record

Date	Description of Service	Performed By

Table 30: Service Record		
Date	**Description of Service**	**Performed By**

C.2 Initial settings

The values for the initial measurement settings immediately after initial installation of the meter and verification of proper operation should be entered in Table 31 below.

Table 31: Initial settings

Parameter	Initial Value
Velocity	
Volumetric	
Mass Flow	
Forward Batch Totals	
Reverse Batch Totals	
Totalizer Time	
Sound Speed	
Current Correction Factor	
Current Reynolds Number	
Current Operating Temperature	
Standard Volumetric	
Net Batch Totals	
Inventory Forward	
Inventory Reverse	
Inventory Net	
Inventory Time	
Channel 1 Velocity	
Channel 1 Sound Speed	
Channel 1 Transit Time Up	
Channel 1 Transit Time Down	
Channel 1 Delta T	
Channel 1 Up Signal Quality	
Channel 1 Down Signal Quality	

Table 31: Initial settings	
Parameter	**Initial Value**
Channel 1 Up Amp Disc	
Channel 1 Down Amp Disc	
Channel 1 SNR on Up	
Channel 1 SNR on Down	
Channel 1 Time in Buffer on Up	
Channel 1 Time in Buffer on Down	
Channel 1 Signal Gain Up	
Channel 1 Signal Gain Down	
Channel 1 Up Peak	
Channel 1 Down Peak	
Channel 1 Dynamic Threshold Up	
Channel 1 Dynamic Threshold Down	
Channel 2 Velocity	
Channel 2 Sound Speed	
Channel 2 Transit Time Up	
Channel 2 Transit Time Down	
Channel 2 Delta T	
Channel 2 Up Signal Quality	
Channel 2 Down Signal Quality	
Channel 2 Up Amp Disc	
Channel 2 Down Amp Disc	
Channel 2 SNR on Up	
Channel 2 SNR on Down	
Channel 2 Time in Buffer on Up	
Channel 2 Time in Buffer on Down	

Table 31: Initial settings	
Parameter	**Initial Value**
Channel 2 Signal Gain Up	
Channel 2 Signal Gain Down	
Channel 2 Up Peak	
Channel 2 Down Peak	
Channel 2 Dynamic Threshold Up	
Channel 2 Dynamic Threshold Down	
Channel 3 Velocity	
Channel 3 Sound Speed	
Channel 3 Transit Time Up	
Channel 3 Transit Time Down	
Channel 3 Delta T	
Channel 3 Up Signal Quality	
Channel 3 Down Signal Quality	
Channel 3 Up Amp Disc	
Channel 3 Down Amp Disc	
Channel 3 SNR on Up	
Channel 3 SNR on Down	
Channel 3 Time in Buffer on Up	
Channel 3 Time in Buffer on Down	
Channel 3 Signal Gain Up	
Channel 3 Signal Gain Down	
Channel 3 Up Peak	
Channel 3 Down Peak	
Channel 3 Dynamic Threshold Up	
Channel 3 Dynamic Threshold Down	

C.3 Diagnostic parameters

The values for the diagnostic parameters immediately after initial installation of the meter and verification of proper operation should be entered in Table 32 below. These initial values can then be compared to current values to help diagnose any future malfunction of the system.

Table 32: Diagnostic Parameters

Parameter	Channel 1		Channel 2		Channel 3	
	Initial	Current	Initial	Current	Initial	Current
Velocity						
Soundspeed						
Transit Time Dn						
Transit Time Up						
Delta T						
Up Signal Quality						
Dn Signal Quality						
Up Amp Disc						
Dn Amp Disc						
SNR Up						
SNR Dn						
Active TWup						
Active TWdn						
Gainup						
Gaindn						
Error Status						
Report Error						
Peak Up						
Peak Dn						
Peak% Up						
Peak% Dn						
Error						

Appendix D. Modbus map

D.1 Input registers map

Category	Measurement	Type	Number of Registers	Format	Composite Register Address		Channel 1 Register Address		Channel 2 Register Address		Channel 3 Register Address	
					In Decimal	In Hex	In Decimal	In Hex	In Decimal	In Hex	In Decimal	In Hex
	Velocity	F	2	Float	33280	0x8200	34352	0x8630	35376	0x8A30	36400	0x8E30
	Volumetric	F	2	Float	33282	0x8202	34350	0x862E	35374	0x8A2E	36398	0x8E2E
Primary Measurements	Std Volumetric	F	2	Float	33306	0x821A	34392	0x8658	35416	0x8A58	36440	0x8E58
	Mass flow	F	2	Float	33284	0x8204	34354	0x8632	35378	0x8A32	36402	0x8E32
	Avg Volumetric Flow Rate	F	2	Float	33340	0x823C	34400	0x8660	35424	0x8A60	36448	0x8E60
	Forward Volumetric Totals	F	2	Float	33286	0x8206	34356	0x8634	35380	0x8A34	36404	0x8E34
	Reverse Volumetric Totals	F	2	Float	33288	0x8208	34358	0x8636	35382	0x8A36	36406	0x8E36
	Net Volumetric Totals	F	2	Float	33308	0x821C	34364	0x863C	35388	0x8A3C	36412	0x8E3C
	Fwd Std Volumetric Totals	F	2	Float	33332	0x8234	34394	0x865A	35418	0x8A5A	36442	0x8E5A
	Rev Std Volumetric Totals	F	2	Float	33334	0x8236	34396	0x865C	35420	0x8A5C	36444	0x8E5C
Flow Totals	Net Std Volumetric Totals	F	2	Float	33336	0x8238	34398	0x865E	35422	0x8A5E	36446	0x8E5E
	Forward Mass Totals	F	2	Float	33318	0x8226	34368	0x8640	35392	0x8A40	36416	0x8E40
	Reverse Mass Totals	F	2	Float	33320	0x8228	34370	0x8642	35394	0x8A42	36418	0x8E42
	Net Mass Totals	F	2	Float	33326	0x822E	34376	0x8648	35400	0x8A48	36424	0x8E48
	Elapsed Total Time	F	2	Float	33290	0x820A	34384	0x8650	35408	0x8A50	36432	0x8E50
	Soundspeed	F	2	Float	33292	0x820C	34306	0x8602	35330	0x8A02	36354	0x8E02
	Raw Velocity	F	2	Float	33338	0x823A	34304	0x8600	35328	0x8A00	36352	0x8E00
	Transit Time Up	F	2	Float			34308	0x8604	35332	0x8A04	36356	0x8E04
Primary Diagnostics	Transit Time Down	F	2	Float			34310	0x8606	35334	0x8A06	36358	0x8E06
	DeltaT	F	2	Float	Not Applicable		34312	0x8608	35336	0x8A08	36360	0x8E08
	Active Tw Up	F	2	Float			34332	0x861C	35356	0x8A1C	36380	0x8E1C
	Active Tw Down	F	2	Float			34314	0x860A	35338	0x8A0A	36362	0x8E0A
	Gain Up[dB]	F	2	Float			34324	0x8614	35348	0x8A14	36372	0x8E14
	Gain Down[dB]	F	2	Float			34326	0x8616	35350	0x8A16	36374	0x8E16
	SNR Up	F	2	Float			34328	0x8618	35352	0x8A18	36376	0x8E18
	SNR Down	F	2	Float	Not Applicable		34330	0x861A	35354	0x8A1A	36378	0x8E1A
	Amplitude Up	F	2	Float			34320	0x8610	35344	0x8A10	36368	0x8E10
Transit Time Diagnostics	Amplitude Down	F	2	Float			34322	0x8612	35346	0x8A12	36370	0x8E12
	Gain Std.Dev	F	2	Float			34388	0x8654	35412	0x8A54	36436	0x8E54
	Soundspeed Std. Dev	F	2	Float	33330	0x8232	Not Applicable					
	Peak Up	I	2	Integer			34564	0x8704	35588	0x8B04	36612	0x8F04
	Peak Down	I	2	Integer	Not Applicable		34566	0x8706	35590	0x8B06	36614	0x8F06
	Peak % Up	I	2	Integer			34568	0x8708	35592	0x8B08	36616	0x8F08
	Peak % Down	I	2	Integer			34570	0x870A	35594	0x8B0A	36618	0x8F0A
	Active Tw Gain Up[dB]	F	2	Float			34342	0x8626	35366	0x8A26	36390	0x8E26
	Active Tw Gain Down[dB]	F	2	Float			34344	0x8628	35368	0x8A28	36392	0x8E28
	Active Tw SNR Up	F	2	Float			34334	0x861E	35358	0x8A1E	36382	0x8E1E
	Active Tw SNR Down	F	2	Float			34336	0x8620	35360	0x8A20	36384	0x8E20
Active Tw Diagnostics	Active Tw Amplitude Up	F	2	Float	Not Applicable		34338	0x8622	35362	0x8A22	36386	0x8E22
	Active Tw Amplitude Down	F	2	Float			34340	0x8624	35364	0x8A24	36388	0x8E24
	Active Tw Peak Up	I	2	Integer			34574	0x870E	35598	0x8B0E	36622	0x8F0E
	Active Tw Peak Down	I	2	Integer			34576	0x8710	35600	0x8B10	36624	0x8F10
	Active Tw Peak % Up	I	2	Integer			34578	0x8712	35602	0x8B12	36626	0x8F12
	Active Tw Peak % Down	I	2	Integer			34580	0x8714	35604	0x8B14	36628	0x8F14
	Reynolds #	F	2	Float	33316	0x8224	Not Applicable					
Factors	Reynolds Factor	F	2	Float	33302	0x8216	Not Applicable					
	Calibration Factor	F	2	Float	33300	0x8214	34348	0x862C	35372	0x8A2C	36396	0x8E2C
	Fluid Temperature Input	F	2	Float	16900	0x4204						
	Supply Temperature Input	F	2	Float	16902	0x4206						
Inputs	Return Temperature Input	F	2	Float	16904	0x4208	Not Applicable					
	Pressure Input	F	2	Float	16906	0x420A						
	Density Input	F	2	Float	16898	0x4202						
	Flow Health Code	B	2	Unsigned integer - Bit field	33536	0x8300	34560	0x8700	35584	0x8B00	36608	0x8F00
Meter Health Indicators	Prioritized Flow Error	I	2	Unsigned integer	33540	0x8304	34562	0x8702	35586	0x8B02	36610	0x8F02
	System Health Code	B	2	Unsigned integer - Bit field	33538	0x8302	Not Applicable					
	Baud Rate	I	2	Unsigned	1408	0x0580						
	Parity	I	2	Unsigned integer	1410	0x0582						
Comm Settings	Stop Bits	I	2	Unsigned integer	1412	0x0584	Not Applicable					
	Meter Addr	I	2	Unsigned integer	1414	0x0586						

Note: Most Modbus Masters add an offset of 1 to the actual register addresses. For Example: Meter Modbus address = 0x8200, Address to input in the Modbus master application = 0x8201.

[no content intended for this page]

Appendix E. CE Mark compliance

E.1 Introduction

For CE Mark compliance, the PanaFlow™ LC flow meter must be wired in accordance with the instructions in this appendix.

IMPORTANT:
CE Mark compliance is required for all units intended for use in EU countries.

E.2 Wiring

The PanaFlow™ LC must be wired with the recommended cable, and all connections must be properly shielded and grounded. Refer to Table 33 below for the specific requirements.

Table 33: Wiring Requirements

Connection	Cable Type	Ground Termination
Transducer	Armored RG62 A/U	Grounded using a cable gland.
Input/Output	Armored 22 AWG shielded (e.g. Baystate #78-1197) with armored material added to outside of jacket	Grounded using a cable gland.
Power	Armored 14 AWG 3 conductor	Grounded using a cable gland.

Note: If the PanaFlow™ LC is wired as described in this appendix, the unit will comply with the EMC Directive.

[no content intended for this page]

Appendix F. HART communication

F.1 Wiring the XMT1000 to the HART communicator

When connecting a HART communicator to the wiring terminals on the XMT1000 electronics terminal board, the circuit must be terminated in an appropriate resistive load, as shown in Figure 123 below. The HART communicator is connected in parallel with that load.

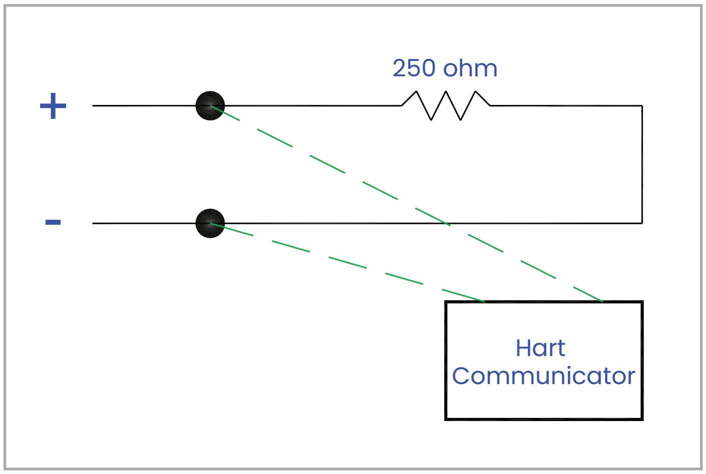


Figure 123: Wiring diagram for HART communication

F.2 HART write mode switch

The XMT1000 HART circuit includes a slide switch which can be used to disable write access to the instrument via HART. This slide switch (pictured in Figure 124 below) is designed to lock out HART configuration access for those customers who require this extra level of security. With the Write Mode switch pushed to the right, the HART circuit is in write enabled mode.

Figure 124: HART circuit write mode switch

Note: The following sections of this Appendix provide menu maps for programming the XMT1000 via HART communication. To make programming changes through HART, the HART circuit must be set to Write Enabled mode. Attempting to write to a device in Read Only mode will cause the device to indicate that the meter is in Write-Protect mode.

F.3 HART menu maps

For reference while programming the XMT1000, see the following HART menu maps:

- "HART Output Menu Map" on page 130
- "HART Review Menu Map" on page 131

F.3.1 HART output menu map

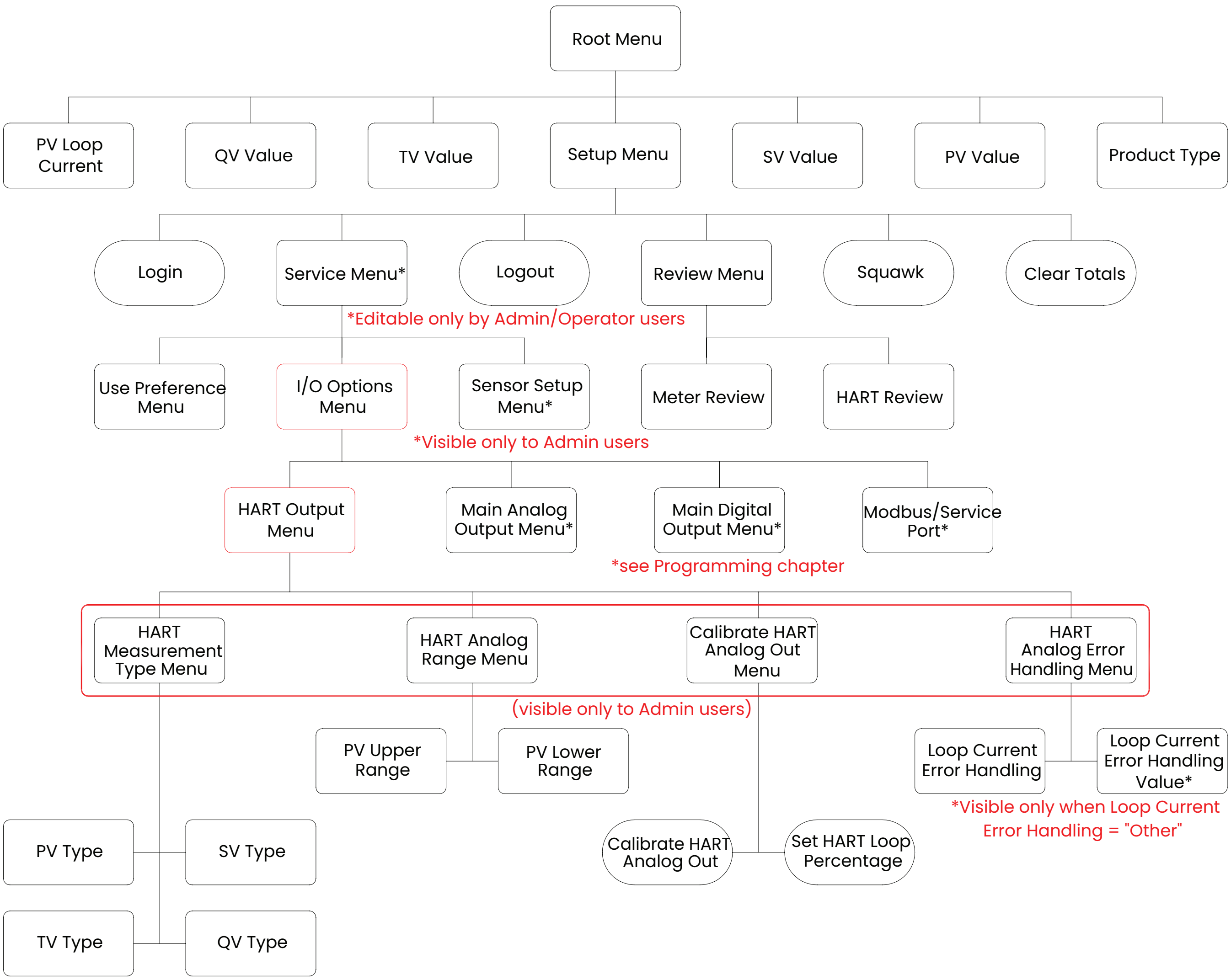


Figure 125: HART output menu map

F.3.2 HART review menu map

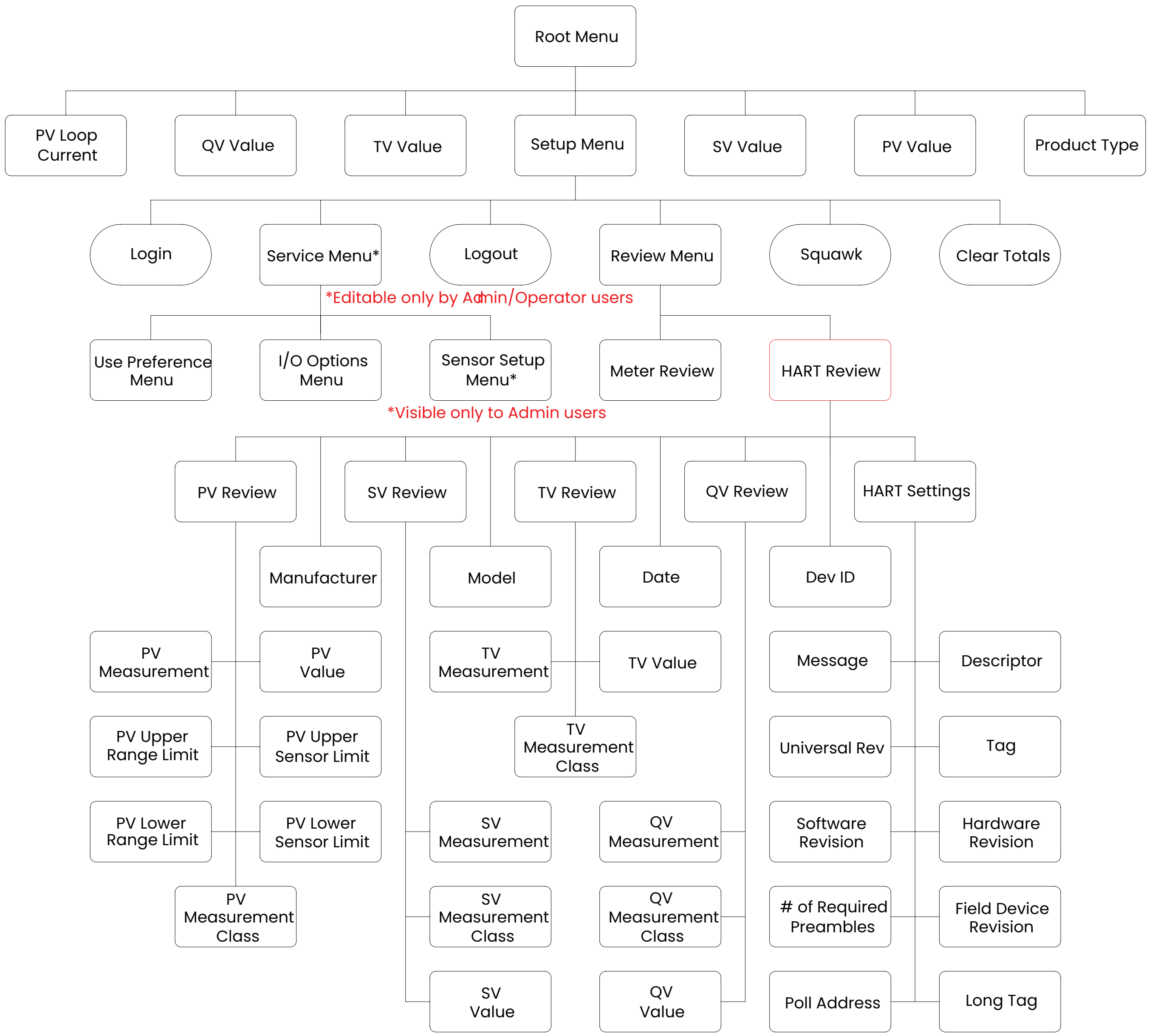


Figure 126: HART review menu map

F.4 Configurable measurements

Below table shows the measurements available over HART:

Table 34: Measurements available over HART		
Velocity	Ch 1 ActiveTw Amplitude Down	Ch 2 Peak Index Up
Volumetric	Ch 1 ActiveTw Gain Up	Ch 2 Peak Index Down
Mass Flow	Ch 1 ActiveTw Gain Down	Ch 2 Peak % Up
Batch Fwd Volumetric Totals	Ch 1 Error Status	Ch 2 Peak % Down
Batch Rev Volumetric Totals	Ch 1 Reported Error	Ch 2 No. Of Errors
Totalizer Elapsed Time	Ch 1 Peak Index Up	Ch 3 Velocity
Soundspeed	Ch 1 Peak Index Down	Ch 3 Soundspeed
Inventory Fwd Volumetric Totals	Ch 1 Peak % Up	Ch 3 Transit Time Up
Inventory Rev Volumetric Totals	Ch 1 Peak % Down	Ch 3 Transit Time Down
Inventory Totalizer Elapsed Time	Ch 1 No. Of Errors	Ch 3 DeltaT
Meter Factor	Ch 2 Velocity	Ch 3 ActiveTw Down
Standard Volumetric	Ch 2 Soundspeed	Ch 3 Signal Quality Up
Batch Net Volumetric Totals	Ch 2 Transit Time Up	Ch 3 Signal Quality Down
Inventory Net Volumetric Totals	Ch 2 Transit Time Down	Ch 3 Amplitude Up
Reynolds Number	Ch 2 DeltaT	Ch 3 Amplitude Down
Ch 1 Velocity	Ch 2 ActiveTw Down	Ch 3 Gain Up
Ch 1 Soundspeed	Ch 2 Signal Quality Up	Ch 3 Gain Down
Ch 1 Transit Time Up	Ch 2 Signal Quality Down	Ch 3 SNR Up
Ch 1 Transit Time Down	Ch 2 Amplitude Up	Ch 3 SNR Down
Ch 1 DeltaT	Ch 2 Amplitude Down	Ch 3 ActiveTw Up
Ch 1 ActiveTw Down	Ch 2 Gain Up	Ch 3 ActiveTw SNR Up
Ch 1 Signal Quality Up	Ch 2 Gain Down	Ch 3 ActiveTw SNR Down
Ch 1 Signal Quality Down	Ch 2 SNR Up	Ch 3 ActiveTw Amplitude Up
Ch 1 Amplitude Up	Ch 2 SNR Down	Ch 3 ActiveTw Amplitude Down
Ch 1 Amplitude Down	Ch 2 ActiveTw Up	Ch 3 ActiveTw Gain Up

Table 34: Measurements available over HART		
Ch 1 Gain Up	Ch 2 ActiveTw SNR Up	Ch 3 ActiveTw Gain Down
Ch 1 Gain Down	Ch 2 ActiveTw SNR Down	Ch 3 Error Status
Ch 1 SNR Up	Ch 2 ActiveTw Amplitude Up	Ch 3 Reported Error
Ch 1 SNR Down	Ch 2 ActiveTw Amplitude Down	Ch 3 Peak Index Up
Ch 1 ActiveTw Up	Ch 2 ActiveTw Gain Up	Ch 3 Peak Index Down
Ch 1 ActiveTw SNR Up	Ch 2 ActiveTw Gain Down	Ch 3 Peak % Up
Ch 1 ActiveTw SNR Down	Ch 2 Error Status	Ch 3 Peak % Down
Ch 1 ActiveTw Amplitude Up	Ch 2 Reported Error	Ch 3 No. Of Errors
Meter Information		
Flow board Serial number	Sensor 1 Dn Serial number	Sensor 3 Up Serial number
Flow board hardware revision	Sensor 2 Up Serial number	Sensor 3 Dn Serial number
Sensor 1 Up Serial number	Sensor 2 Dn Serial number	

Table 35: Configurable through HART	
Pipe Configurations	Pipe Outer Diameter
	Pipe Wall Thickness
	Pipe Inner Diameter
Fluid Configurations	Kinematic Viscosity
Limits	Zero Cutoff
	Flow Averaging
Path Configuration	Path Configuration
	Path Error Handling
	Ch 1 Path Weight
	Ch 2 Path Weight
	Ch 3 Path Weight
	Ch 1 Path Length
	Ch 2 Path Length
	Ch 3 Path Length
	Ch 1 Axial Length
	Ch 2 Axial Length
	Ch 3 Axial Length
	Ch 1 Transducer Type

Table 35: Configurable through HART	
Transducer Configurations	Ch 1 Transducer Number
	Ch 1 Transducer Frequency
	Ch 1 Static Tw
	Ch 2 Transducer Type
	Ch 2 Transducer Number
	Ch 2 Transducer Frequency
	Ch 2 Static Tw
	Ch 3 Transducer Type
	Ch 3 Transducer Number
	Ch 3 Transducer Frequency
	Ch 3 Static Tw
Standard IO	Communication Option Type Selection
	Standard Analog Output (AO)Error handling
	Standard Digital Output (DO) Type
	DO Pulse Measurement Type
	DO Pulse Unit Group selection
	DO Pulse value
	DO Pulse width
	DO Pulse Error handling
	DO Frequency Measurement Type
	DO Frequency Unit Group selection
	DO Frequency Base value
	DO Frequency Full Value
	DO Frequency Full Frequency
	DO Frequency Error handling
	DO Frequency Error handling value

[no content intended for this page]

Appendix G. Wireless HART communication

G.1 Introduction

Wireless HART is a bi-directional digital communication protocol for field devices, that offers multi-vendor, inter-operable wireless standard. It is an advancement in technologies for process control systems and is widely employed by numerous field devices.

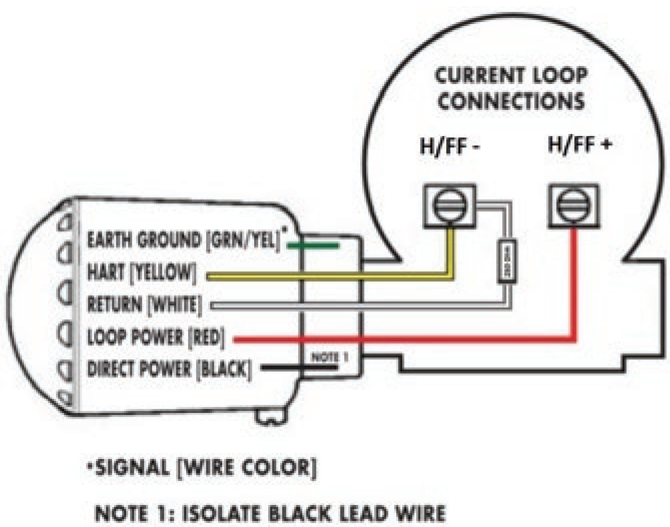
The XMT1000 flowmeter has integrated HART communication with 4-20mA output. Masoneilan VECTOR V1100 Wireless HART adaptor is used along with XMT1000 Flowmeter to setup as Wireless HART node. The below steps will guide to configure XMT1000 flowmeter to work with the Masoneilan VECTOR adaptor.

G.2 Installation and configuration

The following instruments are required for complete setup:

- **XMT1000 Flowmeter with HART option**
- **Masoneilan VECTOR V1100 Wireless HART adaptor.**

G.2.1 XMT1000 to Masoneilan VECTOR connection



Note: Make sure to add the 250Ω resistor across the white and yellow wires.

G.2.2 XMT1000 configuration

1. Program the 4 variables for HART digital output
- PV
- SV
- TV
- QV
2. Typical measurements include Volumetric Flow, Totals, Velocity, Soundspeed etc. but are application dependent.
3. Configure the meter so that it is not in error, systems without errors will be easier to troubleshoot later in the process.
4. Assign the meter a unique Tag and Long Tag so that they can be easily identified on the HART network.

G.2.3 Masoneilan VECTOR V1100 adaptor configuration

This step will configure the VECTOR adaptor so that it will be recognized by the wireless Gateway.

1. Connect an Emerson 475 communicator across the 250Ω resistor installed in the previous step.
2. Turn the communicator on and select HART from the menu. If the Emerson 475 is setup to scan addresses 0-16 then it should see the VECTOR adapter. Please note that the default VECTOR address is 15.

a. If the 475 does not see the VECTOR adapter, verify that the scan settings are correct:

- Press 3, for Utility
- Press 1, for Configure HART Application
- Press 2, Polling Addresses
- Scroll to (0-15) and press enter
- Escape back to the main menu

3. Setup Tag: Program a unique tag name for the VECTOR adapter, so that it is easily recognizable.

a. Select HART application
b. Press 2, Online
c. Press 2, Configure
d. Press 2, Manual Setup
e. Press 7, Device Information
f. Press 2, Long Tag
g. Type Tag name and select enter to program the tag name into the VECTOR adapter

4. Setup network ID and Join Key - These values need to be programmed into the VECTOR adapter so that it can join the Wireless Gateway network. Please note these values are found with the Emerson Gateway documentation and may be different for different networks.

a. Select HART application
b. Press 2, Online
c. Press 2, Configure
d. Press 2, Manual Setup
e. Press 2, Wireless
f. Press 2, Join Device to Network
g. Enter the Network ID and Join Key for your network

G.2.4 Emerson wireless gateway setup configuration

The following information will show how to configure the Wireless Gateway with a STATIC IP to a dedicated PC, this can be useful as a diagnostic tool.

Note: This is not a typical end user application but can be used as a diagnostic tool at the customer site, the gateway may already be setup at the customer site per their procedures.

1. Connect +24VDC power to the wireless Gateway. Refer to the label on the inside cover of the Gateway.
2. Connect a CROSSOVER cable from the Ethernet 1 port of the gateway and the Ethernet port on the PC.
3. Configure the PC TCP/IP Settings (Note this information can be found in the Gateway manual).

a. Open: A network settings in the PC control panel.

b. Select TCP/IP and Properties.

c. Record any current static IP settings, before making changes so that the PC can be returned to its original state.

d. Select "Use the following IP Address" box.

e. Input 192.168.1.12 in the IP Address block.

f. Input 255.255.255.0 in the Subnet Mask.

g. Select OK for both TCP/IP and LAN properties Windows.

4. Disable Proxies.

a. Open the standard Web browser on the PC.

b. Navigate to **Tool->Internet Options->Connections->LAN Settings**.

c. Uncheck the Proxy Server Box.

5. Configure the Wireless Gateway.

a. Under web server, type address https://192.168.1.10.

- Log in as User: admin and Password: default.

b. Navigate to Setup->Internet Protocol Screen.

- Verify the Specify an IP Address box is checked.
- Set IP Address to 192.168.1.10.
- Set mask to 255.255.255.0.
- Set Gateway to 192.168.1.12 (Note: this is the IP Address on the PC)

6. Verify operation: Note that HART is a slow protocol, Wireless HART is even slower, so be patient waiting for the Gateway to see the VECTOR.

a. Look at the Network Overview page to see if there are any "live" devices on the network.

b. When visible switch to the Explorer page to see the VECTOR adapter and Wireless HART Data.

Appendix H. Foundation Fieldbus communication

H.1 Introduction

Fieldbus is a bi-directional digital communication protocol for field devices, which offers an advancement in technologies for process control systems and is widely employed by numerous field devices.

The XMT1000 FF option is designed to the specification standardized by the Fieldbus Foundation, and provides interoperability with devices produced by other manufacturers. The Fieldbus option PCB comes with software consisting of five AI function blocks and one PID function block.

Note: For more general information on other features, engineering, design, construction work, startup and maintenance of Fieldbus, refer to Fieldbus Technical Information (TI 38K3A01-01E).

H.2 Installation

H.2.1 Network configuration

The following instruments are required for use with Fieldbus devices:

- **Power supply:** Fieldbus requires a dedicated power supply. It is recommended that current capacity be well over the total value of the maximum current consumed by all devices (including the host). Conventional DC current cannot be used as is.
- **Terminators:** Fieldbus requires two terminators. Refer to the supplier for details of terminators that are attached to the host.
- **Field devices:** Connect the field devices necessary for instrumentation. XMT1000 has passed the interoperability test conducted by the Fieldbus Foundation. To properly start Fieldbus, use devices that satisfy the requirements of the above test.
- **Host:** Used for accessing field devices. A dedicated host (such as DCS) is used for an instrumentation line while dedicated communication tools are used for experimental purposes.

H.2.2 Polarity

The XMT1000 Foundation Fieldbus terminals are marked (+) and (-). However, the design is polarity insensitive. This means the XMT1000 will communicate even if the connections are reversed.

H.2.3 Connection

Connect the Fieldbus wires to P1 on the terminal PCB (see Figure 127 below). Panametrics recommends using the top right rear port on the enclosure.

IMPORTANT:
Please make sure to follow all local installation guidelines.

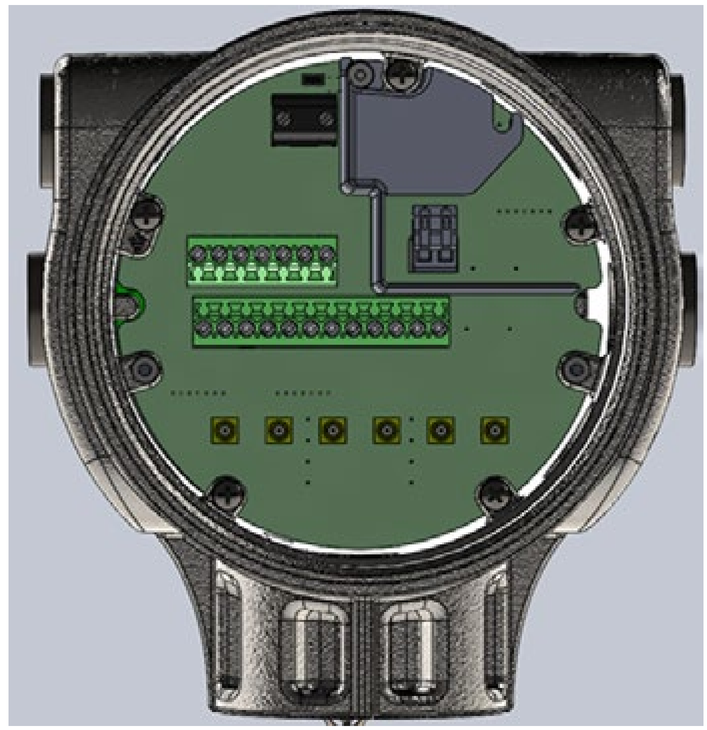


Figure 127: FF Connection to XMT1000

H.2.4 FISCO (Fieldbus intrinsically safe concept)

The XMT1000 Fieldbus is certified as a FISCO connection for both entity and FISCO parameters:

- **FISCO Parameters**
  V_{max} or U_i = 17.5 V
  I_{max} or L_i = 380 mA
  C_i = 0
  L_i = 10 µH
  P_i = 5.32 W
- **Entity Parameters**
  V_{max} or U_i = 24 V
  I_{max} or L_i = 250 mA
  C_i = 0
  L_i = 10 µH
  P_i = 5.32 W

Note: The XMT1000 FISCO control drawing is Panametrics drawing #752-584. Please consult the factory for a copy of the drawing.

Attention!

The FISCO cover must be installed to comply with FISCO guidelines.

IMPORTANT:

The FISCO cover on the XMT1000 terminal PCB is required to provide a barrier between IS and non-IS connections. This cover must be installed if the Fieldbus application is FISCO.

The FISCO cover should come installed from the factory, as shown in Figure 128 below. The Fieldbus cables should be installed through the XMT1000 upper right port for direct entry into the FISCO zone on the terminal PCB.

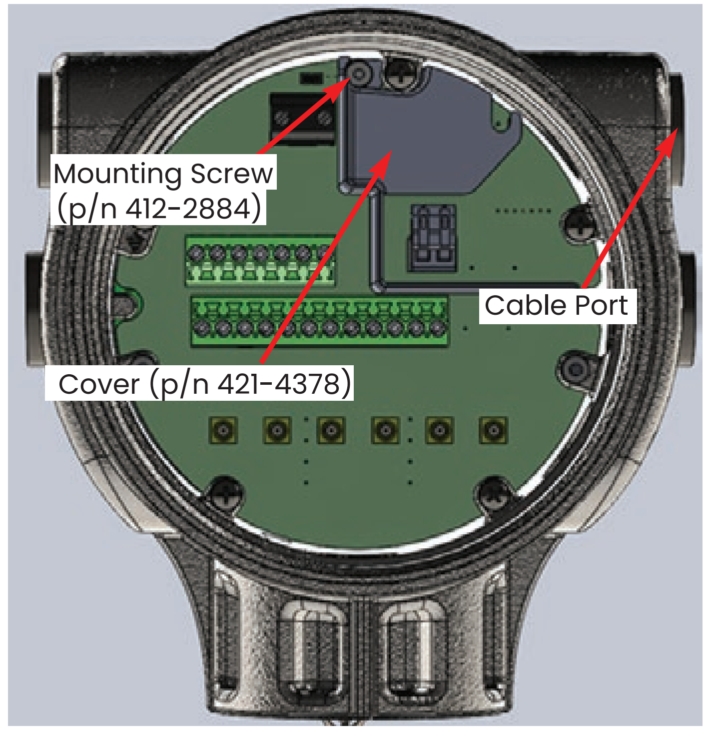


Figure 128: Installed FISCO cover and mounting screw

H.2.5 DD File

The DD file can be found on the Foundation Fieldbus website www.fieldbus.org under Panametrics as manufacturer and XMT1000 as model. It may also be found on the DCS vendor website if available.

H.2.6 Default node address

The default node address for each XMT1000 flow meter from the factory is 17 (see Figure 129 below). This should be changed during commissioning.

Figure 129: XMT1000 device properties

H.3 Specifications

H.3.1 General

Manufacturer Name: Panametrics

Manufacturer ID (Hex): 004745

Model: XMT1000

Device Type: 0010

FF Device Revision: For latest, see Fieldbus Foundation website

FISCO Compliant: Yes

Hazardous Location Certs: See drawing 752-584

ITK Revision: 6.2

Protocol: H1

Protocol Baud (bps): 31.25k

DD and CFF Files: For latest, see Fieldbus Foundation website

Meter Programmable through FF: Yes

H.3.2 Physical

Polarity Sensitive (Yes/No): No

Quiescent Current Draw (mA): 26

Working Voltage: 9-32 VDC

H.3.3 Communication

Stack Manufacturer: Softing AG

Backup LAS Capable: Yes*

Total Number of VCRs: 24

Fixed VCRs for Configuration: 1

*LAS means Link Active Scheduler. It can schedule a network if the main LAS fails.

H.3.4 User layer

FB Application Manufacturer: Softing AG

Function Blocks: 5-AI(e), 1-PID

Supports Block Instantiation: No

Firmware Upgrade over Fieldbus: No

Configuration Write Protect: HW Jumper on PCB

H.3.5 Function blocks

Resource Block Class Type: Enhanced (Field Diagnostics)

Transducer Blocks: XMIT, COMPOSIT CH, CH 1, CH 2, CH 3

Transducer Block Class Type: Custom

Function Blocks: AI (5), PID

FB Execution Time (ms): 20, 40

Function Block Class Type: Standard

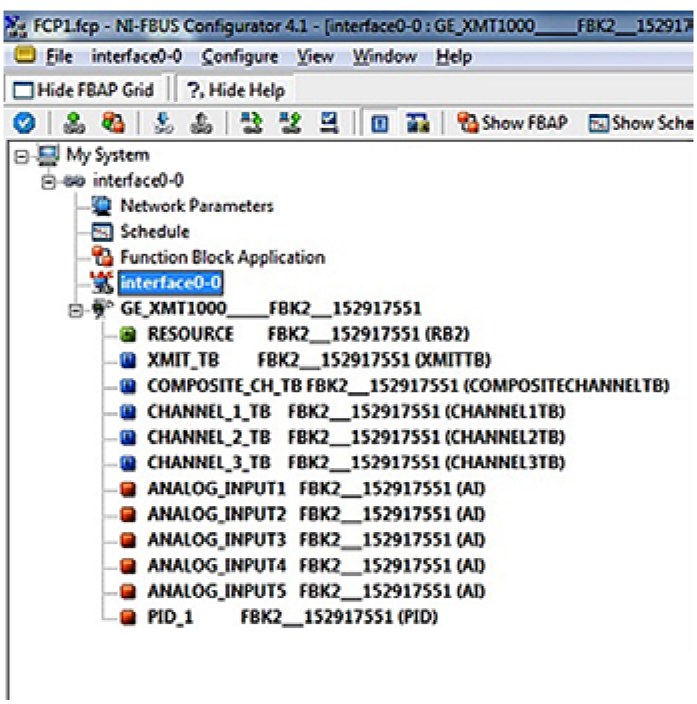


Figure 130: XMT1000 FF blocks

H.4 Resource Block

The Resource Block provides common information about the XMT1000 Foundation Fieldbus implementation. The user can find FF revision numbers, set passwords and configure the NAMUR NE107 bit map.

H.4.1 FF Revision

Figure 131 below shows the Foundation Fieldbus SW and HW versions in the XMT1000 Resource Block, and includes an FF Revision for both.

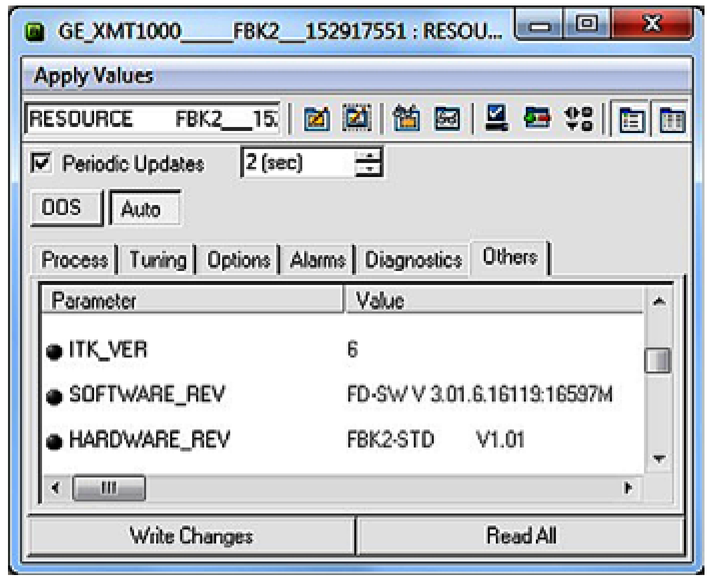


Figure 131: FF Revision in XMT1000 resource block

H.4.2 Password

A password must be entered to change XMT1000 system parameters. This can be done using Foundation Fieldbus. There are different levels of security for different Passwords (Admin or Operator). Please see the standard manual for more detail on password levels. Figure 132 below shows the password fields in the XMT1000 Resource Block.

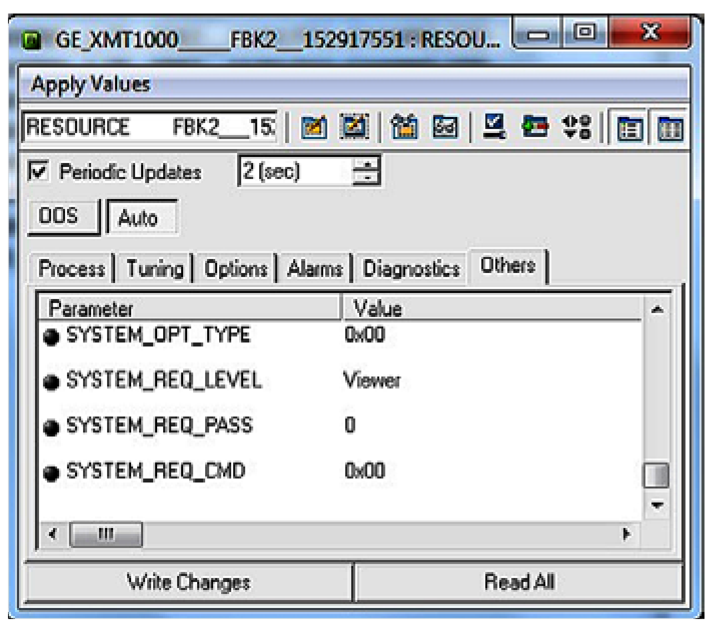


Figure 132: Password Fields in XMT1000 resource block

Attention!

Before entering a password, make sure the XMIT_TB transducer block is in active mode.

To Enter configuration mode, complete the following steps:

1. Select the **Resource Block > Others** tab.
2. Select **SYSTEM_OPT_TYPE** and set to **Option FI**.
3. Select **SYSTEM_REQ_LEVEL** and set to **Admin** or **Operator**.
4. Enter the Admin or Operator password into the **SYSTEM_REQ_PASS** field.
5. Select **Cancel** from the **SYSTEM_REQ_CMD** drop down box.
6. Select **Login** from the **SYSTEM_REQ_CMD** drop down box.
7. Click on the **Write Changes** button.
8. Verify that **S1:In Config Mode** appears on XMT1000 display. You should now be able to edit fields with **Admin** privileges.

To Edit the fields in the Transducer Blocks, complete the following steps:

1. Select or enter the **new value**.
2. Click on the **Write Changes** button.
3. Return to the **Resource Block > Others** tab and select Commit from the **SYTEM_REQ_COM** drop down box
4. Click on the **Write Changes** button.

To Exit configuration mode, complete the following steps:

1. Select Cancel from the **SYSTEM_REQ_CMD** drop down box.
2. Click on the **Write Changes** button.

Note: The XMT1000 will automatically exit configuration mode after 5 minutes of inactivity.

H.4.3 NAMUR NE107

The **NAMUR NE107** recommendation specifies that detailed device-specific diagnostics are summarized as four simple status signals. The diagnostics are set to defaults by Panametrics, but they can be modified to any other level by the user. The four status signals are:

- **Failed:** This category is typically used for hardware or software failures. The meter output is not valid. Consult with the factory for a resolution.
- **Offspec:** This category is typically used for application, installation, or process problems. Consult the troubleshooting section of this appendix or contact Panametrics customer service for assistance.
- **Check:** This category means the output of the device is invalid due to on-going work on the device, such as programming, etc.
- **Maintenance:** This category is typically used to assign parameters that are in good status but which may fall out of specification due to some process condition or wear factor. There are no diagnostics set as default in this category.

The status signals (see Figure 133 below) can either be reported as errors (**ACTIVE**) or masked when the error occurs (**MASK**). There are no default settings for the **MASK** bits.

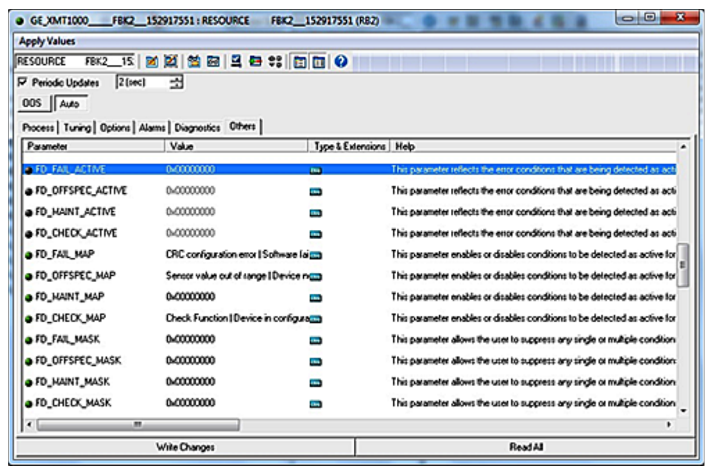


Figure 133: NAMUR NE107 configuration in resource block

The NAMUR NE107 Errors and their Default Categories in the XMT1000 **Resource Block** are listed in Table 36 below.

Table 36: NAMUR NE107 Errors and XMT1000 default categories		
Error	**Sub-Error Description**	**Default Category**
Default Category	Persistent Parameter CRC Fault	Failed
Software Failure	Stack Overflow failure	Failed
	Sequence or Windowed Watch Dog failure	Failed
	Software fault	Failed
Device Initialization Failure	Initialization failed	Failed
Hardware Failure	ADC Bit Test Fault	Failed
	VGA test Fault	Failed
	Clock Frequency Fault	Failed
	CPU test Fault	Failed
	Invariable Flash Memory Fault	Failed
	Variable Memory Fault	Failed
	FPGA Configuration CRC fault	Failed
	Temperature Test Fault	Failed
	Driver Failure	Failed
	Watch Dog failure	Failed
	DSP Hardware Errors	Failed
	Default ISR (DSP Exception)	Failed
	DSP Exception	Failed
Modbus Communication Loss	No Modbus communication	Failed
Sensor Value out of Range	VelocityWarning	Offspec
Device not calibrated	NotCalibrated	Offspec

Table 36: NAMUR NE107 Errors and XMT1000 default categories		
Error	**Sub-Error Description**	**Default Category**
Sensor Measurement Error	SingleChAccuracy	Offspec
	MultiChAccuracy	Offspec
	ActiveTw	Offspec
	CycleSkip	Offspec
	Amplitude	Offspec
	SignalQuality	Offspec
	VelocityRange	Offspec
	SoundSpeed	Offspec
	SNR	Offspec
Device in Configuration Mode	In Configuration Mode - Indication	Check
Unsupported Parameter Warning	Unsupported Parameter - Warning	Check
Invalid Parameter Range Warning	Invalid Parameter Range - Warning	Check
Invalid Request Warning	Invalid request - Warning	Check
Invalid User Warning	Invalid User - Warning	Check

H.5 XMIT Transducer block

The XMIT transducer block contains parameters that can be transmitted onto the Fieldbus via the AI block. The user can view real time data and select the units for each of the parameters (see Figure 134 below).

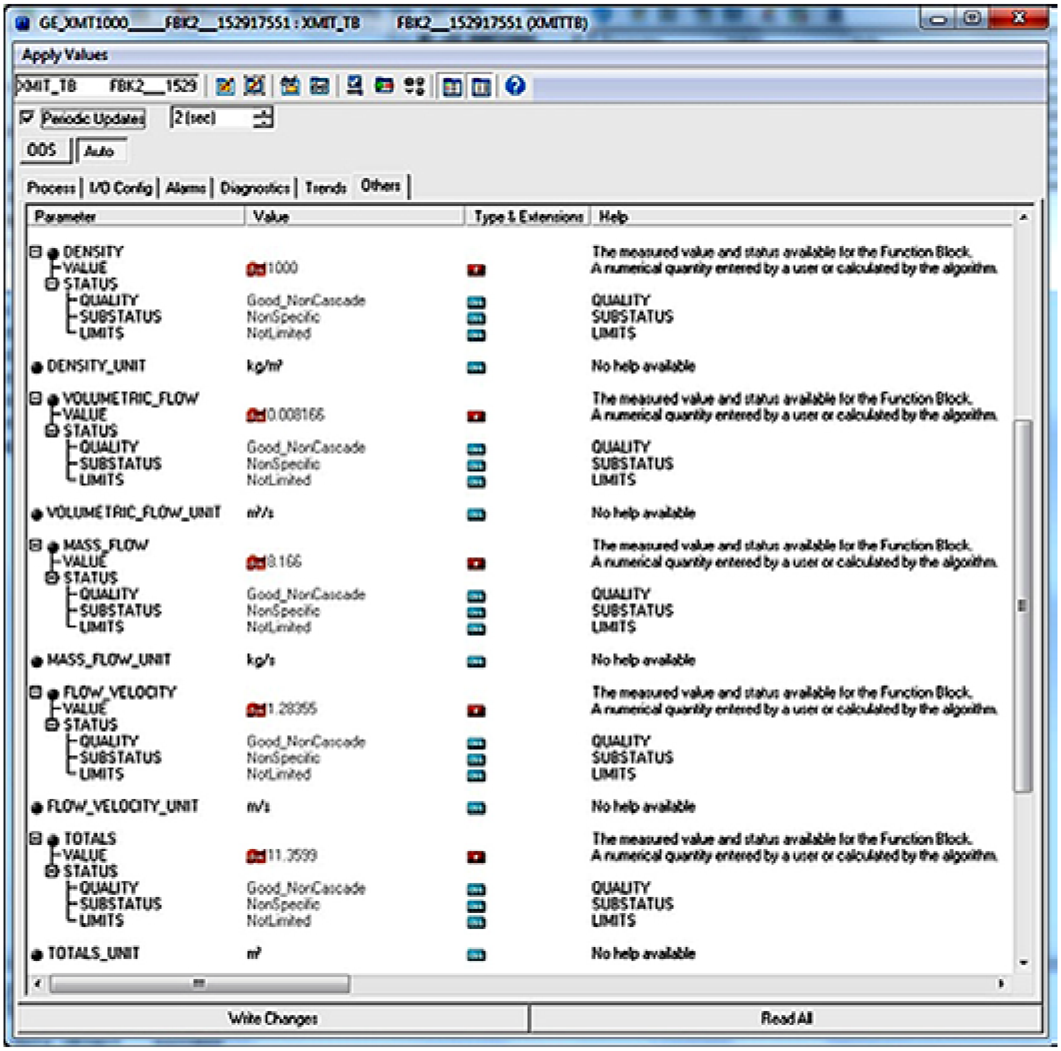


Figure 134: Measurement parameters and units in XMIT transducer block

H.5.1 Units

The measurement parameters found on the **XMIT Transducer Block** have several selectable units. Table 37 below lists the available units for each parameter.

Note: The units can only be changed using an Admin password. Make sure the selected units agree between the **XMIT Transducer Block** and the **AI Block**.

Table 37: Available Parameters and units in XMIT transducer block

Parameter	Units
Density	g/m^3, kg/L, g/ml, kg/m^3, lb/in^3, lb/ft^3, lb/gal
Volumetric Flow (Act)	m^3/s, m^3/m, m^3/h, m^3/d, L/s, L/min, L/h, ML/d, CFS, CFM, CFH, ft^3/d, gal/s, GPM, gal/h, gal/d, ImpGal/s, ImpGal/min, ImpGal/h, ImpGal/d, bbl/s, bbl/min, bbl/h, bbl/d, kgal/min, kgal/h, kgal/d, kbbl/min, kbbl/h, kbbl/d, ac-ft/m, ac-ft/h, ac-ft/d
Mass Flow	kg/s, kg/min, kg/h, kg/d, t/s, t/min, t/h, t/d, lb/s, lb/min, lb/h, lb/d, Ston/s, Ston/min, Ston/h, Ston/d, klb(US)/s, klb(US)/min, klb(US)/h, klb(US)/d
Velocity	m/s, ft/s
Totals	m^3, L, ft^3, gallon, bbl, Mgal, Mft^3, ImpGal, Mbbl, Ml, Mm^3, ac-ft, ac-in, Sm^3, SL, SCF
Temperature	K, C, F, R
Pressure	kg-m^2, Pa, Mpa, kPa, bar, mbar, torr, atm, psia, psig

H.6 Composite Transducer block

The **Composite Transducer Block** provides the measurement values and programmable parameters that are common to all three paths. Figure 135 below shows the **Composite Transducer Block** and Table 38 on page 152 lists the Measurements and Parameters that are available.

Note: The **R/W** designation means that the parameter is writable in **FF** using an **Admin** password.

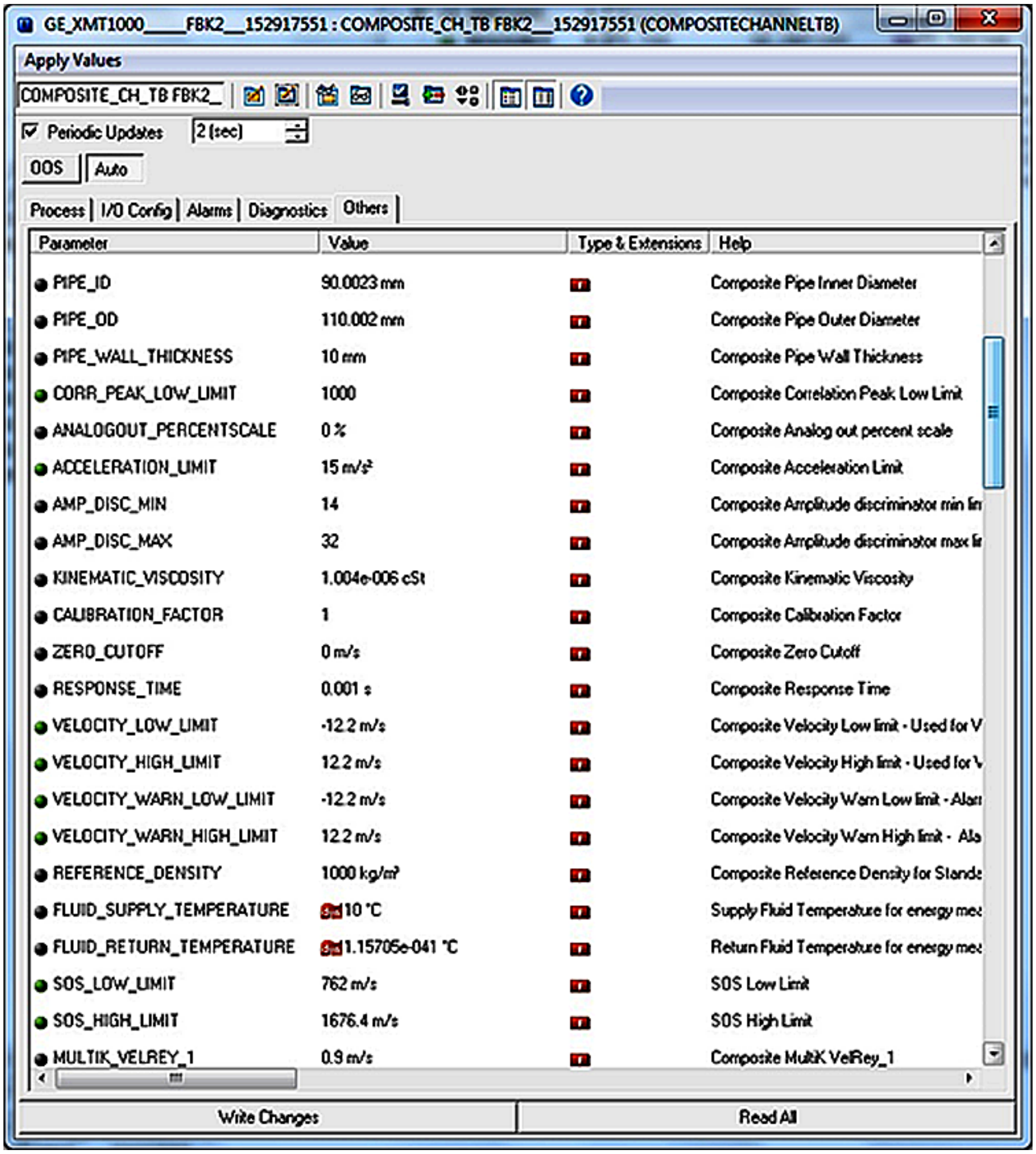


Figure 135: Composite transducer block

Table 38: Available measurement values and parameters in the composite TB		
Composite TB Measurements and Parameters	**Measurement**	**Parameter**
BATCH_FWD_TOTALS	R	
BATCH_REV_TOTALS	R	
BATCH_TOTAL_TIME	R	
SOUND_SPEED	R	
INVENTORY_FWD_TOTALS	R	
INVENTORY_REV_TOTALS	R	
INVENTORY_TOTAL_TIME	R	
MULTI_KFACTOR	R	
REYNOLDS_KFACTOR	R	
CURRENT_OPERATING_TEMP	R	
STANDARD_VOLUMETRIC	R	
BATCH_NET_TOTALS	R	
ERROR_STATUS	R	
HEALTH_CODE	R	
REPORTED_ERROR	R	
GATE_INPUT_STATE	R	
UNIT_TYPE_DENSITY_R	R	
UNIT_TYPE_VELOCITY_R	R	
UNIT_TYPE_TEMPERATURE_R	R	
PIPE_ID		R/W
PIPE_OD		R/W
PIPE_WALL_THICKNESS		R/W
CORR_PEAK_LOW_LIMIT		R/W
ANALOGOUT_PERCENTSCALE		R/W
ACCELERATION_LIMIT		R/W
AMP_DISC_MIN		R/W
AMP_DISC_MAX		R/W
KINEMATIC_VISCOSITY		R/W
CALIBRATION_FACTOR		R/W
ZERO_CUTOFF		R/W
RESPONSE_TIME		R/W
VELOCITY_LOW_LIMIT		R/W
VELOCITY_HIGH_LIMIT		R/W
VELOCITY_WARN_LOW_LIMIT		R/W
VELOCITY_WARN_HIGH_LIMIT		R/W
REFERENCE_DENSITY		R/W

Table 38: Available measurement values and parameters in the composite TB		
Composite TB Measurements and Parameters	**Measurement**	**Parameter**
SOS_LOW_LIMIT, SOS_HIGH_LIMIT		R/W
MULTIK_VELREY_1-12, MULTIK_KFACTOR_1-12		R/W
REYNOLDS_CORRECTION		R/W
FLUID_SUPPLY_TEMPERATURE		R
FLUID_RETURN_TEMPERATURE		R
SOS_LOW_LIMIT		R/W
SOS_HIGH_LIMIT		R/W
MULTIK_VELREY		R/W
MULTIK_KFACTOR		R/W
PATHCONFIGURRATION		R/W
HARDWARE_REVISION		R
SOFTWARE_REVISION		R
UMPU_SERIAL_NUMBER		R
TOTALIZER_CMD		R/W
SENSOR_SERIAL_NUMBER		R
MULTIK_ACTIVE		R/W
MULTIK_TYPE		R/W
MULTIK_PAIRS		R/W
KVINPUT_SELECTION		R/W
ENABLE_ACTIVE_TW		R/W
CALIBR_MODE_SELECTION		R/W
PATH_ERROR_HANDLING		R/W
UNIT_TYPE_DIMENSION		R/W
UNIT_TYPE_TIME		R/W
UNIT_TYPE_VISCOSITY		R/W
UNIT_TYPE_STD_VOL		R/W
SYSTEM_SERIAL_NUMBER		R
FTPA_SERIAL_NUMBER		R
VOLTAGE_SELECTION		R/W
ATTENUATOR_SELECTION		R/W

H.6.1 Clearing the totalizer

Batch totals can be controlled through Foundation Fieldbus (see Figure 136 below). The user can start, stop, or reset batch totalizers by setting the option on the **TOTALIZER_CMD** function of the **Composite Transducer Block**. To set the totalizers from the Foundation Fieldbus:

1. Verify that the gate and ground terminals on the Main PCB are connected.
2. Program the **CALIBR_MODE_SELECTION** parameter on the **Composite Transducer Block** to **Gate Input**.

After these steps are complete, you can control the batch totalizer (start, stop, or reset) by selecting the desired option on **TOTALIZER_CMD** and writing the changes to the meter. No password is required for this function.

IMPORTANT:

The Inventory Totalizer can only be reset at the factory.

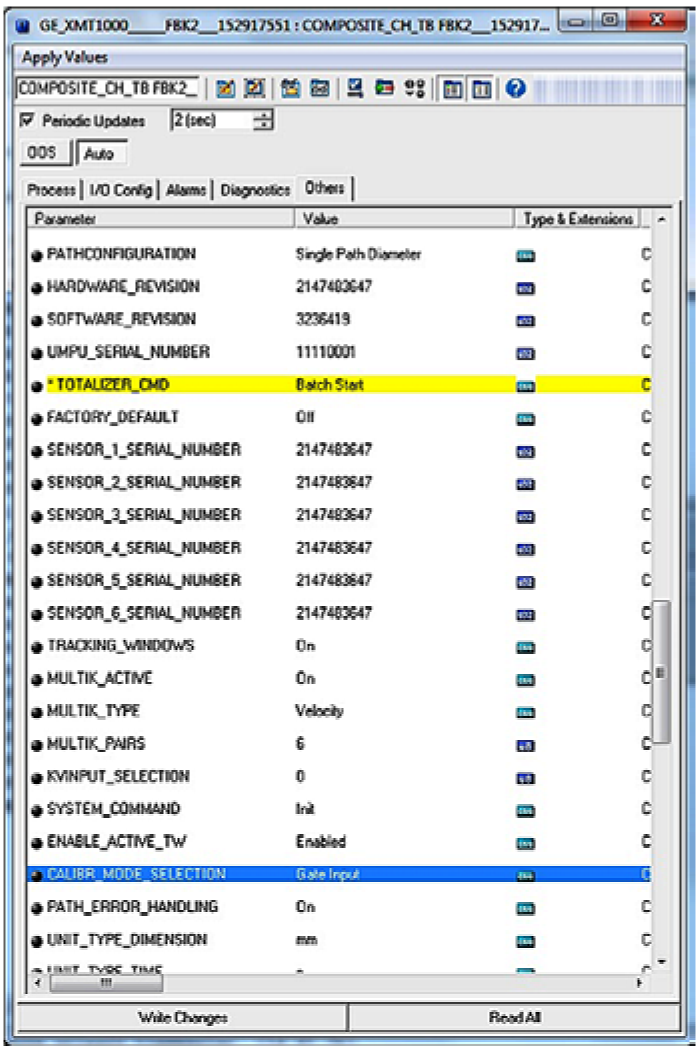


Figure 136: TOTALIZER_CMD function on composite TB

H.7 Configurable measurements

Below table shows the measurements available over FF:

Table 39: Measurements available over FF		
Velocity	Ch 1 Signal Quality Down	Ch 2 SNR Down
Volumetric	Ch 1 Amplitude Up	Ch 2 Peak Index Up
Mass Flow	Ch 1 Amplitude Down	Ch 2 Peak Index Down
Batch Fwd Volumetric Totals	Ch 1 Gain Up	Ch 2 Peak % Up
Batch Rev Volumetric Totals	Ch 1 Gain Down	Ch 2 Peak % Down
Totalizer Elapsed Time	Ch 1 SNR Up	Ch 2 No. Of Errors
Soundspeed	Ch 1 SNR Down	Ch 3 Soundspeed
Inventory Fwd Volumetric Totals	Ch 1 Peak Index Up	Ch 3 Transit Time Up
Inventory Rev Volumetric Totals	Ch 1 Peak Index Down	Ch 3 Transit Time Down
Inventory Totalizer Elapsed Time	Ch 1 Peak % Up	Ch 3 DeltaT
Meter Factor	Ch 1 Peak % Down	Ch 3 Signal Quality Up
Reynolds K-Factor	Ch 1 No. Of Errors	Ch 3 Signal Quality Down
Current Operating Temperature	Ch 2 Soundspeed	Ch 3 Amplitude Up
Standard Volumetric	Ch 2 Transit Time Up	Ch 3 Amplitude Down
Batch Net Volumetric Totals	Ch 2 Transit Time Down	Ch 3 Gain Up
Error Status	Ch 2 DeltaT	Ch 3 Gain Down
Health Code (All System Errors bit map)	Ch 2 Signal Quality Up	Ch 3 SNR Up
Reported Error (highest priority Error)	Ch 2 Signal Quality Down	Ch 3 SNR Down
Gate State	Ch 2 Amplitude Up	Ch 3 Peak Index Up
Ch 1 Soundspeed	Ch 2 Amplitude Down	Ch 3 Peak Index Down
Ch 1 Transit Time Up	Ch 2 Gain Up	Ch 3 Peak % Up
Ch 1 Transit Time Down	Ch 2 Gain Down	Ch 3 Peak % Down
Ch 1 DeltaT	Ch 2 SNR Up	Ch 3 No. Of Errors
Ch 1 Signal Quality Up		
Meter Information		
System Serial number	Sensor 2 Up Serial number	Buffer 1 Dn Serial number
Flow board Serial number	Sensor 2 Dn Serial number	Buffer 2 Up Serial number
Flow board hardware revision	Sensor 3 Up Serial number	Buffer 2 Dn Serial number
Sensor 1 Up Serial number	Sensor 3 Dn Serial number	Buffer 3 Up Serial number
Sensor 1 Dn Serial number	Buffer 1 Up Serial number	Buffer 3 Dn Serial number

Table 40: Configurable through FF	
Pipe Configurations	Pipe Outer Diameter
	Pipe Wall Thickness
	Pipe Inner Diameter
Fluid Configurations	Kinematic Viscosity
	Reference Density
	Tracking Mode Selection
	Minimum Soundspeed
	Maximum Soundspeed
Limits	Minimum Velocity Warning Limit
	Maximum Velocity Warning Limit
	Minimum Velocity
	Maximum Velocity
	Zero Cutoff
	Flow Averaging
	Minimum Amplitude
	Maximum Amplitude
	Correlation Peak Limit
Path Configuration	Path Configuration
	Path Error Handling
	Ch 1 Path Weight
	Ch 2 Path Weight
	Ch 3 Path Weight
	Ch 1 Path Length
	Ch 2 Path Length
	Ch 3 Path Length
	Ch 1 Axial Length
	Ch 2 Axial Length
	Ch 3 Axial Length

Table 40: Configurable through FF	
Transducer Configurations	Ch 1 Transducer Type
	Ch 1 Transducer Number
	Ch 1 Transducer Frequency
	Ch 1 Static Tw
	Ch 2 Transducer Type
	Ch 2 Transducer Number
	Ch 2 Transducer Frequency
	Ch 2 Static Tw
	Ch 3 Transducer Type
	Ch 3 Transducer Number
	Ch 3 Transducer Frequency
	Ch 3 Static Tw
Advanced	Transmit Voltage
	Attenuator
	Reynolds Correction
	Tw Mode Selection
	Ch 1 Active Tw Peak %
	Ch 2 Active Tw Peak %
	Ch 3 Active Tw Peak %
	Ch 1 Delta-T Offset
	Ch 1 Tbc
	Ch 1 Transmit Delay
	Ch 1 Number of Errors Allowed
	Ch 1 Peak %
	Ch 2 Delta-T Offset
	Ch 2 Tbc
	Ch 2 Transmit Delay
	Ch 2 Number of Errors Allowed
	Ch 2 Peak %
	Ch 3 Delta-T Offset
	Ch 3 Tbc
	Ch 3 Transmit Delay
	Ch 3 Number of Errors Allowed
	Ch 3 Peak %

Table 40: Configurable through FF	
Calibration	Meter Factor
	Calibration Mode Selection
	K-Table Selection
	Number of Points
	Calibration Type Selection
Calibration table	Velocity points (1 to 6)
	Reynolds points (1 to 6)
	K-Factors points (1 to 6)

H.8 Channel transducer block

The CH1, CH2 and CH3 transducer blocks show the measurement values and programmable parameters for each of the three paths. Figure 137 below shows the Channel Transducer Block, and Table 41 on page 159 lists the measurements and parameters that are available.

Note: The R/W designation means that the parameter is writable in FF using an Admin password.

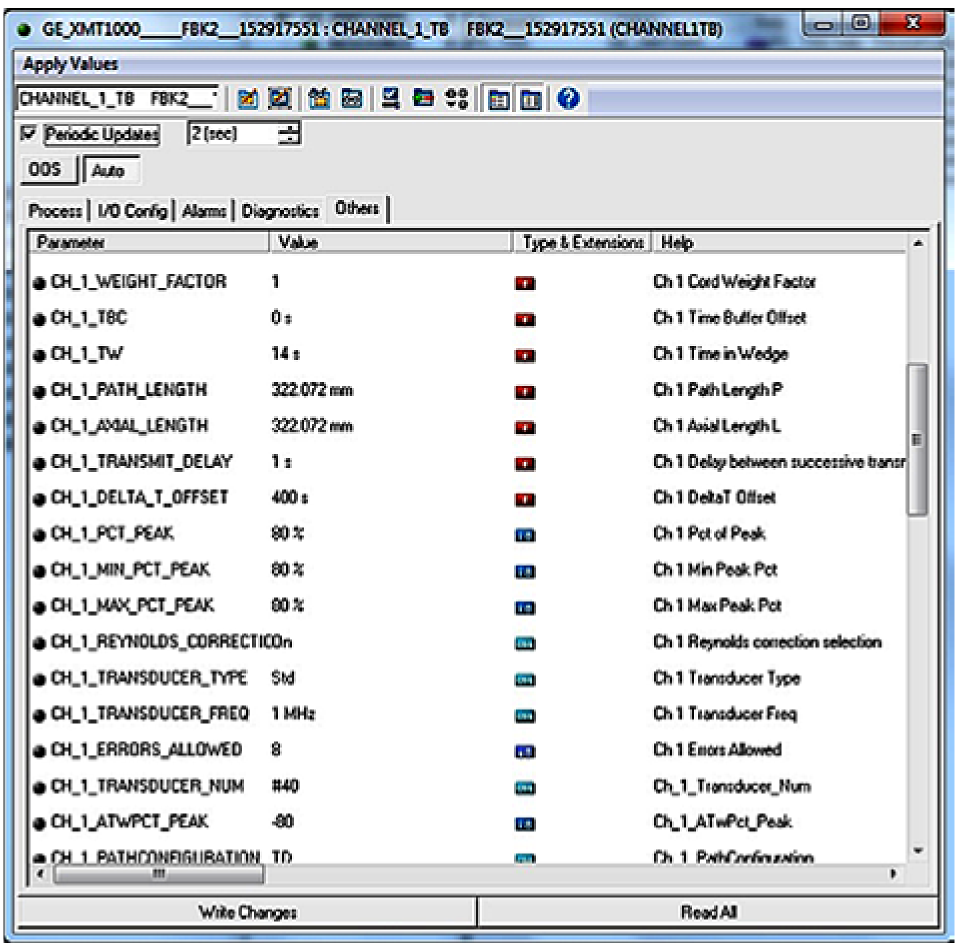


Figure 137: Channel transducer block

Table 41: Available measurement values and parameters in the channel TB

Channel TB Measurements and Parameters	Measurement	Parameter
CH_SOUND_SPEED	R	
CH_TRANSIT_TIME_UP	R	
CH_TRANSIT_TIME_DN	R	
CH_DELTA_T	R	
CH_UP_SIGNAL_QUALITY	R	
CH_DN_SIGNAL_QUALITY	R	
CH_UP_AMP_DISC	R	
CH_DN_AMP_DISC	R	
CH_GAIN_UP	R	
CH_GAIN_DN	R	
CH_SNR_UP	R	
CH_SNR_DN	R	
CH_UP_PEAK	R	
CH_DN_PEAK	R	
CH_PEAK_PCT_UP	R	
CH_PEAK_PCT_DN	R	
CH_NUM_ERRRORS_OF_16	R	
CH_WEIGHT_FACTOR		R/W
CH_TBC		R/W
CH_TW		R/W
CH_PATH_LENGTH		R/W
CH_AXIAL_LENGTH		R/W
CH_TRANSMIT_DELAY		R/W
CH_DELTA_T_OFFSET		R/W
CH_PCT_PEAK		R/W
CH_TRANSDUCER_TYPE		R/W
CH_TRANSDUCER_FREQ		R/W
CH_ERRORS_ALLOWED		R/W
CH_TRANSDUCER_NUMBER		R/W
CH_PATHCONFIGURATION		R/W

H.9 Analog input block

The Analog Input (**AI**) Block (see Figure 138 below) is designed as a generalized signal conditioning function. The output from an **AI** block can be connected to the Fieldbus. The **AI** block receives and processes data measured by the **Transducer Block** and provides additional functions such as scaling, filtering, alarm generation, and trending.

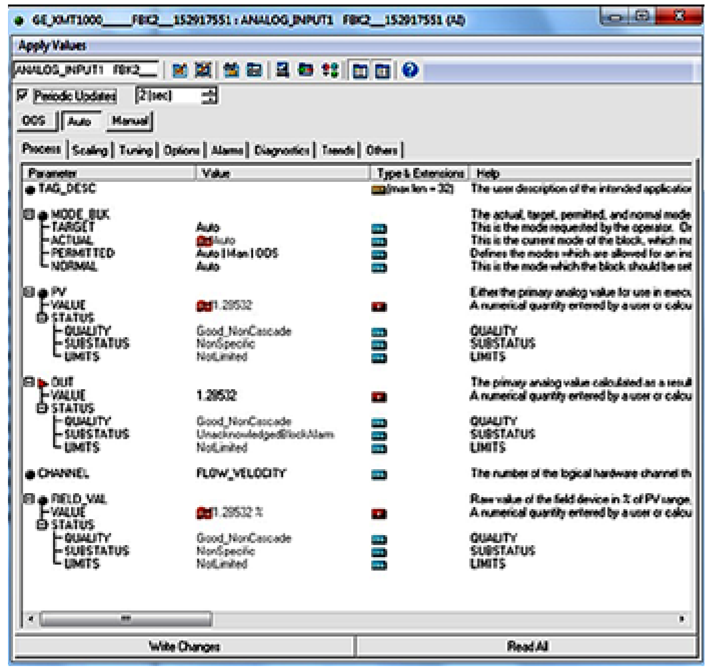


Figure 138: Analog input (AI) block

H.10 PID block

The **PID** function offers control based on a programmable algorithm. The **PID** function block may be used with a valve to control flow.

Note: See Foundation Fieldbus Specifications for more detail on use of the **PID** Block.

H.11 Error handling

The flow meter publishes the error status on the Fieldbus along with the real data. The error status can be seen in the CH_x_Reported Error parameter on the Channel Transducer Block. In addition, the Quality parameter shown with each of the process variables reports the error. In Figure 139 below, the CH1_REPORTED_ERROR shows as E1.

Note: For more information on the actual measurement errors and possible causes, see Chapter 4, Error Codes and Troubleshooting.

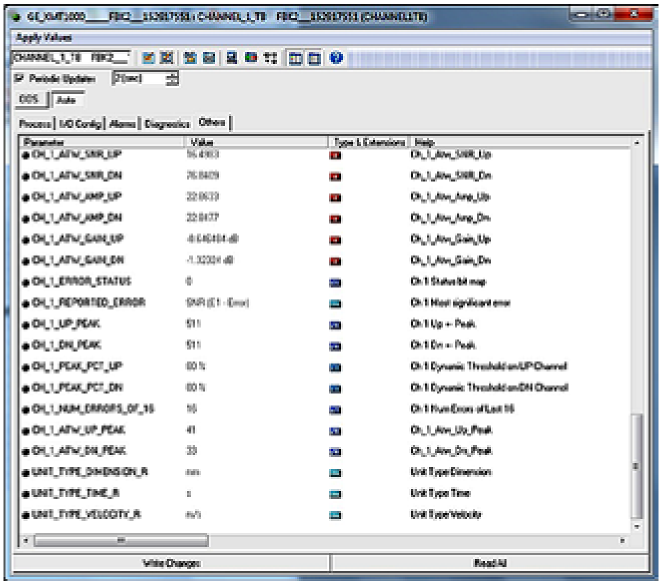


Figure 139: Reported error

Whenever the meter is in measurement error, the quality bit for the published parameter shows bad quality (see Figure 140 below). To change the quality bit to good, the measurement error at the meter must be removed.

Notice the **QUALITY.STATUS** field shows as **Bad** and the **SUBSTATUS** field shows as **Sensor Failure**. This information indicates a measurement error which must be corrected.

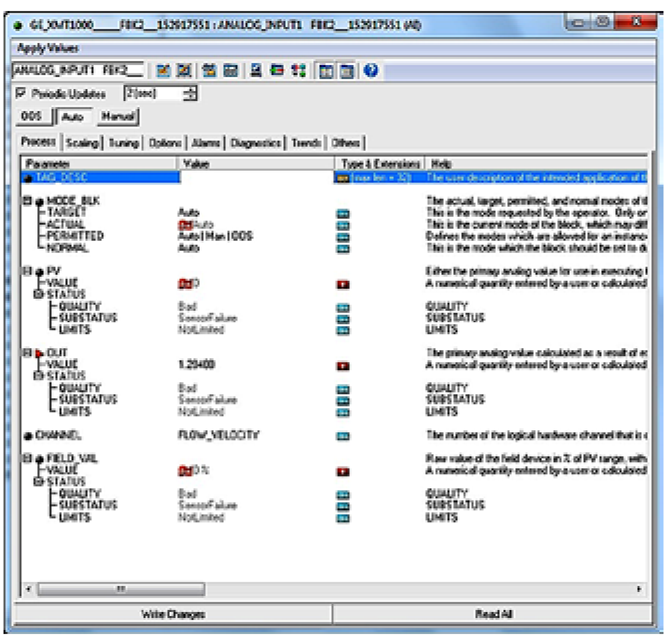


Figure 140: Quality bit error

H.12 Simulation mode

Simulation mode allows the user to test the FF implementation without the instrument providing real data. The meter PCB is shipped with simulation mode disabled. To enable simulation mode, complete the following steps:

CAUTION!

To prevent damage to the electronic components, always use ESD protection whenever handling printed circuit boards.

1. Remove the PCB from the meter.
2. Locate the jumper P5 (see Figure 141 below).
3. Move the P5 jumper to the left one place (pins 2 and 3) to enable simulation mode.
4. Re-install the PCB into meter
5. Verify that the Block error field in the Resource Block shows SimulationActive status.

Figure 141: P5 on XMT1000 PCB

H.13 Fieldbus troubleshooting guide

See *Table 42* below for suggested solution to possible Fieldbus problems.

Table 42: XMT1000 FF troubleshooting guide

Problem	Presumed Cause	Remedy
Communication between DCS and XMT1000 FF cannot be established	Wiring unconnected, broken or shorted	Correct wiring between XMT1000 and spur device coupler.
	The power is off or the power supply voltage is less than 9 V	Supply proper voltage
	The address detection range is not correctly set in the DCS	Correct address detection range - default address for XMT1000 is 0x17
Communication with the XMT1000 FF is frequently cut off.	The fieldbus is experiencing a large amount of noise.	Using an oscilloscope or another fieldbus health monitor to check the waveform on the fieldbus.
	Missing terminators on the bus, incorrect terminator placement or extra terminators.	Refer to FOUNDATION Fieldbus specifications for a full discussion of terminator requirements.
A value cannot be written to a parameter in the XMT1000 FF.	Not in configuration mode.	Enter correct "Admin" password in Resource block - verify "S1 - configuration mode" appears on XMT1000 UI
	You have attempted to write a value outside the valid range.	Check the setting range of parameters.
	The present mode does not allow write access.	Change the target mode.
	The jumper is in write protected configuration.	Contact factory for write protect jumper configuration
The actual mode of a function block differs from the target mode.	Resource block in OOS.	Change the target mode of the Resource Block to Auto.
	Schedules that define when function blocks execute are not set correctly.	Set the schedules using a configuration tool.
	The transducer block is not in Auto mode.	Change the target mode of the transducer block to Auto.
A block's dynamic parameters do not update.	XMT1000 is powered down	Verify the XMT1000 is powered on and measuring properly
	XMT1000 does not recognize the FF PCB	Check Options menu on XMT1000 UI for Fieldbus option - if it appears the meter knows it is present

H.14 DPI620 FF modular communicator

For local diagnostic capability with the XMT1000 FF option, Panametrics recommends the DPI620G-FF Genii advanced modular calibrator and HART/Fieldbus communicator. The calibrator is available in an IS version as well (DPI620G-IS-FF). Table 43 below lists the models, description and key benefits.

<table>
<tr><th colspan="4">Table 43: DPI620 Genii Models</th></tr>
<tr><th>Image</th><th>Model PN</th><th>Description</th><th>Key Benefits</th></tr>
<tr><td></td><td>DPI620G-FF</td><td>Genii advanced modular calibrator and HART/Fieldbus communicator</td><td rowspan="2">• Fully featured communicators for device configuration, trimming and calibration
• Complete device description (DD) libraries
• Internal power hub
• Free software and DD updates via simple web download</td></tr>
<tr><td></td><td>DPI620G-IS-FF</td><td>Genii intrinsically safe advanced modular calibrator and HART/Fieldbus communicator</td></tr>
</table>

Attention!

For more information, see the **DPI620** website:
https://www.bakerhughes.com/druck/test-and-calibration-instrumentation/multifunction-calibrators

[no content intended for this page]

Warranty

Each instrument manufactured by Panametrics, a Baker Hughes business 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 Panametrics. Fuses and batteries are specifically excluded from any liability. This warranty is effective from the date of delivery to the original purchaser. If Panametrics determines that the equipment was defective, the warranty period is:

- One year from delivery for electronic or mechanical failures
- One year from delivery for sensor shelf life

If Panametrics determines that the equipment was damaged by misuse, improper installation, the use of unauthorized replacement parts, or operating conditions outside the guidelines specified by Panametrics, 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 or merchantability and fitness for a particular purpose, and warranties arising from course of dealing or usage or trade).

Return policy

If a Panametrics instrument malfunctions within the warranty period, the following procedure must be completed:

1. Notify Panametrics, 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, Panametrics will issue a RETURN AUTHORIZATION NUMBER (RAN), and shipping instructions for the return of the instrument to a service center will be provided.
2. If Panametrics 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, Panametrics 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 Panametrics 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.

[no content intended for this page]

Certification and Safety Statements for PanaFlow PF10 Zx

- When installing this apparatus, the following requirements must be met:
- Field wiring shall be rated at least 5°C above maximum ambient or fluid temperature, whichever is greater.
- Connecting cables shall be mounted securely and protected from mechanical damage, pulling and twisting.
- Cable entry is ¾" NPT.
- Cable glands of an approved flameproof design are required. These must be installed according to the manufacturer's instructions. Where the cable glands are provided by Panametrics, the manufacturer's instructions, as supplied to Panametrics, will be included in the documentation.
- Conduit seals are required within 18" of the enclosure
- Cable glands of an approved flameproof design are required. These must be installed according to the manufacturer's instructions. Where the cable glands are provided by Panametrics, the manufacturer's instructions, as supplied, to Panametrics, will be included in the documentation.
- The system is covered by the certificate numbers FM13ATEX0070X and IECEx FMG 13.0028X as shown on the labels below. The system is certified as ATEX and IECEx: II 2 G Ex d IIB +H2 T6 Gb in Ta = -40°C to +60°C ambient, Type 4X and IP66. The system temperature code is dependent upon the process fluid temperature ranges of -40°C to +150°C. Refer specific conditions of use for ATEX and US/Canada for more information about temperature code.
- Unused cable entries must be sealed using a certified threaded plug.
- Modifications to the flameproof enclosure are not permitted.
- The apparatus should be de-energized before opening.
- Installation shall be in accordance with the installation instructions and the National Electrical Code® ANSI/NFPA 70, the Canadian Electrical Code C22.1, or IEC/EN 60079-14, as applicable.
- Equipment is of type flameproof "d" design and complies with the standards identified in the table on page 2.
- The product contains no exposed parts which produce surface temperature infrared, electromagnetic ionizing, or non-electrical dangers.
- The product must not be subjected to mechanical or thermal stresses in excess of more than those permitted in the certification documentation and the instruction manual.
- 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.
- Only trained, competent personnel may install, operate and maintain the equipment.
- Consult the manufacturer if dimensional information on the flameproof joints is necessary.
- The product is an electrical apparatus and must be installed in the hazardous area in accordance with the requirements of the EU Type Examination Certificate. The installation must be carried out in accordance with all the 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.
- The flameproof joints of the equipment are not intended to be repaired. Consult the manufacturer if dimensional information on the flameproof joints is necessary.
- Follow the manufacturer's instructions to reduce the potential of an electrostatic charging hazard.
- Consult the manufacturer for genuine replacement flange fasteners. M10x35 hexagon socket cap screws of ISO 12.9 DIN912 grade steel (zinc-plated) or better with a minimum yield strength of 135,000 psi are acceptable alternatives.
- Consult the manufacturer for genuine replacement flange fasteners. M10x35 hexagon socket cap screws of ISO 12.9 DIN912 grade steel (zinc-plated) or better with a minimum yield strength of 135,000 psi are acceptable alternatives.

Standards

The equipment complies with the standards listed in the following table:

Standards	
IEC 60079-0:2011	EN 60079-0:2012 + A11:2013
IEC 60079-1:2014	EN 60079-1:2014
IEC 60529:2001	EN 60529:1991 + A1:2000

ATEX/IEC

Specific Conditions of Use:

1. Ihe flameproof joints of the equipment are not intended to be repaired. Consult the manufacturer if dimensional information on the flameproof joints is necessary.
2. Follow the manufacturer's instructions to reduce the potential of an electrostatic charging hazard.
3. Consult the manufacturer for genuine replacement flange fasteners. M10x35 hexagon socket cap screws of ISO 12.9 DIN912 grade steel (zinc-plated) or better with a minimum yield strength of 135,000 psi are acceptable alternatives. M10x1.5, 365 mm Long, Zinc Plated, ISO 12.9 DIN912, 17-4 H1025 or better with minimum yield strength of 145 KSI.
4. Consult the manufacturer for genuine replacement enclosure/adapter fasteners.
5. Care should be taken to avoid creating an ignition hazard due to impact or friction on the titanium transducers which form part of the flameproof enclosure.
6. The electronics enclosure is rated for an ambient temperature range of -40°C to +60°C. The remote mount junction box and flow body is rated for an ambient temperature range of -40°C to +60°C.
7. The equipment temperature class is dependent on the maximum process temperature and is according to the following table:

Maximum Process Temperature	Temperature Class
85°C	T6
100°C	T5
135°C	T4
150°C	150°C

US/CANADA

Specific Conditions of Use:

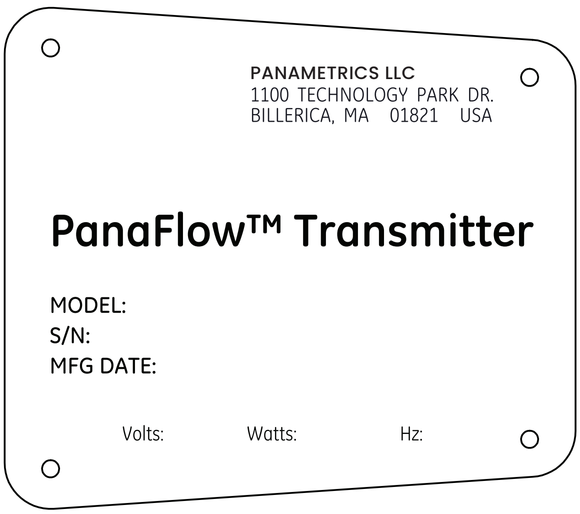
1. The electronics enclosure is rated for an ambient temperature range of -40°C to +60°C. The remote mount junction box and flow body is rated for an ambient temperature range of -40°C to +60°C.
2. The equipment temperature class is dependent on the maximum process temperature and mounting configuration according to the following table

Maximum Process Temperature	Temperature Class
85°C	T6
100°C	T5
120°C	T4A
135°C	T4
150°C	T3C

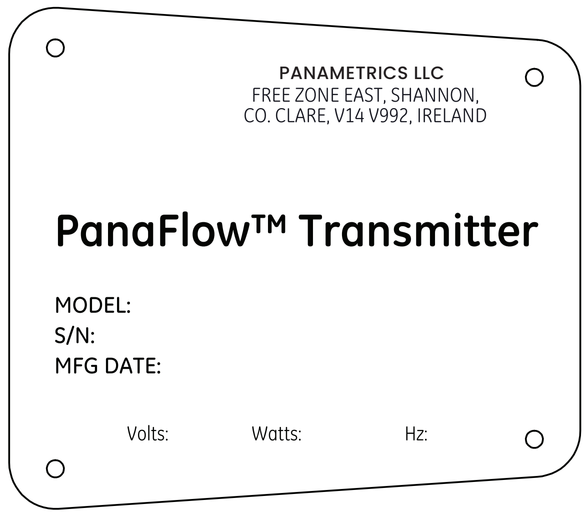
Markings

Markings shall appear on the product as shown below:

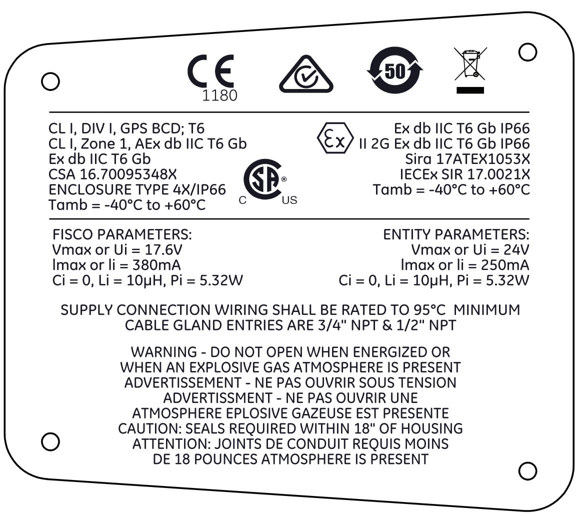
1. XMT1000 Labels (Aluminum Enclosure)



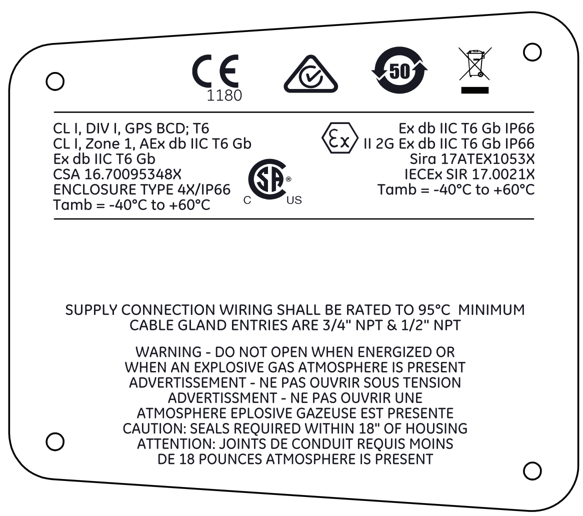
Model & Serial Number (Boston)



Model & Serial Number (Shannon)

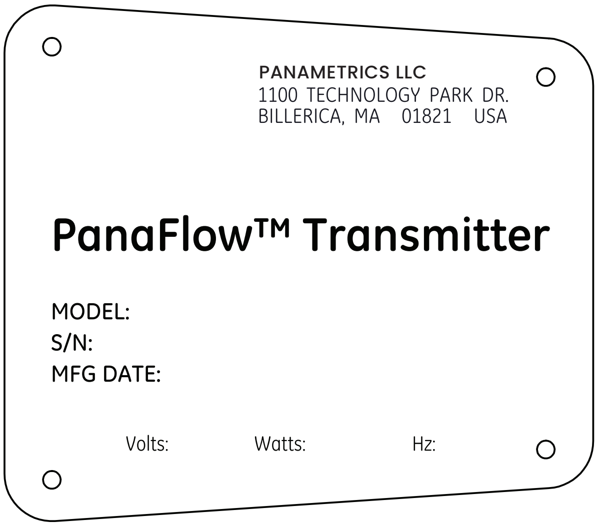


Certification (US/CAN, IECEx/ATEX) [FISCO]

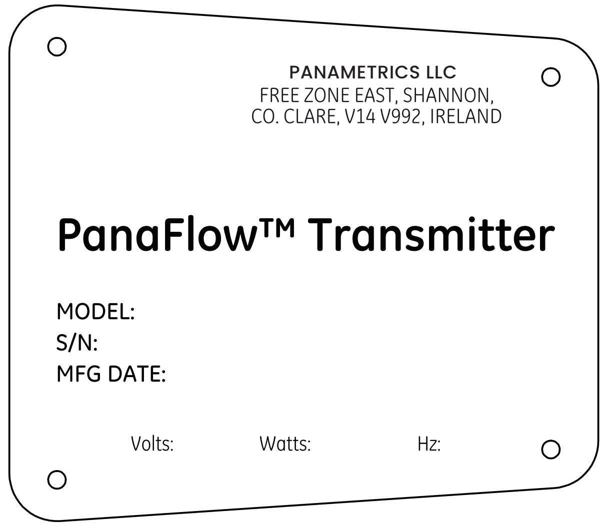


Certification (US/CAN, IECEx/ATEX) [Standard]

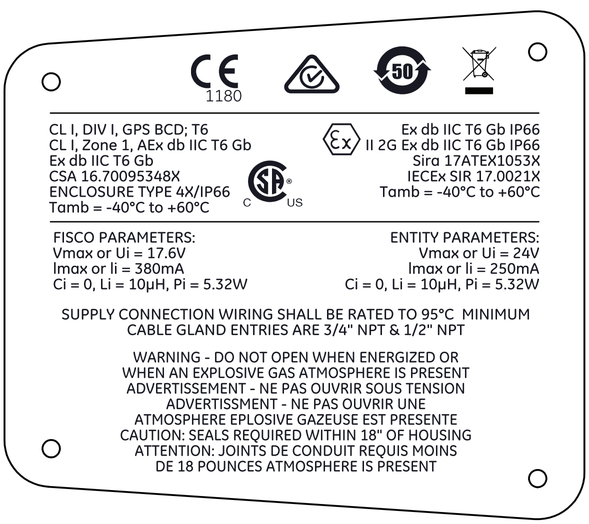
B. XMT1000 Labels (Stainless Steel Enclosure)



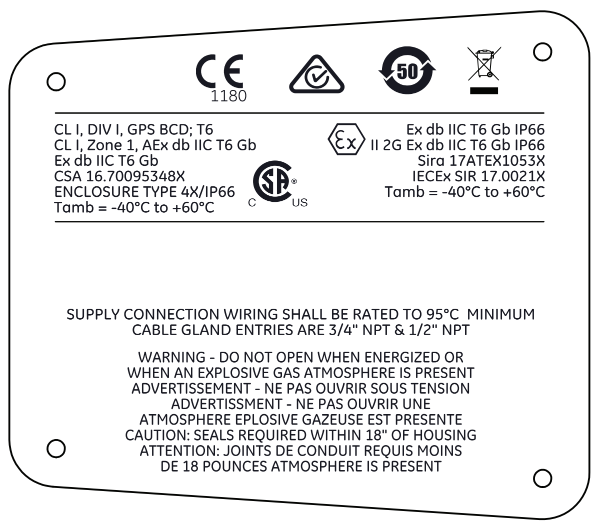
Model & Serial Number (Boston)



Model & Serial Number (Shannon)



Certification (US/CAN, IECEx/ATEX)
[FISCO]



Certification (US/CAN, IECEx/ATEX)
[Standard]

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