Panametrics

User's manual

AquaTrans™ AT620

Panametrics ultrasonic flow meter for liquids

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PANA101C11 EN A

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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://panametrics.com/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 minor personal injury and/or damage to the equipment unless these instructions are followed carefully.

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

Safety Issues

WARNING! It is the responsibility of the user to follow all site rules and applicable regulatory requirements.

IMPORTANT Any instructions on grounding and cable termination in this manual are necessary for compliance with global EMC / RFI standards. Such compliance may be required by National EMC / RFI legislation.

Local Safety Standards

The user shall ensure that he operates the equipment in accordance with the applicable local codes, standards, regulations, or laws.

Qualification of Personnel

Ensure that all personnel have applicable training to use the equipment.

Personal Safety Equipment

Ensure that operators and maintenance personnel have all safety equipment applicable.

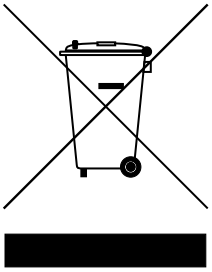
Unauthorized Operation

Ensure that unauthorized personnel cannot gain access to the operation of the equipment.

Environmental Compliance

Waste Electrical and Electronic Equipment

This apparatus required the extraction and use of natural resources for its production. It may contain hazardous substances that could impact health and the environment. To avoid the dispersal of these substances into our environment and to reduce the pressure on natural resources, we encourage you to use an appropriate “take-back” resource recovery scheme. These schemes will reuse or recycle most of the materials of your end-of-life equipment in an environmentally responsible way. The crossed-out wheeled bin symbol marked on the product invites you to use such a scheme.



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

As part of its commitment to the environment and the EU's WEEE Directive 2012/19/EU, Panametrics participates in a take-back scheme.

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

Chapter 1. General Installation Instructions

Chapter 2. Clamp-on Fixture and Transducer Installation

Chapter 3. Wiring the AT620 Electronics

Chapter 4. Initial Setup and Programming

Chapter 1. General Installation Instructions

1.1 Introduction

Thank you for purchasing the AT620 ultrasonic flow meter. The AT620 is a clamp-on ultrasonic flow meter for the measurement of liquid products. It is designed for the industrial applications, including water, wastewater, steel, campus energy, and others. The AT620 utilizes a new electronics platform and industrial design to make it extremely simple to install and use in the field.

The AT620 consists of the new AT620 transmitter, field proven Panametrics ultrasonic transducers, and a clamp-on transducer fixture system (see *Figure 1* below). The AquaTrans AT620 is either a single or dual channel ultrasonic flow meter system. In a two channel configuration, the two pair of transducers can either be installed on the same pipe for additional flow interrogation or on two separate pipes all together.

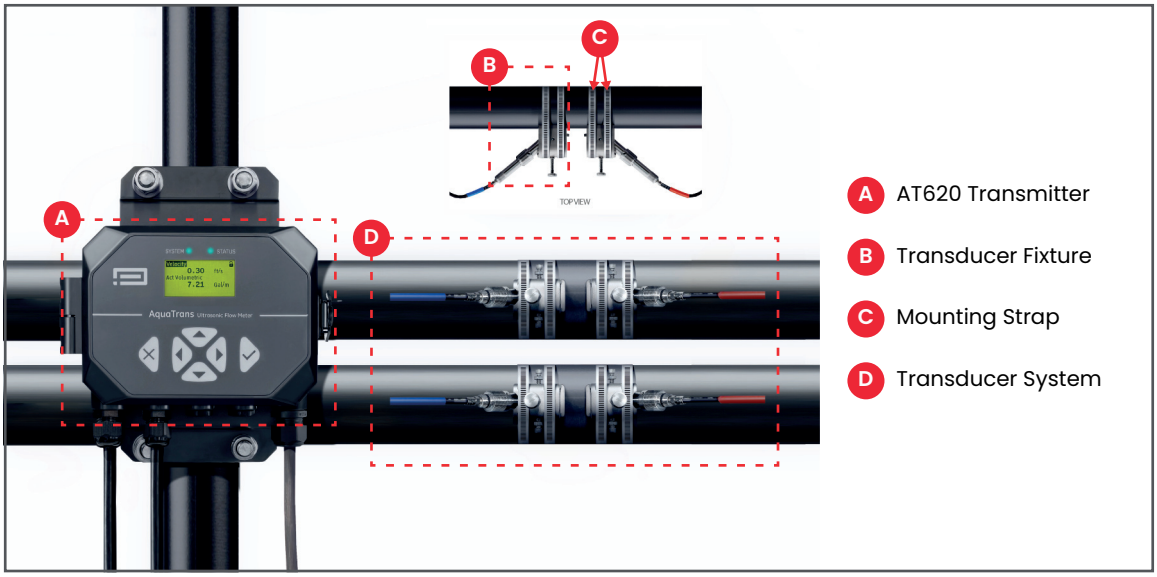


Figure 1: Typical AT620 System Mounted on a Pipe

1.2 Theory of Operation

The AT620 flow meter uses a procedure called transit-time flow measurement. In this method, two transducers, which are in acoustic communication with each other, serve as both ultrasonic signal generators and receivers. That is, the second transducer can receive ultrasonic signals transmitted by the first transducer and vice versa. In operation, each transducer functions as a transmitter, generating a certain number of acoustic pulses, and then as a receiver for an identical number of pulses (see *Figure 2* and *Figure 3* below). The time interval between transmission and reception of the ultrasonic signals is measured in both directions. When the liquid in the pipe is not flowing, the transit-time downstream equals the transit-time upstream. However, when the liquid is flowing, the transit-time downstream is less than the transit-time upstream. The difference between the downstream and upstream transit times is proportional to the velocity of the flowing liquid and its sign indicates the direction of flow.

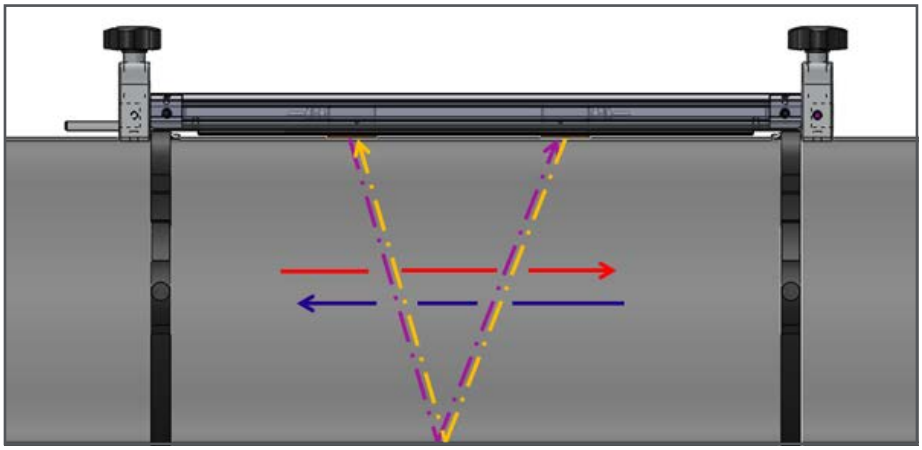


Figure 2: Flow and Transducer Paths (two traverses)

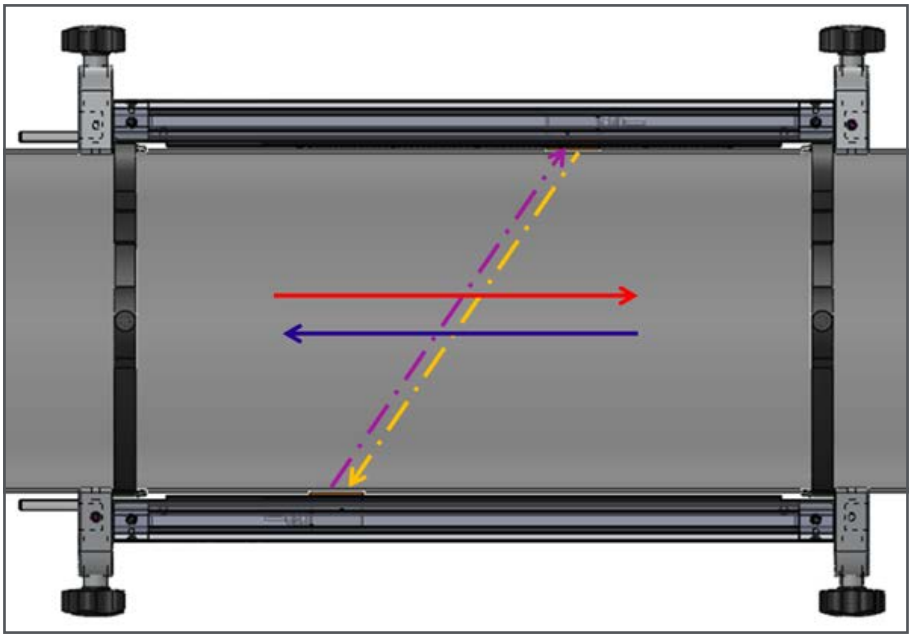


Figure 3: Flow and Transducer Paths (one traverse)

1.3 Safety Guidelines

To ensure safe and reliable operation of the AT620, the system must be installed in accordance with the guidelines discussed in this manual. This chapter includes the following topics:

WARNING! The AT620 flow transmitter can measure the flow rate of many fluids, some of which are 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 marking and UL marking requirements, all cables must be installed as described in *"Wiring Cable Specifications and Requirements" on page 176*

1.4 Unpacking the AT620 System

Before removing the AT620 system from the crate, please inspect the flow meter. 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. Please note that the AT620 system (see *Figure 10* below) is available in a variety of configurations to meet your needs, so the packing list will vary for each system. As an example, a typical packing list is:

1. One AT620 electronics enclosure
2. Four clamp-on fixtures
3. Four transducers (installed in one of the two clamp-on fixtures)
4. Two transducer cables (installed on fixture with transducers)
5. Four clamp-on fixture mounting straps for each fixture
6. Two “U” bolts for pipe mounting of the AT620 electronics enclosure
7. One USB flash drive with user’s manual and calibration sheet
8. One inner hexagon spanner
9. Three M16 cable glands (installed on the AT620 electronics enclosure)
10. Four pieces of solid couplant

1.5 Installing the Electronics Enclosure

The AT620 electronics is housed in a powder-coated, aluminum, NEMA type 4X/IP67 enclosure suitable for indoor or outdoor use. See *Figure 4* below for the mounting dimensions and weight of the AT620 electronics enclosure.

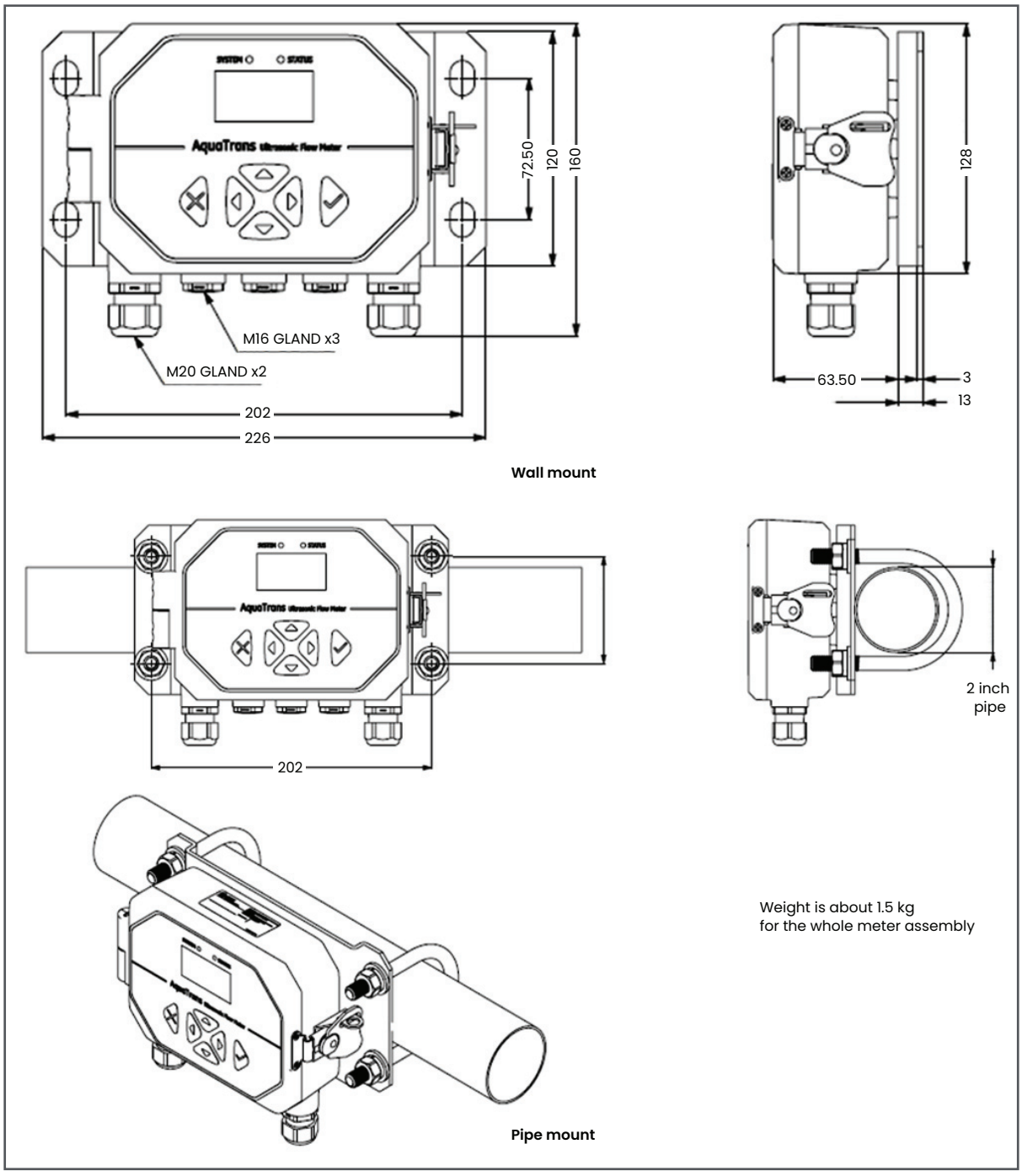


Figure 4: Mounting the AT620 Electronics Enclosure

The installation base of AT620 electronics enclosure can be rotated 90º to keep a horizontal view of the user interface in any mounting orientation. See *Figure 5* below for drawings of the AT620 mounting base.

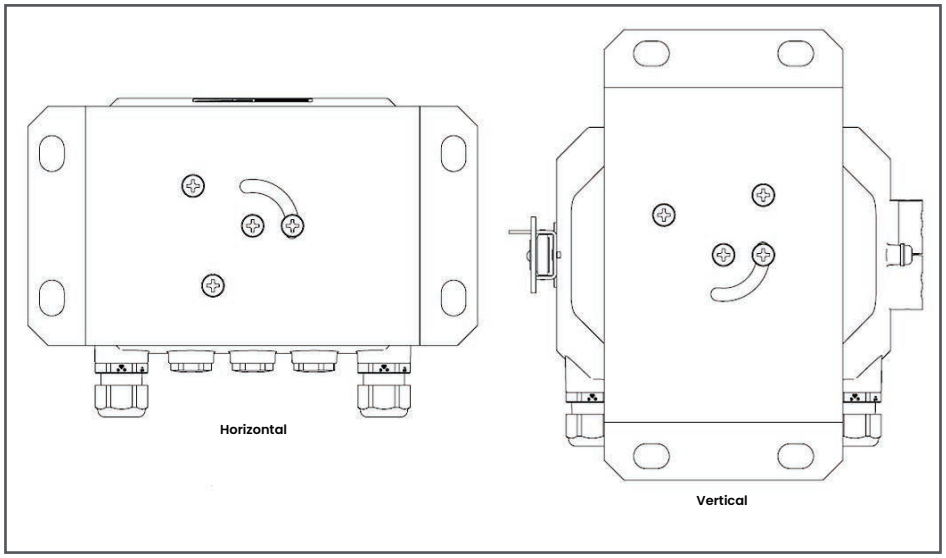


Figure 5: The AT620 Mounting Base

1.6 Calculating the Transducer Spacing

Before installing the clamp-on fixture(s) and transducers, you must program the AT620 to calculate the required transducer spacing for your planned installation. To accomplish this task, go to *"Channel Setup" on page 54* and follow the instructions in that section. After obtaining the required transducer spacing value, return here and continue to the next section.

1.7 Choosing a Clamp-on Fixture/Transducer Location

For a given fluid and pipe, the accuracy of AT620 depends on the location and alignment of the transducers. In addition to accessibility, when choosing a transducer location, follow these guidelines:

- 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 6* below). Undisturbed flow means avoiding sources of turbulence in the fluid such as valves, flanges, expansion joints, elbows, swirl, and cavitation.
- Locate the transducers on a common axial plane along the pipe (see *Figure 7* below). The transducers should be mounted on the side of the pipe, rather than the top or bottom, because the top of the pipe tends to accumulate gases and the bottom tends to accumulate sediment. Either condition may cause excessive attenuation of the ultrasonic signal. There is no similar restriction with vertical pipes, as long as the flow direction is upward to prevent free falling of the fluid in a partially filled pipe.

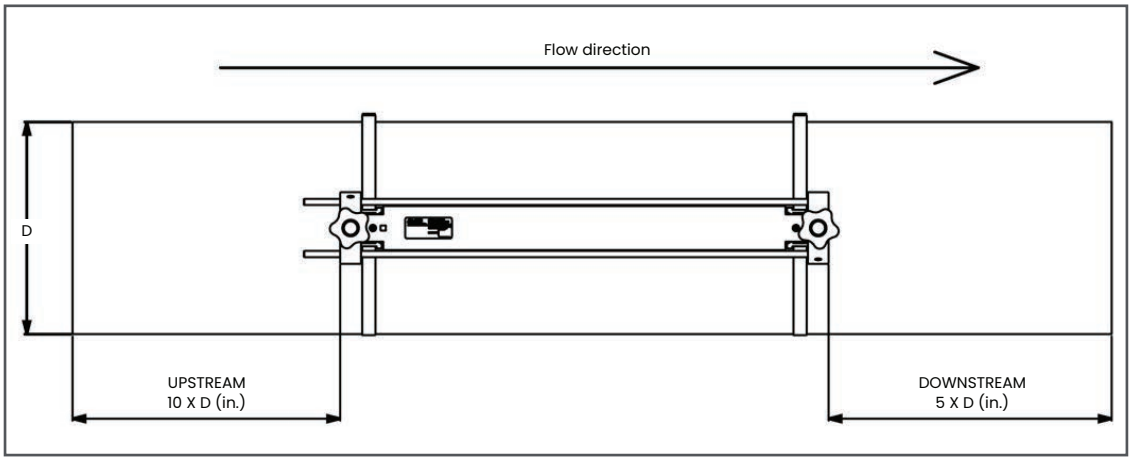


Figure 6: AT620 Clamp-on Fixture/Transducer Location

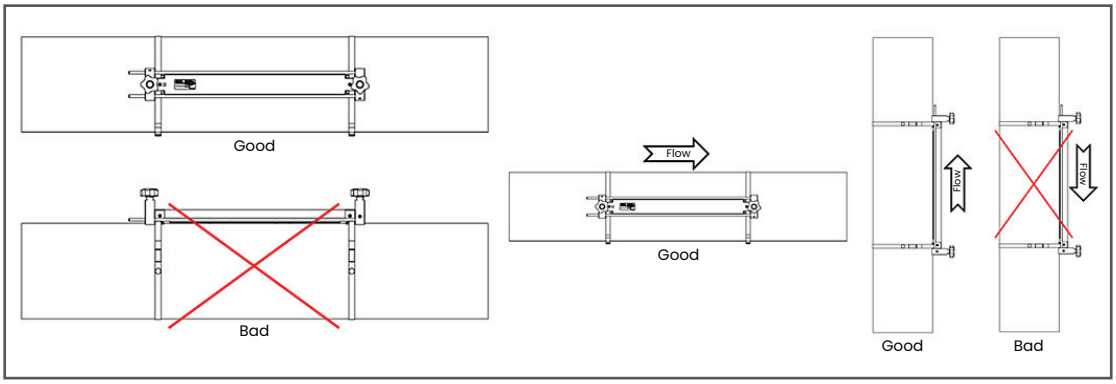


Figure 7: Good and Bad Transducer Locations

1.8 Mounting the Clamp-on Fixture and Transducer System

The AT620 transducer system includes one or two clamp-on fixtures, two transducers and one transducer cable. One clamp-on fixture is shipped with both transducers installed and the transducer cable connected to the transducers. This fixture is the default setup for most applications. If a second fixture has been ordered, it is shipped empty. Transducers available for use with the AT620 flow meter are listed in *Table 1*.

Table 1: Available Transducers

Model	Frequency	Fixture	Pipe sizes
AT6	2, 1, 0.5 MHz	AT620	>=2 in. (50 mm)
CF-LP[1]	4 MHz	Clamp-on Fixture	0.5-2 in. (15-50 mm)
CF-JR[1]	4 MHz	Clamp-on Fixture	0.5-2 in. (15-50 mm)
C-RS[2]	1, 0.5 MHz	Strapped Clamping Fixture	>=2 in. (50 mm)
C-PT[2]	2, 1, 0.5 MHz	Strapped Clamping Fixture	>=2 in. (50 mm)
C-RS HT[2]	1, 0.5 MHz	Strapped Clamping Fixture	>= 2 in. (50 mm)

[1] Go directly to: *"Installing a CF Clamp-on Fixture and Transducer System" on page 16*

[2] Go directly to: *"Installing a Strapped Clamping Fixture and Transducer System" on page 17*

The AT620 clamp-on fixture and AT6 transducer system can be installed on pipe sizes >2 in. (50 mm). For optimum performance in any specific application, either a two traverse or one-traverse installation can be chosen. Because the maximum pipe size for a single clamp-on fixture is 250 mm for 2 MHz transducers or 320 mm for 1 MHz and 0.5 MHz transducers, the detailed installation requirements differ based on the calculated transducer spacing and the chosen number of traverses. Refer to Table below to find the parameters for your specific configuration.

IMPORTANT: See *"Channel Setup" on page 54* to calculate the required transducer spacing. A two traverse installation is recommended for most applications.

IMPORTANT: If there is any type of coating or protective layer on the outer pipe surface, it must be removed at the locations where the transducers and couplant contact the pipe surface.

From the information on the previous page and the documentation included with your AT620 flow meter system, you should already know the following details about your installation:

- Pipe size
- Transducer model
- Transducer frequency
- Number of traverses
- Calculated transducer spacing
- Number of clamp-on fixtures

Based on the known information, proceed directly to one of the following sections in the next chapter for instructions on installing your AT620 clamp-on fixture(s) and transducers on the pipe:

Note: *See the flowchart in Figure 8 on page 9 to assist in choosing the appropriate instructions for your specific configuration.*

- *"Transducer Spacing = 32 to 250 mm or 50 to 320 mm, Traverses = 2, Fixtures = 1" on page 11*
- *"Transducer Spacing = 320 to 940 mm, Traverses = 2, Fixtures = 2" on page 13*
- *"Transducer Spacing = 0 to 250 mm or 0 to 320 mm, Traverses = 1, Fixtures = 2" on page 14*
- *"Transducer Spacing >320 mm, Traverses = 1, Fixtures = 2" on page 16*

Table 2: AT620 Clamp-on Fixture Installation

Pipe size range		Transducer frequency (MHz)	Number of traverses	Transducer spacing (mm)	Number of fixtures
mm	inches				
50 to 100	2 to 4	2	4	32 to 250	1
100 to 150	4 to 6	2	2	32 to 250	1
50 to 150	2 to 6	2	1	0 to 250	2
100 to 300	4 to 12	1	2	50 to 320	1
300 to 600	12 to 24	1	2	320 to 940	2
600 to 1500	24 to 60	1	1	>320	2
200 to 300	8 to 12	0.5	2	50 to 320	1
300 to 900	12 to 36	0.5	2	320 to 940	2
>900	>36	0.5	1	>320	2

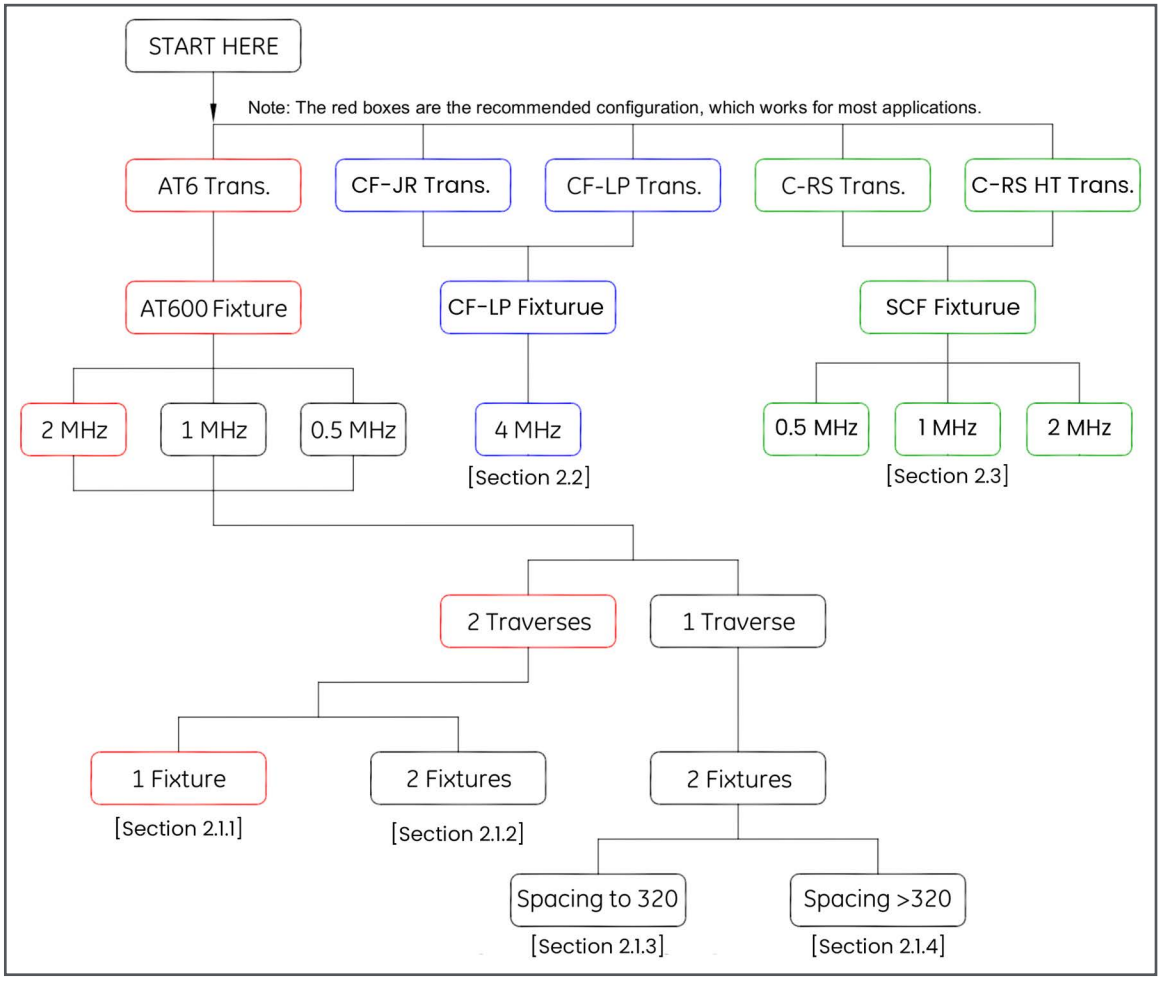


Figure 8: Flowchart to Transducer Installation Instructions

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Chapter 2. Clamp-on Fixture and Transducer Installation

2.1 Installing an AT620 Clamp-on Fixture and Transducer System

The instructions in this section are for installations using the AT620 clamp-on fixture only. For installations using other clamp-on fixtures, see *"Installing a CF Clamp-on Fixture and Transducer System" on page 16* or *"Installing a Strapped Clamping Fixture and Transducer System" on page 17*

2.1.1 Transducer Spacing = 32 to 250 mm or 50 to 320 mm, Traverses = 2, Fixtures = 1

Note: *A two traverse installation with one clamp-on fixture is the standard AT620 configuration.*

When the required transducer spacing is 32 to 250 mm for a 2 MHz transducer or 50 to 320 mm for a 1 MHz or 0.5 MHz transducer, one clamp-on fixture is needed for a dual traverse installation. Proceed as follows:

1. 1.Install the AT620 clamp-on fixture with transducers on the pipe using two mounting straps.
   a. Choose a location with enough straight pipe run (refer to *Figure 6 on page 7*).
   b. Install the two mounting straps on the pipe about 12 in. (30 cm) apart (see *Figure 9* below).

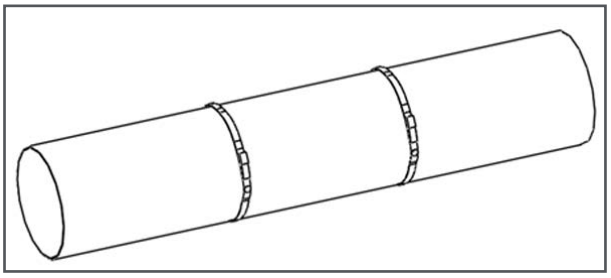


Figure 9: Mounting Straps Installed on Pipe

   c. Hold the fixture against the pipe and move the mounting straps onto the fixture. Then, tighten the screws on the straps, and verify that the straps remain in place on the fixture (see *Figure 10* below).

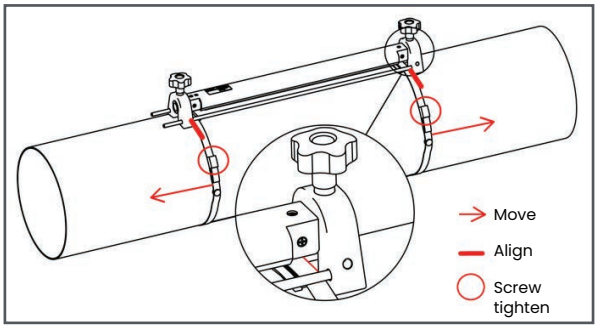


Figure 10: 2 Traverse Installation with 1 Clamp-on Fixture

IMPORTANT: If there is any type of coating or protective layer on the outer pipe surface, it must be removed at the locations where the transducers and the couplant contact the pipe surface.

2. Connect the power and transducer cables to the AT620, as shown in *Figure 23 on page 19*
3. If you haven't already done so, power the meter on and program your site data to determine the required transducer spacing (see *"Channel Setup" on page 54*).

4. Set the two transducers at the spacing calculated by the meter and tighten them in place, as follows:
   a. Loosen both transducers and rotate the fixture so that the transducers are in view (see *Figure 11* below).

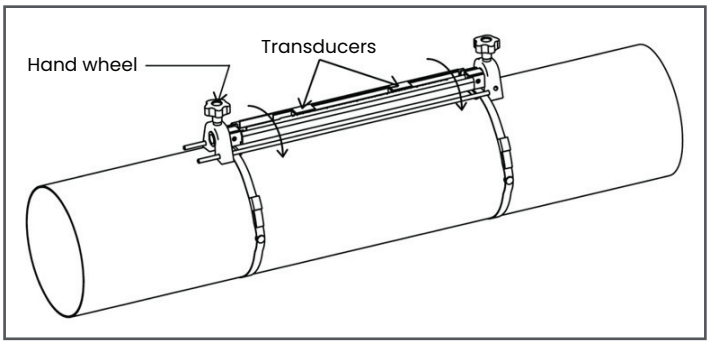


Figure 11: Transducers Rotated into View

   b. Set the transducers to the spacing calculated by the meter. If you are using solid couplant, apply it to both transducer faces. Then, rotate the transducers back onto the rail (see *Figure 12* below).

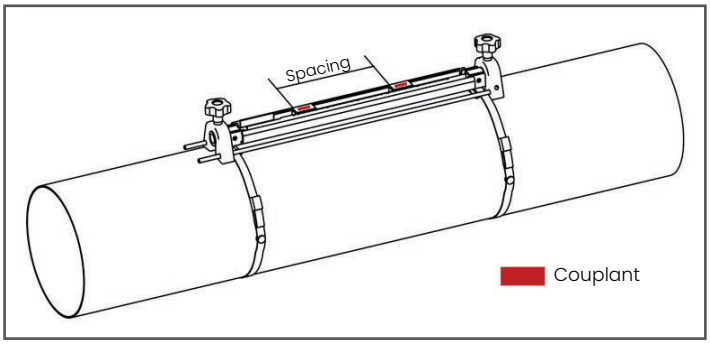


Figure 12: Set Transducer Spacing and Apply Couplant

5. See *Figure 13* below for an example of a completed installation. In this drawing, LSL is the lower specified limit and USL is the upper specified limit for the installation.

Note: *For a one-fixture installation, LSL is 0 on the scale and USL is 250 mm for a 2 MHz transducer or 320 mm for a 1 MHz or 0.5 MHz transducer. The transducer spacing is measured from LSL to a point ≤USL.*

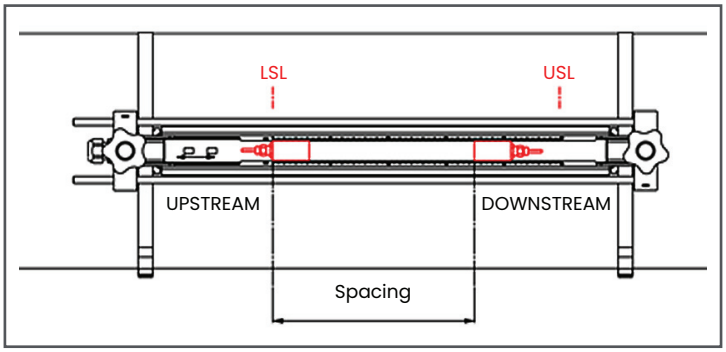


Figure 13: Installation for Two Traverses with One Fixture

6. Your clamp-on fixture and transducer installation is now complete. To wire your AT620 flow meter, proceed to Wiring the AT620 Electronics.

2.1.2 Transducer Spacing = 320 to 940 mm, Traverses = 2, Fixtures = 2

For a two traverse installation with a calculated transducer spacing of 320 to 940 mm for a 1 MHz or 0.5 MHz transducer, two fixtures are installed on the same side of the pipe. To do so, complete the following steps:

1. Install the four mounting straps on the pipe with a spacing of 12 in. (30 cm) between each pair of straps.
2. Hold one of the clamp-on fixtures, with two transducers and one cable, against the pipe between the upstream pair of straps and move the two mounting straps onto the fixture (see *Figure 14* below). Then, tighten the screws on the mounting straps, and verify that the straps remain in place on the fixture.

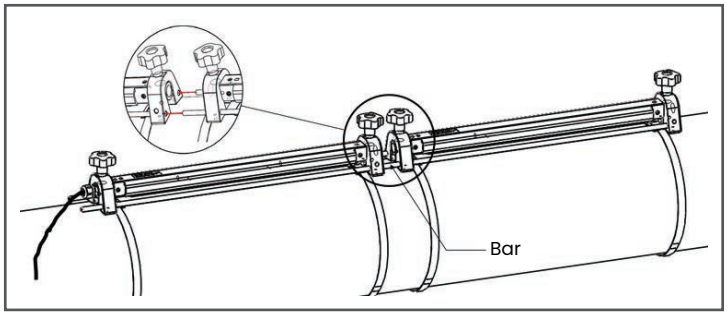


Figure 14: Two Traverse Installation with Two Clamp-on Fixtures

3. Repeat step 2 to install the second clamping fixture, with no transducers or cable, on the pipe between the downstream pair of straps. Use the bar on the second fixture to connect the two fixtures. Then, move the straps onto the second fixture and tighten the screws.

IMPORTANT: Be sure the bar on the left side of the second fixture is in close contact with the bar on the first fixture.

4. 4.Set the spacing between the two transducers in the upstream clamping fixture to the value calculated by the meter and tighten them back onto the pipe, as follows:
   a. Rotate the fixture so that the transducers are in view (see *Figure 11 on page 12*).
   b. Remove the downstream transducer from the first fixture (see *Figure 15* below), disconnect the transducer cable, and route the cable into the second fixture. Then, install the downstream transducer into the second fixture and reconnect the transducer cable. If you are using solid couplant, apply it to both transducer faces. Then, rotate the transducers back onto the rail.

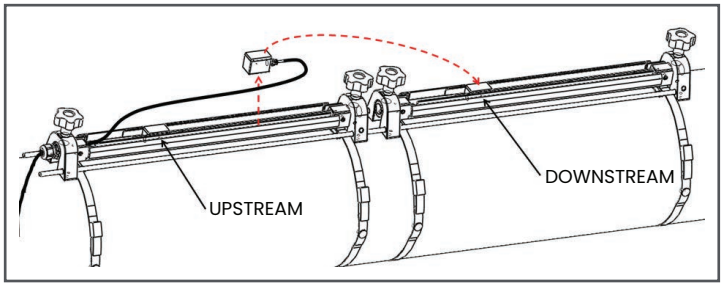


Figure 15: Moving the Downstream Transducer

IMPORTANT: Tight contact must be made between the bars on the two fixtures to ensure an accurate spacing.

5. See *Figure 16* and *Figure 17* below for examples of a completed installation in the following situations:

Note: *In this drawing, LSL is the lower specified limit and USL is the upper specified limit for each fixture.*

a. For a calculated transducer spacing of 320 to 620 mm for a 1 MHz or 0.5 MHz transducer, locate the upstream transducer at the USL1 position on the first fixture. Then, locate the downstream transducer at the calculated transducer spacing position (≤USL2) on the second fixture.

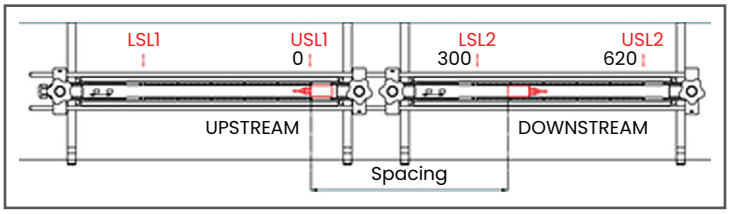


Figure 16: Transducer Spacing of 320 to 620 mm with Two Fixtures

b. For a calculated transducer spacing of 620 to 940 mm for a 1 MHz or 0.5 MHz transducer, locate the upstream transducer at the LSL1 position on the first fixture. Then, locate the downstream transducer at the calculated transducer spacing position (between LSL2 and USL2) on the second fixture.

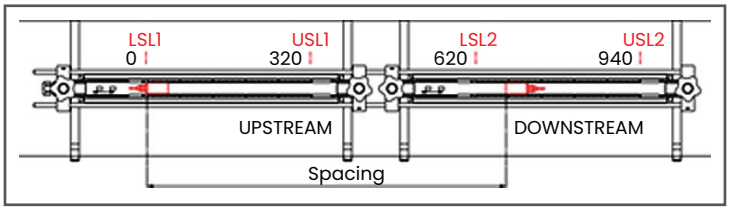


Figure 17: Transducer Spacing of 620 to 940 mm with Two Fixtures

6. Your clamp-on fixture and transducer installation is now complete. To wire your AT620 flow meter, proceed to *Wiring the AT620 Electronics*.

2.1.3 Transducer Spacing = 0 to 250 mm or 0 to 320 mm, Traverses = 1, Fixtures = 2

For a one traverse installation with a calculated transducer spacing of 0 to 250 mm for a 2 MHz transducer or 0 to 320 mm for a 1 MHz or 0.5 MHz transducer, two clamp-on fixtures are installed on opposite sides of the pipe. To install this configuration, complete the following steps:

1. Mark a straight line parallel to the pipe centerline on the top of the pipe (i.e., the 12 o'clock position).
2. Use a band tape to measure the circumference of the pipe. Then, mark two additional lines on the pipe parallel to the first line. Locate these lines 1/4 of the way around the pipe in each direction from the original line (i.e., at the 3 o-clock and 9 o'clock positions).
3. Install two mounting straps on the pipe about 12 in. (30 cm) apart (see *Figure 18* below).
4. Hold one clamp-on fixture, with two transducers and one cable, on the pipe along one of the lines marked in step 2. Then, move the two straps onto the ends of this fixture.
5. Hold the remaining (empty) clamp-on fixture on the opposite side of the pipe from the first fixture. Then, move the two straps onto the ends of this clamp-on fixture.
6. Align the two fixtures to be equal distances from the band tape. Tighten both straps securely.

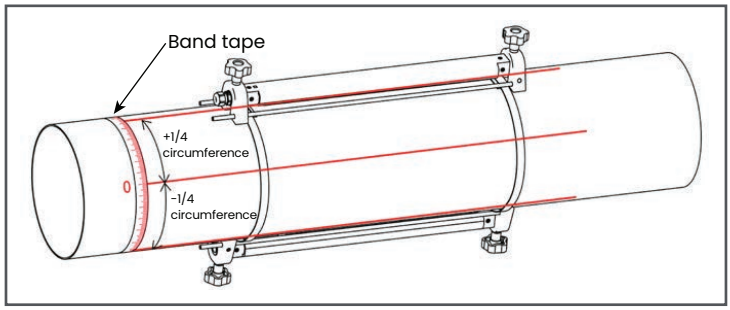


Figure 18: One Traverse Installation with Two Fixtures

7. Set the spacing between the two transducers to the value calculated by the meter as follows:
   a. Loosen the fixture rails and rotate the rails so the transducers are in view.
   b. Remove the upstream transducer from the first fixture (see *Figure 19* below). Disconnect the transducer cable and route the cable into the second fixture.

Note: *The cable for the upstream transducer needs to be pulled out through one side of the rail on the first fixture and inserted through the side of the rail on the second fixture.*

   c. Install the upstream transducer into the second fixture, and reconnect the transducer cable.
   d. Locate the upstream transducer at the zero position of the second fixture, and then move the downstream transducer to the required position on the first fixture. If you are using solid couplant, apply it to both transducer faces. Then, rotate the transducers back onto the rail.

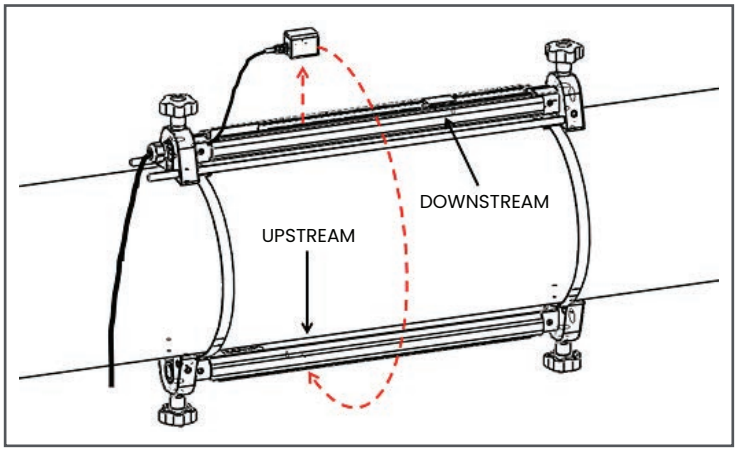


Figure 19: Relocate the Upstream Transducer

8. Your clamp-on fixture and transducer installation is now complete. To wire your AT620 flow meter, proceed to *Wiring the AT620 Electronics*.

2.1.4 Transducer Spacing >320 mm, Traverses = 1, Fixtures = 2

For a one traverse installation with a calculated transducer spacing of >320 mm for a 1 MHz or 0.5 MHz transducer, two clamp-on fixtures are installed on opposite sides of the pipe. To install this configuration, refer to *Figure 20* below and complete the following steps:

1. Mark a straight line parallel to the pipe centerline on the top of the pipe (i.e., the 12 o'clock position).
2. Use a band tape to measure the circumference of the pipe. Then, mark two additional lines on the pipe parallel to the first line. Locate these lines 1/4 of the way around the pipe in each direction from the original line (i.e., at the 3 o-clock and 9 o'clock positions).
3. Install the four mounting straps on the pipe with a spacing of about 12 in. (30 cm) between each pair of straps. Then, mark a fixture position on each of the straight lines, using the band tape as a reference point.
4. Hold one clamp-on fixture, with two transducers and one cable, on the pipe between the pair of downstream straps and along one of the lines marked in step 2. Then, move the two downstream straps onto the ends of this clamp-on fixture. Tighten the strap screws and verify that the straps remain on the ends of the fixture.
5. Hold the remaining (empty) clamp-on fixture along the line on the opposite side of the pipe from the first fixture and between the upstream pair of straps. Then, move the two upstream straps onto the ends of this clamp-on fixture. Tighten the strap screws and verify that the straps remain on the ends of the fixture.
6. Set the spacing between the two transducers to the value calculated by the meter as follows:
   a. Loosen the fixture rails and rotate the rails so the transducers are in view.
   b. Remove the upstream transducer from the first fixture (see *Figure 20* below). Disconnect the transducer cable and route the cable into the second fixture.
   c. Install the upstream transducer in the second fixture, and reconnect the transducer cable.
   d. Locate the upstream transducer at the zero position of the second fixture, and then move the downstream transducer to the required position on the first fixture. If you are using solid couplant, apply it to both transducer faces. Then, rotate the transducers back onto the rail.

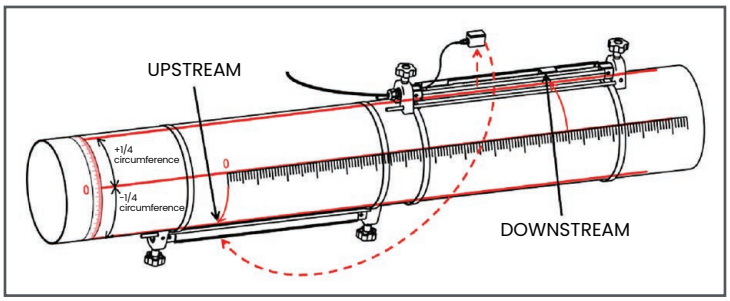


Figure 20: 1 Traverse Installation for Transducer Spacing >320 mm

7. Your clamp-on fixture and transducer installation is now complete. To wire your AT620 flow meter, proceed to *Wiring the AT620 Electronics*.

2.2 Installing a CF Clamp-on Fixture and Transducer System

To use the AT620 flow meter on 0.5 to 2 in. (15 to 50 mm) pipes, the CF clamp-on fixture must be used. CF-LP Note the following specifications:

- CF-LP transducer: Use cable adapter p/n 210-410-LF with the AT6 transducer cable, up to 230°C (446°F) temperatures, 4 MHz frequency.

2.3 Installing a Strapped Clamping Fixture and Transducer System

Both the C-RS and C-PT transducers are mounted on the pipe with the Panametrics strapped clamping fixture. For detailed installation instructions refer to following:

- C-RS transducer Installation Guide (Panametrics document #PANA009C11)

2.3.1 Installing C-RS or C-PT Transducers with an RG316 Cable

The standard AT6 transducer cable is an RG316 cable with an SMA connector on the transducer end. To connect the BNC connector on the C-RS or C-PT transducer to the SMA connector on the AT6 transducer cable, a BNC to SMA adapter is needed. See *Figure 21* below and install the cable adapter on the transducer end of your AT6 cable.

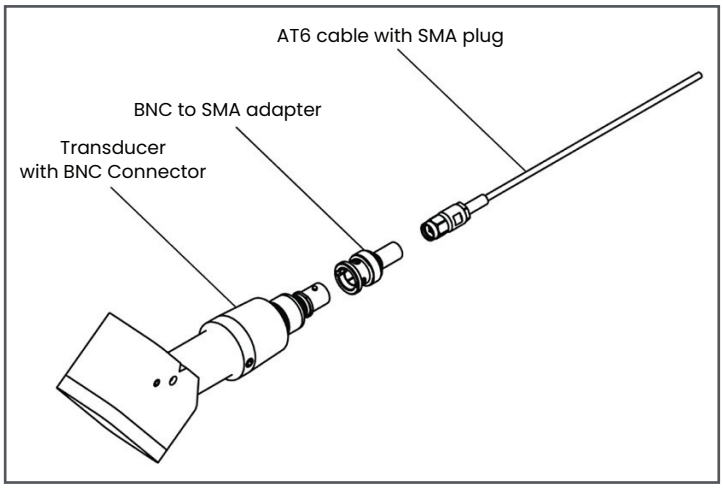


Figure 21: BNC to SMA Cable Adapter Installation

2.3.2 Installing C-RS or C-PT Transducers with an RG62 Cable

The AT620 flow meter can be connected directly to a C-RS or C-PT transducer with an optional RG62 cable, which has a BNC connector at transducer end. Thus, the BNC to SMA adapter is not needed.

This RG62 cable has a submersible cable option for the C-RS transducer. Also, there is a junction box option for the C-RS and C-PT transducers, which provides extra physical protection for the BNC connection on the transducer.

2.3.3 Transducer Installation Guideline for Dual Paths on Single Pipe

The AT620 flow meter can be connected to two pairs of supported transducers on the same pipe for the configuration of dual paths on single pipe. To minimize the ultrasonic signal's interferences, it is generally advised to install the dual paths out of plane to each other. For example, one path is oriented in the 11-5 o'clock plane, the other path is in the 2-10 o'clock direction, as shown in the figure. Avoid installing the transducers at 12 o'clock or 6 o'clock positions.

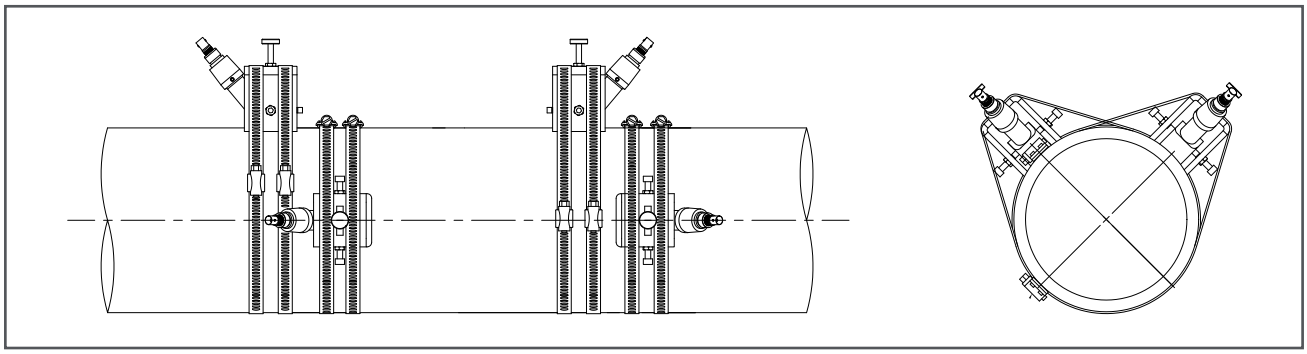


Figure 22: Transducer Installation for Dual Paths on Single Pipe: Left: Side View; Right: End View

Note: *The two fixtures may need to be offset with certain distances to accommodate for the fixture chains.*

Chapter 3. Wiring the AT620 Electronics

3.1 Wiring Diagram

Attention European Customers! To meet CE Mark requirements, all cables must be installed as described in *"Wiring Cable Specifications and Requirements" on page 176*.

This section includes instructions for making all the necessary electrical connections to the AT620 flow meter. Refer to *Figure 23* below for the complete wiring diagram of the meter.

IMPORTANT: Except for the transducer connector, all electrical connectors are stored in their terminal blocks during shipment and may be removed from the enclosure for more convenient wiring. Feed the cables through the cable gland holes on the bottom of the enclosure, attach the wires to the appropriate connectors and plug the connectors back into their terminal blocks.

After the AT620 is completely wired, proceed to Initial Setup and Programming to configure the meter for operation.

Note: *The HART and Modbus communication options must be selected when ordering the AT620.*

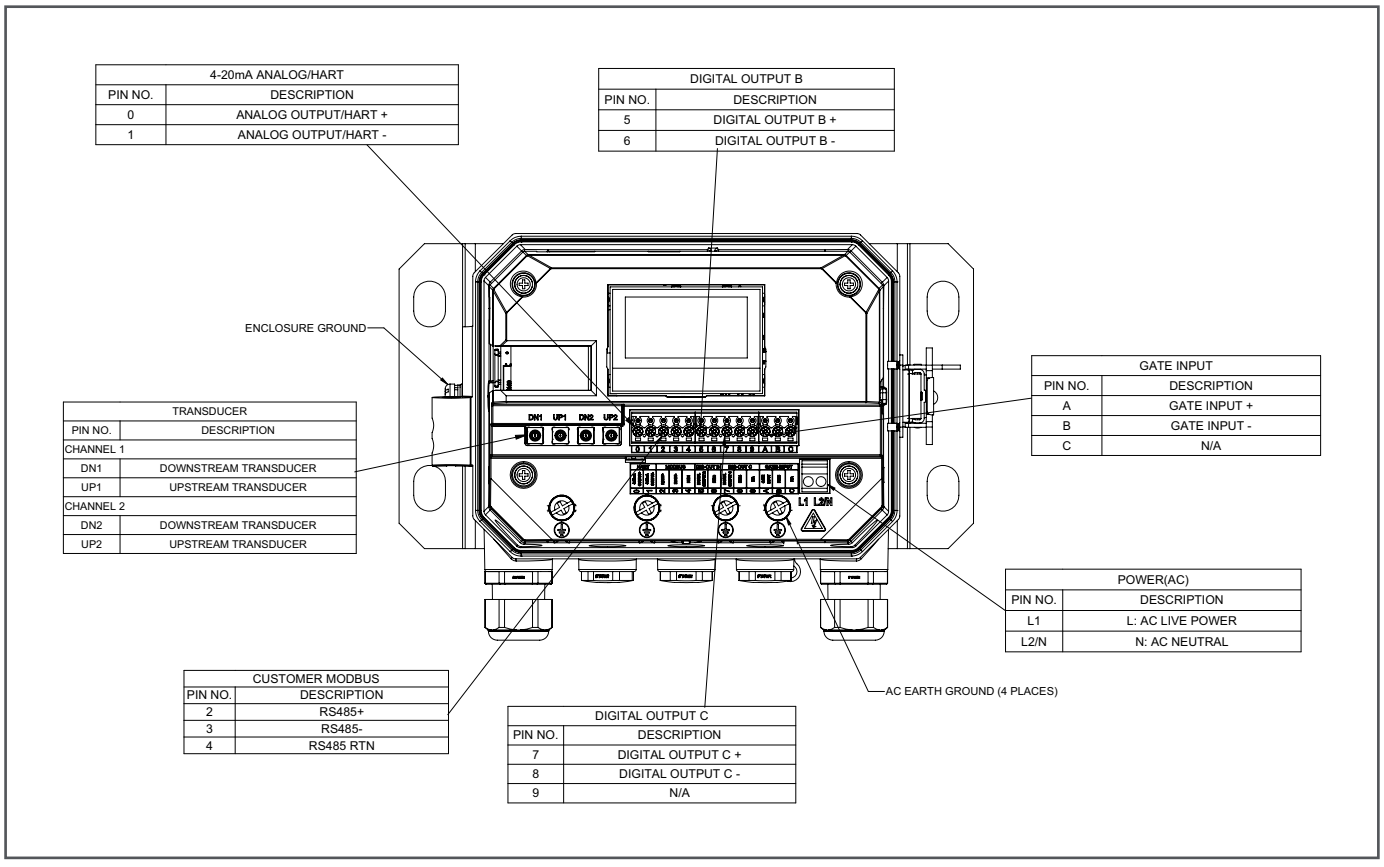


Figure 23: Wiring Diagram AC Option

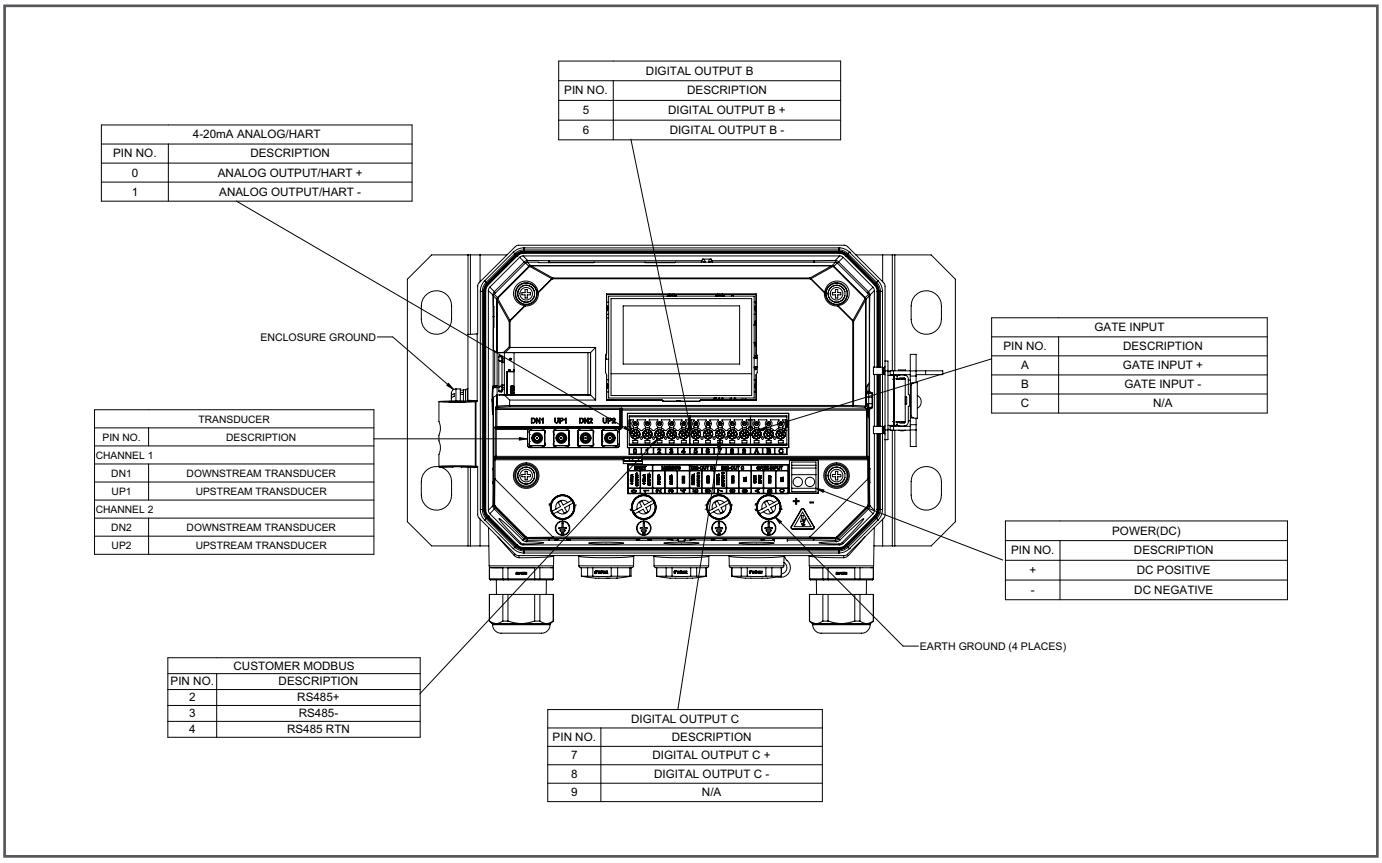


Figure 24: Wiring Diagram DC Option

For proper wiring, the power lines, transducer cable and I/O lines must be routed through the appropriate cable glands (see *Figure 25* below). Also, refer to Wiring Cable Specifications and Requirements for the required cable specifications.

IMPORTANT: Any unused cable glands must be plugged with the cable gland inserts provided with meter.

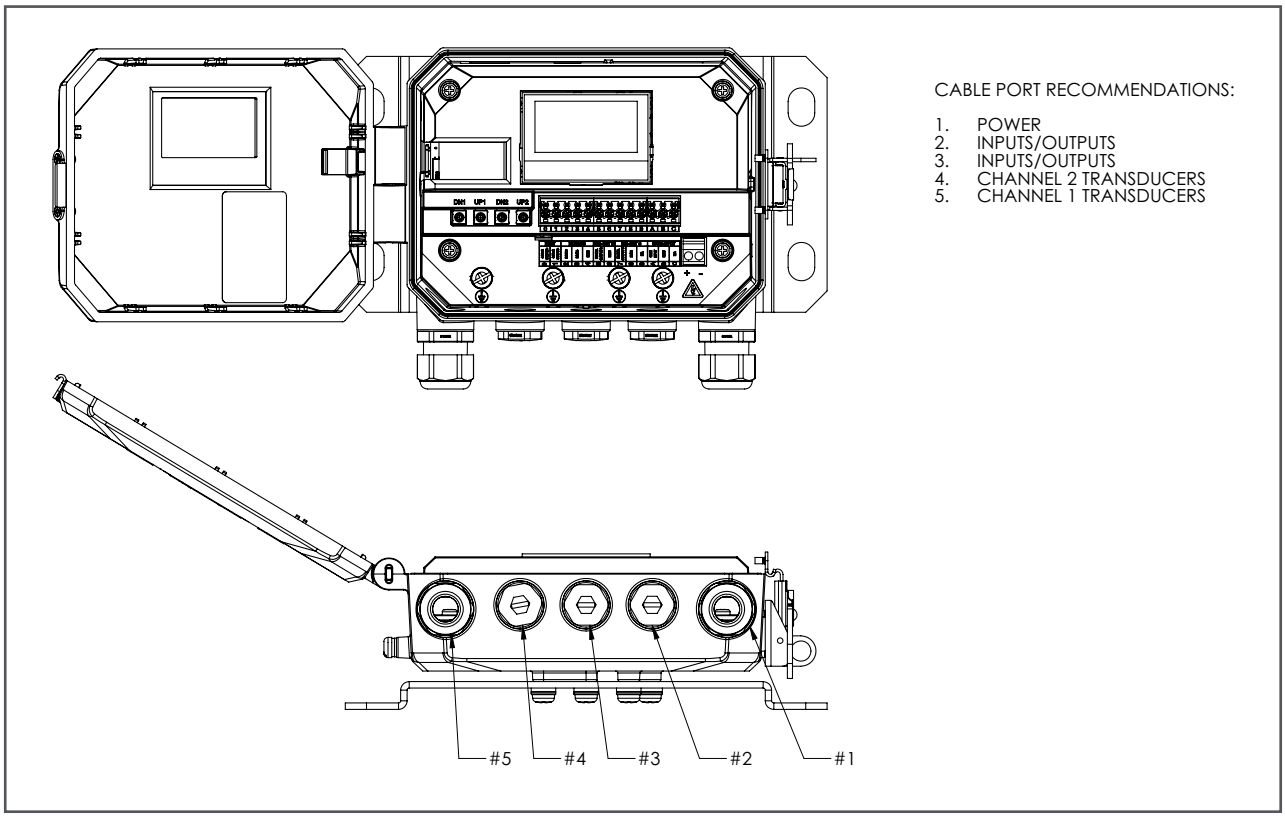


Figure 25: Recommended Cable Gland Usage

3.2 Wiring the Line Power

Attention European Customers! To meet CE marking requirements, all cables must be installed as described in Wiring Cable Specifications and Requirements.

The AT620 may be ordered for operation with power inputs of either 85-264 VAC or 12-28 VDC. The label on the shroud inside the electronics enclosure lists the required line voltage for your meter.

WARNING! Be sure to connect the AT620 only to the specified line voltage.

Attention European Customers! For compliance with the European Union's low voltage directive, this unit requires and external power disconnect device such as a switch or circuit breaker. The disconnect device must be marked as such, clearly visible, directly accessible, and located within 1.8 m (6 ft) of the unit.

Refer to *Figure 23* and *Figure 24* to locate the terminal block and connect the line power as follows:

WARNING! **Improper connection of the line power leads or connecting the meter to the incorrect line voltage will damage the unit. It will also result in hazardous voltages at the flowcell and associated piping and within the electronics console.**

1. Strip 1/4" of insulation from the end of the line and neutral AC leads (or the positive and negative DC leads), and 1/2" of insulation from the end of the ground lead.
2. Connect the ground lead to the internal ground connection (GROUNDING 1) located on the bottom panel of the electronics enclosure (See *Figure 23 on page 19*).

IMPORTANT: The incoming ground lead must be connected to the internal ground connection.

3. Connect the neutral AC lead (or the negative - DC lead) to L2/N(-) and the AC line lead (or the positive DC lead) to L1(+), as shown in *Figure 23 on page 19*.

IMPORTANT: Do not remove the existing PC board ground wire or the cover ground wire.

3.3 Wiring the Transducers

Attention European Customers! To meet CE Mark requirements, all cables must be installed as described in *"Wiring Cable Specifications and Requirements" on page 176*.

Wiring a typical AT620 system requires interconnection of the following components:

- Upstream and downstream transducers installed in the clamping fixtures
- The electronics console

To wire the transducers, complete the following steps:

WARNING! **Before connecting the transducers, take them to a safe area and discharge any static build-up by shorting the center conductor of the transducer cables to the metal shield on the cable connector.**

1. Locate the two transducer cables and connect them to the transducers.
2. Wire the transducer cables into AT620 through ports 4 and 5 per *Figure 25*.
3. Connect the cable connector with yellow DN jacket on the cable to the DN terminal, and connect cable connector with white UP jacket on the cable to the UP terminal, as shown in *Figure 23 on page 19*.
4. Secure the cable gland.

IMPORTANT: Be sure to insert all cable connectors straight into the PCB receptacles to avoid damaging the connector and/or the receptacle.

3.4 Wiring the System Ground

WARNING! The AT620 must always be connected to a proper earth ground, using the system grounding screw shown in *Figure 26* below.

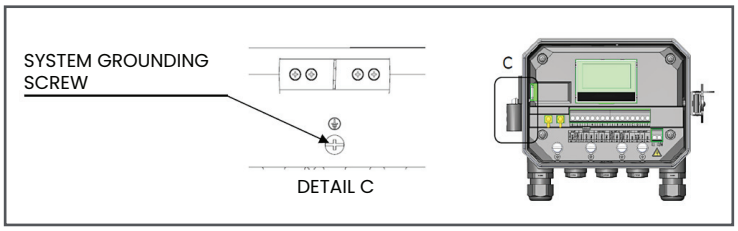


Figure 26: System Grounding Screw

3.5 Wiring the Analog Output for HART Communication

The standard configuration of the model AT620 flow meter includes one isolated 0/4-20mA analog output. Connections to this output may be made with standard twisted-pair wiring. The current loop impedance for this circuit must not exceed 600 ohms.

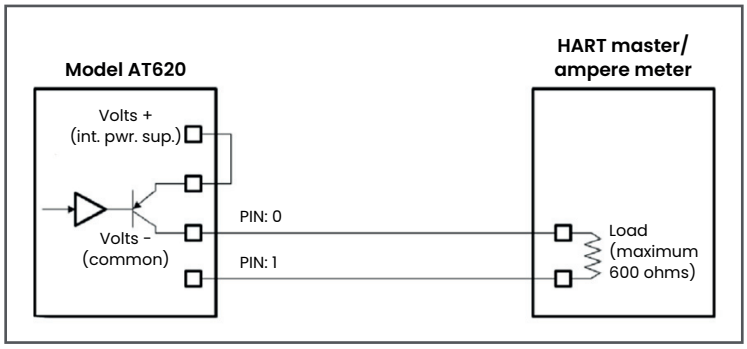


Figure 27: Analog Output/HART Communication Wiring

WARNING! Always be sure to disconnect the main power supply from the AT620 before proceeding with these instructions.

To wire the analog output, refer to *Figure 27 on page 23* and complete the following steps:

1. Verify that the main power has been disconnected from the unit, and then open the enclosure.
2. Install the required cable gland in the chosen gland hole on the bottom of the enclosure.
3. Refer to *Figure 23 on page 19* for the location of terminal block I/O, and wire the terminal block as shown above.
4. Secure the cable clamp.

Note the following:

- The standard analog output port provides only a 0/4-20mA analog output. If the HART communication option is desired, it must be specified at the time of purchase.
- The AT620 analog output is an active mode type, with power provided internally by the meter. Do not connect an external 24V power supply to this circuit.
- Prior to use, the analog output must be set up and calibrated (see *"Inputs/Outputs" on page 39*).
- When in meter is in configuration mode, the analog output is locked at 3.6 mA. After exiting from configuration mode, the meter will resume normal operation.

3.6 Wiring the Modbus Communication

The optional AT620 Modbus port is a two-wire, half-duplex RS485 interface. If this option was specified at the time of purchase, proceed with the wiring instructions below.

WARNING! **Always be sure to disconnect the main power supply from the AT620 before proceeding with these instructions.**

To wire the Modbus RS485 serial port, refer to *Figure 23 on page 19* above and complete the following steps:

1. Verify that the main power has been disconnected from the unit, and then open the enclosure.
2. Install the required cable clamp in the chosen gland hole on the side of the electronics enclosure.
3. Route one end of the cable through the gland hole and wire it to terminal block.
4. Secure the cable clamp.

3.7 Wiring the Frequency/Totalizer/ Alarm Output

The AT620 can accommodate up to two digital outputs. Each of these outputs can be configured as either a totalizer, frequency or alarm output (see *"Programming Digital Communications" on page 52* for instructions). Each totalizer/frequency/alarm output requires a twisted pair cable. Wire the terminal block as shown in *Figure 23 on page 19* and *Figure 28* below.

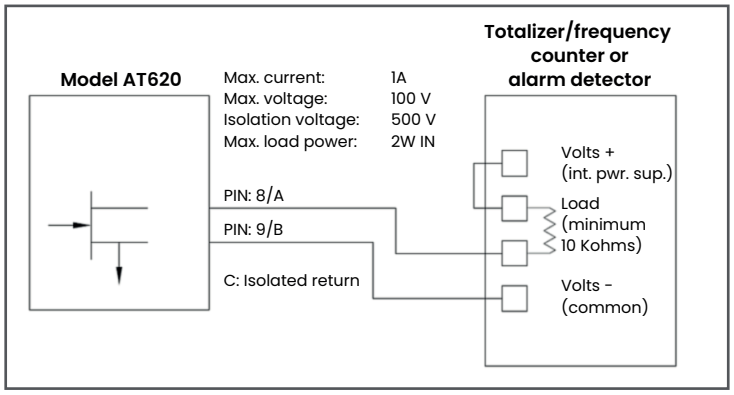


Figure 28: Totalizer/Frequency/Alarm Output Wiring

3.8 Wiring the Gate Input

The AT620 provides a gate contact input port. This port is designed to start/stop the totalizer. During normal measurement mode, thee operator can start or stop the totalizer functionality by toggling the gate switch.

WARNING! **Always be sure to disconnect the main power supply from the AT620 before proceeding with these instructions.**

To wire the Gate input, refer to *Figure 23 on page 19* and *Figure 29* below and complete the following steps:

1. Verify that the main power has been disconnected from the unit, and then open the enclosure.
2. Install the required cable clamp in the chosen gland hole on the side of the electronics enclosure.
3. Route one end of the cable through the gland hole and wire it to terminal block.
4. Secure the cable clamp.

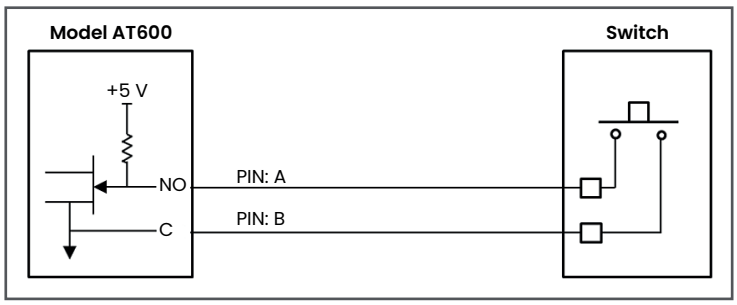


Figure 29: Gate Input Wiring

[no content intended for this page]

Chapter 4. Initial Setup and Programming

4.1 Introduction

This chapter provides instructions for programming the AT620 flow meter to place it into service. Before the AT620 can begin taking measurements, at least the following menus must be programmed:

- *"User Preferences" on page 36*
- *"Inputs/Outputs" on page 39*
- *"Channel Setup" on page 54*

Refer to the main menu map in Figure 30 below, and proceed to the appropriate section for instructions.

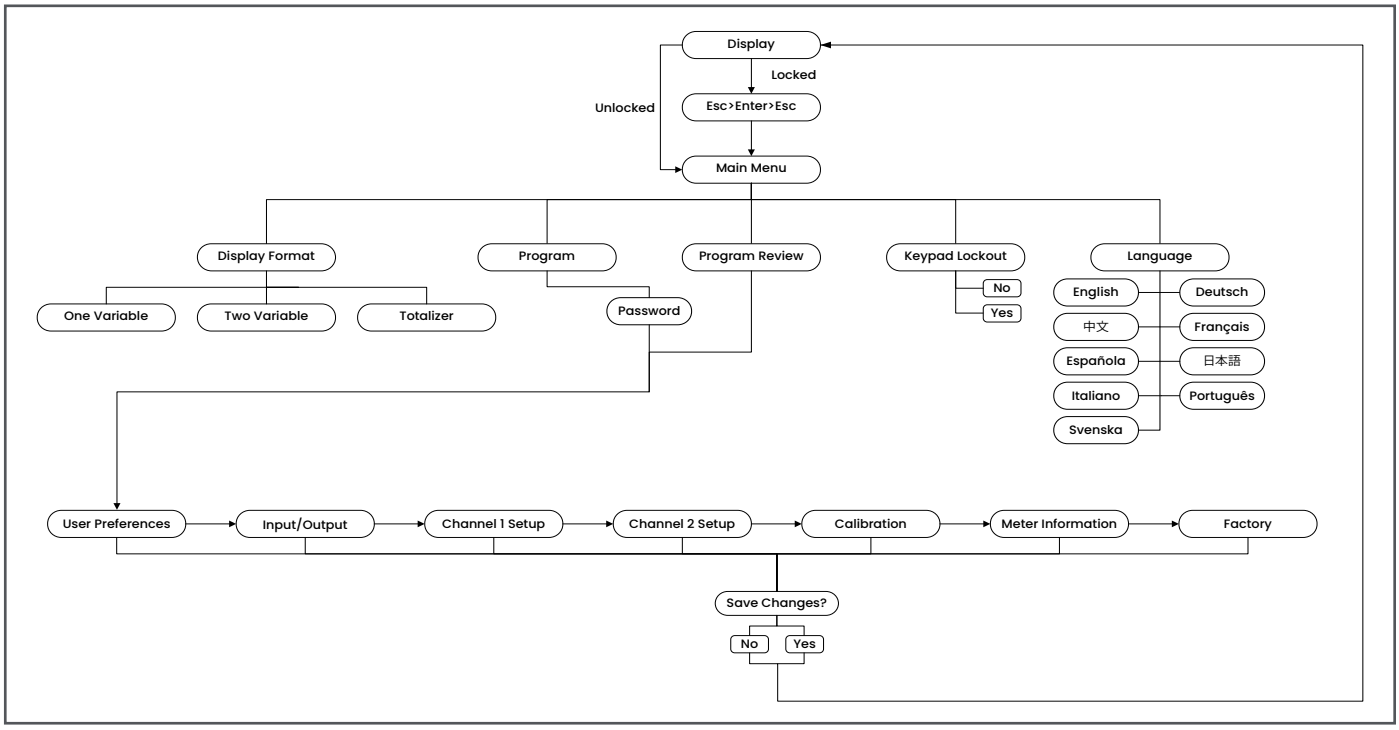


Figure 30: Main Menu Map

4.2 AT620 Keypad Operation

There are six keys and two LEDs on the AT620 keypad. The green light is a system health indicator and is on when the meter is operational and not in error. The red light is a system status indicator and is on when the meter is in error. Both lights being off indicates that the system is in configuration mode or no power has been applied to the meter.

Figure 31: The AT620 Keypad

The six keys on the keypad enable users to program the AT620:

- [✓] - confirms the choice of a specific option and all data entry within that option.
- [x] - enables users to exit from a specific option without saving unconfirmed data.
- [△] and [▽] - enable users to highlight a specific window in the display option or to scroll through a list of options. They are also used to change individual characters in a text string.
- [◁] and [▷] - enable users to scroll to a specific menu option, or to highlight a specific character in a text string.

When powered on, the AT620 initialization screen is shown, followed by a measurement display (see below).

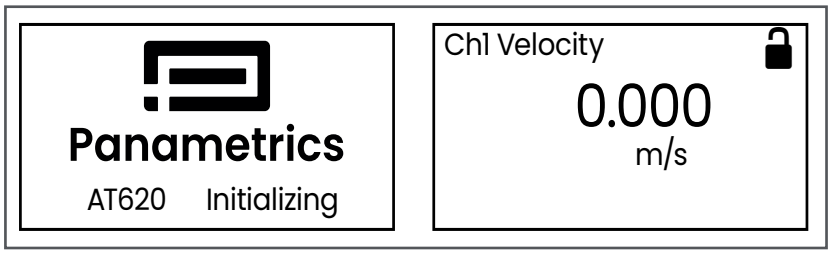


Figure 32: Initialization Screen

As a guide in following the programming instructions in this chapter, the complete AT620 menu maps can be found in *"Menu maps" on page 185*, and the relevant portions are reproduced throughout this chapter.

IMPORTANT: If no key has been pressed for 5 minutes, the AT620 exits the keypad program and returns to displaying measurements. Any unconfirmed configuration changes are discarded.

4.3 Display Programming

The AT620 keypad has six keys (see *"AT620 Keypad Operation" on page 28*) and the following two LEDs:

- **Green:** The green LED is a system health indicator and it is on when the meter is operating without error.
- **Red:** The red LED is a system status indicator and it is on whenever the meter is in error.

Note: *When both LEDs are off, the meter is either in configuration mode or no power is applied.*

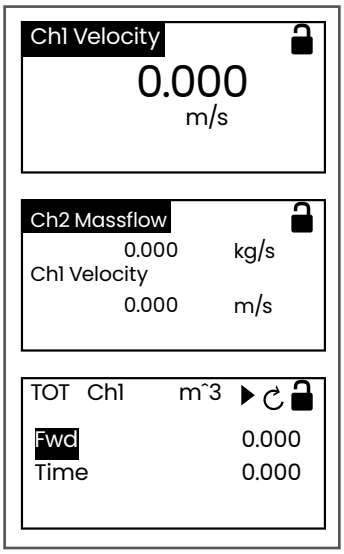


Figure 33: Flashcards Screens

4.3.1 Changing the Display for One or Two Variable Screens

An outline of a typical one- or two-variable screen is shown below.

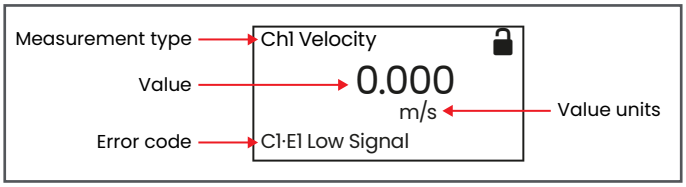
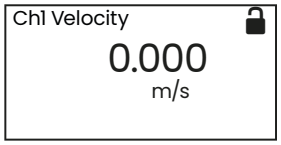
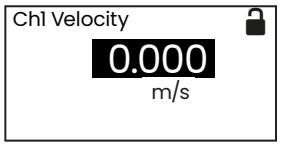


Figure 34: One Variable Screen

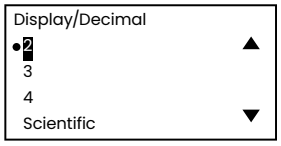
To change the number of decimal places in the displayed value:



From the display screen, press either the [◁] or [▷] keys until the value is highlighted.



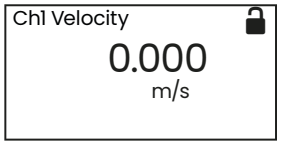
After the value is highlighted, press [✓] to open the display/decimal option.



Use the [△] and [▽] keys to scroll to the desired value. (Available options include 0, 1, 2, 3, 4, and Scientific (Scientific Notation). Press [✓] to select the value, and then press [✓] again to confirm the selection or [x] to cancel the selection.

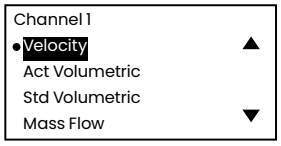
4.3.2 Changing the Measurement Type for One or Two Variable Screens

To change the measurement type:



From the display screen, press either the [◁] or [▷] keys until the measurement is highlighted.

After the measurement is highlighted, press [✓] to open the measurement type option.



The screen changes to display/measurement type. Press the [△] and [▽] keys to scroll to the desired parameter. Available parameters include: velocity, act volumetric, std volumetric, mass, batch totals, inventory totals, sound speed, Reynolds, KFactor, and diagnostics. After you have chosen the measurement type, press [✓] to select the value, and then press [✓] again to confirm the selection or [x] to cancel the selection.

Note: *To select a particular measurement unit, go to "Units Setting" on page 36.*

4.3.3 Changing the Measurement Type or Units for the Totalizer Screens

The totalizer screen opens similar to *Figure 35* below.

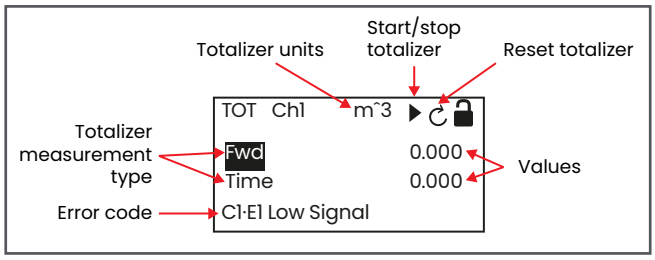
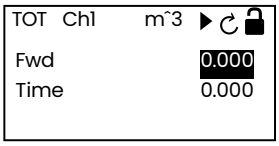


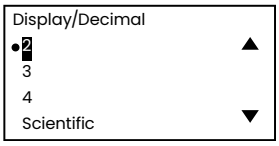
Figure 35: Totalizer Screen

To change the number of decimal places in the value displayed on a totalizer screen, proceed as follows:

From the display screen, press either the [◁] or [▷] keys until the value is highlighted.



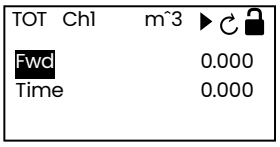
After the value is highlighted, press [✓] to open the display/decimal option.



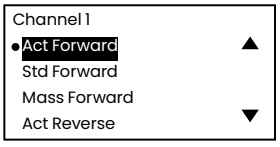
Use the [△] and [▽] keys to scroll to the desired value. (Available options include 0, 1, 2, 3, 4, and Scientific (Scientific Notation). Press [✓] to select the value, and then press [✓] again to confirm the selection or [x] to cancel the selection.

To change the totalizer measurement type, proceed as follows:

From the display screen, press either the [◁] or [▷] keys until the measurement type is highlighted.

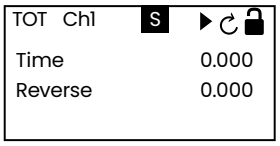


After the type is highlighted, press [✓] to open the display/decimal option.

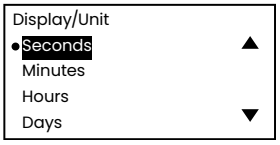


If the measurement is selected the screen changes to totalizer type. Press the [△] and [▽] keys to scroll to the desired parameter. Available parameters include: Standard Batch Fwd Total, Standard Batch Rev Total, Standard Batch Net Total, Mass Fwd Total, Mass Rev Total, Mass Net Total. After you have chosen the type, press [✓] to select the value, and then press [✓] again to confirm the selection or [x] to cancel the selection. The meter will display the selected unit in the units setting selection

If the first value is set to time, the meter displays the time unit. The available time measurement units are seconds, minutes, hours or days. To choose the appropriate units, from the highlighted measurement type, press the [◁] or [▷] keys until the desired measurement unit is highlighted.



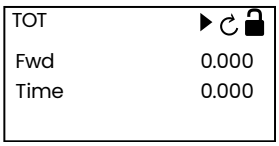
After the unit is highlighted, press [✓] to open the display/unit option.



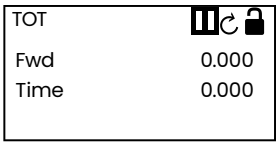
Press the [△] and [▽] keys to scroll to the desired units, and press [✓] to select the unit, and then press [✓] again to confirm the selection or [x] to cancel the selection.

4.3.4 Starting or Stopping the Totalizer Measurement

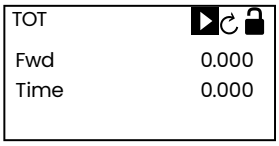
To start or stop totalizer measurements:



From the display, press either the [◁] or [▷] keys until the start/stop icon (either an arrow icon for start or a two-bar icon for stop) is highlighted.



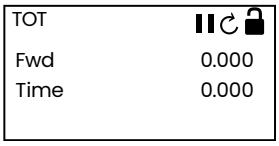
After the value is highlighted, press [✓] to start or stop totalizing.



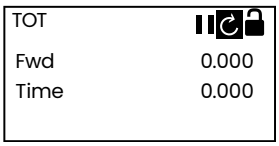
The display icon then changes to indicate the new status (start or stop).

4.3.5 Resetting the Totalizer

To reset the totalizer, proceed as follows:



From the display screen, press either the [◁] or [▷] keys until the reset icon (a partial circle with an arrow) is highlighted.

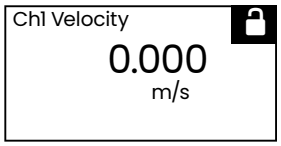


After the reset icon has been highlighted, press [✓] to reset the totalizer to 0.

4.4 Entering the Main Menu

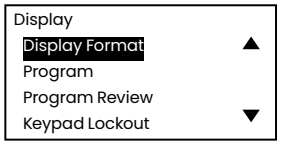
4.4.1 Display Format

To begin programming your meter, you must select the system units as discussed below. Remember to record all programming data in *Appendix B.2 "Data Entry"*. The display format submenu is used to set up the type of format to be used in displaying information.

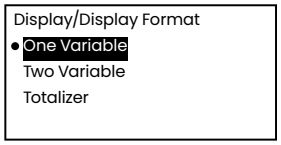


On the initial screen, use the arrow keys to highlight the lock symbol and press [✓].

The following screen opens.

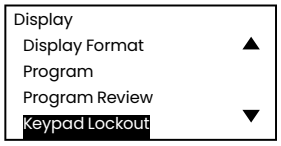


Use the [△] or [▽] keys to highlight display format and press [✓]. The following screen opens.

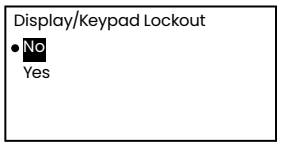


Use the [△] and [▽] arrow keys to highlight the desired format setup and press [✓] to return to the previous screen.

4.4.2 Keypad Lockout



To lock or unlock the keypad for security, on the display menu, select Keypad lockout and press [✓]. A screen similar to the following opens.

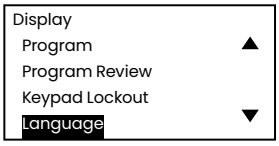


To lock the display, use the [△] and [▽] keys to highlight yes and press [✓]. The screen returns to the previous display.

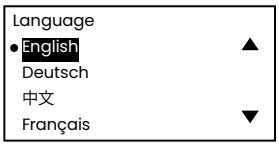
To unlock the display, use the [△] and [▽] keys to highlight no and press [✓]. The screen returns to the previous display.

Note: *When the keypad is locked, press [x], [✓], [x] to unlock it.*

4.4.3 Language



To change the display language, on the display menu, select language and press [✓]. A screen similar to the following opens.



Use the [△] and [▽] arrow keys to highlight the desired language and press [✓] to return to the previous screen. The display language is changed to the new selection.

4.4.4 Program and Program Review Menus

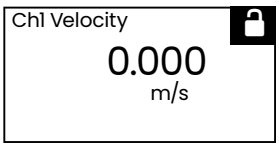
The program and program review menus allow setting up or viewing of several categories of information. As discussed, to edit parameters, you need to input a valid password. The next section describes the access levels required to edit various parameters. To view all parameters without editing, select program review.

4.4.4.1 Program Review

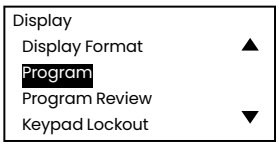
The program review menu requires no user password. However, it provides view-only access to the information. To change any setting or parameter, you must enter the program menu by entering a valid password.

4.4.4.2 Program

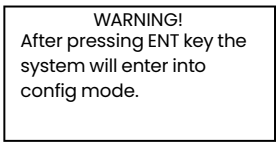
IMPORTANT: When you enter program (configure) mode, measurements stop and the output goes to error level.



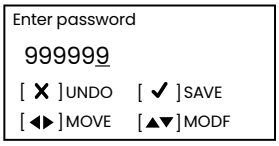
To enter the programming menu, on the display use [◁] and [▷] to highlight padlock icon and press [✓]. The following screen opens.



Use [△] and [▽] to navigate Display menu and highlight Program. Then click [✓] to enter warning screen.



When Warning screen appears, simple press [✓] to proceed to password screen.

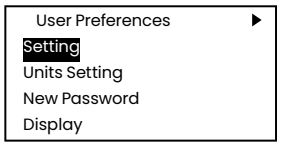


Use the [◁] or [▷] key to select a specific digit, then use the [△] or [▽] key to change that digit as required. After all digits are correct, press [✓] to open the user preference screen

Note: *The default password is 1111.*

4.5 User Preferences

4.5.1 Setting

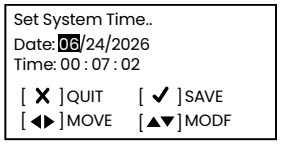


To check or change the desired settings, under user preference, select settings using [△] and [▽] then press [✓]. The following screen opens.

To check the meter tag and/or Label, highlight your choice using [△] and [▽] on the setting menu and press [✓]. Press [x] to return to the previous screen.

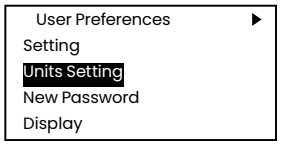
Note: *You can only change the meter tag and label data using Panametrics' Vitality software.*

To check or change the date/time, highlight system date and press [✓]. The following screen opens.

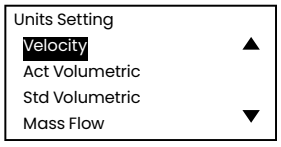


Use the [◁] or [▷] key to select a specific digit, then use the [△] or [▽] key to change that digit as required. After all digits are correct, press [✓] to save. Then, press [x] to return to the previous screen.

4.5.2 Units Setting

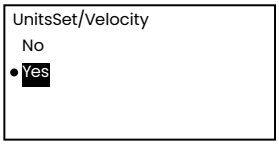


To check or change velocity flow units, use the [△] or [▽] arrow key to select units setting and press [✓]. The following screen opens.

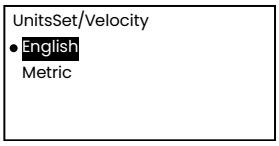


Under units setting menu, use the [△] or [▽] arrow key to select the unit that need to be changed and press [✓] to open the following screen.

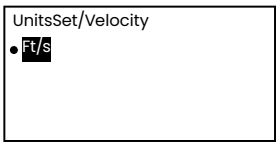
Note: *Velocity is shown here as a typical example.*



If no change is desired, press [x] twice to return to the units setting menu. To change the measurement system, select the desired option, press [✓] twice to open a screen similar to the following.

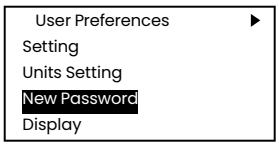


If no change is desired, press [x] twice to return to the units setting menu. To change the measurement system, select the desired option, press [✓] twice to open a screen similar to the following.

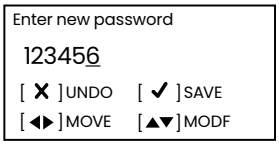


Confirm the selected units, press [x] three times to return to the units setting menu.

4.5.3 New Password



To set up a new password, use the [△] or [▽] arrow key to select New Password and press [✓]. The following screen opens.

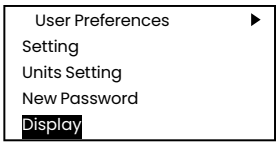


Use the [◁] or [▷] key to select a specific digit, then use the [△] or [▽] key to change that digit as required. After all digits are correct, press [✓] to save. Then, press [x] to return to the previous screen.

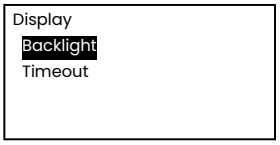
The default password is 111111.

4.5.4 Display

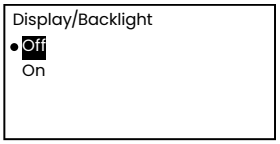
4.5.4.1 Backlight



To turn the backlight OFF or ON, use the [△] or [▽] arrow key to select display and press [✓]. The following screen opens.



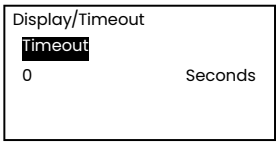
Select backlight and press [✓] to open a screen similar to the following.



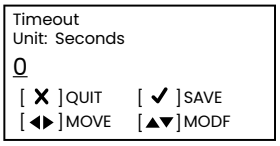
Select OFF or ON and press [✓] twice to return to the previous screen.

4.5.4.2 Timeout

To provide a timeout, select timeout and press [✓]. A screen similar to the following opens.



Press [✓] again, and a screen similar to the following opens.



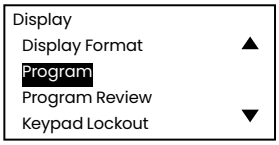
Use the [◁] or [▷] key to select a specific digit, then use the [△] or [▽] key to change that digit as required. After all digits are correct, press [✓] to save. Then, press [x] three times to return to the user preference screen.

Note: *The default value for the timeout is 0*

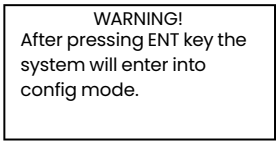
4.6 Inputs/Outputs

4.6.1 Programming the Analog Output Menu

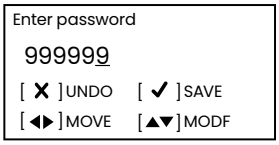
To enter the programming menu, on the display use [◁] and [▷] to highlight padlock icon and press [✓]. The following screen opens.



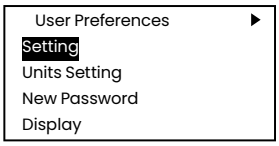
Use [△] and [▽] to navigate Display menu and highlight Program. Then click [✓] to enter warning screen.



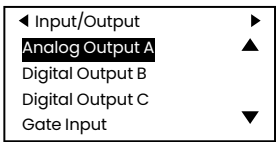
When Warning screen appears, simple press [✓] to proceed to password screen.



Use the [◁] or [▷] key to select a specific digit, then use the [△] or [▽] key to change that digit as required. After all digits are correct, press [✓] to open the user preference screen.

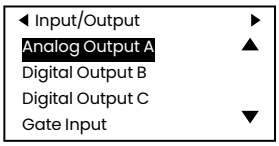


Once inside the program menu, use [▷] key to go to Input/Output menu.

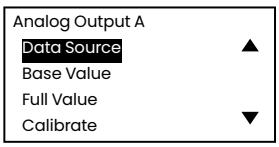


Select the desired output with the [△] or [▽] arrow keys, and press [✓] to enter the configuration menu.

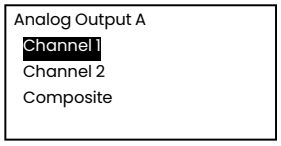
4.6.1.1 Setting the Analog Measurements



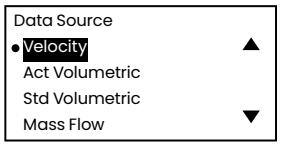
Select the desired output with the [△] or [▽] arrow keys, and press [✓] to enter the configuration menu.



Select Data Source and press [✓]. The following screen opens.

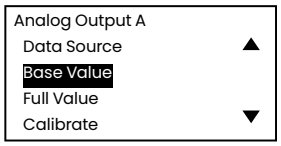


In the Data Source menu, select the channel and press [✓] to go to selection screen.

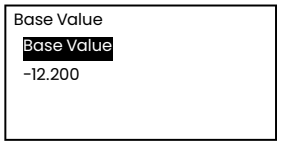


Now select the type of analog output to be used, and press [✓] to return to the previous screen.

4.6.1.2 Setting the Base Value and the Full Value

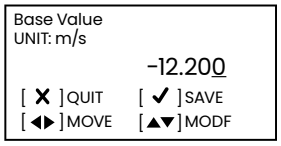


Base value is the flow rate represented by a 4 mA output signal, and full value is the flow rate represented by a 20 mA output signal. In the analog output menu, select base value or full value, using [△] or [▽] and press [✓]. A screen similar to the following opens.



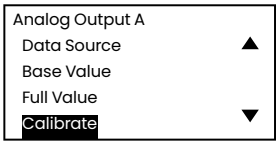
Press [✓] again and a screen similar to the following opens.

Note: *The units shown are the units selected in the units setting menu.*

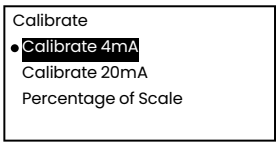


Use the [◁] or [▷] key to select a specific digit, then use the [△] or [▽] key to change that digit as required. After all digits are correct, press [✓] to save. Then, press [x] to return to the previous screen. Repeat these steps to set the full value setting and press [x] to return to the analog output A menu.

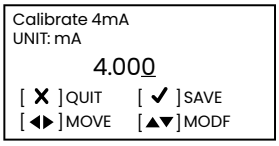
4.6.1.3 Calibrate the Output



Use the calibrate menu to trim the analog output. In the analog output menu, select calibrate and press [✓]. A screen like the following opens.

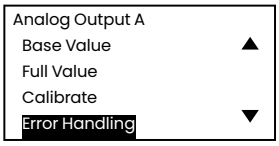


Select either 4 mA to trim the 4 mA level, 20 mA to trim the 20 mA level, or percentage of scale to test the output linearity. Select the desired option and press [✓]. A screen similar to the following opens.

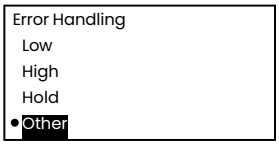


Read the analog output with a digital multimeter, and enter that value. Use the [◁] or [▷] key to select a specific digit, then use the [△] or [▽] key to change that digit as required. After all digits are correct, press [✓] to save. Then, press [x] to return to the previous screen. Repeat these steps until the actual output value matches the programmed value.

4.6.1.4 Setting Error Handling

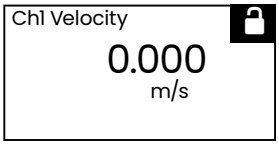


To specify the error handling status in the analog output A menu, select error handling and press [✓]. The following screen opens.

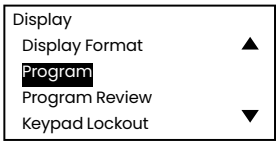


During an error condition, selecting low forces the analog output to 3.6 mA or below, while selecting high forces it to 21.6 mA or above. Hold keeps the last good value during an error condition. Select the desired setting and press [✓].

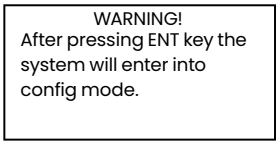
4.6.2 Programming the Digital Output Menu



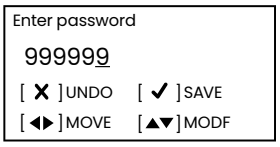
To enter the programming menu, on the display use [◁] and [▷] to highlight padlock icon and press [✓]. The following screen opens.



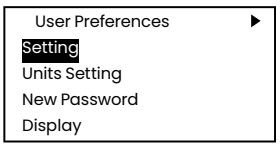
Use [△] and [▽] to navigate Display menu and highlight Program. Then click [✓] to enter warning screen.



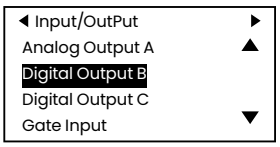
When Warning screen appears, simple press [✓] to proceed to password screen.



Use the [◁] or [▷] key to select a specific digit, then use the [△] or [▽] key to change that digit as required. After all digits are correct, press [✓] to open the user preference screen



Once inside the program menu, use [▷] key to go to Input/Output menu.

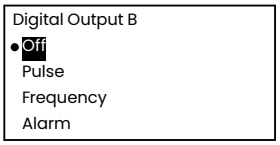


Select the desired output with the [△] or [▽] arrow keys, and press [✓] to enter the configuration menu.

Note: *The programming steps for digital output C are the same as those for digital output B.*

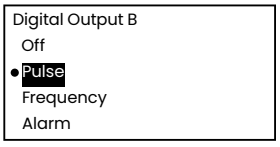
Note: *Digital outputs can be programmed as pulse, frequency or alarm, or they can be turned off.*

4.6.2.1 Disable the Digital Output



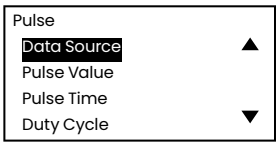
To disable digital output B, select off in the menu and press [✓] twice.

4.6.2.2 Setting the Pulse Output

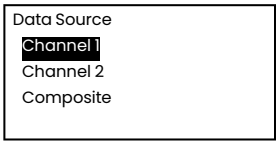


The pulse output generates a square wave pulse for each unit of flow that passes through the pipeline. Select pulse and press [✓] to open the following screen.

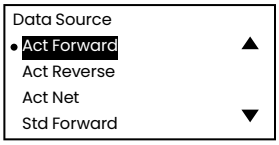
Setting the Measurement Type



Select Data Source and press [✓] to open the following screen.

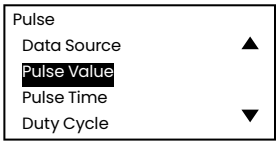


Select channel source to open next menu

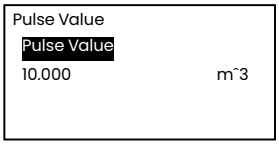


In the measurement menu, select the type of digital output to be used, and press [✓] to return to the previous screen.

Setting the Pulse Value

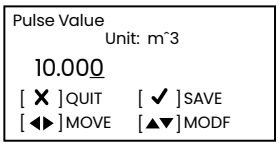


Use the [△] or [▽] arrow keys to select Pulse Value and press [✓]. A screen similar to the following opens.



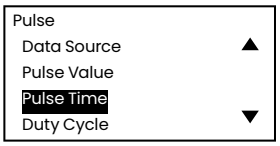
The pulse value is the amount of flow represented by one pulse in the display (e.g., 1 pulse = 10 m^3.) To change the existing setting, press [✓] and a screen similar to the following opens.

Note: *The units shown are the units selected in the units setting menu.*

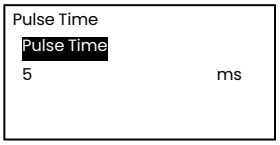


Use the [◁] or [▷] key to select a specific digit, then use the [△] or [▽] key to change that digit as required. After all digits are correct, press [✓] to save. Then, press [x] to return to the previous screen.

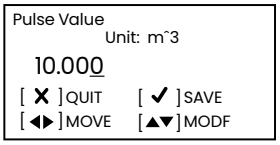
Setting the Pulse Time



Use the [△] or [▽] arrow keys to select pulse time and press [✓]. A screen similar to the following opens.

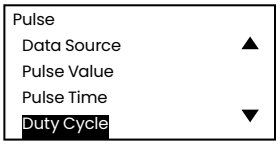


The pulse time (i.e., the pulse width) is displayed. To change the existing setting, press [✓] and a screen similar to the following opens.

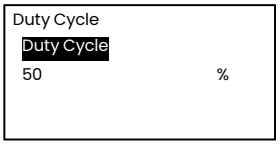


Use the [◁] or [▷] key to select a specific digit, then use the [△] or [▽] key to change that digit as required. After all digits are correct, press [✓] to save. Then, press [x] to return to the previous screen.

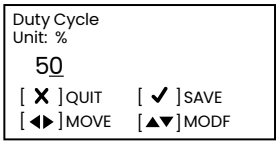
Setting the Pulse Duty Cycle



Use the [△] or [▽] arrow keys to select duty cycle and press [✓]. A screen similar to the following opens.

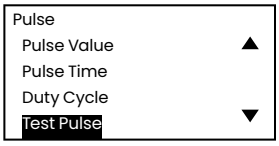


The pulse duty cycle (i.e., the percentage of pulse that is active during a full cycle) is displayed. To change the existing setting, press [✓] and a screen similar to the following opens.

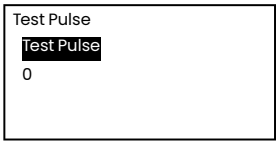


Use the [◁] or [▷] key to select a specific digit, then use the [△] or [▽] key to change that digit as required. After all digits are correct, press [✓] to save. Then, press [x] to return to the previous screen.

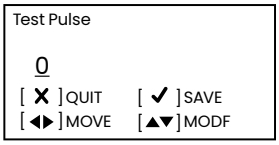
Test the Pulse



To test the pulse output, select test pulse and press [✓]. The following screen opens.

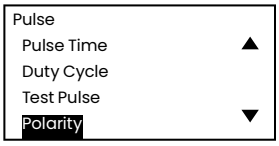


Press [✓] to open a screen similar to the following. Press [✓] again and the screen returns to the previous display. Press [x] to return to the digital output menu.



Use the [◁] or [▷] key to select a specific digit, then use the [△] or [▽] key to change that digit as required. After all digits are correct, press [✓] to save. Verify on your frequency counter that the correct number of pulses were received. After testing is complete, press [x] to return to the digital output menu.

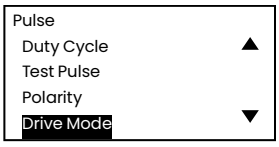
Setting the Pulse Polarity



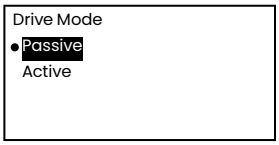
Use the [△] or [▽] arrow keys to select polarity and press [✓]. A screen similar to the following opens.

Use [△] or [▽] to select the desired polarity and [✓] twice to confirm selection.

Setting the Pulse Drive Mode

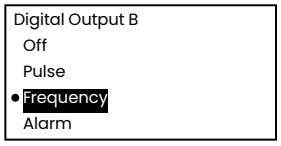


Use the [△] or [▽] arrow keys to select Drive Mode and press [✓]. A screen similar to the following opens.



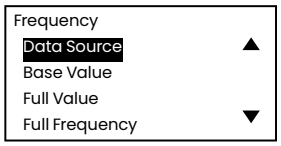
Use [△] or [▽] to select the desired drive mode and [✓] twice to confirm selection.

4.6.2.3 Setting the Frequency

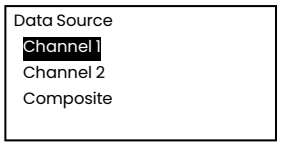


Frequency sends out a continuous square wave, with a frequency proportional to the measured flow rate. Select frequency and press [✓] to open the following screen.

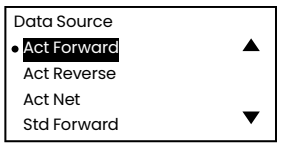
Setting Data Source



Select Data Source and press [✓] to open a screen similar to the following.

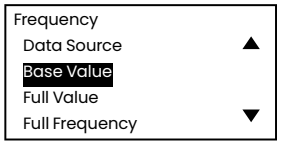


Select the source channel



In the measurement menu, select the type of analog output to be used and press [✓] to return to the previous screen.

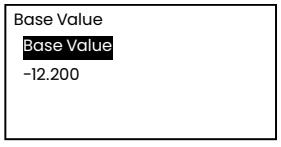
Setting the Base Value, Full Value, and Frequency



The base value is the measurement that corresponds to a 0 Hz pulse. The full value is the measurement value that corresponds to a full frequency pulse. The full frequency is the maximum frequency used for the output pulse, and it indicates the maximum flow rate measurement.

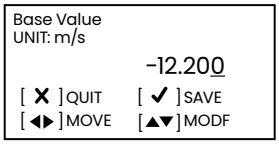
Use the [△] or [▽] arrow keys to select the appropriate option and press[✓]. A screen similar to the following opens.

Note: *Use the same steps to program the base value, full value and full frequency.*



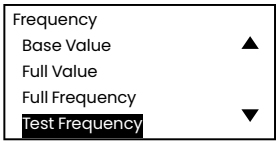
To change the existing number, press [✓] and a screen similar to the following opens.

Note: *The units shown are the units selected in the units setting menu.*

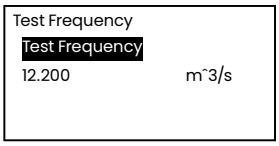


Use the [◁] or [▷] key to select a specific digit, then use the [△] or [▽] key to change that digit as required. After all digits are correct, press [✓] to save. Then, press [x] to return to the previous screen.

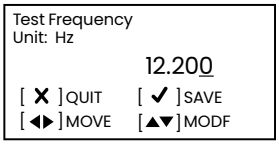
The Test Frequency



To test the frequency output, select test frequency and press [✓]. The following screen opens.

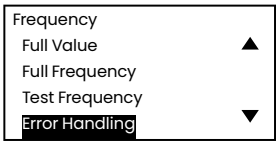


Press [✓] to open a screen similar to the following.

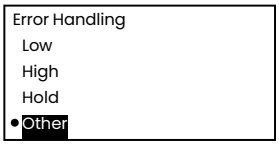


Use the [◁] or [▷] key to select a specific digit, then use the [△] or [▽] key to change that digit as required. After all digits are correct, press [x] to save. Then, verify at your frequency counter that you see the frequency you entered. If desired, you can repeat this procedure with several different frequencies. After testing is complete, press [x] to return to the digital output menu.

Setting the Frequency Error Handling

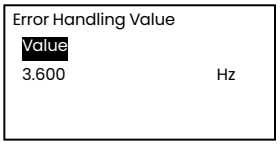


To change the error handling status, select error handling in the menu and press [✓]. The following screen opens.

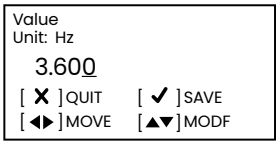


To change the current error handling status, select the desired option, and press [✓]. The screen returns to the previous display. There are four options for response to an error situation:

- **Low:** display 0 Hz
- **High:** display the full frequency
- **Hold:** hold the last good value
- **Other:** If selected, a screen similar to the following opens

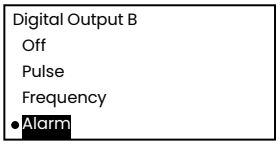


Enter the frequency value you want to display during an error situation. (e.g., if full frequency = 1 kHz, you may want to set the error handling value to 2 kHz.) Press [✓] again, and a screen similar to the following opens.



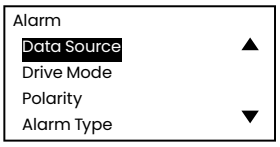
Use the [◁] or [▷] key to select a specific digit, then use the [△] or [▽]key to change that digit as required. After all digits are correct, press [✓] to save. Then, press [x] to return to the previous screen.

4.6.2.4 Setting the Alarm

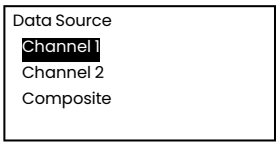


The alarm can be either an open circuit (normally closed type) or a short circuit (normally open type), depending on the error condition. To check the alarm or change its settings, in the digital output menu select alarm and press [✓]. The following screen opens.

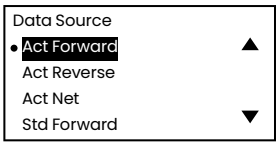
Setting the Measurement Type



Select Data Source and press [✓]. A screen similar to the following opens.

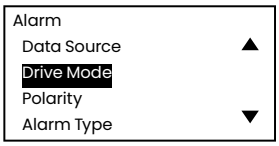


Select the channels source to open a screen similar to the following.

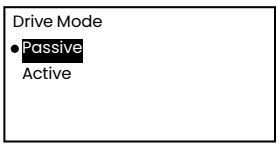


In the measurement menu, select the type of analog output to be used, and press [✓]. The screen returns to the previous display.

Setting the Alarm Drive Mode

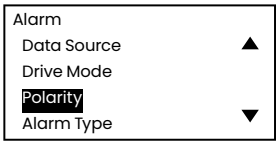


Use the [△] or [▽] arrow keys to select Drive Mode and press [✓]. A screen similar to the following opens.



Use [△] or [▽] to select the desired drive mode and [✓] twice to confirm selection.

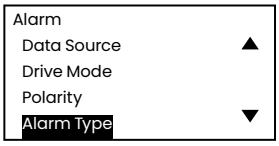
Setting the Alarm Polarity



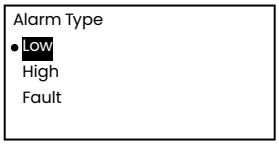
Use the [△] or [▽] arrow keys to select polarity and press [✓]. A screen similar to the following opens.

Use [△] or [▽] to select the desired polarity and [✓] twice to confirm selection.

Setting the Alarm Type



Use the [△] or [▽] arrow keys to select alarm type and press [✓]. A screen similar to the following opens.

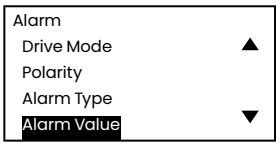


You can choose from three alarm types:

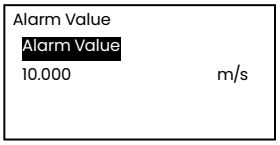
- **Low:** the alarm trips only if the measurement falls to or below the threshold value
- **High:** the alarm trips if the measurement rises to or exceeds the threshold value
- **Fault:** the alarm trips only for system errors, such as a power failure

To change the type of alarm, select the desired type and press [✓] to return to the previous screen.

Setting the Alarm Value

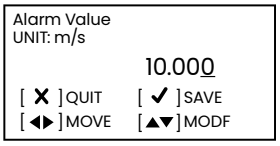


The alarm value is the threshold that trips a low or high alarm. To check or change the alarm value, select alarm value and press [✓]. A screen similar to the following opens.



Press [✓] again, and a screen similar to the following opens.

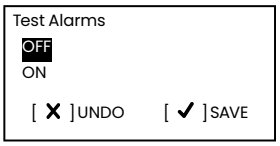
Note: *The units shown are the units selected in the units setting menu.*



Use the [◁] or [▷] key to select a specific digit, then use the [△] or [▽] key to change that digit as required.

Test the Alarms

To test the alarms output, select test alarms and press [✓]. The following screen opens.



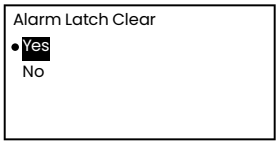
Select OFF to disable the alarm or ON to enable the alarm. To begin testing, select ON and press [✓]. To stop testing, press [x].

Setting Alarm Latch

Use the [△] or [▽] arrow keys to select Alarm Latch and press [✓]. A screen similar to the following opens.

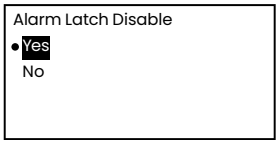
When Enable

Use the [△] or [▽] arrow keys to select Alarm Latch Clear and press [✓]. A screen similar to the following opens



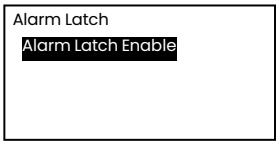
Select Yes and press [✓], will clear the current latched alarm.

Use the [△] or [▽] arrow keys to select Alarm Latch Disable and press [✓]. A screen similar to the following opens

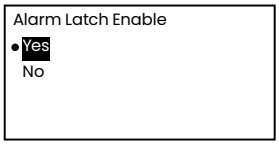


Select Yes and press [✓], will disable Alarm Latch.

When Disable

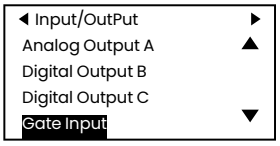


If Alarm Latch is disabled, Select Alarm Latch Enable and press [✓],

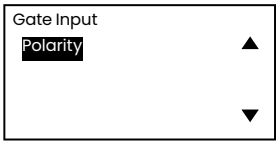


Use the [△] or [▽] arrow keys to select Yes and press [✓]. Alarm Latch shall be enabled.

4.6.2.5 Setting Gate Input



Use the [△] or [▽] arrow keys to select Gate Input and press [✓]. A screen similar to the following opens



Use the [△] or [▽] arrow keys to select Polarity and press [✓]. A screen similar to the following opens

Use the [△] or [▽] arrow keys to select gate input polarity and press [✓].

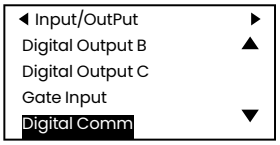
4.6.3 Programming Digital Communications

The AT620 flow meter supports the following digital communication types:

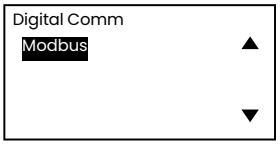
- Modbus
- HART

A password is required to activate the digital communications options. In case of problems, contact Panametrics for assistance.

4.6.3.1 Modbus

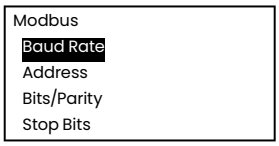


To set up Modbus, select digital comm on the input/ output screen and press [✓]. The following screen opens.



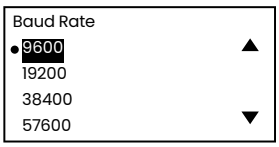
Press [✓] again, and a screen similar to the following opens.

Selecting the Baud Rate



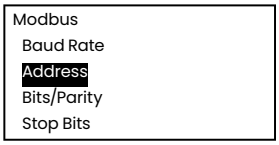
To set the baud rate, select baud rate and press [✓].

A screen similar to the following opens.

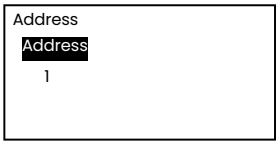


The default baud rate is 115200. To change the default, select the desired baud rate and press [✓] to return to the previous screen.

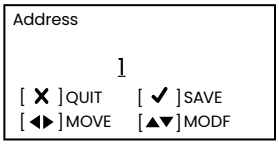
Selecting the Modbus Address



To set the address, select Address and press [✓]. A screen similar to the following opens.

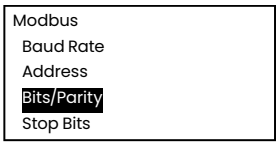


Press [✓] again, and a screen similar to the following opens.

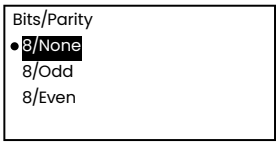


The default address is 1, but 1 to 254 are the acceptable values. Use the [◁] or [▷] key to select a specific digit, then use the [△] or [▽] key to change that digit as required. After all digits are correct, press [✓] to save. Then, press [x] to return to the previous screen.

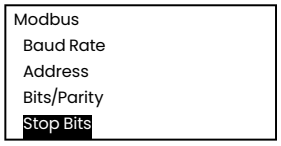
Selecting the Bits/Parity



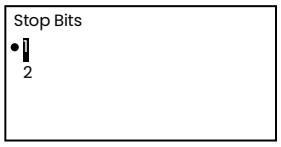
To set the bits/parity, select bits/parity and press [✓]. A screen similar to the following opens.



The default bits/parity is 8/none. Select the desired setting and press [✓] to return to the previous screen.

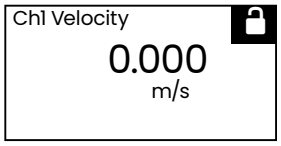


The default stop bits is 1. To set the stop bits, select stop bits and press [✓]. A screen similar to the following opens.

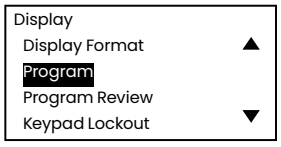


Select the desired setting and press [✓] to return to the previous screen.

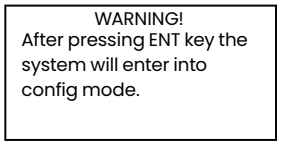
4.7 Channel Setup



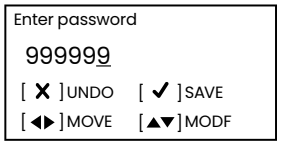
To enter the programming menu, on the display use [◁] and [▷] to highlight padlock icon and press [✓]. The following screen opens.



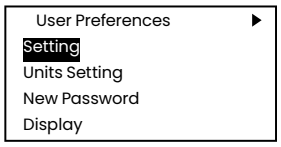
Use [△] and [▽] to navigate Display menu and highlight Program. Then click [✓] to enter warning screen.



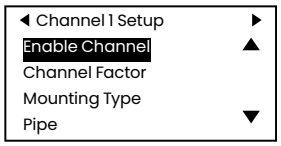
When Warning screen appears, simple press [✓] to proceed to password screen.



Use the [◁] or [▷] key to select a specific digit, then use the [△] or [▽] key to change that digit as required. After all digits are correct, press [✓] to open the user preference screen



Once inside the program menu, use [▷] key twice to go to Channel 1 Setup and thrice to Channel 2 Setup menu.

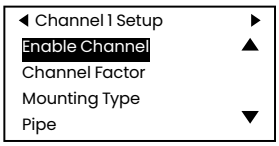


Select the desired configuration with the [△] or [▽] arrow keys, and press [✓] to enter the configuration menu.

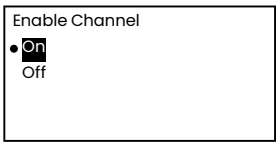
Note: *The programming steps for Channel 2 are the same as those for Channel 1.*

4.7.1 Enable Channel

AT620 flow meter can be used for single or dual channel measurement, by enabling or disabling each channel individually.



Use [△] and [▽] to navigate setup menu and highlight Enable Channel. Then click [✓] to open following screen.

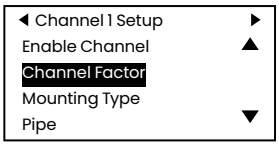


Select the desired status and click [✓] to confirm and save your election.

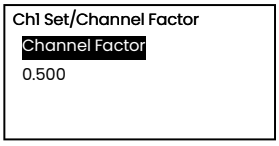
Note: *If any channel is disabled, it can still be configured. But no measurement will be performed.*

4.7.2 Channel Factor

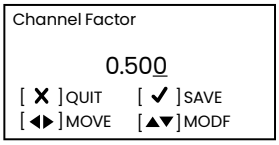
When measurement type is composite, the result will be a sum of each individual channel multiplied by a channel factor. The channel factors will be used for composite measurements, they will not impact the channel-wise measurements.



Use [△] and [▽] to navigate setup menu and highlight Channel Factor. Then click [✓] to open following screen.



This information screen shows the current value for channel factor. Click [✓] and a new screen will open to modify factor.

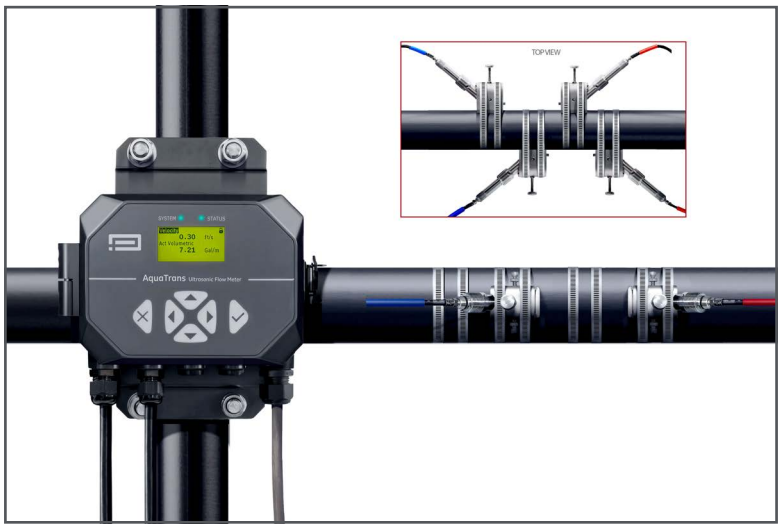


Use the [◁] or [▷] key to select a specific digit, then use the [△] or [▽] key to change that digit as required.

The programming guides below are for the two channel composite use cases:

4.7.2.1 One Pipe and Two Paths

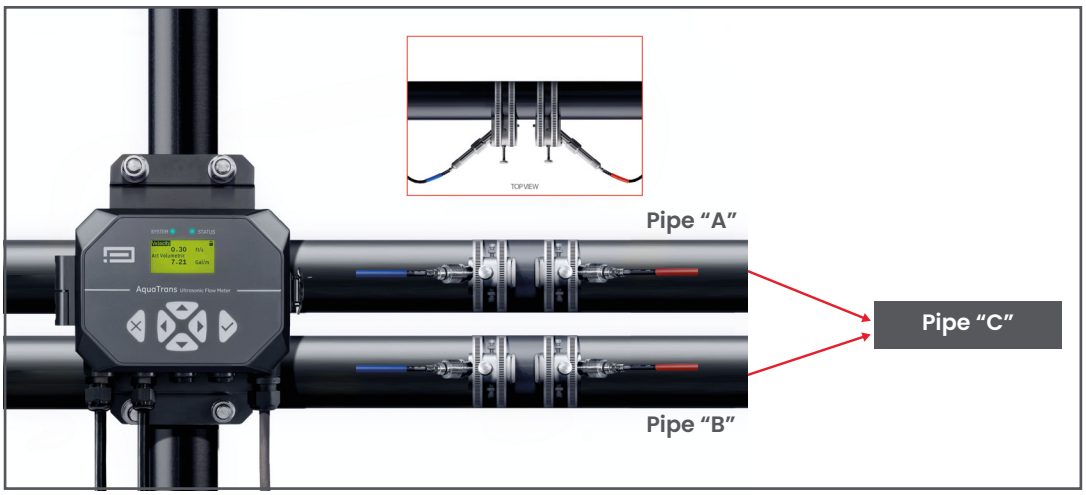
This configuration is used to measure flow in a single pipe using two measurement paths. The meter combines the measurements from both paths and averages the resulting values.



- Outputs: Use the composite value (example: composite actual volumetric for Analog Output A)
- Channel Factors: Set to 0.5 for both channel 1 and channel 2
- Customer would program channel 1 and 2 with the same pipe parameters

4.7.2.2 Two Separate Pipes and One Path (Adding pipe "A" and pipe "B" values)

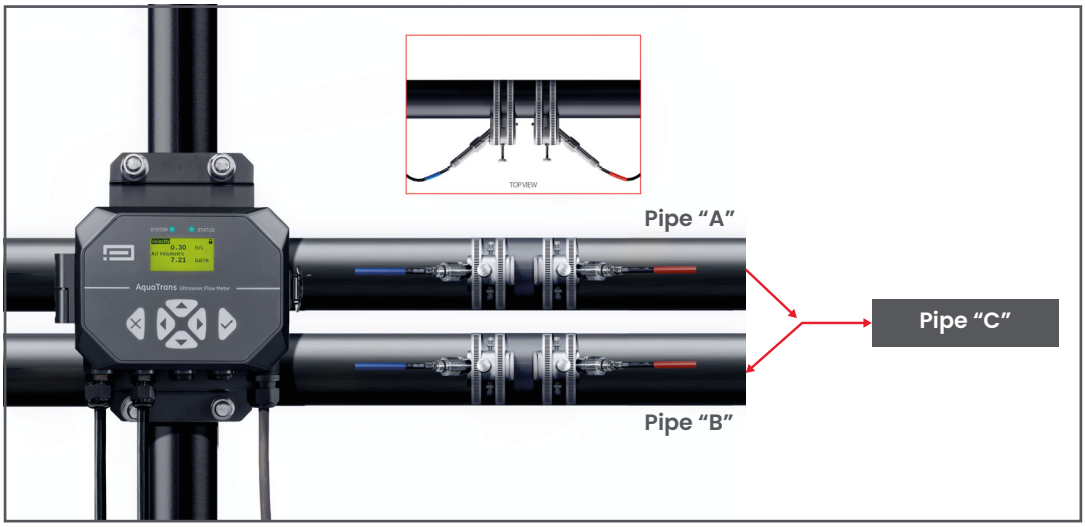
This configuration is used to calculate the combined flow from two separate pipes (pipe "A" and pipe "B"). The meter adds the flow values measured in both pipes.



- Outputs: Use the composite value to determine flow in pipe "C" (example: composite actual volumetric for Analog Output A)
- Channel Factors: Set to 1.0 for both channel 1 and channel 2
- Customer would program channel 1 and 2 based on the specific pipe (can be different or the same)
- This configuration is equivalent to the Sum functionality in the AT868

4.7.2.3 Two Separate Pipes and One Path (Subtracting pipe "B" from pipe "A" values)

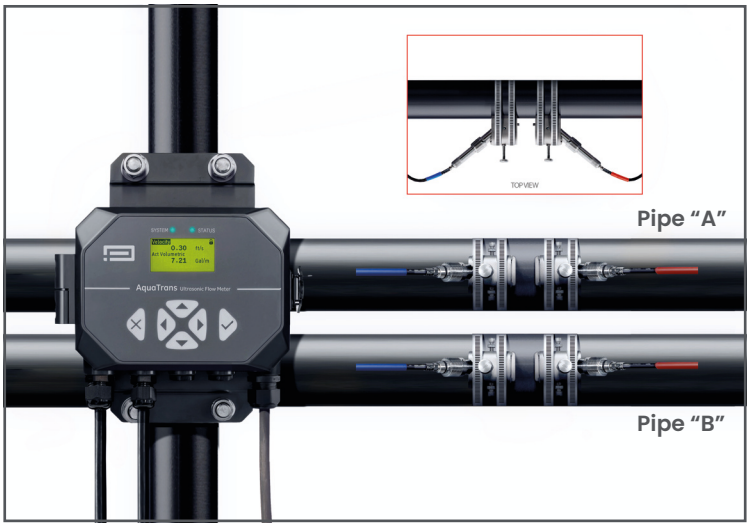
This configuration is used to calculate the difference between the flow values measured in two separate pipes (Pipe A and Pipe B). The meter subtracts the flow value in Pipe B from the flow value in Pipe A.



- Outputs: Use the composite value to determine flow in pipe "C" (example: composite actual volumetric for Analog Output A)
- Channel Factors: Set to 1.0 for channel 1 (pipe "A") and -1.0 for channel 2 (pipe "B")
- Customer would program channel 1 and 2 based on the specific pipe (can be different or the same)
- This configuration is equivalent to the Dif functionality in the AT868

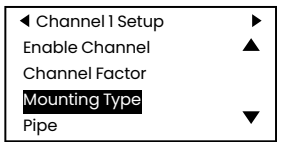
4.7.2.4 Two Separate Pipes and One Path (Separate Measurements)

This configuration is used to measure flow independently in two separate pipes (Pipe A and Pipe B). No combination of the measured values is performed.

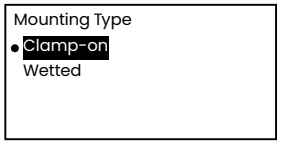


- Outputs: Use the channel value to output flow (example: Ch1 actual volumetric for Analog Output A)
- Channel Factors: Set to 1.0 for channel 1 (pipe "A") and 1.0 for channel 2 (pipe "B")
- Customer would program channel 1 and 2 based on the specific pipe (can be different or the same)

4.7.3 Mounting Type



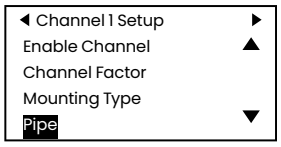
Use [△] and [▽] to navigate setup menu and highlight Mounting Type. Then click [✓] to open following screen.



Select clamp-on or wetted as needed and press [✓] to return to the previous screen.

4.7.4 Programming the Pipe Menu when Wetted is Selected

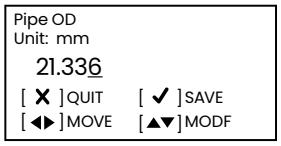
4.7.4.1 Setting the Pipe OD, ID and Wall Thickness



Select pipe and press [✓]. The following screen opens.

In the pipe setup menu, select pipe OD, pipe ID or wall thickness and press [✓]. A screen like the following opens.

Press [✓] again, and a screen like the following opens.



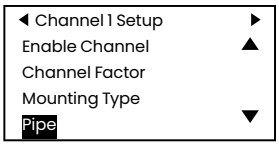
Use the [◁] or [▷] key to select a specific digit, then use the [△] or [▽] key to change that digit as required.

Note: *The units shown are the units selected in the units setting menu*

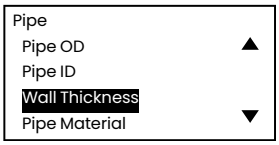
IMPORTANT: Changing the pipe ID (inside diameter) automatically changes the wall thickness. Similarly, changing the wall thickness automatically changes the pipe ID

4.7.5 Programming the Pipe Menu when Clamp-On is Selected

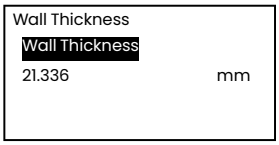
4.7.5.1 Setting the Pipe OD, ID and Wall Thickness



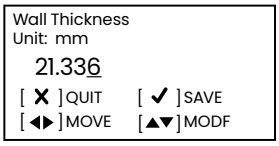
Select pipe and press [✓]. The following screen opens.



In the pipe setup menu, select pipe OD, pipe ID or wall thickness and press [✓]. A screen like the following opens.



Press [✓] again, and a screen like the following opens.



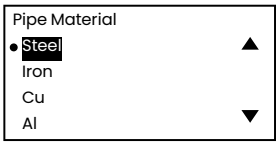
Use the [◁] or [▷] key to select a specific digit, then use the [△] or [▽] key to change that digit as required.

Note: *The units shown are the units selected in the units setting menu.*

IMPORTANT: Changing the pipe ID (inside diameter) automatically changes the wall thickness. Similarly, changing the wall thickness automatically changes the pipe ID.

4.7.5.2 Selecting the Pipe Material

In the pipe menu, select pipe material and press [✓]. The following screen opens.

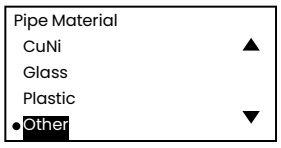


Select the appropriate pipe material from the list, and press [x] to return to the previous screen. If your pipe material is not listed, select other and press [✓] twice. A screen similar to the following opens.

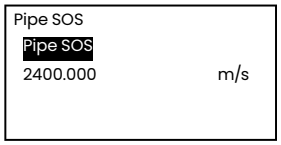
Note: *Table 3 below lists the available pre-programmed pipe materials.*

Table 3: Pre-programmed Pipe Materials

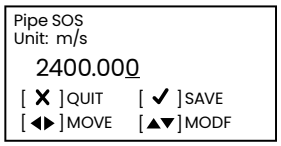
Name	Pipe material
CARBON	Carbon steel
SS	Stainless steel
DUCT	Duct Iron
CAST	Cast Iron
Cu	Cuprum
Al	Aluminum
BRASS	Brass
30%Ni	30% nickel copper alloy
10%Ni	10% nickel copper alloy
PYREX	Pyrex glass
FLINT	Flint glass
CROWN	Crown glass
NYLON	Nylon plastic
PE-LP	Polyethylene
PP	Polypropylene
PVC	Polyvinyl chloride
ACRYL	Acrylic plastic



Select Other if the pipe material not in the list, and press [✓]. A screen similar to the following opens.



Press [✓] again, and a screen similar to the following opens.



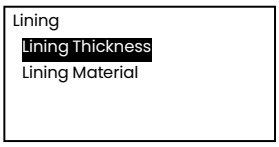
Use the [◁] or [▷] key to select a specific digit, then use the [△] or [▽] key to change that digit as required.

4.7.5.3 Setting the Pipe Lining

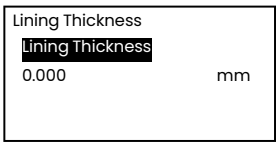
In the pipe menu, select lining and press [✓]. The following screen opens.

If there is no lining in your pipe, select no and press [✓] to return to the previous screen. If your pipe does have a lining, select yes and press [✓] twice. A screen similar to the following opens.

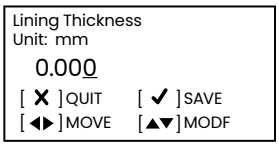
4.7.5.3.1 Lining Thickness



To set the lining thickness, select lining thickness and press [✓]. A screen similar to the following opens.

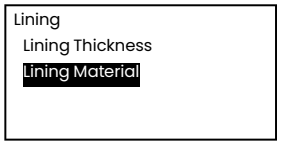


Press [✓] again, and a screen similar to the following opens.

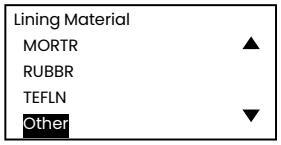


Use the [◁] or [▷] key to select a specific digit, then use the [△] or [▽] key to change that digit as required.

4.7.5.3.2 Lining Material



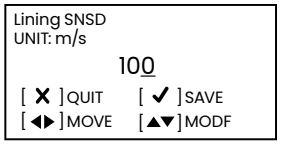
To set the lining material, select lining material and press [✓]. A screen similar to the following opens.



Select the material from the list.

In case the material is not listed, you can select "other" and a screen like the following will open.

Press [✓] again, and a screen like the following opens.



Use the [◁] or [▷] key to select a specific digit, then use the [△] or [▽] key to change that digit as required.

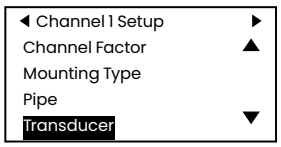
Note: *The units shown are the units selected in the units setting menu.*

Table 4: Pre-programmed Pipe Lining Materials

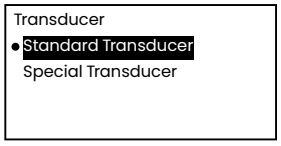
Name	Lining material
Tar epoxy	Tar epoxy
Pyrex glass	Pyrex glass
Asbestos cement	Asbestos cement
Mortar	Mortar
Rubber	Rubber
Teflon	Teflon (PFTE)

4.7.6 Programming the Transducer when Clamp-On is Selected

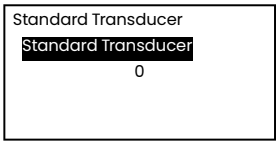
4.7.6.1 Entering a Standard Transducer



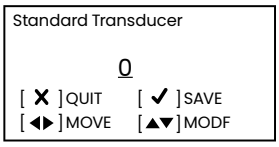
Use [△] and [▽] to navigate setup menu and highlight Transducer. Then click [✓] to open following screen.



Highlight Standard Transducer and press [✓] twice to open the information screen.



In this information screen, click [✓] and a screen like the following will open.



Use the [◁] or [▷] key to select a specific digit, then use the [△] or [▽] key to change that digit as required.

The available AT620 standard transducers are listed in *Table 5* below.

Table 5: Standard Transducer Types

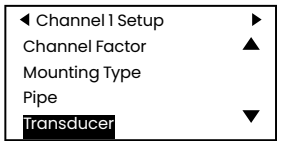
Transducer number	Transducer type
10	CPT-0.5CPT-0.5
11	CPT-2.0
12	CPT-0.5-MT C-PB-05-M
13	CPT-1.0-MT C-PB-10-M
14	CPT-2.0-MT C-PB-20-M
15	CPT-0.5-HT
16	CPT-1.0-HT
17	CPT-2.0-HT
18	CPS-0.5
19	CPSM-2.0
20	CTS-1.0
21	CTS-1.0-HT
22	CTS-2.0
23	C-LP-40-HM
24	C-LP-40-NM
25	CPB-0.5-HT
26	CPB-2.0-MT
27	CPB-0.5-MT
28	CPB-2.0
29	CPB-0.5
30	CPS-1.0 CPT-1.0
31	CWL-2
32	CPS-1.0
33	CPW (WT-1P-1.0 on AB82)
34	CPW (WT-1P-0.5 on NDT plastic)
35	CPW (WT-1P-1.0 on NDT plastic)
36	CPB-1.0-HT
37	CPB-2.0-HT
38	CPB-1.0
39	CPB-1.0-MT

Table 5: Standard Transducer Types(Continued)

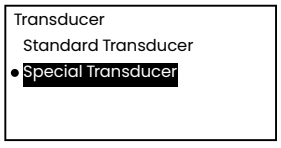
Transducer number	Transducer type
301	C-RL-0.5
302	C-RL-1
304	C-RL-0.5
305	C-RL-1
307	C-RL-0.5
308	C-RL-1
310	C-RV-0.5
311	C-RV-1
313	C-RW-0.5
314	C-RW-1
401	C-RS-0.5[1]
402	C-RS-1[1]
403	C-RS-2
407	UTXDR-2
408	UTXDR-5
430	C-RS-HT-0.5
431	C-RS-HT-1
601	CAT-0.5
602	CAT-1
603	CAT-2[1]

[1] Currently supported transducer

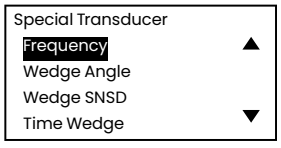
4.7.6.2 Entering a Special Transducer



Use [△] and [▽] to navigate setup menu and highlight Transducer. Then click [✓] to open following screen.

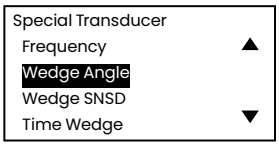


Highlight Special Transducer and press [✓] to open the following screen.

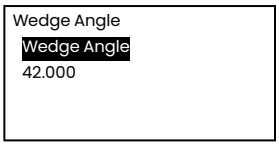


In the Special Transducer menu, select Frequency and press [✓]. The following screen opens.

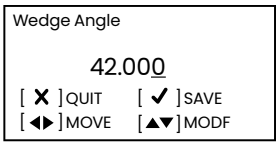
Using [△] or [▽], highlight the appropriate option and press [✓] twice to select and return to previous screen.



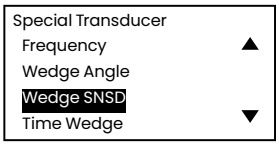
In the Special Transducer menu, select Wedge Angle and press [✓]. The following screen opens.



In this information screen, click [✓] and a screen like the following will open.

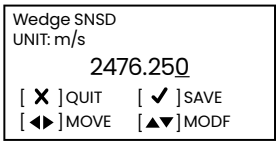


Use the [◁] or [▷] key to select a specific digit, then use the [△] or [▽] key to change that digit as required.

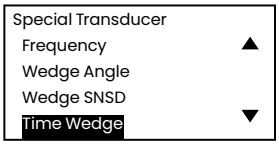


In the Special Transducer menu, select Wedge SNSD and press [✓]. The following screen opens.

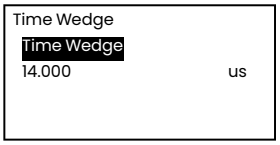
In this information screen, click [✓] and a screen like the following will open.



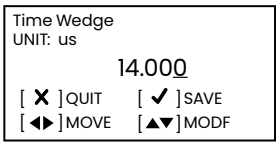
Use the [◁] or [▷] key to select a specific digit, then use the [△] or [▽] key to change that digit as required.



In the Special Transducer menu, select Time Wedge and press [✓]. The following screen opens.



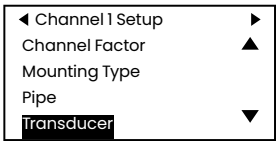
In this information screen, click [✓] and a screen like the following will open.



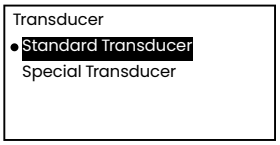
Use the [◁] or [▷] key to select a specific digit, then use the [△] or [▽] key to change that digit as required.

4.7.7 Programming the Transducer when Wetted is Selected

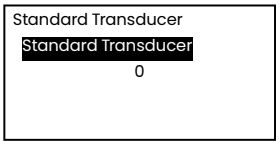
4.7.7.1 Entering Standard Transducer



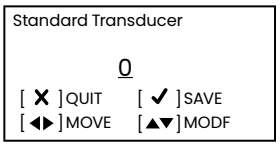
Use [△] and [▽] to navigate setup menu and highlight Transducer. Then click [✓] to open following screen.



Highlight Standard Transducer and press [✓] twice to open the information screen.



In this information screen, click [✓] and a screen like the following will open.



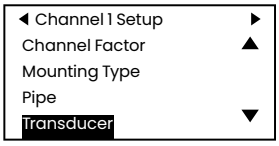
Use the [◁] or [▷] key to select a specific digit, then use the [△] or [▽] key to change that digit as required.

The available AT620 standard transducers are listed in *Table 6* below.

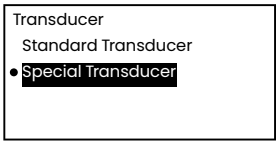
Table 6: Standard Wetted Transducer Types

Transducer number	Transducer type
40	WT-1/1P-10-00-NT
44	WT-1/1P-05-00-NT
71	PA-36-1P/WT-1/1P-10-00
72	PA-36-1P/WT-1/1P-10-00-HL
73	PA-PV-1P or F/WT-1/1P-10-EW
74	PA-36-1P-EW/WT-1/1P-10
75	PA-36-1P-EW/WT-1/1P-10-00-HL

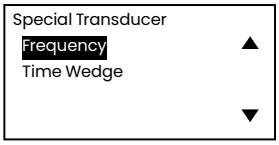
4.7.7.2 Entering a Special Transducer



Use [△] and [▽] to navigate setup menu and highlight Transducer. Then click [✓] to open following screen.

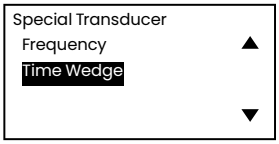


Highlight Special Transducer and press [✓] to open the following screen.

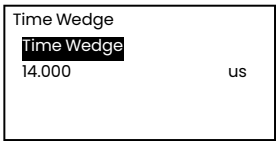


In the Special Transducer menu, select Frequency and press [✓]. The following screen opens.

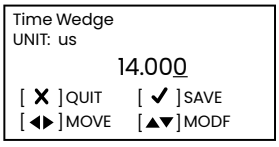
Using [△] or [▽], highlight the appropriate option and press [✓] twice to select and return to previous screen.



In the Special Transducer menu, select Time Wedge and press [✓]. The following screen opens.



In this information screen, click [✓] and a screen like the following will open.



Use the [◁] or [▷] key to select a specific digit, then use the [△] or [▽] key to change that digit as required.

4.7.8 Programming the Number of Traverses

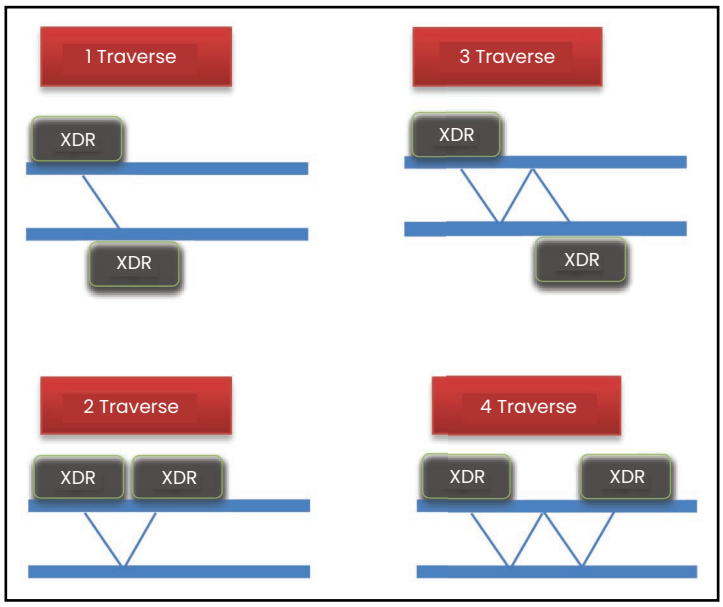
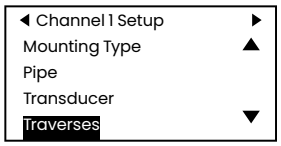
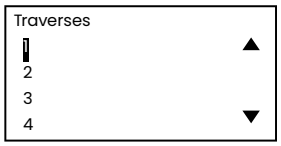


Figure 36: Examples of 1 to 4 Traverses



Select traverses and press [✓]. The following screen opens.



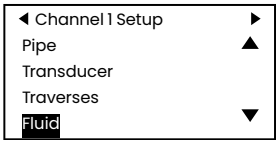
Select the appropriate option and press [✓] to return to the previous screen.

4.7.9 Programming the Fluid Properties

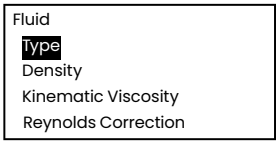
4.7.9.1 Programming the Fluid Type

If the fluid type is known, the meter performs flow rate calculations based on the programmed parameters for that fluid. However, if the fluid type is not known, you must activate the tracking windows function described below.

Relocating the transducers is not necessary.

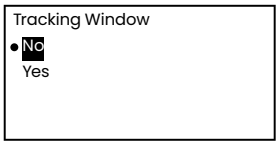


Select Fluid and press [✓]. The following screen opens.

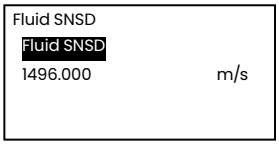


Select Type and press [✓]. The following screen opens.

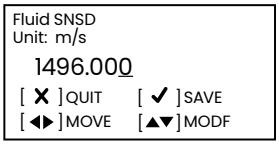
If the fluid type is water, select water and press [✓] to return to the previous screen. If the fluid is not water, select other and press [✓]. A screen similar to the following opens.



To disable the tracking window, select no and press [✓]. A screen similar to the following opens, so that you can enter the speed of sound (fluid SOS.) in your fluid. If you don't know your fluid SOS, you should enable the tracking window so that the meter can detect it automatically. If the tracking window is enabled, select Yes and press [✓]. A screen similar to the following opens. Enter the maximum SOS and minimum SOS.



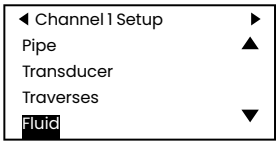
This is the screen that appears if tracking window is disabled. Press [✓] again, and a screen similar to the following opens.



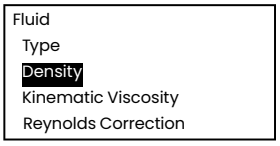
Use the [◁] or [▷] key to select a specific digit, then use the [△] or [▽] key to change that digit as required.

Note: *Fluid SOS, maximum SOS and minimum SOS are all programmed in the same manner.*

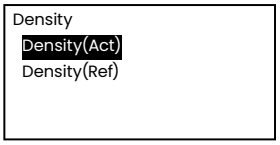
4.7.9.2 Programming the Fluid Density



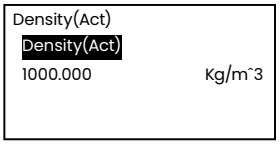
Select Fluid and press [✓]. The following screen opens.



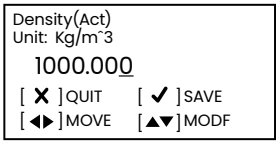
Select Density and press [✓]. The following screen opens.



Depending of the value you want to modify, select Density(Act) or Density(Ref), then press [✓] and the next information screen will open.



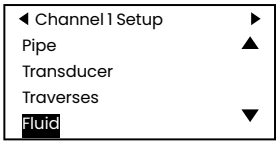
In this information screen, click [✓] and a screen like the following will open.



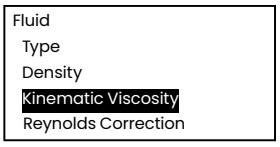
Use the [◁] or [▷] key to select a specific digit, then use the [△] or [▽] key to change that digit as required.

Note: *Both Density(Act) and Density(Ref) are programmed in the same manner*

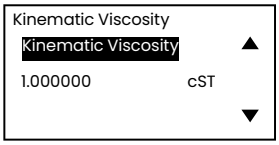
4.7.9.3 Programming the Kinematic Viscosity



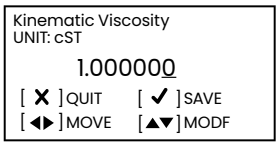
Select Fluid and press [✓]. The following screen opens.



Select Kinematic Viscosity and press [✓]. The following screen opens.

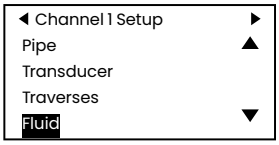


In this information screen, click [✓] and a screen like the following will open.

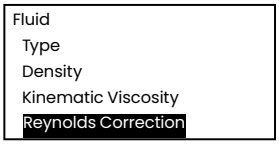


Use the [◁] or [▷] key to select a specific digit, then use the [△] or [▽] key to change that digit as required.

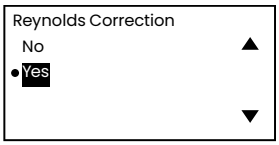
4.7.9.4 Programming the Reynolds Correction



Select Fluid and press [✓]. The following screen opens.

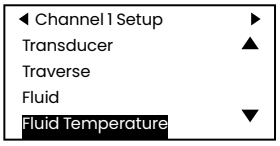


Select Reynolds Correction and press [✓]. The following screen opens.

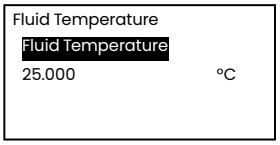


A new screen will prompt you to confirm if you want t use Reynolds Correction or not.

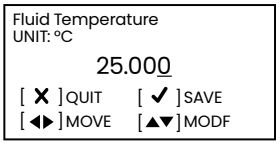
4.7.10 Programing the Fluid Temperature



Select fluid temperature in the sensor setup menu and press [✓]. The following screen opens.



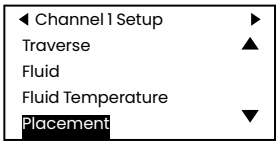
Press [✓] again, and a screen similar to the following opens



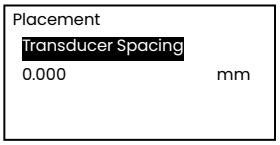
Use the [◁] or [▷] key to select a specific digit, then use the [△] or [▽] key to change that digit as required. After all digits are correct, press [✓] to save. Then, press [x] to return to the previous screen.

Note: *Because the meter calculations are based on customer inputs, the fluid temperature affects the speed of sound used during a measurement.*

4.7.11 Calculating the Path when Clamp-On is Selected

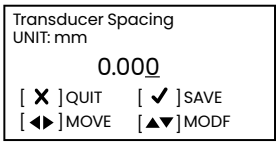


Select Placement and press [✓]. The following screen opens.



Press [✓] again. Record this calculated transducer spacing for use in installing your transducers on the pipe. The calculation is based on your sensor setup input (pipe, transducer, fluid, and traverses).

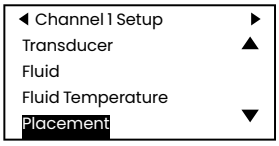
Note: *If setting the calculated spacing for your transducers is not possible, contact the factory for assistance. Only if instructed by the factory, press [✓] again, and a screen similar to the following opens.*



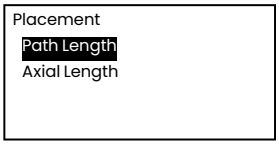
Use the [◁] or [▷] key to select a specific digit, then use the [△] or [▽] key to change that digit as required. After all digits are correct, press [✓] to save. Then, press [x] to return to the previous screen.

IMPORTANT: Changing the transducer spacing should only be completed according to instructions received from the factory.

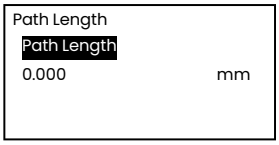
4.7.12 Enter the Path when Wetted is Selected



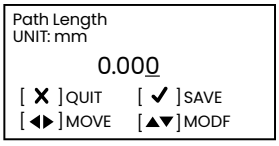
Select Placement and press [✓]. The following screen opens.



In the Placement menu, select path length or axial length and press [✓]. A screen similar to the following opens.



Press [✓] again. Enter this path use in installing your transducers on the pipe. The calculation is based on your sensor setup input (pipe, transducer, fluid, and traverses).

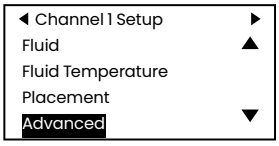


Use the [◁] or [▷] key to select a specific digit, then use the [△] or [▽] key to change that digit as required. After all digits are correct, press [✓] to save. Then, press [x] to return to the previous screen.

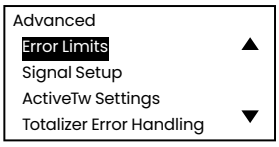
IMPORTANT: Changing the transducer spacing should only be completed according to instructions received from the factory.

4.7.13 Advanced

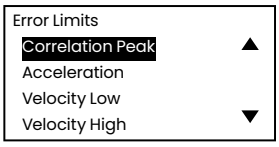
4.7.13.1 Programming Error Limits



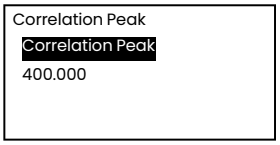
Select Advanced and press [✓]. The following screen opens



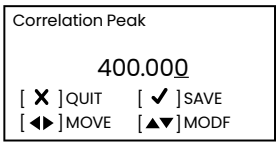
Use the [△] or [▽] key to select Error Limits and press [✓]. A screen similar to the following opens.



Use the [△] or [▽] key to select Correlation Peak and press [✓]. A screen similar to the following opens.



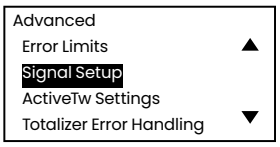
Press [✓]. A screen similar to the following opens.



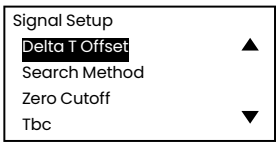
Use the [◁] or [▷] key to select a specific digit, then use the [△] or [▽] key to change that digit as required. After all digits are correct, press [✓] to save. Then, press [x] to return to the previous screen.

4.7.13.2 Programming Signal Setup

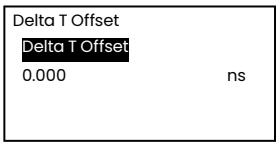
4.7.13.2.1 Delta T Offset



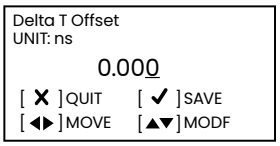
Use the [△] or [▽] key to select Signal Setup and press [✓]. A screen similar to the following opens.



Use the [△] or [▽] key to select DeltaT Offset and press [✓]. A screen similar to the following opens.

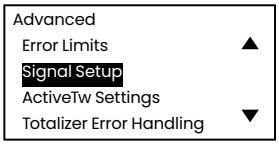


Press [✓]. A screen similar to the following opens.

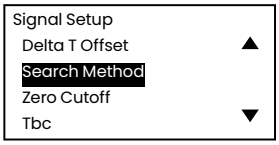


Use the [◁] or [▷] key to select a specific digit, then use the [△] or [▽] key to change that digit as required. After all digits are correct, press [✓] to save. Then, press [x] to return to the previous screen.

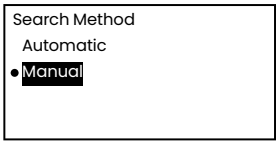
4.7.13.2.2 Search Method



Use the [△] or [▽] key to select Signal Setup and press [✓]. A screen similar to the following opens.

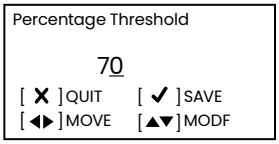


Use the [△] or [▽] key to select Search Method and press [✓]. A screen similar to the following opens.



Use the [△] or [▽] key to Manual Method and press [✓]. A screen similar to the following opens.

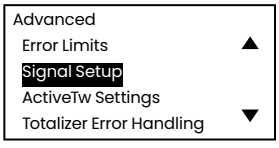
Press [✓]. A screen similar to the following opens.



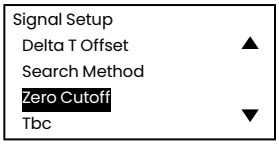
Use the [◁] or [▷] key to select a specific digit, then use the [△] or [▽] key to change that digit as required. After all digits are correct, press [✓] to save. Then, press [x] to return to the previous screen.

4.7.13.2.3 Zero Cutoff

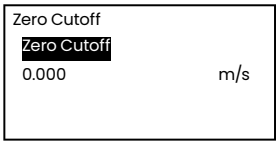
Near zero flow rate, the readings may fluctuate due to small offsets caused by thermal drift or similar factors. To force a zero-display reading when there is minimal flow, enter a zero cutoff value as described below.



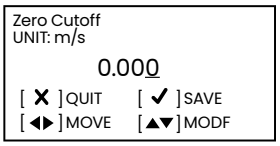
Select Signal Setup and press [✓]. The following screens open.



Select Zero Cutoff and press [✓]. The following screen opens.



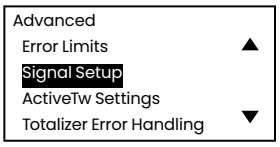
Press [✓] again, and a screen similar to the following opens.



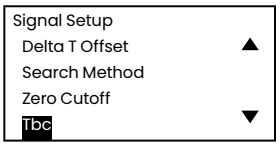
Use the [◁] or [▷] key to select a specific digit, then use the [△] or [▽] key to change that digit as required. After all digits are correct, press [✓] to save. Then, press [x] to return to the previous screen.

Note: *The units shown are the units selected in the units setting menu*

4.7.13.2.4 Tbc

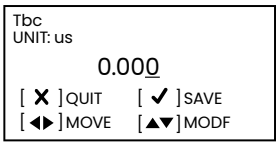


Use the [△] or [▽] key to select Signal Setup and press [✓]. A screen similar to the following opens.



Use the [△] or [▽] key to select Tbc and press [✓]. A screen similar to the following opens.

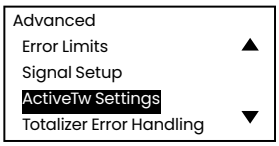
Press [✓]. A screen similar to the following opens.



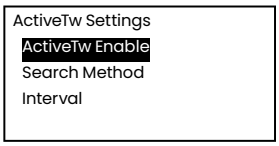
Use the [◁] or [▷] key to select a specific digit, then use the [△] or [▽] key to change that digit as required. After all digits are correct, press [✓] to save. Then, press [x] to return to the previous screen.

4.7.13.3 Active Tw Settings

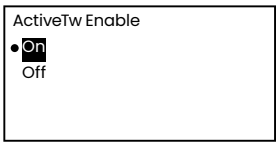
4.7.13.3.1 ActiveTw Enable



Use the [△] or [▽] key to select ActiveTw Settings and press [✓]. A screen similar to the following opens.

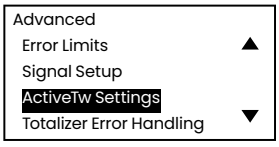


Use the [△] or [▽] key to select ActiveTw Enable and press [✓]. A screen similar to the following opens.

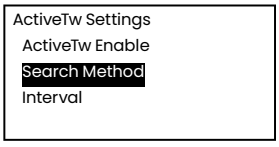


Use the [△] or [▽] key to select On and press [✓] to enable ActiveTw.

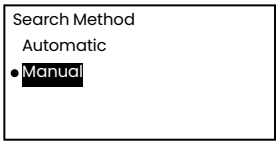
4.7.13.3.2 Search Method



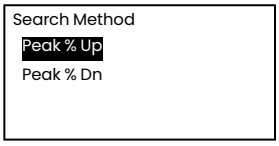
Use the [△] or [▽] key to select ActiveTw Settings and press [✓]. A screen similar to the following opens.



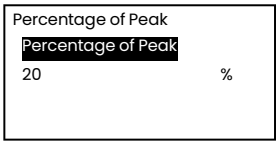
Use the [△] or [▽] key to select Search Method and press [✓]. A screen similar to the following opens.



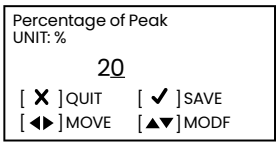
Use the [△] or [▽] key to select Manual and press [✓] to enable ActiveTw.



Use the [△] or [▽] key to select Peak % Up and press [✓] to enable ActiveTw.

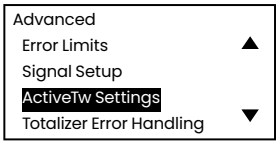


Press [✓]. A screen similar to the following opens.

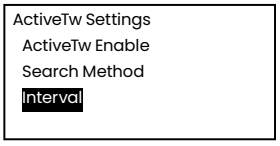


Use the [◁] or [▷] key to select a specific digit, then use the [△] or [▽] key to change that digit as required. After all digits are correct, press [✓] to save. Then, press [x] to return to the previous screen.

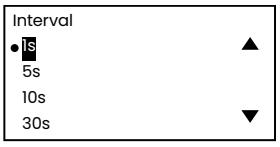
4.7.13.3.3 Interval



Use the [△] or [▽] key to select ActiveTw Settings and press [✓]. A screen similar to the following opens.

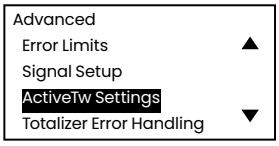


Use the [△] or [▽] key to select Interval and press [✓]. A screen similar to the following opens.

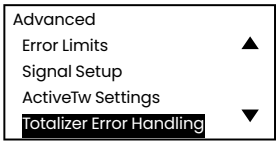


Use the [△] or [▽] key to select Interval time and press [✓].

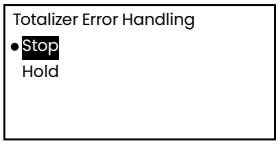
4.7.13.4 Totalizer Error Handling



Use the [△] or [▽] key to select ActiveTw Settings and press [✓]. A screen similar to the following opens.

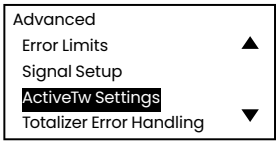


Use the [△] or [▽] key to select Totalizer Error Handling and press [✓]. A screen similar to the following opens.



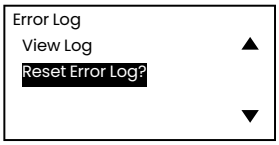
Use the [△] or [▽] key to select and press [✓].

4.7.13.5 Error Log

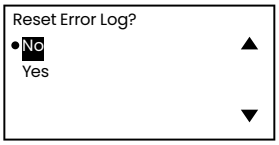


Use the [△] or [▽] key to select ActiveTw Settings and press [✓]. A screen similar to the following opens.

Use the [△] or [▽] key to select Error Log and press [✓]. A screen similar to the following opens.

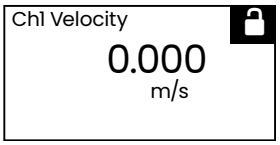


Use the [△] or [▽]key to select Reset Error Log and press [✓]. A screen similar to the following opens.



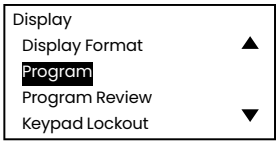
Use the [△] or [▽] key to select Error Log and press [✓].

4.8 Calibration

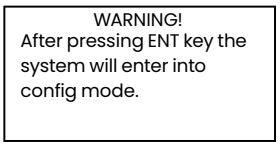


On the initial screen, use the arrow keys to highlight the lock symbol and press [✓].

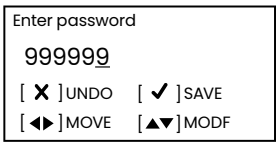
The following screen opens.



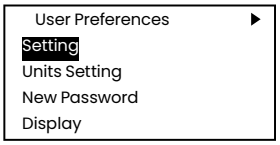
Use [△] and [▽] to navigate Display menu and highlight Program. Then click [✓] to enter warning screen.



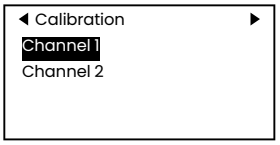
When Warning screen appears, simple press [✓] to proceed to password screen.



Use the [◁] or [▷] key to select a specific digit, then use the [△] and [▽] key to change that digit as required. After all digits are correct, press [✓] to open the user preference screen

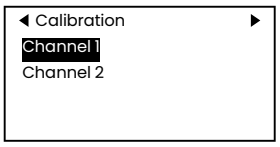


To check or change the desired settings, under user preference, select settings using [△] and [▽] then press [✓]. The following screen opens.

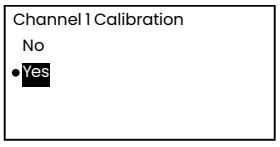


Using [△] and [▽] key to select Channel 1 then press [✓].

4.8.1 Type

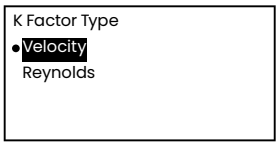


Select channel and press [✓]. The following screen opens.



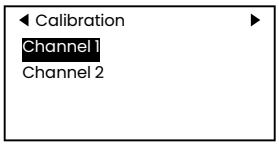
Select Yes and Press [✓]. The following screen opens.

Select Type and Press [✓]. The following screen opens.

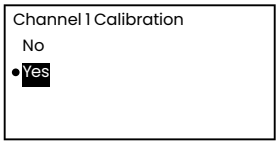


Select Velocity and Press [✓]. The following screen opens.

4.8.2 Static



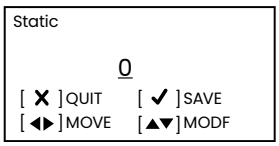
Select channel and press [✓]. The following screen opens.



Select Yes and Press [✓]. The following screen opens.

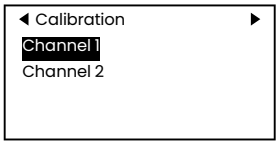
Select Static and Press [✓]. The following screen opens.

Press [✓]. The following screen opens.

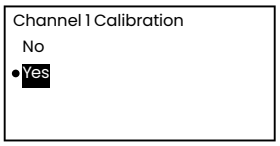


Use the [◁] or [▷] key to select a specific digit, then use the [△] or [▽] key to change that digit as required.

4.8.3 Points

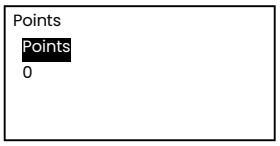


Select channel and press [✓]. The following screen opens.

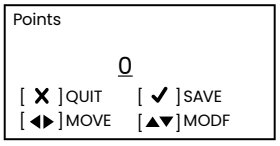


Select Yes and press [✓]. The following screen opens.

Select Points and press [✓]. The following screen opens.

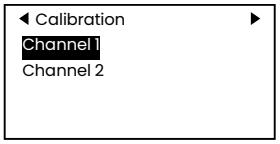


Press [✓]. The following screen opens.

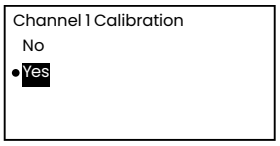


Use the [◁] or [▷] key to select a specific digit, then use the [△] or [▽] key to change that digit as required.

4.8.4 Table

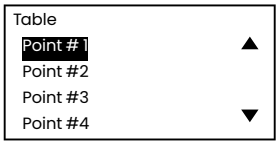


Select channel and press [✓]. The following screen opens.

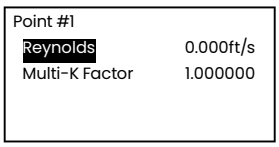


Select Yes and press [✓]. The following screen opens.

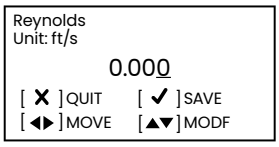
Select Table and press [✓]. The following screen opens.



Select Point number and press [✓]. The following screen opens.

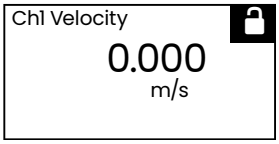


Select and press [✓]. The following screen opens.



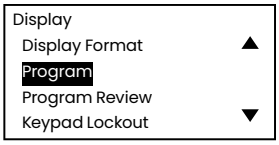
Use the [◁] or [▷] key to select a specific digit, then use the [△] or [▽] key to change that digit as required.

4.9 Meter Information

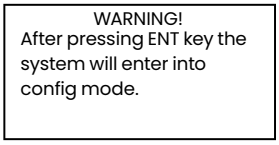


On the initial screen, use the arrow keys to highlight the lock symbol and press [✓].

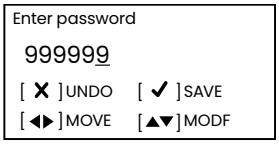
The following screen opens.



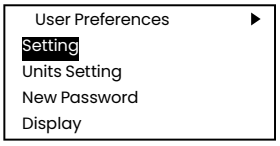
Use [△] or [▽] to navigate Display menu and highlight Program. Then click [✓] to enter warning screen.



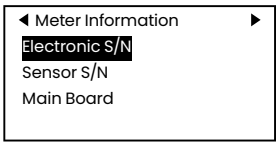
When Warning screen appears, simple press [✓] to proceed to password screen.



Use the [◁] or [▷] key to select a specific digit, then use the [△] or [▽] key to change that digit as required. After all digits are correct, press [✓] to open the user preference screen

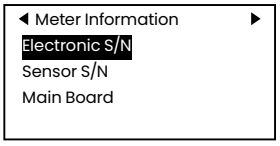


Once inside the program menu, use [▷] key twice to go to Channel 1 Setup and thrice to Channel 2 Setup menu.

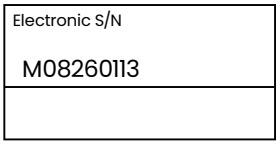


Use [△] and [▽] to select Electronic S/N and press [✓].

4.9.1 Electronic S/N

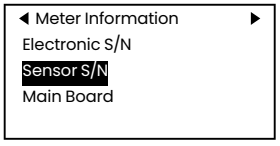


Use [△] and [▽] to select Electronic S/N and press [✓].

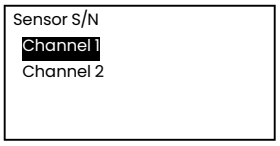


Electronic S/N is displayed

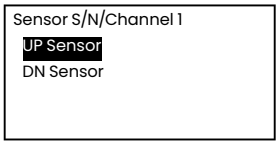
4.9.2 Sensor S/N



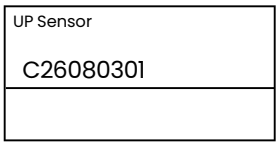
Use [△] and [▽] to select Sensor S/N and press [✓].



Use [△] and [▽] to select channel and press [✓].

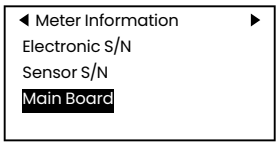


Use [△] and [▽] to select sensor and press [✓].

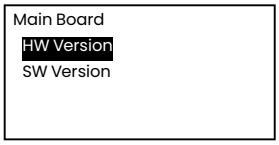


Sensor S/N s displayed

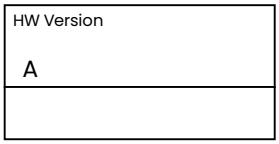
4.9.3 Main Board



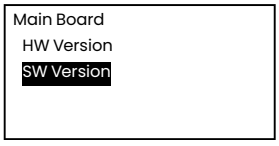
Use [△] and [▽] to select Main Board and press [✓].



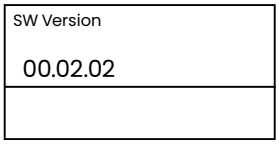
Use [△] and [▽] to select HW Version and press [✓].



HW Version is displayed.

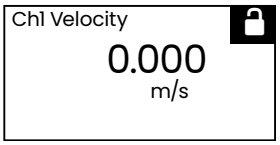


Use [△] and [▽] to select SW Version and press [✓].

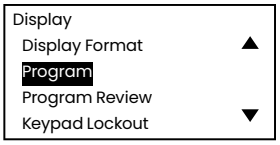


SW Version is displayed.

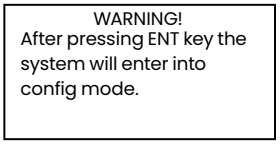
4.10 Factory



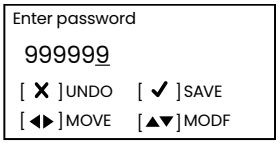
To enter the programming menu, on the display use [◁] and [▷] to highlight padlock icon and press [✓]. The following screen opens.



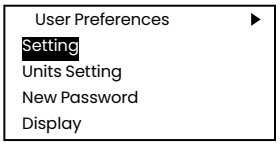
Use [△] and [▽] to navigate Display menu and highlight Program. Then click [✓] to enter warning screen.



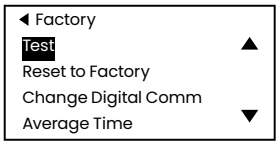
When Warning screen appears, simple press [✓] to proceed to password screen.



Use the [◁] or [▷] key to select a specific digit, then use the [△] or [▽] key to change that digit as required. After all digits are correct, press [✓] to open the user preference screen.



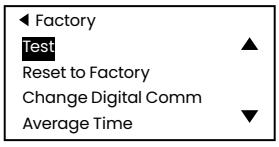
Once inside the program menu, use [▷] key twice to go to Test and thrice to Channel 2 Setup menu.



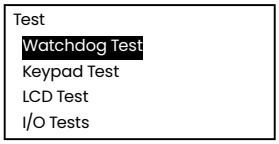
Use [△] and [▽] to select Test and press [✓].

4.10.1 Test

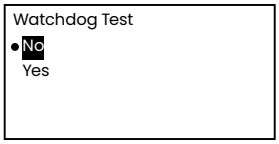
4.10.1.1 Watchdog Test



Use [△] and [▽] to select Test and press [✓].

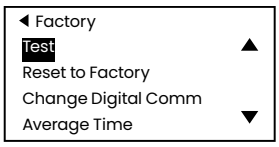


Use [△] and [▽] to select Watchdog Test and press [✓].

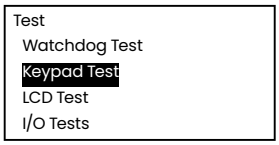


Use [△] and [▽] to select and press [✓].

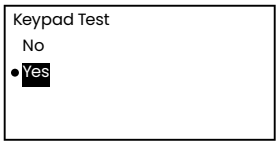
4.10.1.2 Keypad Test



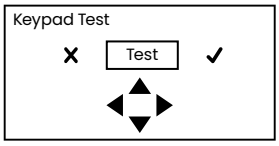
Use [△] and [▽] to select Test and press [✓].



Use [△] and [▽] to select Keypad Test and press [✓].

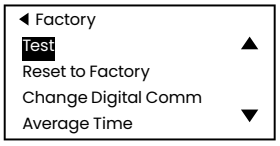


Use [△] and [▽] to select and press [✓].

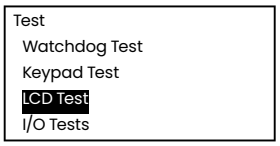


Use [△] and [▽] to select and test.

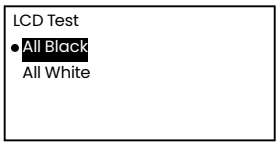
4.10.1.3 LCD Test



Use [△] and [▽] to select Test and press [✓].



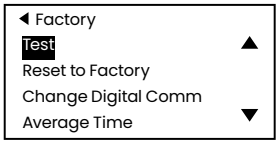
Use [△] and [▽] to select LCD Test and press [✓].



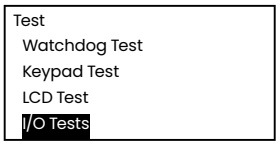
Use [△] and [▽] to select and press [✓].

4.10.1.4 I/O Tests

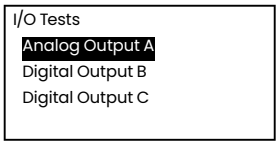
4.10.1.4.1 Analog Output



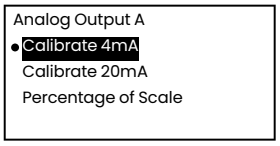
Use [△] and [▽] to select Test and press [✓].



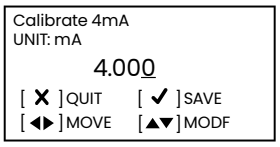
Use [△] and [▽] to select I/O Test and press [✓].



Use [△] and [▽]to select Analog Output A and press [✓].

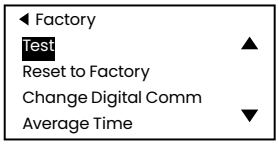


Use [△] and [▽] to select and press [✓].



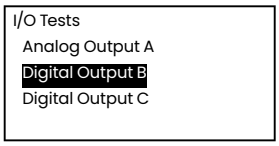
Use the [◁] or [▷] key to select a specific digit, then use the [△] or [▽] key to change that digit as required.

4.10.1.4.2 Digital Output

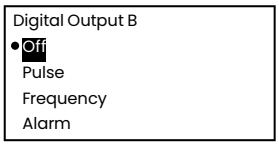


Use [△] and [▽] to select Test and press [✓].

Use [△] and [▽] to select I/O Test and press [✓].

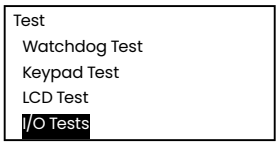


Use [△] and [▽] to select Digital Output B and press [✓].

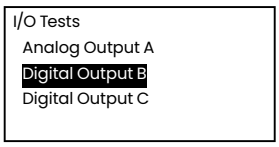


Use [△] and [▽] to select and press [✓].

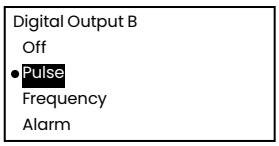
Pulse



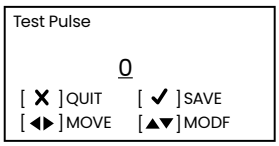
Use [△] and [▽] to select Test I/O and press [✓].



Use [△] and [▽] to select Digital Output B and press [✓].



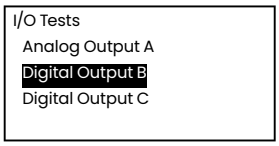
Use [△] and [▽] to select Pulse and press [✓].



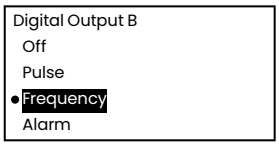
Use the [◁] or [▷] key to select a specific digit, then use the [△] or [▽] key to change that digit as required, then press [✓] to test.

Frequency

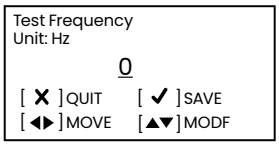
Use [△] and [▽] to select Test I/O and press [✓].



Use [△] and [▽] to select Digital Output B and press [✓].



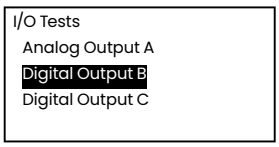
Use [△] and [▽] to select Frequency and press [✓].



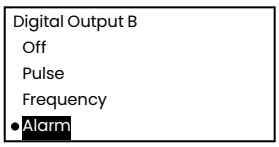
Use the [◁] or [▷] key to select a specific digit, then use the [△] or [▽] key to change that digit as required, then press [✓] to test.

Alarm

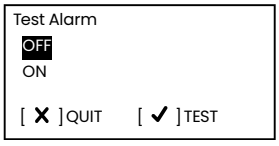
Use [△] and [▽] to select Test I/O and press [✓].



Use [△] and [▽] to select Digital Output B and press [✓].

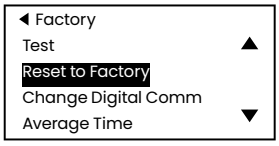


Use [△] and [▽] to select Alarm and press [✓].

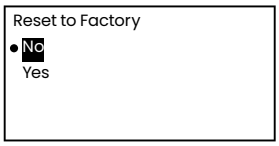


Use the [◁] or [▷] key to select then press [✓] to test.

4.10.2 Reset to Factory

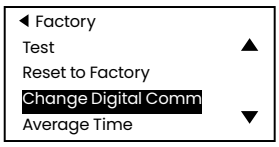


Use [△] and [▽] to select Reset to Factory and press [✓].

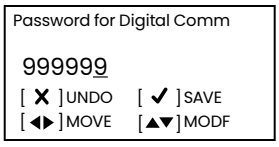


Use [△] and [▽] to select and press [✓].

4.10.3 Change Digital Comm



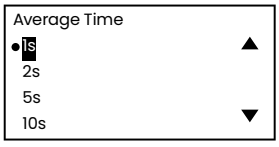
Use [△] and [▽] to select Reset to Factory and press [✓].



Use the [◁] or [▷] key to select a specific digit, then use the [△] or [▽] key to change that digit as required. After all digits are correct, press [✓] to open the user preference screen.

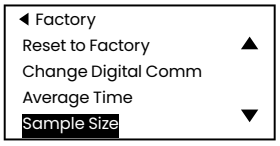
4.10.4 Average Time

Use [△] and [▽] to select Average Time to Factory and press [✓].

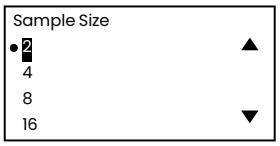


Use the [△] or [▽] key to change and press [✓].

4.10.5 Sample Size



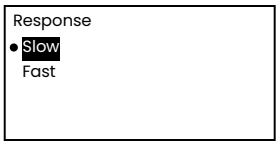
Use [△] and [▽] to select Sample Size and press [✓].



Use the [△] or [▽] key to change and press [✓].

4.10.6 Response

Use [△] and [▽] to select Response and press [✓].



Use the [△] or [▽] key to change and press [✓].

Chapter 5. Error Codes and Troubleshooting

5.1 Error Display in the User Interface

The bottom line of the LCD displays a single, top priority error message during operation. This line, called the error line, includes two parts: error header and error string. The error header indicates the error pattern and error number, while the error string gives a detailed description of the error information.

5.1.1 Error Header

Error pattern	Error header
Flow error	Cn-Em (n is channel number, and n is error number)
Device error	Dn (n is error number)
Warning	Sn (n is error number)

5.1.2 Flow Error String

Flow errors are errors that occur during a flow measurement. These errors can be caused by disturbances in the fluid, such as excessive particles in the flow stream or extreme temperature gradients. The errors could also be caused by an empty pipe or other such issue. Flow errors are typically not caused by a malfunction of the flow measurement device, but by a problem with the fluid itself or with the process piping.

Option Bar	Description	Good	Bad
Tup	Displays the upstream ultrasonic signal transit time.	NA	NA
Tdn	Displays the downstream ultrasonic signal transit time.	NA	NA
DeltaT	Displays the transit time difference between the upstream and downstream signals.	NA	NA
Up signal quality	Displays the signal quality for the upstream transducer.	≥1200	<400
Dn signal quality	Displays the signal quality for the downstream transducer.	≥1200	<400
Up amp disc	Displays the value for the signal amplitude of the upstream transducer.	24±5	<19 or >29
Dn amp disc	Displays the value for the signal amplitude of the downstream transducer.	24±5	<19 or >29
SNR up	Display the value for the signal-to-noise of the upstream signal.	≥4	<4
SNR Dn	Display the value for the signal-to-noise of the downstream signal.	≥4	<4
Gain up	Display the value for the gain of the upstream transducer.	9-85	<9 or >85
Gain Dn	Display the value for the gain of the downstream transducer.	9-85	<9 or >85
Up peak	Displays the first value in the upstream correlation signal, which is more than the positive threshold or is less than the negative threshold.	NA	NA
Dn peak	Displays the first value in the downstream correlation signal, which is more than the positive threshold or is less than the negative threshold.	NA	NA
PeakPctUp	Displays the percentage of peak of the upstream signal.	NA	NA
PeakPctDn	Displays the percentage of peak of the downstream signal.	NA	NA

5.1.2.1 C1/2-E1: Low Signal

Problem: Poor ultrasonic signal strength or the signal exceeds the programmed limit.

Cause: When the SNR is less that the value of signal low limit or the signal cannot be found when the flow is started, the low signal error is displayed. Poor signal strength may be caused by a defective cable, a flowcell problem, a defective transducer or a problem in the electronics console. A signal that exceeds the programmed limits is probably caused by the entry of an improper value in the menu program > advanced > error limits > signal low limits.

Action: Refer to *"Diagnostics" on page 95*. Also, check the programmed value in the program > advanced > error limits> signal low limit menu.

5.1.2.2 C1/2-E2: Sound Speed Error

Problem: The sound speed exceeds the limit programmed in the program > advanced > error limits> SNSD+- limit menu.

Cause: When the measured sound speed exceeds the programmed sound speed limit, this error is displayed. The error may result from incorrect programming, poor flow conditions, and/or poor transducer orientation.

Action: Correct the programming errors. Refer to *"Diagnostics" on page 95*, to correct the flowcell and/or transducer problems. Also, check the value programmed in the program > advanced > error limits SNSD +- limit menu.

5.1.2.3 C1/2-E3: Velocity Range

Problem: The velocity exceeds the limits programmed in the program > advanced > error limits velocity low/high menu.

Cause: When the measured velocity exceeds the programmed velocity limit, this error is displayed. The error may be caused by improper programming, poor flow conditions, and/or excessive flow turbulence.

Action: Make sure the actual flow rate is within the programmed limits. Also, check the value programmed in the program > advanced > error limits > velocity low/high menu. Refer to *"Diagnostics" on page 95*, to correct the flowcell and/or transducer problems.

5.1.2.4 C1/2-E4: Signal Quality

Problem: The signal quality is outside the limits programmed in the program > advanced > error limits correlation peak menu.

Cause: The peak of the upstream or downstream correlation signals has fallen below the correlation peak limit programmed in the program > advanced > error limits > correlation peak menu. This may be caused by a flowcell or electrical problem.

Action: Check for sources of electrical interference and verify the integrity of the electronics console by temporarily substituting a test flowcell that is known to be good. Check the transducers and relocate them, if necessary. See *"Diagnostics" on page 95*, for instructions.

5.1.2.5 C1/2-E5: Amplitude Error

Problem: The signal amplitude exceeds the limits programmed in the program > advanced > error limits amp disc min/max menu.

Cause: Solid or liquid particulates may be present in the flowcell. Also, poor coupling for the clamp-on transducers can cause this problem.

Action: Refer to *"Diagnostics" on page 95*, to correct any flowcell problems.

5.1.2.6 C1/2-E6: Cycle Skip

Problem: The fluid acceleration exceeds the limits programmed in the program > advanced > error limits acceleration menu.

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

Action: Refer to *"Diagnostics" on page 95*, to correct any flowcell and/or transducer problems.

5.2 Diagnostics

5.2.1 Introduction

This section explains how to troubleshoot the AT620 if problems arise with the electronics enclosure, the flowcell, or the transducers. Indications of a possible problem include:

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

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

5.2.2 Flowcell Problems

If preliminary troubleshooting of an error code display indicates a possible flowcell problem, proceed with this section. Flowcell problems fall into two categories: fluid problems or pipe problems. Read the following sections carefully to determine if the problem is indeed related to the flowcell. If the instructions in this section fail to resolve the problem, contact Panametrics for assistance.

5.2.2.1 Fluid Problems

Most fluid-related problems result from a failure to observe the flow meter system installation instructions. Refer to *Chapter 2, Clamp-on Fixture and Transducer Installation,* to correct any installation problems.

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

- The fluid must be homogeneous, single-phase, relatively clean and flowing steadily.

5.2.2.2 Pipe Problems

Pipe-related problems may result either from a failure to observe the installation instructions, as described in *Chapter 2, Clamp-on Fixture and Transducer Installation,* or from improper programming of the meter. By far, the most common pipe problems are the following:

- The collection of material at the transducer location(s).
  - Accumulated debris at the transducer location(s) will interfere with transmission of the ultrasound signals. As a result, accurate flow rate measurements are not possible. Realignment of the flowcell or transducers often cures such problems, and in some cases, transducers that protrude into the flow stream may be used. Refer to *Chapter 2, Clamp-on Fixture and Transducer Installation,* for more details on proper installation practices.
- Inaccurate pipe measurements.
  - The accuracy of the flow rate measurements is no better than the accuracy of the programmed pipe dimensions. For a flowcell supplied by Panametrics, the correct data will be included in the documentation. For other flowcells, measure the pipe wall thickness and diameter with the same accuracy desired in the flow rate readings. Also, check the pipe for dents, eccentricity, weld deformity, straightness and other factors that may cause inaccurate readings. Refer to *Chapter 4, Initial Setup and Programming,* for instructions on

programming the pipe data. In addition to the actual pipe dimensions, the path length (P) and the axial dimension (L), based on the actual transducer mounting locations, must be accurately programmed into the flow meter. For a Panametrics flowcell, this data will be included with the documentation for the system. If the transducers are mounted onto an existing pipe, these dimensions must be precisely measured.

- The inside of the pipe or flowcell must be relatively clean.
  - Excessive buildup of scale, rust or debris will interfere with flow rate measurement. Generally, a thin coating or a solid well-adhered build up on the pipe wall will not cause problems. Loose scale and thick coatings (such as tar or oil) will interfere with ultrasound transmission and may result in incorrect or unreliable measurements.

5.2.2.3 Multi-Pipe Multi-Path Problems

In addition to the Pipe Problems described in *Section 5.2.2.2*, in the multi-pipe multi-path configurations, the problems may be related to the following:

- The transducer cables are incorrectly connected
  - There are four connectors at the meter side, and four connectors at the transducers side. Make sure the upstream and downstream cables for each channel are correctly connected.
- The channel factors are incorrectly entered for Composite measurement
  - The composite measurement value is the sum of the corresponding channel-wise values weighted by the channel factors. The sum of the two channel factors should be equal to 1 (one). Incorrect setting of the channel factors will make the composite measurements be inconsistent with the channel-wise measurements.

Chapter 6. Communication

6.1 MODBUS

6.1.1 Introduction

The AT620 flow meter generally follows the standard MODBUS communications protocol defined by the MODBUS APPLICATION PROTOCOL SPECIFICATION V1.1b, which is available at www.modbus.org. With this reference as a guide, an operator can use any MODBUS master to communicate with the AT620 flow meter.

For the AT620, there are two limits of this implementation:

1. The AT620 supports only four of the standard function codes. These are read holding registers (0x03), read input registers (0x04), write multiple registers (0x10), and read file record (0x14).
2. The AT620 needs a 15 ms gap between Modbus requests. The prime objective of the flow meter is to measure flow and drive the output, so the Modbus server has a low priority.

6.1.2 AT620 MODBUS Register Map

Table 7: MODBUS Register Map

	Register (in hex)	Register (in decimal)	Access level	Description	RO/RW	Format
100	100	256	User	Product short tag	RW	CHAR * 16
	108	264	User	Product long tag	RW	CHAR * 32
	118	280	User	Product message (for HART)	RW	CHAR * 32
	128	296	User	Product descriptor (for HART)	RW	CHAR * 16
140	140	320	User	Product electronic serial number	RW	CHAR * 16
	150	336	User	Product transducer 1 serial number	RW	CHAR * 16
	158	344	User	Product transducer 2 serial number	RW	CHAR * 16
	168	360	User	Product transducer 1 serial number	RW	CHAR * 16
	170	368	User	Product transducer2 serial number	RW	CHAR * 16
300	300	768	RO	Main hardware version	RO	CHAR * 8
	308	772	RO	Main software version	RO	CHAR * 8
	318	792	RO	Meter Identification	RO	CHAR * 8
500	500	1280	User	Global unit group 1 for actual volumetric	RW	INT32
	502	1282	User	Global unit group 2 for day	RW	INT32
	504	1284	User	Global unit group 3 for dB	RW	INT32
	506	1286	User	Global unit group 4 for density	RW	INT32
	508	1288	User	Global unit group 5 for dimension	RW	INT32
	50A	1290	User	Global unit group 6 for Hz	RW	INT32
	50C	1292	User	Global unit group 7 for viscosity	RW	INT32
	50E	1294	User	Global unit group 8 for mA	RW	INT32
	510	1296	User	Global unit group 9 for mass	RW	INT32
	512	1298	User	Global unit group 10 for milli second	RW	INT32
	514	1300	User	Global unit group 11 for nano second	RW	INT32
	516	1302	User	Global unit group 12 for percent	RW	INT32
	518	1304	User	Global unit group 13 for second	RW	INT32
	51A	1306	User	Global unit group 14 for standard volumetric	RW	INT32

Table 7: MODBUS Register Map(Continued)

	Register (in hex)	Register (in decimal)	Access level	Description	RO/RW	Format
500	51C	1308	User	Global unit group 15 for thermo	RW	INT32
	51E	1310	Viewer	Global unit group 16 for totalizer time	RW	INT32
	520	1312	User	Global unit group 17 for totalizer	RW	INT32
	522	1314	User	Global unit group 18 for unitless	RW	INT32
	524	1316	User	Global unit group 19 for micro second	RW	INT32
	526	1318	User	Global unit group 20 for velocity	RW	INT32
	528	1320	User	Global unit group 21 for acceleration	RW	INT32
	52A	1322	User	Global Unit group for CP	RW	INT32
	52C	1324	User	Global Unit group for Energy	RW	INT32
	52E	1326	User	Angle Degree	RW	INT32
	530	1328	User	Global Unit group for Power	RW	INT32
	534	1332	User	Communication mode: TBD	RW	INT32
	536	1334	User	Global Unit group 17 for Totalizer	RW	INT32
	538	1336	User	Global Unit group 17 for Totalizer	RW	INT32
540	540	1344	Viewer	Batch request command	RW	INT32
	544	1348	Viewer	System request password	RW	INT32
	546	1350	Viewer	System request command	RW	INT32
	548	1352	Viewer	System update command	RW	INT32
	54A	1354	Viewer	System test automation command	RW	INT32
700	700	1792	RO	System reported error	RO	INT32
	702	1794	RO	System error bitmap	RO	INT32
	704	1796	RO	System startup error bitmap	RO	INT32
	706	1798	RO	System startup error bitmap	RO	INT32
	708	1800	RO	System startup error bitmap	RO	INT32
	70A	1802	RO	System warning bitmap	RO	INT32
	710	1808	RO	System Flow Ch2 error Bitmap	RO	INT32
740	740	1856	RO	System protocol type	RO	INT32
	750	1872	Viewer	System Totalizer Status	RW	INT32
	780	1920	RO	Meter Identification	RO	INT32
900	900	2304	Viewer	Display language	RW	INT32
	90A	2314	Viewer	Display variable 2 type	RW	INT32
	90C	2316	Viewer	Display totalizer 1 type	RW	INT32
	90E	2318	Viewer	Display totalizer 2 type	RW	INT32
	910	2320	Viewer	Display decimal selection	RW	INT32
	912	2322	Viewer	Display Variable 2 Decimal selection	RW	INT32
	914	2324	Viewer	Display Totalizer 1 Decimal selection	RW	INT32
	916	2326	Viewer	Display Totalizer 2 Decimal selection	RW	INT32
940	940	2368	User	Select the velocity	RW	INT32
	942	2370	User	Select the actual volumetric	RW	INT32
	944	2372	User	Select the standardized volumetric	RW	INT32

Table 7: MODBUS Register Map(Continued)

	Register (in hex)	Register (in decimal)	Access level	Description	RO/RW	Format
940	946	2374	User	Select mass	RW	INT32
	948	2376	User	Select totalizer	RW	INT32
	94A	2378	User	Select Power	RW	INT32
	94C	2380	User	Select Energy	RW	INT32
	94E	2382	User	Select Temperature	RW	INT32
A00	A00	2560	RO	Display variable 1 value	RO	(IEEE 32 bit)
	A02	2562	RO	Display variable 2 value	RO	(IEEE 32 bit)
	A04	2564	RO	Display totalizer 1 value	RO	(IEEE 32 bit)
	A06	2566	RO	Display totalizer 2 value	RO	(IEEE 32 bit)
C00	C00	3072	User	Analog out error handling value	RW	(IEEE 32 bit)
	C02	3074	User	Analog out test value (percent of span)	RW	(IEEE 32 bit)
	C04	3076	User	Analog out zero value	RW	(IEEE 32 bit)
	C06	3078	User	Analog out Span value	RW	(IEEE 32 bit)
	C08	3080	User	Analog out base value	RW	(IEEE 32 bit)
	C0A	3082	User	Analog out full value	RW	(IEEE 32 bit)
C40	C40	3136	User	Digital out 1 pulse value	RW	(IEEE 32 bit)
	C42	3138	User	Digital out 1 frequency base value	RW	(IEEE 32 bit)
	C44	3140	User	Digital out 1 frequency full value	RW	(IEEE 32 bit)
	C46	3142	User	Digital out 1 alarm value	RW	(IEEE 32 bit)
C80	C80	3200	User	Digital out 2 pulse value	RW	(IEEE 32 bit)
	C82	3202	User	Digital out 2 frequency base value	RW	(IEEE 32 bit)
	C84	3204	User	Digital out 2 frequency full value	RW	(IEEE 32 bit)
	C86	3206	User	Digital out 2 alarm value	RW	(IEEE 32 bit)
D00	D00	3328	User	Analog out mode	RW	(IEEE 32 bit)
	D02	3330	User	Analog out type	RW	(IEEE 32 bit)
	D04	3332	User	Digital out 1 mode	RW	(IEEE 32 bit)
	D06	3334	User	Digital out 1 type	RW	(IEEE 32 bit)
	D08	3336	User	Digital out 2 mode	RW	(IEEE 32 bit)
	D0A	3338	User	Digital out 2 type	RW	(IEEE 32 bit)
D20	D20	3360	User	Analog out measurement type	RW	INT32
	D22	3362	User	Analog out error handling	RW	INT32
D30	D30	3376	User	Digital Out 1 Alarm Latch	RW	INT32
	D32	3378	User	Digital Out 2 Alarm Latch	RW	INT32
	D34	3380	User	Digital Out 1/2 Alarm Latch Clear	RW	INT32
D40	D40	3392	User	Digital out 1 pulse measurement type	RW	INT32
	D42	3394	User	Digital out 1 pulse test value	RW	INT32
	D46	3398	User	Digital out 1 pulse time	RW	INT32
	D48	3400	User	Digital Out 1 Pulse Duty	RW	INT32

Table 7: MODBUS Register Map(Continued)

	Register (in hex)	Register (in decimal)	Access level	Description	RO/RW	Format
D50	D50	3408	User	Digital out 2 pulse measurement type	RW	INT32
	D52	3410	User	Digital out 2 pulse test value	RW	INT32
	D56	3414	User	Digital out 2 pulse time	RW	INT32
	D58	3416	User	Digital Out 2 Pulse Duty	RW	INT32
D60	D60	3424	User	Digital out 1 frequency measurement type	RW	INT32
	D62	3426	User	Digital out 1 test frequency value	RW	INT32
	D64	3428	User	Digital out 1 frequency error handling	RW	INT32
	D66	3430	User	Digital out 1 frequency error handling value	RW	INT32
	D68	3432	User	Digital out 1 frequency full frequency	RW	INT32
D70	D70	3440	User	Digital out 2 frequency measurement type	RW	INT32
	D72	3442	User	Digital out 2 test frequency value	RW	INT32
	D74	3444	User	Digital out 2 frequency error handling	RW	INT32
	D76	3446	User	Digital out 2 frequency error handling value	RW	INT32
	D78	3448	User	Digital out 2 frequency full frequency	RW	INT32
D80	D80	3456	User	Digital out 1 alarm measurement type	RW	INT32
	D82	3458	User	Digital out 1 alarm measurement type	RW	INT32
	D84	3460	User	Digital out 1 alarm state	RW	INT32
	D96	3478	User	Digital out 2 alarm type	RW	INT32
D90	D90	3472	User	Digital out 2 alarm measurement type	RW	INT32
	D92	3474	User	Digital out 2 alarm test value	RW	INT32
	D94	3476	User	Digital out 2 alarm state	RW	INT32
	D96	3478	User	Digital out 2 alarm type	RW	INT32
E00	E00	3584	RO	Analog out measurement value	RO	(IEEE 32 bit)
	E02	3586	RO	Digital out 1 pulse measurement value	RO	(IEEE 32 bit)
	E04	3588	RO	Digital out 1 frequency measurement value	RO	(IEEE 32 bit)
	E06	3590	RO	Digital out 1 alarm measurement value	RO	(IEEE 32 bit)
	E08	3592	RO	Digital out 2 pulse measurement value	RO	(IEEE 32 bit)
	E0A	3594	RO	Digital out 2 frequency measurement value	RO	(IEEE 32 bit)
	E0C	3596	RO	Digital out 2 alarm measurement value	RO	(IEEE 32 bit)
1100	1100	4352	Viewer	HART meter address	RW	INT32
	1102	4354	Viewer	HART preamble length	RW	INT32
	1104	4356	Viewer	HART device ID	RW	INT32
	1106	4358	Viewer	HART assembly number	RW	INT32
1140	1140	4416	Viewer	HART dynamic variable index_1	RW	INT32
	1142	4418	Viewer	HART dynamic variable index_2	RW	INT32
	1144	4420	Viewer	HART dynamic variable index_3	RW	INT32
	1146	4422	Viewer	HART dynamic variable index_4	RW	INT32

Table 7: MODBUS Register Map(Continued)

	Register (in hex)	Register (in decimal)	Access level	Description	RO/RW	Format
1300	1300	4864	RO	HART configuration change count	RO	INT32
	1302	4866	RO	HART device status	RO	INT32
	1304	4868	RO	HART device status extended	RO	INT32
	1306	4870	RO	HART master status	RO	INT32
	1308	4872	RO	HART secondary status	RO	INT32
	130A	4874	RO	HART variable status	RO	INT32
1500	1500	5376	User	PC MODBUS baud rate	RW	INT32
	1502	5378	User	PC MODBUS parity	RW	INT32
	1504	5380	User	PC MODBUS stop bits	RW	INT32
	1506	5382	User	PC MODBUS meter address	RW	INT32
1540	1540	5440	User	Log control/status	RW	INT32
	1542	5442	User	Log interval	RW	INT32
	1544	5444	User	Logging time	RW	INT32
	1546	5446	User	Number of variables to log	RW	INT32
1580	1580	5504	User	Variable address array	RW	INT32
15C0	15C0	5568	User	Variable unit code array	RW	INT32
1700	1700	5888	RO	PC service baud rate	RO	INT32
	1702	5890	RO	PC service parity	RO	INT32
	1704	5892	RO	PC service stop bits	RO	INT32
	1706	5894	RO	PC service meter address	RO	INT32
1740	1740	5952	RO	Number of records	RO	INT32
2000	2000	8192	User	Channel 1 composite factor	RW	(IEEE 32 bit)
	2002	8194	User	Channel 2 composite factor	RW	(IEEE 32 bit)
20C0	20C0	8384	User	Correlation peak low limit	RW	(IEEE 32 bit)
	20C2	8386	User	Acceleration Limit	RW	(IEEE 32 bit)
	20C8	8392	User	Amplitude discriminator min limit	RW	(IEEE 32 bit)
	20CA	8394	User	Amplitude discriminator max limit	RW	(IEEE 32 bit)
	20CC	8396	User	Soundspeed Plus minus limit	RW	(IEEE 32 bit)
	20CE	8398	User	Signal low limit	RW	(IEEE 32 bit)
	20D0	8400	User	Pcr	RW	(IEEE 32 bit)
	20D2	8402	User	SOSVariationRate	RW	(IEEE 32 bit)
	20D4	8404	User	The maximum threshold	RW	(IEEE 32 bit)
	20D6	8406	User	The minimum threshold	RW	(IEEE 32 bit)
2100	2100	8448	User	Enable Ch1	RW	INT32
	2102	8450	User	Enable Ch2	RW	INT32
	2104	8452	Viewer	ImpulseResponse	RW	INT32
	2106	8454	Viewer	ImpulseRespCmd	RW	INT32
	210C	8460	User	Channel 1 Totalizer Error Handling	RW	INT32
	210E	8462	User	Channel 2 Totalizer Error Handling	RW	INT32

Table 7: MODBUS Register Map(Continued)

	Register (in hex)	Register (in decimal)	Access level	Description	RO/RW	Format
21C0	21C0	8640	User	Average Time	RW	INT32
	21C2	8642	User	Response	RW	INT32
	21C4	8644	User	Sample Size	RW	INT32
2200	2200	8704	RO	Velocity	RO	(IEEE 32 bit)
	2202	8706	RO	Volumetric	RO	(IEEE 32 bit)
	2204	8708	RO	Standard volumetric	RO	(IEEE 32 bit)
	2206	8710	RO	Mass flow	RO	(IEEE 32 bit)
2250	2250	8784	RO	Batch fwd totals	RO	(IEEE 64 bit)
	2254	8788	RO	Batch rev totals	RO	(IEEE 64 bit)
	2258	8792	RO	Batch net totals	RO	(IEEE 64 bit)
	225C	8796	RO	Batch totals time	RO	(IEEE 64 bit)
	2260	8800	RO	Batch std fwd totals	RO	(IEEE 64 bit)
	2264	8804	RO	Batch std rev totals	RO	(IEEE 64 bit)
	2268	8808	RO	Batch std net totals	RO	(IEEE 64 bit)
	226C	8812	RO	Batch Mass fwd totals	RO	(IEEE 64 bit)
	2270	8816	RO	Batch Mass rev totals	RO	(IEEE 64 bit)
	2274	8820	RO	Batch Mass net totals	RO	(IEEE 64 bit)
2400	2400	9216	User	Ch1 Pipe Inner Diameter	RW	(IEEE 32 bit)
	2402	9218	User	Ch1 Pipe Outer Diameter	RW	(IEEE 32 bit)
	2404	9220	User	Ch1 Pipe Wall Thickness	RW	(IEEE 32 bit)
	2406	9222	User	Ch1 Pipe Soundspeed	RW	(IEEE 32 bit)
	2408	9224	User	Ch1 Lining Thickness	RW	(IEEE 32 bit)
	240A	9226	User	Ch1 Lining Soundspeed	RW	(IEEE 32 bit)
	240C	9228	User	Ch1 XDR wedge angle	RW	(IEEE 32 bit)
	240E	9230	User	Ch1 XDR wedge time	RW	(IEEE 32 bit)
	2410	9232	User	Ch1 Wedge Sound speed	RW	(IEEE 32 bit)
	2412	9234	User	Ch1 Fluid Sound speed	RW	(IEEE 32 bit)
	2414	9236	User	Ch1 Fluid Sound speed Min	RW	(IEEE 32 bit)
	2416	9238	User	Ch1 Fluid Sound speed Max	RW	(IEEE 32 bit)
	2418	9240	User	Ch1 Fluid Static Density	RW	(IEEE 32 bit)
	241A	9242	User	Ch1 Fluid Reference Density	RW	(IEEE 32 bit)
	241C	9244	User	Ch1 Fluid Temperature	RW	(IEEE 32 bit)
	241E	9246	User	Ch1 XDR space	RW	(IEEE 32 bit)
	2420	9248	User	Ch1 Calibration Factor	RW	(IEEE 32 bit)
	2422	9250	User	Ch1 Kinematic Viscosity	RW	(IEEE 32 bit)
	2424	9252	User	Ch1 XDR Temperature	RW	(IEEE 32 bit)
	2426	9254	User	Ch1 Ch1Goycol	RW	(IEEE 32 bit)
	2428	9256	User	Ch1 Zero Cutoff	RW	(IEEE 32 bit)
	242A	9258	User	Ch1 DeltaT Offset (unit: second)	RW	(IEEE 32 bit)
	242C	9260	User	Ch1 Customized SOS	RW	(IEEE 32 bit)

Table 7: MODBUS Register Map(Continued)

	Register (in hex)	Register (in decimal)	Access level	Description	RO/RW	Format
2400	242E	9262	User	Ch1 the input threshold under manual mode	RW	(IEEE 32 bit)
	2430	9264	User	Ch1 Path Length P	RW	(IEEE 32 bit)
	2432	9266	User	Ch1 Axial Length L	RW	(IEEE 32 bit)
	2434	9268	User	Ch1 TBC	RW	(IEEE 32 bit)
2440	2440	9280	User	Ch1 MultiK Velocity 1	RW	(IEEE 32 bit)
	2442	9282	User	Ch1 MultiK Velocity 2	RW	(IEEE 32 bit)
	2444	9284	User	Ch1 MultiK Velocity 3	RW	(IEEE 32 bit)
	2446	9286	User	Ch1 MultiK Velocity 4	RW	(IEEE 32 bit)
	2448	9288	User	Ch1 MultiK Velocity 5	RW	(IEEE 32 bit)
	244A	9290	User	Ch1 MultiK Velocity 6	RW	(IEEE 32 bit)
244E	244E	9294	User	Correlation peak low limit	RW	(IEEE 32 bit)
	2450	9296	User	Acceleration Limit	RW	(IEEE 32 bit)
	2452	9298	User	Velocity Low limit - Used for Volumetric low limit calculation	RW	(IEEE 32 bit)
	2454	9300	User	Velocity High limit - Used for Volumetric High limit calculation	RW	(IEEE 32 bit)
	2456	9302	User	Amplitude discriminator min limit	RW	(IEEE 32 bit)
	2458	9304	User	Amplitude discriminator max limit	RW	(IEEE 32 bit)
	245A	9306	User	Signal low limit	RW	(IEEE 32 bit)
	245C	9308	User	Soundspeed Plus minus limit	RW	(IEEE 32 bit)
	245E	9310	User	Errors allowed	RW	(IEEE 32 bit)
2460	2460	9312	User	Ch1 MultiK Velocity KFactor1	RW	(IEEE 32 bit)
	2462	9314	User	Ch1 MultiK Velocity KFactor2	RW	(IEEE 32 bit)
	2464	9316	User	Ch1 MultiK Velocity KFactor3	RW	(IEEE 32 bit)
	2466	9318	User	Ch1 MultiK Velocity KFactor4	RW	(IEEE 32 bit)
	2468	9320	User	Ch1 MultiK Velocity KFactor5	RW	(IEEE 32 bit)
	246A	9322	User	Ch1 MultiK Velocity KFactor6	RW	(IEEE 32 bit)
2480	2480	9344	User	Ch1 MultiK Reynolds 1	RW	(IEEE 32 bit)
	2482	9346	User	Ch1 MultiK Reynolds 2	RW	(IEEE 32 bit)
	2484	9348	User	Ch1 MultiK Reynolds 3	RW	(IEEE 32 bit)
	2486	9350	User	Ch1 MultiK Reynolds 4	RW	(IEEE 32 bit)
	2488	9352	User	Ch1 MultiK Reynolds 5	RW	(IEEE 32 bit)
	248A	9354	User	Ch1 MultiK Reynolds 6	RW	(IEEE 32 bit)
24A0	24A0	9376	User	Ch1 MultiK Reynolds KFactor1	RW	(IEEE 32 bit)
	24A2	9378	User	Ch1 MultiK Reynolds KFactor2	RW	(IEEE 32 bit)
	24A4	9380	User	Ch1 MultiK Reynolds KFactor3	RW	(IEEE 32 bit)
	24A6	9382	User	Ch1 MultiK Reynolds KFactor4	RW	(IEEE 32 bit)
	24A8	9384	User	Ch1 MultiK Reynolds KFactor5	RW	(IEEE 32 bit)
	24AA	9386	User	Ch1 MultiK Reynolds KFactor6	RW	(IEEE 32 bit)

Table 7: MODBUS Register Map(Continued)

	Register (in hex)	Register (in decimal)	Access level	Description	RO/RW	Format
2500	2500	9472	User	Ch1 Pipe Material	RW	INT32
	2502	9474	User	Ch1 Lining Material	RW	INT32
	2504	9476	User	Ch1 XDR Type	RW	INT32
	2506	9478	User	Ch1 XDR frequency	RW	INT32
	2508	9480	User	Ch1 XDR wedge type (obsoletely)	RW	INT32
	250A	9482	User	Ch1 Fluid Type	RW	INT32
	250C	9484	User	Ch1 Lining existence	RW	INT32
	250E	9486	User	Ch1 Traverse number	RW	INT32
	2512	9490	User	Ch1 Mounting type	RW	INT32
	2516	9494	User	Ch1 ActiveTw Enable	RW	INT32
	2518	9496	User	Ch1 ActiveTw Interval	RW	INT32
	251A	9498	User	Ch1 ActiveTw Detection Mode	RW	INT32
	251C	9500	User	Define how to search the threshold	RW	INT32
2540	2540	9536	User	Ch1 Enable Reynolds Correction	RW	INT32
	2542	9538	User	Ch1 Enable Active MultiK	RW	INT32
	2544	9540	User	Ch1 MultiK Type	RW	INT32
	2546	9542	User	Ch1 MultiK Pairs	RW	INT32
	2548	9544	User	Ch1 Density	RW	INT32
	254A	9546	User	Ch1 DensityPairs	RW	INT32
2580	2580	9600	User	Ch1 Peak%	RW	INT32
	2582	9602	User	Ch1 Min Peak%	RW	INT32
	2584	9604	User	Ch1 Max Peak%	RW	INT32
	2586	9606	User	Ch1 Enable Tracking Windows	RW	INT32
	2588	9608	User	Ch1 Flag of Customized Spacing	RW	INT32
	258C	9612	User	Ch1 Pipe Standard	RW	INT32
	258E	9614	User	Ch1 Pipe Standard - Nominal	RW	INT32
	2590	9616	User	Ch1 Pipe Standard - Schedule	RW	INT32
	2592	9618	User	Ch1 transducer style	RW	INT32
	2594	9620	User	Ch1 ActiveTw Peak% Up	RW	INT32
	2596	9622	User	Ch1 ActiveTw Peak% Down	RW	INT32
2600	2600	9728	RO	Ch1 Velocity	RO	(IEEE 32 bit)
	2602	9730	RO	Ch1 Volumetric	RO	(IEEE 32 bit)
	2604	9732	RO	Ch1 Standard Volumetric	RO	(IEEE 32 bit)
	2606	9734	RO	Ch1 Mass Flow	RO	(IEEE 32 bit)
2650	2650	9808	RO	Ch1 Batch fwd totals	RO	(IEEE 32 bit)
	2654	9812	RO	Ch1 Batch rev totals	RO	(IEEE 32 bit)
	2658	9816	RO	Ch1 Batch net totals	RO	(IEEE 32 bit)
	265C	9820	RO	Ch1 Batch totals time	RO	(IEEE 32 bit)
	2660	9824	RO	Ch1 Batch std fwd totals	RO	(IEEE 32 bit)

Table 7: MODBUS Register Map(Continued)

	Register (in hex)	Register (in decimal)	Access level	Description	RO/RW	Format
2650	2664	9828	RO	Ch1 Batch std rev totals	RO	(IEEE 32 bit)
	2668	9832	RO	Ch1 Batch std net totals	RO	(IEEE 32 bit)
	266C	9836	RO	Ch1 Batch Mass fwd totals	RO	(IEEE 32 bit)
	2670	9840	RO	Ch1 Batch Mass rev totals	RO	(IEEE 32 bit)
	2674	9844	RO	Ch1 Batch Mass net totals	RO	(IEEE 32 bit)
2680	2680	9856	RO	Ch1 Transit Time Up	RO	(IEEE 32 bit)
	2682	9858	RO	Ch1 Transit Time Dn	RO	(IEEE 32 bit)
	2684	9860	RO	Ch1 DeltaT	RO	(IEEE 32 bit)
	2686	9862	RO	Ch1 Up Signal Quality	RO	(IEEE 32 bit)
	2688	9864	RO	Ch1 Dn Signal Quality	RO	(IEEE 32 bit)
	268A	9866	RO	Ch1 Up Amp Disc	RO	(IEEE 32 bit)
	268C	9868	RO	Ch1 Dn Amp Disc	RO	(IEEE 32 bit)
	268E	9870	RO	Ch1 SNR on UP channel	RO	(IEEE 32 bit)
	2690	9872	RO	Ch1 SNR on DOWN channel	RO	(IEEE 32 bit)
	2692	9874	RO	Ch1 Time in buffer on Up channel	RO	(IEEE 32 bit)
	2694	9876	RO	Ch1 Time in buffer on Dn channel	RO	(IEEE 32 bit)
	2696	9878	RO	Ch1 Signal Gain Up	RO	(IEEE 32 bit)
	2698	9880	RO	Ch1 Signal Gain Down	RO	(IEEE 32 bit)
	269A	9882	RO	Ch1 Partial Corrolatoin Ratio Up	RO	(IEEE 32 bit)
	269C	9884	RO	Ch1 Partial Corrolatoin Ratio Dn	RO	(IEEE 32 bit)
	269E	9886	RO	Ch1 Angle in Fluid	RO	(IEEE 32 bit)
	26A0	9888	RO	Ch1 Signal Dynamic	RO	(IEEE 32 bit)
	26A2	9890	RO	Ch1 ActiveTw Signal Gain Up	RO	(IEEE 32 bit)
	26A4	9892	RO	Ch1 ActiveTw Signal Gain Down	RO	(IEEE 32 bit)
	26A6	9894	RO	Ch1 ActiveTw SNR on UP channel	RO	(IEEE 32 bit)
	26A8	9896	RO	Ch1 ActiveTw SNR on DOWN channel	RO	(IEEE 32 bit)
	26AA	9898	RO	Ch1 Up ActiveTw Amp Disc	RO	(IEEE 32 bit)
	26AC	9900	RO	Ch1 Dn ActiveTw Amp Disc	RO	(IEEE 32 bit)
26C0	26C0	9920	RO	Ch1 Sound Speed	RO	(IEEE 32 bit)
	26C2	9922	RO	Ch1 Current Reynolds K Factor	RO	(IEEE 32 bit)
	26C4	9924	RO	Ch1 Current Correction Factor	RO	(IEEE 32 bit)
	26C6	9926	RO	Ch1 calculated Density	RO	(IEEE 32 bit)
	26C8	9928	RO	Ch1 Current Reynolds Number	RO	(IEEE 32 bit)
2700	2700	9984	RO	Ch1 Up +- Peak	RO	INT32
	2702	9986	RO	Ch1 Dn +- Peak	RO	INT32
	2704	9988	RO	Ch1 dynamic threshold on UP channel	RO	INT32
	2706	9990	RO	Ch1 dynamic threshold on DOWN channel	RO	INT32

Table 7: MODBUS Register Map(Continued)

	Register (in hex)	Register (in decimal)	Access level	Description	RO/RW	Format
2718	2718	10008	RO	Ch1 ActiveTw Up +- Peak	RO	INT32
	271A	10010	RO	Ch1 ActiveTw Dn +- Peak	RO	INT32
	271C	10012	RO	Ch1 ActiveTw threshold on UP channel	RO	INT32
	271E	10014	RO	Ch1 ActiveTw threshold on DOWN channel	RO	INT32
2800	2800	10240	User	Ch2 Pipe Inner Diameter	RW	(IEEE 32 bit)
	2802	10242	User	Ch2 Pipe Outer Diameter	RW	(IEEE 32 bit)
	2804	10244	User	Ch2 Pipe Wall Thickness	RW	(IEEE 32 bit)
	2806	10246	User	Ch2 Pipe Soundspeed	RW	(IEEE 32 bit)
	2808	10248	User	Ch2 Lining Thickness	RW	(IEEE 32 bit)
	280A	10250	User	Ch2 Lining Soundspeed	RW	(IEEE 32 bit)
	280C	10252	User	Ch2 XDR wedge angle	RW	(IEEE 32 bit)
	280E	10254	User	Ch2 XDR wedge time	RW	(IEEE 32 bit)
	2810	10256	User	Ch2 Wedge Sound speed	RW	(IEEE 32 bit)
	2812	10258	User	Ch2 Fluid Sound speed	RW	(IEEE 32 bit)
	2814	10260	User	Ch2 Fluid Sound speed Min	RW	(IEEE 32 bit)
	2816	10262	User	Ch2 Fluid Sound speed Max	RW	(IEEE 32 bit)
	2818	10264	User	Ch2 Fluid Static Density	RW	(IEEE 32 bit)
	281A	10266	User	Ch2 Fluid Reference Density	RW	(IEEE 32 bit)
	281C	10268	User	Ch2 Fluid Temperature	RW	(IEEE 32 bit)
	281E	10270	User	Ch2 XDR space	RW	(IEEE 32 bit)
	2820	10272	User	Ch2 Calibration Factor	RW	(IEEE 32 bit)
	2822	10274	User	Ch2 Kinematic Viscosity	RW	(IEEE 32 bit)
	2824	10276	User	Ch2 XDR Temperature	RW	(IEEE 32 bit)
	2826	10278	User	Ch2 Goycol	RW	(IEEE 32 bit)
	2828	10280	User	Ch2 Zero Cutoff	RW	(IEEE 32 bit)
	282A	10282	User	Ch2 DeltaT Offset	RW	(IEEE 32 bit)
	282C	10284	User	Ch2 Customized SOS	RW	(IEEE 32 bit)
	282E	10286	User	Ch2 the inputted threshold under manual mode	RW	(IEEE 32 bit)
	2830	10288	User	Ch2 Path Length P	RW	(IEEE 32 bit)
	2832	10290	User	Ch2 Axial Length L	RW	(IEEE 32 bit)
	2834	10292	User	Ch2 TBC	RW	(IEEE 32 bit)
2840	2840	10304	User	Ch2 MultiK Velocity 1	RW	(IEEE 32 bit)
	2842	10306	User	Ch2 MultiK Velocity 2	RW	(IEEE 32 bit)
	2844	10308	User	Ch2 MultiK Velocity 3	RW	(IEEE 32 bit)
	2846	10310	User	Ch2 MultiK Velocity 4	RW	(IEEE 32 bit)
	2848	10312	User	Ch2 MultiK Velocity 5	RW	(IEEE 32 bit)
	284A	10314	User	Ch2 MultiK Velocity 6	RW	(IEEE 32 bit)

Table 7: MODBUS Register Map(Continued)

	Register (in hex)	Register (in decimal)	Access level	Description	RO/RW	Format
284E	284E	10318	User	Correlation peak low limit	RW	(IEEE 32 bit)
	2850	10320	User	Acceleration Limit	RW	(IEEE 32 bit)
	2852	10322	User	Velocity Low limit - Used for Volumetric low limit calculation	RW	(IEEE 32 bit)
	2854	10324	User	Velocity High limit - Used for Volumetric High limit calculation	RW	(IEEE 32 bit)
	2856	10326	User	Amplitude discriminator min limit	RW	(IEEE 32 bit)
	2858	10328	User	Amplitude discriminator max limit	RW	(IEEE 32 bit)
	285A	10330	User	Signal low limit	RW	(IEEE 32 bit)
	285C	10332	User	Soundspeed Plus minus limit	RW	(IEEE 32 bit)
	285E	10334	User	Errors allowed	RW	(IEEE 32 bit)
2860	2860	10336	User	Ch2 MultiK Velocity KFactor1	RW	(IEEE 32 bit)
	2862	10338	User	Ch2 MultiK Velocity KFactor2	RW	(IEEE 32 bit)
	2864	10340	User	Ch2 MultiK Velocity KFactor3	RW	(IEEE 32 bit)
	2866	10342	User	Ch2 MultiK Velocity KFactor4	RW	(IEEE 32 bit)
	2868	10344	User	Ch2 MultiK Velocity KFactor5	RW	(IEEE 32 bit)
	286A	10346	User	Ch2 MultiK Velocity KFactor6	RW	(IEEE 32 bit)
2880	2880	10368	User	Ch2 MultiK Reynolds 1	RW	(IEEE 32 bit)
	2882	10370	User	Ch2 MultiK Reynolds 2	RW	(IEEE 32 bit)
	2884	10372	User	Ch2 MultiK Reynolds 3	RW	(IEEE 32 bit)
	2886	10374	User	Ch2 MultiK Reynolds 4	RW	(IEEE 32 bit)
	2888	10376	User	Ch2 MultiK Reynolds 5	RW	(IEEE 32 bit)
	288A	10378	User	Ch2 MultiK Reynolds 6	RW	(IEEE 32 bit)
28A0	28A0	10400	User	Ch2 MultiK Reynolds KFactor1	RW	(IEEE 32 bit)
	28A2	10402	User	Ch2 MultiK Reynolds KFactor2	RW	(IEEE 32 bit)
	28A4	10404	User	Ch2 MultiK Reynolds KFactor3	RW	(IEEE 32 bit)
	28A6	10406	User	Ch2 MultiK Reynolds KFactor4	RW	(IEEE 32 bit)
	28A8	10408	User	Ch2 MultiK Reynolds KFactor5	RW	(IEEE 32 bit)
	28AA	10410	User	Ch2 MultiK Reynolds KFactor6	RW	(IEEE 32 bit)
2900	2900	10496	User	Ch2 Pipe Material	RW	INT32
	2902	10498	User	Ch2 Lining Material	RW	INT32
	2904	10500	User	Ch2 XDR Type	RW	INT32
	2906	10502	User	Ch2 XDR frequency	RW	INT32
	2908	10504	User	Ch2 XDR wedge type (obsoletely)	RW	INT32
	290A	10506	User	Ch2 Fluid Type	RW	INT32
	290C	10508	User	Ch2 Lining existence	RW	INT32
	290E	10510	User	Ch2 Traverse number	RW	INT32
	2912	10514	User	Ch2 Mounting type	RW	INT32
	2916	10518	User	Ch2 ActiveTw Enable	RW	INT32
	2918	10520	User	Ch2 ActiveTw Interval	RW	INT32

Table 7: MODBUS Register Map(Continued)

	Register (in hex)	Register (in decimal)	Access level	Description	RO/RW	Format
2900	291A	10522	User	Ch2 ActiveTw Detection Mode	RW	INT32
	291C	10524	User	Define how to search the threshold	RW	INT32
2940	2940	10560	User	Ch2 Enable Reynolds Correction	RW	INT32
	2942	10562	User	Ch2 Enable Active MultiK	RW	INT32
	2944	10564	User	Ch2 MultiK Type	RW	INT32
	2946	10566	User	Ch2 MultiK Pairs	RW	INT32
	2948	10568	User	Ch2 Density	RW	INT32
	294A	10570	User	Ch2 DensityPairs	RW	INT32
2980	2980	10624	User	Ch2 Peak%	RW	INT32
	2982	10626	User	Ch2 Min Peak%	RW	INT32
	2984	10628	User	Ch2 Max Peak%	RW	INT32
	2986	10630	User	Ch2 Enable Tracking Windows	RW	INT32
	2988	10632	User	Ch2 Flag of Customized Spacing	RW	INT32
	298A	10634	User	Ch2 choose single or table	RW	INT32
	298C	10636	User	Ch2 Pipe Standard	RW	INT32
	298E	10638	User	Ch2 Pipe Standard - Nominal	RW	INT32
	2990	10640	User	Ch2 Pipe Standard - Schedule	RW	INT32
	2992	10642	User	Ch2 transducer style	RW	INT32
	2994	10644	User	Ch2 ActiveTw Peak% Up	RW	INT32
	2996	10646	User	Ch2 ActiveTw Peak% Down	RW	INT32
2A00	2A00	10752	RO	Ch2 Velocity	RO	(IEEE 32 bit)
	2A02	10754	RO	Ch2 Volumetric	RO	(IEEE 32 bit)
	2A04	10756	RO	Ch2 Standard Volumetric	RO	(IEEE 32 bit)
	2A06	10758	RO	Ch2 Mass Flow	RO	(IEEE 32 bit)
2A50	2A50	10832	RO	Ch2 Batch fwd totals	RO	(IEEE 64 bit)
	2A54	10836	RO	Ch2 Batch rev totals	RO	(IEEE 64 bit)
	2A58	10840	RO	Ch2 Batch net totals	RO	(IEEE 64 bit)
	2A5C	10844	RO	Ch2 Batch totals time	RO	(IEEE 64 bit)
	2A60	10848	RO	Ch2 Batch std fwd totals	RO	(IEEE 64 bit)
	2A64	10852	RO	Ch2 Batch std rev totals	RO	(IEEE 64 bit)
	2A68	10856	RO	Ch2 Batch std net totals	RO	(IEEE 64 bit)
	2A6C	10860	RO	Ch2 Batch Mass fwd totals	RO	(IEEE 64 bit)
	2A70	10864	RO	Ch2 Batch Mass rev totals	RO	(IEEE 64 bit)
	2A74	10868	RO	Ch2 Batch Mass net totals	RO	(IEEE 64 bit)
2A80	2A80	10880	RO	Ch2 Transit Time Up	RO	(IEEE 32 bit)
	2A82	10882	RO	Ch2 Transit Time Dn	RO	(IEEE 32 bit)
	2A84	10884	RO	Ch2 DeltaT	RO	(IEEE 32 bit)
	2A86	10886	RO	Ch2 Up Signal Quality	RO	(IEEE 32 bit)
	2A88	10888	RO	Ch2 Dn Signal Quality	RO	(IEEE 32 bit)
	2A8A	10890	RO	Ch2 Up Amp Disc	RO	(IEEE 32 bit)

Table 7: MODBUS Register Map(Continued)

	Register (in hex)	Register (in decimal)	Access level	Description	RO/RW	Format
2A80	2A8C	10892	RO	Ch2 Dn Amp Disc	RO	(IEEE 32 bit)
	2A8E	10894	RO	Ch2 SNR on UP channel	RO	(IEEE 32 bit)
	2A90	10896	RO	Ch2 SNR on DOWN channel	RO	(IEEE 32 bit)
	2A92	10898	RO	Ch2 Time in buffer on Up channel	RO	(IEEE 32 bit)
	2A94	10900	RO	Ch2 Time in buffer on Dn channel	RO	(IEEE 32 bit)
	2A96	10902	RO	Ch2 Signal Gain Up	RO	(IEEE 32 bit)
	2A98	10904	RO	Ch2 Signal Gain Down	RO	(IEEE 32 bit)
	2A9A	10906	RO	Ch1 Partial Corrolatoin Ratio Up	RO	(IEEE 32 bit)
	2A9C	10908	RO	Ch1 Partial Corrolatoin Ratio Dn	RO	(IEEE 32 bit)
	2A9E	10910	RO	Ch2 Angle in Fluid	RO	(IEEE 32 bit)
	2AA0	10912	RO	Ch2 Signal Dynamic	RO	(IEEE 32 bit)
	2AA2	10914	RO	Ch2 ActiveTw Signal Gain Up	RO	(IEEE 32 bit)
	2AA4	10916	RO	Ch2 ActiveTw Signal Gain Down	RO	(IEEE 32 bit)
	2AA6	10918	RO	Ch2 ActiveTw SNR on UP channel	RO	(IEEE 32 bit)
	2AA8	10920	RO	Ch2 ActiveTw SNR on DOWN channel	RO	(IEEE 32 bit)
	2AAA	10922	RO	Ch2 Up ActiveTw Amp Disc	RO	(IEEE 32 bit)
	2AAC	10924	RO	Ch2 Dn ActiveTw Amp Disc	RO	(IEEE 32 bit)
2AC0	2AC0	10944	RO	Ch2 Sound Speed	RO	(IEEE 32 bit)
	2AC2	10946	RO	Ch2 Current Reynolds K Factor	RO	(IEEE 32 bit)
	2AC4	10948	RO	Ch2 Current Correction Factor	RO	(IEEE 32 bit)
	2AC6	10950	RO	Calculated Density	RO	(IEEE 32 bit)
	2AC8	10952	RO	Ch1 Current Reynolds Number	RO	(IEEE 32 bit)
2B00	2B00	11008	RO	Ch2 Up +- Peak	RO	INT32
	2B02	11010	RO	Ch2 Dn +- Peak	RO	INT32
	2B04	11012	RO	Ch2 dynamic threshold on UP channel	RO	INT32
	2B06	11014	RO	Ch2 dynamic threshold on DOWN channel	RO	INT32
2B18	2B18	11032	RO	Ch2 ActiveTw Up +- Peak	RO	INT32
	2B1A	11034	RO	Ch2 ActiveTw Dn +- Peak	RO	INT32
	2B1C	11036	RO	Ch2 ActiveTw threshold on UP channel	RO	INT32
	2B1E	11038	RO	Ch2 ActiveTw threshold on DOWN channel	RO	INT32
3D00	3D00	15616	Viewer	Factory command register	RW	INT32
	3D02	15618	Viewer	Factory register for simulation key input	RW	INT32
	3D04	15620	Viewer	Factory register for simulate responsion	RW	INT32
3F00	3F00	16128	RO	System password	RO	INT32
	3F02	16130	RO	System Log In Status	RO	INT32

6.2 HART

6.2.1 Device Identification

The AT620 flow meter supports the HART communication protocol, for which the manufacturer ID is 0x9D (157 Dec) and the device type code is 0x9D73 (127 Dec).

6.2.2 AT620 Commands

6.2.2.1 Universal Commands

Table 8: Universal Commands for HART

Command	Function	Description
0	Read unique identifier	Returns identity information about the meter including: the device type, revision levels, and device ID.
1	Read primary variable	Returns the primary variable value along with its unit code
2	Read loop current and percent of range	Reads the loop current and its associated percent of range.
3	Read dynamic variables and loop current	Reads the loop current and up to four predefined dynamic variables. The dynamic variables and associated units are defined via commands 51 and 53.
6	Write polling address	Writes the polling address and the loop current mode to the field device.
7	Read loop configuration	Read polling address and the loop current mode.
8	Read dynamic variable upification	Reads the upification associated with the dynamic variable.
9	Read device variables with status	Request the value and status of up to eight device or dynamic variables.
11	Read unique identifier associated with tag	If the specified tag matches that of the meter, it responds with the command 0 response.
12	Read message	Reads the message contained within the meter.
13	Read tag, descriptor, date	Reads the tag, descriptor, and date contained within the meter.
14	Read primary variable transducer information	Reads the transducer (meter) serial number, limits/minimum span units code, upper transducer limit, lower transducer limit, and minimum span for the primary variable transducer.
15	Read device information	Reads the alarm selection code, transfer function code, range values units code upper range value, primary variable lower range value, damping value, write protect code, and private label distributor code.
16	Read final assembly number	Reads the final assembly number associated with the meter.
17	Write message	Write the message into the meter.
18	Write tag, descriptor, date	Write the tag, descriptor, and date code into the meter.
19	Write final assembly number	Write the final assembly number into the meter.
20	Read long tag	Read the 32-byte long tag.
21	Read unique identifier associated with long tag	Read unique identifier associated with long tag
22	Write long tag	Write the 32-byte long tag

Table 8: Universal Commands for HART(Continued)

Command	Function	Description
38	Reset configuration changed flag	Resets the configuration changed indicator (device status byte bit 6).
48	Read additional device status	Returns meter status information not included in the response code or device status byte.

6.2.2.2 Common Commands

Table 9: Common Commands

Command	Function	Description
33	Read device variables	Allows a master to request the value of up to four device variables.
50	Read dynamic variable assignments	Reads the device variables assigned to the primary, secondary, tertiary, and quaternary variables.
51	Write dynamic variable assignments	Allows the user to assign device variables to the primary, secondary, tertiary, and quaternary variables.
54	Read device variable information	Get device variable information.
59	Write number of response preambles	Sets the number of asynchronous preamble bytes to be sent by the meter before the start of a response message.

6.2.2.3 Device Specific Commands

The AT620 flow meter supports a variety of device specific commands in which the parameter may be the measurement type. The available measurement types are listed in *Table 10* below.

Table 10: Available Measurement Types

Index	Meaning
0	Velocity
1	Actual Volumetric
2	Standard volumetric
3	Mass flow
4	Batch Forward Total
5	Batch Reverse Total
6	Batch Net Total
7	Batch Time
8	ActiveTw Peak Index Up
9	ActiveTw Peak Index Dn
10	ActiveTw Peak Pct Up
11	ActiveTw Peak Pct Dn
12	Transit Time Up
13	Transit Time Dn
14	Delta T
15	Signal Quality Up
16	Signal Quality Dn
17	Amp Disc Up
18	Amp Disc Dn
19	SNR Up

Index	Meaning
20	SNR Dn
21	Active TW Up
22	Active TW Dn
23	Gain Up
24	Gain Dn
25	Sound Speed
26	Reynolds KFactor
27	Multi K KFactor
28	Peak Up
29	Peak Dn
30	Peak Pct Up
31	Peak Pct Dn
32	Active Tw Gain Up
33	Active Tw Gain Dn
34	Active Tw SNR Up
35	Active Tw SNR Dn
36	Active Tw Amp Up
37	Active Tw Amp Dn
38	Batch Std Fwd Total
39	Batch Std Rev Total

Table 10: Available Measurement Types(Continued)

Index	Meaning
40	Batch Std Net Total
41	Batch Mass Fwd Total
42	Batch Mass Rev Total
43	Batch Mass Net Total
44	Reynolds Number
45	Ch2 Velocity
46	Ch2 Actual Volumetric
47	Ch2 Standard Volumetric
48	Ch2 Mass Flow
49	Ch2 Batch Forward Total
50	Ch2 Batch Reverse Total
51	Ch2 Batch Net Total
52	Ch2 Batch Time
53	Ch2 ActiveTw Peak Index Up
54	Ch2 ActiveTw Peak Index Dn
55	Ch2 ActiveTw Peak Pct Up
56	Ch2 ActiveTw Peak Pct Dn
57	Ch2 Transit Time Up
58	Ch2 Transit Time Dn
59	Ch2 Delta T
60	Ch2 Signal Quality Up
61	Ch2 Signal Quality Dn
62	Ch2 Amp Disc Up
63	Ch2 Amp Disc Dn
64	Ch2 SNR Up
65	Ch2 SNR Dn
66	Ch2 Active TW Up
67	Ch2 Active TW Dn
68	Ch2 Gain Up
69	Ch2 Gain Dn
70	Ch2 Sound Speed
71	Ch2 Reynolds KFactor

Index	Meaning
72	Ch2 Multi K KFactor
73	Ch2 Peak Up
74	Ch2 Peak Dn
75	Ch2 Peak Pct Up
76	Ch2 Peak Pct Dn
77	Ch2 Active Tw Gain Up
78	Ch2 Active Tw Gain Dn
79	Ch2 Active Tw SNR Up
80	Ch2 Active Tw SNR Dn
81	Ch2 Active Tw Amp Up
82	Ch2 Active Tw Amp Dn
83	Ch2 Batch Std Fwd Total
84	Ch2 Batch Std Rev Total
85	Ch2 Batch Std Net Total
86	Ch2 Batch Mass Fwd Total
87	Ch2 Batch Mass Rev Total
88	Ch2 Batch Mass Net Total
89	Ch2 Reynolds Number
90	Composite Velocity
91	Composite Volumetric
92	Composite Standard Volumetric
93	Composite Mass Flow
94	Composite Batch Fwd Total
95	Composite Batch Rev Total
96	Composite Batch Net Total
97	Composite Batch Total Time
98	Composite Batch Std Fwd Total
99	Composite Batch Std Rev Total
100	Composite Batch Std Net Total
101	Composite Batch Mass Fwd Total
102	Composite Batch Mass Rev Total
103	Composite Batch Mass Net Total

Command 128 (0x80): Login with Password

This command sends a password to the flow meter. If the password is correct, the user may operate the meter until there has been a gap of 10 minutes since the last command.

Table 11: Request Data Bytes for Login with Password

Byte	Format	Description
0 - 3	Unsigned-32	User password

Table 12: Response Data Bytes for Login with Password

Byte	Format	Description
None		

Table 13: Command-Specific Response Codes for Login with Password

Code	Class	Description
0	Success	No command-specific errors
1 - 4		Undefined
5	Error	Too few data bytes received
6	Error	Device-specific command error
7 - 15		Undefined
16	Error	Access restricted
17 - 127		Undefined

Command 129 (0x81): Logout and Save

This command will save any changes and logout from the flow meter.

Table 14: Request Data Bytes for Logout and Save

Byte	Format	Description
None		

Table 15: Response Data Bytes for Logout and Save

Byte	Format	Description
None		

Table 16: Command-Specific Response Codes for Logout and Save

Code	Class	Description
0	Success	No command-specific errors
1 - 4		Undefined
5	Error	Device-specific command error
6	Error	In write protect mode
7 - 15		Undefined
16	Error	Access restricted
17 - 127		Undefined

Command 130 (0x82): Logout without saving

This command will logout the flow meter and not save anything.

Table 17: Request Data Bytes for Logout Without Saving

Byte	Format	Description
None		

Table 18: Response Data Bytes for Logout Without Saving

Byte	Format	Description
None		

Table 19: Command-Specific Response Codes for Logout without Saving

Code	Class	Description
0	Success	No command-specific errors
1 - 5		Undefined
6	Error	Device-specific command error
7 - 15		Undefined
16	Error	Access restricted
17 - 127		Undefined

Command 135 (0x87): Read Current User Access Right

This command will read the current user access right.

Table 20: Request Data Bytes for Read Current User Access Right

Byte	Format	Description
None		

Table 21: Response Data Bytes for Read Current User Access Right

Byte	Format	Description
None		

Table 22: Command-Specific Response Codes for Read Current User Access Right

Code	Class	Description
0	Success	No command-specific errors
1 - 127		Undefined

Command 136 (0x88): Sends new password

This command will send a new password to the flow meter. If the user has the right, the flow meter changes the user password

Table 23: Request Data Bytes for Sends New Password

Byte	Format	Description
0 - 3	Unsigned-32	User password

Table 24: Response Data Bytes for Sends New Password

Byte	Format	Description
None		

Table 25: Command-Specific Response Codes for Sends New Password

Code	Class	Description
0	Success	No command-specific errors
1 - 4		Undefined
5	Error	Too few data bytes received
6	Error	Device-specific command error
7	Error	In write protect mode
8 - 15		Undefined
16	Error	Access restricted
17 - 127		Undefined

Command 144 (0x90): Read unit group

This command will read the unit group in the meter.

Table 26: Request Data Bytes for Read Unit Group

Byte	Format	Description
0	Unsigned-8	Group index: 1: Velocity unit; 2: Actual volumetric unit; 3: Standard volumetric unit; 4: Mass unit; 5: Totalizer unit; 6: Density unit; 7: Pipe dimension; 8: Thermal; 9: Acceleration;

Table 27: Response Data Bytes for Read Unit Group

Byte	Format	Description
0	Unsigned-8	Group index: 1: Velocity unit; 2: Actual volumetric unit; 3: Standard volumetric unit; 4: Mass unit; 5: Totalizer unit; 6: Density unit; 7: Pipe dimension; 8: Thermal; 9: Acceleration;
1	Enum	Unit code

Table 28: Command-Specific Response Codes for Sends New Password

Code	Class	Description
0	Success	No command-specific errors
1		Undefined
2	Error	Invalid selection
3 - 4		Undefined
5	Error	Too few data bytes received
6	Error	Device-specific command error
7 - 127		Undefined

Command 145 (0x91): Read density value

This command will read density value in meter.

Table 29: Request Data Bytes for Read Density Value

Byte	Format	Description
0	Unsigned-8	Density type: 1: Actual density; 2: Reference density;

Table 30: Response Data Bytes for Read Density Value

Byte	Format	Description
0	Unsigned-8	Density type: 1: Actual density; 2: Reference density;
1	Unsigned-8	Density unit code
2 - 5	Float	Density value

Table 31: Command-Specific Response Codes for Read Density Value

Code	Class	Description
0	Success	No command-specific errors
1		Undefined
2	Error	Invalid selection
3 - 4		Undefined
5	Error	Too few data bytes received
6	Error	Device-specific command error
7 - 127		Undefined

Command 146 (0x92): Read Backlight Setting

This command is to read the backlight setting.

Table 32: Request Data Bytes for Read Backlight Setting

Byte	Format	Description
None		

Table 33: Response Data Bytes for Read Backlight Setting

Byte	Format	Description
0	Unsigned-8	Backlight control switch (0:off/ 1:on)
1 - 4	Unsigned-32	Display backlight timeout, unit is second.

Table 34: Command-Specific Response Codes for Read Backlight Setting

Code	Class	Description
0	Success	No command-specific errors
1 - 5		Undefined
6	Error	Device-specific command error
7 - 127		Undefined

Command 152 (0x98): Write Unit Group

This command will write unit group in meter

Table 35: Request Data Bytes for Write Unit Group

Byte	Format	Description
0	Unsigned-8	Group index: 1: Velocity unit; 2: Actual volumetric unit; 3: Standard volumetric unit; 4: Mass unit; 5: Totalizer unit; 6: Density unit; 7: Pipe dimension; 8: Thermal; 9: Acceleration;
1	Enum	Unit code

Table 36: Response Data Bytes for Write Unit Group

Byte	Format	Description
0	Unsigned-8	Group index: 1: Velocity unit; 2: Actual volumetric unit; 3: Standard volumetric unit; 4: Mass unit; 5: Totalizer unit; 6: Density unit; 7: Pipe dimension; 8: Thermal; 9: Acceleration;
1	Enum	Unit code

Table 37: Command-Specific Response Codes for Write Unit Group

Code	Class	Description
0	Success	No command-specific errors
1		Undefined
2	Error	Invalid selection
3 - 4		Undefined
5	Error	Too few data bytes received
6	Error	Device-specific command error
7	Error	In write protect mode
8 - 15		Undefined
16	Error	Access restricted
17 - 127		Undefined

Command 153 (0x99): Write density value

This command will write density value in meter.

Table 38: Request Data Bytes for Write Density Value

Byte	Format	Description
0	Unsigned-8	Density type: 1: Actual density; 2: Reference density;
1	Unsigned-8	Density unit code
2 - 5	Float	Density value

Table 39: Response Data Bytes for Write Density Value

Byte	Format	Description
0	Unsigned-8	Density type: 1: Actual density; 2: Reference density;
1	Unsigned-8	Density unit code
2 - 5	Float	Density value

Table 40: Command-Specific Response Codes for Write Density Value

Code	Class	Description
0	Success	No command-specific errors
1		Undefined
2	Error	Invalid selection
3 - 4		Undefined
5	Error	Too few data bytes received
6	Error	Device-specific command error
7	Error	In write protect mode
8 - 15		Undefined

Table 40: Command-Specific Response Codes for Write Density Value(Continued)

Code	Class	Description
16	Error	Access restricted
17 - 127		Undefined

Command 154 (0x9A): Write display backlight

This command is to set the back light.

Table 41: Request Data Bytes for Write Display Backlight

Byte	Format	Description
0	Unsigned-8	Backlight control switch (0:off/ 1:on)
1 - 4	Unsigned-32	Display backlight timeout, unit is second.

Table 42: Response Data Bytes for Write Display Backlight

Byte	Format	Description
0	Unsigned-8	Backlight control switch (0:off/ 1:on)
1 - 4	Unsigned-32	Display backlight timeout, unit is second.

Table 43: Command-Specific Response Codes for Write Display Backlight

Code	Class	Description
0	Success	No command-specific errors
1 - 4		Undefined
5	Error	Too few data bytes received
6	Error	Device-specific command error
7	Error	In write protect mode
8 - 15		Undefined
16	Error	Access restricted
17 - 127		Undefined

Command 160 (0xA0): Read Analog Measurement Range Values

This command is to read the analog measurement range.

Table 44: Request Data Bytes for Read Analog Measurement Range Values

Byte	Format	Description
None		

Table 45: Response Data Bytes for Read Analog Measurement Range Value

Byte	Format	Description
0	Unsigned-8	Upper and lower range values unit code
1 - 4	Float	Upper range value
5 - 8	Float	Lower range value

Table 46: Command-Specific Response Codes for Read Analog Measurement Range Value

Code	Class	Description
0	Success	No command-specific errors
1 - 5		Undefined
6	Error	Device-specific command error
17 - 127		Undefined

Command 161 (0xA1): Read loop current error handling

This command is to read the loop current output error handling

Table 47: Request Data Bytes for Read Loop Current Error Handling

Byte	Format	Description
None		

Table 48: Response Data Bytes for Read Analog Measurement Range Value

Byte	Format	Description
0	Unsigned-8	Analog output error handling: 0: Low; 1: High; 2: Hold; 3: Other value;
1 - 4	Float	Error value, unit is mA

Table 49: Command-Specific Response Codes for Read Loop Current Error Handling

Code	Class	Description
0	Success	No command-specific errors
1 - 5		Undefined
6	Error	Device-specific command error
17 - 127		Undefined

Command 168 (0xA8): Enter/exit fixed loop current

Enter or exit the fixed mode of loop current.

Table 50: Request Data Bytes for Enter/Exit Fixed Loop Current

Byte	Format	Description
0	Unsigned-8	Fixed current level: 0: Exit fixed loop current; 1: fixed 4 mA; 2: fixed 20mA; 3: fixed percentage of scale

Table 51: Response Data Bytes for Enter/Exit Fixed Loop Current

Byte	Format	Description
0	Unsigned-8	Fixed current level: 0: Exit fixed loop current; 1: fixed 4 mA; 2: fixed 20mA; 3: fixed percentage of scale;

Table 52: Command-Specific Response Code for Enter/Exit Fixed Loop Currents

Code	Class	Description
0	Success	No command-specific errors
1 - 4		Undefined
5	Error	Too few data bytes received
6	Error	Device-specific command error
7	Error	In write protect mode
8 - 10		Undefined
11	Error	Loop current not active
12 - 15		Undefined
16	Error	Access restricted
17 - 31		Undefined
32	Error	Busy
33 - 127		Undefined

Command 169 (0xA9): Set loop current zero

This command is to trim the zero or lower endpoint value of the loop current to its minimum.

Table 53: Request Data Bytes for Set Loop Current Zero

Byte	Format	Description
0 - 3	Float	Externally measured loop current level, units of milliamperes

Table 54: Response Data Bytes for Set Loop Current Zero

Byte	Format	Description
0 - 3	Float	Externally measured loop current level, units of milliamperes

Table 55: Command-Specific Response Codes for Set Loop Current Zero

Code	Class	Description
0	Success	No command-specific errors
1 - 2		Undefined
3	Error	Passed parameter too large
4	Error	Passed parameter too small
5	Error	Too few data bytes received
6	Error	Device-specific command error
7	Error	In write protect mode
8		Undefined
9	Error	Incorrect loop current mode or value
10 - 15		Undefined
16	Error	Access restricted
17 - 31		Undefined
32	Error	Busy
33 - 127		Undefined

Command 170 (0xAA): Set loop current gain

This command is to trim the gain or upper endpoint value of the loop current to its maximum.

Table 56: Request Data Bytes for Set Loop Current Gain

Byte	Format	Description
0 - 3	Float	Externally measured loop current level, units of milliamperes

Table 57: Response Data Bytes for Set Loop Current Zero

Byte	Format	Description
0 - 3	Float	Externally measured loop current level, units of milliamperes

Table 58: Command-Specific Response Codes for Set Loop Current Gain

Code	Class	Description
0	Success	No command-specific errors
1 - 2		Undefined
3	Error	Passed parameter too large
4	Error	Passed parameter too small
5	Error	Too few data bytes received
6	Error	Device-specific command error
7	Error	In write protect mode

Table 58: Command-Specific Response Codes for Set Loop Current Gain(Continued)

Code	Class	Description
8		Undefined
9	Error	Incorrect loop current mode or value
10 - 15		Undefined
16	Error	Access restricted
17 - 31		Undefined
32	Error	Busy
33 - 127		Undefined

Command 171 (0xAB): Set loop current percentage

This command is to set the output percentage of loop current.

Table 59: Request Data Bytes for Set Loop Current Percentage

Byte	Format	Description
0 - 3	Float	Loop current percentage, units of percent.

Table 60: Response Data Bytes for Set Loop Current Percentage

Byte	Format	Description
0 - 3	Float	Loop current percentage, units of percent.

Table 61: Command-Specific Response Codes for Set Loop Current Percentage

Code	Class	Description
0	Success	No command-specific errors
1 - 2		Undefined
3	Error	Passed parameter too large
4	Error	Passed parameter too small
5	Error	Too few data bytes received
6	Error	Device-specific command error
7	Error	In write protect mode
8		Undefined
9	Error	Incorrect loop current mode or value
10 - 15		Undefined
16	Error	Access restricted
17 - 31		Undefined
32	Error	Busy
33 - 127		Undefined

Command 172 (0xAC): Set analog measurement range values

This command is to set the analog measurement range.

Table 62: Request Data Bytes for Set Analog Measurement Range Values

Byte	Format	Description
0	Unsigned-8	Upper and lower range values unit code
1 - 4	Float	Upper range value
5 - 8	Float	Lower range value

Table 63: Response Data Bytes for Set Analog Measurement Range Values

Byte	Format	Description
0	Unsigned-8	Upper and lower range values unit code
1 - 4	Float	Upper range value
5 - 8	Float	Lower range value

Table 64: Command-Specific Response Codes for Set Analog Measurement Range Values

Code	Class	Description
0	Success	No command-specific errors
1 - 4		Undefined
5	Error	Too few data bytes received
6	Error	Device-specific command error
7	Error	In write protect mode
8	Warning	Set to nearest possible value (upper or lower range pushed)
9	Error	Lower range value too high
10	Error	Lower range value too low
11	Error	Upper range value too high
12	Error	Upper range value too low
13-15		Undefined
16	Error	Access restricted
17		Undefined
18	Error	Invalid units code
19 - 31		Undefined
32	Error	Busy
33 - 127		Undefined

Command 173 (0xAD): Set loop current error handling

This command will set the loop current output error handling.

Table 65: Request Data Bytes for Set loop Current Error Handling

Byte	Format	Description
0	Unsigned-8	Analog output error handling: 0: Low; 1: High; 2: Hold; 3: Other value;
1 - 4	Float	Error value, unit is mA

Table 66: Response Data Bytes for Set loop Current Error Handling

Byte	Format	Description
0	Unsigned-8	Analog output error handling: 0: Low; 1: High; 2: Hold; 3: Other value;
1 - 4	Float	Error value, unit is mA

Table 67: Command-Specific Response Codes for Set loop Current Error Handling

Code	Class	Description
0	Success	No command-specific errors
1 - 4		Undefined
5	Error	Too few data bytes received
6	Error	Device-specific command error
7	Error	In write protect mode
8 - 15		Undefined
16	Error	Access restricted
17 - 127		Undefined

Command 176 (0xB0): Read digital configuration

This command is to read the digital output configuration.

Table 68: Request Data Bytes

Byte	Format	Description
None	Unsigned-8	Channel number (1/2)

Table 69: Response data bytes

Byte	Format	Description
0	Unsigned-8	Channel number
1	Unsigned-8	Digital output type: 0: Off; 1: Pulse; 2: Frequency; 3: Alarm;

Table 70: Command-Specific Response Codes

Code	Class	Description
0	Success	No command-specific errors
1		Undefined
2	Error	Invalid selection
3 - 4		Undefined
5	Error	Too few data bytes received
6	Error	Device-specific command error
7 - 127		Undefined

Command 177 (0xB1): Read pulse configuration

This command is to read the pulse configuration.

Table 71: Request Data Bytes for read pulse configuration

Byte	Format	Description
0	Unsigned-8	Channel number (1/2)

Table 72: Response data bytes for read pulse configuration

Byte	Format	Description
0	Unsigned-8	Channel number
1	Unsigned-8	Measurement type: 5: Forward batch total; 6: Reverse batch total; 7: Net batch total;
2	Unsigned-8	Pulse value unit
3 - 6	Float	Pulse value
7 - 10	Unsigned-32	Pulse time, unit is MS
11	Unsigned-8	Pulse error handling: 2: Hold good value; 4: Stop;

Table 73: Command-Specific Response Codes for read pulse configuration

Code	Class	Description
0	Success	No command-specific errors
1		Undefined
2	Error	Invalid selection
3 - 4		Undefined
5	Error	Too few data bytes received
6	Error	Device-specific command error
7 - 127		Undefined

Command 178 (0xB2): Read frequency configuration

This command is to read the frequency configuration.

Table 74: Request Data Bytes for Read Frequency Configuration

Byte	Format	Description
0	Unsigned-8	Channel number (1/2)

Table 75: Response Data Bytes for Read Frequency Configuration

Byte	Format	Description
0	Unsigned-8	Channel number
1	Unsigned-8	Measurement type
2	Unsigned-8	Frequency value unit
3 - 6	Float	Frequency base value
7 - 10	Float	Frequency full value
11 - 14	Unsigned-32	Full frequency, unit is Hz
15	Unsigned-8	Frequency error handling: 0: Low; 1: High; 2: Hold; 3: Value
16 - 19	Unsigned-32	Error handling value, unit is Hz

Table 76: Command-Specific Response Codes for Read Frequency Configuration

Code	Class	Description
0	Success	No command-specific errors
1		Undefined
2	Error	Invalid selection
3 - 4		Undefined
5	Error	Too few data bytes received
6	Error	Device-specific command error
7 - 127		Undefined

Command 179 (0xB3): Read alarm configuration

This command is to read the alarm configuration.

Table 77: Request Data Bytes for Read Alarm Configuration

Byte	Format	Description
0	Unsigned-8	Channel number (1/2)

Table 78: Response Data Bytes for Read Alarm Configuration

Byte	Format	Description
0	Unsigned-8	Channel number
1	Unsigned-8	Measurement type
2	Unsigned-8	Alarm value unit
3 - 6	Float	Alarm value
7	Unsigned-8	Alarm type: 0: Low; 1: High; 2: Fault
8	Unsigned-8	Alarm state: 0: Normally; 1: Failsafe;

Table 79: Command-Specific Response Codes for Read Alarm Configuration

Code	Class	Description
0	Success	No command-specific errors
1		Undefined
2	Error	Invalid selection
3 - 4		Undefined
5	Error	Too few data bytes received
6	Error	Device-specific command error
7 - 127		Undefined

Command 184 (0xB8): Write digital configuration

This command is to write the digital output configuration.

Table 80: Request Data Bytes for Write Digital Configuration

Byte	Format	Description
0	Unsigned-8	Channel number (1/2)
1	Unsigned-8	Digital output type: 0: Off; 1: Pulse; 2: Frequency; 3: Alarm;

Table 81: Response Data Bytes for Write Digital Configuration

Byte	Format	Description
0	Unsigned-8	Channel number(1/2)
1	Unsigned-8	Digital output type: 0: Off; 1: Pulse; 2: Frequency; 3: Alarm;

Table 82: Command-Specific Response Codes for Write Digital Configuration

Code	Class	Description
0	Success	No command-specific errors
1		Undefined
2	Error	Invalid selection
3 - 4		Undefined
5	Error	Too few data bytes received
6	Error	Device-specific command error
7	Error	In write protect mode
8 - 15		Undefined
16	Error	Access restricted
8 - 127		Undefined

Command 185 (0xB9): Write pulse configuration

This command is to write the pulse configuration.

Table 83: Request Data Bytes for Write Pulse Configuration

Byte	Format	Description
0	Unsigned-8	Channel number (1/2)
1	Unsigned-8	Measurement type: 5: Forward batch total; 6: Reverse batch total; 7: Net batch total; 38: Batch Std Fwd Total 39: Batch Std Rev Total 40: Batch Std Net Total 41: Batch Mass Fwd Total 42: Batch Mass Rev Total 43: Batch Mass Net Total
2	Unsigned-8	Pulse value unit
3 - 6	Float	Pulse value
7 - 10	Unsigned-32	Pulse time, unit is ms
11	Unsigned-8	Pulse error handling: 2: Hold good value; 4: Stop;

Table 84: Response Data Bytes for Write Pulse Configuration

Byte	Format	Description
0	Unsigned-8	Channel number(1/2)
1	Unsigned-8	Measurement type: 5: Forward batch total; 6: Reverse batch total; 7: Net batch total; 38: Batch Std Fwd Total 39: Batch Std Rev Total 40: Batch Std Net Total 41: Batch Mass Fwd Total 42: Batch Mass Rev Total 43: Batch Mass Net Total
2	Unsigned-8	Pulse value unit
3 - 6	Float	Pulse value
7 - 10	Float	Pulse time, unit is ms
11	Unsigned-8	Pulse error handling: 0: Hold good value; 1: Stop;

Table 85: Command-Specific Response Codes for Write Pulse Configuration

Code	Class	Description
0	Success	No command-specific errors
1		Undefined
2	Error	Invalid selection
3 - 4		Undefined
5	Error	Too few data bytes received
6	Error	Device-specific command error
7	Error	In write protect mode
8 - 15		Undefined
16	Error	Access restricted
8 - 127		Undefined

Command 186 (0xBA): Write frequency configuration

This command is to write the frequency configuration.

Table 86: Request Data Bytes for Write Frequency Configuration

Byte	Format	Description
0	Unsigned-8	Channel number (1/2)
1	Unsigned-8	Measurement type
2	Unsigned-8	Frequency value unit
3 - 6	Float	Frequency base value
7 - 10	Float	Frequency full value
11 - 14	Unsigned-32	Full frequency, unit is Hz
15	Unsigned-8	Frequency error handling: 0: Low; 1: High; 2: Hold; 3: Value
16 - 19	Unsigned-32	Error handling value, unit is Hz

Table 87: Response Data Bytes for Write Frequency Configuration

Byte	Format	Description
0	Unsigned-8	Channel number(1/2)
1	Unsigned-8	Measurement type
2	Unsigned-8	Frequency value unit
3 - 6	Float	Frequency base value
7 - 10	Float	Frequency full value
11 - 14	Float	Full frequency, unit is Hz

Table 87: Response Data Bytes for Write Frequency Configuration(Continued)

Byte	Format	Description
15	Unsigned-8	Frequency error handling: 0: Low; 1: High; 2: Hold; 3: Value
16 - 19	Unsigned-32	Error handling value, unit is Hz

Table 88: Command-Specific Response Codes for Write Frequency Configuration

Code	Class	Description
0	Success	No command-specific errors
1		Undefined
2	Error	Invalid selection
3 - 4		Undefined
5	Error	Too few data bytes received
6	Error	Device-specific command error
7	Error	In write protect mode
8 - 15		Undefined
16	Error	Access restricted
8 - 127		Undefined

Command 187 (0xBB): Write alarm configuration

This command is to write the alarm configuration.

Table 89: Request Data Bytes for Write Alarm Configuration

Byte	Format	Description
0	Unsigned-8	Channel number (1/2)
1	Unsigned-8	Measurement type
2	Unsigned-8	Alarm value unit
3 - 6	Float	Alarm value
7	Unsigned-8	Alarm type: 0: Low; 1: High; 2: Fault
8	Unsigned-8	Alarm state: 0: Normally; 1: Failsafe;

Table 90: Response Data Bytes for Write Alarm Configuration

Byte	Format	Description
0	Unsigned-8	Channel number(1/2)
1	Unsigned-8	Measurement type

Table 90: Response Data Bytes for Write Alarm Configuration(Continued)

Byte	Format	Description
2	Unsigned-8	Alarm value unit
3 - 6	Float	Alarm value
7	Unsigned-8	Alarm type: 0: Low; 1: High; 2: Fault
8	Unsigned-8	Alarm state: 0: Normally; 1: Failsafe;

Table 91: Command-Specific Response Codes for Write Alarm Configuration

Code	Class	Description
0	Success	No command-specific errors
1		Undefined
2	Error	Invalid selection
3 - 4		Undefined
5	Error	Too few data bytes received
6	Error	Device-specific command error
7	Error	In write protect mode
8 - 15		Undefined
16	Error	Access restricted
8 - 127		Undefined

Command 191 (0xBF): Test digital output

This command is to test the digital output

Table 92: Request Data Bytes for Test Digital Output

Byte	Format	Description
0	Unsigned-8	Channel number (1/2)
1	Unsigned-8	Test DO type Test stop Pulse Frequency Alarm
2 - 5	Unsigned-32	Test value

Table 93: Response Data Bytes for Test Digital Output

Byte	Format	Description
0	Unsigned-8	Channel number(1/2)
1	Unsigned-8	Test DO type Test stop Pulse Frequency Alarm;
2 - 5	Unsigned-32	Test value

Table 94: Command-Specific Response Codes for Test Digital Output

Code	Class	Description
0	Success	No command-specific errors
1		Undefined
2	Error	Invalid selection
3 - 4		Undefined
5	Error	Too few data bytes received
6	Error	Device-specific command error
7	Error	In write protect mode
8 - 15		Undefined
16	Error	Access restricted
8 - 127		Undefined

Command 192 (0xC0): Read pipe size

This command is to read pipe size.

Table 95: Request Data Bytes for Read Pipe Size

Byte	Format	Description
0	Unsigned-8	Optional channel selection

Table 96: Response Data Bytes for Read Pipe Size

Byte	Format	Description
0	Unsigned-8	Pipe size unit
1 - 4	Float	Pipe OD value
5 - 8	Float	Pipe ID value
9 - 12	Float	Pipe WT value

Table 97: Command-Specific Response Codes for Read Pipe Size

Code	Class	Description
0	Success	No command-specific errors
1 - 5		Undefined
6	Error	Device-specific command error
7 - 127		Undefined

Command 193 (0xC1): Read pipe material

This command is to read pipe material.

Table 98: Request Data Bytes for Read Pipe Material

Byte	Format	Description
0	Unsigned-8	Optional channel selection

Table 99: Response Data Bytes for Read Pipe Material

Byte	Format	Description
0 - 3	Unsigned-8	Pipe material
4 - 7	Float	Pipe sound speed

Table 100: Command-Specific Response Codes for Read Pipe Material

Code	Class	Description
0	Success	No command-specific errors
1 - 5		Undefined
6	Error	Device-specific command error
7 - 127		Undefined

Command 194 (0xC2): Read pipe lining attribute

This command is to read pipe lining attribute.

Table 101: Request Data Bytes for Read Pipe Lining Attribute

Byte	Format	Description
0	Unsigned-8	Optional channel selection

Table 102: Response Data Bytes for Read Pipe Lining Attribute

Byte	Format	Description
0	Unsigned-8	Lining existing
1 - 4	Float	Lining thickness
5 - 8	Unsigned-32	Lining material
9 - 12	Float	Lining sound speed

Table 103: Command-Specific Response Codes for Read Pipe Lining Attribute

Code	Class	Description
0	Success	No command-specific errors
1 - 5		Undefined
6	Error	Device-specific command error
7 - 127		Undefined

Command 195 (0xC3): Read sensor meter setup

This command is to read the sensor meter setup.

Table 104: Request Data Bytes for Read Sensor Meter Setup

Byte	Format	Description
0	Unsigned-8	Optional channel selection

Table 105: Response Data Bytes for Read Sensor Meter Setup

Byte	Format	Description
0 - 3	Float	Zero cutoff

Table 106: Command-Specific Response Codes for Read Sensor Meter Setup

Code	Class	Description
0	Success	No command-specific errors
1 - 5		Undefined
6	Error	Device-specific command error
7 - 127		Undefined

Command 196 (0xC4): Read transducer information

This command is to read transducer information.

Table 107: Request Data Bytes for Read Transducer Information

Byte	Format	Description
0	Unsigned-8	Optional channel selection

Table 108: Response Data Bytes for Read Transducer Information

Byte	Format	Description
0 - 3	Unsigned-32	Transducer type: 0: Other; 10: CPT-0.5 11: CPT-2.0 12: CPT-0.5-MT C-PB-05-M 13: CPT-1.0-MT C-PB-10-M 14: CPT-2.0-MT C-PB-20-M 15: CPT-0.5-HT 16: CPT-1.0-HT 17: CPT-2.0-HT 18: CPS-0.5 19: CPSM-2.0 20: CTS-1.0 21: CTS-1.0-HT 22: CTS-2.0 23: C-LP-40-HM

Table 108: Response Data Bytes for Read Transducer Information (Continued)

Byte	Format	Description
0 - 3	Unsigned-32	24: C-LP-40-NM 25: CPB-0.5-HT 26: CPB-2.0-MT 27: CPB-0.5-MT 28: CPB-2.0 29: CPB-0.5 30: CPS-1.0 CPT-1. 31: CWL-2 32: CPS-1.0 33: CPW (WT-1P-1.0 on AB82) 34: CPW (WT-1P-0.5 on NDT plastic) 35: CPW (WT-1P-1.0 on NDT plastic) 36: CPB-1.0-HT 37: CPB-2.0-HT 38: CPB-1.0 39: CPB-1.0-MT 40: WT-1/1P-10-00-NT 44: WT-1/1P-05-00-NT 71: PA-36-1P/WT-1/1P-10-00 72: PA-36-1P/WT-1/1P-10-00-HL 73: PA-PV-1P or F/WT-1/1P-10-EW 74: PA-36-1P-EW/WT-1/1P-10 75: PA-36-1P-EW/WT-1/1P-10-00-HL 301: C-RL-0.5 302: C-RL-1 304: C-RL-0.5 305: C-RL-1 307: C-RL-0.5 308: C-RL-1 310: C-RV-0.5 311: C-RV-1 313: C-RW-0.5 314: C-RW-1 401: C-RS 0.5M 402: C-RS 1M 403: C-RS 2M 407: UTXDR-2 408: UTXDR-5 601: CAT0.5M 602: CAT1M 603: CAT2M

Table 108: Response Data Bytes for Read Transducer Information (Continued)

Byte	Format	Description
4 - 7	Unsigned-32	Transducer frequency
8 - 11	Unsigned-32	Transducer wedge type
12 - 15	Float	Transducer wedge angle
16 - 19	Float	Transducer wedge angle
20 - 23	Float	Transducer Tw

Table 109: Command-Specific Response Codes for Read Transducer Information

Code	Class	Description
0	Success	No command-specific errors
1 - 5		Undefined
6	Error	Device-specific command error
7 - 127		Undefined

Command 197 (0xC5): Read transducer traverses and spacing

This command is to read transducer traverses and spacing.

Table 110: Request Data Bytes for Read Transducer Traverses and Spacing

Byte	Format	Description
0	Unsigned-8	Optional channel selection

Table 111: Response Data Bytes for Read Transducer Traverses and Spacing

Byte	Format	Description
0	Unsigned-8	Transducer traverse
1 - 4	Float	Transducer spacing

Table 112: Command-Specific Response Codes for Read Transducer Traverses and Spacing

Code	Class	Description
0	Success	No command-specific errors
1 - 5		Undefined
6	Error	Device-specific command error
7 - 127		Undefined

Command 198 (0xC6): Read fluid information

This command is to read fluid information.

Table 113: Request Data Bytes for Read Fluid Information

Byte	Format	Description
0	Unsigned-8	Optional channel selection

Table 114: Response Data Bytes for Read Fluid Information

Byte	Format	Description
0 - 3	Unsigned-32	Fluid type: 0: Other 1. Water
4 - 7	Float	Fluid SOS
8 - 11	Float	Fluid minimum SOS
12 - 15	Float	Fluid maximum SOS
16 - 19	Float	Fluid temperature

Table 115: Command-Specific Response Codes for Read Fluid Information

Code	Class	Description
0	Success	No command-specific errors
1 - 5		Undefined
6	Error	Device-specific command error
7 - 127		Undefined

Command 200 (0xC8): Write pipe size

This command is to write pipe size.

Table 116: Request Data Bytes for Write Pipe Size

Byte	Format	Description
0	Unsigned-8	Unit code
1 - 4	Float (32-bit)	Channel 1 OD
5 - 8	Float (32-bit)	Channel 1 ID
9 - 12	Float (32-bit)	Channel 1 Wall Thickness
13–16*	Float (32-bit)	Channel 2 OD (optional)
17–20*	Float (32-bit)	Channel 2 ID (optional)
21–24*	Float (32-bit)	Channel 2 Wall Thickness (optional)

Table 117: Response Data Bytes for Write Pipe Size

Byte	Format	Description
0	Unsigned-32	Unit code
1 - 4	Float (32-bit)	Channel 1 OD
5 - 8	Float (32-bit)	Channel 1 ID
9 - 12	Float (32-bit)	Channel 1 Wall Thickness
13–16*	Float (32-bit)	Channel 2 OD (if provided in request)
17–20*	Float (32-bit)	Channel 2 ID (if provided in request)
21–24*	Float (32-bit)	Channel 2 Wall Thickness (if provided in request)

Table 118: Command-Specific Response Codes for Write Pipe Size

Code	Class	Description
0	Success	No command-specific errors
1 - 4		Undefined
5	Error	Too few data bytes received
6	Error	Device-specific command error
7	Error	In write protect mode
8 - 15		Undefined
16	Error	Access restricted
17		Undefined
18	Error	Wrong unit code
19 - 127		Undefined

Command 201 (0xC9): Write pipe material

This command is to write pipe material.

Table 119: Request Data Bytes for Write Pipe Material

Byte	Format	Description
0 - 3	Unsigned-32	Channel 1 pipe material
4 - 7	Float (32-bit)	Channel 1 sound speed
8–11*	Unsigned-32	Channel 2 pipe material (optional)
12–15*	Float (32-bit)	Channel 2 sound speed (optional)

Table 120: Response data bytes for Write Pipe Material

Byte	Format	Description
0 - 3	Unsigned-32	Channel 1 pipe material
4 - 7	Float (32-bit)	Channel 1 sound speed
8–11*	Unsigned-32	Channel 2 pipe material (if provided)
12–15*	Float (32-bit)	Channel 2 sound speed (if provided)

Table 121: Command-Specific Response Codes for Write Pipe Material

Code	Class	Description
0	Success	No command-specific errors
1 - 4		Undefined
5	Error	Too few data bytes received
6	Error	Device-specific command error
7	Error	In write protect mode
8 - 15		Undefined
16	Error	Access restricted
17 - 127		Undefined

Command 202 (0xCA): Write pipe lining attribute

This command is to write pipe lining attribute.

Table 122: Request Data Bytes for Write Pipe Lining Attribute

Byte	Format	Description
0	Unsigned-8	Channel 1 lining existence
1 - 4	Float (32-bit)	Channel 1 lining thickness
5 - 8	Unsigned-32	Channel 1 lining material
9 - 12	Float (32-bit)	Channel 1 lining sound speed
13*	Unsigned-8	Channel 2 lining existence (if provided)
14–17*	Float (32-bit)	Channel 2 lining thickness (if provided)
18–21*	Unsigned-32	Channel 2 lining material (if provided)
22–25*	Float (32-bit)	Channel 2 lining sound speed (if provided)

Table 123: Response Data Bytes for Write Pipe Lining Attribute

Byte	Format	Description
0	Unsigned-8	Channel 1 lining existence
1 - 4	Float (32-bit)	Channel 1 lining thickness
5 - 8	Unsigned-32	Channel 1 lining material
9 - 12	Float (32-bit)	Channel 1 lining sound speed
13*	Unsigned-8	Channel 2 lining existence (optional)
14–17*	Float (32-bit)	Channel 2 lining thickness (optional)
18–21*	Unsigned-32	Channel 2 lining material (optional)
22–25*	Float (32-bit)	Channel 2 lining sound speed (optional)

Table 124: Command-Specific Response Codes for Write Pipe Lining Attribute

Code	Class	Description
0	Success	No command-specific errors
1 - 4		Undefined
5	Error	Too few data bytes received
6	Error	Device-specific command error
7	Error	In write protect mode
8 - 15		Undefined
16	Error	Access restricted
17 - 127		Undefined

Command 203 (0xCB): Write sensor meter setup

This command is to write sensor meter setup.

Table 125: Request Data Bytes for Write Sensor Meter Setup

Byte	Format	Description
0 - 3	Float (32-bit)	Channel 1 zero cutoff value
4–7*	Float (32-bit)	Channel 2 zero cutoff value (optional)

Table 126: Response Data Bytes

Byte	Format	Description
0 - 3	Float (32-bit)	Channel 1 zero cutoff value
4–7*	Float (32-bit)	Channel 2 zero cutoff value (optional)

Table 127: Command-Specific Response Codes for Write Sensor Meter Setup

Code	Class	Description
0	Success	No command-specific errors
1 - 4		Undefined
5	Error	Too few data bytes received
6	Error	Device-specific command error
7	Error	In write protect mode
8 - 15		Undefined

Table 127: Command-Specific Response Codes for Write Sensor Meter Setup(Continued)

Code	Class	Description
16	Error	Access restricted
17 - 127		Undefined

Command 204 (0xCC): Write transducer information

This command is to write transducer information.

Table 128: Request Data Bytes for Write Transducer Information

Byte	Format	Description
0–3	Unsigned-32	Channel 1 Transducer type: 0: Other 10: CPT-0.5 11: CPT-2.0 12: CPT-0.5-MT C-PB-05-M 13: CPT-1.0-MT C-PB-10-M 14: CPT-2.0-MT C-PB-20-M 15: CPT-0.5-HT 16: CPT-1.0-HT 17: CPT-2.0-HT 18: CPS-0.5 19: CPSM-2.0 20: CTS-1.0 21: CTS-1.0-HT 22: CTS-2.0 23: C-LP-40-HM 24: C-LP-40-NM 25: CPB-0.5-HT 26: CPB-2.0-MT 27: CPB-0.5-MT 28: CPB-2.0 29: CPB-0.5 30: CPS-1.0 CPT-1. 31: CWL-2 32: CPS-1.0 33: CPW (WT-1P-1.0 on AB82) 34: CPW (WT-1P-0.5 on NDT plastic) 35: CPW (WT-1P-1.0 on NDT plastic) 36: CPB-1.0-HT 37: CPB-2.0-HT 38: CPB-1.0

Table 128: Request Data Bytes for Write Transducer Information(Continued)

Byte	Format	Description
0–3	Unsigned-32	39: CPB-1.0-MT 40: WT-1/1P-10-00-NT 44: WT-1/1P-05-00-NT 71: PA-36-1P/WT-1/1P-10-00 72: PA-36-1P/WT-1/1P-10-00-HL 73: PA-PV-1P or F/WT-1/1P-10-EW 74: PA-36-1P-EW/WT-1/1P-10 75: PA-36-1P-EW/WT-1/1P-10-00-HL 301: C-RL-0.5 302: C-RL-1 304: C-RL-0.5 305: C-RL-1 307: C-RL-0.5 308: C-RL-1 310: C-RV-0.5 311: C-RV-1 313: C-RW-0.5 314: C-RW-1 401: C-RS 0.5M 402: C-RS 1M 403: C-RS 2M 407: UTXDR-2 408: UTXDR-5 601: CAT0.5M 602: CAT1M 603: CAT2M
4–7	Unsigned-32	Channel 1 transducer frequency
8–11	Unsigned-32	Channel 1 wedge type
12–15	Float (32-bit)	Channel 1 wedge angle
16–19	Float (32-bit)	Channel 1 wedge speed of sound
20–23	Float (32-bit)	Channel 1 wedge time
24–27*	Unsigned-32	Channel 2 Transducer type (optional): 0: Other 10: CPT-0.5 11: CPT-2.0 12: CPT-0.5-MT C-PB-05-M 13: CPT-1.0-MT C-PB-10-M 14: CPT-2.0-MT C-PB-20-M 15: CPT-0.5-HT 16: CPT-1.0-HT

Table 128: Request Data Bytes for Write Transducer Information(Continued)

Byte	Format	Description
24–27*	Unsigned-32	17: CPT-2.0-HT 18: CPS-0.5 19: CPSM-2.0 20: CTS-1.0 21: CTS-1.0-HT 22: CTS-2.0 23: C-LP-40-HM 24: C-LP-40-NM 25: CPB-0.5-HT 26: CPB-2.0-MT 27: CPB-0.5-MT 28: CPB-2.0 29: CPB-0.5 30: CPS-1.0 CPT-1. 31: CWL-2 32: CPS-1.0 33: CPW (WT-1P-1.0 on AB82) 34: CPW (WT-1P-0.5 on NDT plastic) 35: CPW (WT-1P-1.0 on NDT plastic) 36: CPB-1.0-HT 37: CPB-2.0-HT 38: CPB-1.0 39: CPB-1.0-MT 301: C-RL-0.5 302: C-RL-1 304: C-RL-0.5 305: C-RL-1 307: C-RL-0.5 308: C-RL-1 310: C-RV-0.5 311: C-RV-1 313: C-RW-0.5 314: C-RW-1 401: C-RS 0.5M 402: C-RS 1M 403: C-RS 2M 407: UTXDR-2 408: UTXDR-5 601: CAT0.5M 602: CAT1M 603: CAT2M

Table 128: Request Data Bytes for Write Transducer Information(Continued)

Byte	Format	Description
28–31*	Unsigned-32	Channel 2 transducer frequency (optional)
32–35*	Unsigned-32	Channel 2 wedge type (optional)
36–39*	Float (32-bit)	Channel 2 wedge angle (optional)
40–43*	Float (32-bit)	Channel 2 wedge speed of sound (optional)
44–47*	Float (32-bit)	Channel 2 wedge time (optional)

Table 129: Response Data Bytes for Write Transducer Information

Byte	Format	Description
0 - 3	Unsigned-32	Transducer type: 0: Other; 10: CPT-0.5 11: CPT-2.0 12: CPT-0.5-MT C-PB-05-M 13: CPT-1.0-MT C-PB-10-M 14: CPT-2.0-MT C-PB-20-M 15: CPT-0.5-HT 16: CPT-1.0-HT 17: CPT-2.0-HT 18: CPS-0.5 19: CPSM-2.0 20: CTS-1.0 21: CTS-1.0-HT 22: CTS-2.0 23: C-LP-40-HM 24: C-LP-40-NM 25: CPB-0.5-HT 26: CPB-2.0-MT 27: CPB-0.5-MT 28: CPB-2.0 29: CPB-0.5 30: CPS-1.0 CPT-1. 31: CWL-2 32: CPS-1.0 33: CPW (WT-1P-1.0 on AB82) 34: CPW (WT-1P-0.5 on NDT plastic) 35: CPW (WT-1P-1.0 on NDT plastic) 36: CPB-1.0-HT 37: CPB-2.0-HT 38: CPB-1.0

Table 129: Response Data Bytes for Write Transducer Information(Continued)

Byte	Format	Description
0 - 3	Unsigned-32	39: CPB-1.0-MT 40: WT-1/1P-10-00-NT 44: WT-1/1P-05-00-NT 71: PA-36-1P/WT-1/1P-10-00 72: PA-36-1P/WT-1/1P-10-00-HL 73: PA-PV-1P or F/WT-1/1P-10-EW 74: PA-36-1P-EW/WT-1/1P-10 75: PA-36-1P-EW/WT-1/1P-10-00-HL 301: C-RL-0.5 302: C-RL-1 304: C-RL-0.5 305: C-RL-1 307: C-RL-0.5 308: C-RL-1 310: C-RV-0.5 311: C-RV-1 313: C-RW-0.5 314: C-RW-1 401: C-RS 0.5M 402: C-RS 1M 403: C-RS 2M 407: UTXDR-2 408: UTXDR-5 601: CAT0.5M 602: CAT1M 603: CAT2M
4 - 7	Unsigned-32	Channel 1 transducer frequency
8 - 11	Unsigned-32	Channel 1 wedge type
12 – 15	Float (32-bit)	Channel 1 wedge angle
16 – 19	Float (32-bit)	Channel 1 wedge speed of sound
20 - 23	Float (32-bit)	Channel 1 wedge time
24–27*	Unsigned-32	Channel 2 Transducer type (optional): 0: Other 10: CPT-0.5 11: CPT-2.0 12: CPT-0.5-MT C-PB-05-M 13: CPT-1.0-MT C-PB-10-M 14: CPT-2.0-MT C-PB-20-M 15: CPT-0.5-HT 16: CPT-1.0-HT 17: CPT-2.0-HT

Table 129: Response Data Bytes for Write Transducer Information(Continued)

Byte	Format	Description
24–27*	Unsigned-32	18: CPS-0.5 19: CPSM-2.0 20: CTS-1.0 21: CTS-1.0-HT 22: CTS-2.0 23: C-LP-40-HM 24: C-LP-40-NM 25: CPB-0.5-HT 26: CPB-2.0-MT 27: CPB-0.5-MT 28: CPB-2.0 29: CPB-0.5 30: CPS-1.0 CPT-1. 31: CWL-2 32: CPS-1.0 33: CPW (WT-1P-1.0 on AB82) 34: CPW (WT-1P-0.5 on NDT plastic) 35: CPW (WT-1P-1.0 on NDT plastic) 36: CPB-1.0-HT 37: CPB-2.0-HT 38: CPB-1.0 39: CPB-1.0-MT 301: C-RL-0.5 302: C-RL-1 304: C-RL-0.5 305: C-RL-1 307: C-RL-0.5 308: C-RL-1 310: C-RV-0.5 311: C-RV-1 313: C-RW-0.5 314: C-RW-1 401: C-RS 0.5M 402: C-RS 1M 403: C-RS 2M 407: UTXDR-2 408: UTXDR-5 601: CAT0.5M 602: CAT1M 603: CAT2M
28–31*	Unsigned-32	Channel 2 transducer frequency (optional)

Table 129: Response Data Bytes for Write Transducer Information(Continued)

Byte	Format	Description
32–35*	Unsigned-32	Channel 2 wedge type (optional)
36–39*	Float (32-bit)	Channel 2 wedge angle (optional)
40–43*	Float (32-bit)	Channel 2 wedge speed of sound (optional)
44–47*	Float (32-bit)	Channel 2 wedge time (optional)

Table 130: Command-Specific Response Codes for Write Transducer Information

Code	Class	Description
0	Success	No command-specific errors
1 - 4		Undefined
5	Error	Too few data bytes received
6	Error	Device-specific command error
7	Error	In write protect mode
8 - 15		Undefined
16	Error	Access restricted
17 - 127		Undefined

Command 205 (0xCD): Write Transducer Traverses and Spacing

This command is to write transducer traverses and spacing.

Table 131: Request Data Bytes or Write Transducer Traverses and Spacing

Byte	Format	Description
0–3	Unsigned-32	Channel 1 traverse count
4–7	Float (32-bit)	Channel 1 spacing value
8–11*	Unsigned-32	Channel 2 traverse count (optional)
12–15*	Float (32-bit)	Channel 2 spacing value (optional)

Table 132: Response Data Bytes for Write Transducer Traverses and Spacing

Byte	Format	Description
0	Mixed	Channel 1 traverse and spacing
1 - 4	Mixed	Channel 2 traverse and spacing (if provided)

Table 133: Command-Specific Response Codes for Write Transducer Traverses and Spacing

Code	Class	Description
0	Success	No command-specific errors
1 - 4		Undefined
5	Error	Too few data bytes received
6	Error	Device-specific command error
7	Error	In write protect mode
8 - 15		Undefined
16	Error	Access restricted
17 - 127		Undefined

Command 206 (0xCE): Write Fluid Information

This command is to write fluid information.

Table 134: Request Data Bytes for Write Fluid Information

Byte	Format	Description
0 - 3	Unsigned-32	Channel 1 fluid type
4 - 7	Float (32-bit)	Channel 1 speed of sound
8 - 11	Float (32-bit)	Channel 1 minimum speed of sound
12 - 15	Float (32-bit)	Channel 1 maximum speed of sound
16 - 19	Float (32-bit)	Channel 1 temperature
20–23*	Float (32-bit)	Channel 2 fluid type (optional)
24–27*	Float (32-bit)	Channel 2 speed of sound (optional)
28–31*	Float (32-bit)	Channel 2 minimum speed of sound (optional)
32–35*	Float (32-bit)	Channel 2 maximum speed of sound (optional)
36–39*	Float (32-bit)	Channel 2 temperature (optional)

Table 135: Response Data Bytes for Write Fluid Information

Byte	Format	Description
0 - 3	Unsigned-32	Channel 1 fluid type
4 - 7	Float (32-bit)	Channel 1 speed of sound
8 - 11	Float (32-bit)	Channel 1 minimum speed of sound
12 - 15	Float (32-bit)	Channel 1 maximum speed of sound
16 - 19	Float (32-bit)	Channel 1 temperature
20–23*	Unsigned-32	Channel 2 fluid type (optional)
24–27*	Float (32-bit)	Channel 2 speed of sound (optional)
28–31*	Float (32-bit)	Channel 2 minimum speed of sound (optional)
32–35*	Float (32-bit)	Channel 2 maximum speed of sound (optional)
36–39*	Float (32-bit)	Channel 2 temperature (optional)

Table 136: Command-Specific Response Codes

Code	Class	Description
0	Success	No command-specific errors
1		Undefined
2	Error	Invalid selection
3 - 4		Undefined
5	Error	Too few data bytes received
6	Error	Device-specific command error
7	Error	In write protect mode
8 - 15		Undefined
16	Error	Access restricted
17 - 127		Undefined

Command 208 (0xD0): Read calibration configuration

This command is to read calibration configuration.

Table 137: Request Data Bytes for Read Calibration Configuration

Byte	Format	Description
0	Unsigned-8	Optional channel selection

Table 138: Response Data Bytes for Read Calibration Configuration

Byte	Format	Description
0	Unsigned-8	Reynolds correction
1	Unsigned-8	Active MultiK Enable
2	Unsigned-8	KFactor type: 0: Velocity, 1: Reynolds
3 - 6	Float	Static KFactor
7	Unsigned-8	KFactor points
8 - 11	Float	Kinematic viscosity

Table 139: Command-Specific Response Codes for Read Calibration Configuration

Code	Class	Description
0	Success	No command-specific errors
1 - 5		Undefined
6	Error	Device-specific command error
7 - 127		Undefined

Command 209 (0xD1): Read velocity KFactor table

This command is to read the velocity KFactor table.

Table 140: Request Data Bytes for Read Velocity KFactor Table

Byte	Format	Description
0	Unsigned-8	Channel Index

Table 141: Response Data Bytes for Read Velocity KFactor Table

Byte	Format	Description
0	Unsigned-8	Channel Index
1	Unsigned-8	Unit code
2 - 5	Float (32-bit)	Velocity
6 - 9	Float (32-bit)	K-Factor

Table 142: Command-Specific Response Codes for Read Velocity KFactor Table

Code	Class	Description
0	Success	No command-specific errors
1		Undefined
2	Error	Invalid selection
3 - 4		Undefined
5	Error	Too few data bytes received
6	Error	Device-specific command error
7 - 127		Undefined

Command 210 (0xD2): read Reynolds KFactor table

This command is to read Reynolds KFactor table.

Table 143: Request Data Bytes for Read Reynolds KFactor Table

Byte	Format	Description
0	Unsigned-8	Channel Index

Table 144: Response Data Bytes for Read Reynolds KFactor Table

Byte	Format	Description
0	Unsigned-8	Channel Index
1 - 4	Float (32-bit)	Reynolds Number
5 - 8	Float (32-bit)	K-Factor

Table 145: Command-Specific Response Codes for Read Reynolds KFactor Table

Code	Class	Description
0	Success	No command-specific errors
1		Undefined
2	Error	Invalid selection
3 - 4		Undefined
5	Error	Too few data bytes received
6	Error	Device-specific command error
7 - 127		Undefined

Command 216 (0xD8): Write calibration configuration

This command is to write calibration configuration.

Table 146: Request Data Bytes for Write Calibration Configuration

Byte	Format	Description
0	Unsigned-8	Channel 1 Reynolds correction enable
1	Unsigned-8	Channel 1 MultiK enable
2	Unsigned-8	Channel 1 MultiK type
3 - 6	Float (32-bit)	Channel 1 calibration factor
7	Unsigned-8	Channel 1 MultiK pairs
8 - 11	Float (32-bit)	Channel 1 kinematic viscosity
12	Unsigned-8	Channel 2 Reynolds correction enable (optional)
13	Unsigned-8	Channel 2 MultiK enable (optional)
14	Unsigned-8	Channel 2 MultiK type (optional)
15–18	Float (32-bit)	Channel 2 calibration factor (optional)
19	Unsigned-8	Channel 2 MultiK pairs (optional)
20–23	Float (32-bit)	Channel 2 kinematic viscosity (optional)

Table 147: Response Data Bytes for Write Calibration Configuration

Byte	Format	Description
0	Unsigned-8	Channel 1 Reynolds correction enable
1	Unsigned-8	Channel 1 MultiK enable
2	Unsigned-8	Channel 1 MultiK type
3 - 6	Float (32-bit)	Channel 1 calibration factor
7	Unsigned-8	Channel 1 MultiK pairs
8 - 11	Float (32-bit)	Channel 1 kinematic viscosity
12	Unsigned-8	Channel 2 Reynolds correction enable (optional)
13	Unsigned-8	Channel 2 MultiK enable (optional)
14	Unsigned-8	Channel 2 MultiK type (optional)
15–18	Float (32-bit)	Channel 2 calibration factor (optional)
19	Unsigned-8	Channel 2 MultiK pairs (optional)
20–23	Float (32-bit)	Channel 2 kinematic viscosity (optional)

Table 148: Command-Specific Response Codes for Write Calibration Configuration

Code	Class	Description
0	Success	No command-specific errors
1 - 4		Undefined
5	Error	Too few data bytes received
6	Error	Device-specific command error
7	Error	In write protect mode
8 - 15		Undefined
16	Error	Access restricted
17 - 127		Undefined

Command 217 (0xD9): Write velocity KFactor table

This command is to write velocity KFactor table

Table 149: Request Data Bytes for Write Velocity KFactor Table

Byte	Format	Description
0	Unsigned-8	Index
1	Unsigned-8	Velocity unit
2 - 5	Float	Velocity value
6 - 9	Float	Velocity KV value;

Table 150: Response Data Bytes for Write Velocity KFactor Table

Byte	Format	Description
0	Unsigned-8	Index
1	Unsigned-8	Velocity unit
2 - 5	Float	Velocity value
6 - 9	Float	Velocity KV value;

Table 151: Command-Specific Response Codes for Write Velocity KFactor Table

Code	Class	Description
0	Success	No command-specific errors
1		Undefined
2	Error	Invalid selection
3 - 4		Undefined
5	Error	Too few data bytes received
6	Error	Device-specific command error
7	Error	In write protect mode
8 - 15		Undefined
16	Error	Access restricted
17 - 127		Undefined

Command 218 (0xDA): Write Reynolds KFactor Table

This command is to write Reynolds KFactor table.

Table 152: Request Data Bytes for Write Reynolds KFactor Table

Byte	Format	Description
0	Unsigned-8	Index
1 - 4	Float	Reynolds value
5 - 8	Float	Reynolds KV value;

Table 153: Response Data Bytes for Write Reynolds KFactor Table

Byte	Format	Description
0	Unsigned-8	Index
1 - 4	Float	Reynolds value
5 - 8	Float	Reynolds KV value;

Table 154: Command-Specific Response Codes for Write Reynolds KFactor Table

Code	Class	Description
0	Success	No command-specific errors
1		Undefined
2	Error	Invalid selection
3 - 4		Undefined
5	Error	Too few data bytes received
6	Error	Device-specific command error
7	Error	In write protect mode
8 - 15		Undefined
16	Error	Access restricted
17 - 127		Undefined

Command 224 (0xE0): Read error limits

This command is to read flow meter error limits.

Table 155: Request Data Bytes for Read Error Limits

Byte	Format	Description
0	Unsigned-8	Error limit: 1. Correlation peak limit 2. Acceleration limit 3. Velocity low limit 4. Velocity high limit 5. Amp disc min 6. Amp disc max 7. Signal low limit 8. Sound speed limit 9. Errors allowed

Table 156: Response Data Bytes for Read Error Limits

Byte	Format	Description
0	Unsigned-8	Error limit: 1. Correlation peak limit 2. Acceleration limit 3. Velocity low limit 4. Velocity high limit 5. Amp disc min 6. Amp disc max 7. Signal low limit 8. Sound speed limit 9. Errors allowed
1 - 4	Float	Error limit value;

Table 157: Command-Specific Response Codes for Read Error Limits

Code	Class	Description
0	Success	No command-specific errors
1		Undefined
2	Error	Invalid selection
3 - 4		Undefined
5	Error	Too few data bytes received
6	Error	Device-specific command error
7 - 127		Undefined

Command 225 (0xE1): Read signal setup

This command is to read flow meter signal setup.

Table 158: Request Data Bytes for Read Signal Setup

Byte	Format	Description
0	Unsigned-8	Signal setup type: 1. Delta T offset 2. Percentage peak 3. Min peak percentage 4. Max peak percentage

Table 159: Response Data Bytes for Read Signal Setup

Byte	Format	Description
0	Unsigned-8	Signal setup type: 1. Delta T offset 2. Percentage peak 3. Min peak percentage 4. Max peak percentage
1 - 4	Float	Signal setup value

Table 160: Command-Specific Response Codes for Read Signal Setup

Code	Class	Description
0	Success	No command-specific errors
1		Undefined
2	Error	Invalid selection
3 - 4		Undefined
5	Error	Too few data bytes received
6	Error	Device-specific command error
7 - 127		Undefined

Command 226 (0xE2): Read flowmeter S/N

This command is to read flow meter s/n.

Table 161: Request Data Bytes for Read Flowmeter S/N

Byte	Format	Description
0	Unsigned-8	Flowmeter S/N: 1. Electronic S/N 2. UP sensor 3. S/N 4. DN sensor S/N

Table 162: Response Data Bytes for Read Flowmeter S/N

Byte	Format	Description
0	Unsigned-8	Signal setup type: 1. Electronic S/N 2. UP sensor 3. S/N 4. DN sensor S/N
1 - 4	Unsigned-8	S/N

Table 163: Command-Specific Response Codes for Read Flowmeter S/N

Code	Class	Description
0	Success	No command-specific errors
1		Undefined
2	Error	Invalid selection
3 - 4		Undefined
5	Error	Too few data bytes received
6	Error	Device-specific command error
7 - 127		Undefined

Command 227 (0xE3): Read flowmeter version

This command is to read flow meter version.

Table 164: Request Data Bytes for Read Flowmeter Version

Byte	Format	Description
0	Unsigned-8	Flowmeter version 1. Main hardware version 2. Main software version

Table 165: Response Data Bytes for Read Flow Meter Version

Byte	Format	Description
0	Unsigned-8	Version type: 1. Main hardware version 2. Main software version
1 - 8	Unsigned-8	Version number

Table 166: Command-Specific Response Codes for Read Flow Meter Version

Code	Class	Description
0	Success	No command-specific errors
1		Undefined
2	Error	Invalid selection
3 - 4		Undefined
5	Error	Too few data bytes received

Table 166: Command-Specific Response Codes for Read Flow Meter Version(Continued)

Code	Class	Description
6	Error	Device-specific command error
7 - 127		Undefined

Command 232 (0xE8): Write error limits

This command is to write flow meter error limits.

Table 167: Request Data Bytes for Write Error Limits

Byte	Format	Description
0	Unsigned-8	Error limit: Correlation peak limit Acceleration limit Velocity low limit Velocity high limit Amp disc min Amp disc max Signal low limit Sound speed limit Errors allowed
1 - 4	Float	Error limit value;

Table 168: Response Data Bytes for Write Error Limits

Byte	Format	Description
0	Unsigned-8	Error limit: Correlation peak limit Acceleration limit Velocity low limit Velocity high limit Amp disc min Amp disc max Signal low limit Sound speed limit Errors allowed
1 - 4	Float	Error limit value;

Table 169: Command-Specific Response Codes for Write Error Limits

Code	Class	Description
0	Success	No command-specific errors
1		Undefined
2	Error	Invalid selection
3 - 4		Undefined
5	Error	Too few data bytes received

Table 169: Command-Specific Response Codes for Write Error Limits(Continued)

Code	Class	Description
6	Error	Device-specific command error
7	Error	In write protect mode
8 - 15		Undefined
16	Error	Access restricted
17 - 127		Undefined

Command 233 (0xE9): Write Signal Setup

This command is to write flow meter signal setup.

Table 170: Request Data Bytes for Write Signal Setup

Byte	Format	Description
0	Unsigned-8	Signal setup type: Delta T offset percentage peak Min peak percentage Max peak percentage
1 - 4	Float	Signal setup value

Table 171: Response Data Bytes for Write Error Limits

Byte	Format	Description
0	Unsigned-8	Signal setup type: Delta T offset percentage peak Min peak percentage Max peak percentage
1 - 4	Float	Signal setup value

Table 172: Command-Specific Response Codes for Write Signal Setup

Code	Class	Description
0	Success	No command-specific errors
1		Undefined
2	Error	Invalid selection
3 - 4		Undefined
5	Error	Too few data bytes received
6	Error	Device-specific command error
7	Error	In write protect mode
8 - 15		Undefined
16	Error	Access restricted
17 - 127		Undefined

Command 239 (0xEF): Reset flow meter data

This command is to reset flow meter data.

Table 173: Request Data Bytes for Reset Flow Meter Data

Byte	Format	Description
0	Unsigned-8	Reset type: 1. Reset error log 2. Forward inventory 3. Reverse inventory 4. All

Table 174: Response Data Bytes for Reset Flow Meter Data

Byte	Format	Description
0	Unsigned-8	Reset type: Reset error log Forward inventory Reverse inventory

Table 175: Command-Specific Response Codes for Reset Flow Meter Data

Code	Class	Description
0	Success	No command-specific errors
1		Undefined
2	Error	Invalid selection
3 - 4		Undefined
5	Error	Too few data bytes received
6	Error	Device-specific command error
7	Error	In write protect mode
8 - 15		Undefined
16	Error	Access restricted
17 - 127		Undefined

Command 241 (0xF1): Read the factory setting

This command is to read the factory setting.

Table 176: Request Data Bytes for Read the Factory Setting

Byte	Format	Description
None		

Table 177: Response Data Bytes for Read the Factory Setting

Byte	Format	Description
0	Unsigned-8	Response time 0.5s 1s 5s 10s 30s 60s
1 - 4	Unsigned-32	Sample Size: 2 4 8 16 32

Table 178: Command-Specific Response Codes for Read the Factory Setting

Code	Class	Description
0	Success	No command-specific errors
1		Undefined
2	Error	Invalid selection
3 - 4		Undefined
5	Error	Too few data bytes received
6	Error	Device-specific command error
7 - 127		Undefined

Command 248 (0xF8): Write the Factory Setting

This command is to Write the Factory Setting.

Table 179: Request Data Bytes for Write the Factory Setting

Byte	Format	Description
0	Unsigned-8	Response time 0.5s 1s 5s 10s 30s 60s
1 - 4	Unsigned-32	Sample size: 2 4 8 16 32

Table 180: Response Data Bytes for Write the Factory Setting

Byte	Format	Description
0	Unsigned-8	Response time 0.5s 1s 5s 10s 30s 60s
1 - 4	Unsigned-32	Sample size: 2 4 8 16 32

Table 181: Command-Specific Response Codes for Write the Factory Setting

Code	Class	Description
0	Success	No command-specific errors
1		Undefined
2	Error	Invalid selection
3 - 4		Undefined
5	Error	Too few data bytes received
6	Error	Device-specific command error

Table 181: Command-Specific Response Codes for Write the Factory Setting(Continued)

Code	Class	Description
7	Error	In write protect mode
8 - 15		Undefined
16	Error	Access restricted
17 - 127		Undefined

Command 253 (0xFD): Reset to Factory Setting

This command is to reset the setting to the factory default.

Table 182: Request Data Bytes for Reset to Factory Setting

Byte	Format	Description
None		

Table 183: Response Data Bytes for Reset to Factory Setting

Byte	Format	Description
None		

Table 184: Command-Specific Response Codes for Reset to Factory Setting

Code	Class	Description
0	Success	No command-specific errors
1 - 4		Undefined
5	Error	Too few data bytes received
6	Error	Device-specific command error
7	Error	In write protect mode
8 - 15		Undefined
16	Error	Access restricted
17 - 127		Undefined

6.3 Additional Device Status

Command 48 returns 4 bytes of data, with

Table 185: HART Additional Device Status

HART additional device status			Class	Device status bits set
Byte	Bit	Error description		
0	0	Amplitude error	Error	4, 7
	1	Low signal	Error	4, 7
	2	Sound speed error	Error	4, 7
	3	Velocity range	Error	4, 7
	4	Signal quality	Error	4, 7
	5	Cycle skip	Error	4, 7
	6	Reserve		
	7	Reserve		
1	0	Reserve		
	1	Reserve		
	2	Reserve		
	3	Reserve		
	4	Reserve		
	5	Reserve		
	6	Reserve		
	7	Reserve		
2	0	FPGA error;		4, 7
	1	Setting files CRC error;		4, 7
	2	Flash error		4, 7
	3	KEY/LED error		4, 7
	4	I/O error		4, 7
	5	Display error		4, 7
	6	RTC error		4, 7
	7	Reserve		
3	0	In configure mode;		4, 0
	1	Not calibrated;		4, 0
	2	Reserve		
	3	Reserve		
	4	Reserve		
	5	Reserve		
	6	Reserve		
	7	Reserve		

6.4 Device Variables

Table 186: Device Variables

Measurement	Device variable code	Device variable classification code	
		Code	Classification
Velocity	0	67	Velocity
Actual volumetric	1	66	Volumetric Flow
Standard Volumetric	2	66	Volumetric Flow
Mass Flow	3	72	Mass Flow
Batch Forward Total	4	68	Volumetric
Batch Reverse Total	5	68	Volumetric
Batch Net Total	6	68	Volumetric
Batch Time	7	70	Time
ActiveTw Peak Index Up	8	0	Not Classified
ActiveTw Peak Index Dn	9	0	Not Classified
ActiveTw Peak Pct Up	10	0	Not Classified
ActiveTw Peak Pct Dn	11	0	Not Classified
Transit Time Up	12	70	Time
Transit Time Dn	13	70	Time
Delta T	14	70	Time
Signal Quality Up	15	0	Not Classified
Signal Quality Dn	16	0	Not Classified
Amp Disc Up	17	70	Not Classified
Amp Disc Dn	18	70	Not Classified
SNR Up	19	70	Not Classified
SNR Dn	20	0	Not Classified
Active TW Up	21	0	Time
Active TW Dn	22	0	Time
Gain Up	23	0	Not Classified
Gain Dn	24	0	Not Classified
Sound Speed	25	0	Velocity
Reynolds KFactor	26	0	Not Classified
Multi K KFactor	27	0	Not Classified
Peak Up	28	0	Not Classified
Peak Dn	29	0	Not Classified
Peak Pct Up	30	0	Not Classified
Peak Pct Dn	31	0	Not Classified
Active Tw Gain Up	32	0	Not Classified
Active Tw Gain Dn	33	0	Not Classified
Active Tw SNR Up	34	0	Not Classified
Active Tw SNR Dn	35	0	Not Classified
Active Tw Amp Up	36	0	Not Classified
Active Tw Amp Dn	37	0	Not Classified
Batch Std Fwd Total	38	68	Volumetric

Table 186: Device Variables(Continued)

Measurement	Device variable code	Device variable classification code	
		Code	Classification
Batch Std Rev Total	39	68	Volumetric
Batch Std Net Total	40	68	Volumetric
Batch Mass Fwd Total	41	68	Volumetric
Batch Mass Rev Total	42	68	Volumetric
Batch Mass Net Total	43	68	Volumetric
Reynolds Number	44	0	Not Classified
Ch2 Velocity	45	67	Velocity
Ch2 Actual Volumetric	46	66	Volumetric Flow
Ch2 Standard Volumetric	47	66	Volumetric Flow
Ch2 Mass Flow	48	72	Mass Flow
Ch2 Batch Forward Total	49	68	Volumetric
Ch2 Batch Reverse Total	50	68	Volumetric
Ch2 Batch Net Total	51	68	Volumetric
Ch2 Batch Time	52	70	Time
Ch2 ActiveTw Peak Index Up	53	0	Not Classified
Ch2 ActiveTw Peak Index Dn	54	0	Not Classified
Ch2 ActiveTw Peak Pct Up	55	0	Not Classified
Ch2 ActiveTw Peak Pct Dn	56	0	Not Classified
Ch2 Transit Time Up	57	70	Time
Ch2 Transit Time Dn	58	70	Time
Ch2 Delta T	59	70	Time
Ch2 Signal Quality Up	60	0	Not Classified
Ch2 Signal Quality Dn	61	0	Not Classified
Ch2 Amp Disc Up	62	70	Not Classified
Ch2 Amp Disc Dn	63	70	Not Classified
Ch2 SNR Up	64	70	Not Classified
Ch2 SNR Dn	65	0	Not Classified
Ch2 Active TW Up	66	0	Time
Ch2 Active TW Dn	67	0	Time
Ch2 Gain Up	68	0	Not Classified
Ch2 Gain Dn	69	0	Not Classified
Ch2 Sound Speed	70	0	Velocity
Ch2 Reynolds KFactor	71	0	Not Classified
Ch2 Multi K KFactor	72	0	Not Classified
Ch2 Peak Up	73	0	Not Classified
Ch2 Peak Dn	74	0	Not Classified
Ch2 Peak Pct Up	75	0	Not Classified
Ch2 Peak Pct Dn	76	0	Not Classified
Ch2 Active Tw Gain Up	77	0	Not Classified
Ch2 Active Tw Gain Dn	78	0	Not Classified

Table 186: Device Variables(Continued)

Measurement	Device variable code	Device variable classification code	
		Code	Classification
Ch2 Active Tw SNR Up	79	0	Not Classified
Ch2 Active Tw SNR Dn	80	0	Not Classified
Ch2 Active Tw Amp Up	81	0	Not Classified
Ch2 Active Tw Amp Dn	82	0	Not Classified
Ch2 Batch Std Fwd Total	83	68	Volumetric
Ch2 Batch Std Rev Total	84	68	Volumetric
Ch2 Batch Std Net Total	85	68	Volumetric
Ch2 Batch Mass Fwd Total	86	68	Volumetric
Ch2 Batch Mass Rev Total	87	68	Volumetric
Ch2 Batch Mass Net Total	88	68	Volumetric
Ch2 Reynolds Number	89	0	Not Classified
Composite Velocity	90	67	Velocity
Composite Volumetric	91	66	Volumetric Flow
Composite Standard Volumetric	92	66	Volumetric Flow
Composite Mass Flow	93	72	Mass Flow
Composite Batch Fwd Total	94	68	Volumetric
Composite Batch Rev Total	95	68	Volumetric
Composite Batch Net Total	96	68	Volumetric
Composite Batch Total Time	97	0	Time
Composite Batch Std Fwd Total	98	68	Volumetric
Composite Batch Std Rev Total	99	68	Volumetric
Composite Batch Std Net Total	100	68	Volumetric
Composite Batch Mass Fwd Total	101	68	Volumetric
Composite Batch Mass Rev Total	102	68	Volumetric
Composite Batch Mass Net Total	103	68	Volumetric

6.5 HART Engineering Units

The unit types allowed for the AT620 flow meter device variables are listed below

Table 187: HART Engineering Units

Device variable		Unit	
Code	Classification	Code	Description
64	Temperature	32	Degrees Celsius
		33	Degrees Fahrenheit
66	Volumetric flow	27	Cubic feet per day
		130	Cubic feet per hour
		15	Cubic feet per minute
		26	Cubic feet per second
		187	Standard cubic feet per day
		185	Standard cubic feet per hour
		123	Standard cubic feet per minute
		186	Standard cubic feet per second
		29	Cubic meter per day
		19	Cubic meter per hour
		131	Cubic meters per minute
		28	Cubic meters per second
		240	Million cubic meters per day
		187	Standard cubic meter per day
		188	Standard cubic meter per hour
		189	Standard cubic meter per minute
		190	Standard cubic meter per second
		235	Gallon per day
		136	Gallons per hour
		16	Gallons per minute
		22	Gallons per second
		135	Barrels per day
		134	Barrels per hour
		133	Barrels per minute
		132	Barrels per second
		174	Liters per day
		138	Liters per hour
		17	Liters per minute
		24	Liters per second
		25	Million liters per day
		177	Standard liter per day
		178	Standard liter per hour
		179	Standard liter per minute
		180	Standard liter per second

Table 187: HART Engineering Units(Continued)

Device variable		Unit	
Code	Classification	Code	Description
67	Velocity	20	Feet per second
		21	Meters per second
68	Volume	43	Cubic meter
		41	Cubic decimeter (liter)
		243	Mega liters
		244	Million cubic meter
		112	Cubic feet
		40	Gallon
		46	Barrel
		245	Mega gallons
		246	Million cubic feet
		172	Standard cubic meter
		171	Standard liters
		61	Kilogram
		62	Metric ton
		168	Standard cubic feet
		63	Pound
		247	Kilo pound
		64	Short tons
69	Length	44	Feet
		47	Inch
		45	Meter
		49	Millimeter
70	Time	172	Nanoseconds
		171	Microseconds
		170	Milliseconds
		51	Seconds
		50	Minute
		52	Hour
		53	Day

Table 187: HART Engineering Units(Continued)

Device variable		Unit	
Code	Classification	Code	Description
72	Mass flow	73	Kilograms per seconds
		74	Kilograms per minute
		75	Kilograms per hour
		76	Kilograms per day
		242	Metric tons per second
		77	Metric tons per minute
		78	Metric tons per hour
		79	Metric tons per day
		80	Pounds per seconds
		81	Pounds per minute
		82	Pounds per hour
		83	Pounds per day
		241	Short ton per seconds
		84	Short ton per minute
		85	Short ton per hour
		86	Short ton per day
73	Mass per volume	94	Pounds per cubic feet
		92	Kilograms per cubic meter
74	Viscosity	54	Centistokes
		248	Square meter per sec
81	Analytical	57	Percent
96	Acceleration	171	Feet per second squared
		172	Meter per second squared
0	Not Classification	38	dB
		156	Hertz

Appendix A. Specifications

A.1 Overall 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

Flow measurement: Correlation Transit-Time™ mode

Pipe sizes: 0.5 in. (15 mm) or greater

Pipe materials: All metals and most plastics. Consult Panametrics for concrete, composite materials, and highly corroded or lined pipes.

Accuracy: ±1% of reading in application, for ≥2 in. (50 mm) pipe and >1 ft/s (0.3 m/s) velocity ±2% of reading in application, for <2 in. (50 mm) pipe and >1 ft/s (0.3 m/s) velocity ±0.5% in field calibration

Note: *Installation assumes a fully developed, symmetrical flow profile (typically 10 diameters upstream and 5 diameters downstream of straight pipe run). Final installation accuracy is a function of multiple factors including fluid, temperature range, pipe centricity and others.*

Calibration: All meters are water calibrated and delivered with a traceable calibration certificate.

Repeatability: ±0.2% of reading

Range (bidirectional): -40 to +40 ft/s (-12 to +12 m/s)

Rangeability (overall): 400:1

Measurement parameters: Velocity, volumetric, and totalized flow

A.2 Electronics

Enclosure:	Epoxy-coated, copper free, aluminum weatherproof type 4X/IP67
Dimensions:	6.6 x 5.0 x 2.4 in. (168 x 128 x 61 mm)
Weight:	3.5 lb/1.5 kg
Channels:	One channel
Display:	Graphic LCD (128 x 64 pixels)
Keypad:	Six-button keypad for full functionality operation
Error display indicator:	Green or red light
Power supplies:	Standard: 85 to 265 VAC, 50/60 Hz Optional: 12 to 28 VDC, ± 5%
Power consumption:	In-rush: 10 W Normal operation: 5 W
Operating temperature:	-4 to 131°F (-20 to 55°C)
Storage temperature:	-40 to 158°F (-40 to 70°C)
Outputs (based on configuration):	• 4-20 mA (24VDC powered, 600 Ω maximum load, 1500 VDC isolation) • Frequency, pulse, alarm (passive output, 100 VDC, 1 A/1 W maximum, 1500 VDC isolation) • HART (FSK modulation, category flow, protocol version 7.5, device revision 2, MFG ID 157, device type code 127, number of device variables 34) • Modbus/RS485 (half-duplex, 1500 VDC isolation) ***Note:*** *Analog outputs are Namur NE43 compliant.*
Certification:	CE (LVD,EMC), US/CAN Ordinary Locations

A.3 Clamp-on Ultrasonic Flow Transducers

Materials:

- AT6 transducer
  - Transducer body: aluminum (ASTM AL6061)
  - Fixture body: aluminum (ASTM AL6061)/stainless steel (ASTM A316)
- C-RS transducer
  - Transducer body: stainless steel (ASTM A316)
  - Fixture body: stainless steel
- C-RS HT transducer
  - Transducer body: stainless steel (ASTM A316)
  - Fixture body: stainless steel
- UTXDR transducer
  - Transducer body: aluminum (ASTM AL6061)
  - Fixture body: aluminum (ASTM AL6061)/stainless steel (ASTM A304)
- CF-LP transducer
  - Transducer body: stainless steel (ASTM A316)
  - Fixture body: aluminum (ASTM AL6061)
- C-PT transducer
  - Transducer body: stainless steel (ASTM A316)
  - Fixture body: stainless steel

Note: *Contact Panametrics for other transducer models.*

Temperature range:

- AT6 transducer: -40 to 302°F (-40 to 150°C)
- C-RS transducer: -40 to 302°F (-40 to 150°C)
- C-RS HT transducer: -40 to 446°F (-40 to 230°C)
- UTX transducer: -40 to 248°F (-40 to 120°C)
- CF-LP transducer: -40 to 446°F (-40 to 230°C)
- C-PT transducer: -4 to 410°F (-20 to 210°C)

Note: *Contact Panametrics for other transducer models*

Humidity range: Up to 90% RH

Note: *Contact Panametrics for tropicalization of the unit for 100% RH.*

Altitude range: Up to 2000 m (6500 ft) maximum

CAT transducer cables: Cable: RG316 coaxial cable, up to 90 m (300 ft) long,
Temperature range: -40 to 302°F (-40 to 150°C)

Couplant: Standard: solid couplant
Optional: liquid couplant

Rating: Standard: General purpose (IP66 or IP68)

Note: *See specific transducer model for exact rating.*

A.4 General

A.4.1 Wiring Cable Specifications and Requirements

- Cable diameter range for PWR connection: 7 to 12mm, refer to gland Hole 1 on *Figure 25 on page 21*
- Cable diameter range for Hart, Modbus and I/O connection: 5 to 8mm, refer to gland Hole 2,3 and 4 in *Figure 25 on page 21*
- Temperature range of cable for PWR, Hart, Modbus and IO connection: 14° to 185°F (-10° to 85°C)

The cable should meet the CE and UL standard below:

- Conductor cross section solid range: 0.2 mm^2 to 2.5 mm^2
- Conductor cross section stranded range: 0.2 mm^2 to 2.5 mm^2
- Conductor cross section stranded, with ferrule without plastic sleeve range: 0.25 mm^2 to 1 mm^2
- Conductor cross section stranded, with ferrule with plastic sleeve range: 0.25 mm^2 to 1 mm
- Conductor cross section AWG/kcmil range: 12 to 26 AWG according to UL/CUL range: 14 to 28

A.4.2 Cable Fixing Requirement and Gland Torque

Refer to *Figure 25 on page 21* for the gland hole position.

To make a reliable IP67 sealing performance of the enclosure during cabling, the gland must be tightened well, below torque value is a reference to make a reliable NEMA 4X/IP67 sealing between cable and gland:

- Operation torque for gland hole 1 and 5: 2.7 N.M
- Operation torque for gland hole 2, 3 and 4: 2.5 N.M

A.4.3 Display Languages

English/Chinese/German/French/Italian/Japanese/Portuguese/Russian/Spanish/Swedish/Turkish

Note: *The meter will be set to the language specified by the customer before shipping.*

A.4.4 Product Models

Based on the line power type, the AT620 ultrasonic flow meter is available in two series:

- Models of AC meter: 85-264VAC, 50-60Hz, 10W, up I AT6-**-****-****-*-1-*-**-**-*-*, AT6KIT-*1, AT6KIT-*2, AT6KIT-*3 and AT6KIT-*7
- Models of DC meter: 12-28VDC, 10W, up I AT6-**-****-****-*-2-*-**-**-*-*, AT6KIT-*4, AT6KIT-*5, AT6KIT-*6 and AT6KIT-*8

Note: ** in the product model name is either a number from 0-9 or a letter from A-Z.*

Appendix B. Data Records

B.1 Service Record

Whenever any service procedure is performed on the AT620 flow meter, the details of the service should be recorded in this appendix. An accurate service history of the meter can prove very helpful in troubleshooting any future problems.

B.2 Data Entry

Record the complete and detailed service data for the AT620 in *Table 188* below. Make additional copies of the table as needed.

Table 188: Service Record

Date	Description of service performed	Performed

B.3 Initial Settings

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

Table 189: Initial Settings

Parameter	Initial value
Pipe OD	
Pipe ID	
Pipe Wall Thickness	
Pipe Material	
Pipe Sound Speed	
Lining Thickness	
Lining Material	
Transducer ID	
Transducer Frequency	
Transducer Wedge Type	
Transducer Wedge Angle	
Transducer Wedge SOS	
Transducer TW	
Traverses	
Fluid Type	
Fluid SOS	
Fluid Minimum SOS	
Fluid Maximum SOS	
Fluid Temperature	
Transducer Spacing	

B.4 Diagnostic Parameters

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

Table 190: Diagnostic Parameters

Parameter	Initial value
Velocity	
Actual Volumetric	
Standardized Volumetric	
Fwd. Batch Totals	
Rev Batch Totals	
Net Batch Totals	
Batch Totalizer Time	
Fwd. Inventory Totals	
Rev Inventory Totals	
Net Inventory Totals	
Inventory Totalizer Time	
Mass Flow	
Sound Speed	
Reynolds	
KFactor	
Transit Time Up	
Transit Time Dn	
DeltaT	
Up Signal Quality	
Dn Signal Quality	
Up Amp Disc	
Dn Amp Disc	
SNR Up	
SNR Dn	
ActiveTw Up	
ActiveTw Dn	
Gain Up	
Gain Dn	
Error Status	
Reported Error	
Up Peak	
Down Peak	
Peak % Up	
Peak % Down	

[no content intended for this page]

Appendix C. Updating the Firmware in the Field

C.1 Introduction

The AT620 firmware can be updated in the field. However, before attempting a firmware update, read the information in this section thoroughly to ensure a successful update process.

C.1.1 System Requirements

Make sure that your AT620 flow meter system meets the following requirements:

- Verify that your current AT620 firmware version is 01.02.25 or later.
- Verify that you have the AquaTrans flow meter software update version 20161117V1.2 or later available to run on your PC.
- Verify that your AT620 service port has a 2-wire RS485 connection to your PC, and that the connection baud rate is set to 115200 baud.
- Verify that your AT620 firmware binary file is version 1.02.25 or later.

C.1.2 Preparation

To ensure a successful firmware update, be prepared for the following:

- Allow about 10 minutes for the firmware update to complete.
- Before starting the firmware update, make sure that the AT620 is in normal measurement mode.
- The AT620 main power must remain ON throughout the firmware update. DO NOT turn the main power OFF until the firmware update has been completed.
- Because the firmware update uses the AT620 Modbus/service port, you must NOT allow any other AT620 Modbus activity during the firmware update.
- During the firmware update, the AT620 will attempt to validate the new firmware image file. At the end of the update process, if the validation was successful, the AT620 will reboot with the updated firmware installed. However, if the validation was not successful, the original firmware will still be installed after the reboot.

C.2 Performing the Firmware Update

If your AT620 flow meter system meets all of the requirements discussed on the previous page and you are prepared to perform the firmware update according to those guidelines, proceed with the instructions in this section.

C.2.1 Check the Current Firmware Version

To determine the firmware version currently installed in your AT620, access the following information screen:

Main menu > Program > Advanced > Flow Meter Data > Main Board > SW Version

For reference, an example of this screen is shown in *Figure 37* below.

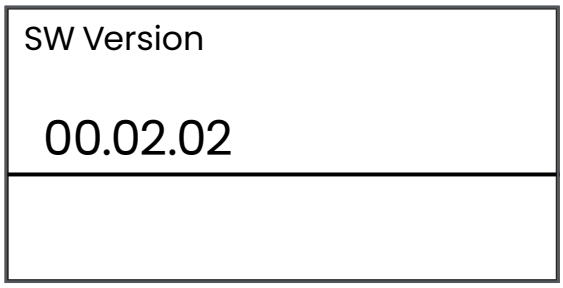


Figure 37: Example Software Version Screen

Note: *As indicated on the previous page, the current version of your AT620 firmware must be 01.02.23 or later. If your version is older than this, you cannot use this update method. Software versions 01.02.24, 01.03.xx, 02.xx.xx are examples of acceptable versions.*

C.2.2 Update Steps

If your AT620 firmware version qualifies for the field firmware update process, complete the following steps:

1. Prepare the RS485 Modbus connection:
   a. Disconnect the main power from the AT620.
   b. Wire the Modbus connection as described in *"Wiring the Modbus Communication" on page 24*.
2. Locate the AquaTrans flow meter Software update (version 20161117V1.2 or later) software on your PC. If the folder containing the software is zipped, you must unzip it prior to use.
3. Run the update software by clicking on the upgrade.exe file (see *Figure 38* below). Installation of the software on the PC is not required.

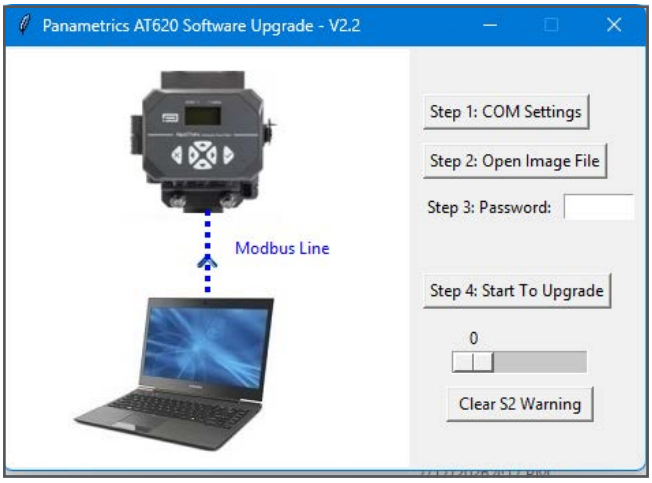


Figure 38: Running the update.exe Software

4. Click on the COM port button and enter the specific com port on the PC that is connected to the AT620 Modbus/service port.

5. Click on the open image file button, and open the Panametrics image file to be used for the AT620 firmware update.
6. Click on the start To upgrade button. After verifying that the selected image file and Com port are correct, click the OK button to start the update process.
7. After the progress bar indicates that the firmware update is 100% complete (about 10 minutes), the message shown in *Figure 39* below will be displayed. Note that the AT620 will automatically reboot in 30 seconds.

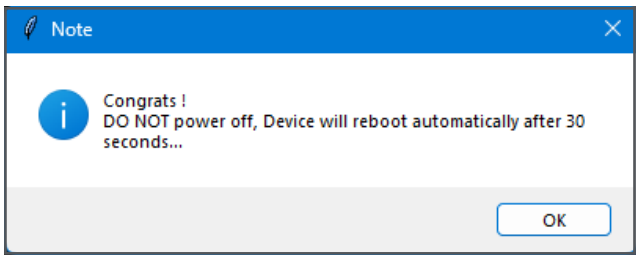


Figure 39: Reboot Message

8. After the reboot is complete, refer to *"Check the Current Firmware Version" on page 182* and confirm that the new firmware version has been installed. If the original firmware version is still installed, the AT620 was not able to validate the image file that was used - contact Panametrics for assistance.

C.3 Clearing an S2 Warning

After the firmware update, the AT620 may show an S2 warning. If so, complete the following steps:

1. In the update software, click on the com port button and select the specific port that was used for the update (see top red box in *Figure 41* below).

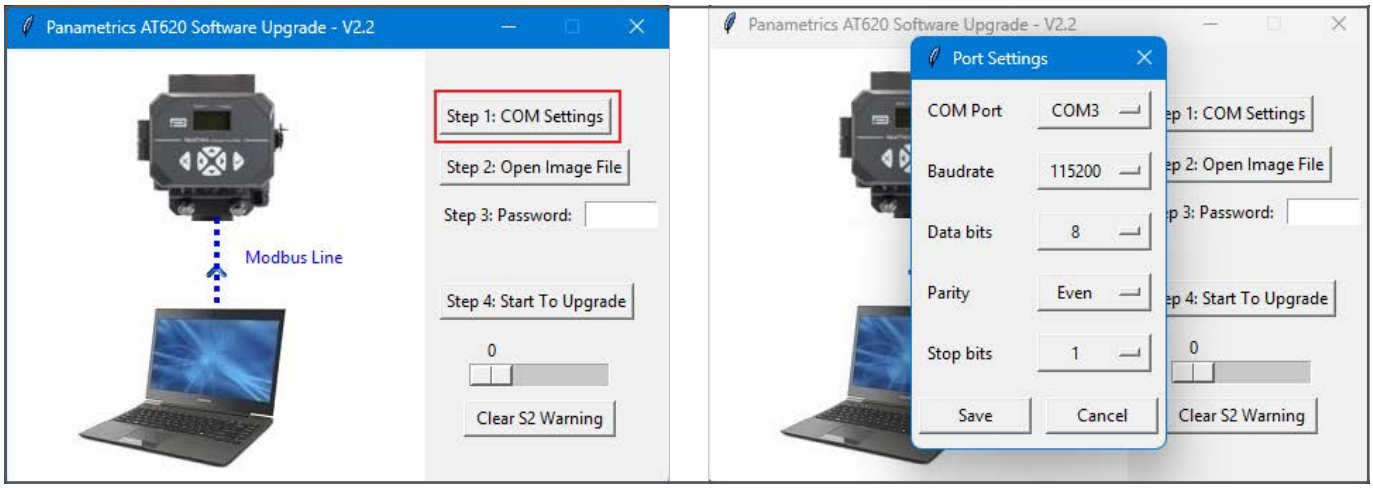


Figure 40: Selecting the Port

2. Click on the clear S2 warning button (see bottom red box in *Figure 41* below).

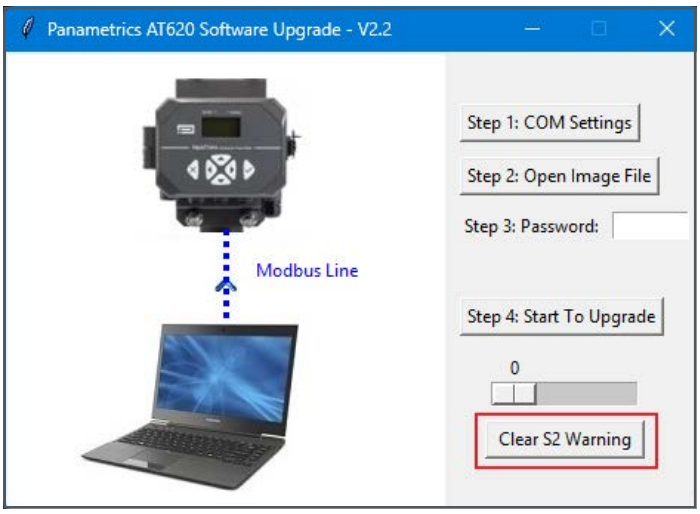


Figure 41: Clearing an S2 Warning

3. After about 15 seconds, a screen similar to *Figure 42* below is displayed. Click OK and then reboot the AT620 to confirm that the S2 error has been cleared.

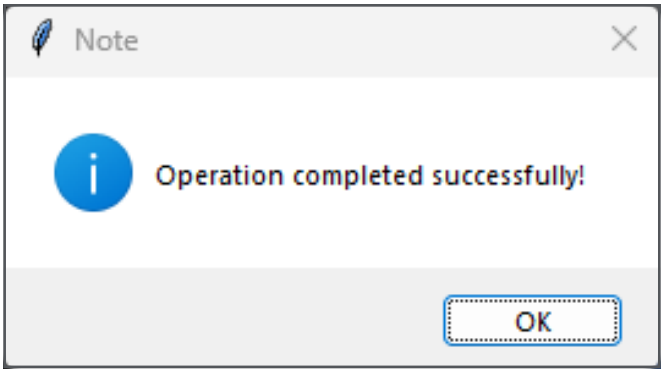


Figure 42: S2 Warning Successfully Cleared

C.4 Support

If the firmware update was unsuccessful, reboot the AT620 and repeat the procedure described in this appendix. If there is still a problem, send an email to https://panametrics.com/tech-support/ and describe the problem in detail.

Appendix D. Menu maps

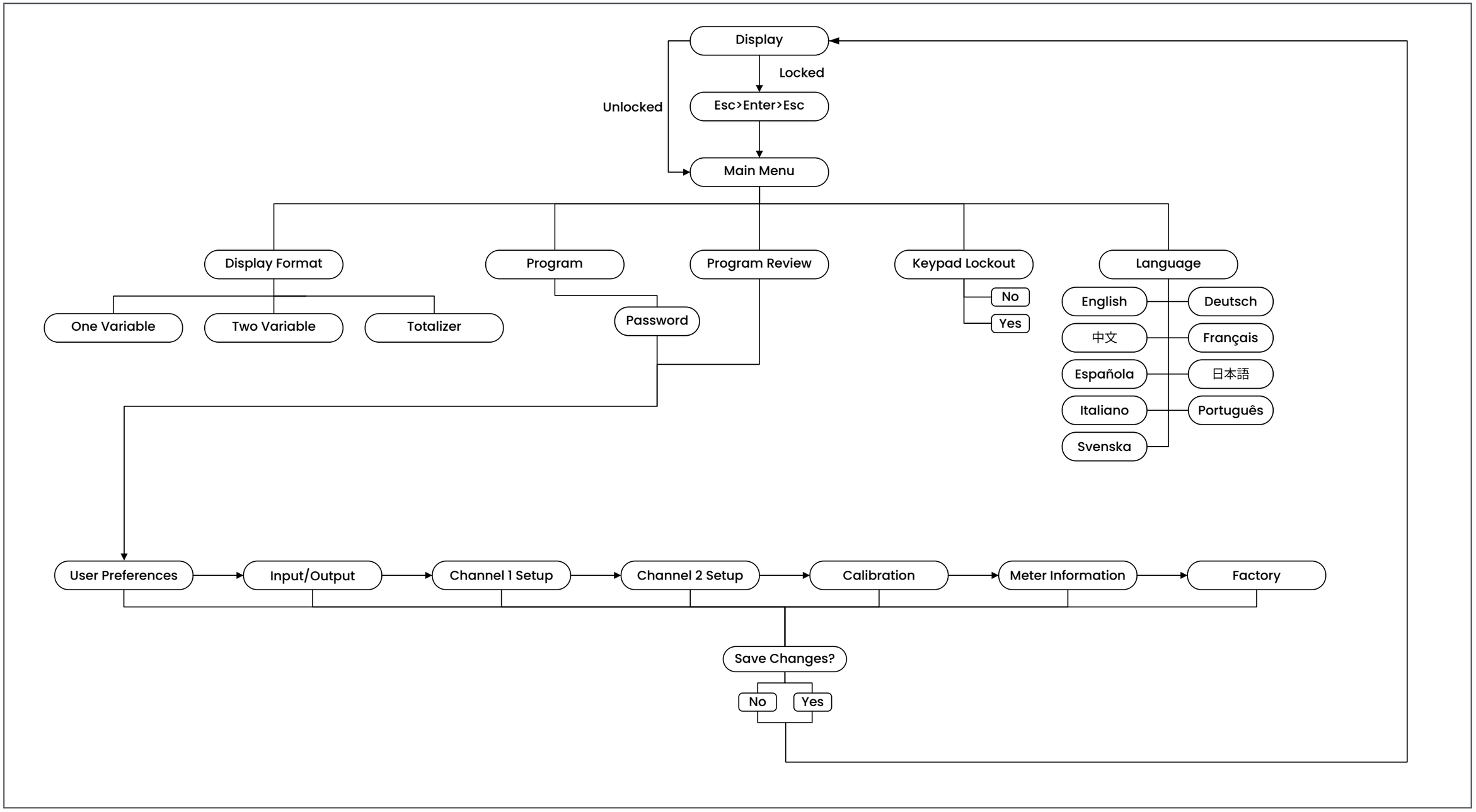


Figure 43: The Main Menu

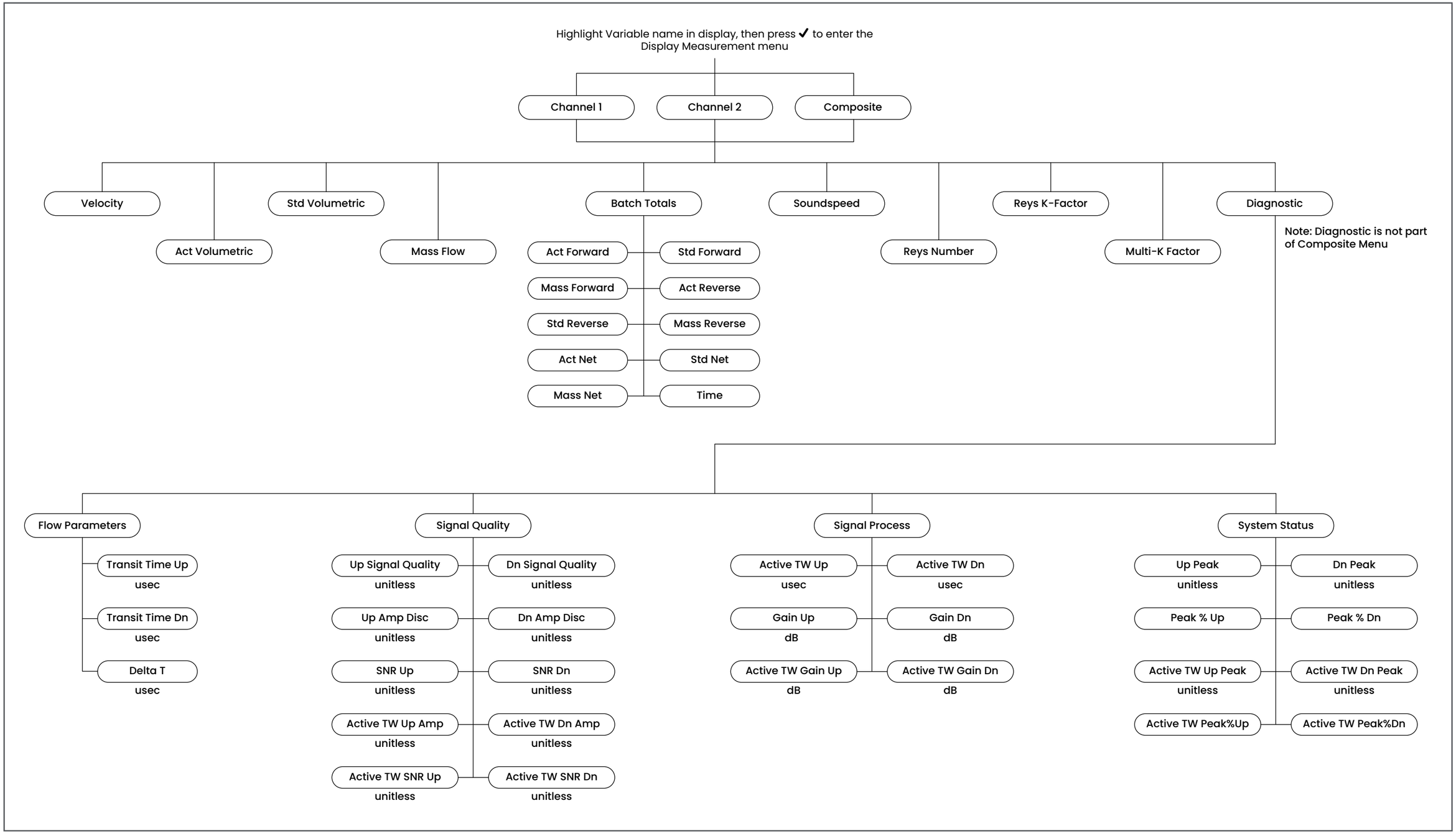


Figure 44: The Display Measurement Menu

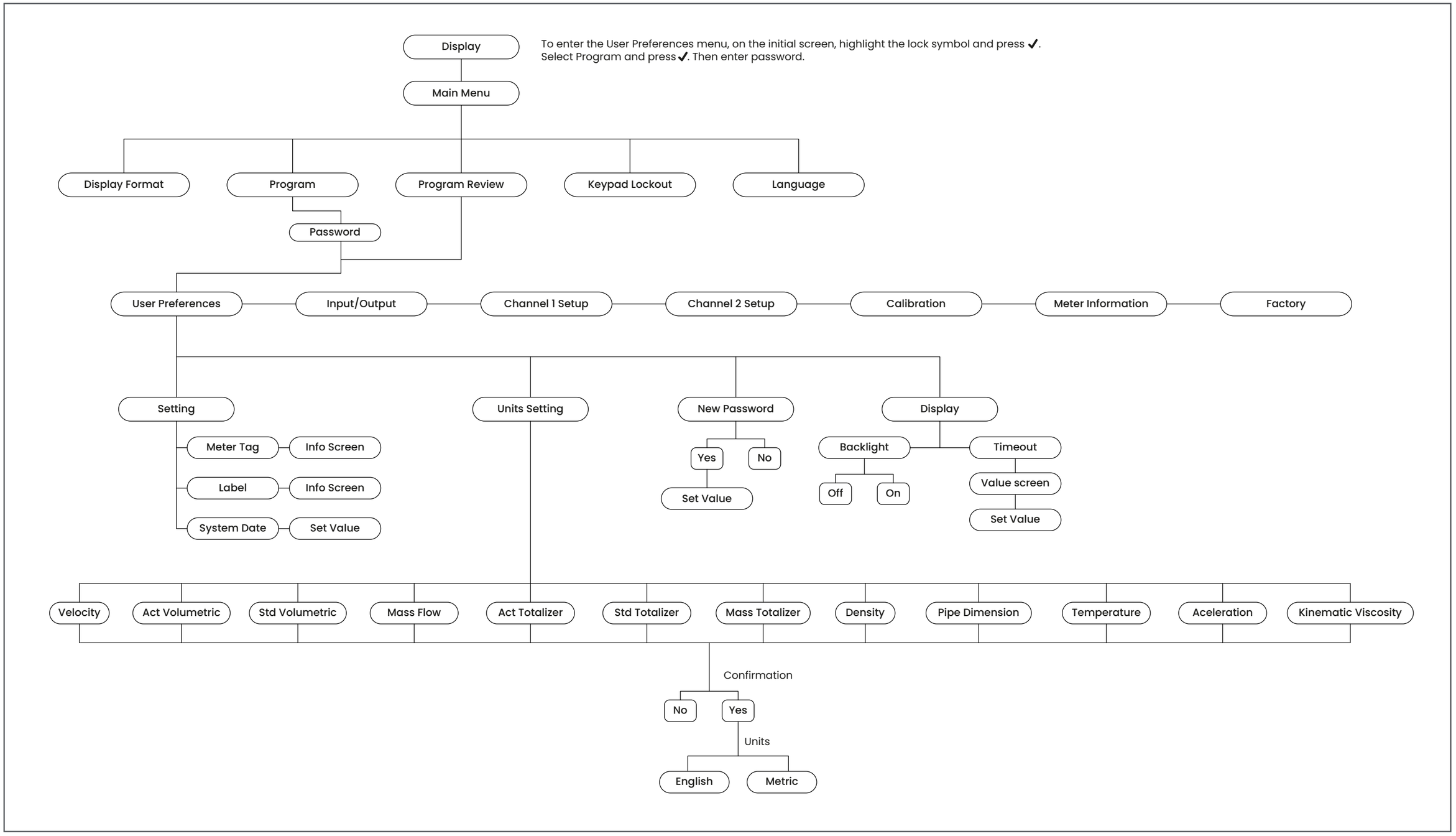


Figure 45: The User Preferences Menu

Units Setting

UnitsSet/Velocity	
English	Metric
Ft/s	m/s

UnitsSet/StdVol	
English	Metric
SCFS	Sm^3/s
SCFM	Sm^3/m
SCFH	Sm^3/h
SGal/s	Sm^3/d
	SL/s
	SL/m
	SL/h
	SML/d
	SkL/s
	SML/s

UnitsSet/ActVol	
English	Metric
Ft^3/s	m^3/s
Ft^3/m	m^3/m
Ft^3/h	m^3/h
Ft^3/d	m^3/d
Gal/s	L/s
Gal/m	L/m
Gal/h	L/h
Gal/d	L/d
M Gal/d	ML/D
BBL/s	kL/s
BBL/m	Mm^3/d
BBL/h	ML/s
BBL/d	
KGal/m	
KGal/h	
KGal/d	
MBL/d	
MFt^3/d	
A-I/s	
A-I/m	
A-I/h	
A-I/d	
A-F/s	
A-F/m	
A-F/h	
A-F/d	

UnitsSet/Mass Flow	
English	Metric
LB/s	g/s
LB/m	kg/s
LB/h	kg/m
LB/d	kg/h
KLB/s	kg/d
KLB/s	Mg/s
KLB/m	t/s
KLB/h	t/m
KLB/d	t/h
SHTN/s	t/d
SHTN/m	
SHTN/h	
SHTN/d	
oz/s	

UnitsSet/Act Totalizer	
English	Metric
FT^3	m^3
GAL	L
BBL	ML
KGAL	Mm^3
MGAL	
MFt^3	
MBBL	

UnitsSet/Std Totalizer	
English	Metric
SFt^3	Sm^3
SGAL	SL
	SML
	SMm^3

UnitsSet/Mass Totalizer	
English	Metric
oz	g
LB	kg
KLB	Mg
St	t

UnitsSet/Density	
English	Metric
Lb/Ft^3	Kg/m^3

UnitsSet/Pipe Dimension	
English	Metric
ft	m
in	mm

UnitsSet/Temperature	
English	Metric
°F	°C

UnitsSet/Acceleration	
English	Metric
ft/s^2	m/s^2

UnitsSet/Kinematic Viscosity	
English	Metric
This menu doesn't have English units	m^2/s
	cST

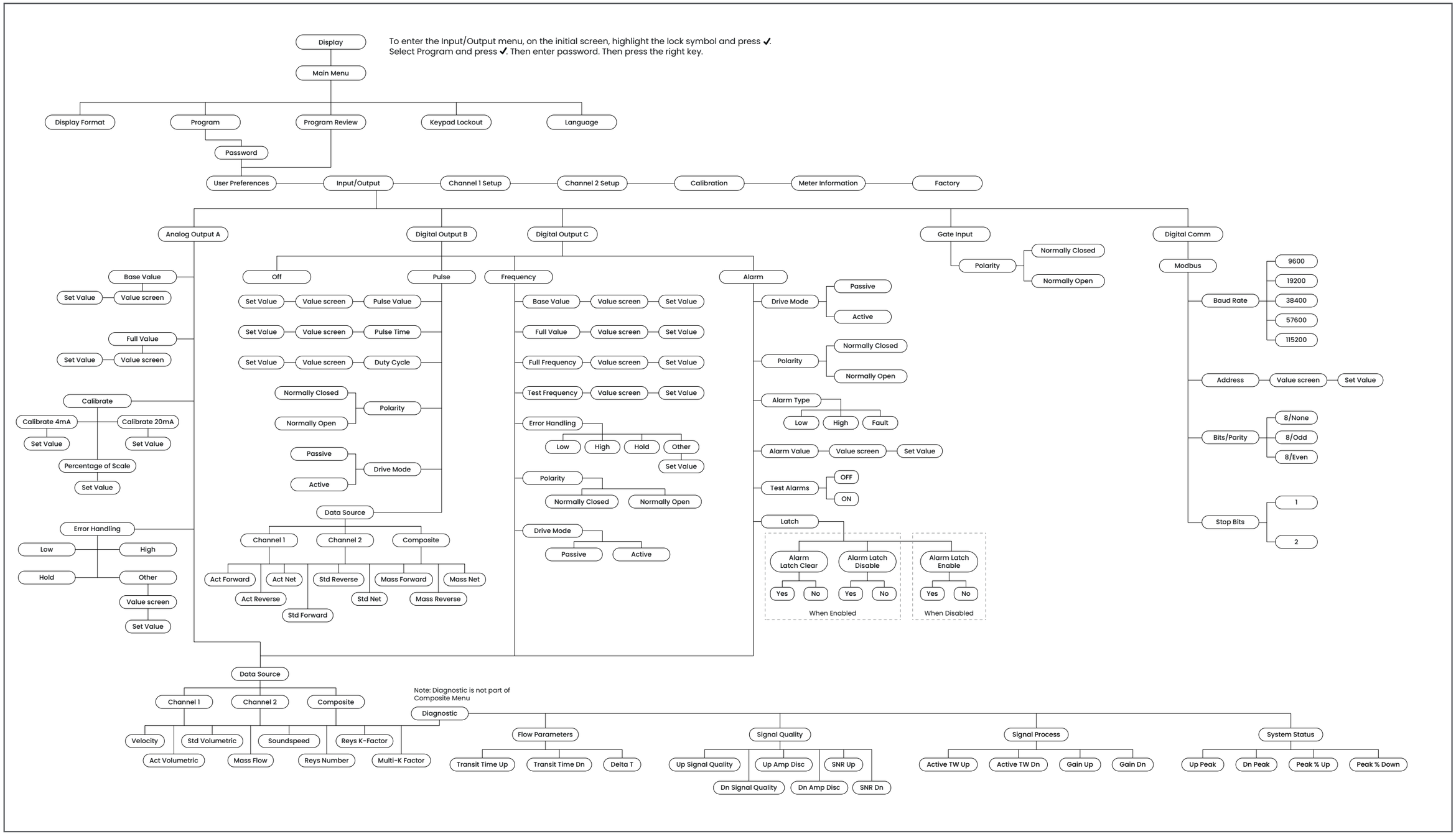


Figure 46: The Input Output Menu

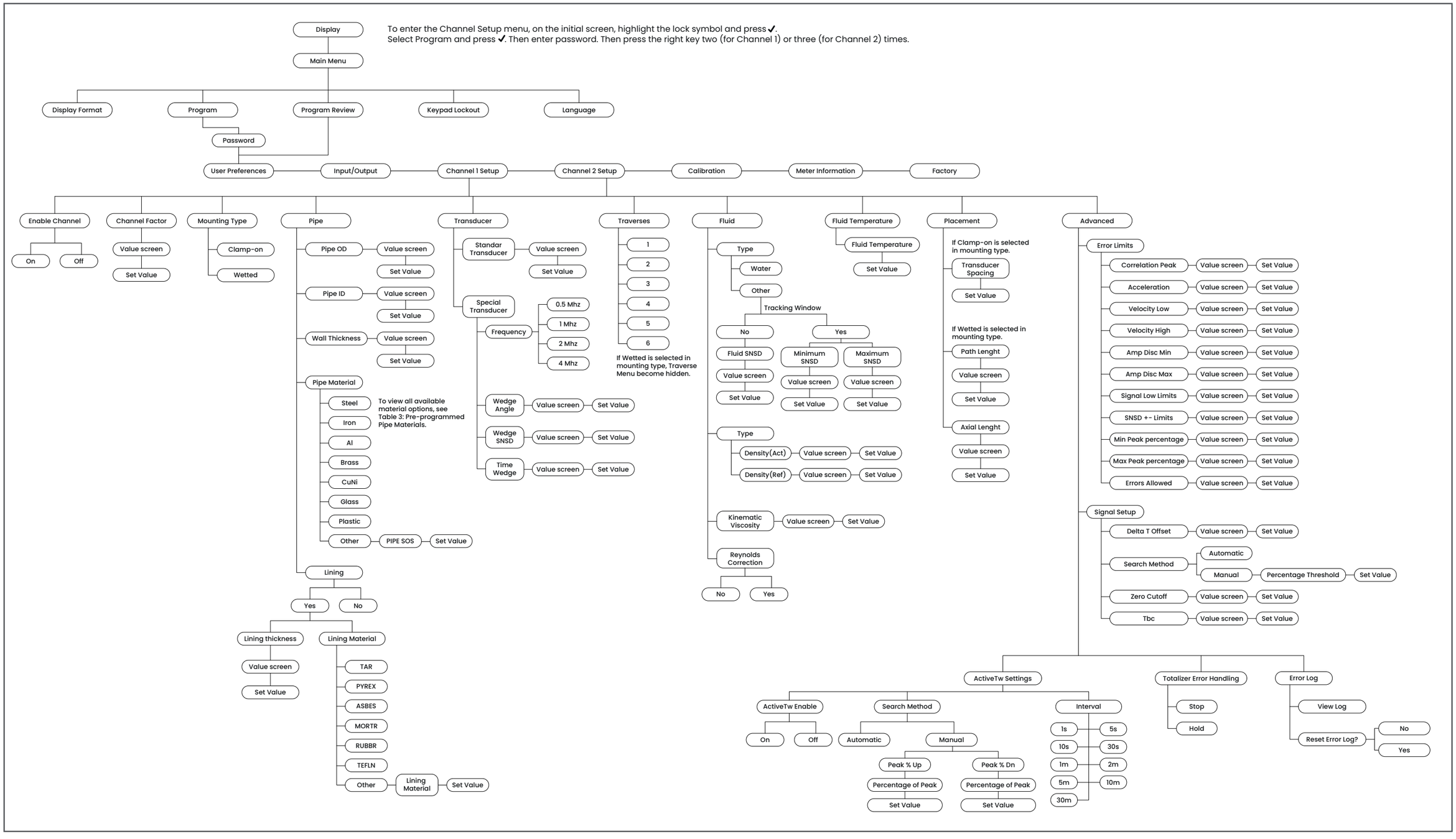


Figure 47: The Channel Setup Menu

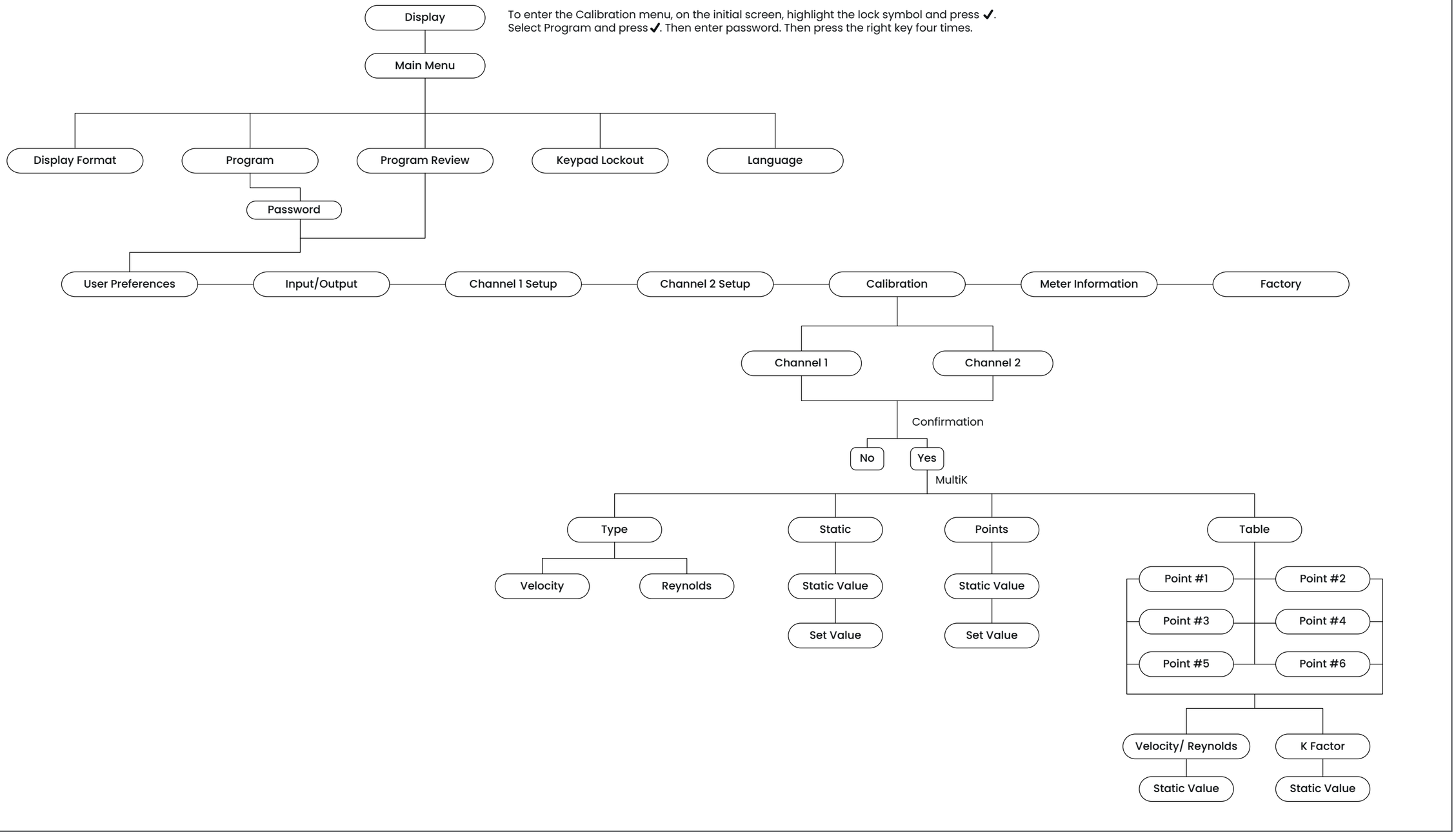


Figure 48: The Calibration Menu

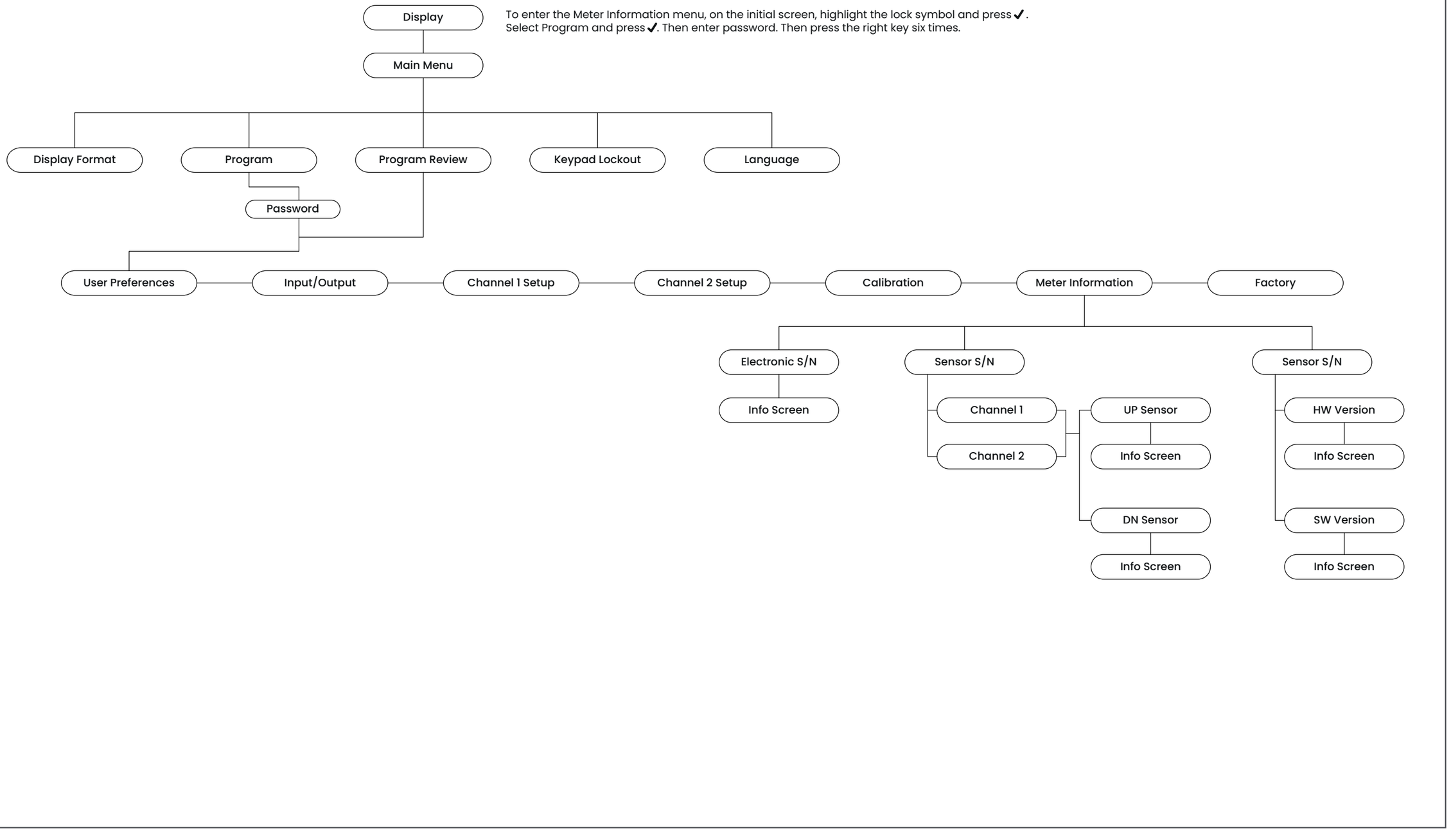


Figure 49: The Meter Information Menu

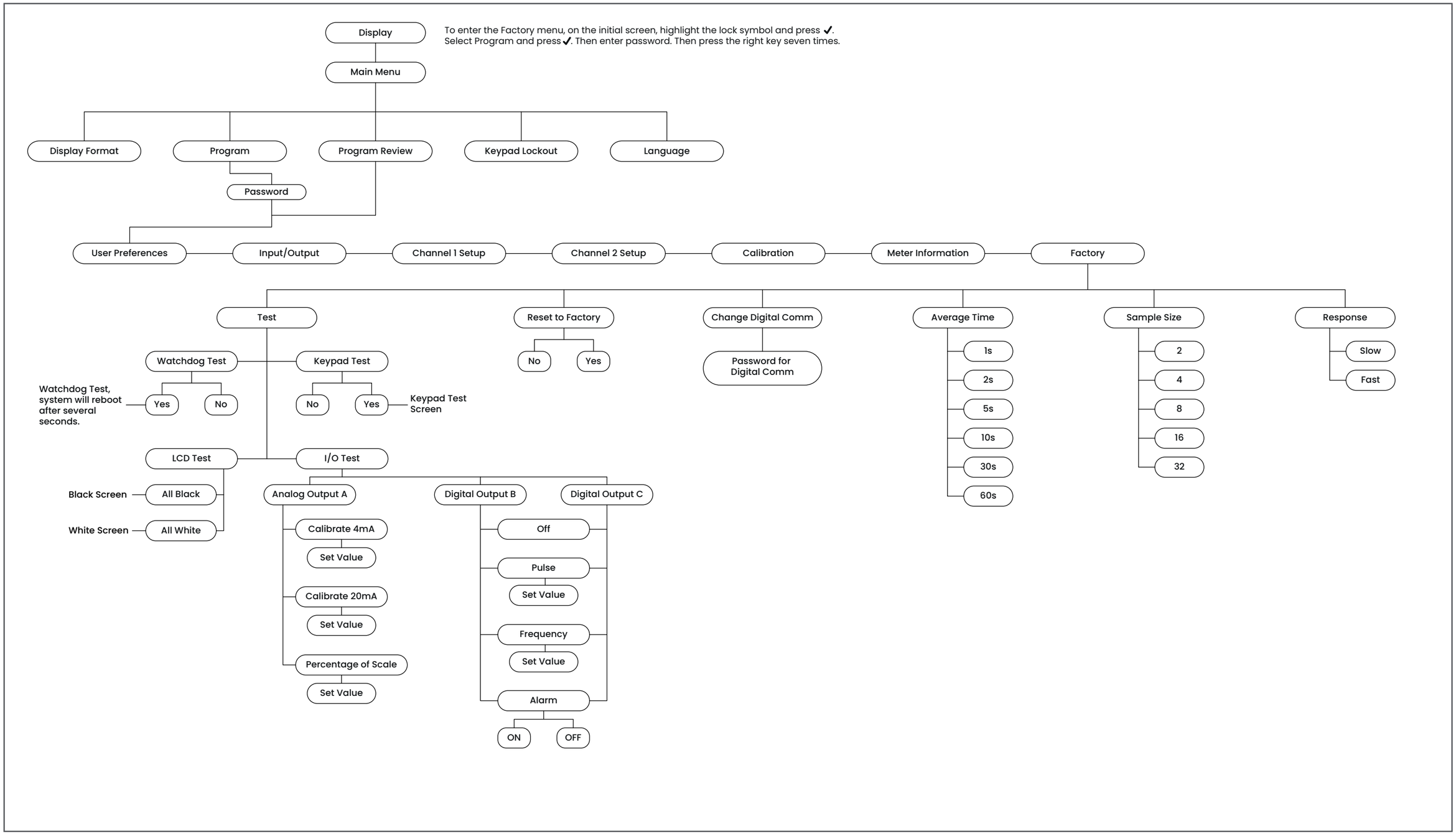


Figure 50: The Factory Menu

[no content intended for this page]

Scan here or use the link below for
Customer Service, Technical Support,
or Service Information:
panametrics.com/support

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