GUIDANT

Smith Meter® MPU™ Series C

Installation, Operation, and Maintenance Manual

Bulletin MNKS025 Issue/Rev. 0.2 (4/24)

Important

All information and technical specifications in this document have been carefully checked and compiled by the author; however, we cannot completely exclude the possibility of errors. Guidant Measurement is always grateful to be informed of any errors; contact us at TechnicalCommunications@GuidantMeasurement.com.

Caution

The default or operating values used in this document and in the configuration parameters of the MPU Series C are for factory testing only and should not be construed as default or operating values for your metering system. Each metering system is unique and each configuration parameter must be reviewed and programmed for that specific metering system application.

Disclaimer

Guidant hereby disclaims all responsibility for damages, including but not included to consequential damages arising out of or related to the inputting of incorrect or improper program or default values entered in connection with the MPU Series C.

Technical Support

Field Service Response Center

24/7 Technical Support/Schedule a Technician: +1 844.203.4014
System installation supervision, startup, and commissioning services are available.

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1 General

1.1 Safety Instructions

The Smith Meter MPU Series C Ultrasonic Gas Flowmeters are non-intrusive and the transducers are flush-mounted to the internal meter body to provide for undisturbed and accurate measurement of gas flow. They are suitable for a wide range of applications in fiscal metering of dry, high pressure, and non-condensing gases.

> NOTE: This information must be carefully read and understood before operating the unit.

The operator must ensure that the MPU and its equipment are operated and monitored by expert and qualified personnel in such a way that there are no risks to employees or third parties. Protection zones must be provided. The operator must prepare the corresponding operating instructions so that the operating and maintenance personnel have all of the necessary instructions for operation of the meter or the system.

The compatibility between medium, meter, and sealing material is the responsibility of the operator.

The relevant national regulations in the country of installation for the operation of the pressure equipment must be observed.

1.1.1 Safety Instruction Examples

- European Union: The Pressure Equipment Directive (PED) applies and equipment shall be marked with the PED required markings.
- Canada: Equipment must be registered in the province in which it is to be installed and must have a valid Canadian Registration Number (CRN) for the applicable province.

1.1.2 Installation in Hazardous Areas

Components marked with the symbol Ⓔx are explosion-proof electrical equipment and safety-tested and certified. See section 3.8: For ATEX and IECEx Installations on page 23 for electrical installation.

> WARNING: Any modifications, mechanical or electrical, are not permitted.

> WARNING: Warning: Ex-protection regulations must be observed.

In case of a malfunction of the electronic board fitted in the flameproof housing only, the complete board has to be replaced. Testing and repair of the board is only possible in the factory. The installation and replacement of the board is to be performed by trained technical personnel.

1.1.2.1 General Directives

- The electrical installation shall be compliant with EN/IEC 60079-14 and the ordinary electric installation rules or country specific regulations, as applicable.
- To prevent ignition of hazardous atmospheres and to prevent electrical shock, disconnect from supply circuits before opening. Protect the device against unintended power on. Before bringing the device into operation make sure that it is tightly closed.
- The flameproof housing contains one or more of the following threaded entries: ½" National Pipe Taper (NPT). All cable entries, stopping boxes, or plugs shall be certified according to the requirements in EN/IEC 60079-1.
- The flameproof housing contains an internal battery-powered circuit. Do not open the housing unless an area is known to be non-hazardous. To reduce the risk of ignition of hazardous atmospheres, conduit runs must have a sealing fitting connected within 45 centimeters (cm) of the enclosure.
- Before the first power up after installation, check that the connected voltage conforms to the power rating on the nameplate. Unused cable entries shall be closed with Ex certified plugs.
- The field-provided wiring shall be made according to the wiring diagrams. Reference section 4.2: UMCB/UMCB-W Field Wiring Examples and Information

on page 37.

- Modification of the internal construction of the flameproof enclosure and adding additional parts to the electronics is prohibited.
- Additional precaution must be made when bringing the supplied personal computer (PC) into the hazardous area. A hot work permit is required before bringing the PC into the restricted area as stated by local site regulations. A gas detector must be in operation continuously while the PC is present in the restricted area. This also applies while the PC is turned off.

1.1.3 Danger from High Pressure and Explosive Gas

The MPU is directly integrated into gas-carrying pipelines. The operating company shall be responsible for safe operation and for complying with additional national regulations.

> WARNING: In plants with toxic and explosive gases, high pressure, or high temperatures, the MPU shall only be installed or removed if the pipelines are vented to atmospheric pressure or if the plant is not in operation. The same applies to repair and service work which involves opening the measuring channel or the explosion-proof signal processing unit.

1.1.4 Temperature Drop and Depressurization

Please be aware that rapid temperature changes can damage the MPU and should be avoided. If the meters are subjected to a temperature change of more than 10 degree Celsius (°C) or 50 degrees Fahrenheit (°F) per five minutes, the transducers can be damaged and may have to be replaced. This can also occur under rapid pressure changes such as emergency depressurization. Therefore, the maximum rate of depressurization is 10 bars per minutes. Ensure the MPU operating temperatures are as stated on the meter type plate.

1.1.5 Lifting Heavy Loads

> NOTE: If using a crane when lifting the MPU, only use the supplied lifting lugs. Lifting and handling must always be performed in accordance with Series C

> Meter Lifting Instructions (SVLS003).

At offshore installations, it is very important to secure the meter during crane handling due to motion on the platform or vessel resulting in pendulum motion of the load.

1.1.6 Disposal

It is the operator's responsibility to obtain the necessary information about all relevant regulations and requirements from your local authorities. Ensure that relevant materials are disposed of in an environmentally safe fashion.

> NOTE: The operator is responsible for ensuring compliance with all general and local regulations which are in force at the time of disposal.

1.1.6.1 Disposal of a Functional Component or System

- When a functional component or system is taken out of service, we recommend that it should be sorted into its different types of waste and then disposed of or recycled as appropriate. Sort and separate iron, nonferrous metals, plastics, electronic waste, etc.
- Fuels, grease, oil, and objects or lines contaminated with them must be disposed of separately.

1.1.7 Proper Intended Use

> WARNING: Any form of use which exceeds the scope described above is deemed to be improper use. Guidant is not liable for damages resulting from improper use.

Proper use also includes compliance with the conditions set out by Guidant with regard to operation, installation, and maintenance.

The system must only be operated, serviced, and repaired by personnel who are familiar with the equipment and who have been trained regarding the dangers involved.

If you discover any signs of damage or breakage on any parts of the system or if the system's safe operation cannot be guaranteed for any other reason, do not start the system or, if already in operation, shut down the system immediately. Notify your maintenance department.

Guidant cannot be held liable for any damages arising as a result of unauthorized changes to the system.

1.2 Maintenance

The MPU must not be modified mechanically or electronically in any way.

WARNING: During cleaning with a steam cleaner or with pressurized water, the MPU Electronic Enclosure cover joint (Display if equipped) and electrical entrances should be protected from the water jet.

NOTE: We cannot accept responsibility for any damage caused by moisture in the equipment as a result of improper cleaning procedures.

NOTE: A regular safety check in accordance with EN/IEC 60079-17 or country-specific policies shall be carried out for Ex Equipment and protective systems which fall under the scope of Directive 2014/34/EU or other National Electrical Safety regulations, as applicable.

1.2.1 Recommended Maintenance Plan Checklist

Table 1: Recommended Maintenance Plan Checklist

	2 Years	5 Years	5-10 Years
Cleaning of the outside of the meter	X		

	2 Years	5 Years	5-10 Years
Visual examination for damage and wear: 1. Ensure that there is no mechanical or corrosion damage to the spool piece, transducer cover, or Ex electronics enclosure 2. Ensure that there is no damage to transducer cables (or transducer micro conduits, if supplied) or the external cables and Ex cable glands or conduiting	X		
Examination of the case mounting	X		
Check the transducer cables	X		
Ex enclosure O-rings, transducer O-rings/sealing			X
Ex related tests according EN/IEC 60079-17			X
Change RTC (real time clock) battery		X	

For environmental conditions such as strong vibrations, strong temperature differences during operation, unusually high degrees of contamination, corrosive salt air atmospheres which deviate from environmental conditions typical for such measuring devices, the maintenance intervals must be shortened in order to meet the increased environmental conditions.

2 Product Overview

The Smith Meter MPU Series C Ultrasonic Gas Flowmeters are multi-path ultrasonic meters with signal processing unit (SPU) for custody transfer or custody transfer accuracy measurement of petroleum products such as natural gas and new energy gas such as hydrogen and carbon dioxide. The following ultrasonic meters are covered in this manual:

- MPU 200c: Single-path flowmeter
- MPU 600c: Three-path flowmeter
- MPU 800c: Four-path flowmeter
- MPU 1600c: Eight-path flowmeter

The difference between these models is the number of paths. All other parts are identical. The MPU 1600c has eight paths (16 transducers), MPU 800c has four paths (eight transducers), and MPU 600c has three paths (six transducers) and the MPU 200c has one path (two transducers). All models use identical electronics with the appropriate number of transducers connected. The MPU 800c and 600c are lower-cost versions of the MPU 1600c with slightly lower measurement performance. The MPU 200c is intended for applications with non-fiscal accuracy requirements.

2.1 Purpose of Equipment

The MPU flowmeters are non-intrusive and the transducers are flush mounted to the internal meter body to provide for undisturbed and accurate measurement of gas flow. They are suitable for a wide range of applications in fiscal metering of dry, high pressure, and non-condensing gases, such as:

- Custody transfer of gas onshore and offshore
- Pipeline node bi-directional measurements
- Gas terminals

- Gas mixing stations
- Gas power plants
- Pipeline junctions
- Compressor stations

The MPU 1600c has fiscal accuracy with 5 diameter (D) straight upstream pipe and the MPU 800c has fiscal accuracy with 10 D straight upstream pipe and 5 D downstream straight pipe.

The MPU 600c has fiscal accuracy with a well-developed flow profile, and thus requires long (>20 D) upstream straight pipe or be used in combination with a flow conditioner.

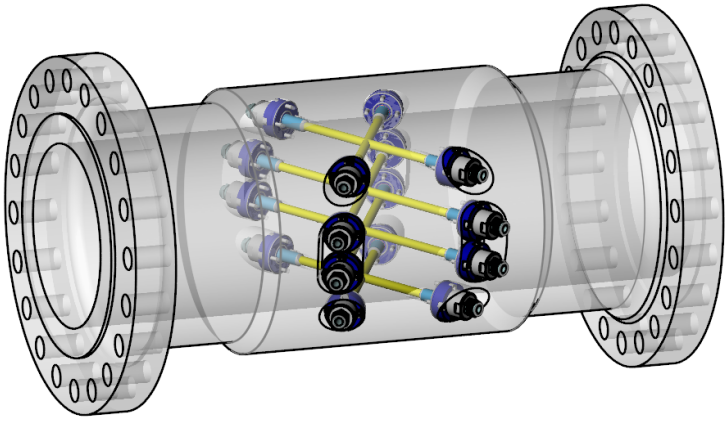
The MPU 200c cannot be guaranteed for fiscal accuracy.

2.2 Measurement Principle

The MPU flowmeters operate using the acoustic transit time measurement principle. The meter transmits ultrasonic signals between two transducers that are located on opposite sides of the meter body. These two transducers form a measurement path through the fluid with one transducer in the upstream position and the other downstream.

An ultrasonic signal that is transmitted from one transducer travels through the fluid medium and is received by the transducer on the opposite side of the path. Each transducer can either send or receive a signal and the meter alternates between sending and receiving across the measurement path. An ultrasonic pulse travels through the meter at the velocity of sound (VOS) of the fluid in the meter plus or minus the velocity of that fluid medium itself.

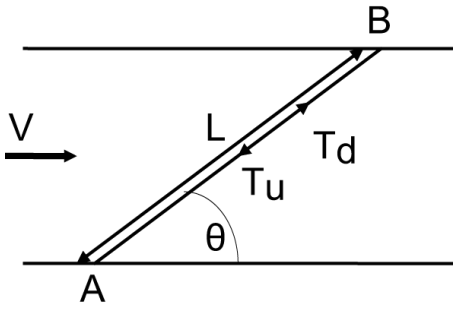
Figure 1: Measurement Principle



2.2.1 Transit Time Measurement

To measure gas flow and velocity of sound (VOS), the MPU employs the fact that sound travels faster with the gas flow than against it. The figure below shows a top view of a pipe with gas flow. The gas flow velocity is V, Θ is the angle the sound beams make with the pipe wall, A and B are the positions of the transducers, and L is the distance between transducer A and B. Tu and Td are the times of flight up- and downstream respectively. These travel times, together with the geometry of the system (for example, transducer mounting and pipe diameter), are all that is needed to calculate the gas flow velocity and the velocity of sound for each path.

Figure 2: Transit Time Measurement



2.2.1.1 Top View of Path; Travel Times

The sound travels slower upstream and faster downstream due to the velocity component of the gas flow in the direction of the sound path.

This yield

$$T_d = \frac{L}{c + v\cos(\theta)}$$

and

$$T_u = \frac{L}{c - v\cos(\theta)}$$

where

- c is the velocity of sound in the gas
- v is the gas flow velocity

From these equations one can isolate the gas flow velocity and VOS.

Thus

$$v = \frac{L}{2\cos(\theta)} \bullet \frac{T_u - T_d}{T_u T_d}$$

and

$$c = \frac{L}{2} \bullet \frac{T_u + T_d}{T_u T_d}$$

2.2.2 Travel Time Corrections

The signal pulse in the transducers is converted from an electrical signal to an acoustic signal and back to an electrical signal on the receiver side. The signal is delayed during these conversions and these transducer delays are measured for each transducer during internal testing. The typical magnitude of the transducer delays is 8 to 10 microseconds (µS).

2.2.3 Calculate Average Gas Flow Velocity

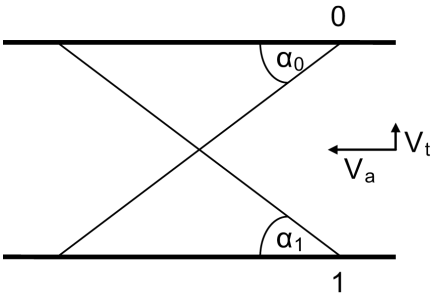
To calculate the average gas flow velocity over the pipe area, information from all sound paths, including transducer delays, are put into an integration formula.

Figure 3: Front View of Pipeshows a front view of the pipe, with the placement of the eight sound paths in the four planes for the MPU 1600. The average velocity is given by:

$$\overline{v} = \sum_{i=1}^{8} w_i \bullet v_i$$

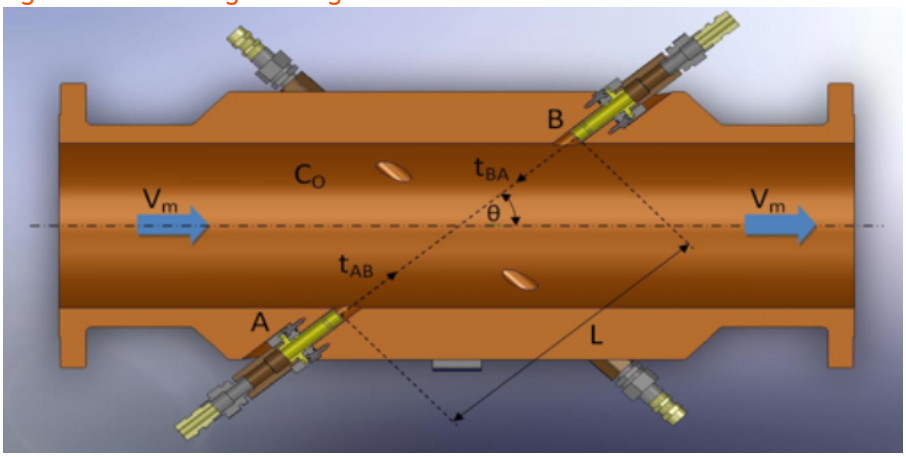
where w_i is the weighting factors and v_i is the average gas flow velocity for each path. Similar equations are used for the MPU 800, MPU 600, and the MPU 200. See Figure 3: Front View of Pipe showing internal positions of the paths.

Figure 3: Front View of Pipe



By checking the direction and magnitude of the transverse flow components in the two upper planes, the flow regime can be determined, as shown in the following picture:

Figure 4: Determining Flow Regime



2.2.4 MPU Series Flowmeter Features

- Custody Transfer Accuracy: The MPUs combine the latest in ultrasonic design, sensitivity analysis, integration methods, and signal processing optimization to deliver accurate custody transfer measurement.
- Compliance to OIML R137 Accuracy Class 0.5 for MPU 800 and MPU 1600 is achieved if the recommended piping plan in section 3.6, Figures 6 and 7 is followed and after calibration.
- Measurement Stability: The path configuration and integration algorithms give superior flow profile correction and compensation for swirl and crossflow over a wide range of operating conditions.
- Field-Proven Electronics: The MPU Series meter designs use the proven know-how in ultrasonic measurement and microprocessor-based instrumentation for harsh outdoor petroleum applications from Smith Meter.
- Excellent Noise Immunity: The software and transducers are designed to operate in difficult applications with attenuation and noise for excellent performance in challenging applications.
- Automatic Compensation for Path Loss: In the unlikely event that a transducer should fail, the software automatically compensates for the loss in path information, with reduced accuracy, in addition to advising the operator that an alarm is present.

- Reciprocity: The optimum transducer and electronics design ensures full reciprocity and zero influences on linearity, independent of pressure, temperature, and transducer aging.

2.2.5 Applications

Measurement of hydrocarbons for:

- Custody transfer
- Allocation
- Leak detection
- Inventory control
- Off-loading and on-loading

3 MPU Operation

3.1 Major Components of the Ultrasonic Flowmeter

MPU gas flowmeters consist of the following components:

- Meter body
- Measurement paths
- MPU800 consists of four measurement paths in four chordal planes
- MPU1600 consists of eight measurement paths in eight chordal planes
- Transducer assemblies, two per measurement path
- Cables
- Electronics assembly consisting of:
  - Electronics enclosure
  - UMCB (Ultrasonic Meter Control Board)

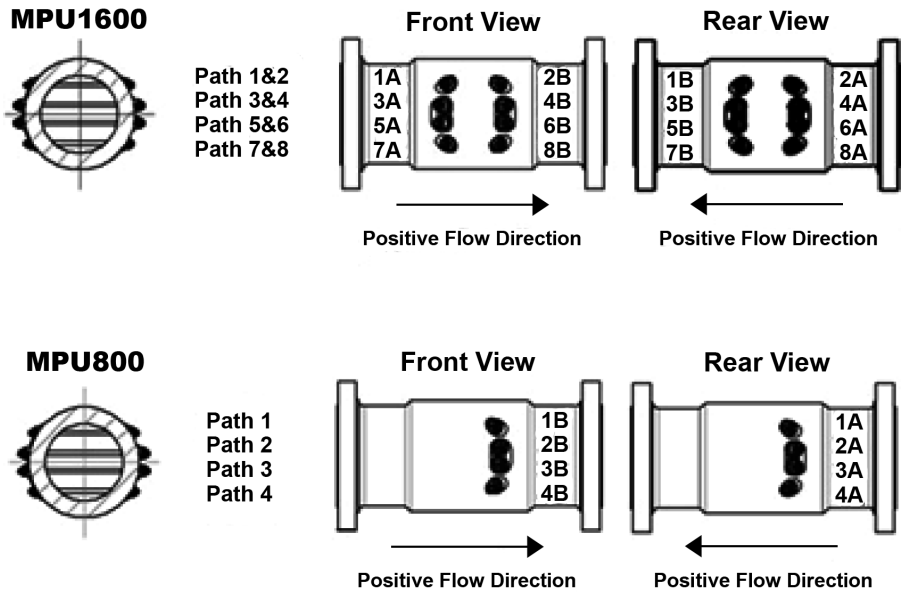
> NOTE: If the optional touch display is not included, an Ethernet connection to a remote PC with a compatible web browser is required to set up the UMCB. This connection and equipment is required even with the optional display in order to download parameters, parameter logs, and the weights and measures log when requested by local authorities.

To perform correct installation, it is important that the correct ultrasonic meter and its ultrasonic signal paths are identified.

Table 2: Identification Markings on the MPU

Item	Markings
Spool Piece	Serial number of the MPU
Adapter/Spool Piece	Transducer position number
Electronics Enclosure	Name plates with: • Serial number of the MPU • Tag number according to customer requirements • Electrical classification • Operational conditions • Spool piece data
Transducer	Serial number of the transducer (not visible while mounted)
Transducer Cable	Marked with number 1 and 2 on the strands

Figure 5: MPU Identification Markings



3.2 Receipt of Equipment

When the equipment is received, the outside packing case should be checked immediately for any shipping damage. If the packing case is damaged, the local

carrier should be notified at once regarding their liability. Carefully remove the unit from its packing case and inspect for damaged or missing parts.

If damage occurred during shipping or parts are missing, a written report should be submitted to the customer service department using the contact information at the beginning of this manual.

Prior to installation, the unit should be stored in its original packing case and protected from adverse weather conditions and abuse. Throughout the installation process, the electronics should be protected from adverse weather conditions.

3.3 Preinstallation Inspection

Visually inspect the meter and meter nameplate to ensure the proper size, model number, flange rating, and flow range. Note the direction of forward flow, described by an arrow, to determine the installation orientation.

Ultrasonic flowmeters are precise measuring instruments and should be treated as such. Install the unit carefully. When transporting the meter, make certain it is not subjected to any severe shock as electronic components may be damaged. Cover flange openings to protect the internal diameter of the meter body. Lift the meter only by the lifting eyes located on each flange. DO NOT lift or move the meter by way of the cabling or conduit system. DO NOT lift or move the meter by inserting a forklift tine into the internal diameter of the meter.

- If the MPU transducer retraction tool (TRT) is used, at least two meters of space on both sides of the MPU is required. Two meters of space also is required on both sides of the piping, one meter upstream and one meter downstream of the MPU.
- For a one upstream bend configuration, a flow straightener is usually not required. Please contact the supplier for advice.
- For multiple upstream bend configurations, a flow straightener may be required. Please contact the supplier for advice.
- According to customer requirements, insulation to maintain a stable gas temperature may be done.

3.3.1 Mechanical Inspection

Preferably, the original protection covers should be intact. These may be removed during the mechanical inspection. Before the spool piece is mounted in the pipeline, the following conditions must be controlled:

- The inside surface must be clean and dry. Use rags or similar to remove preservative. Make sure no preservative is left in the transducer ports as this may affect the measurements.
- Check the flanges for damage. The gasket surfaces must not be damaged.
- Ensure the meter is not damaged and check the electronics enclosure, cable glands, transducer cables, transducer end covers, etc.
- Check the positive flow direction indicated on the name plate is in the same direction as the defined positive flow direction of the site.
- Use the correct type of flange gaskets and ensure the gaskets are not damaged.

The support legs are threaded and may be removed after installation. They should be stored and remounted before removal of the meter.

> NOTE: The supplied lifting lugs are not designed to be left in outdoor environments subject to corrosion and should be removed to preserve them for future use when servicing the meter.

3.3.2 Equipment and Tools Required

The following tools and equipment are necessary to perform a safe and correct installation of the spool piece:

- Crane or forklift
- Certified lifting slings
- Hydraulic tools for correct torque of the bolts
- Rags for cleaning of inside surface

- Necessary gasket lubricant
- Bolt lubricant

The size of some of the tools depend on the flange type and size. Check the weight and pressure rating on the spool piece to get suitable equipment.

- Use a forklift or a crane to place the meter in its position in the pipeline.
- While a few bolts are fastened on both sides, check that the gaskets are entered correctly.
- Fasten the remaining bolts.
- Use the hydraulic tools and set the torque according to the pressure rating of the flanges.
- Pressurize the pipeline and check for leakage.

3.3.3 Tool Kit

A tool kit is provided with each meter to aid in installation and any future maintenance of the electronics. This tool kit should be stored in an accessible place, ensuring it is available to any technician who may need to access the meter electronics in the future.

The tool kit contains:

- 5 millimeter (mm) Allen wrench—Used for removing the electronic cover housing bolts
- Small slotted screwdriver—Used for tightening the screw terminals on the terminal blocks
- Calibrated torque wrench—Used for tightening and loosening the transducer coax connectors from the UMCB
- Serrated tweezers—Used for moving jumpers on the UMCB (for example, to disable the built in RS-485 termination resistor or to switch between copper and fiber Ethernet options (ETH1 and ETH2)) for older versions of the UMCB boards.

3.4 Mechanical Installation

Installation of the ultrasonic flowmeter should follow good piping practices, such as alignment of the pipe center lines before installing the meter to minimize compressive, tensile or torsional stresses placed on the meter. A temporary, straight-pipe spool can be used to align the process piping prior to meter installation if required. Do not use the meter to align the piping.

It is important that no portion of the gasket intrude into the inner diameter (ID) of the pipe. This could cause a distorted flow profile in the meter that affects the performance and stability of the measurement.

Gasket, bolt, and nut materials selected must be compatible with the application environment and specifications. Pipe supports should be installed upstream and downstream of the meter to provide sufficient support of the process piping in accordance with good piping practices.

It is recommended that the meter be installed in the section of piping where the pressure is highest, downstream from pumps, and upstream from flow control valves. When it is expected that flow will be intermittent, the meter should not be mounted at or near a low point or high point in the piping. Solids or water can settle in a low point in the piping and gas can accumulate in a high point in the piping. Both of these conditions may impede proper meter operation.

The installation instructions described herein are intended to be general recommendations and thus may require modification to fit your specific application.

> WARNING: Care must be taken in the installation of the meter. The installer must comply with all national, regional, and local codes.

3.5 Handling of Flowmeter

Do not lift the flowmeter by the electronics box. Use the lifting lugs that are attached to the flanges. Reference Series C Meter Lifting instructions Service Bulletin (SVLS003).

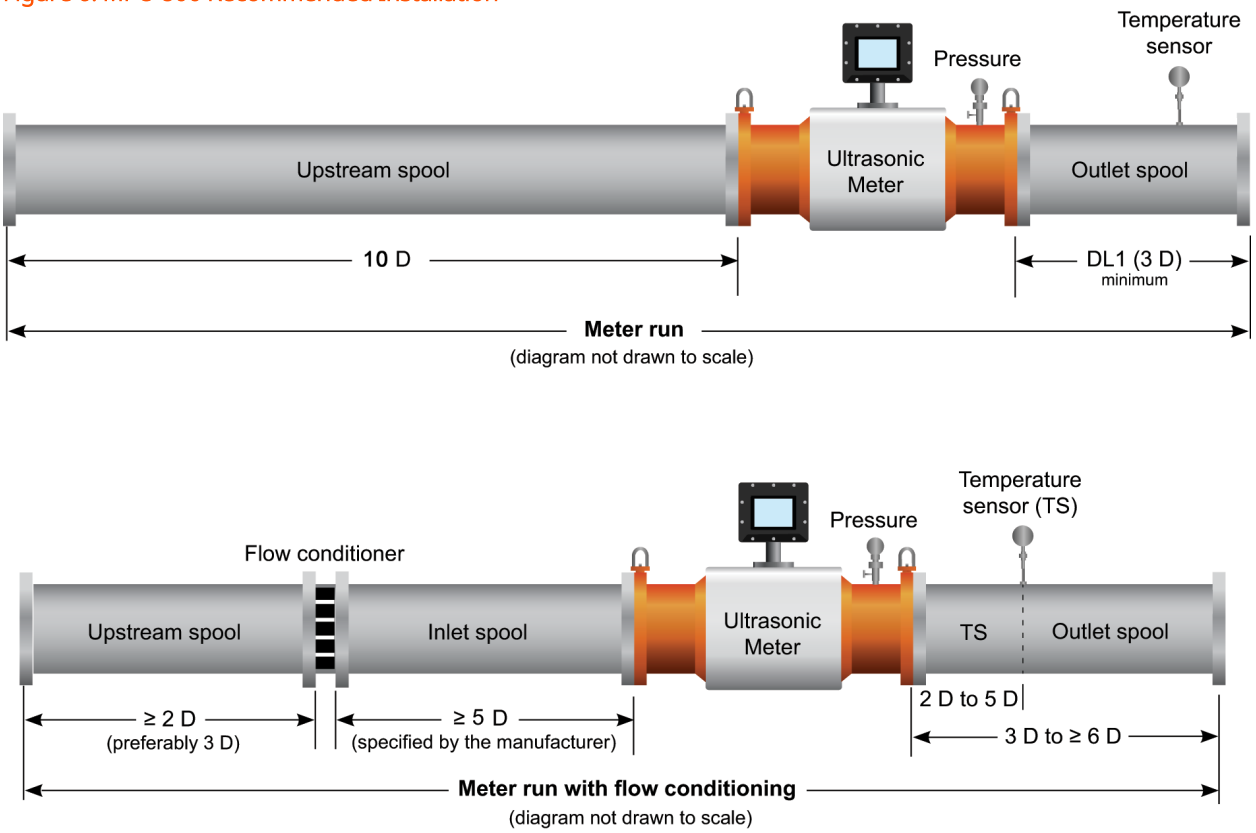
3.6 Flow Conditioning

3.6.1 MPU 800 Recommended Installation

The recommended installation for the MPU 800c is 10 D upstream straight run. For optimum performance, it is recommended to keep partial restrictions or variable flow diversions, such as control valves, away from the upstream area. Consult the factory for an evaluation in case of a complex upstream piping geometry. When using flow conditioning, the meter should be installed a minimum of 5 D from the flow conditioner outlet.

The meter run must be the same pipe diameter as the meter inlet and concentrically centered so that neither the pipe edge nor the gasket protrude into the flow stream. For correct centering, it is recommended to use the centering dowel pin provided on the meter flange.

Figure 6: MPU 800 Recommended Installation

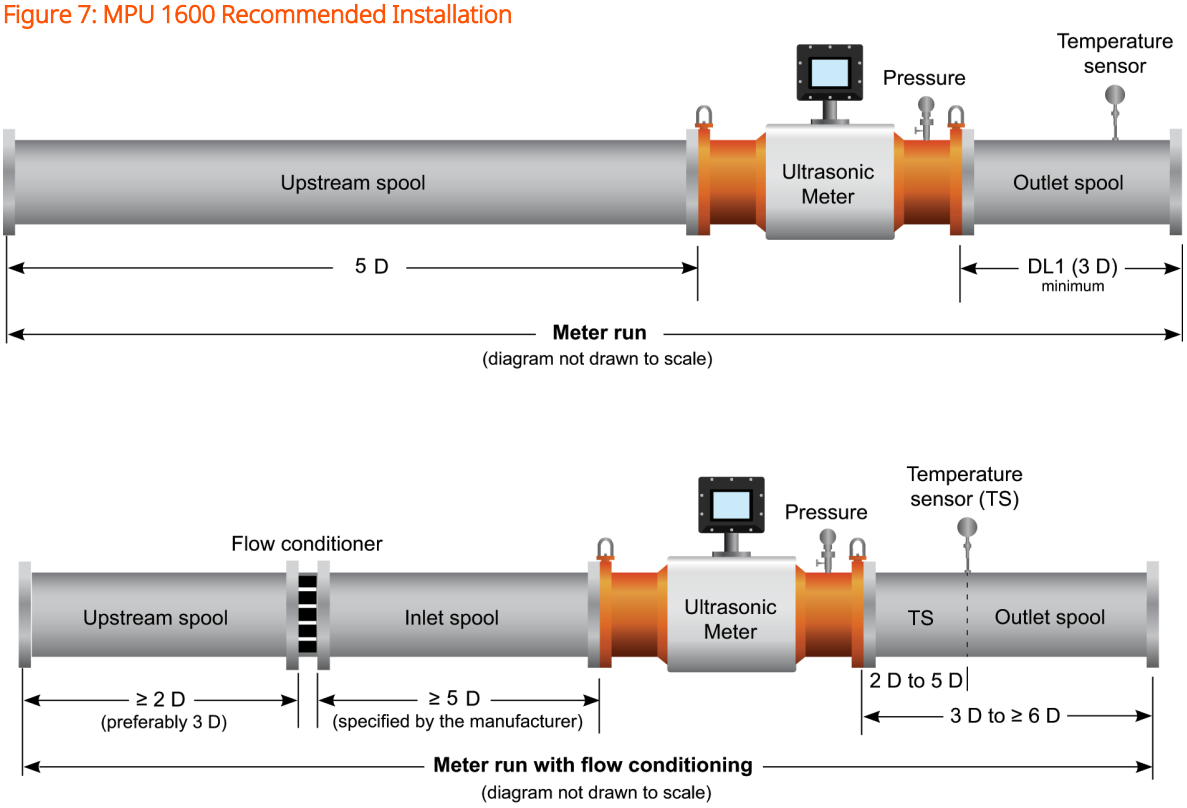


3.6.2 MPU 1600 Recommended Installation

The recommended installation for the MPU 1600C is 5 D upstream straight run. For optimum performance it is recommended to keep partial restrictions or variable flow diversions such as control valves away from the upstream area. Consult the factory for an evaluation in the case of a complex upstream piping geometry. When using flow conditioning the meter should be installed a minimum of 5 D from the flow conditioner outlet.

The meter run must be the same pipe diameter as the meter inlet and concentrically centered so that neither the pipe edge nor the gasket protrude into the flow stream. For correct centering it is recommended to use the centering dowel pin provided on the meter flange.

Figure 7: MPU 1600 Recommended Installation



3.7 Electrical Installation

3.7.1 Electrical Installation General Requirements

It is imperative that the electrical installation be performed by a competent individual that is familiar with associated risks involved with the installation, operation, and maintenance of electrical equipment in hazardous (classified) locations. This individual must possess knowledge of local and national electrical codes and ordinances concerned with hazardous location safety requirements. It is recommended and may be required in some jurisdictions that the final installation be verified and inspected by the authority having jurisdiction before placing the equipment into service.

Electrical installations in hazardous areas have features specifically designed to make them suitable for use in such locations and it is the operator's responsibility to maintain the integrity of those special features.

The operator must ensure that electrical equipment is:

- Installed and operated correctly
- Monitored on a regular basis
- Maintained with due regard to safety

Ensure all connections on the terminal blocks are tight.

All shields must be properly terminated on one end only to prevent ground loops.

All exposed shields must be properly insulated to prevent short circuits to other terminals or to the chassis. The shield at the device (such as a temperature device or transmitter) must be cut back to the insulation and taped off. All shields should be continuous. If splices are required, they must be soldered and properly insulated. If other communicating devices are used with the MPU, refer to the manual for that unit for shielding information. Shields for other communicating equipment should not be terminated in the MPU.

3.8 For ATEX and IECEx Installations

The following instructions apply for the certified equipment listed in the equipment covered portion of the table below as per Directive 2014/34/EU (ATEX Directive):

Standards used:

- IEC 60079-0 6th Edition, EN 60079-0: 2012 +A11:2013, UL 60079-0 4th Edition
- IEC 60079-1 6th Edition, EN 60079-1: 2007, UL 1203 4th Edition
- IEC 60079-11 6th Edition, EN 60079-11: 2012, UL 60079-ll 5th Edition, UL 913 7 Edition UL 1203 4th Edition
- IEC 60079-28 1st Edition, EN 60079-28:2007

Cable entries must be in accordance to EN/IEC 60079-1 section 13.

For wiring systems or fiber optic cables utilizing cable glands, the gland and or thread adapter must be Ex d certified. The cable end must be securely installed and depending on the cable type be properly protected from mechanical damage.

For wiring systems utilizing conduit, an Ex d certified sealing device must be used immediately at the entrance of the enclosure. Any unused entry must be suitably

blocked with an Ex d certified plug. Any optical feed-through or bushing used must be Ex d certified.

Any fiber optic cables must be installed in accordance with the appropriate local standards such as: IEC/EN 60079-14, National Electrical Code (NFPA 70, esp. Article 770), Canadian Electrical Code (CSA C22.1-12, esp. Section 56), for example, or other local codes, as applicable.

The maximum ambient temperature for the enclosure is 60 °C; if the enclosure is directly mounted to a process piping system that exceeds this value then the enclosures must be remotely mounted to guarantee the 60 °C ambient temperature is not exceeded.

Direct exposure to long-term sun exposure of the meter should be avoided. If this cannot be guaranteed, a sun shade is necessary.

Equipment bonding must be provided at the external grounding facility terminal; external connection is not required when using metallic conduit or armored cable.

3.8.1 Touch Screen

The touch screen (if provided) is protected by an intrinsic safe barrier. The enclosure must be grounded as per national electrical code regulations, such as NEC/CEC etc.

3.8.2 Fiber Optics Communication

This device contains a fiber optic Ethernet transceiver module; any fiber optics devices connected to this device through the connecting fiber optic cable must be suitable for the location in which they are installed and any locations where the fiber optic cables are run, with respect to both electrical circuits and optical radiation, for ATEX and/or IECEx installations.

3.8.2.1 Special Conditions for Safe Use

- Select wiring and cable glands suitable for 90 °C operation.
- Contact the manufacturer at one of the below addresses for information on the dimensions of the flameproof joints:

  - Germany operations
    Regentstrasse 1 25474 Ellerbek, Germany +49 4101 304.0
  - USA operations
    1602 Wagner AvenueErie, PA 16510 USA+1 814.898.5000

- When Housing Model UMC - E - (A or S) - (P or H) - ... is used, the pedestal mount base should provide a maximum 0.9246 in. (23.485 mm) O.D. for interface with an enclosure covered by ATEX Certificate DEMKO 09 ATEX 0907098X and IECEx Certificate IECEx UL 09.0023X with the required dimensions listed below. This joint is factory made and the two ATEX/IECEx certified products are shipped together.
- Required Dimensions
  - Maximum diametrical clearance is 0.003 in (.076 mm)
  - Minimum length is 0.5 in (12.7 mm)
  - The joints described above are held in place by use of two Allen head cap screws, DIN 912-A4-70 or DIN 912-A2-70, inserted through the retaining flange and threaded into the pedestal mount base

> WARNING: Using a PC in a hazardous location is not permitted unless the PC is Ex certified. Additionally, the copper Ethernet connection is not rated for operation in the hazardous location as it is not evaluated to be intrinsically safe. The fiber optic interface may be used with an appropriately Ex rated PC in the hazardous location.

The meter electronics are mounted in a flame-proof Exd (explosion-proof) enclosure which is then mounted on top of the meter housing. Transducers are wired into the electronics enclosure by means of a cabling system. The meter electronics perform all signal processing calculations and outputs the indicated flow rate. The calculated flow rate is transmitted using the either pulse output (0 to 10,000 Hz) or the analog (4-20 mA) output. Modbus over transmission control protocol/internet protocol (TCP/IP) Ethernet or serial RS485 communications can also be used to communicate flow rate as well as historical data and diagnostic information to other ancillary systems, such as a PC or a programmable logic controller (PLC) system.

WARNING: If the meter is not connected to an Ethernet network, then Guidant strongly recommends that an Ethernet cable is connected to the UMCB - ETH1 RJ45 connector on the meter and is fed into the closest control room. The cable does not need to be connected to any device but should be available for connection by either service or weights and measures personnel. This makes it unnecessary to open the meter electronics enclosure in the field for verification of metrological parameters, applying software upgrades, and performing remote meter diagnostics. If the optional display is not included, the Ethernet connection is the only means to change parameters through a remote browser.

NOTE: The network connection is the only means to download logs and parameters that may be required by local authorities during verification visits.

WARNING: To prevent ignition of hazardous atmospheres and to prevent electrical shock, disconnect from supply circuits before opening; keep tightly closed when circuits are in operation.

WARNING: The enclosure contains an internal battery-powered circuit. To prevent ignition of hazardous atmospheres, do not open enclosure unless area is known to be non-hazardous. Substitution of components may impair intrinsic safety and Op is.

CE 0539 Ex II 2G

Marking	Equipment	Certificate
Ex d IIB T4 – T6 IP66 Tamb = -40 °C to +70 °C		
	Ultrasonic Transducer System	DEMKO 09 ATEX 0907098X IECEx UL 09.0023X

Marking	Equipment	Certificate
Ex d ia op is IIB T5 Gb (Um=250v) IP66 Tamb = -40 °C to 60 °C	Ultrasonic Meter Control (UMC) with display	DEMKO 13 ATEX 1204991X IECEx UL 13.0019X
Ex d op is IIB T5 Gb IP66 Tamb = -40 °C to 60 °C	Ultrasonic Meter Control (UMC) without display	
Ex d ib IIB T5 Gb IP66 Tamb = -40 °C to 60 °C	Remote Mounted Display: Touchscreen Control Interface (TCI)	

Marking	Equipment	Certificate
Ex db op is IIB + H2 T5 Tamb = -50 °C to +60 °C	Aluminum: UMH-H-... Stainless steel: UMHX-H-...	BVS 17 ATEX E 052 X IECEx BVS 17.0046X

3.8.3 Installation of Cables

Cables for communication and power supply lines are not a part of the order. However, the technical specifications for the cables MUST be followed. Prior to the installation, these requirements must be checked.

The number of and types of cables are dependent on which version or options that are delivered. A set of wiring diagrams are available covering the different options. Project specific wiring diagrams may also be available. Cable installation and connection must be done by professionals with the required skills and certificates.

> WARNING: DO NOT SWITCH POWER ON until the installation has been verified against the relevant connection diagrams contained in this manual. Any damage caused by incorrect installation will void the warranty.

3.8.3.1 Equipment Required

- Conventional hand tools for cable installation
- If a fiber optic cable is a part of the delivery, special tools for connecting straight-tip (ST) connectors are required

3.8.3.2 Cable Installation Check List

- All cables to and from the MPU are connected to dedicated terminals in the electronic enclosure.

- Check that the connection of armor and screens are done according to the drawings and relevant specifications. General descriptions for installation of the various power or signal types are shown below. Consider various types of cable glands and how these should be installed.
- The cable must be installed on cable trays or in pipes, protected against mechanical damage.
- The external cables are entered into the Ex d enclosure and relevant regulations for such installation must be followed. Consider the minimum segregation between power and signal cables.
- Be aware of the minimum bending radius of the cable. Cable specifications must be checked as the bending radius for a multicore cable is normally six times the diameter, though this measurement may vary.
- Ensure that the earthing system is maintained. The protective earth (PE) bars have to be connected to the main earth system.
- All cable armor or cable shield connections should be as short as possible.

3.8.3.3 Conduit Installation

For North American Installations or other areas utilizing conduit, conduit connections must be in accordance with:

- USA: National Electric Code (NFPA 70)
- Canada: Canadian Electric Code (CSA C22.1)

A listed seal-off box must be used immediately at the entrance of the enclosure for all conduit connections; for example, within three inches. Any unused entry must remain blocked with the provided plug or a suitably listed alternative at all times.

Figure 8: Example of Ex d Cable Gland Connection European Market

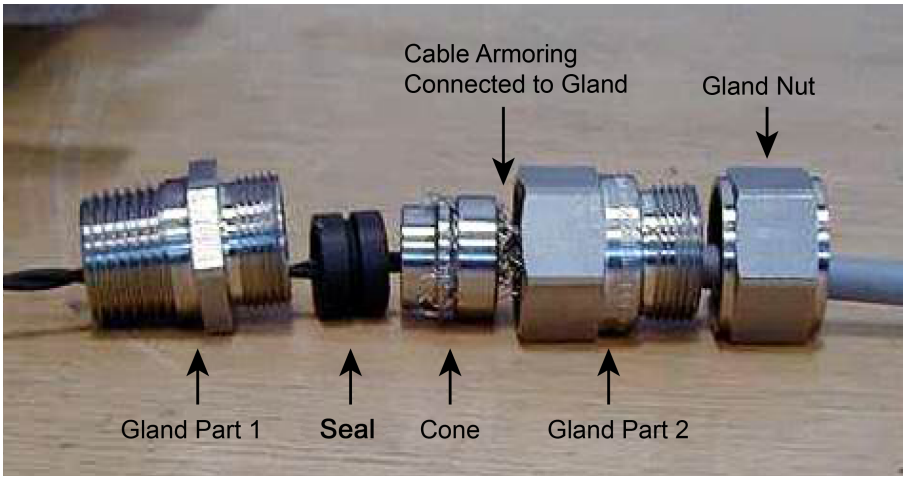
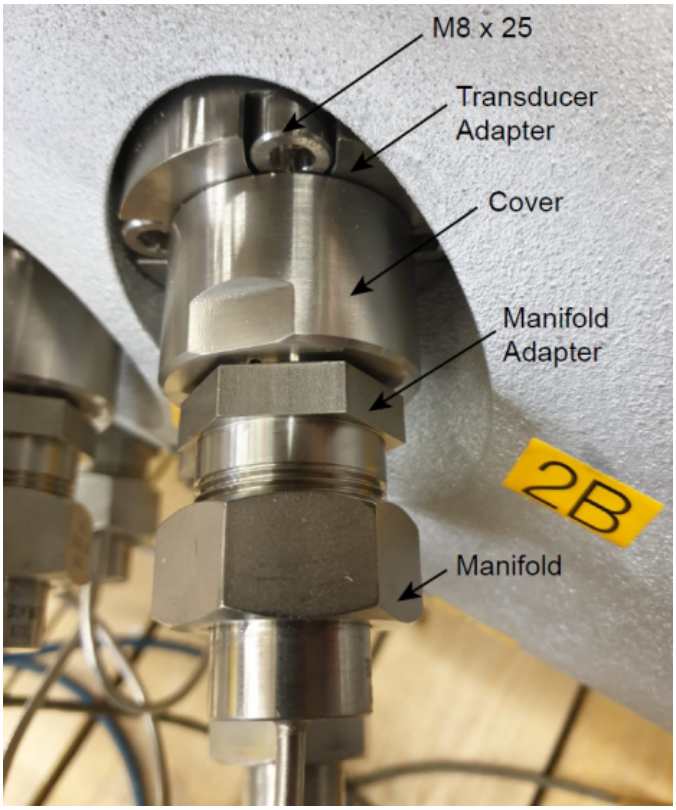


Figure 9: Micro Conduit, Standard Offering

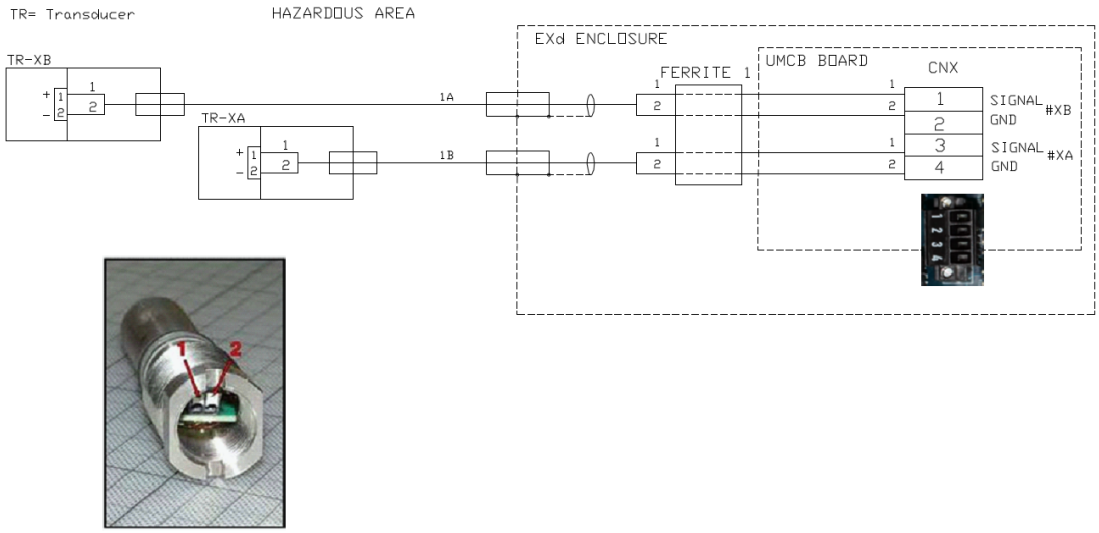


3.9 Transducer Wiring

The transducer wiring is factory mounted.

UMCB-W Connector-PATHx	
Position	Function
1	B-Sig
2	B-GND
3	A-Sig
4	A-GND

Figure 10: Transducer Wiring



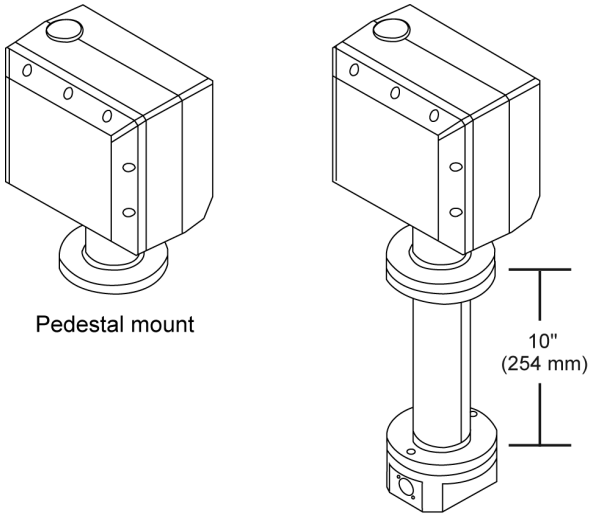
3.10 Explosion-Proof Housing Closure

When securing the front cover of the UMC, TCI, or UMH enclosure, use the following procedure to ensure the unit is properly sealed and is safe to operate in the hazardous environment:

1. Inspect the door seal O-ring for damage and replace if damaged. The O-ring is not required to maintain the explosion-proof rating; however, it is required to maintain the IP 65 ingress protection rating. Grease cover flange with petroleum jelly (part number 644886401) before attachment of the cover to the housing.
2. Verify the mating areas between the front cover and the main housing are not scratched, corroded, or otherwise damaged such that the surface contact between them would be compromised.

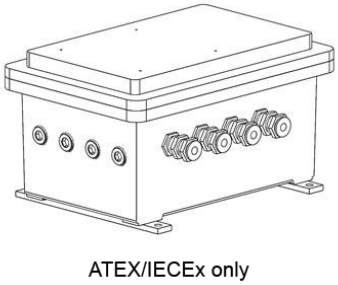
3. Close the cover and tighten the bolts around the perimeter of the front cover. The final torque should be 70 in•lb (8 newton meters (N•m)) for the UMC/TCI enclosure type (pedestal style).

Figure 11: UMC (Standard Enclosure)



- UMH alternate enclosure type (as shown below)—Once the cover is fitted, ensure that all the fasteners are present and fully tightened.
  - Cover bolt torque requirement:
    - Aluminum enclosure: 20 Nm
    - Stainless steel enclosure: 25 Nm

Figure 12: UMH Style Alternative Enclosure



4. Check that the enclosure is properly sealed by verifying the cover to enclosure joint gap with a 0.0015 inch (") (0.038 mm) feeler gauge. The feeler gauge must

not enter the joint for more than a ¼" (6 mm) at any point around the perimeter of the cover to housing joint.

3.11 Flame Path Inspection Criteria

> WARNING: To prevent ignition of hazardous atmospheres, disconnect from mains power supply before opening the cover.

1. Installation, inspection, maintenance, repair, overhaul, and reclamation of the MPU in the European Union must be performed by qualified personnel in accordance with the applicable requirements of EN 60079-14, EN 60079-17, and EN 60079-19 in addition to all local codes and regulations.
2. Installation/inspection/maintenance/repair/overhaul/reclamation of AccuLoad's relying upon the IECEx certification must be performed by qualified personnel in accordance with the applicable requirements of IEC 60079-14, IEC 60079-17, and IEC 60079-19 as required by local codes and regulations.
3. Guidance for equipment inspection and maintenance is provided by EN/IEC 60079- 17: "Electrical Apparatus for explosive gas atmospheres, "Inspection and maintenance of electrical installations in hazardous areas" and should be utilized for the inspection/maintenance process.
4. When performing maintenance that requires opening of the enclosure cover, all flame paths, which are defined as the machined flanged surface between the housing and the cover, shall be inspected to ensure that they are clean and undamaged, no scratches, nicks, corrosion, or other defects that would affect the integrity of the flame path are allowed. If defects are detected the equipment should not be placed back into service until the issues are resolved.
5. Verify that all tapped cover bolt threaded locations in the enclosure are clean and intact with no missing or stripped threads.
6. For the UMC/TCI enclosure verify that the cover bolts are the required M6 x 1 - 6g x 20 mm long, Din 912-A4-70, stainless steel part number P8000007970 and part number P8000007847 drilled for seal wires.

For the UMH enclosure, when replacing any cover bolts with Hexagon socket head cap screw ISO 4762 is for “regular type screw thread” M8 x 1.25 x 25 (6g), A2-70. Cover screw minimum yield stress: MINIMUM YIELD STRESS 450 N/mm2.

Prior to reassembly apply a light coating of nickel based anti-seize (such as part number 646002401) to all bolt threads.

7. Verify that any blind threaded cover bolt holes do not have excessive grease/anti-seize packed into them as this could cause hydraulic fractures of the enclosure when the bolts are tightened.
8. Inspect to see that the environmental O-ring is correctly installed (seated into the groove) and in good condition, no cracks etc., if defective replace to maintain environmental protection. Grease cover flange with petroleum jelly (part number 644886401) before reattachment of the cover to the housing.
9. Ensure cover bolt torquing has been completed, verify the flame path gaps as per section 3.11: Flame Path Inspection Criteria on the previous page of this manual.

3.12 Ultrasonic Transducer System (UTS)

If provided with the UTS—a micro conduit connection to the transducers and the Electronic Ex d enclosure—the following applies:

The UTS must be connected to an Ex d IIB Gb flameproof enclosure with an EC-Type Examination certificate. Component certified enclosures are not to be used. It shall have appropriate threaded connection facilities and ambient temperature range.

Alternately, the J-Box manifold adapter will provide a minimum 0.9245 in (23.482 mm) O.D. for interface with an enclosure covered by ATEX Certificate DEMKO 12 ATEX 1204991X & IEC Ex UL 12.0025X with the following dimensions: Maximum diametrical clearance = 0.003 in; minimum length = 0.5 in.

This joint is held in place by use of a two Allen head cap screws, DIN 912-A4-70 or DIN 912-A2-70, inserted through the retaining flange and threaded into the

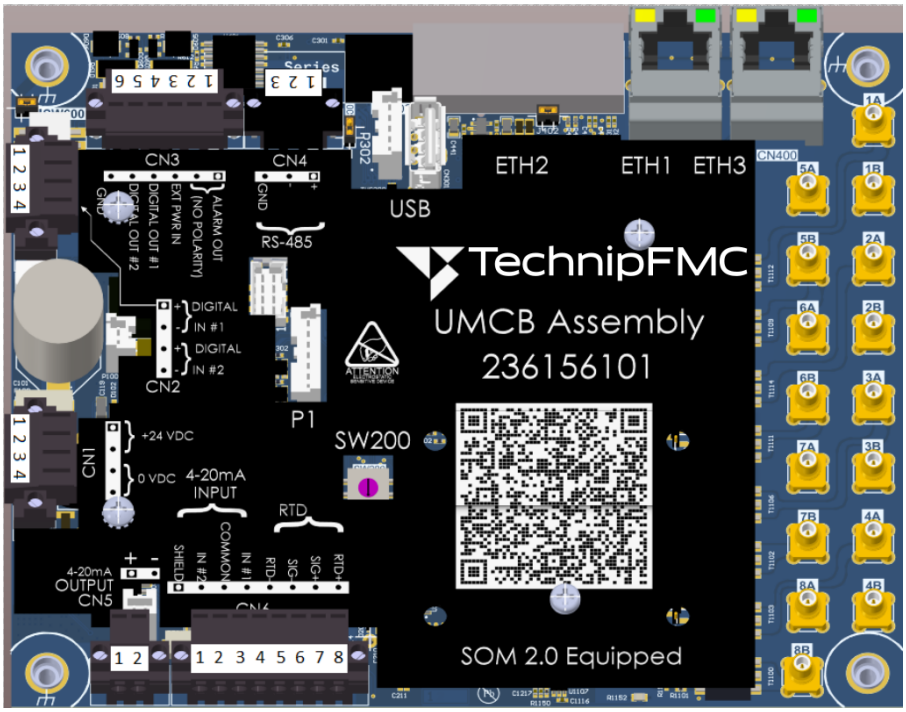
flameproof enclosure. This joint will be factory-made and the two ATEX certified products will always be shipped together.

4 Ultrasonic Meter Control Board

The ultrasonic meter control board (UMCB) is the heart of the ultrasonic meter. The standard board contains coaxial connections for the interface to the transducers. The UMCB-W is a special version that has terminal style connections to the transducers.

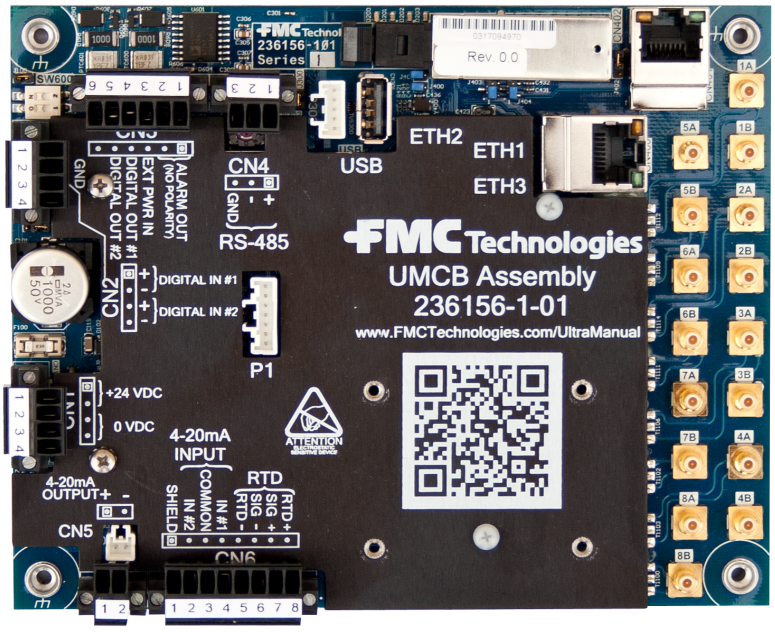
4.1 Boards

Figure 13: UMCB Board Revision 4 and Above



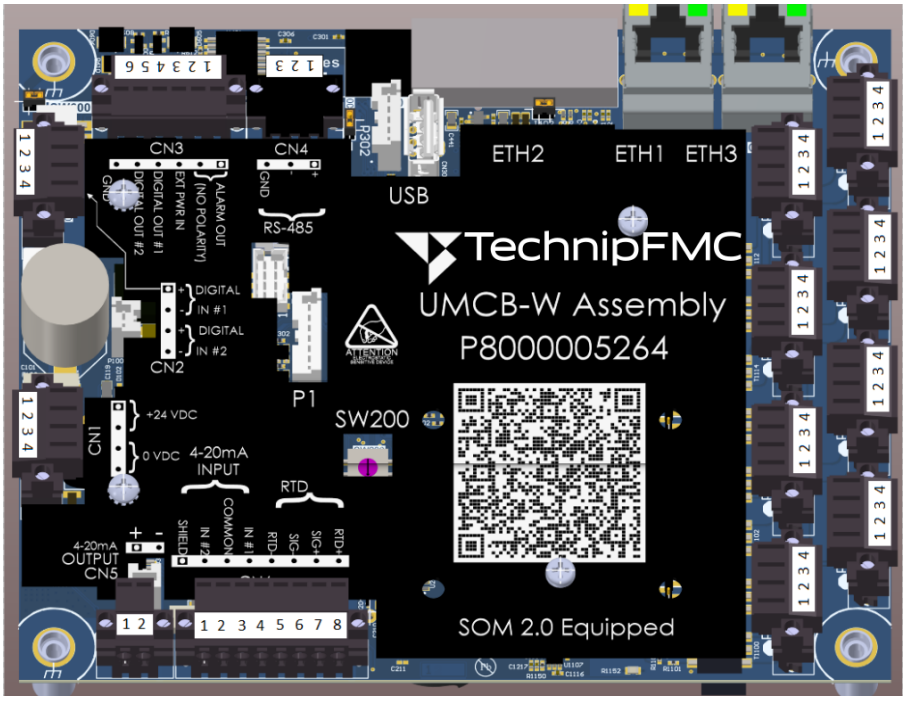
NOTE: UMCB board, Revision C and above, equipped with second generation system on module (SoM), Revision C legend shown.

Figure 14: UMCB Revision 3 and Below



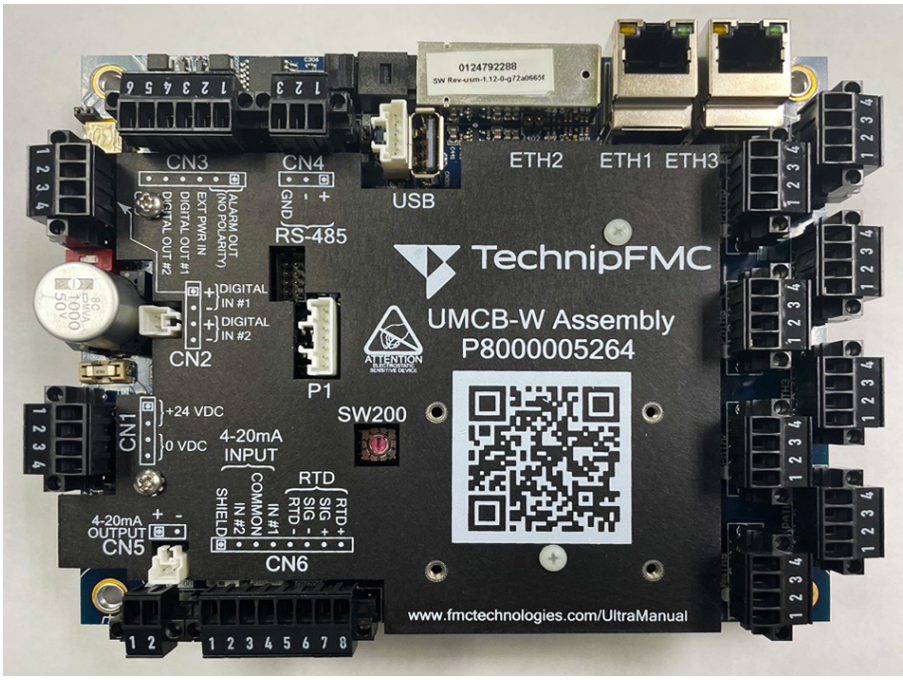
NOTE: On the UMCB cover shield legends connector position 1 is indicated by a circle enclosed in a square.

Figure 15: Rev A UMCB-W and above



NOTE: UMCB board, Revision A and above, equipped with second generation system on module (SoM), Revision A legend shown.

Figure 16: Rev 3 UMCB-W and below



4.2 UMCB/UMCB-W Field Wiring Examples and Information

4.2.1 External User Supplied Power Supply

The UMCB is designed to be powered by 24 volts direct current (VDC) as per the following requirements:

- 24 VDC, +20%/-15%, current minimum of 0.5 ampere (amp) without integrated display and a minimum of 0.7 amp with integrated display
- Power inrush: 10 amp for < 20 milliseconds (ms) at 24 VDC
- The DC power input circuitry of the UMCB is reverse current protected and fused with an 8 amp fast blow fuse (F100)
- Tested to 20 ms power dropout, 100 ms power brownout without shut down

- Meter will restart orderly after power loss and reapplication of power
- The shield of the cable should be connected only at the electronic enclosure, preferably via the cable gland
- Connect input power cable to connector CN1

DC Input Wire	Terminal
24 VDC (+)	CN1-1 (or CN1-2)
Ground	CN1-3 (or CN1-4)

It is recommended to provide a fast blow-type fuse in series with the +24 VDC supply to the UMCB board to protect the on board fuse.

4.2.2 Input/Output Wiring

- Digital Input/Output (I/O)
  - Two digital inputs (CN2)
  - Two digital pulse outputs/digital outputs (CN3)
  - Alarm Output (CN3)
- Analog I/O
  - Two 4 to 20 milliampere (mA) input (CN6)
  - 4 to 20 mA output (CN5)
- Communications
  - Two ANSI/IEEE 802.3 ethernet port (ETH1 and ETH3)
  - Fiber optic port
  - 100Base-FX (ETH2)
  - RS-485 half-duplex (two-wire) (CN4)

NOTE: Reference the MPU product specification documents in the Guidant Knowledge Base for technical specifications of the I/O. Note in diagrams below:

= Customer wiring and equipment

4.2.3 Digital I/O

Connections for the digital I/O are made on the UMCB board using terminal CN2 and CN3.

4.2.4 Digital/Pulse Output

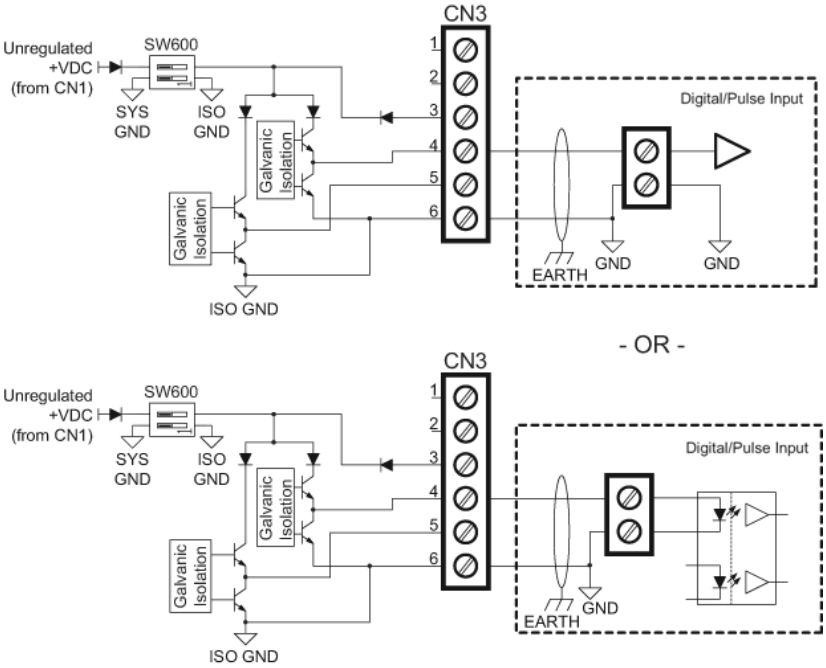
The pulse output connections are made using terminal CN3 as follows:

Function	Connection Port
Digital/Pulse Out #1	CN3 - Terminal 4 and 6
Digital/Pulse Out #2	CN3 - Terminal 5 and 6

- Pulse Out #2 is 90 electrical degrees out of phase with Pulse Out #1
- For forward flow, Pulse Out #2 lags Pulse Out #1
- For reverse flow, Pulse Out #2 leads Pulse Out #1

The pulse outputs can be configured to act as active outputs or pseudo open collectors. They are “pseudo” because the two output grounds are not isolated from each other.

Figure 17: Digital Output, Active Output Mode, Preferred

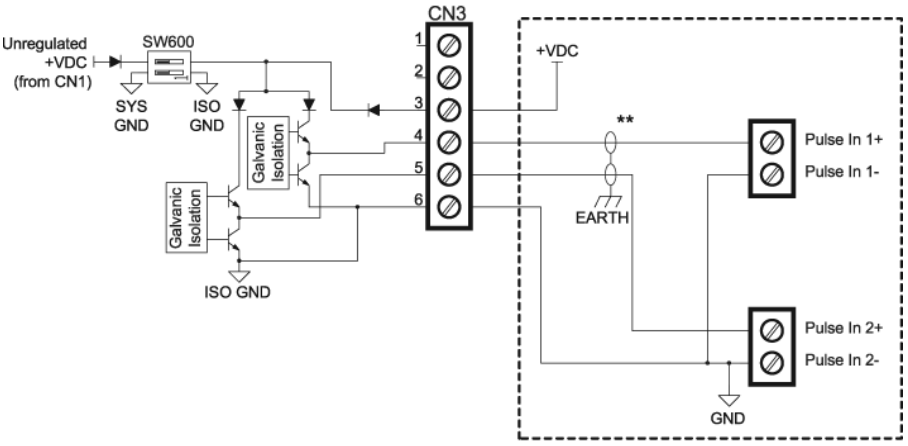


NOTE: *Out2B is wired identically between position 5 and 6.

Customer can power active outputs with higher or lower voltage by setting both positions of SW600 to OFF and connecting external power supply between CN3 positions 3 and 6.

If using dual pulse output the two conductors carrying the outputs must not be in the same pair and ideally are individually shielded.

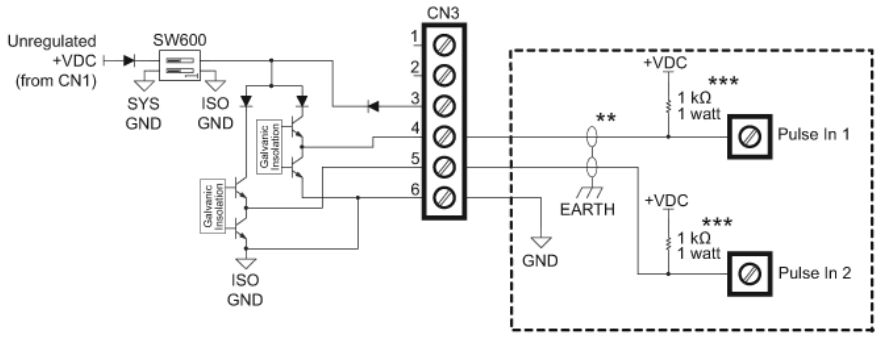
Figure 18: Digital Outputs, Active Output Mode, Externally Powered by +24VDC



NOTE: *SW600 Positions 1 and 2 must be set to OFF.

**If using dual pulse output, the two conductors carrying the outputs must not be in the same pair and ideally are individually shielded.

Figure 19: User supplied Pull Up Resistor



NOTE: *SW600 Positions 1 and 2 must be set to OFF

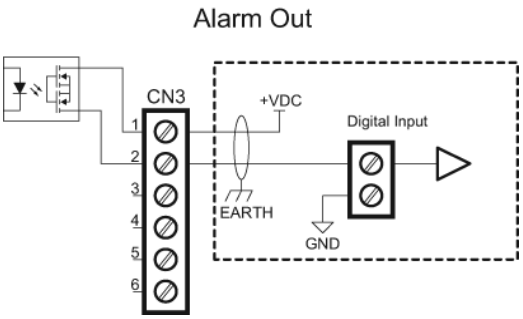
**If using dual pulse output, the two conductors carrying the outputs must not be in the same pair and ideally are individually shielded.

***Customer supplied pull-up resistor

When operated in pseudo open collector mode, the outputs will require a “pull-up” resistor in order to function properly unless the receiving instrument has a current-limiting resistor built into the circuit.

4.2.5 Alarm Out

Figure 20: Alarm Out



The solid state relay (SSR) is closed during normal operation. During an alarm, or when the power is off the SSR is open. The relay is direct current (DC) only.

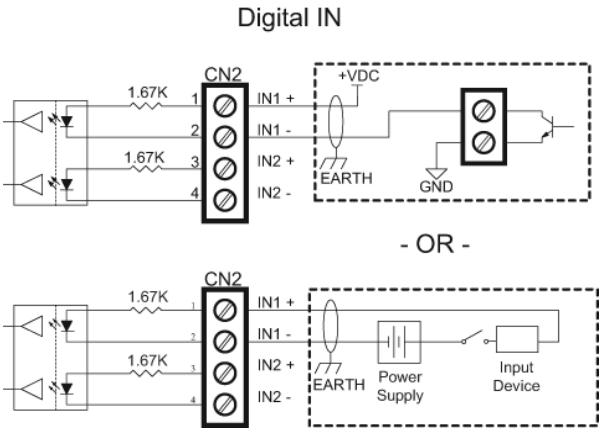
4.2.6 Digital Inputs

Function	Connection Port
Digital In #1	CN2 - Terminal 1 and 2
Digital In #2	CN2 - Terminal 3 and 4

Digital In #2 is currently dedicated to the use as an external weights and measures hardware lock switch.

Digital In #1 is not supported at this time.

Figure 21: Digital Inputs



NOTE: IN2 is wired identically.

4.2.7 Weights and Measures Lock

Weights and measures parameters are hardware locked by a slide switch located next to CN2, the lock position is towards the center of the board. The unlock position is towards the edge of the board. If an external switch is desired, it can be connected to Digital In #2. In this case, the switch is required to be set to (hardware locked), i.e., towards the center of the board to allow the external switch to function. The application of +24 VDC to terminals (IN 2 + and -) will "unlock" the hardware seal.

> NOTE: For boards UMCB version 3 and lower and version 2 and lower for UMCB-W, the weights and measures lock is controlled by removing jumper J_WM which is located next to CN2. If an external switch is desired, it can be connected to Digital In #2. In this case, jumper J_WM must be removed to allow the external switch to work..

4.2.8 Analog Inputs

Connections for the analog inputs are made on the UMCB board using terminal CN6:

Function	Connection Port
4-20 mA In #1	CN6 - Terminal 4 and 3
4-20 mA In #2	CN6 - Terminal 2 and 3
RTD +	CN6 - Terminal 8
RTD Sig +	CN6 - Terminal 7
RTD Sig -	CN6 - Terminal 6
RTD -	CN6 - Terminal 5

Input Signal Ranges	
4-20 mA In #1 and #2	3.8 - 22 mA
Resistance temperature detector (RTD)	76.7278 - 168.4783 ohms

Figure 22: Analog Inputs, RTD

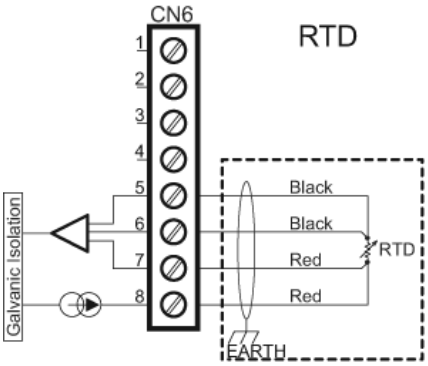
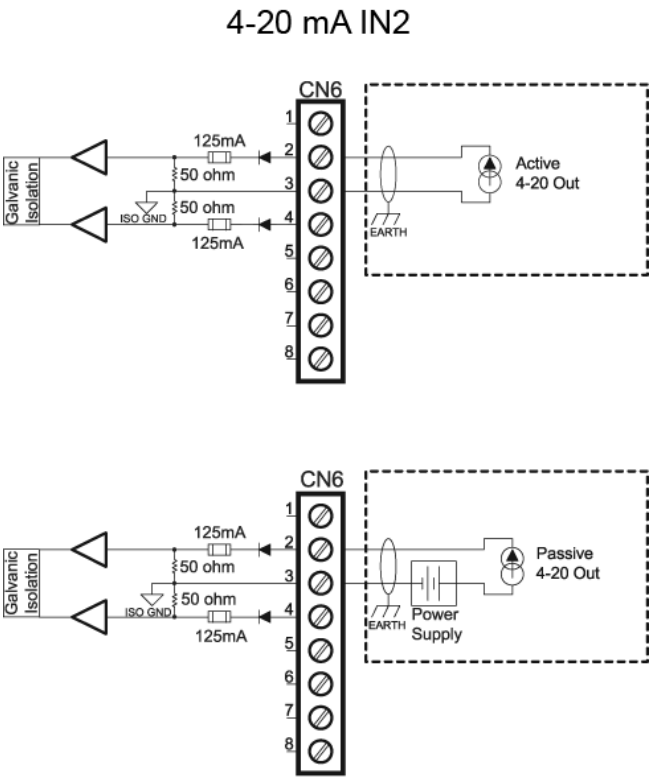


Figure 23: Analog Inputs, 4-20 mA IN2



NOTE: IN2 is wired identically.

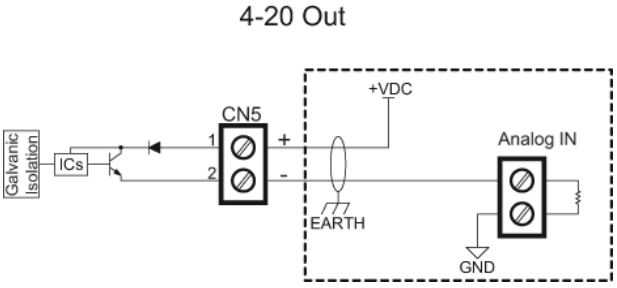
4.2.9 Analog Outputs

Connections for the analog output are made on the UMCB board using terminal CN5:

Function	Connection Port
4-20 mA In #1	CN5 - Terminal 1 and 2

The 4-20 mA output is passive and requires an external voltage source. If an external isolated voltage source is not desired, the same 24 VDC that is powering the electronics may be used as the voltage source. This can be done by wiring CN5 Terminal 1 to CN1 Terminal 1 or 2.

Figure 24: Output Signal Range: 3.8 - 21.0 mA



4.3 Communications

4.3.1 Ethernet

The 10/100 base-T Ethernet connections are made using terminal ETH1 and ETH3. Fiber optic connection is made using terminal ETH2.

Comm. Port	Connection Port
Copper Ethernet #1	ETH1
Copper Ethernet #2	ETH3
Fiber Optic	ETH2

NOTE: For revision 4 (or any alpha revision) and above UMCB board and revision 3 (or any alpha revision) and above UMCB-W board assemblies the fiber optic port ETH2 is always active. To conserve power and lessen heat generation, the power supply to the fiber optic converter may be removed. This is controlled by jumper J402, which may be removed if ETH2 is not required.

NOTE: The following table applies only to revision 3 and older UMCB board assemblies and revision 2 and older UMCB-W board assemblies.

If fiber optic communications is required, only one copper Ethernet port will be available, ETH2. The unit will be factory set the Ethernet connectivity mode that was ordered.

Modifying the Ethernet connectivity ports requires removal of the UMCB board. Consult the factory before proceeding. Proper electrostatic discharge (ESD)

precautions must also be followed. The jumpers on the top and bottom side of the UMCB must be positioned according to the table below. Only modify jumpers with the power to the electronics off. DO NOT USE needle nose pliers or other large tools to move the jumpers as the jumpers and printed circuit board (PCB) can be damaged.

Figure 25: Jumper Configuration for Copper Versus Fiber Optic Mode

Jumper	Copper (CN401)	Fiber Optic (CN402)
J400	OUT	IN
J401	OUT	IN
J402	OUT	IN
J403	1 and 2	2 and 3
J404	1 and 2	2 and 3
J405 (under shield)	OUT	IN
J406 (bottom side of board)	2 and 3	1 and 2
J407 (bottom side of board)	2 and 3	1 and 2

Figure 26: Top View of UMCB Revision 3 or Older

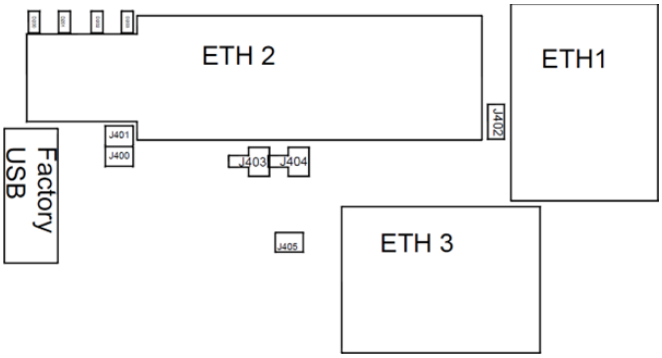
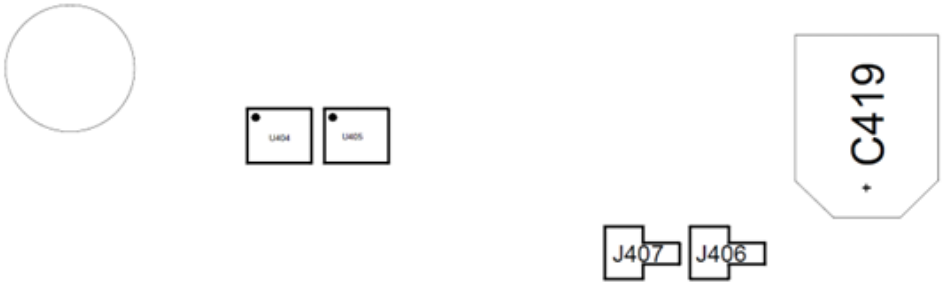
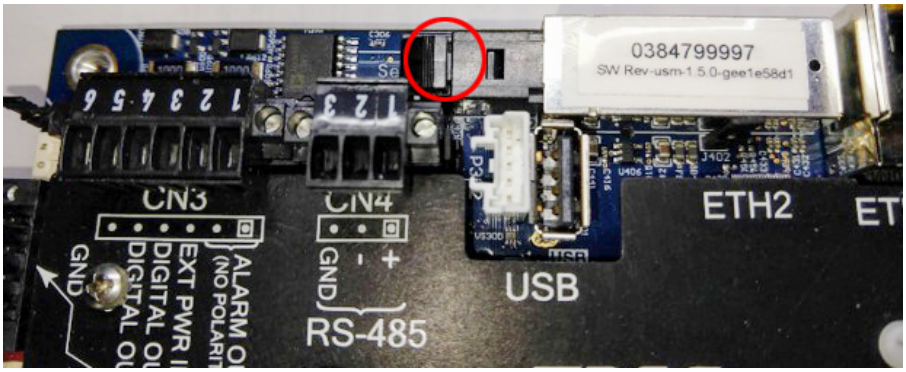


Figure 27: Bottom View of UMCB Board Revision 3 or Older



4.3.2 ETH2 (CN402) Fiberoptic Connector

Figure 28: ETH2 (CN402) Fiber Optic Connector



> WARNING: To remove blank protective plug press down on tab and slide back. Do not remove protective plug until ready to insert fiber cable assembly terminated with mechanical transfer registered jack (MT-RJ) connector to prevent contamination of the optic components.

Revision 4 UMCB and greater/revision 3 UMCB-W and greater board shown, jumper J402 is also shown in the view.

4.3.3 Mating Connector Type MT-RJ

Follow manufactures termination instructions provided with MT-RJ connector.

> WARNING: Fiber optic radiation; do not remove plugs while power is supplied to UMCB.

4.3.4 Fiber Optical Cables

An MT-RJ connector is used to connect the optical fiber cable to the UMCB PCB. The MT-RJ plug must be terminated to the end of the cable entering the electronics enclosure. The connectors may be pre-terminated or special tools must be available for mounting these.

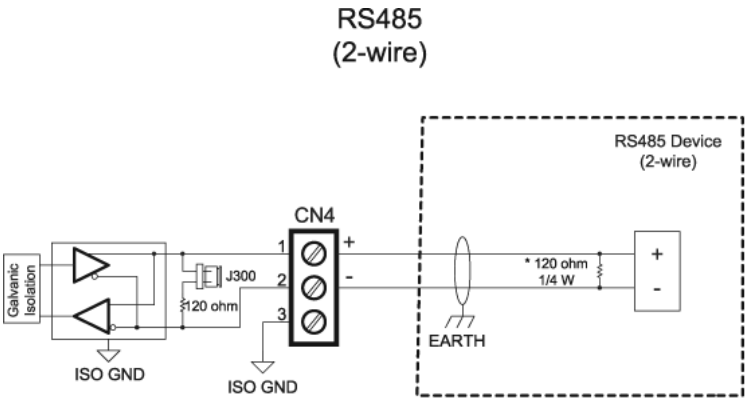
> NOTE: If the MT-RJ connector will be pre-terminated to the cable, ensure that it is possible to feed the connector through the cable gland or conduit entrance.

The maximum number of cable splices/junctions in one fiber run is given by the total power budget. This is dependent on the type of cable, length of cable, type of transmitter and receiver at both ends, use of repeaters, and number of connections.

4.3.5 RS-485

The meter features a two-wire (half duplex) RS-485 serial communication port. The serial port terminals are accessed on connector CN4 on the UMCB board. The port supports Modbus-ASCII and Modbus-remote terminal unit (RTU) communication protocols. More information about Modbus-RTU communications can be found in the MPU 200c, 600c, 800c, and 1600c External Communications Manual (MN0A003).

Figure 29: RS-485



> NOTE: Customer-supplied resistor is only necessary if customer equipment does not have internal termination.

4.3.6 USB

A universal serial bus (USB) female A connector is only provided on the UMCB for connection to Guidant-approved devices. Connection of unauthorized devices may result in unexpected meter behavior, damage to the electronics, and a voided warranty. Do not connect anything unless directed to by the factory.

5 Meter Start-Up

> NOTE: Guidant Measurement was previously the Measurement Solutions division of TechnipFMC (previously FMC Technologies). As such, some information in your system may vary based on when it was installed.

Before powering on the meter and beginning flow measurement, verify that the following items are completed:

- Meter has been properly installed (flow direction is correct) in the piping and all connections are free from leaks
- Power supply and input/output connections have been checked for proper wiring and connection integrity
- All conduit and gland connections are in adherence to applicable electrical codes

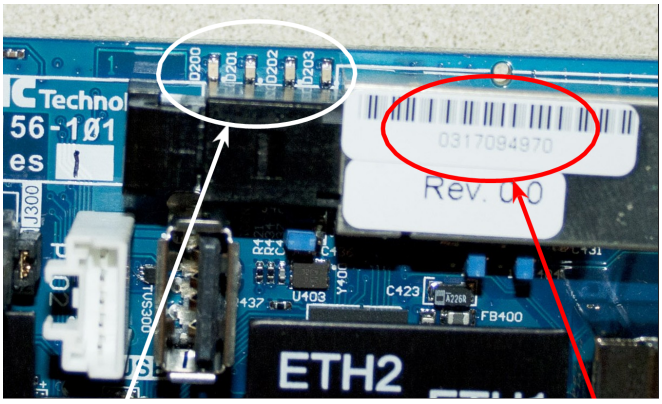
When power is applied to the meter, it will go through a boot sequence and will then begin measurement automatically. This process can take several minutes. If flow is present, the pulse output will begin and the connected flow PC should begin totalizing.

If power is interrupted for a period of less than 20 ms during operation, the meter will continue operating with no loss of measurement. If power is lost for more than 100 ms during operation, the meter will reset. Once power is re-supplied, the meter will go through the power-on boot sequence and will resume measurement.

5.1 LEDs Overview

During start-up and normal operation four light-emitting diodes (LED) on the UMCB board above the ETH2 connector are visible and intended to communicate status information.

Figure 30: LEDs and Meter Serial Number



LEDs consist of:
- LED 200 - Blue
- LED 201 - Green
- LED 202 - Yellow
- LED 203 - Red

Electronics Meter Serial Number

5.1.1 LED Behavior

5.1.1.1 Start-Up

During start-up the following LED behavior should be observed:

1. All visible LEDs will briefly flash
2. All LEDs shutoff except yellow
3. Yellow shuts off when the main operating system (OS) starts booting

5.1.1.2 Normal Operation

During normal operation the following LED behavior should be observed:

1. Green (LED 201) turns on when the metering start-up process has successfully completed
2. Blue (LED 200) will flash at about a 1 hertz (Hz) rate that confirms that the core measurement process are running

5.2 Setting the Meter IP Address

There are two ways to identify the meter internet protocol (IP) address after first starting up the meter:

1. The rotary switch can be used to force the IP address to the factory default value of 169.254.165.10. This will allow the user to access the meter interface to configure the permanent address settings. Before doing this, take note of the original position of the rotary switch and record this position. Then turn the switch to position 9.

   The meter must reboot for new address settings to activate. Either cycle power to the meter or reboot from the Diagnostics -> Meter restart menu.

   The IP address will be 169.254.165.10. Type this address into the URL input of a browser (for example, Firefox, Chrome, or IE9+), and a connection to the user interface will be established.

   In order to change the meter's address settings to a different value set the rotary switch to position 0 and configure in the Settings -> Communications menu. The meter must restarted in order for communication setting changes to take effect.

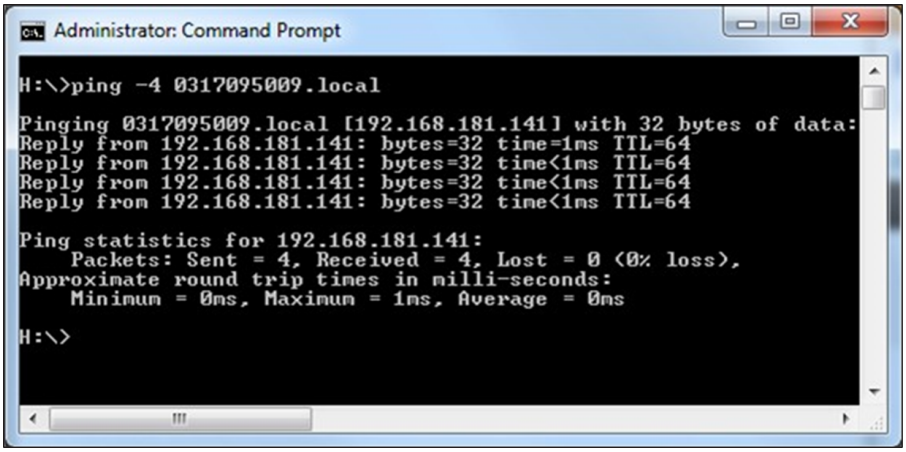
   > NOTE: The rotary switch must be set to position 0 and the meter restarted in order for the software configuration to take effect.

2. A PC with a domain name system system discovery (DNS-SD) driver installed may be used to determine the meter IP address. An example driver is Apple's Bonjour (Windows). With that driver active and the meter on the network, the “Ping” command from the command prompt may be used if the serial number is known. The meter serial number is shown on the control board near the fiber optic input connector. See section 4.2: UMCB/UMCB-W Field Wiring Examples and Information on page 37.

   Enter following ping command in the command prompt screen to communicate with the meter and receive the IP address. See Figure 31: IP Address Command Prompt on the next page.

   H:\> ping -4 <serial number> local

Figure 31: IP Address Command Prompt



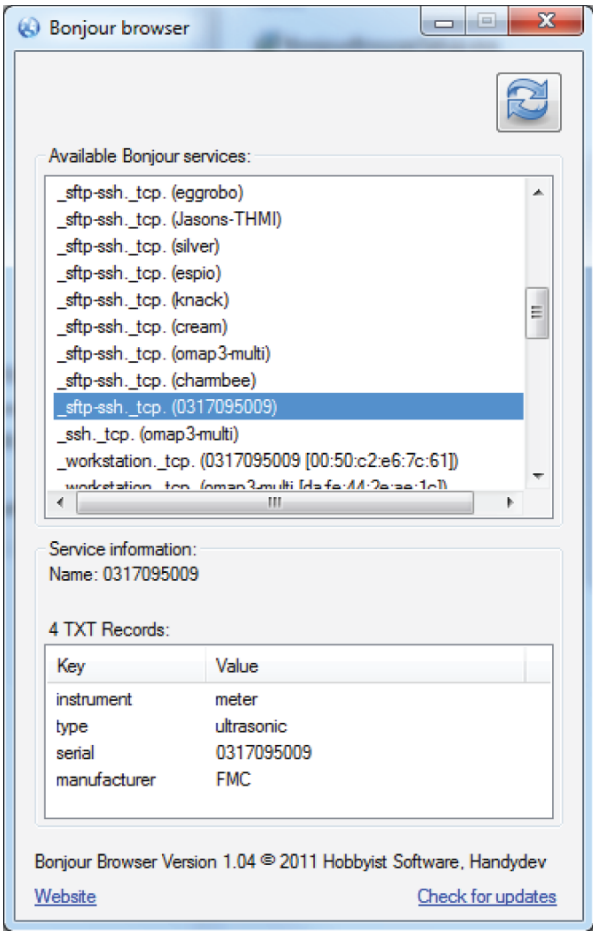
A service discovery software such as Bonjour browser can be used find the meter serial number if the meter is not physically accessible. The meter will broadcast the following identification data over the network.

- Manufacturer: TechnipFMC
- Instrument: Meter
- Type: Ultrasonic
- Serial: <electronics serial number>
- Tag : <configured tag name>

The value of serial is set at the factory to the serial number of the meter electronics. This will also be the default configured tag name. Refer to section 6.3.2.4.8: Meter Tag on page 69 for updating the meter tag name once connected.

The following procedure can be followed to access the meter.

1. Install the latest version of Bonjour.
2. The Bonjour browser will show devices on the network as indicated below. Identify the meter as the device listed as a TechnipFMC Ultrasonic Meter.
3. Use the serial number to “ping” the meter from the command prompt as per Section B instructions above.



For Linux hosts, AVAHI may be used.

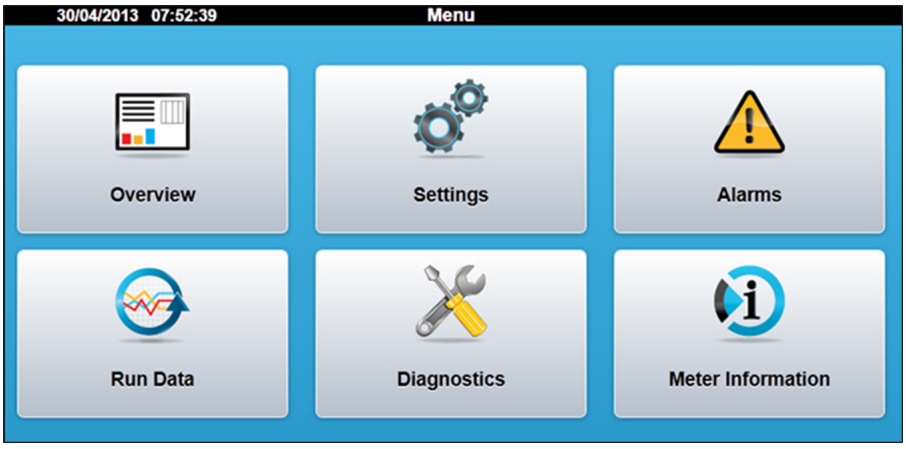
6 Web User Interface

6.1 Main Menu

The MPU Series C main menu offers the ability to navigate anywhere on the user interface and offers large buttons that are easy to press along with icons that are easily recognized.

- Overview: General summary of prominent flow data
- Settings: Configuration parameters for the meter
- Alarms: Indicates the 10 most current alarms
- Run Data: Engineering/advanced-technical level information
- Diagnostics: Additional meter features
- Meter Information: Applicable meter properties

> NOTE: A connection to a remote PC is required for the Web User Interface. Seesection 7: Integrated Touchscreen Display on page 147 for required ancillary equipment for connection details.



6.1.1 Language Selection

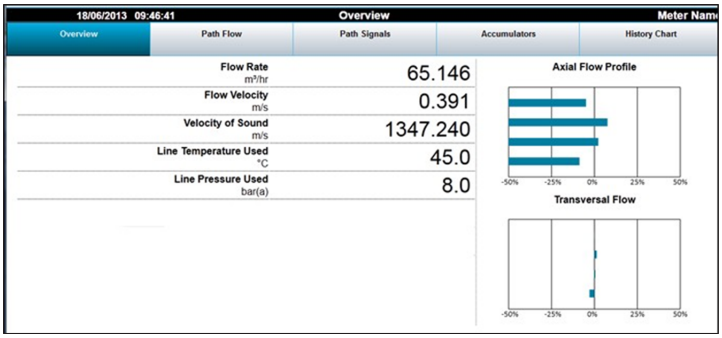
On the Overview screen, use the flag icon in the lower left corner to select a language. After selecting a new language, allow up to a minute for the change to take effect.

6.2 Overview Menu

(Path: Main Menu > Overview)

6.2.1 Overview

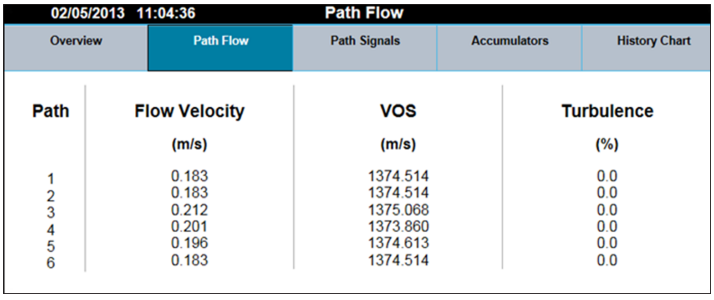
Main Overview shows general flow information of the meter.



6.2.2 Path Flow

(Path: Overview > Path Flow)

Path Flow shows the flow velocity, VOS, and turbulence per path of the meter.

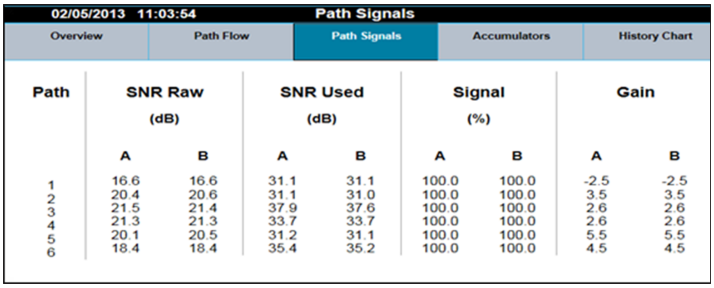


Path	Flow Velocity (m/s)	VOS (m/s)	Turbulence (%)
1	0.183	1374.514	0.0
2	0.183	1374.514	0.0
3	0.212	1375.068	0.0
4	0.201	1373.860	0.0
5	0.196	1374.613	0.0
6	0.183	1374.514	0.0

6.2.3 Path Signals

(Path: Overview > Path Signals)

Path Signals shows Path, Signal Noise Ratio (SNR) Raw, SNR Used, Signal %, and Gain per path per channel.

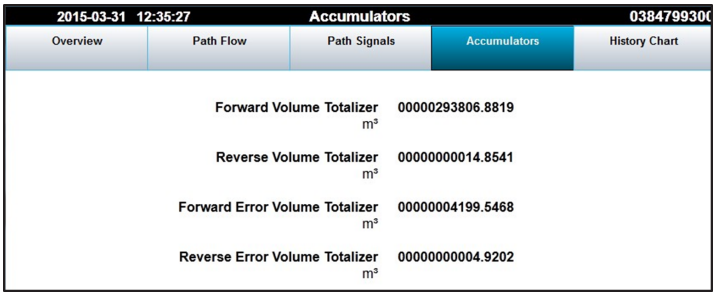


Path	SNR Raw (dB)		SNR Used (dB)		Signal (%)		Gain	
	A	B	A	B	A	B	A	B
1	16.6	16.6	31.1	31.1	100.0	100.0	-2.5	-2.5
2	20.4	20.6	31.1	31.0	100.0	100.0	3.5	3.5
3	21.5	21.4	37.9	37.6	100.0	100.0	2.6	2.6
4	21.3	21.3	33.7	33.7	100.0	100.0	2.6	2.6
5	20.1	20.5	31.2	31.1	100.0	100.0	5.5	5.5
6	18.4	18.4	35.4	35.2	100.0	100.0	4.5	4.5

6.2.4 Accumulators

(Path: Overview > Accumulators)

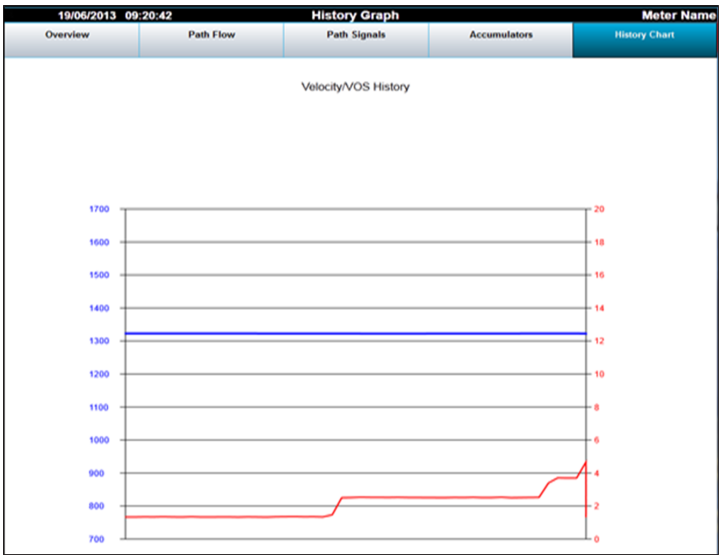
Accumulators shows Forward Volume Totalizer, Reverse Volume Totalizer, Forward Error Volume Totalizer, and Reverse Error Volume Totalizer.



6.2.5 History Chart

(Path: Overview > History Chart)

History Chart illustrates Flow Velocity and VOS trending.



6.3 Settings Menu

When Settings is selected, a login screen will appear. A password is required to access the configuration settings. There are five different levels of security access for the meter and each have the following default passwords:

- Level 1: 1111
- Level 2: 2222
- Level 3: 3333
- Level 4: 4444
- Level 5: 5555 (highest level where changes can be made to the meter data, etc.)

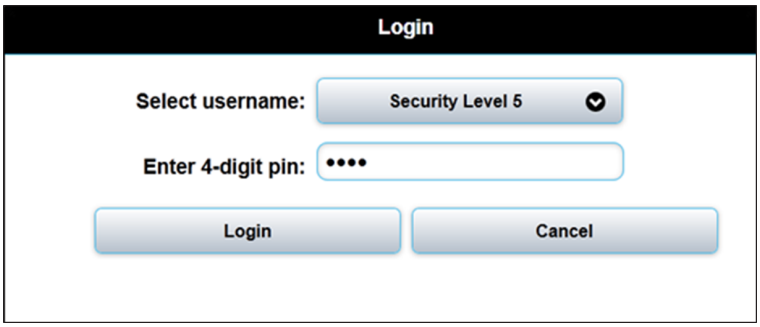
It is recommended that these default passwords be changed to a more secure password. This may be accomplished at the Account Administration screen. See section 6.3.2.1.1: Account Administration, Set Password on page 59 for the setting procedure through the user interface (UI).

If passwords have been forgotten, the passwords can be reset using the Diagnostics -> Reset Passwords function. This requires physically accessing the meter and setting the rotary dip switch to position 8. See section 6.4: Alarms Menu on page 112 for further details.

> NOTE: Requires breaking of the physical seal to open the enclosure and may require action from the local jurisdiction.

6.3.1 Login Screen

Select the desired user level and enter the corresponding password.



6.3.2 Settings Screen

(Path: Main Menu > Settings)

The meter settings are partitioned into smaller more manageable groups. The settings may be accessed by selecting a particular group. The settings options are:

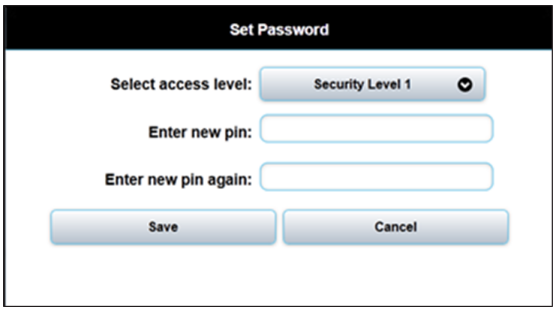
- General
- Network Settings
- Communications
- Diagnostic
- Factory Settings
- Flow Calibration
- Fluid Corrections
- Gas Composition
- Inputs and Outputs
- Limits

- Meter Body
- Modes
- Signal
- Transducer

6.3.2.1 General

6.3.2.1.1 Account Administration, Set Password

(Path: Settings > General > Account Administration)



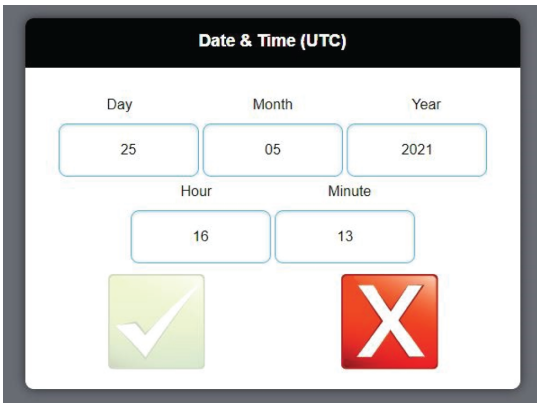
Password modifications are accomplished here. The user level currently logged in is capable of changing its own password and any user level lower. For example, A user logged in at level 3 may change the password for levels 1-3.

- Drop down menu: Contains all available user levels
- Input fields: Enter new four digit numeric pin
- Save: Save new pin
- Discard: Discard new pin

> NOTE: Changes to password levels 3 through 5 are considered meteorological relevant and will be logged in the weights and measures log.

6.3.2.1.2 Date and Time

(Path: Settings > General > Date/Time)



The system date and time follow the international coordinated universal time (UTC) standard.

- Save: Save the current selection, exit dialog
- Discard: Discard changes, exit dialog

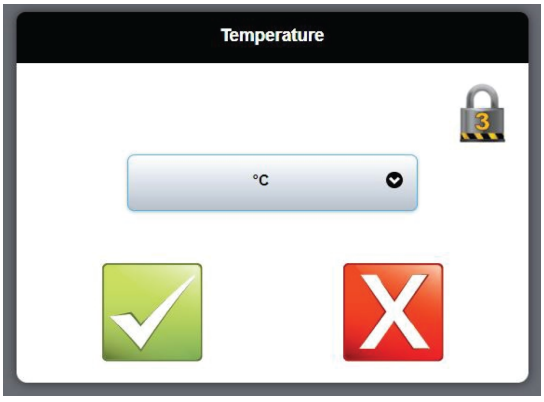
6.3.2.1.3 Units of Measurement

(Path: Settings > General > Units of Measurement)

There are 13 user settable units of measurement parameters, see section Appendix A: Description of Legally Relevant Parameters on page 1 for the full listing.

> NOTE: The units of measure is used to select the engineering units that will be displayed on the UI and will be applied to the digital pulse outputs.

Figure 32: Example Menu



Selecting any unit of measure to modify will display the dialog shown below:

- Lock Icon: Indicates the security level required to modify the current setting
- Drop Down Menu: Contains various units of measure options to choose from

There are two other menus that require the selection of engineering units of measures that are associated to the Analog/Modbus Data Inputs only. Modes Menu (for example Line Temperature and Pressure Input Units) and Fluid Corrections Menu (for example Temperature, Pressure and Density Input Units) for the Analog/Modus Inputs.

There are no units of measure selections for analog output as they are set to SI units only. Analog output can be set to echo one of the following values:

- Flow rate
- Viscosity
- Density
- Reynolds number
- Standard volume

6.3.2.2 Network Settings

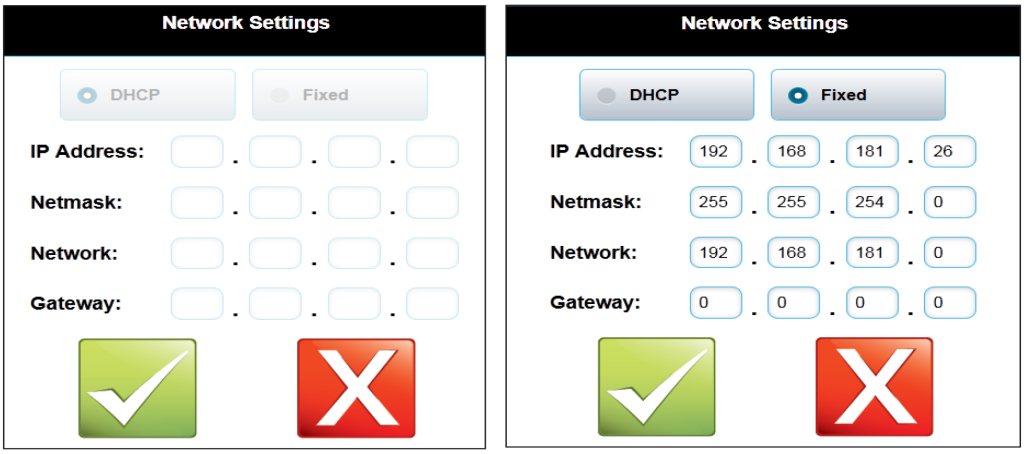
(Path: Settings > Network Settings)

Configure the necessary Ethernet settings for network communication.

- DHCP: Meter will automatically be assigned an IP per the network's dynamic host configuration protocol (DHCP) server
- Fixed: Allows for manual configuration of the meter's network settings
- Save: Accepts new configuration

> NOTE: These changes will not take effect until the meter has been power cycled.

Figure 33: Network Settings



6.3.2.3 Flow Calibration

(Path: Settings > Flow Calibration)

The menu allows for implementation of a meter factor that is variable with the flow rate over up to 16 meter factor nodes. Each node is comprised of two parameters: a flow rate and a corresponding meter factor.

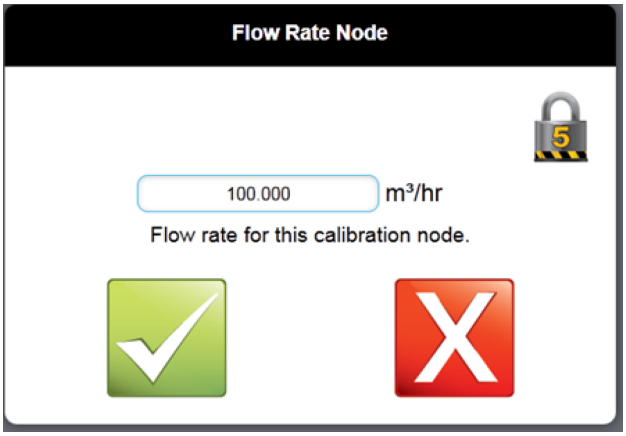
Calibration Node 1 sets the meter factor for all flow rates at or below the entered flow rate. Additional calibration nodes can be entered in order from low to high flow rate in order to vary the meter factor with flow rate.

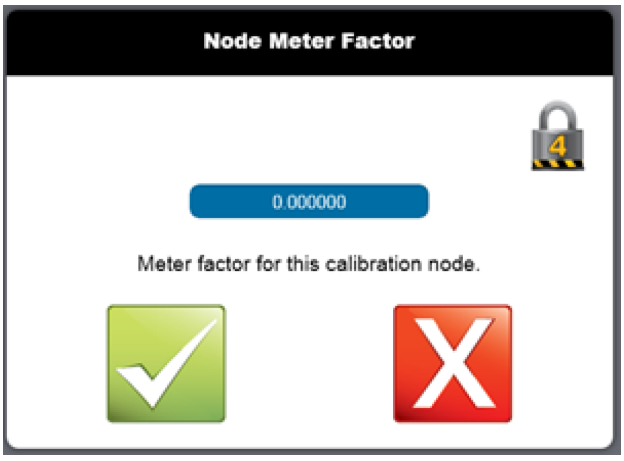
Not all 16 available calibration nodes need to be configured. The last configured calibration node sets the meter factor for all flow rates at or above the entered flow rate. If a single calibration node is configured then this sets the meter factor for all flow rates above and below the flow rate set point.

6.3.2.3.1 Calibration Node Entry Guidelines:

1. All 16 of the calibration nodes do not need to be configured. Start the calibration range at Node 1 and leave unused nodes set to (0,0).
2. Use the single calibration Node 1 to set a fixed meter factor valid for all flow rates.
3. Program additional nodes starting at the lowest flow rate at Node 1 progressing to the highest.

4. Program nodes contiguously. Do not leave unused nodes in the middle of the list.
5. The first configured node in the list sets the meter factor for all flow rates at or below the entered flow rate.
6. The last configured node in the list before an un-configured node sets the meter factor for all flow rates above that flow rate.
    - Security: Indicates the security level required to modify the current setting
    - Input Field: Desired flow rate of meter factor values
    - Unit Literal: Current unit of measure programmed in the meter
    - Help: Text describing the current parameter's purpose
    - Save: Save the units currently selected, exit dialog
    - Discard: Discard changes, exit dialog





6.3.2.4 Communications

(Path: Settings > Communications)

This menu provides configuration options for the meter's only serial port (CN4). The selection are as follows:

- Serial Port Function
- Baud Rate Selection
- Parity Selection
- Word Length Selection
- Stop Bit Selection
- Modbus Unit ID
- Modbus Endian
- Meter Tag
- Modbus NaN Substitution Mode
- Modbus NaN Substitution Value
- Modbus Inactivity Timeout
- MQTT Data Mode
- MQTT Broker URL
- MQTT Topic Group Name
- MQTT Topic Device Name
- MQTT Password
- MQTT Reported Latitude
- MQTT Reported Longitude
- MQTT Reported Altitude
- MQTT TLS Mode

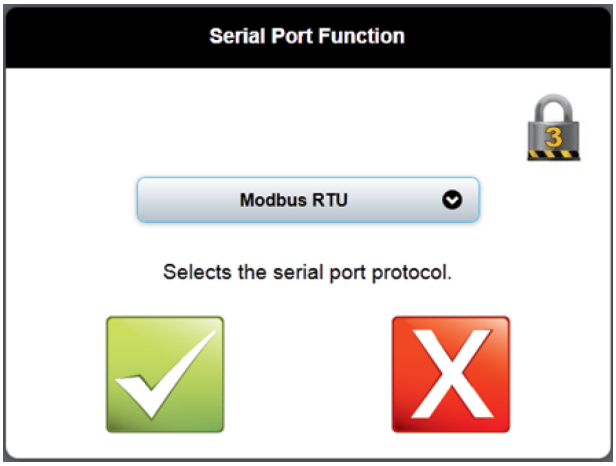
6.3.2.4.1 Serial Port Function

> NOTE: Changes will not take effect until the meter has been power cycled.

(Path: Settings > Communications > Serial Port Function)

This option determines the primary functionality for the serial port (CN4). The options are as follows:

- None (inactive)
- Modbus RTU
- Modbus ASCII



6.3.2.4.2 Baud Rate Selection

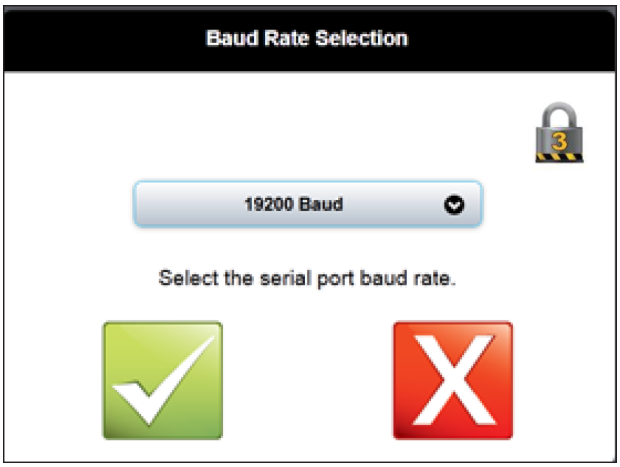
> NOTE: Changes will not take effect until the meter has been power cycled.

(Path: Settings > Communications > Baud Rate Selection)

This option sets the serial port's rate of communication. The options are as follows:

- 1200 Baud
- 2400 Baud
- 4800 Baud
- 9600 Baud
- 19200 Baud

- 38400 Baud
- 57600 Baud
- 115200 Baud



6.3.2.4.3 Parity Selection

> NOTE: Changes will not take effect until the meter has been power cycled.

(Path: Settings > Communications > Parity Selection)

This option dictates the use of a parity bit. The options are as follows:

- None
- Odd
- Even

6.3.2.4.4 Word Length Selection

> NOTE: Changes will not take effect until the meter has been power cycled.

(Path: Settings > Communications > Word Length Selection)

This option determines the word length for the serial port. The options are as follows:

- 7 bits
- 8 bits

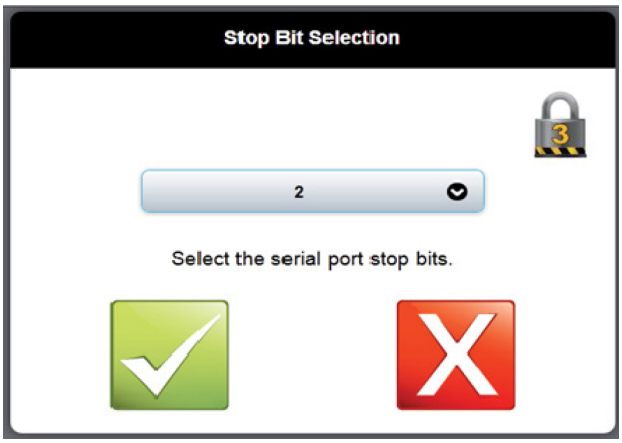
6.3.2.4.5 Stop Bit Selection

> NOTE: Changes will not take effect until the meter has been power cycled.

(Path: Settings > Communications > Stop Bit Selection)

This option determines the stop period between byte frames. The options are as follows:

- 1
- 2



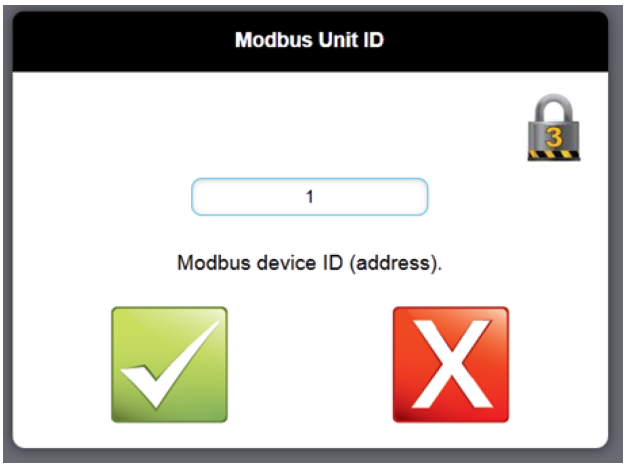
6.3.2.4.6 Modbus Unit ID

> NOTE: Changes will not take effect until the meter has been power cycled.

(Path: Settings > Communications > Modbus Unit ID)

This parameter sets a unique address for the Modbus functionality to use during communications.

- Input Field: Desired address (must match Modbus Master Device)
- Input Range: 1 to 247



6.3.2.4.7 Modbus Endian

> NOTE: Changes will not take effect until the meter has been power cycled.

(Path: Settings > Communications > Modbus Endian)

This option determines the order in which words are transmitted via Modbus. The options are as follows:

- Modbus Format Floats
- Alternate Format Floats

Value of Pi Test	Byte Order
Modbus Format Floats	0FDB 4049
Alternate Format Floats	4049 0FDB

6.3.2.4.8 Meter Tag

> NOTE: Changes will not take effect until the meter has been power cycled.

(Path: Settings > Communications > Meter Tag)

This parameter provides the meter with a unique identifier for ease of distinguishing between it and other potential meters on the network. This tag is visible in the top-right corner of the Main Menu and Overview screens. By default this parameter is set to the UMCB's serial number.

- Input Field: Desired Tag
- Input Range: Up to 16 characters

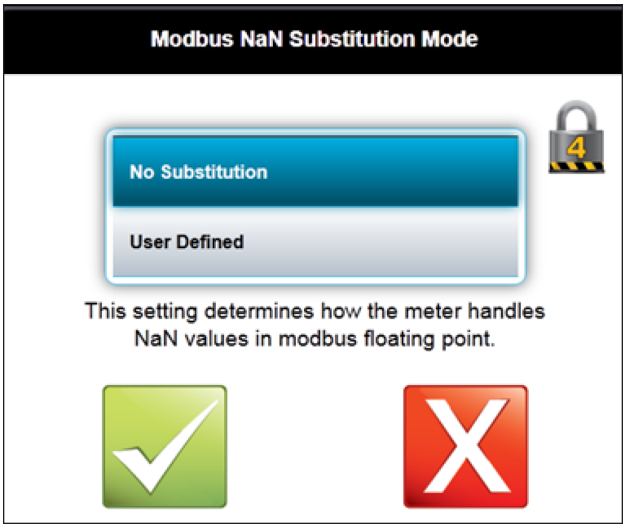
Figure 34: Meter Tag

6.3.2.4.9 Modbus NaN Substitution Mode

(Path: Settings > Communications > Modbus NaN Substitution Mode)

By default the meter outputs Not a Number (NaN) when an output is not being calculated or undefined. This output can be modified to output a user defined fail value instead by selecting User Defined.

Figure 35: Modbus NaN Substitution Mode

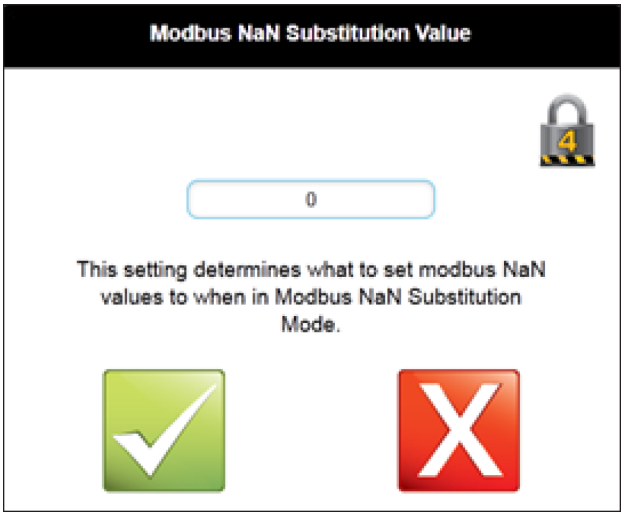


6.3.2.4.10 Modbus NaN Substitution Value

(Path: Settings > Communications > Modbus NaN Substitution Value)

When NaN output mode is set to User Defined, the value entered here as the substitution value will be used in case the output is undefined or not calculated.

Figure 36: Modbus NaN Substitution Value



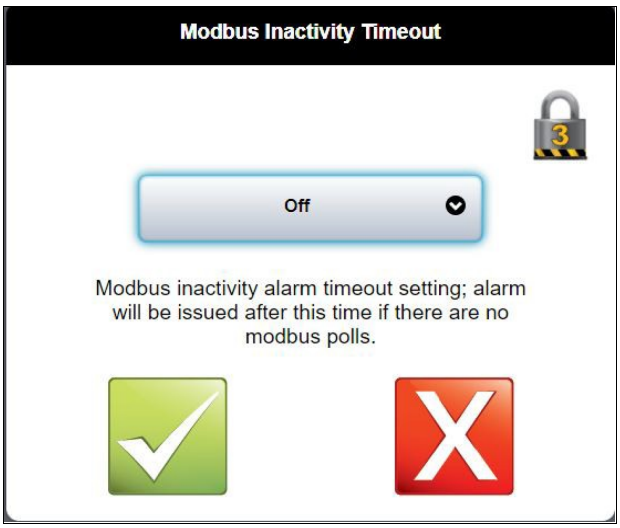
6.3.2.4.11 Modbus Inactivity Timeout

(Path: Settings> Communications>Modbus Inactivity Time Out)

The selections are as follows:

- Off
- 30 seconds
- 1 minute

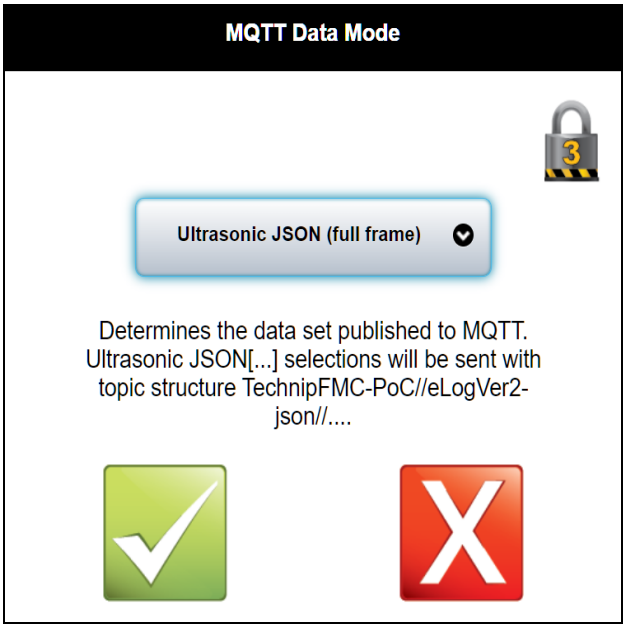
Figure 37: Modbus Inactivity Timeout



6.3.2.4.12 MQTT Data Mode

(Path: Settings > Communications > MQTT Data Mode)

Figure 38: MQTT Data Mode



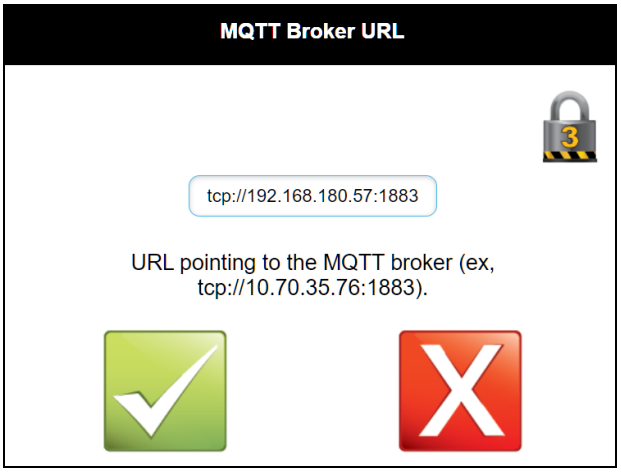
The selections are as follows:

- Off (no MQTT data publishing)
- Ultrasonic JSON (full frame): All JSON data is sent every time, even if a variable has not changed since the last time.
- Ultrasonic JSON (differential: Only JSON variables that have changed since the last time are sent, and a full frame is sent every several seconds to get new subscribers caught up. This is useful for reducing the data channel traffic if needed, as long as the subscriber can handle differential data.

6.3.2.4.13 MQTT Broker URL

(Path: Settings > Communications > MQTT Broker URL)

Figure 39: MQTT Broker URL

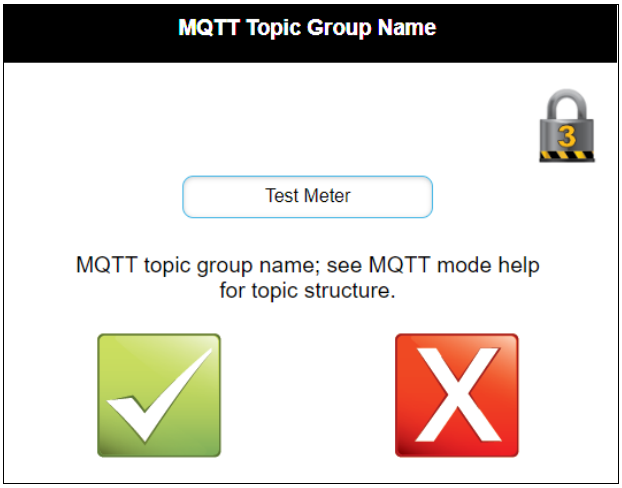


Must be in URL format as shown in the example above.

6.3.2.4.14 MQTT Topic Group Name

(Path: Settings > Communications > MQTT Topic Group Name)

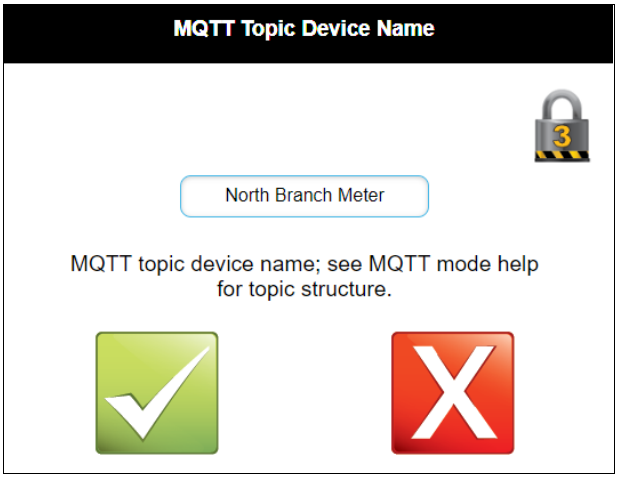
Figure 40: MQTT Topic Group Name



6.3.2.4.15 MQTT Topic Device Name

(Path: Settings > Communications > MQTT Topic Device Name)

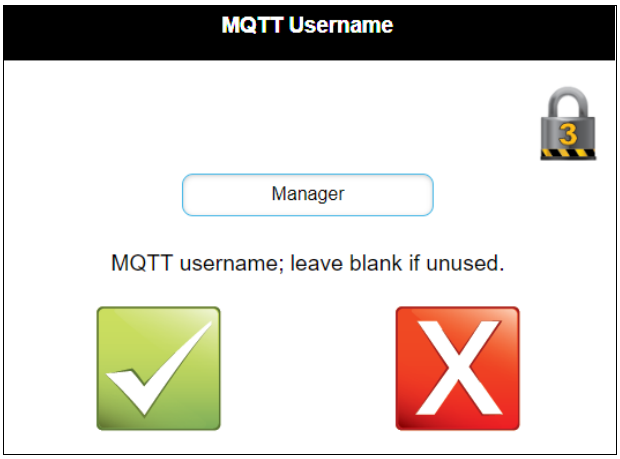
Figure 41: MQTT Topic Device Name



6.3.2.4.16 MQTT Username

(Path: Settings > Communications > MQTT Username)

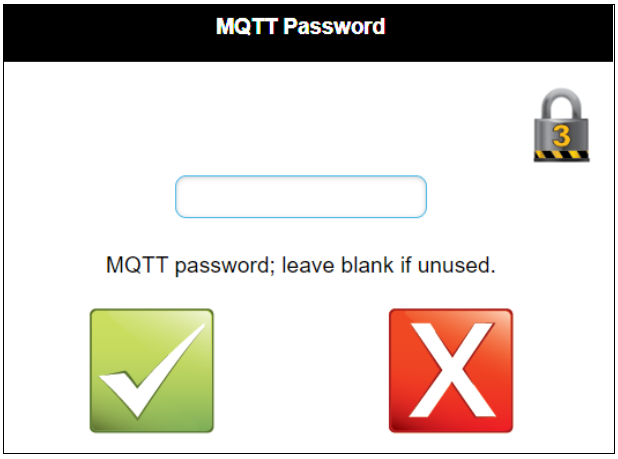
Figure 42:



6.3.2.4.17 MQTT Password

(Path: Settings > Communications > MQTT Password)

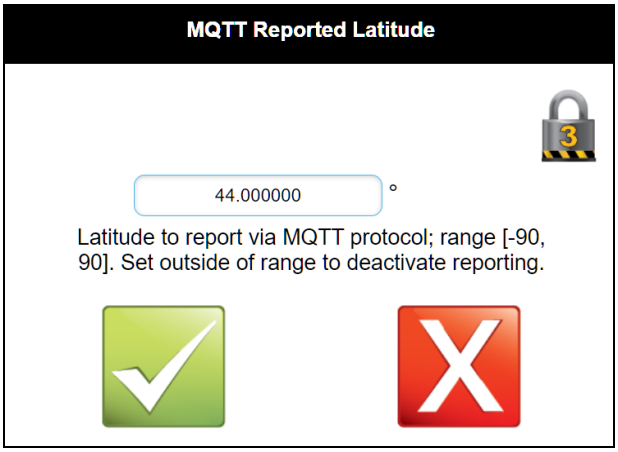
Figure 43: MQTT Password



6.3.2.4.18 MQTT Reported Latitude

(Path: Settings > Communications > MQTT Reported Latitude)

Figure 44: MQTT Reported Latitude

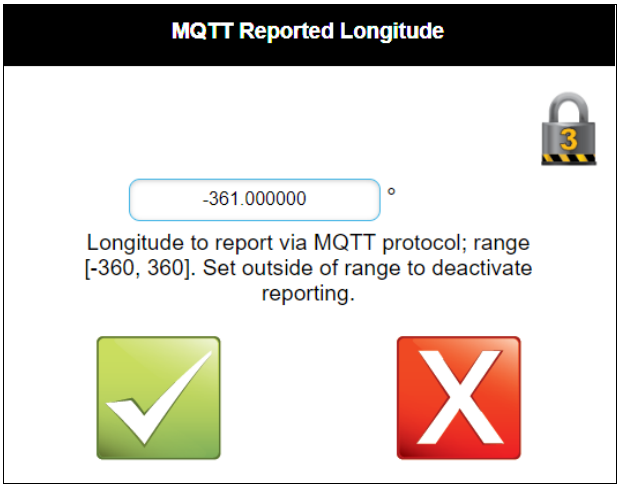


This parameter sets the MQTT reported latitude.

6.3.2.4.19 MQTT Reported Longitude

(Path: Settings > Communications > MQTT Reported Longitude)

Figure 45: MQTT Reported Longitude

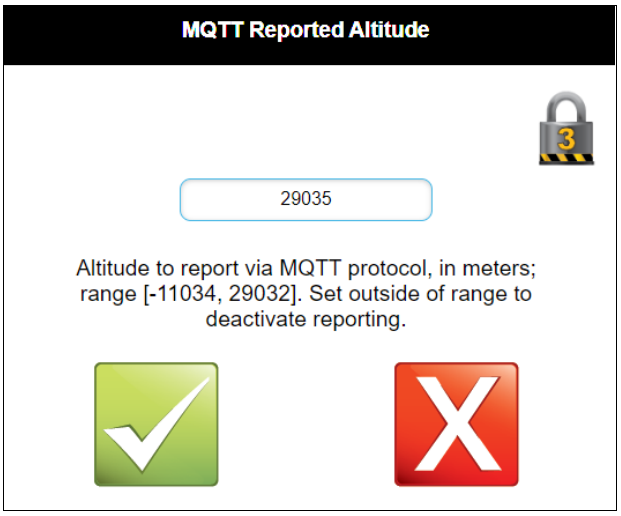


This parameter sets the MQTT reported latitude.

6.3.2.4.20 MQTT Reported Altitude

(Path: Settings > Communications > MQTT Reported Altitude)

Figure 46: MQTT Reported Altitude

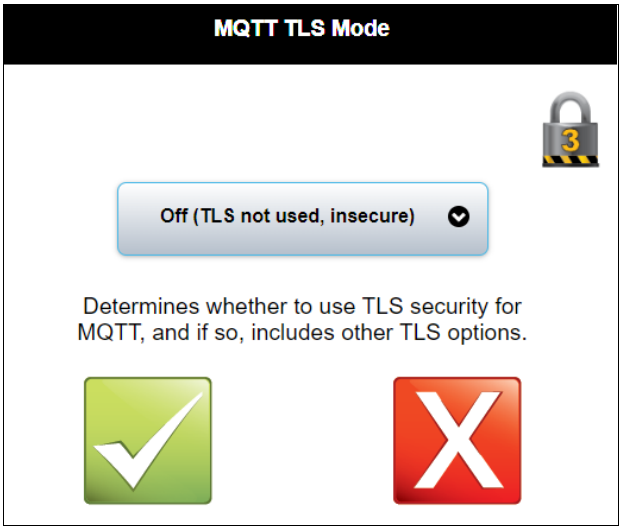


This parameter sets the MQTT reported altitiude.

6.3.2.4.21 MQTT TLS Mode

(Path: Settings > Communications > MQTT TLS Mode)

Figure 47: MQTT TLS Mode



6.3.2.5 Diagnostic

(Path: Settings > Diagnostic)

This screen contains options that affect the collection of historical data. The selections are as follows:

- Datalog Interval
- Signal Logging Interval
- Alarm Sensitivity
- Powerup Alarm Delay

6.3.2.5.1 Datalog Interval

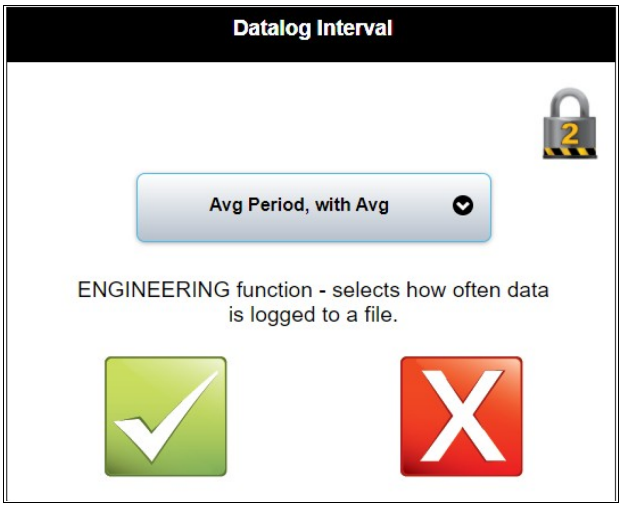
(Path: Settings > Diagnostic > Datalog Interval)

This option determines the type of, and the interval at which engineering data is stored to file. The selections are as follows:

- Off
- Avg Period, with Avg
- Avg Period, without Avg

> NOTE: It is recommended to keep the factory default setting for this parameter unless otherwise instructed by an authorized Guidant engineer.

Figure 48: Datalog Interval



6.3.2.5.2 Signal Logging Interval

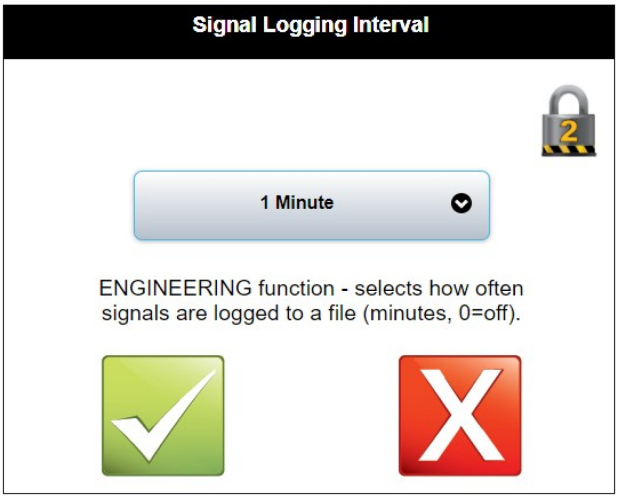
(Path: Settings > Diagnostic > Signal Logging Interval)

This option determines the interval at which signal data is stored to file. The selections are as follows:

- Off
- 1 Minute
- 5 Minutes
- 10 Minutes
- 1 Hour
- 8 Hours
- 1 Day

> NOTE: It is recommended to keep the factory default setting for this parameter unless otherwise instructed by an authorized Guidant engineer.

Figure 49: Signal Logging Interval



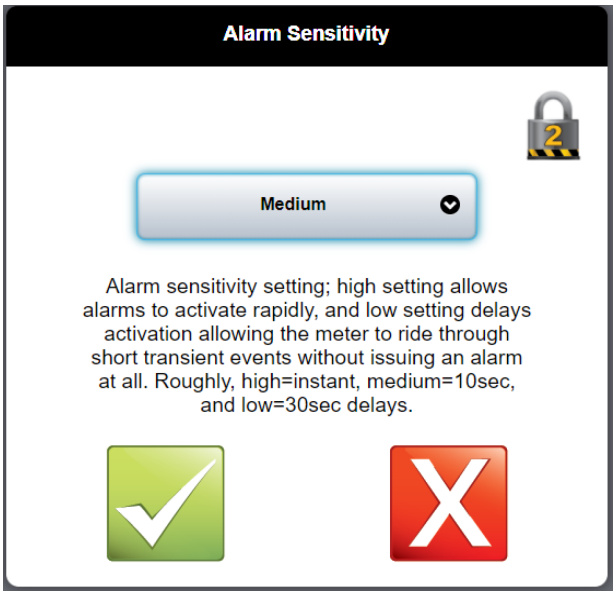
6.3.2.5.3 Alarm Sensitivity

(Path: Settings > Diagnostics > Alarm Sensitivity)

This option determines the response time for Alarms after detection. The selections are as follows:

- High
- Medium
- Low

Figure 50: Alarm Sensitivity



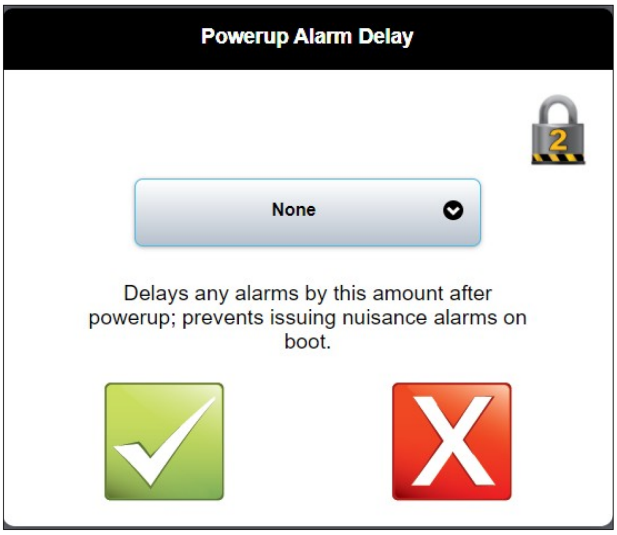
6.3.2.5.4 Power Up Alarm Delay

(Path: Settings > Diagnostics > Power UP Alarm Delay)

This option determines the delay time for Alarms after power up to filter nuisance alarms. The selections are as follows:

- None
- 5 seconds
- 30 seconds
- 1 minute
- 5 minutes

Figure 51: Powerup Alarm Delay



6.3.2.6 Factory Settings

(Path: Settings > Factory Settings)

> NOTE: The data that is in this section is installed at the factory. Do not attempt to change any values without pre-authorization.

6.3.2.7 Meter Body

(Path: Settings > Meter Body)

> NOTE: The data that is in this section is installed at the factory. Do not attempt to change any values without pre-authorization.

6.3.2.8 Inputs and Outputs

(Path: Settings > Inputs and Outputs)

> NOTE: The data that is in this section is installed at the factory. Do not attempt to change any values without pre-authorization.

6.3.2.9 Limits

(Path: Settings > Limits)

These settings control the meter's built in alarms and other setpoint limits. Many values are set by the factory according to typical operational limits. Please read these instructions or consult factory before adjusting limits. The selections are as follows:

- Maximum Velocity of Sound
- Minimum Velocity of Sound
- Minimum Signals Used
- Maximum RX Gain
- Maximum RX Gain Difference
- Maximum VOS Deviation
- Minimum Signal to Noise Ratio
- Maximum Turbulence Level
- Maximum Swirl/Crossflow Deviation
- Maximum Flow Velocity
- Maximum Profile Flatness Deviation
- Maximum Profile Symmetry Deviation
- Low Flow Cutoff

- Enable Confidence Alarms
- Flow Rate Cutoff Selector
- Accumulator Low Flow Cutoff

6.3.2.9.1 Minimum and Maximum Velocity of Sound

Sets the upper and lower limits for the measured fluid velocity of sound.

6.3.2.9.2 Maximum RX Gain Difference

RX Gain the amount of amplification the meter requires to receive the ultrasonic sound signal. This sets the upper limit alarm for receiver gain. The value is set by the factory and not typically adjusted unless otherwise instructed.

6.3.2.9.3 Maximum VOS Deviation

Maximum deviation between the measured velocity of sound on any two paths. The value is set by the factory and not typically adjusted unless otherwise instructed.

6.3.2.9.4 Minimum SNR

SNR measures the amount of signal noise being measured with the ultrasonic sound signals. A lower reading indicates increased noise. This limit sets the low limit value. This is set by the factory and not typically adjusted unless otherwise instructed.

6.3.2.9.5 Maximum Turbulence Level

Turbulence is a measure of the variability of the flow rate. This limit sets the high level alarm.

6.3.2.9.6 Maximum Swirl/Crossflow Deviation

The meter will alarm when the maximum percent transverse flow is detected. This limit sets this percentage.

6.3.2.9.7 Minimum and Maximum Flow Rate

Alarm on the minimum and maximum flow rate in engineering units.

6.3.2.9.8 Maximum Profile Flatness Deviation

Maximum percentage deviation in flatness across the meter.

6.3.2.9.9 Maximum Profile Symmetry Deviation

Maximum allowable profile symmetry.

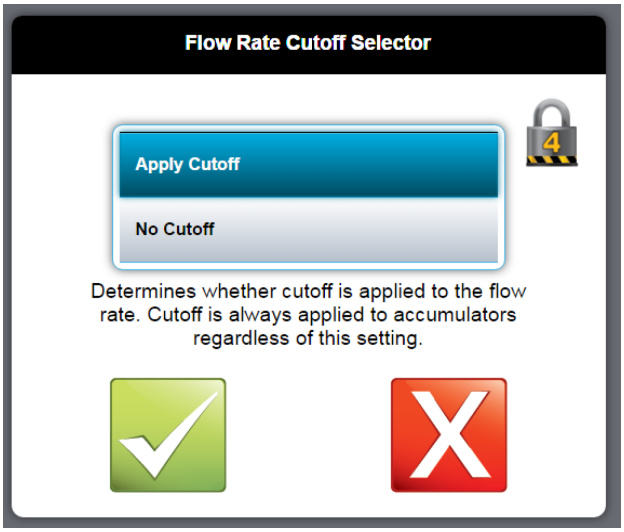
6.3.2.9.10 Low Flow Cutoff

When the measured flow drops below this value the meter will output zero flow. The low flow cutoff prevents random noise from registering as flow when the meter is in a shut in situation. The flowrate cutoff selector feature allows the user to turn the cutoff function on or off. This is a new feature for software versions 1.9 and higher.

6.3.2.9.11 Low Flow Cutoff Selector

The flowrate cutoff selector feature allows the user to turn the cutoff function on or off for only the flow rate output; the accumulators always have cutoff applied. This is a new feature for software versions 1.9 and higher.

Figure 52: Flow Rate Cutoff Selector



6.3.2.10 Factory Settings

(Path: Settings > Factory Settings)

> NOTE: The data that is in this section is installed at the factory. Do not attempt to change any values without pre-authorization.

> NOTE: As these values are factory set they are outside the scope of this manual.

The sections are as follows:

- Initial Profile Factor
- Size Constants A
- Size Constants B
- VPC X
- VPC Meter Factor
- ReNo VPC X
- Reynolds Number
- Path Constant
- Running Average Buffer Size
- VPCX Average Buffer Size
- Profile Compensation A Gain
- Profile Compensation A Low
- Profile Compensation B Gain
- Profile Compensation B Low
- Density Correction A
- Density Correction B
- 3rd Reflected Diagnostic

6.3.2.11 Meter Body

(Path: Settings > Meter Body)

> NOTE: The data that is in this section is installed at the factory. Do not attempt to change any values without pre-authorization.

> NOTE: As these values are factory set they are outside the scope of this manual.

The sections are as follows:

- Path Length
- Path Angle
- Lateral Path Position
- Internal Diameter
- Wall Thickness
- Material
- Reference Temperature
- Diameter Compensation Mode
- Meter Type

6.3.2.12 Inputs and Outputs

(Path: Settings > Inputs and Outputs)

Some of the menu selection parameters that are in this section contains data that is set at the factory and will be identified by the following Informational box. Other parameter sections will be required to be set by the end user at the time of commissioning.

> NOTE: The data that is in this section is installed at the factory. Do not attempt to change any values without pre-authorization.

The sections are as follows:

- An In Engineering Value at Max
- An In Engineering Value at Min
- An In High Limit

- An In Low Limit
- An In Cal Factor A
- An In Cal Factor B
- An In Alarm Hysteresis
- An In High Alarm Point
- An In Low Alarm Point
- Digital Output Function
- Pulse Output Factor
- Pulse Output Mode
- Reverse Flow Handling
- An Out Function
- An Out Max Engineering Value
- An Out Min Engineering Value
- An Out Cal Factor A
- An Out Cal Factor B
- RTD In Temperature Offset
- RTD Input High Limit
- RTD Input Low Limit
- Pulser Frequency Limit
- Flow Direction Deadband
- Pulser PID Gain
- Pulser PID Reset
- Pulser PID Rate
- An Out Fail Setting

- Pulse Output Function

The following sections are subject to field configuration.

6.3.2.12.1 An In Engineering Values at Maximum and Minimum

An In Engineering Values at Maximum and Minimum values determine the engineering range of the two 4-20 mA inputs. The function assignment of the two analog inputs are selected in the Modes Menu.

The engineering units are selected in the Modes Menu Sub Menu for the particular property to be used, for example, pressure, temperature, or density.

(Path: Settings > Inputs and Outputs > An In Engineering Values at Max values)

The selections are as follows:

- An In Engineering Value at Max - 4-20 mA Input 1
- An In Engineering Value at Max - 4-20 mA Input 2

(Path: Settings > Inputs and Outputs > An In Engineering Values at Max values)

The selections are as follows:

- An In Engineering Value at Min - 4-20 mA Input 1
- An In Engineering Value at Min - 4-20 mA Input 2

6.3.2.12.2 An In High and Low Limits

An In High and Low Limits determine the 4-20 range that is valid, inputs outside of the set range will trigger an alarm.

(Path: Settings > Inputs and Outputs > An In High Limits)

The selections are as follows:

- An In Low Limit - 4-20 mA Input 1
- An In Low Limit - 4-20 mA Input 2

6.3.2.12.3 An In Cal Factor A and B

An In Cal Factor A and B for the three analog inputs are factory set and should not be changed. If for any reason these are inadvertently changed, please contact the factory for the correct values to be entered, the data is tracked by board serial number.

See section 6.6.2.1: Analog Calibration on page 123.

> NOTE: Calibration may affect weight and measures controlled settings. Equipment used for calibration must be traceable to national standards when controlled by local jurisdictions.

> NOTE: The data that is in this section is installed at the factory. Do not attempt to change any values without pre-authorization.

Selections for An In Cal Factor A are as follows:

- An In Cal Factor A - Analog Input 1
- An In Cal Factor A - Analog Input 2
- An In Cal Factor A - Analog Input 3

Selections for An In Cal Factor B are as follows:

- An In Cal Factor B - Analog Input 1
- An In Cal Factor B - Analog Input 2
- An In Cal Factor B - Analog Input 3

6.3.2.12.4 An In Alarm Hysteresis

The An Alarm Hysteresis is the setting for the amount of delay for the three individual analog inputs, this is used to provide time for stabilization after a transition of the inputs before issuing an alarm.

(Path: Settings > Inputs and Outputs > An Alarm Hysteresis)

(Valid Input Range: 0% to 10%)

Selections are as follows:

- An In Alarm Hysteresis - Analog Input 1
- An In Alarm Hysteresis - Analog Input 2
- An In Alarm Hysteresis - Analog Input 3

6.3.2.12.5 An In High and Low Alarm Point

The An In High and Low Alarm Point is the setting to determine where the analog input alarm will trigger when the values of the inputs exceed the set range.

(Path: Settings > Inputs and Outputs > An In High Point)

(Valid Input range: 3.8 to 22)

Selections for An In High Alarm Point are as follows:

- An In High Alarm Point - Analog Input 1
- An In High Alarm Point - Analog Input 2
- An In High Alarm Point - Analog Input 3

(Path: Settings > Inputs and Outputs > An In Low Alarm Point)

Selections for An In Low Alarm Point are as follows:

- An In Low Alarm Point - Analog Input 1
- An In Low Alarm Point - Analog Input 2
- An In Low Alarm Point - Analog Input 3

6.3.2.12.6 Digital Output Function

The Digital Output Function setting is used to select the type of signal provided by the two digital pulse outputs located on connector(CN3).

(Path: Settings > Inputs and Outputs > Digital Output Function)

Selections are as follows:

- Quadrature I, Quadrature Q
- Pulses Forward, Pulses Reverse

- Pulses (bi-di), Flow Dir
- Pulses (bi-di), Flow Dir (inv)

6.3.2.12.7 Pulse Output Factor

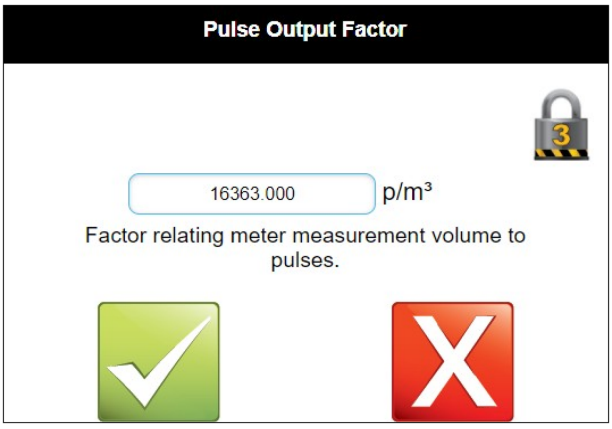
The Pulse Output Factor setting is used to set the scaling factor related to the pulse output to the selected units of measurement. The units of measurement is selected in the (Units of Measurements > Pulse Factor menu), see section 6.3.2.1.3: Units of Measurement on page 60

If the units of measurement are changed for the pulse factor after entering a pulse factor value, a new factor will automatically be calculated for the units chosen. This setting controls the two digital pulse outputs on connector CN3.

> NOTE: Care must be taken to not exceed the maximum rated frequency output of 10 kHz when calculating the pulse output factor considering the maximum process flow rate. 10 kHz is the maximum pulse output frequency that meets accuracy specifications; however, the output is capable of up to 15 kHz (but pulse rate accuracy is not guaranteed). Also, the maximum output frequency may be limited by another program parameter; if used (set lower than 10 kHz), the calculated factor must kee the rate below that limit as well.

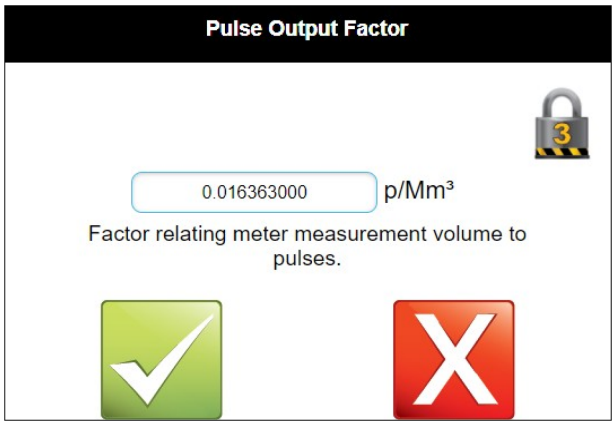
(Path: Settings > Inputs and Outputs > Pulse Output Factor)

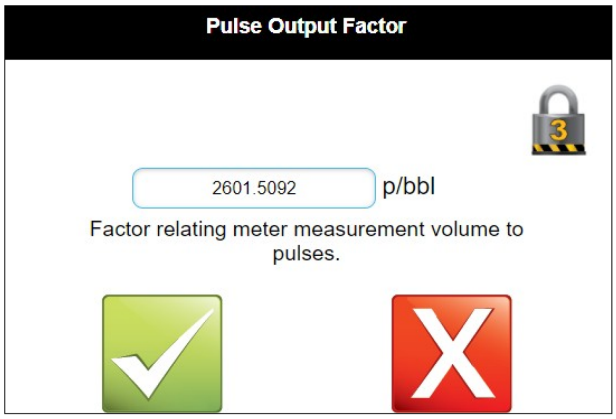
(Valid Input Range: User selectable pulses/unit not to exceed a frequency of (10 kHz or 15 kHz) when at maximum flow rate.)



Example 1: Set units of measurement to p/m^3 and then set factor to 16363 p/m^3.

Changing the Units of Measure Pulse Factor setting will then result in the pulse factor being automatically calculated for the new units of measure.





Verifying that the pulse factor will not exceed the 10,000 Hz limit

6.3.2.12.7.1 Example 1

Calculating the Maximum Pulse Output Factor for an Ultra 10" meter the flow units of m^3/hr.

Published Maximum Normal flow rate = 2200 m^3/hr

Maximum Pulse frequency output = 10,000 Hz

2200 m^3/hr/3600 sec = .6111 m^3/sec 10,000 Hz/.6111 m^3/sec = 16,363 p/m^3

Maximum Pulse Output Factor = 16,363

6.3.2.12.8 Pulse Output Mode

- The “Pulse Output Mode” setting is used to select the type of pulse signal processing provided to the signal at the two digital pulse outputs located on connector (CN3).
- The recommended setting is Pulse Accounting Full PID Mode as this is the latest addition to the firmware. This mode also requires that the parameters Pulser PID Gain, Pulser PID Reset, and Pulser PID Rate to be set for proper tuning.

(Path: Settings > Inputs and Outputs > Pulse Output Mode)

The selections are as follows:

- Pulse Accounting Mode
- Frequency
- Pulse Accounting Full PID Mode

6.3.2.12.9 Reverse Flow Handling

This selection controls the behavior the pulse outputs and the internal accumulators during reverse flow conditions. In bidirectional mode the pulse output will provide pulse output when flow is in either direction, and the and the forward and reverse accumulators will increment depending on flow direction.

In forward only mode, the pulse output will not produce pulses when in reverse flow, and reverse accumulator will not increment.

In reverse only mode, the pulse output will not produce pulses when in forward flow, and the forward accumulator will not increment.

(Path: Settings > Inputs and Outputs > Reverse Flow Handling)

The selections are as follows:

- Bidirectional
- Forward Only
- Reverse Only

6.3.2.12.10 An Out Function

The An Out Function determines what type of information that the 4-20 output will provide.

This setting also requires that An Output Max and Min Engineering Values are programmed to the proper range of engineering values.

(Path: Settings > Inputs and Outputs > An Out Function)

The selections are as follows:

- Flow Rate
- Viscosity-Kinematic
- Density
- Reynolds Number

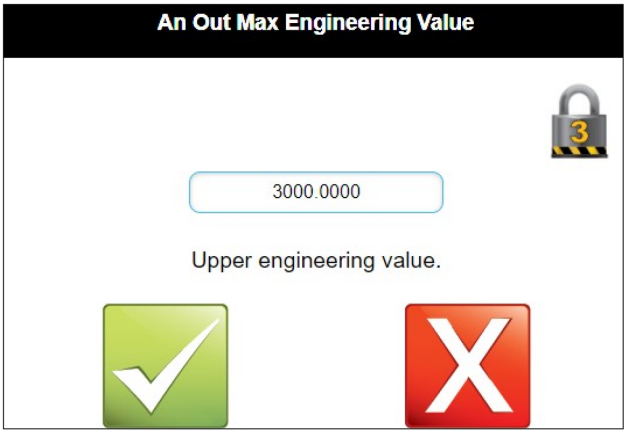
6.3.2.12.11 An Output Max and Min Engineering Value

These setting establish the maximum and minimum engineering values for the information being converted to a 4 to 20 mA signal, that was selected in the An Output Function.

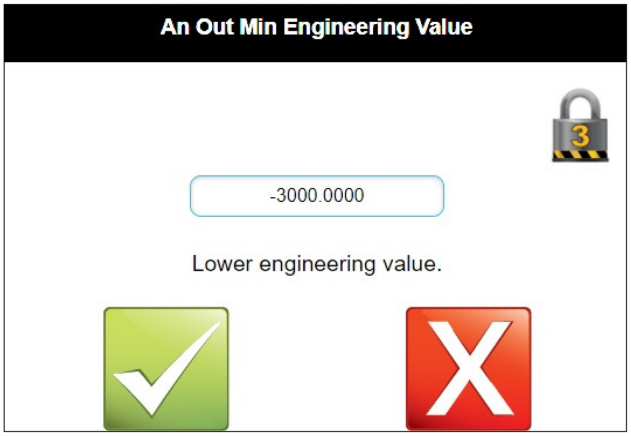
The selections are negative and positive integers representing the engineering unit.

> NOTE: Negative integers are used to indicate reverse flow if Flow Rate is the function selected. (Path: Settings > Inputs and Outputs > An Output Max Engineering Value).

(Path: Settings > Inputs and Outputs > An Output Max Engineering Value)



(Path: Settings > Inputs and Outputs > An Output Min Engineering Value)



6.3.2.12.12 An Out Cal Factor A & B

An Out Cal Factor A and B for the analog output is factory set and should not be changed as the data is developed on a factory test fixture. If for any reason these are inadvertently changed, please contact the factory for the correct values to be entered, the data is tracked by board serial number.

See section 6.6.2.1: Analog Calibration on page 123.

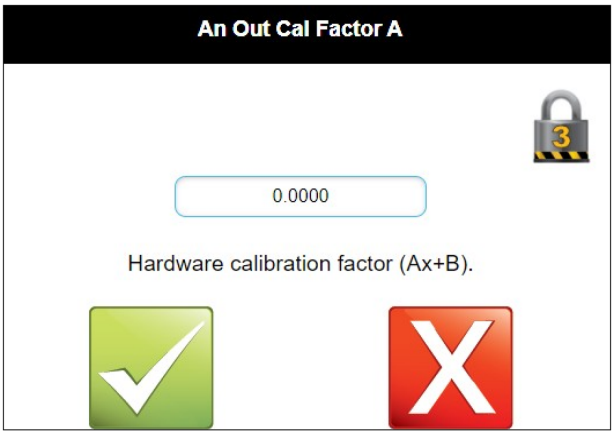
> NOTE: Calibration may affect weight and measures controlled settings, equipment used for calibration must be traceable to national standards when controlled by local jurisdictions.

> NOTE: The data that is in this section is installed at the factory. Do not attempt to change any values without pre-authorization.

Valid selections include positive integers.

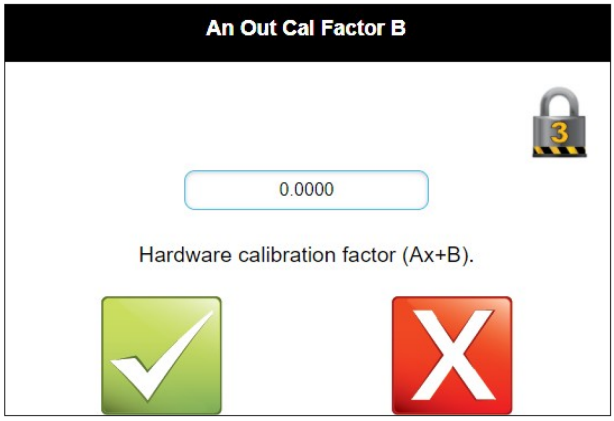
(Path: Settings > Inputs and Outputs > An Out Cal Factor A)

Figure 53: An Out Cal Factor A



(Path: Settings > Inputs and Outputs > An Out Cal Factor B)

Figure 54: An Out Cal Factor B



6.3.2.12.13 RTD In Temperature Offset

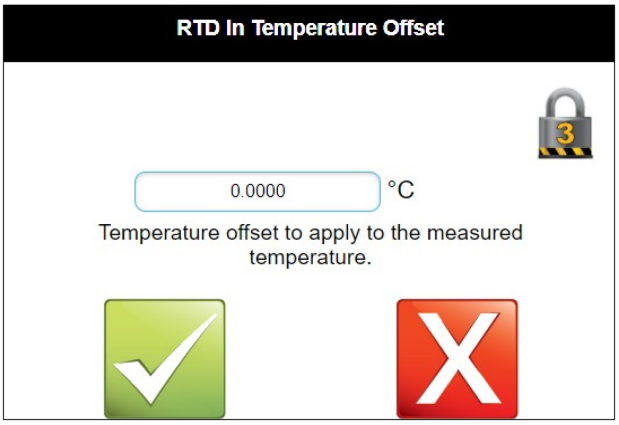
RTD In Temperature Offset is used to create an offset to a known measured value. The amount of offset may be controlled by the local jurisdiction.

(Path: Settings > Inputs and Outputs > RTD In Temperature Offset)

Valid Selections are positive or negative integers.

> NOTE: The displayed Engineering Units for Temperature are selected in the Units of Measurement menu.

Figure 55: RTD In Temperature Offset



6.3.2.12.14 RTD Input High and Low Limit

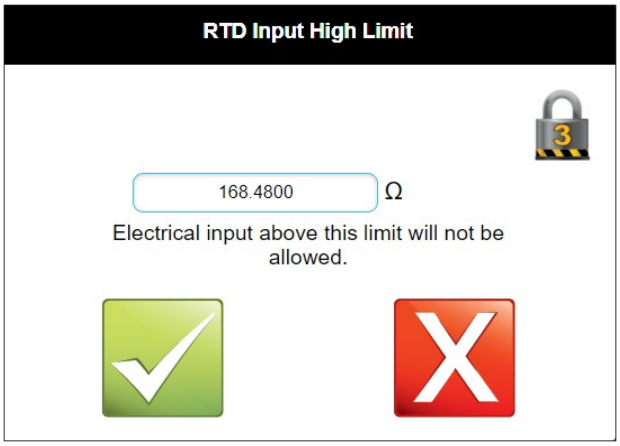
RTD Input High and Low Limit is used to set the upper and lower valid resistance range for the RTD input.

The resistance input is designed for a four-wire 100 ohm platinum resistance temperature detector (PRTD) probe with a temperature coefficient at 0 °C equal to 0.00385ohm/ohm/°C

Valid selections are resistance values from PT100 resistance table corresponding to -60 °C to +180 °C

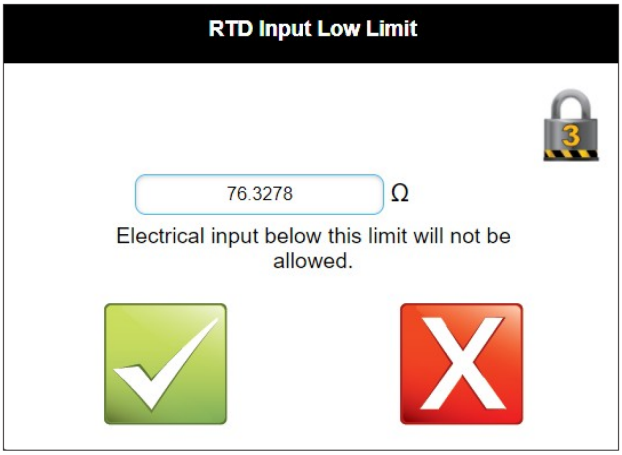
(Path: Settings > Inputs and Outputs > RTD Input High Limit)

Figure 56: RTD Input High Limit



(Path: Settings > Inputs and Outputs > RTD Input Low Limit)

Figure 57: RTD Input Low Limit



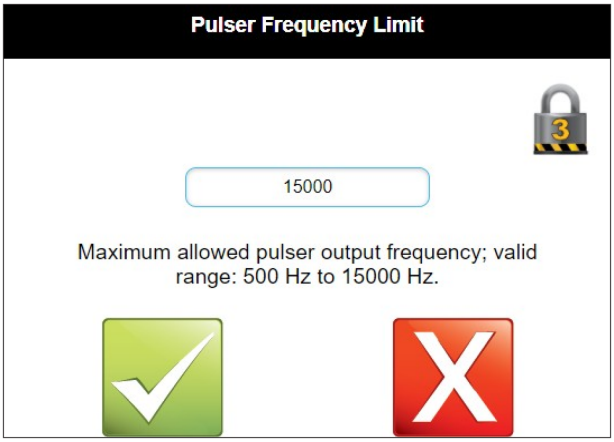
6.3.2.13 Pulser Frequency Limit

The value entered for Pulser Frequency Limit is only used when the Pulse Output Mode is set to Frequency. This entry is not used for the other two modes. This value is used to limit the pulse signal frequency provided by the two digital pulse outputs located on connector (CN3).

(Path: Settings > Inputs and Outputs > Pulser Frequency Limit)

The valid Input range is 500 Hz to 15,000 Hz.

Figure 58: Pulser Frequency Limit



6.3.2.13.1 Flow Direction Deadband

Flow Direction Deadband is used when bi-directional mode is enabled and sets the amount of dead volume between forward and reverse directions before

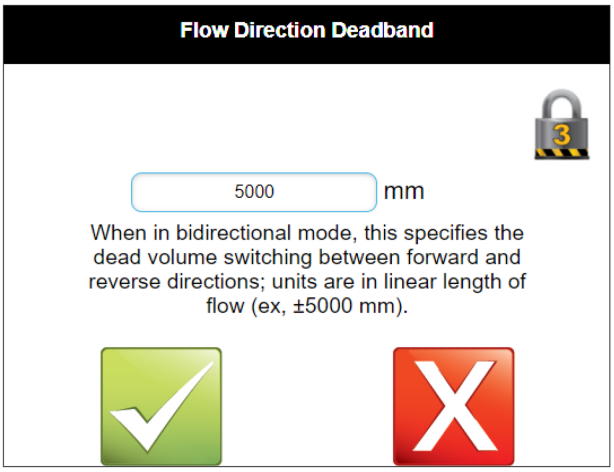
accumulation in the appropriate register begins, the units entered are in length and is either in millimeters or inches.

> NOTE: The displayed engineering units for length are selected in the Units of Measurement menu.

The valid selections are positive or negative integers.

(Path: Settings > Inputs and Outputs > Flow Direction Deadband)

Figure 59: Flow Direction Deadband

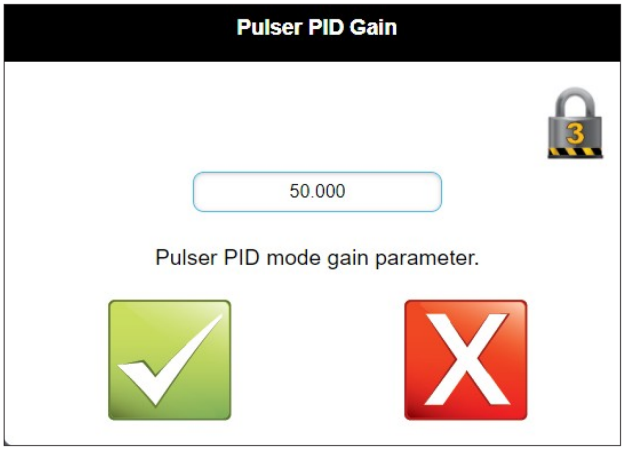


6.3.2.13.2 Pulser PID Gain

The value entered for Pulser PID Gain is only used when the Pulse Output Mode is set to Pulse Accounting Full PID Mode. This entry is not used for the other two modes. This value is used to tune the pulse signal provided by the two digital pulse outputs located on connector (CN3).

(Path: Settings > Inputs and Outputs > Pulser PID Gain)

Figure 60: Pulser PID Gain

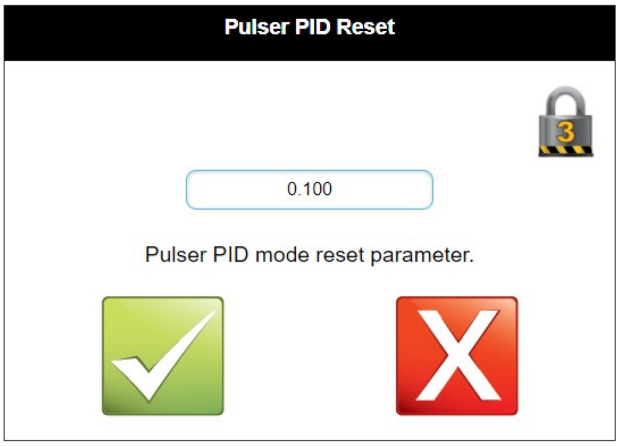


6.3.2.13.3 Pulser PID Reset

The value entered for Pulser PID Reset is only used when the Pulse Output Mode is set to Pulse Accounting Full PID Mode. This entry is not used for the other two modes. This value is used to tune the pulse signal provided by the two digital pulse outputs located on connector (CN3).

(Path: Settings > Inputs and Outputs > Pulser PID Reset)

Figure 61: Pulser PID Reset

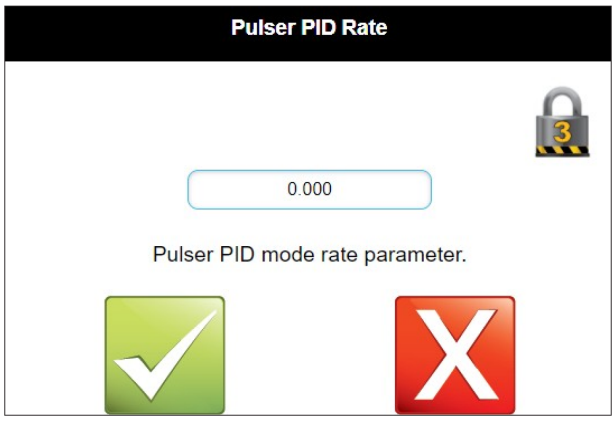


6.3.2.13.4 Pulser PID Rate

The value entered for Pulser PID Rate is only used when the Pulse Output Mode is set to Pulse Accounting Full PID Mode. This entry is not used for the other two modes. This value is used to tune the pulse signal provided by the two digital pulse outputs located on connector (CN3).

(Path: Settings > Inputs and Outputs > Pulser PID Rate)

Figure 62: Pulser PID Rate



6.3.2.13.5 An Out Fail Setting

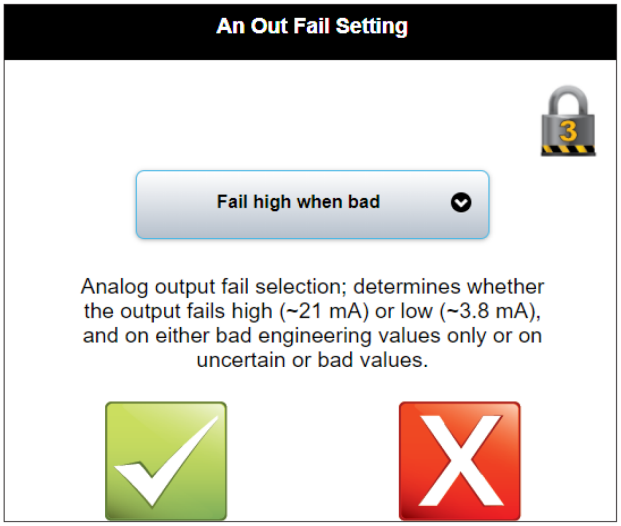
An Out Fail Setting is used to program the analog output behavior if the condition selected is detected by the processor.

(Path: Settings > Inputs and Outputs > An Out Fail Setting)

The valid selections are as follows:

- Fail high when bad
- Fail low when bad
- Fail high when uncertain or bad
- Fail low when uncertain or bad

Figure 63: An Out Fail Setting



6.3.2.13.6 Pulse Output Function

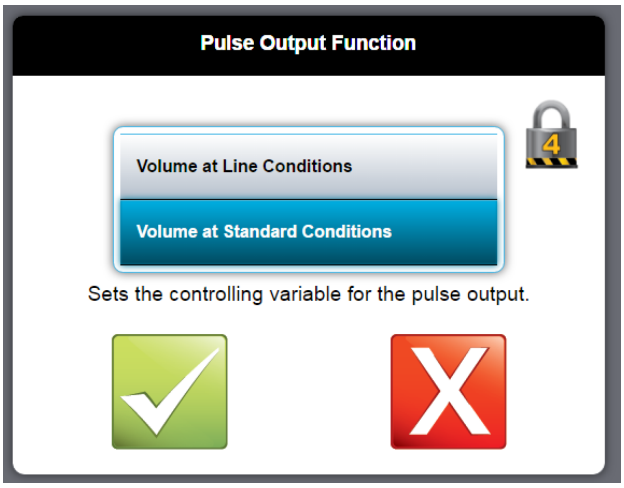
The Pulse Output Function setting is used to select the type of pulse signal correction provided by the two digital pulse outputs located on connector (CN3).

(Path: Settings > Inputs and Outputs > Pulse Output Mode)

Valid Selections:

- Volume at Line Conditions
- Volume at Standard Conditions

Figure 64: Pulse Output Function



6.3.2.13.7 Enable Confidence Alarms

The confidence alarms provide an indication of the measurement quality for a number of meter outputs. These alarms output through Modbus measurement health status word only.

The input to enable the alarm is in the format of a decimal integer that can be used to mask specific Alarm bits from activating. Enter the decimal integer value of the six bit binary mask to enable the alarms. A decimal value of zero (0) disables all alarms and decimal value of 63 (bin 111111) enables all six alarm bits.

Valid input range is 0 through 63.

The following alarms are available:

Binary Mask	Bit	Process Variable	Description
1	0	Flow Rate	Flow rate output quality alarm
1	1	Velocity of Sound	Velocity of sound quality alarm
1	2	Density	Density computation quality alarm
1	3	Viscosity	Viscosity computation quality alarm
1	4	Reynolds Number	ReNo computation quality alarm
1	5	Analog Output	Analog output quality alarm

Examples:

- All Alarms enabled: Binary = 1 1 1 1 1 1
- Decimal = 63
- Flow Rate only: Binary = 1 0 0 0 0 0
- Decimal = 32
- Analog Output only: Binary = 0 0 0 0 0 1
- Decimal = 1
- Reynolds Number only: Binary = 0 0 0 0 1 0
- Decimal = 2

- Reynolds Number & Analog Output: Binary = 0 0 0 0 1 1
- Decimal = 3

6.3.2.13.8 Flow Rate Cut Off Selector

This selection enables or disables the Flow Rate output utilizing the value entered under the Low Flow Cutoff selection.

(Valid Input: Apply Cutoff, No Cutoff)

6.3.2.13.9 Accumulator Low Flow Cutoff

This selection sets the velocity at which the low flow cutoff is applied. (Valid Input: Minimum allowed velocity entry: 0.100 m/s)

6.3.2.13.9.1 Min Signals Used

The alarm is set when the percentage of signal used falls below entered value. (Valid Input range: 1% to 99%)

6.3.2.13.9.2 Max Rx Gain

The alarm is set when the receiver gain exceeds the entered value. (Valid Input range: -12 dB to 48 dB)

6.3.2.14 Modes

The Modes Settings are used to control the meters operational behavior during measurement, diagnostics, and simulation. There are 14 modes selections.

- The ability to disable a flow path
- Selection of line temperature pressure input source and their associated fallback values in case of a failure and the selection of the engineering type units associated with them
- Selection of electronic sealing mode for weights and measures applications
- Setting of diagnostic modes

(Path: Settings > Modes)

6.3.2.14.1 Disable Paths

(Path: Settings > Modes > Disable Paths)

This option will disable a particular path and replace its flow profile factor value with an internally calculated substitution.

Input Field: Desired path state (1 = disabled/substitution)

> WARNING: This is used for diagnostics or mitigation purposes.

> NOTE: VOS deviation limit will trigger a path substitution.

Figure 65: Disable Paths

6.3.2.14.2 Manual Values

(Path: Settings > Modes > Manual Valves)

This option places the meter into a simulation—non-measured—type mode. Be aware that measured values are not displayed while this mode is enabled.

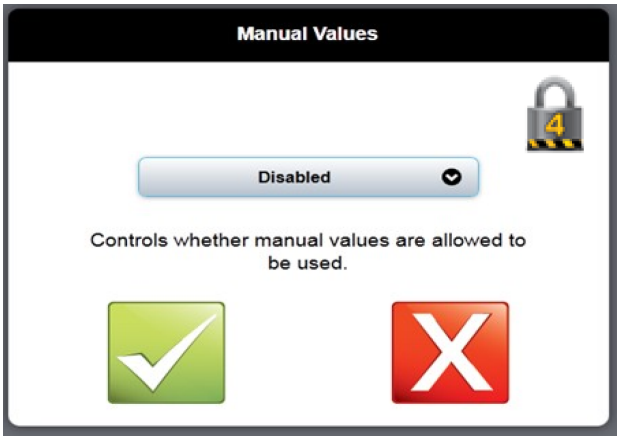
The options are:

- Disabled
- Enabled

> WARNING: For legal measurements this setting must be set to Disabled.

> NOTE: This is not typically changed from this menu: this mode is automatically enabled if a particular diagnostic feature is triggered, for example Simulate Flow.

Figure 66: Manual Values



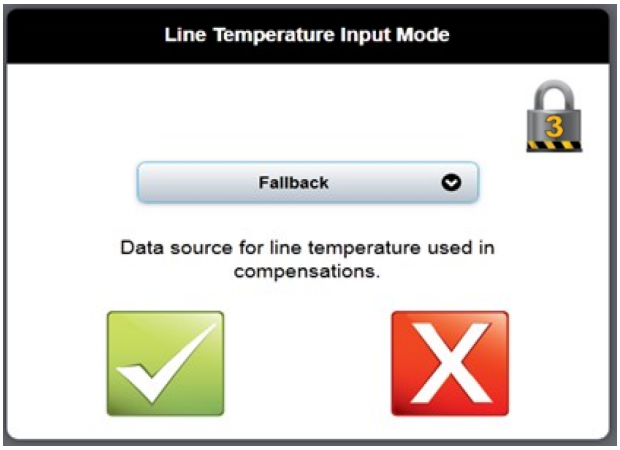
6.3.2.14.3 Line Temperature Input Mode

(Path: Settings > Modes > Line Temperature Input Mode)

This option determines the source of the temperature compensation value. The options are as follows:

- Fallback: Programmed value
- 4-20 mA Input #1: Live input value
- 4-20 mA Input #2: Live input value
- RTD Input: Live input value
- Modbus: Provided through comm.

Figure 67: Line Temperature Input Mode



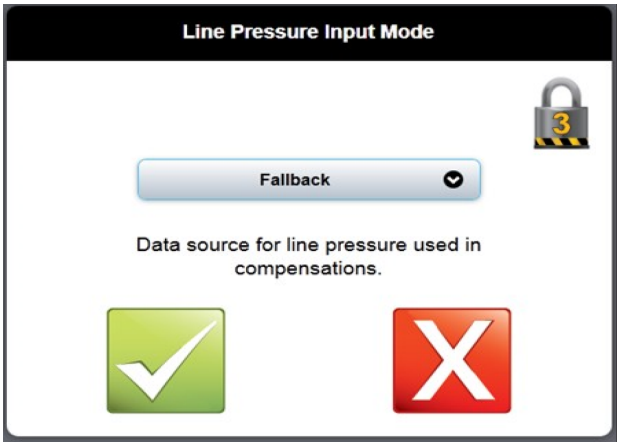
6.3.2.14.4 Line Pressure Input Mode

(Path: Settings > Modes > Line Pressure Input Mode)

This option determines the source of the pressure compensation value. The options are as follows:

- Fallback: Programmed value
- 4-20 mA Input #1: Live input value
- 4-20 mA Input #2: Live input value
- RTD Input: Live input value
- Modbus: Provided through comm.

Figure 68: Line Pressure Input Mode



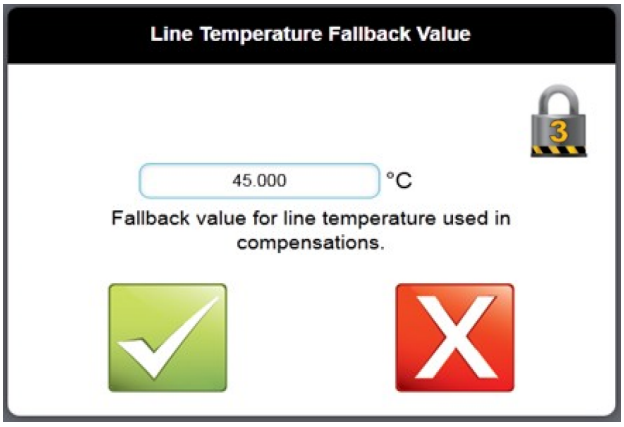
6.3.2.14.5 Line Temperature Fallback Value

(Path: Settings > Modes > Line Temperature Fallback Value)

This value is used in temperature compensation calculations; the Line Temperature Input Mode setting must be configured for Fallback in order to use this value.

- Input Field: Site value to match temperature of product flowing in line.

Figure 69: Line Temperature Fallback Value



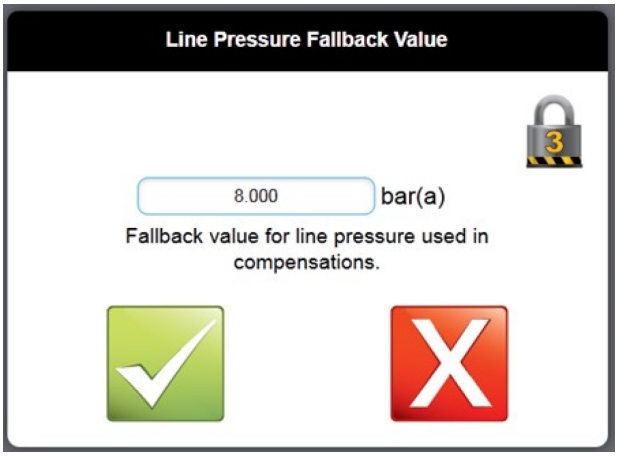
6.3.2.14.6 Line Pressure Fallback Value

(Path: Settings > Modes > Line Pressure Fallback Value)

This value is used in temperature compensation calculations; the Line Pressure Input Mode setting must be configured for Fallback in order to use this value.

- Input Field: Site value to match pressure of product flowing in line.

Figure 70: Line Pressure Fallback Value

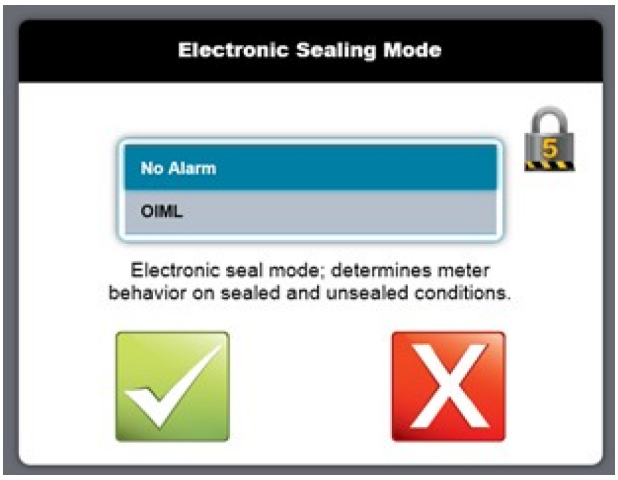


6.3.2.14.7 Electronic Sealing Mode

(Path: Settings > Modes > Electronic Sealing Mode)

> NOTE: This determines the meter behavior on sealed and unsealed conditions as it relates to OIML test conditions. The selection options are No Alarm or OIML. This must be set to OIML to comply with the EU-MID sealing requirements and requirements of other global countries that control the measurement for legal trade.

Figure 71: Electronic Sealing Mode

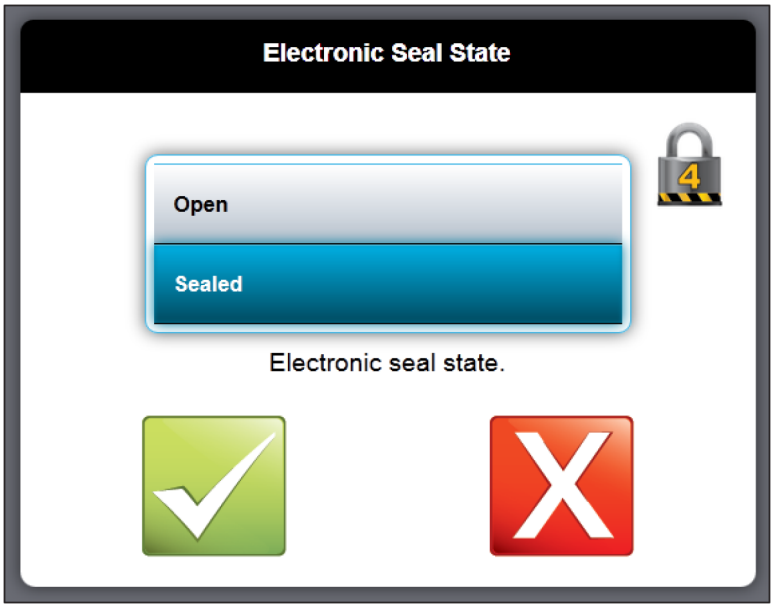


6.3.2.14.8 Electronic Seal State

(Path: Settings > Modes > Electronic Sealing Mode)

Setting the electronic seal prevents the manipulation of metrologically significant parameters unless the seal is broken. The selection options are Open or Sealed. See section 6.4: Alarms Menu on page 112 for a detailed description of software sealing.

Figure 72: Electronic Seal State



NOTE: This parameter requires a level 4 password to break the seal, and a level 5 password to make the seal. This parameter is not controlled by the hardware sealing switch. For example, electronic seal state can be broken even if the hardware switch is sealed.

6.3.2.14.9 Diagnostic Mode

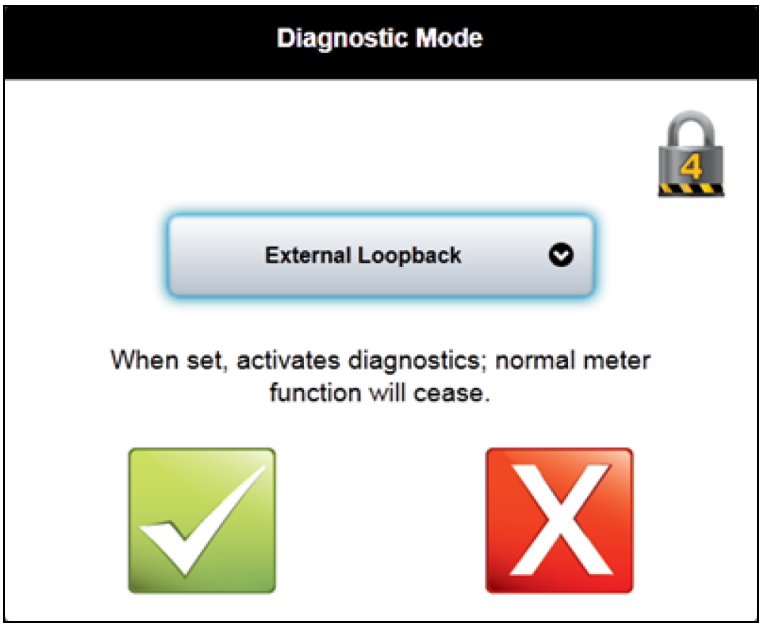
(Path: Settings > Modes > Diagnostic Mode)

Diagnostic mode allows the meter to be set into a bench test simulation mode. This setting eliminates actual flow measurement and replaces it with the selected simulated flow outputs. The following settings can be selected.

- Off: Under this setting the meter operates normally, for example legal requirements
- External Loopback: A loopback coaxial connector must be jumpered to the Path 1 A and B transducer connection jacks. This allows the control board to exercise all circuit pathways while bypassing the transducers.
- Internal Loopback: Allows bench testing without the coaxial jumper on Path 1.

> WARNING: Any setting other than Off puts the meter into a non weights and measures legal mode. A warning Icon will appear on the main menu showing that the meter is in loop back mode.

Figure 73: Diagnostic Mode

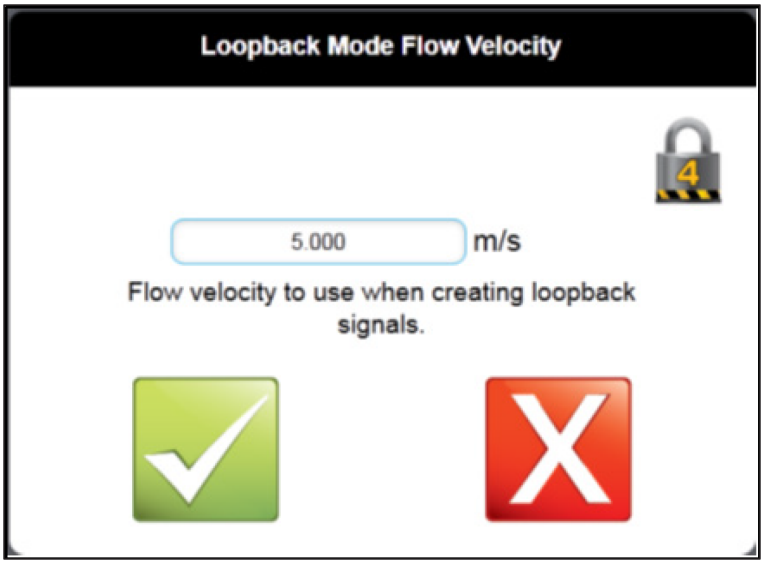


6.3.2.14.10 Loopback Flow Velocity

(Path: Settings > Modes > Loopback Flow Velocity)

Sets the simulated velocity to be used in the loopback mode simulation.

Figure 74: Looback Mode Flow Velocity

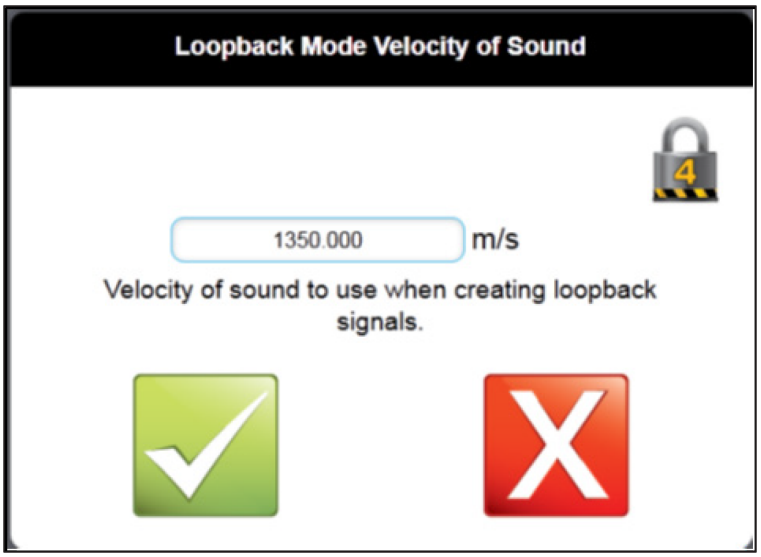


6.3.2.14.11 Loopback Velocity of Sound

(Path: Settings > Modes > Loopback Velocity of Sound)

Sets the simulated velocity of sound to be used in the loopback mode simulation.

Figure 75: Loopback Velocity of Sound

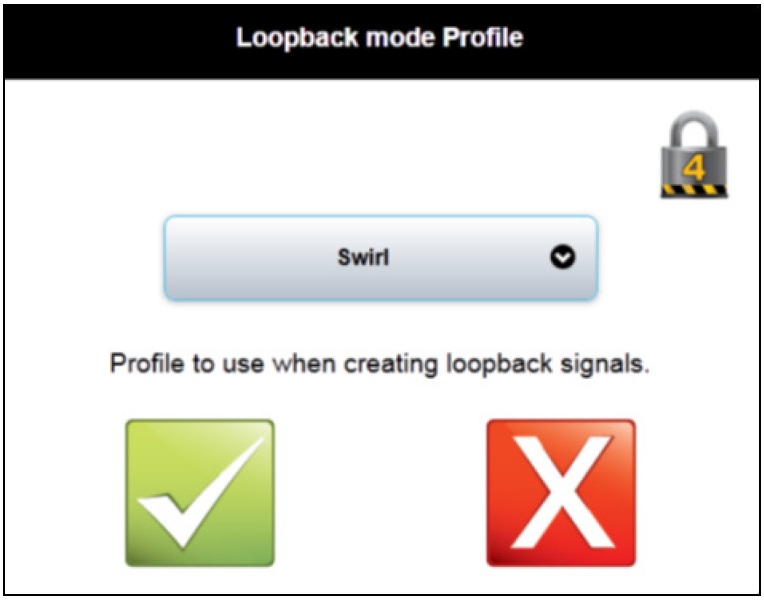


6.3.2.14.12 Loopback Flow Profile

(Path: Settings > Modes > Loopback Flow Profile)

Sets the simulated flow profile to be used in the loopback mode simulation.

Figure 76: Loopback Model Profile



6.3.2.15 Signal

(Path: Settings > Signal)

> NOTE: The data that is in this section is installed at the factory. Do not attempt to change any values without pre-authorization.

6.3.2.16 Transducer

(Path: Settings > Transducer)

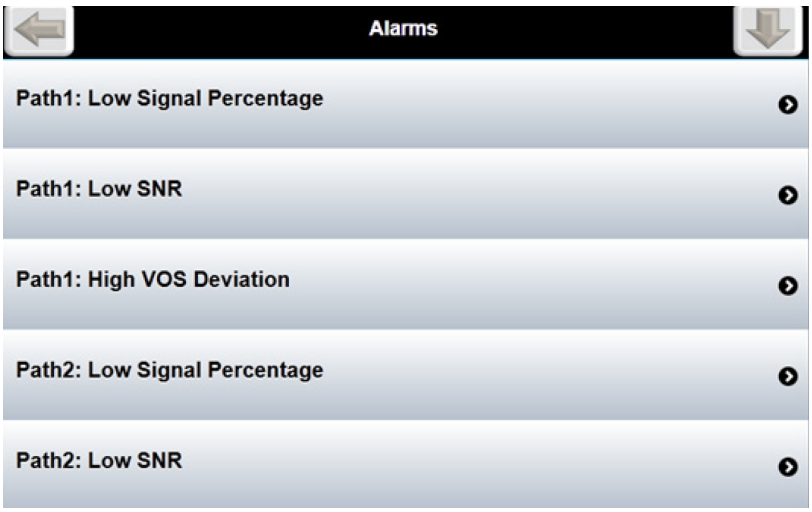
The data that is in this section is installed at the factory. Do not attempt to change any values without pre-authorization.

6.4 Alarms Menu

The Alarms menu navigates from the main menu to the Alarms Screen.

This screen displays the 10 most recent active alarms. These alarms are dynamically updated and cleared as the conditions are corrected.

Figure 77: Alarms Menu Options



6.5 Run Data Menu

The Run Data menu navigates from the main menu to the Path Data, System Data and Computational Data menus shown under Measurement Data.

6.5.1 Run Data Screens

(Path Main Menu > Run Data)

All meter information is grouped into three distinct sections:

- Path Data: Information separated on a per path basis
- System Data: General meter information details
- Computation Data: Calculated information

6.5.1.1 Path Data

(Path: Run Data > Path Data)

This section shows the data for each individual path. Some of this information is also located on the Overview Path Flow screen.

The selections are as follows:

- Flow Data
- Velocity of Sound
- Signal Percentage A
- Signal Percentage B
- Rx Gain
- Tx Gain
- Raw SNR A
- Raw SNR B
- Used SNR A
- Used SNR B

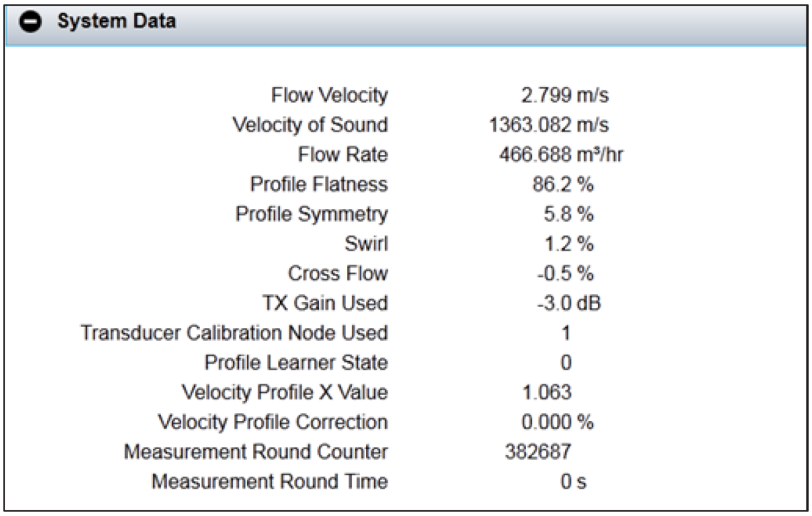
- Turbulence Level
- Raw Transit Time
- Transit Time Difference
- Used Transit Time Delay
- Raw Transit Time 3rd
- Calculated Transducer Delay
- Uncorrected Flow Velocity
- Uncorrected VOS
- Velocity Profile Factor
- Travel Time Correction Count
- Window Start
- Window End
- Axial Velocity
- Transversal Velocity

6.5.1.2 System Data

(Path: Run Data > System Data)

This section illustrates general system-level data. Some of this information is also located on the Overview screen.

Figure 78: System Data

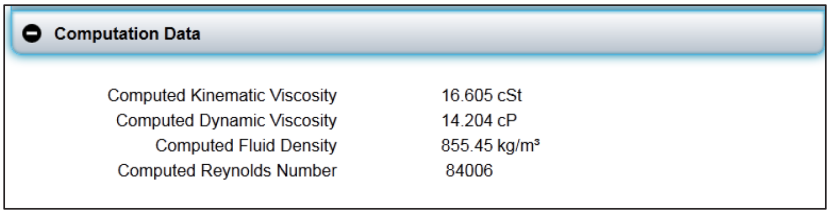


6.5.1.3 Computation Data

(Path: Run Data > Computation Data)

This section exhibitions physical property data calculated within the meter.

Figure 79: Computation Data



Flow Correction Data

(Path: Run Data > Flow Correction Data)

6.6 Diagnostics Menu

The Diagnostic Button navigates from the Main Menu to the Diagnostics sub-menu.

This top level diagnostics screen contains several meter diagnostic features partitioned into groups. Some of these menu options are user-interface-dependent and will be hidden if not supported. On a local touchscreen display, the Upload Program Parameters, Download Program Parameters, and the Update Software

options are hidden. On a PC browser, the Refresh Display option is hidden. Monitoring and Commissioning are always accessible.

The selections available are:

- Monitoring
- Commissioning
- Meter Restart
- Download Parameters as PDF
- Download Program Parameters
- Upload Program Parameters

6.6.1 Monitoring

(Path: Diagnostics > Monitoring) This screen provides access to the:

- Inputs and Outputs: Displays current state of physical I/O
- Logs: Top-level menu for viewing log data

6.6.1.1 Inputs and Outputs

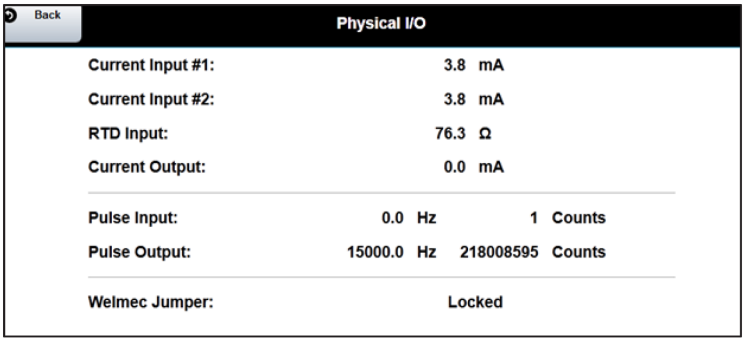
(Path: Diagnostics > Monitoring > Inputs and Outputs)

The display screen displays the current state of all physical inputs and outputs including the parameter lock. Normal ranges for the physical I/O are provided in the table below.

Inputs and Outputs	
Current Input #1	3.8 - 22 mA
Current Input #2	3.8 - 22 mA
RTD Input	76.7278 - 168.4783 ohms
Current Output	3.8 - 21.0 mA
Pulse Input	0 - 10,000 Hz, counts
Pulse Output	0 - 10,000 Hz, counts
Parameter Lock	Locked/Unlocked

> NOTE: Parameter lock monitors both the internal weights and measures slide switch and the optional customer supplied weights and measures key lock switch positions if connected to In #2.

Figure 80: Physical I/O

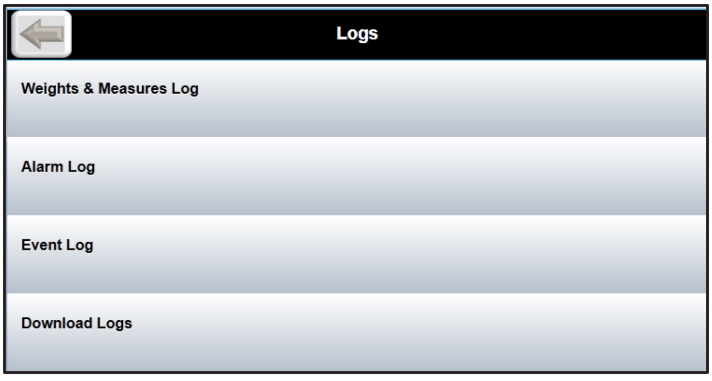


6.6.1.2 Logs

(Path: Diagnostics > Monitoring > Logs) This menu provides access to the following:

- Weights and Measures Log: Stored data entries
- Alarm Log: Stored data entries
- Event Log: Stored data entries
- Download Logs: Top-level menu for downloading log

Figure 81: Logs



6.6.1.2.1 Weights and Measures Log

(Path: Diagnostics > Monitoring > Logs > Weights and Measures Log)

This screen displays all entries pertaining to anything Weights and Measures related. The entry layout is as follows:

Table 3: Weight and Measures Log

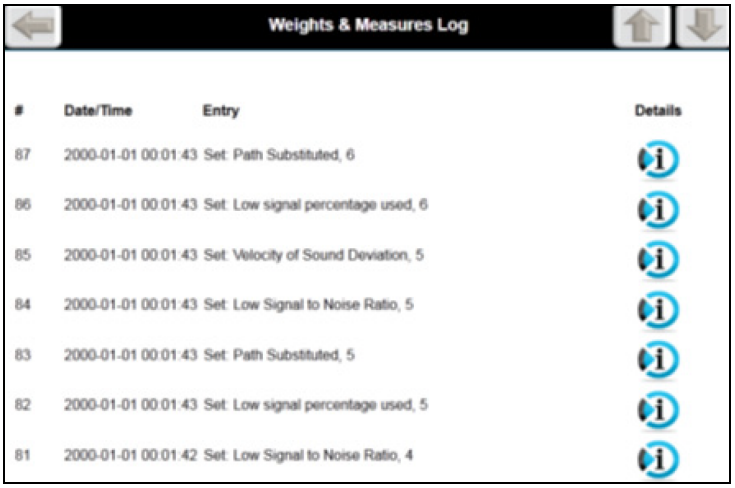
Log Entry Number	Date/Time	Entry	Details

Figure 82: Weights and Measures Example Log

Entry:	Internal Diameter
Type:	0
Date:	2021-05-18 08:07:12
User:	5
Old Value:	0.0
New Value:	258.39000
Log ID:	70
Vol Forward:	00000000000.0000 m^3
Vol Reverse:	00000000000.0000 m^3
Error Vol Forward:	00000000000.0000 m^3
Error Vol Reverse:	00000000000.0000 m^3

NOTE: All parameters that are controlled by security level 3 through 5 will be recorded in the weights and measures log if changes are made. If the hardware seal or the software seal are applied (sealed state), no changes to parameters will be allowed until the seals are broken.

Figure 83: Weights and Measures Log



6.6.1.2.2 Alarm Log

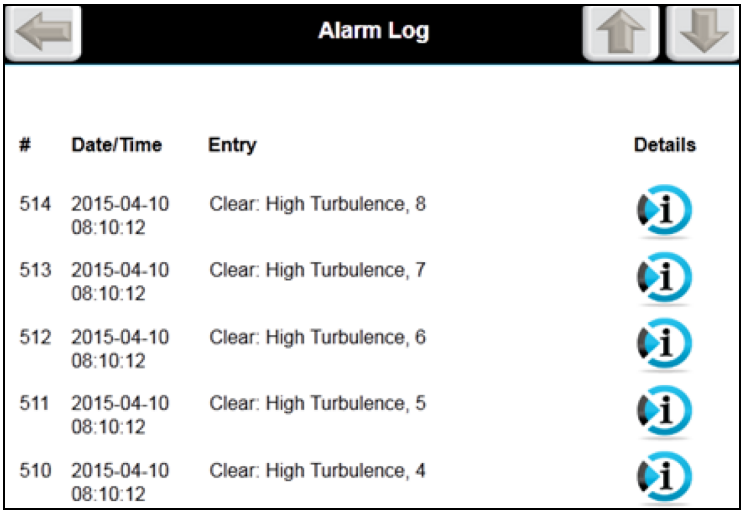
(Path: Diagnostics > Monitoring > Logs > Alarm Log)

This screen displays all alarm related entries. The entry layout is as follows:

Table 4: Alarm Log

Log Entry Number	Date/Time	Entry Description	Details

Figure 84: Alarm Log



6.6.1.2.3 Event Log

The Event Log records parameters that were changed.

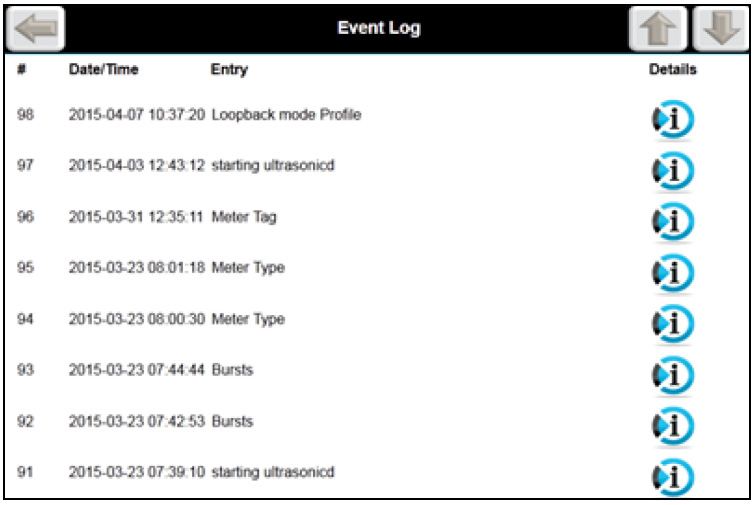
(Path: Diagnostics > Monitoring > Logs > Event Log)

The entry layout is as follows:

Table 5: Event Log

Log Entry Number	Date/Time	Entry Description	Details

Figure 85: Event Log



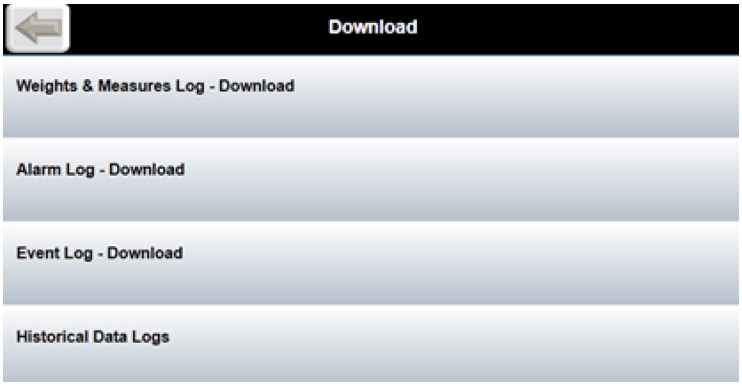
6.6.1.2.4 Download Logs

(Path: Diagnostics > Monitoring > Logs > Download Logs)

This screen provides a method for downloading any of the log files from the meter. To download a log:

1. Select the desired log to download.
    - The process will initiate automatically
    - The meter gathers all available entries and creates a text file
    - Once the text file is ready a prompt will appear to accept or decline the download
2. Accept the download.
    - The file will be located in the operating system's default downloads folder

Figure 86: Download Log



6.6.1.2.5 Historical Data Logs

(Path: Diagnostics > Monitoring > Logs > Download Logs > Historical Data Logs)

This screen provides a method for downloading the engineering log files from the meter. When the screen is first traversed the 10 most recent data logs will appear.

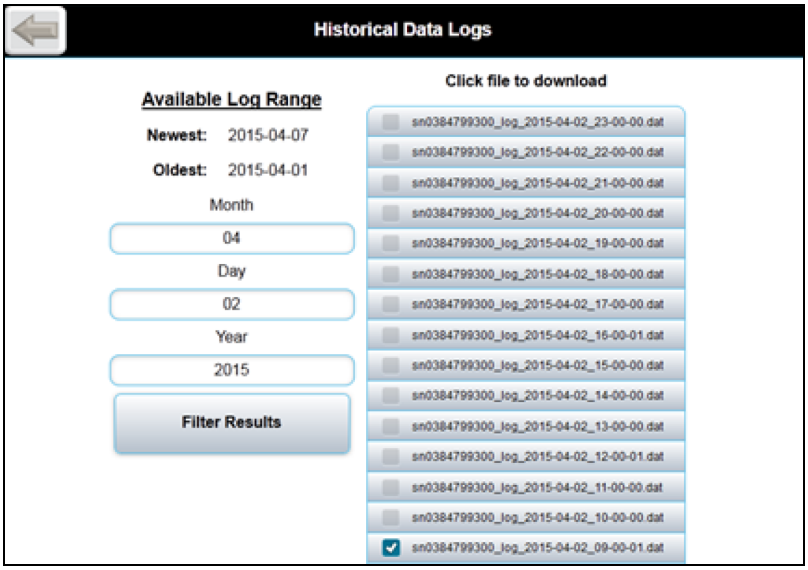
To download a log:

1. Select the desired log to download
    - The process will initiate automatically
    - The check box associated with the file will be checked. The checked file can be downloaded as many times as desired.
    - Once the data file is ready, a prompt will appear to accept or decline the download
2. Accept the download
    - The file will be located in the operating system's default downloads folder

The logs may also be filtered on a per-day basis. To filter the results:

1. Select a desired date
2. Check the filter results
    - If logs exist for the filtered date, the list of logs will update accordingly
    - If no logs exist, a prompt will appear stating this

Figure 87: Historical Data Logs

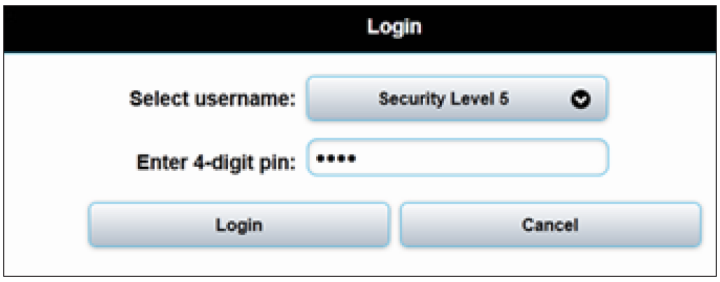


6.6.2 Commissioning

(Path: Diagnostics > Commissioning)

A user login of level 4 or level 5 is required in order to access the commissioning features.

Figure 88: Commissioning Login



The top-level commissioning screen provides two primary sets of features:

- To assist with commissioning of the meter
- Provide a mean for simulating meter operation

Selections are as follows:

- Analog Calibration
- Simulate Flow

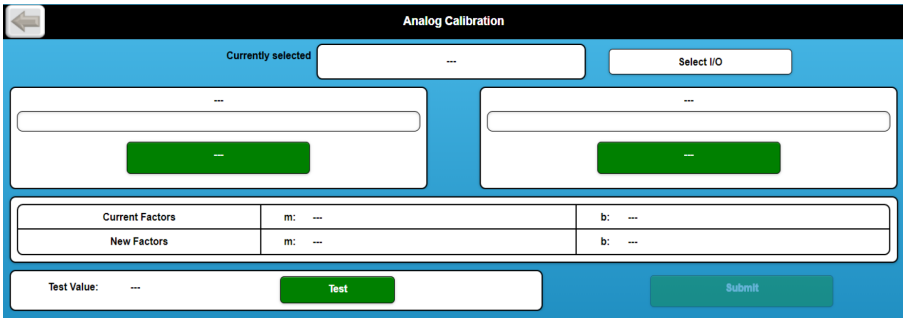
- Simulate Analog Output
- Simulate Pulse Output
- Force Values

6.6.2.1 Analog Calibration

The Analog Input calibration menus are located as follows:

(Path: Diagnostics > Commissioning > Analog Calibration)

Figure 89: Analog Calibration



> WARNING: Analog calibration may affect weight and measures controlled settings, equipment used for calibration must be traceable to national standards when controlled by local or national jurisdictions. Calibration may also be required to be witnessed and certified by the appropriate jurisdiction or an ISO 17025 accredited laboratory.

Analog calibration uses a wizard type program to adjust the analog (current inputs/output) and RTD input for zero and span for optimum accuracy.

6.6.2.1.1 Example Current Input Calibration

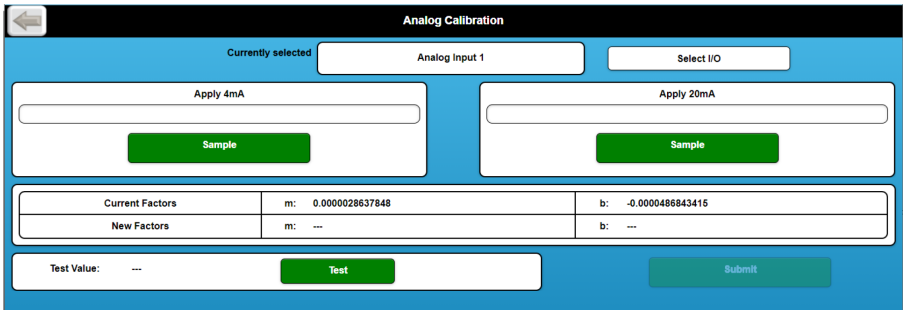
The two analog current inputs may be calibrated in the field when utilizing a high accuracy current input source providing 4.000 mA and 20.000 mA output. The resistance input (Analog #3) may be calibrated with two precision resistors, the first having a 80.000 ohm resistance and the second with a 120.000 ohm resistance.

Upon navigating into the Analog Calibration menu the Analog Input type must be selected from the Select I/O button.

Selections are:

- Analog Input 1
- Analog Input 2
- RTD Input (for example, Analog input #3)

Figure 90: Analog Calibration, Current Input

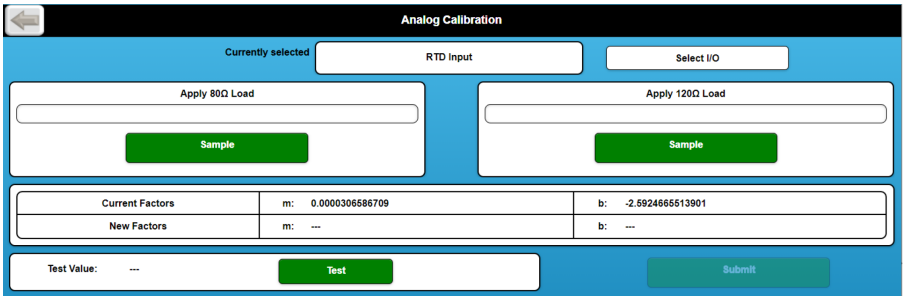


The current inputs are calibrated by applying the 4 or 20 mA source to An Input (CN6) either IN #1 or IN #2. The signal is then read by selecting the “Sample” button from the wizard either for the 4 mA or the 20 mA current input. When both values have been sampled, the calibration can now be tested. Apply the appropriate current input source to the An Input (CN6) either IN #1 or IN #2. Select “Test” to check if the meter reads the correct value. Enter “Submit” to enter new factors if the calibration was successful. The calibration factors will be automatically written to the appropriate An In Cal Factor A and An In Cal Factor B parameters for the current Input selected, repeated the process for the other current input if required.

6.6.2.1.2 Example RTD Calibration

The RTD input is calibrated by selecting the RTD Input from the select I/O button in the wizard. Then connecting a 80 ohm or 120 ohm source to the four RTD Inputs on connector plug (CN6) “Signal +, RTD+, Signal -, RTD-" . The Resistance is then read by selecting the “Sample” button from the wizard once for the 80 ohm load and once for the 120 ohm load. When both values have been sampled, the calibration can now be tested. Connect the appropriate four wire resistance input source. Select “Test” to check if the meter reads the correct resistance value. Enter “Submit” to enter new factors if the calibration was successful. The calibration factors will be automatically written to the appropriate An In Cal Factor A and An In Cal Factor B parameters for the RTD Input.

Figure 91: Example RTD Calibration



6.6.2.1.3 Example Analog Output Calibration

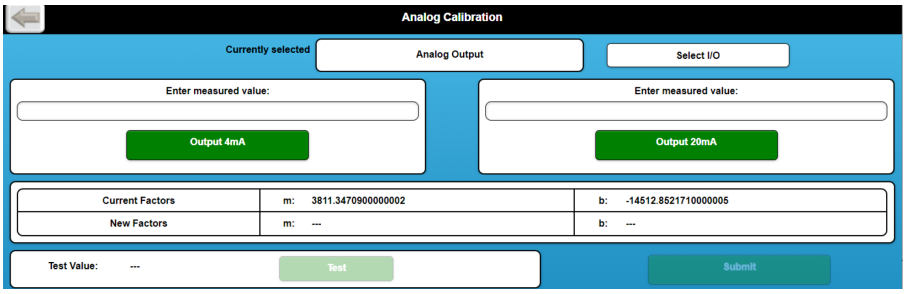
The analog output may also be calibrated in the field with a high accuracy digital multi meter (DMM). The analog output calibration menu is located as follows:

(Path: Diagnostics > Commissioning > Analog Calibration)

Upon navigating into the Analog Calibration menu the Analog Output must be selected from the “Select I/O” button.

Selections are: Analog Output

Figure 92: Example Analog Output Calibration



Using the calibrated digital multimeter (DMM), measure the current on the An output terminals (CN5) located on the UMCB. The measured value is then manually entered into the appropriate “Measured Value” box in the calibration wizard. Once completed, the calibration can now be tested. Measure the current output source (CN5). Select “Test” to check if the meter reads the correct value as compared to the DMM reading. Enter “Submit” to enter new factors if the calibration was successful. The calibration factors will be automatically written to the An Out Cal Factor A and An Out Cal Factor B parameters for the current output.

6.6.2.2 Simulate Flow

(Path: Diagnostics > Commissioning > Simulate Flow)

This option allows the meter to run in a simulated ("forced") state. While in this state, the values displayed are not real measured information. To simulate:

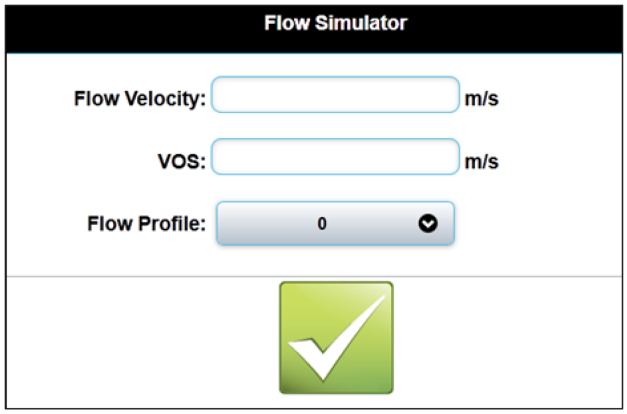
1. Enter a desired flow velocity; typical 700-1700
2. Enter a desired velocity of sound (VOS); typical 0-20
3. Select a desired flow profile from the drop down menu (0-8)
4. Press button to start simulation

> NOTE: A "Forced Values" indicator will appear (if not already present) in the bottom right corner of the display denoting simulation started.

Table 6: Simulate Flow

Profile	Behavior
0	Standard ("Normal") operation
1 - 8	Various non-standard flow profile types

Figure 93: Flow Simulator



6.6.2.3 Simulate Analog Output

(Path: Diagnostics > Commissioning > Simulate Analog Output)

This option places the meter into a simulated ("forced") state and sets the output current

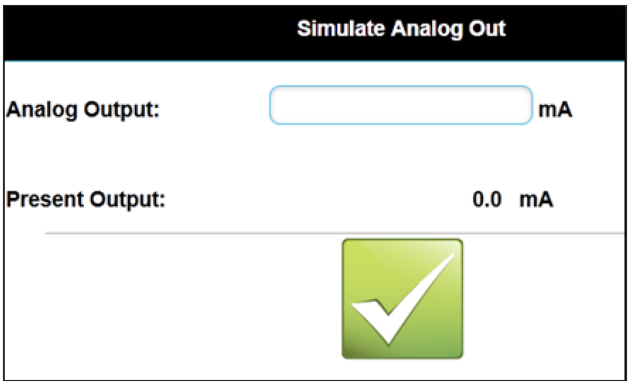
(CN5) to the value set here.

- Input field: Desired current value
- Save: Accept value and simulate output

NOTE: A "Forced Values" indicator will appear (if not already present) in the bottom right corner of the display denoting simulation started.

WARNING: Forced analog values are not legal for trade this function should be used for diagnostic purposes only.

Figure 94: Simulate Analog Out



6.6.2.4 Simulate Pulse Output

(Path: Diagnostics > Commissioning > Simulate Pulse Output)

This option places the meter into a simulated ("forced") state and set the output pulse frequency (CN3) to the value set here.

- Input field: Desired pulse frequency value
- Save: Accept value and simulate output

NOTE: A "Forced Values" indicator will appear (if not already present) in the bottom right corner of the display denoting simulation started.

WARNING: Simulated pulse outputs are not legal for trade. This function should be used for diagnostic purposes only.

6.6.2.5 Force Values

(Path: Diagnostics > Commissioning > Force Values)

This option used to indicate when the meter is in a simulation ("forced") state. While in this state, the information outputted by the meter may not be the real measured

data. This state is meant for simulating flow and forcing desired analog and pulse output values.

Button State:

Turn Off --> Meter is currently in a simulated state

> NOTE: A "Forced Values" indicator will appear (if not already present) in the bottom right corner of the display denoting simulation started.

Figure 95: Forced Values

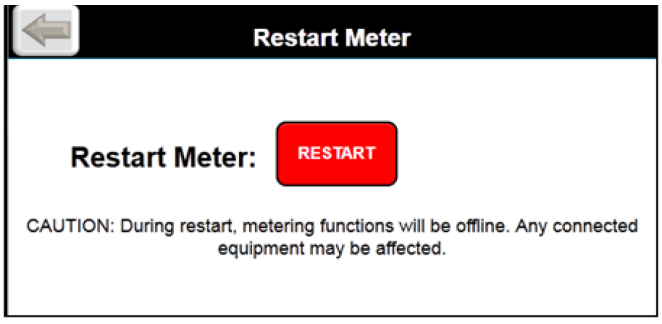
6.6.3 Meter Restart

(Path: Diagnostics > Meter Restart)

The meter restart is used to completely reboot the operating system. The meter will be offline and not metering during this sequence. A restart is required if the IP addressing settings are changed in order to initialize the new settings. This feature is also available to use as directed by a factory service representative.

> CAUTION: The meter will be offline during the reboot time.

Figure 96: Restart Meter



6.6.4 Download Parameters as PDF

(Path: Diagnostics > Download Parameters as PDF)

The parameter download file documents lists all metrologically relevant settings in a conveniently formatted pdf document. This document serves as a link between the software checksum and actual software and configuration settings. The parameter file also documents all correction factors as configured for verification of calibration testing.

The following data is included in the Parameter Listing document:

- Meter Information
  - Meter Type
  - Spool Serial Number
  - Meter Tag
  - Electronics Serial Number
  - Software Revision Number
  - Checksums
    - Parameters
    - Calibration Parameters
    - Commissioning Parametres
  - Network Settings
    - IP Address
    - Netmask
    - Network
    - Gateway
- Communications
  - Serial Port Function
  - Baud Rate Selection
  - Parity Selection
  - Word Length Selection

- Stop Bit Selection
- Modbus Unit ID
- Modbus Endian
- Modbus NaN Substitution Mode
- Modbus NaN Selection
- Modbus Inactivity Timeout
- MQTT Data Mode
- MQTT Broker URL
- MQTT Topic Group Name
- MQTT Username

- Diagnostics
  - Data Interval
  - Signal Logging Interval
  - Alarm Sensitivity
  - Power Up Alarm Delay
- Factory Settings
  - Initial Profile Factor (eight variable)
  - Running Average Buffer Size
  - VPCx Average Buffer Size
  - Size Constants A an B (four variables each)
  - VPCx and VPC Meter Factor (eight variables each)
  - ReNo VPCx and Reynolds Number (eight variables each)
  - Path Constant (eight positions each)
  - Profile Compensation A and B, Low and Gain

- Density Correction A
- Density Correction B
- 3rd Reflected Diagnostic

- Flow Calibration
  - Flow Rate (16 variables)
  - Meter Factor (16 variables)
- Fluid Corrections
  - Fluid Correction Mode
  - Temperature Input Source
  - Temperature Input Units
  - Pressure Input Source
  - Pressure Input Units
  - Density Input Source
  - Density Input Units
  - API Thermal Expansion Coeff
  - Reference Density
  - Reference Temperature
  - API Commodity Selection
  - Reference Pressure
  - Reference Density Input Source
  - Vapor Pressure Fallback
- Gas Composition
  - Gas Composition Input Source
  - Nitrogen Mole Fraction

    - Carbon Dioxide Mole Fraction
- Inputs and Outputs
    - Digital Output Function
    - Pulse Output Factor
    - Pulse Output Mode
    - Reverse Flow Handling
    - An Output Function
    - An Out Engineering Value at Max
    - An Out Engineering Value at Min
    - An Out Cal Factor A
    - An Out Cal Factor B
    - An In Engineering Value at Max (two variables)
    - An In Engineering Value at Min (two variables)
    - An In High Limit (two variables)
    - An In Low Limit (two variables)
    - RTD In Temperature Offset
    - RTD Input High Limit
    - RTD Input Low Limit
    - An In Cal Factor A (three variables)
    - An In Cal Factor B (three variables)
    - An In Alarm Hysteresis (three variables)
    - An In High Alarm Point (three variables)
    - An In Low Alarm Point (three variables)
    - Pulser Frequency Limit

- Flow Direction Deadband
- Pulser PID Gain
- Pulser PID Reset
- Pulser PID Rate
- An Out Fail Setting
- Pulse Output Function

- Limits
  - Max Velocity of Sound
  - Min Velocity of Sound
  - Min Signals Used
  - Max RX Gain
  - Max RX Gain Difference
  - Max VOS Deviation
  - Min Signal to Noise Ratio
  - Max Turbulence Level
  - Max Swirl/Crossflow Deviation
  - Max flow rate velocity
  - Min flow rate velocity
  - Max Profile Flatness Deviation
  - Max Profile Symmetry Deviation
  - Low Flow Cutoff
  - Enable Confidence Alarms
  - Flow Rate Cutoff Selector
  - Accumulator Low Flow Cutoff

- Meter Body
  - Path Length (eight variables)
  - Path Angle (eight variables)
  - Lateral Path Position (eight variables)
  - Internal Diameter
  - Wall Thickness
  - Material
  - Reference Temperature
  - Diameter Compensation Mode
  - Spool Serial Number
- Modes
  - Disable Paths (eight variables)
  - Manual (force) Values
  - Line Temperature Input Mode
  - Line Temperature Fallback Value
  - Line Pressure Input Mode
  - Line Pressure Fallback Value
  - Electronic Sealing Mode
  - Electronic Seal State
  - Diagnostic Mode
  - Line Temperature Input Units
  - Line Pressure Input Units

- Signal
  - Signal Type
  - Signal Filter Kernel Length
  - Signal Frequency
  - Signal End Frequency
  - Signal Length
  - Bursts
  - Burst Interval
  - Low Pass Filter Frequency
  - High Pass Filter Frequency
  - Delay Between Firings
  - Level Control Setpoint
  - Detection Method
  - Number of Zero Crossings
  - Manual TX Gain
  - TX Signal Processing
  - Travel Time Deviation Limit
  - TX Gain Mode
  - RX Gain Setpoint
  - TX Gain High Limit
  - TX Gain Low Limit
  - Signal Offset A
  - Threshold Level
  - Threshold Method

- Transducer
  - Upstream Port Number (eight variables)
  - Downstream Port Number (eight variables)
  - Transducer Delay (eight variables)
  - Transducer Delay (node 2) (eight variables)
  - Transducer Delay (node 3) (eight variables)
  - Transducer Type
  - Number of Trans Cal Nodes
  - Correction Mode
  - Node Pressure (three variables)
  - Node Temperature (three variables)
  - Transducer Phase (eight variables)
  - Transducer Pair Delta T (* variables)

6.6.5 Download Program Parameters

(Path: Diagnostics > Download Program Parameters)

This feature is used to download a configuration file to the meter. To upload a configu- ration file:

1. Select this feature on the screen
   - The process will initiate automatically
   - The meter gathers all configuration settings
   - Once the USC-file is ready, a prompt will appear to accept/decline the download
2. Accept the download
   - The file will be located in the operating system's default download's folder

6.6.6 Upload Program Parameters

(Path: Diagnostics > Upload Program Parameters)

This feature is used to upload a configuration file to the meter. To upload a configuration file:

1. Select this feature on the screen
2. Browse the local machine for the appropriate file
3. Press the Upload File button. The uploading process will automatically start. Prompt based feedback from the meter will provide further instruction, if appropriate.

6.6.7 Update Software

(Path: Diagnostics > Update Software)

This feature is used to update the software within a meter, and is a two step process. The first step is uploading the software image file, and the second is to perform the installation. The meter will not function during the second step, so it is important to have the meter off-line. Also, the meter will reboot during the second step, so there will be a time where it will not communicate with neither attached equipment nor the user interface (web pages).

Further, as a precautionary measure, it is recommended that the current database be backed-up prior to updating the software. This is also done inside the Diagnostics menu. In order to generate a back-up of the current database, please follow the instructions in section 6.6.3: Meter Restart on page 128.

1. Locate the software package to be installed. The file should be in the following format: TechnipFMC-Ultrasonic-usm-[version].raucb.
2. Click the Update Software button. The following message will appear. Click anywhere on the screen to remove the warning.

3. Logon utilizing the proper credentials for Security Level 5.

4. Verify that the Parameter Seal is unlocked; you cannot update software on a sealed unit.
5. Select Choose File.
6. Locate the proper software revision package.
7. Select the file in the format of TechnipFMC-Ultrasonic-usm-[version].raucb and select Open.
8. Once the proper file has been selected, click Upload File.
9. A progress bar will show upload status. Once the file is uploaded, the following should appear (with an appropriate IP address) - click OK to proceed with a reboot and update.
10. Another progress bar will indicate the status. The browser should automatically reconnect after the meter reboot; if for some reason it does not, re-type the IP Address into the web browser to refresh the meter.
11. Verify that the meter is properly functioning:
    - Verify that the date and time are updating and set properly
    - Navigate to the Meter Information screen and verify the software version number is correct
12. The meter will now be updated to the new software.

The software update mechanism has changed with the release of usm-2.0 software; here are some important facts about the new update mechanism:

- You cannot update from software version 1.x to 2.x because version 2 software and higher requires new hardware (a new SoM, or PC module). SOM upgrade kits are available from the factory. The UMCB cover plate will indicate if the new SoM is installed, either by the silkscreen or by an applied label.
- Once you have completed the first software update step by uploading the file, the meter is poised to execute the software update on the next meter reset. This means whether the OK button is pressed or the meter restarts for any reason (for example, power cycle), the new software will be installed. Note that this may happen unexpectedly months later if the file was uploaded and for

some reason the second step was not initiated. Therefore, it is wise to ensure the second step was completed and verify the update was successful.

- The new software update mechanism has built in redundancy. If the software install fails (step 2), the meter will reboot to the previous software install and run normally.
- The redundancy offered by the new software updater has another side effect; if for any reason the current software version cannot boot, even years later, the meter will attempt to boot to the previous software version. This includes reverting parameters to those in effect at the time of the last software update. It is feasible, if you wish, to update to the same software version twice; this would have the effect, when a software reversion is forced due to a boot failure (rare event), of booting to a separate redundant copy of the same software version (although the parameters would revert to those in effect during the first software update).

6.6.8 Reset Passwords

This selection resets all passwords to the factory default values in case the user defined passwords have been lost. In order to reset passwords, the meter must be opened in order to set the rotary dip switch SW200.

> WARNING: The electronics inside the explosion-proof enclosure are not suitable for exposure in a hazardous area. Proper precautions must be taken before opening the enclosure when the meter is installed in a hazardous area.

> NOTE: The position of the rotary dip switch must be noted prior to making any adjustments. This switch can affect the Ethernet communication settings after a meter restart. The switch must be returned to the original position immediately after performing the reset operation. The factory default position of the rotary switch is position “0”.

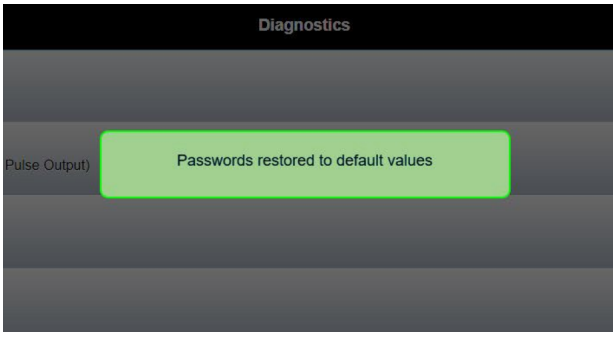
Set the rotary switch SW200 to position 8, follow the on-screen instructions for the password reset, and when complete, return the switch to the original position.

(Path: Diagnostics > Reset Passwords)

Figure 97: Reset Passwords

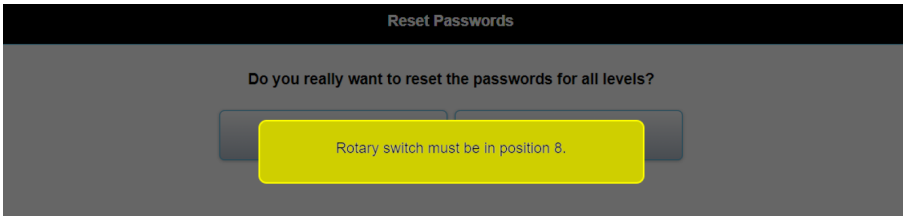
Upon successful reset, the following message will be displayed.

Figure 98: Successful Reset Message



If the rotary switch was not set to position 8, the following error message will be displayed.

Figure 99: Error Message



NOTE: Changes to password levels 3 through 5 are considered meteorological relevant and will be logged in the weights and measures log. As this function resets all passwords this event is recorded in weights and measures log as well as the event log and may be viewed by navigating to Menu > Diagnostics > Monitoring > Logs and then choose either weights and measures log or event log.

Figure 100: Weights & Measures and Event Log

6.7 Weights and Measures Sealing

There are two main features that support controlling access to legally relevant parameters, hardware sealing and software sealing. Either system alone is a robust complete system and use of only one method provides adequate protection. Both may be used together if desired.

> NOTE: A complete list of all parameters and the security levels they are secured under is available in the appendix of this manual. All parameters that are listed as level 3 through 5 will be logged to the weights and measures log if changes are made regardless if the software sealing is activated or not.

6.7.1 Hardware Sealing

Hardware sealing is accomplished using a seal wire and a crimped lead seal. Two of the cover cap screws are drilled to accept a seal wire; this allows for detection of illegal entry into the enclosure. This seal protects the following hardware features within the enclosure.

Figure 101: Hardware Sealing

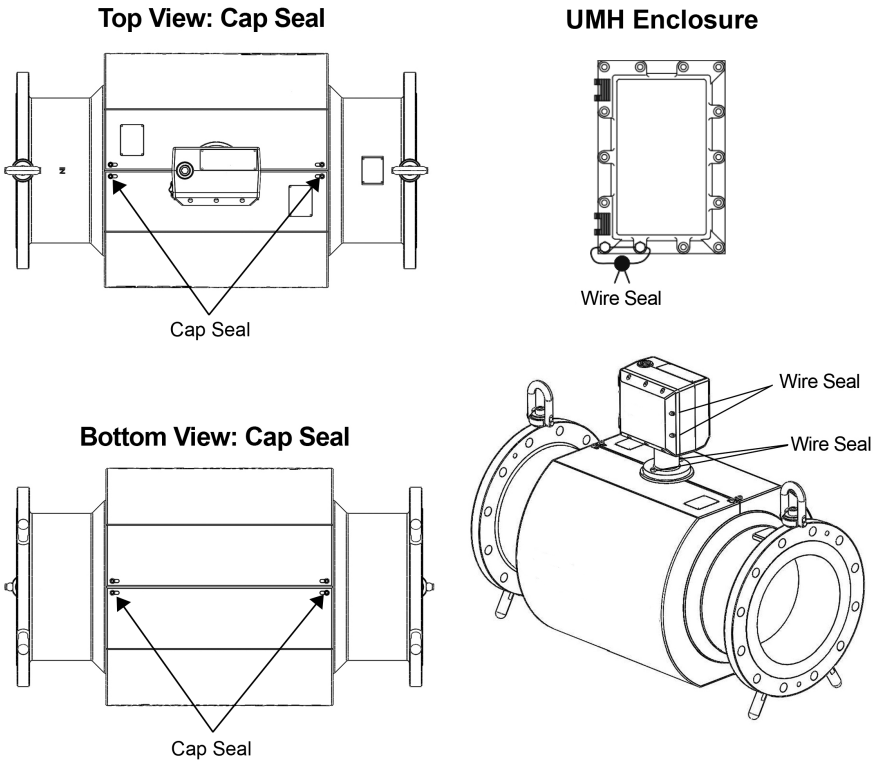
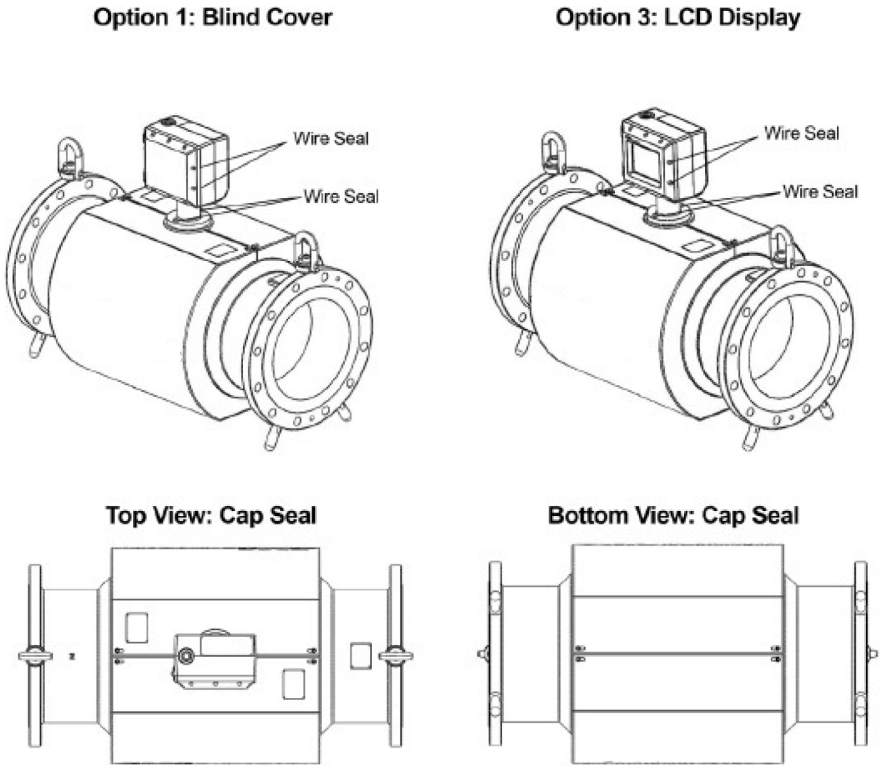


Figure 102: Enclosure Sealing



Inside the enclosure digital input #2, which is located on terminal strip CN2 terminals 3 and 4, provides the hardware seal. The meter is shipped from the factory with a jumper (J_WM) across the terminals.

> NOTE: Old revision board assemblies (UMCB Series 3 and lower and UMCB-W series 2 and lower) had the jumper, newer revision boards (UMCB Series 4 and higher* and UMCB-W series 3 and higher*) have a Weight and Measures slide switch located next to connector CN2.
> *(including Alpha revision codes)

When removed, no legally relevant parameters may be changed.

The hardware seal may be wired out to a key switch or other security device supplied by the customer in order to provide remote activation/deactivation. When this feature is used, the customer is responsible for complying with appropriate weights and measures requirements.

There is also an encoder switch that may be set (using a screw driver) that allows for maintenance. Switch position 9 forces the unit to boot to a fixed, documented, IP address (for commissioning purposes). Switch position 8 allows for password reset to factory default values.

6.7.2 Software Sealing

Path: Settings > Modes > Electronic Sealing Mode/Electronic Seal State)

Software sealing is accomplished by a 5 level password system and two program parameters that control software sealing. Passwords are four-digit numbers.

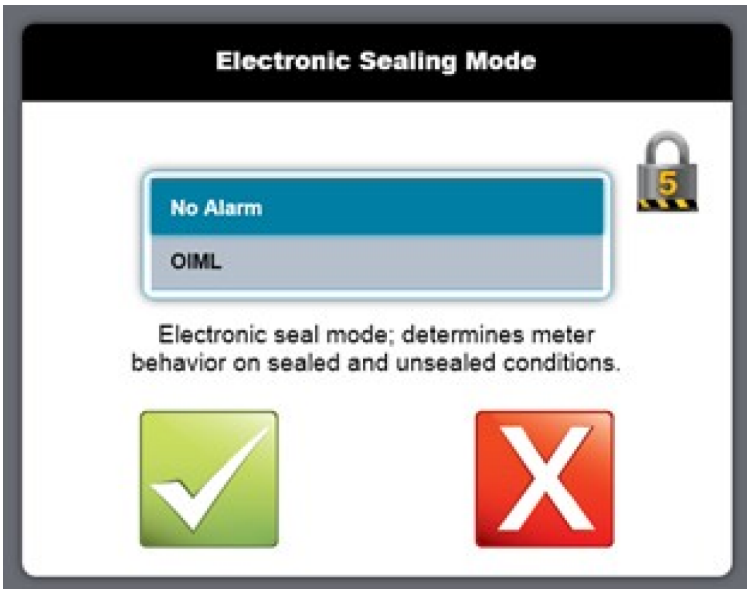
The five levels are:

1. Lowest security level (not used)
2. Diagnostic parameters that are not legally relevant
3. Commissioning parameters that are not legally relevant, such as serial comm. parameters
4. Owner, legally relevant parameters

5. Weights and measures, legally relevant parameters including sealing parameters.

The two parameters that control sealing are in the Modes menu under Settings. Electronic Seal Mode determines the alarms that are generated by the various checking facilities. This must be set to OIML to comply with the EU-MID and other various global regulatory agencies sealing requirements.

Figure 103: Electronic Sealing Mode



Electronic Seal State determines whether the unit is sealed by password or not. When set to Sealed, no legally relevant parameter may be changed. When set to Open, parameters may be changed according to the security level they are assigned.Security level 4 (Owner) and level 5 (weights and measures) may break a seal (switch from Sealed to Open); only security level 5 (weights and measures) may seal the unit (switch from Open to Sealed). This allows the owner control of the unit, yet allows the weights and measures level to detect the unsealed condition, and then may look into the logs for changes that have been made.

> NOTE: If the internal weights and measures switch or external key switch option is used, that seal must be broken before any changes can be made to parameters protected under security level 3 through 5.

6.7.3 Procedure for Weights and Measures Official

6.7.3.1 When using software sealing, the Weights and Measures official shall:

1. Change the level 5 password and record in a private manner for future use.
2. Set the Electronic Seal Mode in the Settings > Modes menu to OIML.
3. Set the Electronic Seal State in the Settings > Modes menu to Sealed.
4. Exit the settings screens and verify parameters have been saved by navigating to the Menu > Meter Information > Security menu and verify the seal type, Software should be displayed for seal type.
5. Navigate to the Checksum menu from the Meter Information screen and record the checksums.
6. It is recommended that copy of all parameters should be downloaded and saved for future reference, this will require a connection to a local PC. Once communications have been established this is accomplished by navigating in the web browser as follows: Menu > Diagnostics > Download Parameters as PDF. This process may take a couple of minutes to complete, a PDF file will be downloaded when complete.
7. It is also recommended that a copy of the Weights and Measures log be downloaded, as in step 6 above a connection will be required to a PC/laptop. This is accomplished by navigating in the web browser as follows: Menu > Diagnostics > Monitoring > Logs > Download Logs > Weights and Measures Log - Download. This process may take a couple of minutes to complete depending on the size of the log, a text file will be downloaded when complete.
8. Verify the rotary encoder switch on the UMCB board is in position 0.
9. Close the box and apply a physical wire seal.

6.7.3.2 When using hardware sealing. the Weights and Measures official shall:

1. Before the enclosure is sealed, verify the rotary encoder switch is in position 0.
2. The jumper or slide switch (depending on board version) is used for hardware parameter protection, the jumper must be removed or the switch located next to CN2 is placed in sealed state; for example, switch position is slid towards the

center of the UMCB board.

3. If the digital input #2 is used for parameter protection (customer decision), the jumper must also be removed, or the switch placed in the sealed state. The external switch mechanism and wiring to the switch needs to be validated for physical sealing requirements.
4. Verify the hardware seal status by navigating to the Menu > Meter Information > Security menu and verify the seal type, “Hardware” should be displayed for seal type.
5. Close the box and apply a physical wire seal.

> NOTE: Both software and hardware sealing methods may be used simultaneously, it is recommended that a physical seal be used to secure the Ex enclosure to deter unauthorized entry. When navigating to the Menu > Meter Information > Security menu with both types of seals applied, the seal type, “Hardware and Software” should be displayed for seal type.

6.8 Meter Information

This screen provides pertinent meter information in regards to electronics software and hardware properties.

- Type: Style of meter; for example, MPU1600, MPU800, etc.
- Tag ID: The unique identifier given to this particular meter
- Revision: Current software running on the meter
- Serial: Serial number of the UMCB
- Security: Weights and measures seal type and status:
- Checksums: Includes checksums for the parameters, ultrasonic, DSP, and Modbus software and settings.
- Reference: Quick response (QR) code scan

7 Integrated Touchscreen Display

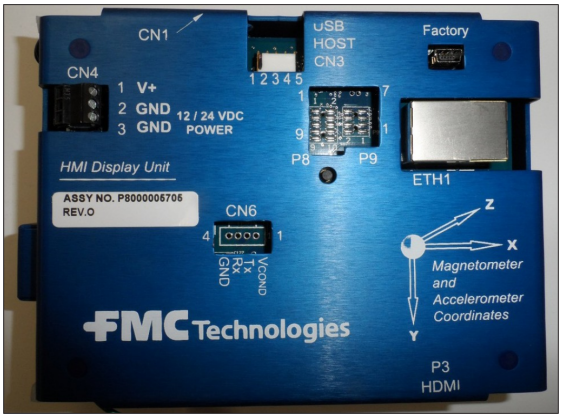
The optional MPU Series flowmeter display is a touch screen device that functions as a complete HMI equivalent to a remote connection by PC. It allows complete access to interfaces to the web-based user interface functions from section 6: Web User Interface on page 54.

The display includes all software for configuring connections to the UMCB in case the network configuration is changed from the default factory settings. The integrated display includes built in security functions for compliance with weights and measures requirements. Once configured, the display will automatically connect to the desired MPU Series flowmeter during start up. The display is available as an integrated device or a remotely mounted device

7.1 Features

- Touch Screen Display: The touch screen display is usable wearing gloves and is enclosed behind an explosion proof enclosure for use in hazardous areas.
- Security: The display includes built in security features for compatibility with WELMEC standards for custody transfer.
- Automatic Connection: Once configured the display will automatically connect to the configured device upon reboot.

7.2 HMI Display



7.2.1 Electrical Installation

7.2.1.1 Power Supply

The electronics are designed to be powered by 24 VDC, +20%/-15%, 7W.

The shield of the cable should be connected at only the electronic enclosure, preferably via the cable gland.

Connect input power cable to connector CN4.

DC Input Wire	Terminal
24 VDC (+)	CN4-1
24 VDC (common)	CN4-2
Ground	CN4-3

7.2.1.2 Connection to UMCB

The display connects to the UMCB through an ANSI/ IEEE 802.3 Ethernet connection by way of an RJ45 jack.

HMI Display Unit	UMCB
ETH1	ETH1 or ETH3

7.2.1.3 Display Start-Up

The display will require unique IP addresses that is separate from the main UMCB. The display links to the ultrasonic meter control board by way of its configured IP address. The factory default network setting for the display is DHCP where the network automatically assigns this IP address. If the meter is not connected to an Ethernet network or if the network does not support DHCP then a fixed address may need to be assigned.

Upon power up the unit will proceed through the following boot sequence:

1. Logo screen with boot progress bar.
2. For a short period, a configuration icon is shown as a gears graphic; if this button is pressed, the connection sequence in the next item is skipped and the display connects immediately to the Display main menu.
3. If the display is configured, it will attempt to connect with the host device:
    a. If the Primary URL is configured, the display will attempt to connect to this host. If the Primary URL fails it will try to connect to the device with the specified device serial number.
    b. If a host serial number is configured, the display will search the network for a device with the specified serial number, obtain an IP address, and attempt to connect with that host. If it fails with the device serial number it will attempt to connect to the secondary URL.
    c. If a fallback URL is configured the display will attempt to connect to that host.
4. If Step 2 is unsuccessful in connecting to any configured device or if the remote display has not been configured, the remote display main menu will be shown. From the main menu the connection settings can be configured and the connection sequence repeated.

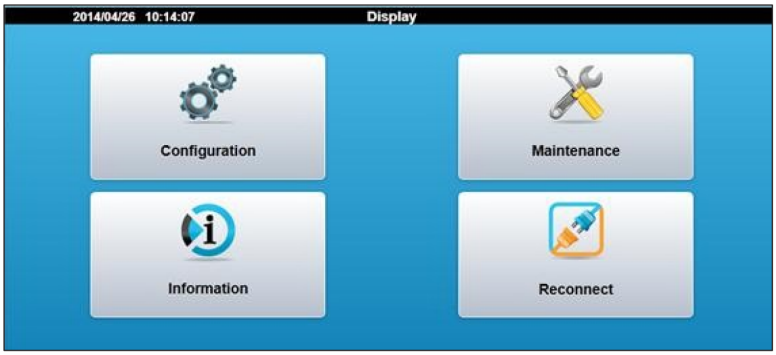
7.3 Integrated Display Operation

7.3.1 Display Main Menu

The display's main menu will be displayed if the display does not connect to the UMCB after powering up sequence. The display's main menu can also be accessed by inter rupting the startup process by tapping the screen while the boot icon is displayed. The following options are provided:

- Configuration: Settings for a connection to a device
- Maintenance: Adjustment of display setting
- Information: Key identification and settings data
- Reconnect: Initiate a reconnection to the configured device

Figure 104: Integrated Display Main Menu



7.3.1.1 Display Configuration

The Configuration option is used to set up the display to communicate with the desired device and to set the password to control access of the display settings. A password is required to access the configuration settings. When the Configuration Button Icon is selected, a Login Screen will appear. There are two different levels of security access for the Display with the following default passwords:

- Level 4 Password: 4444 Network configuration level
- Level 5 Password: 5555 Weights and Measurement access level

It is recommended to change the passwords from the default value to a more secure setting. Refer to section 7.3.1.2: Display Configuration, General below password setting instructions.

> NOTE: The password in the display menu is separate from ultrasonic meter control board (UMCB) password.

Figure 105: Integrated Display Configuration Login

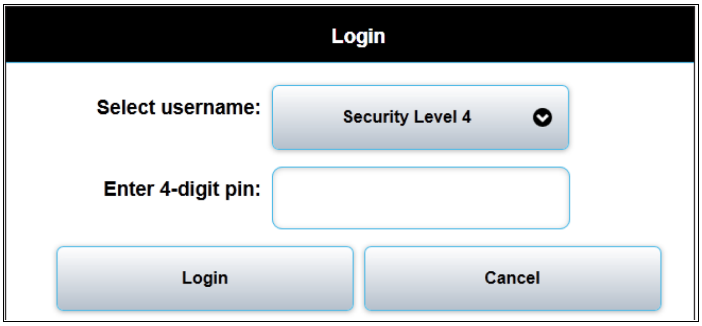
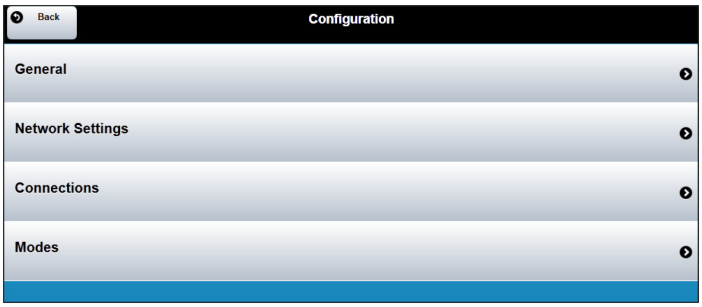
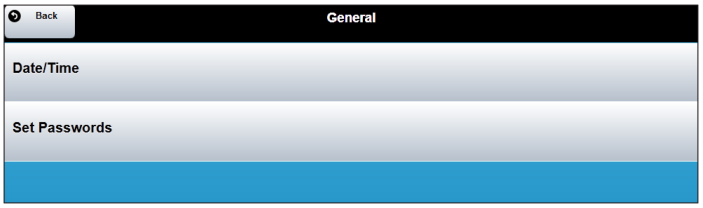


Figure 106: Integrated Display Configuration



7.3.1.2 Display Configuration, General

Figure 107: Integrated Display General



Date/Time: Adjust the date and time of the display unit. Once the display has been sealed the date and time adjustment will be locked out.

Set Passwords: Update the passwords for either level 4 or level 5 access. The screen will prompt for the old password and for the new password to be entered twice for confirmation.

The password is unique to the display and is not shared with the ultrasonic meter.

> NOTE: Record all password modifications and store in a secure location.

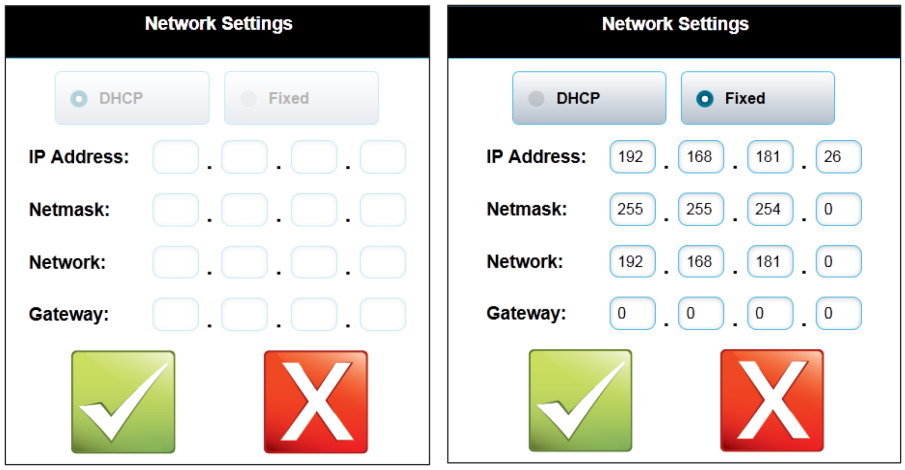
7.3.1.3 Display Network Settings

The network settings are to configure the address of the Display on the network. Note that this is not the address of the meter that the display is connecting to. The display is required to have a unique IP address because it exists as a device on the IP network. There are two modes to create the display's network address:

DHCP: The Dynamic Host Configuration Protocol is used to request the IP address from the network server. With this configuration checked, the DHCP server assigns a local IP address to the Display connected to the local network. This is the default net- work setting from the factory.

Fixed: If the Ethernet network does not support DHCP or if the meter is not connected to a network a fixed IP address should be used. The network settings for the fixed ad- dress must be entered manually on the display screen.

Figure 108: Integrated Display Network Settings



> NOTE: The unit must be power cycled for the new settings to take effect.

7.3.1.4 Display Connections

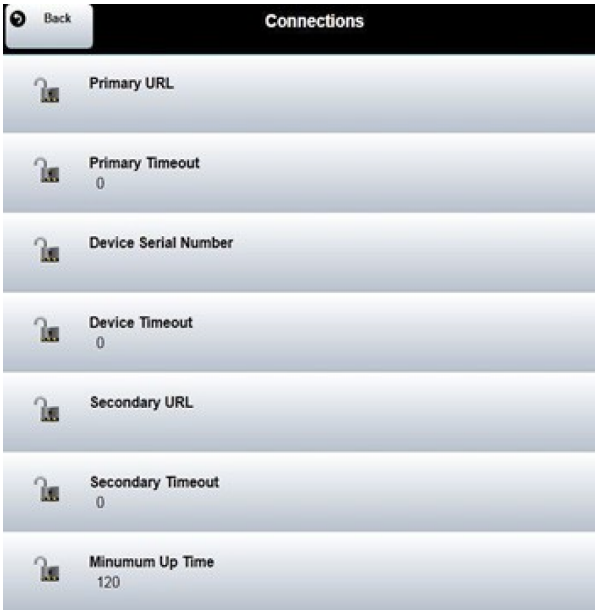
The connections setting is used to connect to the desired ultrasonic flowmeter.

- Primary URL: This fixes a target IP/URL address that the display will first attempt to connect to upon startup of the unit. In order to configure this value the IP

address of the ultrasonic flowmeter must be known.

- Primary Timeout: Maximum time allowed for the primary URL connection attempt, in seconds. The URL connection attempt can be skipped by setting a zero timeout.
- Device Serial Number: The unique serial number assigned to the ultrasonic meter control board. The meter will broadcast this serial number over the network in a way that the display unit can detect. When the display matches the configured serial number to a device on the network it will form a connection. The ultrasonic meter Serial Number will be displayed in the meter electronics box. This is the recommended connection method to the ultrasonic flowmeter.
- Device Timeout: Maximum time allowed for the device serial number connection attempt.
- Secondary URL: An alternate target IP/URL address the display will attempt to connect to. In order to configure this value the IP address of the ultrasonic flowmeter must be known.
- Secondary Timeout: Maximum time allowed for the secondary URL connection at- tempt, in seconds. The secondary URL connection attempt can be skipped by setting a zero timeout.
- Minimum Up Time: A minimum time allowed since power up to allow attempting a host connection. Setting this to a larger value (in seconds) may be needed if the display attempts to connect to its host before the host is ready to accept connections (for example, if all instruments are turned on with the same power source, and the host takes longer to boot up).

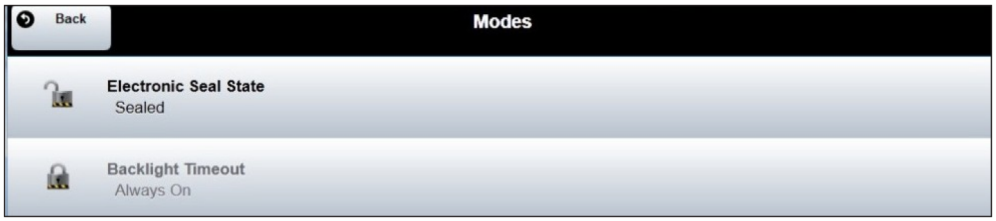
Figure 109: Integrated Display Connections



7.3.1.5 Display Modes

The Modes setting is used configure the set the electronic seal and to configure the backlighting sleep mode for the display.

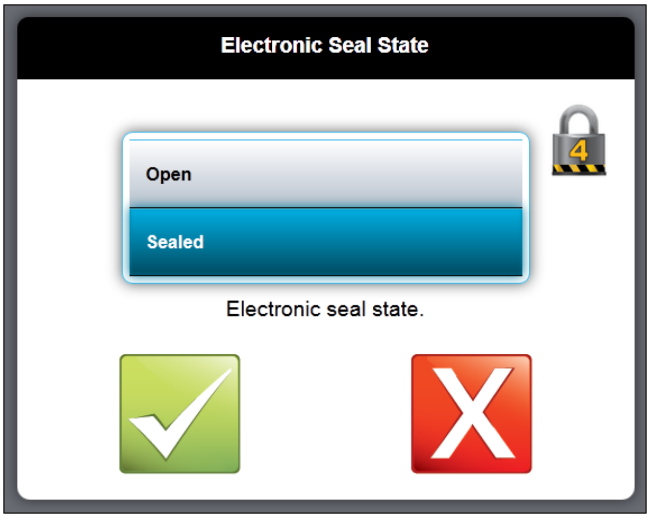
Figure 110: Integrated Display Display Modes



7.3.1.6 Electronic Seal State

This is used to set the electronic seal onto the display unit. Sealing locks out the adjustment of parameters that would be required to be fixed by a weights and measures official. Sealing can only be opened on Level 4 or 5 access level. Sealing can only be set by Level 5 access.

Figure 111: Integrated Display Electronic Seal State

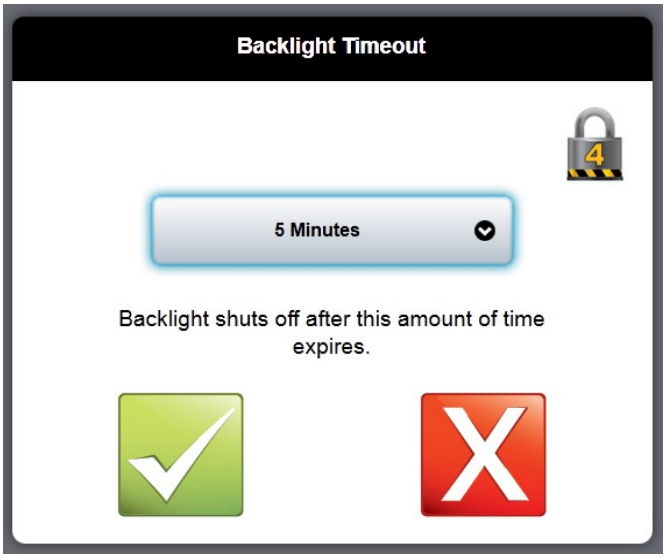


7.3.1.7 Backlight Timeout

This sets the amount of time before the LCD backlight switched off for a sleep mode. The following backlight timer duration options are available from the configuration screen:

- Always On
- 1 Minute
- 5 Minutes
- 20 Minutes
- 1 Hour

Figure 112: Integrated Display Backlight Timeout



7.3.2 Display Maintenance Settings

Allows for the unit to be reset to factory defaults by clearing all new settings.

Figure 113: Integrated Display Display Maintenance Settings

7.3.2.1 Touchscreen Calibration

Opens a touch position calibration screen. This will calibrate the screen input by displaying a series of touch screen targets and matching the input values with the known location of the targets.

7.3.2.2 Password Reset

This option allows resetting all passwords to factory defaults. The procedure described below must be followed to successfully accomplish this task. Please note that if successful, the electronic seal will be broken and the action logged; if the unit is under Weights and Measures control, it will need inspected and sealed again.

1. Order a USB adapter cable from Guidant; this cable connects to CN3 and presents a standard type A USB connector.

2. Prepare a USB flash drive by creating an empty file named “password-reset.txt” on the root directory (folder).
3. Ensure the area contains no flammable gases and break the physical seal on the display enclosure. Open the housing and plug the adapter cable into CN3. Plug the USB flash drive into the other end of the cable.
4. Select the password reset on the Maintenance Menu and follow the instructions.
5. Once the passwords have been reset, remove the flash drive and cable.

7.3.3 Display Information

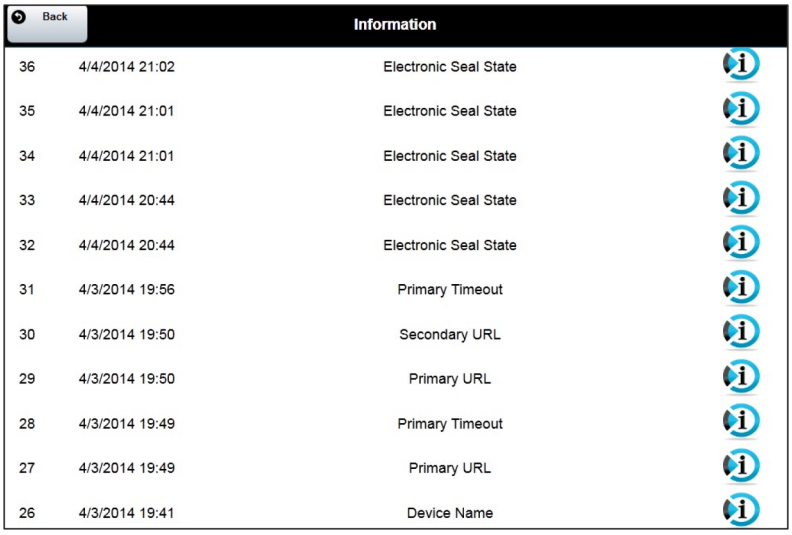
The information screen displays key data about the integrated display.

- Software Version: Software version running on the display
- Browser Signature: Checksum value to be noted after the unit has been sealed
- Parameter Seal: Indicates if the display has been sealed—A lock icon for sealed and an unlock icon for unsealed
- Welmec Log: A log of all changes to parameters than could be relevant to a Weights and Measures official

The entry layout is as follows:

Log Entry Number	Timestamp	Entry Type	Description of Change

Figure 114: Display Information



7.3.4 Display Reconnect

The Reconnect button initiates an attempt to connect to configured devices using the same sequence used during power up.

If the connection attempts are unsuccessful the remote display will return to the main menu.

7.3.5 Weights and Measures Sealing Procedures

The display may be sealed for Weights and Measures purposes; this guarantees the display may only connect to the devices configured and cannot be redirected using the touch screen. There are two seals that must be applied:

1. Electronic seal: This seal may only be activated using a level 5 password. When this seal is active, no legally relevant parameters may be changed; the seal must be deactivated before changes may be made. Note that the display seal is distinct and different than the ultrasonic meter UMCB electronic seal; both must be sealed.

2. Physical seal: This is the wire and seal crimped on to the enclosure such that it is impossible to open the enclosure without destroying the seal.

The following procedure must be used to seal the unit (in addition to the procedure to seal the UMCB) using either the UMCB serial number or the primary URL connection method.

7.3.5.1 UMCB Serial Number Connection Method

1. Ensure that only the UMCB and display are connected together and that no other Ethernet devices are active. If the UMCB and display are in the same enclosure, ensure the display is the only device connected to the Ethernet ports on the UMCB.

   > NOTE: This also applies to a remote display connected to a UMCB directly with no other network connections.

2. Configure the display.

Figure 115: Display Menu

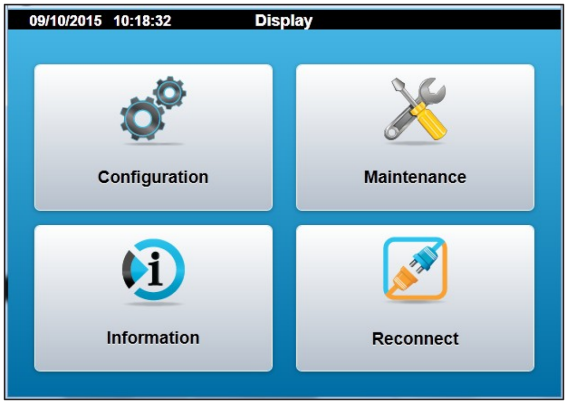


Figure 116: Display Login

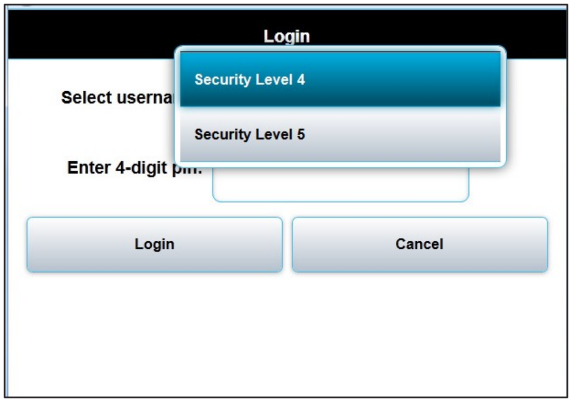
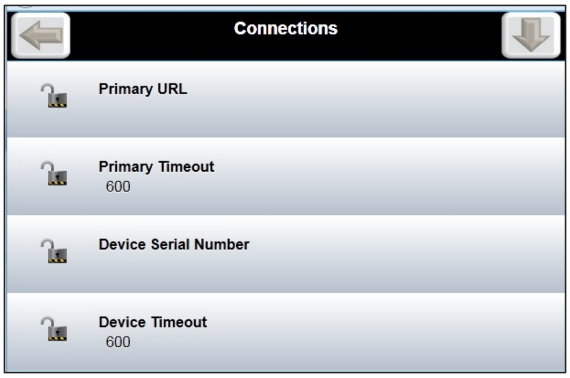


Figure 117: Display Connections



3. • Select Configuration.
   • Select Security Level 5.
      • Enter 4-digit pin [default is 5555].

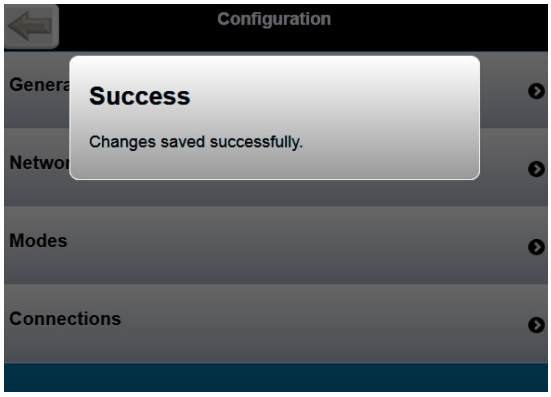
Figure 118: Device Serial Number

- Select the blue find button.
- The display will find the UMCB unique identifier serial number.
- Press the return key (upper left-hand corner).

- The serial number is shown in the display dialog box. Write this number down for future reference.
- Press the green accept button.

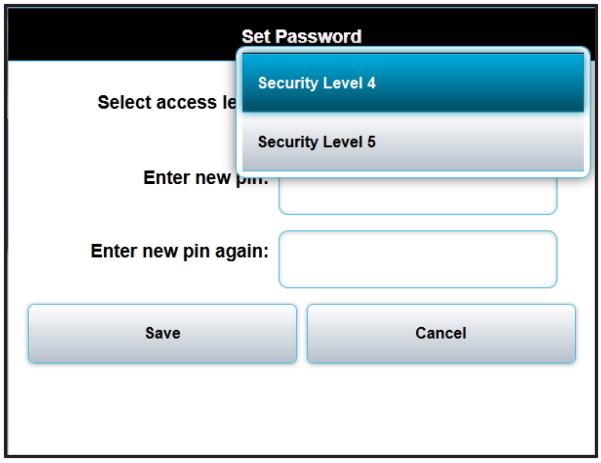
- Select Primary URL.
  - Ensure no data is entered in the dialog box (disables search).
  - Press green accept button.
- Select Primary Timeout.
  - Ensure 0 is entered in the dialog box (disables time to search).
  - Press green accept button.
- Select Secondary URL.
  - Ensure no data is entered in the dialog box (disables search).
  - Press green accept button.
- Press down arrow in upper right hand corner.
- Select Secondary Timeout.
  - Ensure 0 is entered in the dialog box (disables time to search).
  - Press Save.
- Select the back button in the upper left hand corner of the display.
- SUCCESS message is displayed. Touch the display anywhere to acknowledge the success message.

Figure 119: Success Window



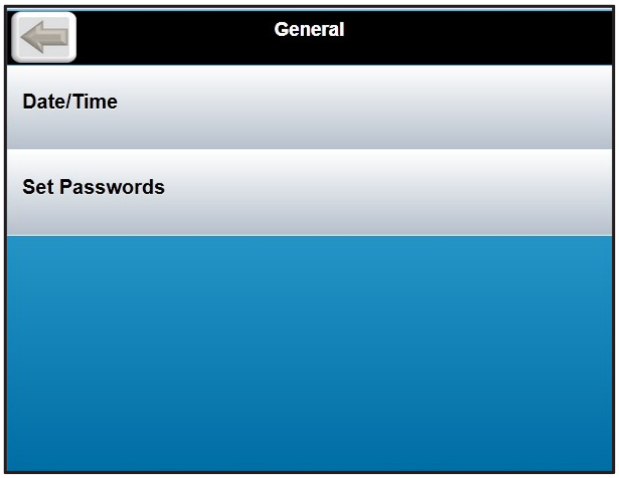
4. Change the display passwords.

Figure 120: Change Display Passwords



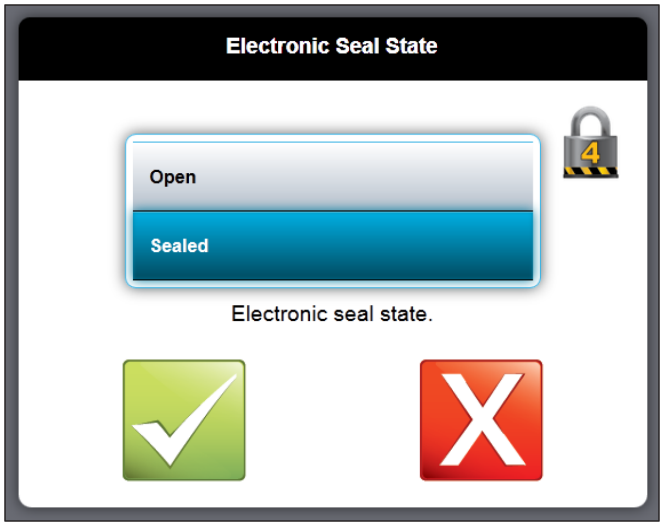
- Select General.
  - Select Set Passwords.
  - Select Security Level 5.
  - Put in new security code.
  - Select Save.
  - SUCCESS message is displayed. Touch the display anywhere to acknowledge the success message.
  - Press Cancel to return to the previous screen.
  - Select the back button in the upper left-hand corner of the display.

5. Change the display electronic seal state parameter to “Sealed”.



- Select Configuration.
  - Select Security Level 5 and sign in.
  - Select Modes.

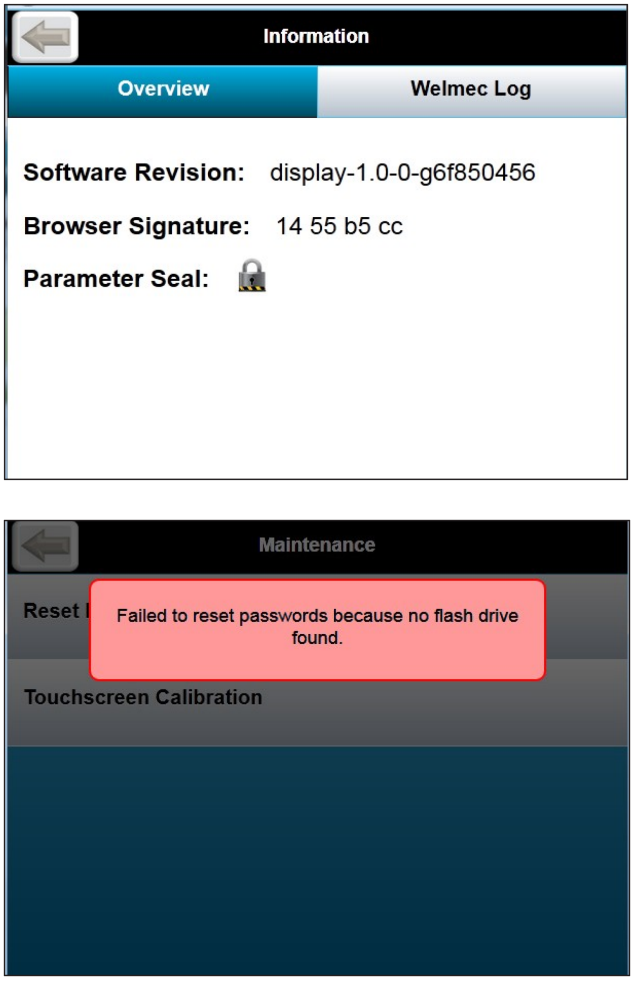
Figure 121: Electronic Seal State



  - Select Electronic Seal State.
  - Select the drop down.
  - Select Sealed.
  - Press green accept button.

6. Verify software seal.

Figure 122: Verify Software Seal



- Select Information.
  - Verify that the Parameter Seal shows a closed lock.
  - Select the back button in the upper left hand corner of the display.
- Select Maintenance.
  - Select reset passwords.
    - Press green accept button.
  - Verify that an error message is displayed, “Failed to reset passwords because no flash drive found.” Touch the display anywhere to

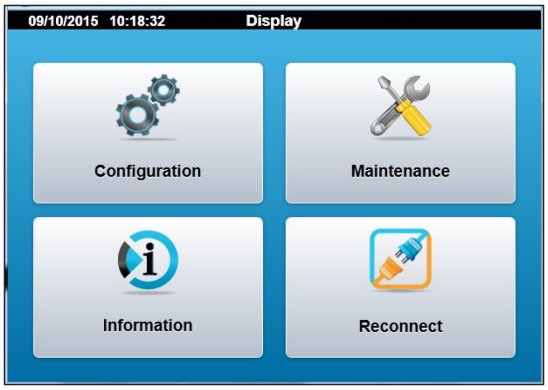
acknowledge the message.

- Select the back button in the upper left-hand corner of the display.

7. Finding the meter serial number.
    - Select Configuration.
        - Select Security Level 4.
        - Enter 4-digit pin [default is 4444].
        - Press Login.
            - Press Connections.
            - Notice that all options are greyed out and that a lock appears in front of all of the selections.
            - The Device Serial Number is shown under the selection and can be read from this screen. Write down the number for later reference.
            - Press the return key (upper left hand corner).
8. Verify the connection parameters only allow the display to connect with devices that are part of thelegally relevant system.
    - Select Reconnect.
        - Verify that the serial number written down earlier is shown in the upper left hand corner of the meter display overview screen.
        - Note that you can also select the Meter Information screen and the serial number is displayed in the General category of that page.
9. For a remote display, inspect the connections to the display; verify there are NO connections to the display except for power (CN4) and Ethernet (ETH1). Any other connections to the display are not allowed as they compromise security. Bolt the enclosure closed and apply a seal wire such that it must be destroyed to open the enclosure again.

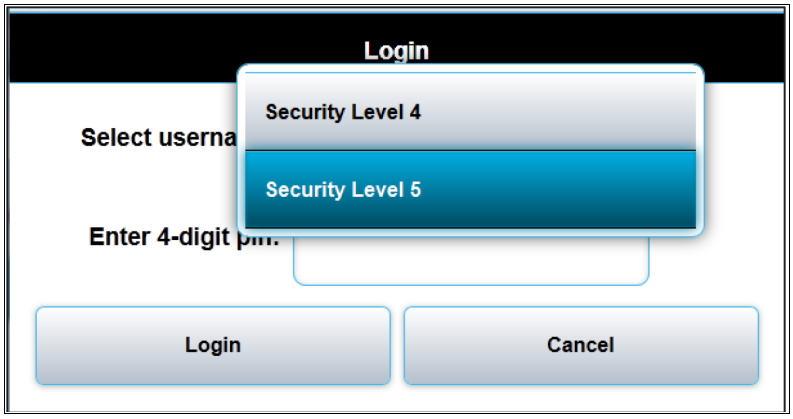
7.3.5.2 Primary URL Connection Method

Figure 123: Primary URL Connections Method Main Menu



1. Ensure that only the UMCB and display are connected together and that no other Ethernet devices are active. If the UMCB and display are in the same enclosure, ensure the display is the only device connected to the Ethernet ports on the UMCB. Note that this process assumes that the URL of the meter has been set and is known.
2. Configure the display.
    - Select Configuration.
        - Select Security Level 5.

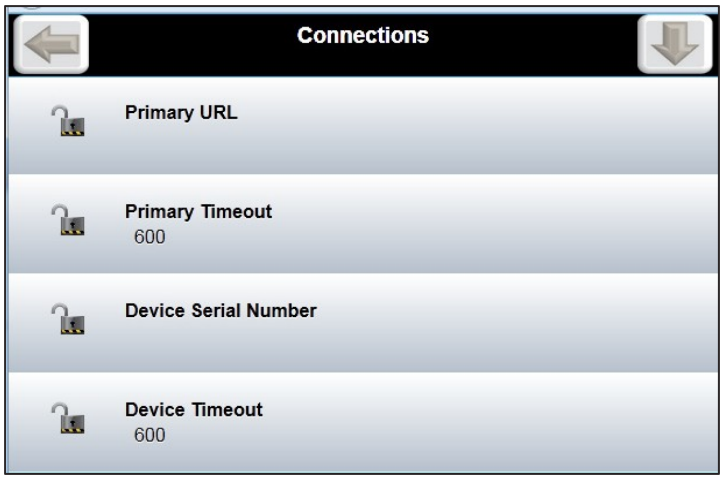
Figure 124: Primary URL Connection Login



- Enter 4-digit pin [default is 5555].
- Press Login.

- Press Connections.
- Select Primary URL.

Figure 125: Primary URL Connections



- Select the dialog box.
- Enter the Primary URL (address of the meter assigned during meter setup) using the on-screen alphanumeric keyboard EX: http://192.168.181.7.
- Press the checkmark (accept) key.

Figure 126: Primary URL Connection Network Settings

- Ensure that the primary timeout value is set (default is 600). This value, set in seconds, is the maximum amount of time that the display will spend attempting to contact the meter before reverting to the display main menu.
- Select device serial number.
  - Ensure 0 is entered in the dialog box.
  - Press green accept button.
- Select device serial number timeout.
  - Ensure 0 is entered in the dialog box.
  - Press green accept button.

- Select Secondary URL.
  - Press green accept button.
  - Press down arrow in upper right hand corner.
- Press down arrow in right-hand corner.
- Select Secondary Timeout.
  - Ensure 0 is entered in the dialog box.
  - Press green accept button.
- Press down arrow in upper right-hand corner.
- Select secondary timeout.
  - Ensure 0 is entered in the dialog box.
  - Press green accept button.
- Select the back button in the upper left-hand corner of the display.

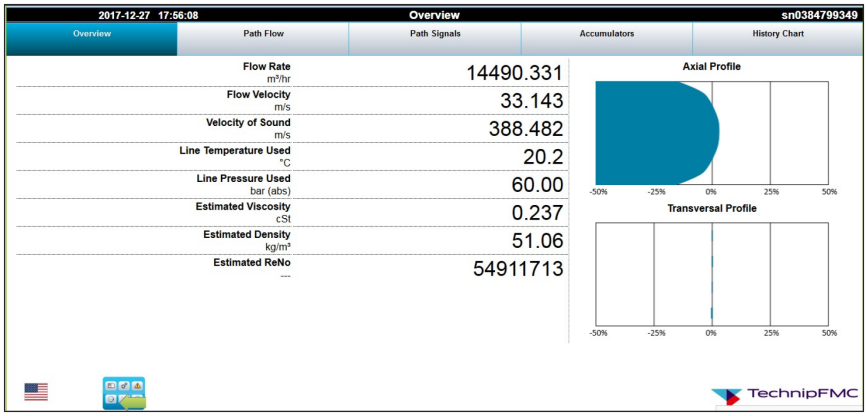
- SUCCESS message is displayed. Touch the display anywhere to acknowledge the success message.

3. Change the display passwords.
4. Change the display electronic seal state parameter to “Sealed”.
   - Select Information.
     - Verify that the Parameter Seal shows a closed lock.
     - Select the back button in the upper left hand corner of the display.
   - Select Maintenance.
     - Select reset passwords.
       - Press green accept button.
     - Verify that an error message is displayed, “Failed to reset passwords because no flash drive found.” Touch the display anywhere to acknowledge the message.

- Select the back button in the upper left hand corner of the display.

5. Verify the connection parameters only allow the display to connect with devices that are part of the Legally Relevant system.

Figure 127: Primary URL Connection Overview



- Select Reconnect.
  - Write down the serial number of the meter that is shown in the upper right hand corner of the display.
- Note that you can also select the Meter Information Screen and the serial number is displayed in the General category of that page.
- For a remotely mounted display, cycle power to the display.
- For a integral local display (where the display is the front panel of the meters electronic enclosure), cycle main power.
- When power is restored the display will automatically connect to the meter.
- Verify that the meter serial number written down previously is the same number as is now shown (after the power cycle) in the upper right hand corner of the display.

6. For a remote display, inspect the connections to the display; verify there are NO connections to the display except for power (CN4) and Ethernet (ETH1). Any other connections to the display are not allowed as they compromise security. Bolt the enclosure closed and apply a seal wire such that it must be destroyed to open the enclosure again. Note that the meter enclosure must also be sealed (software and weights and measure jumper and physical seal wire on bolts) as

shown in the manual.

7.3.6 Display Network Configuration

The ultrasonic meter control board (UMCB) and optional display will be configured with DHCP network settings as a default. In this mode the meter and display will wait to be assigned an IP address from the network server. If the ultrasonic meter is started without a network connection then a fixed IP address may need to be configured to the UMCB during commissioning.

If fixed addresses are to be used, both the ultrasonic board and the display must be assigned addresses. Using the display, configure the ultrasonic address first. Cycle power and force the display into local mode (press the configuration icon when it shows). Configure the display address and also configure the ultrasonic address into the primary URL, for example, format: HTTP://192.168.1.22).

8 Fluid Volume Correction

Fluid correction is used to calculate a volumetric correction factor between volume at flowing conditions to volume at standard reference conditions. This factor is not a meter factor as it is not correcting any measurement anomalies. It is associated only with the fluid properties.

8.1 Inputs

Fluid correction algorithms typically need one or more inputs:

- Temperature
- Pressure
- Density
- Fluid composition
- Other fluid properties, for example, configuration items, not live inputs

The selected algorithm to be used for fluid correction determines the inputs that are required.

8.1.1 Input Routing

Input variables may typically be routed from sources listed below, however, some input routing may have limitations:

- Fallback Value: A fixed value used for the input
  - Programmed in the parameter database
- Analog Input: 4-20 mA
  - Range values must be specified for each 4 and 20 mA
  - Units of measure may be converted. For example, pressure range values may be set up for psi (gauge), and the units of measure converted to that

required by the algorithm (bar absolute)

- Error Selection: Hold last or use fallback value. This behavior typically activates when an analog input exceeds range.

- Analog RTD Input
  - Automatically ranged
  - Error selection—hold last or use fallback value—this behavior typically activates when an analog input exceeds range
- Modbus Input (see the Smith Meter MPU 200c, 600c, 800c, and 1600c External Communications manual (MN0A003) for Modbus addresses and number formats):
  - A floating-point input value written to the ultrasonic meter by an external host.
  - Error selection: Hold last or use fallback value. This behavior typically activates when the host does not write a value to the ultrasonic meter for a time. There is a short timeout and a long one; the actual times may be different for different input variables. See below for recommended update rates.
    - Short timeout
      - Hold last: An algorithm alarm is issued but the calculations continue using the last value written
      - Fallback: An algorithm alarm is issued but the calculations continue using the programmed fallback value
    - Long timeout
      - An algorithm alarm is issued and calculations stop. Correction factor is forced to 1.000.
  - Units of measure may be converted except for mole fractions, which are always percentage.
  - Recommended update rates from the host are below. Updating more frequently risks overloading the meter CPU causing delayed responses in

other Modbus queries and user display; updating less frequently risks the meter issuing an alarm if more than one update in a row fails to write for some reason:

- Temperature, Pressure, Live Density: Recommended update rate is between 10 and 25 second interval. The short timeout occurs at 60 seconds and the long at 10 minutes.
- Reference Density, Gas composition: Recommended update rate is between two and four minute interval. The short timeout occurs at 10 minutes, and the long at 60 minutes. If new data is not available at four minute interval, the same values may be rewritten, thus preventing an alarm from being issued.

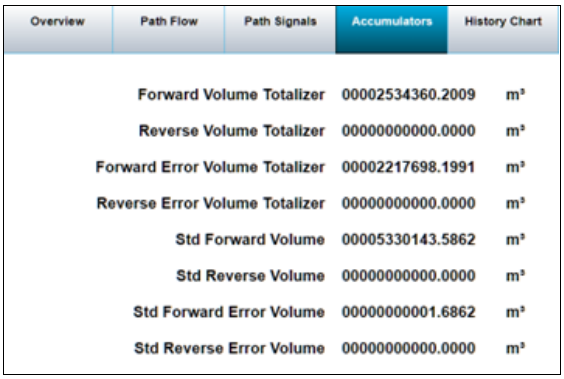
8.2 Outputs

Fluid correction outputs include:

- Fluid correction alarm: Set if calculation cannot be completed due to various reasons, including inputs that are not valid
- Correction factor
- Standard volumetric flow rate: May be assigned to the analog output
- Standard volume totalizers: May be assigned to the pulse output
- Additional outputs specific to the selected algorithm

There may be circumstances when the selected algorithm cannot compute outputs; if this should occur, the algorithm outputs are set to “not a number” (a floating point number status), as well as any other variables that are derived from them, and an algorithm alarm is issued. On the user interface web pages, "not a number" values are displayed as "--".

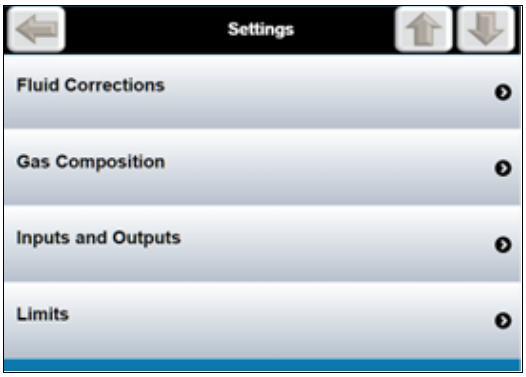
Standard volume totalizers are shown on the Overview/Accumulators page and are available via Modbus. See Smith Meter Ultra 4c, 6c, 8c, and MPU 200c, 600c, 800c, and 1600c External Data Communications Manual (MN0A003).



8.3 Configuration

Configuration consists of selecting an algorithm, assigning inputs from various sources, and assigning output functions. Below are examples for setting up fluid correction settings. The selections below are in the Settings/Fluid Corrections menu:

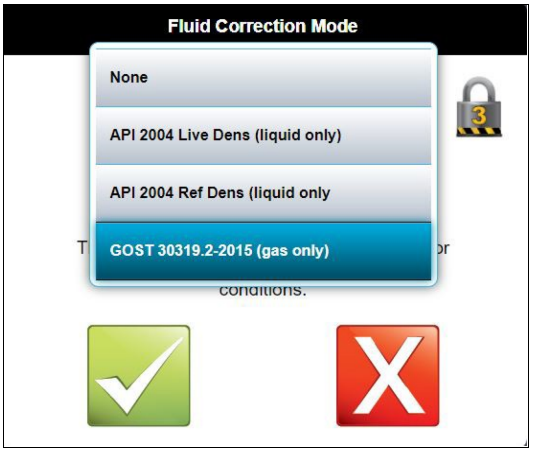
Figure 128: Configuration Settings



8.3.1 Algorithm Selection Fluid Correction Mode

If None is selected, no algorithm is run and the output correction factor is always 1.000.

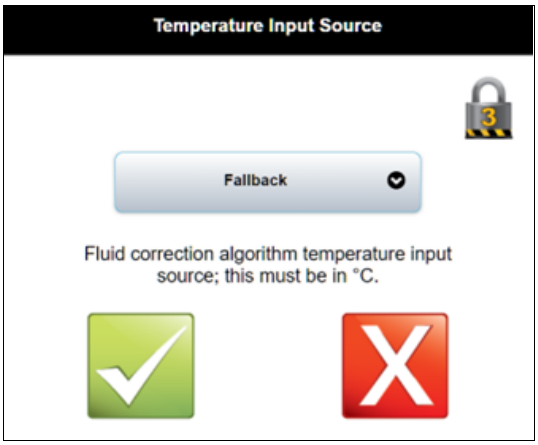
Figure 129: Fluid Correction Mode



8.3.2 Input Configuration

Below is shown an example for setting up a temperature input for fluid correction; select the temperature input source:

Figure 130: Temperature Input Source



> NOTE: The temperature input may be in other units of measure than °C as you can specify the units of measure.

Temperature input source selections are as follows:

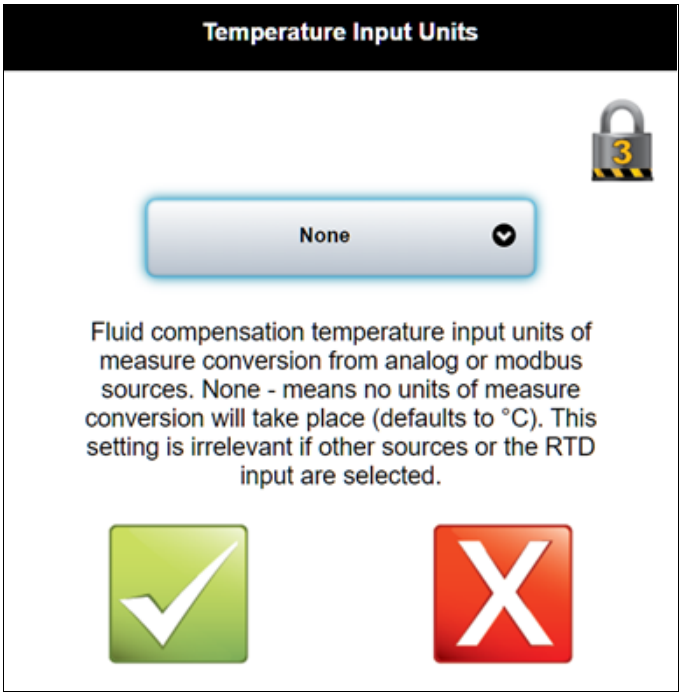
- None
- Fallback
- 4-20mA Input #1 (fallback mode)

- 4-20mA Input #1 (hold mode)
- 4-20mA Input #2 (fallback mode)
- 4-20mA Input #2 (hold mode)
- RTD Input (fallback mode)
- RTD Input (hold mode)
- Modbus (fallback mode)
- Modbus (hold mode)

When selecting an analog input, the input scaling must be set up correctly. See section 6: Web User Interface on page 54

Input units of measure may be specified for many of the input types:

Figure 131: Temperature Input Units



In this example, the algorithm requires °C input; if the analog input for temperature is scaled for degrees F or some other scaling, you must tell the algorithm the actual units of measure of the input so it may do an appropriate conversion:

Temperature input units of measure selections include:

- None

> NOTE: This selection assumes the default; in this case, °C.

- K
- °C
- °F
- °R

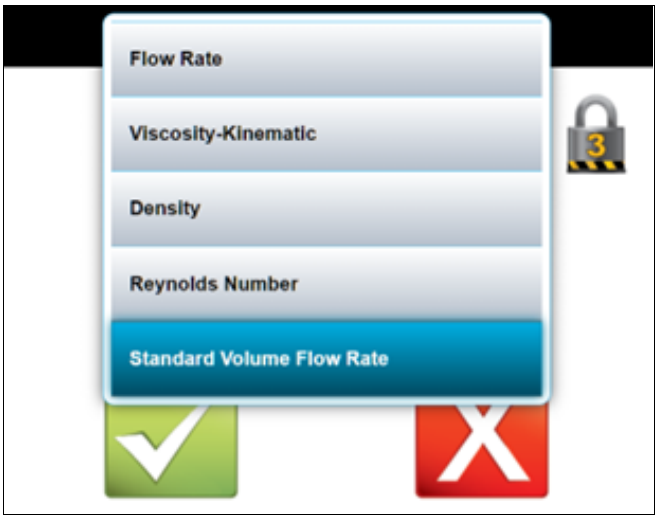
8.3.3 Output Configuration

There are two outputs that may be configured based on the result of the fluid correction algorithm.

8.3.3.1 Analog Output, Corrected Flow Rate

From the Settings/Inputs and Outputs/An Out Function, select Standard Volume Flow Rate if desired:

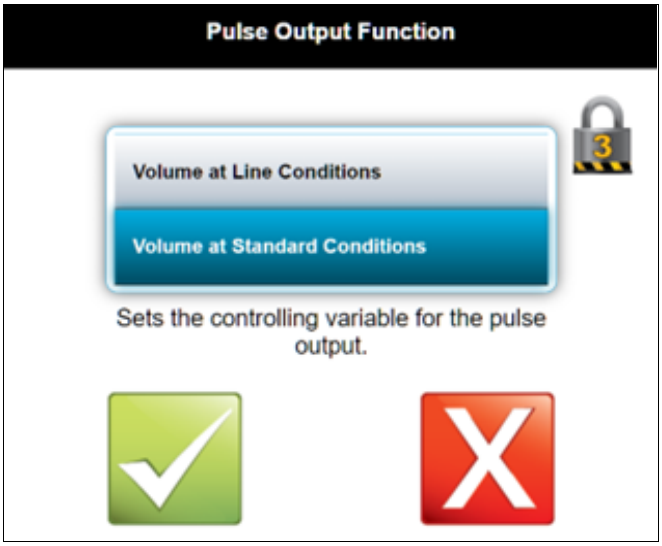
Figure 132: Analog Output Corrected Flow Rate



8.3.3.2 Pulse Output, Corrected Volume

From the Settings/Inputs and Outputs/Pulse Output Function, select Volume at Standard Conditions if desired:

Figure 133: Pulse Output Function



8.4 GOST Fluid Correction

The GOST standard implemented is based on GOST 30319.2-2015. The heat energy equations use are:

Superior:

H = 92,819 (0,51447ρc + 0,05603 - 0,65689xa - xy)

Inferior:

H = 85,453 (0,52190ρc + 0,04242 - 0,65197xa - xy)

where:

- ρc: density at reference conditions, kg/m^3
- xa: Nitrogen mole fraction
- xy: Carbon dioxide mole fraction

8.4.1 Inputs

When GOST is selected for the algorithm, the following inputs must be configured:

- Temperature

- Pressure
- Density at Reference Conditions
  - Settings / Fluid Corrections / Reference Density Input Source
  - Settings / Fluid Corrections / Reference Density (fallback)
- Fluid Composition
  - Elements
    - Nitrogen
    - Carbon dioxide
  - Sources limited to:
    - Fallback
    - Modbus
  - Configuration
    - Settings / Gas Composition / Gas Composition Input Source
    - Settings / Gas Composition / Nitrogen Mole Fraction (fallback)
    - Settings / Gas Composition / Carbon Dioxide Mole Fraction (fallback)

If any GOST input range limit exceeds those specified in the GOST 30319.2-2015 specification, the Fluid Correction Alarm is set and the correction factor is set to 1.0.

8.4.2 Outputs

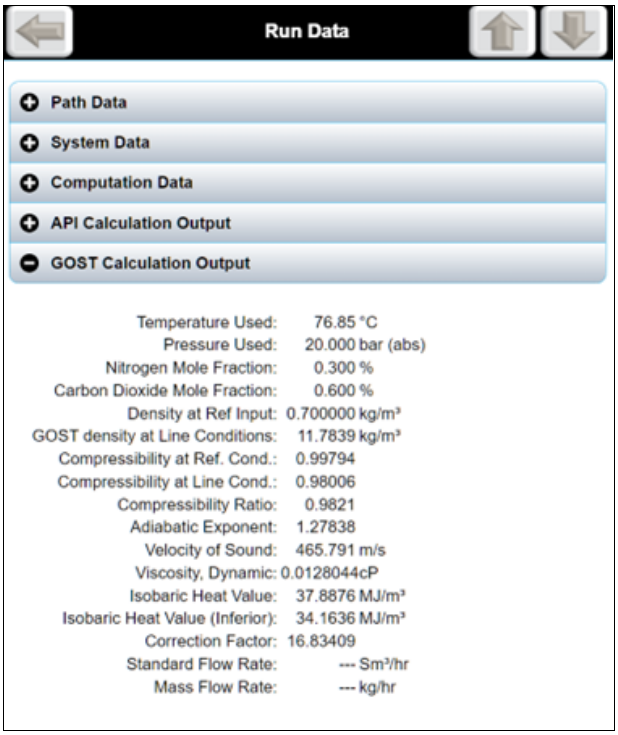
In addition to the standard fluid correction outputs above, GOST also outputs the following:

- Density at line conditions
- Compressibility at reference conditions
- Compressibility at line conditions
- Compressibility ratio

- Adiabatic exponent
- Velocity of sound
- Dynamic viscosity
- Isobaric heat value (superior)
- Isobaric heat value (inferior)
- Mass flow rate

These values may be acquired via Modbus. See Smith Meter Ultra 4c, 6c, 8c, and MPU 200c, 600c, 800c, and 1600c External Data Communications Manual (MN0A003). They may also be viewed on the user interface. Navigate to Run Data and open the GOST Calculation Output bar:

Figure 134: Run Data



8.5 ISO 20765-2 (AGA8-2) Fluid Correction

These calculations are based on GERG 2008 and are compliant with ISO 20765-2:2018 and AGA8-2. Inputs and outputs are specified below.

ISO 20765-2 Section 6.3 specifies ranges of application; these ranges are based on input ranges and gas composition ranges. This implementation calculates outputs over the full range and computes the application range the inputs fall into (either Pipeline Quality, Intermediate Quality, Full Range, or Out of Range). The computed application range does not affect the computed outputs, but is available for end users. The Pipeline Quality Range is the narrowest and typically represents algorithm output that is well documented with test data. At the other end of the spectrum is the wide Full Range, which typically has less supporting test data. In general, Pipeline Quality Range has less algorithm output errors. See ISO 20765-2 Sections 6.3 and 7 for more information on algorithm uncertainty.

Gas compositions may have trace components that are not specified as inputs by the algorithm. ISO 20765-2 Annex F may provide information where to assign trace components.

Gas component fractions must add up to 100%. The implemented algorithm allows a wide leeway for summation errors to avoid shutting down a calculation that may still be useful; it is the responsibility of the user/integrator to ensure the sum is as close to 100% as possible for the best accuracy of the algorithm. Sums grossly different than 100% will shut down the calculation and assert an error.

The algorithm is not a straightforward calculation—it is an iterative calculation that requires repeating a calculation set until the computed molar density is within an acceptable tolerance. However, as the Ultrasonic meter has limited computational power, it cannot allow the calculation to repeat too many times or it will affect metering performance. If this happens, the algorithm sets an error and indicates a failure to converge. This is not expected to happen often for normal pipeline conditions.

ISO 20765-2 does not inherently compute a volume correction factor. The implementation in the Ultrasonic meter achieves this by running the algorithm twice, once at reference conditions (temperature and pressure) and once at line conditions for a given mixture. It then uses the computed line and reference

densities to compute a volumetric correction factor. If either calculation fails for some reason, a volume correction cannot be computed and an error is issued.

8.5.1 Inputs

When ISO 20765-2 (AGA8-2) is selected for the algorithm, the following inputs must be configured:

- Temperature (line)
  - From selected source
- Pressure (line)
  - From selected source
- Temperature (reference)
  - Program parameter only
- Pressure (reference)
  - Program parameter only
- Fluid Composition
  - Elements
    - Nitrogen
    - Carbon dioxide
    - Methane (C1)
    - Ethane (C2)
    - Propane (C3)
    - Butane (C4)
    - Isobutane (C4i)
    - Pentane (C5)
    - Isopentane (C5i)
    - Hexane (C6)
    - Heptane (C7)
    - Octane (C8)
    - Nonane (C9)
    - Decane (C10)
    - Hydrogen
    - Oxygen
    - Carbon monoxide
    - Water
    - Hydrogen sulfide
    - Helium
    - Argon

- Sources limited to:
  - Fallback
  - Modbus
- Configuration
  - Settings/gas composition/gas composition input source
  - Settings/gas composition/fallback values for the components (see element list above)

8.5.2 Outputs

In addition to the standard fluid correction outputs above, the ISO 20765-2 algorithm also outputs the following data:

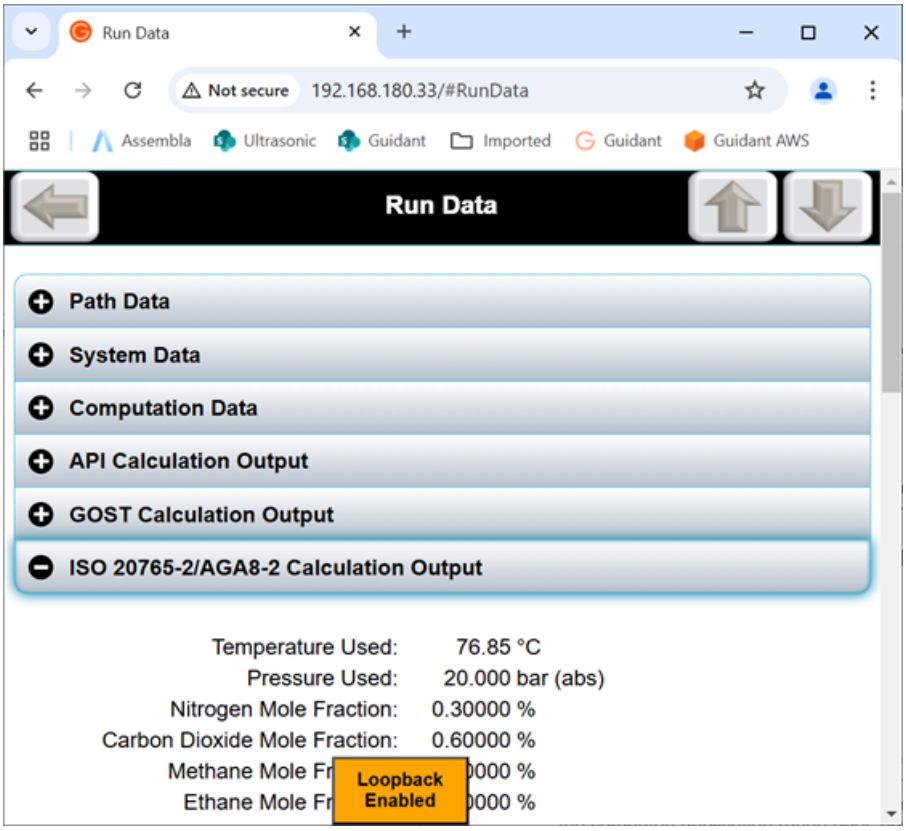
- Molar density
- Molar mass
- Range classification (described above)
  - Numeric values, from widest range to narrowest:
    - 0: Out of range
    - 1: Full range
    - 2: Intermediate range
    - 3: Pipeline quality range
- Compressibility (reference)
- Compressibility (line)
- Velocity of sound
- Velocity of sound deviation
  - Algorithm output vs. measured
- Density (reference)
- Density (line)
- Mass flow rate

The algorithm sets the ISO 20765-2 result code (which is different than the fluid calc result code):

- 0: Calculation ok
- 1: Calculation failed to converge
- 99: ISO 20765-2 (AGA8-2) is not enabled
- 102: Temperature is out of range
- 103: Pressure is out of range
- 105: One or more component fractions are out of range
- 501: Internal calculation mode error, should never happen; report to Guidant
- 502: Internal calculation mode error, should never happen; report to Guidant

- 999: One or more algorithm inputs is bad (not a usable measurement)
- 10001: The calculation proceeded, but one or more inputs is uncertain (might be stale or a fallback value)

The algorithm outputs may be acquired via Modbus. See the Smith Meter Ultra 4c, 6c, 8c, and MPU 200c, 600c, 800c, and 1600c External Data Communications Manual (MN0A003). They may also be viewed on the user interface. Navigate to Run Data and open the ISO 20765-2/AGA8-2 Calculation Output bar.



NOTE: Some variables shown here when the ISO 20765-2 algorithm is not selected do not represent ISO 20765-2 outputs, but the algorithm that is selected as they are common to all fluid correction algorithms.

9 Language Selection

English, Polish, or Russian is selectable through the overview screen.

Reference section 6.1.1: Language Selection on page 55 to access the Settings Menu.

10 Maintenance

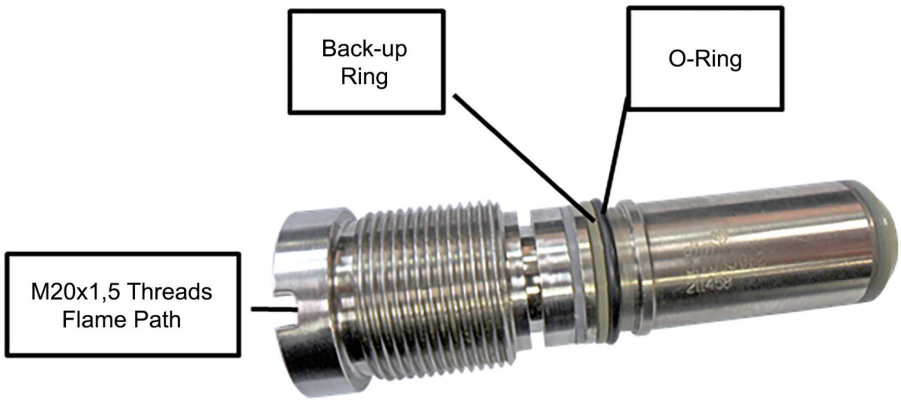
The Maintenance section is to give the user applicable information regarding maintenance of the MPU to maintain the warranty requirements arranged. In addition, to ensure that the user can perform safe and timely replacement and repair of their equipment.

10.1 External Inspection Every Two Years

- Ensure that there is no mechanical damage to the spool piece, transducer covers, or electronics enclosure leading to malfunction, leakage, or corrosion.
- Ensure that there is no damage to the transducer cables or the external cables with cable glands.

10.2 Replacement of O-Ring and Back-Up Ring

Figure 135: Transducer O-Ring Replacement



O-rings facing the natural gas are made of Fluoroelastomers (FKM). The O-ring manufacturers do not specify any exact lifetime of the O-rings, but during normal operation (continuously pressurized and untouched) the O-rings will last for several years. However, to be on the safe side it is strongly advised to:

- Change all O-rings and backup-rings during revision stops.
- Change all O-rings and backup-rings if the meter has been depressurized for an extended period of time.
- Change O-rings and backup-rings during transducer exchange.
- Change all O-rings and backup-rings when meter is removed from service for recalibration.

O-rings of material Nitrile, nitrile butadiene rubber (NBR), and FKM can be stored for 10 to 15 years without reduction of quality. This depends on storage in air tight plastic bags in an environment of low humidity and not subjected to sunlight. The ambient temperature must be between +5 °C and +20/25 °C.

10.3 Troubleshooting and Replacement of Parts

WARNING: Troubleshooting and replacement outside of what is described in this manual require special skills.

Any replacement of parts must only be performed by personnel with the required knowledge.

Maintenance courses from the manufacturer are available, held at supplier's or customer's location. Required documentation and manuals are a part of the course.

Supplier's service department is available for call-outs on short notice, but it is recommended to sign a service agreement with the supplier, ensuring the necessary support at all times.

Remote troubleshooting via modem is possible if the system is prepared for this. It will be specially integrated for each customer.

10.4 Replacement of Transducers

Replacement of Transducers is described in the MPU Transducer Replacement Procedure Using Transducer Retraction Tool “MPU Transducer Replacement Procedure Series B” without pressure and “MPU Transducer Replacement Procedure Using Transducer Retraction Tool” under pressure.

An external pressure connection is required for pressure balancing during operation of the transducer retraction tool. A pressure balance hose according to part number 870027043 is required. On site, a pressure tap with valve is required, in maximum distance of seven meters (m) from each the ultrasonic meters.

10.4.1 Warning Examples

WARNING: Ensure meter is not under pressure.

Ensure meter power is removed and the area is safe.

Replacement of transducers and board may require recertification and calibration by local authorities having jurisdiction.

10.5 Replacement of Electronic Boards

WARNING: The meter must be powered off while the electronics enclosure is open in a hazardous atmosphere. The meter must also be powered off if any electronic boards are being replaced.

Removal of the UMCB board or handling the board outside of the enclosure should only be performed while following ESD-safe procedures. Electronic assemblies should be immediately placed into anti-static bags upon removal and sealed. A grounded wrist strap, such as 3M #2209, should be worn anytime the boards are handled.

10.5.1 UMCB Board Replacement

To replace the UMCB board, perform these steps:

1. Save the meter database.
2. Remove power from the device.
3. Open the electronics box.
4. Disconnect and remove all connectors from CN1, CN2, CN3, CN4, CN5, CN6, ETH1 or ETH2 or ETH3.
5. Remove the transducer cable connectors 1 through 8 for the MPU 1600c and 1 through 4 for the MPU 800c with the included torque wrench from tool kit.
6. Remove the four screws on the UMCB board with a screwdriver and gently pull the UCMB board out of the electronics box.
7. Repeat this procedure in reverse order to install a new UMCB board.

10.5.2 After replacement of the UMCB board, the following actions must be performed:

1. Configure UMCB board with correct network IP address.
2. Load current firmware.
3. Load meter with saved meter database file. (If unavailable, meter must be re-programmed manually.)

10.6 Replacement of Clock Battery

The recommended clock battery replacement interval is five years when meter is in service.

The RTC is used for time stamping of log entries which is incidental information. Each log entry also has a sequence number that can be used to uniquely identify each entry. The sequence number is not affected by the clock operation. The life of the RTC battery can vary due to operational conditions, particularly the amount of

time that the unit is left in a powered off state. It is suggested the RTC battery be replaced approximately every five years or during a regularly scheduled maintenance period if the meter has been in service with power applied. If the meter has been powered down for an extended period, it is recommended to replace the battery prior to placing back into service.

> NOTE: For applications that are under strict metrological control it may be convenient to replace the battery whenever a weights and measures official is on site since the cover seal will need to be broken and must then be reapplied.

To facilitate replacement of the battery, the UMCB assembly must be removed from the Ex enclosure to gain access to the rear side of the board assembly to replace the battery.

10.6.1 Battery Replacement Procedure

1. Power down the ultrasonic meter and ensure the hazardous area is safe.
2. Remove the weights and measures seal wire on the appropriate cover bolt.
3. Remove the front cover bolts and open the front cover.
4. It may be necessary to unplug all pluggable connectors that would restrict the removal of the UMCB assembly from the enclosure to gain access to the rear-mounted battery. These include CN1, CN2, CN3, CN4, CN5, CN6, ETH1 or ETH2 or ETH3. Ensure that any cable is marked for correct replacement position. The transducer cables have enough length to allow removal without disconnecting them.
5. Remove the four mounting screws from the UMCB.
6. Remove the old battery and replace battery with Energizer CR2032 (substitutes not allowed), part number 644581418.
7. Place the UMCB assembly back into enclosure and secure with the four mounting screws.
8. Restore any removed cabling to the same position that it was removed from.

9. Close the front cover and ensure that no internal cables are pinched in the cover closure.
10. Follow cover bolt re-torquing instructions and flame path gap inspection.
11. Power-up the meter and set the RTC.
12. Re-seal the unit via the cover seal bolts. This may require local weights and measures jurisdiction.

Figure 136: Battery Type CR 2032 3V

WARNING: Breaking the physical seals and changing the hardware lock from closed to open should only be done when approved by the authorities having jurisdiction.

10.7 Storage and Preservation of the MPU and Spare Parts

10.7.1 Short Term Storage: Up to One Month

- Depending on where the meter is stored, indoors or outdoors, precautions should be taken to preserve the meter during storage. Even for outdoor storage of less than a day, precautions are required.
- When the meter is delivered, it is guarded by protection covers. Inspect them for damage, and keep them on during storage.

- For outdoor storage, protect the flanges and inner pipe with Cortech or a similar corrosion inhibitor to prevent degradation of the spool (unless the spool is made of non-corrosive material). For indoor storage at room temperature and low humidity, this is not necessary. Ensure that the transducer fronts and O-rings inside the spool piece are not subjected to any solvents. This may lead to component damage.
- Mount protection covers on the flanges to prevent mechanical damage.
- Store the meter in such a way that it is not subject to inadvertent damage caused by the handling of other equipment.
- If outdoor storage is necessary, plug all cable glands and check that the electronics enclosure is properly closed. This is very important to prevent water ingress.

10.7.2 Long Term Storage: More than One Month

Precautions must always be taken to preserve the meter during storage. The preservations must be checked every three months. Precautions are the same as for short term storage with the following additions:

- Flanges and inner pipe must be protected with Cortech corrosion inhibitor or similar to prevent degradation of the spool (unless the spool is made of non-corrosive material).
- Ensure that the transducer fronts and O-rings inside the spool piece are not subjected to any solvents. This may lead to damage.

> NOTE: If the meter has been subject to long term storage, all O-rings and backup rings must be checked and replaced if necessary.

10.8 Preservation

For preservation of the meter, the following is required:

- Cortech or a similar corrosion inhibitor to prevent degradation of the spool.
- Covers for the flanges to protect against mechanical damage.

- Necessary supports and extra covers to secure against damage caused by handling of other equipment.

10.9 Returned Goods Policy

A Return Material Authorization (RMA) number must be obtained prior to returning any equipment to Guidant for any reason. An RMA number can be obtained by contacting Section 1: Address and Contact Information on page 1.

To conform with the Occupational Safety and Health Administration (OSHA) Right to Know Act and provide a safe working environment for our employees, the following requirements have been made for any returned material:

1. All equipment must be completely cleaned and decontaminated. Incomplete cleaning of the returned equipment may result in having the equipment cleaned or returned at the owner's expense.
2. A Material Safety Data Sheet (MSDS) is required for all process fluids and fluids used for cleaning that have come in contact with the equipment.
3. The RMA number must be clearly marked on the outside of the shipping container. A document packet containing copies of the RMA and MSDS forms for all process fluids and cleaning fluids must also be attached to the outside of the shipping container.

Returned equipment that does not conform to these requirements may not be processed.

11 Related Publications

The following documents are available online at KB.GuidantMeasurement.com. Printed copies can be requested from Guidant Literature Fulfillment at MeasurementFulfillment@GuidantMeasurement.com. When requesting literature, please reference the appropriate title and document number.

11.1 Manuals

- UItra 4c, 6c, and 8c, and MPU 200c, 600c, 800c, and 1600c External Data Communications Manual (MN0A003)
- UItra 4c, 6c, and 8c, and MPU 200c, 600c, 800c, and 1600c External Data Communications Manual in Portuguese (MN0A003GS)
- Ultra Series C and MPU Series C System On Module Replacement Manual (MN0A005)
- MPU Series C Installation, Operation, and Maintenance Manual in French (MNKS025FR)

11.2 Specifications

- MPU 1600c Specifications (SSKS009)
- MPU 800c Specifications (SSKS008)
- MPU 600c Specifications (SSKS007)
- MPU 200c Specifications (SSKS006)

Appendix A: Description of Legally Relevant Parameters

A.1 MPU Series Meter Database Parameters

Menu Path	Parameter Name	Security Level	Range	Nominal	Description
General Menu					
General: Account Administration	Set Passwords	Set at user level	Limited to four-digit alpha numeric entry	User Defined	Allows user to set passwords for the various security levels 1 through 5

Menu Path	Parameter Name	Security Level	Range	Nominal	Description
Date/Time Menu					
General: Date/Time	Date /Time	3	Current Time and Date	User Defined	Allows user to set time NOTE: Universal Coordinated Time (UTC)

Menu Path	Parameter Name	Security Level	Range	Nominal	Description
Units of Measurement Menu					
General: Units of Measurement	dZ/Dt	3	K-1 °C-1 °F-1	User Defined	Set unit of dZ/dT used for fluid correction
General: Units of Measurement	Length	3	mm in	User Defined	Sets length units to be used
General: Units of Measurement	Temperature	3	°C °F	User Defined	Sets temperature units to be used

Menu Path	Parameter Name	Security Level	Range	Nominal	Description
General: Units of Measurement	Pressure	3	bar (abs) MPa (abs) lbf/in^2 (abs) psi (abs) psi (abs) bar (gauge) MPa (gauge) lbsf/in^2 (gauge) psi (gauge)	User Defined	Sets pressure units to be used
General: Units of Measurement	Velocity	3	m/s ft/s	User Defined	Sets velocity units to be used
General: Units of Measurement	Flow Rate	3	m^3/hr Mm3/hr ft^3/hr gal/min Mbbl/day	User Defined	Sets flow rate units to be used
General: Units of Measurement	Volume	3	m^3 Mm^3 ft^3 bbl gal Mbbl/day	User Defined	Sets volume units to be used
General: Units of Measurement	Standard Flow Rate	3	Sm^3/hr SMm^3/day Sft^3/hr	User Defined	Sets standard flow rate units to be used
General: Units of Measurement	Standard Volume	3	Sm^3 SMm^3 Sft^3	User Defined	Sets standard volume units to be used
General: Units of Measurement	Pulse Factor	3	p/m^3 p/Mm^3 p/ft^2 p/bbl p/gal p/Mbbl	User Defined	Sets pulse factor units to be used
General: Units of Measurement	Density	3	kg/m^3 g/cm^3 lb/ft^2	User Defined	Sets density units to be used
General: Units of Measurement	Viscosity-Kinematic	3	cm^2/s cSt	User Defined	Sets kinematic viscosity units to be used
General: Units of Measurement	Viscosity-Dynamic	3	cP Pa-s	User Defined	Sets dynamic viscosity units to be used

Menu Path	Parameter Name	Security Level	Range	Nominal	Description
Network Settings Menu					
Network Settings	Address Mode	3	DHCP Fixed	User Defined	Ethernet mode: DHCP acquired address or static address
Network Settings	IP Address	3	IPv4	User Defined	Static ethernet IP address, first octet
Network Settings	IP Netmask	3	IPv4	User Defined	Static ethernet IP subnet mask, first octet
Network Settings	Network	3	IPv4	User Defined	Static ethernet network, first octet
Network Settings	Gateway	3	IPv4	User Defined	Static ethernet gateway address, first octet

Menu Path	Parameter Name	Security Level	Range	Nominal	Description
Communications					
Communications	Serial Port Function	3	None Modbus RTU Modbus ASCII	Modbus RTU	Selects the serial port protocol
Communications	Baud Rate Selection	3	1200 2400 4800 9600 19200 38400 57600 115200	9600	Select the serial port baud rate
Communications	Parity Selection	3	None Odd Even	None	Select the serial port parity
Communications	Word Length Selection	3	7 bits 8 bits	8 bits	Select the serial port word length
Communications	Stop Bit Selection	3	1 2	1	Select the serial port stop bits
Communications	Modbus Unit ID	3	1 247	User Defined	Modbus device ID (address).
Communications	Modbus Endian	3	Modbus format floats Alternate format floats	Modbus format floats	Modbus endian (word order of transmission for floating point numbers).

Menu Path	Parameter Name	Security Level	Range	Nominal	Description
Communications	Meter Tag	4	Up to 16 characters	(Factory set to electronics serial number)	Unique tag name designated for this meter; used for identification.
Communications	Modbus NaN Substitution Mode	4	No Substitution User Defined	User Defined	Sets Modbus substitution mode to on or off
Communications	Modbus NaN Substitution Value	4	Numeric Value Floating Point	User Defined	Sets the number to be substituted
Communications	Modbus Inactivity TimeOut	4	Off 30 Seconds 1 minute	User Defined	Sets the amount of time before issuing a Modbus failure
Communications	MQTT Data Mode	3	Off JSON (full frame) JSON (differential)	Off	Determines the data set published to MQTT. Ultrasonic JSON[...] selections will be sent with topic structure TechnipFMC--PoC/<group name>/eLogVer2-json/ <device name>/....
Communications	MQTT Broker URL	3	up to 256 characters	[blank]	URL pointing to the MQTT broker (ex, tcp://10.70.35.76:1883)
Communications	MQTT Topic Group Name	3	up to 32 characters	[blank]	MQTT topic group name
Communications	MQTT Topic Device Name	3	up to 32 characters	[blank]	MQTT topic device name
Communications	MQTT Username	3	up to 32 characters	[blank]	MQTT username; leave blank if unused
Communications	MQTT Password	3	up to 32 characters	[blank]	MQTT password; leave blank if unused
Communications	MQTT Reported Latitude	3	-90 to 90 (deg)	91 (not reported)	Latitude to report via MQTT protocol
Communications	MQTT Reported Longitude	3	-360 to 360 (deg)	361 (not reported)	Longitude to report via MQTT protocol
Communications	MQTT Reported Altitude	3	-11034 to 29032 (meters)	30000 (not reported	Altitude to report via MQTT protocol, in meters
Communications	MQTT TLS Mode	3	Off (insecure)	Off (insecure)	Determines whether to use TLS security for MQTT, and if so, includes other TLS options

Menu Path	Parameter Name	Security Level	Range	Nominal	Description
Factory Settings Menu					
Factory Settings	Initial Profile Factor	4	0.8 1.0	Depends on path configuration of meter spool	Profile (reference factor) to use before the learner runs Paths 1 - 8
Factory Settings	Size Constants A	4	Factory determined value	0	Factory adjustment for the meter. There is a correction table for each size of the meter A = velocity. Up to 4 nodes
Factory Settings	Size Constants B	4	Factory Determined value	0	Factory adjustment for the meter. There is a correction table for each size of the meter B = adj. Factor. Up to 4 nodes
Factory Settings	VPCx Meter Factor	4	1.0 4.0	Per calibration	Velocity profile correction nodes 1 - 8
Factory Settings	VPC Meter Factor	4	0.9 1.1	Per calibration	Meter factor for this calibration node. Nodes 1 - 8
Factory Settings	VPCx ReNo	4	1.0 4.0	Per calibration	Velocity profile correction node X value. Nodes 1 - 8
Factory Settings	Reynolds Number	4	10 10000000	Per calibration	Corresponding Reynolds number. Nodes 1 - 8
Factory Settings	Path Constant	4	Numeric Value	0	Alternative weight factors. 0 = not used Path 1 - 8
Factory Settings	Running Average Buffer Size	4	0 200	0	Entry is time in seconds. Size of the running average buffer (amount of filtering). Used for Display and Modbus value output (not pulse outputs)
Factory Settings	VPCxAverage Buffer Size	4	0 500	100	Size of the VPCX running average buffer (amount of filtering).
Factory Settings	Profile Compensation A Gain	4	Numeric Value	0	Extra compensation of swirl. Only for 8 paths.
Factory Settings	Profile Compensation A Low	4	Numeric Value	0	Ax+B
Factory Settings	Profile Compensation B Gain	4	Numeric Value	0	Extra compensation of cross flow. Only for 8 paths.
Factory Settings	Profile Compensation B Low	4	Numeric Value	0	Ax+B
Factory Settings	Density Correction A	4	Numeric Value	1	Adjustment Factor for Estimated Density (Ax + B)
Factory Settings	Density Correction B	4	Numeric Value	0	Adjustment Factor for Estimated Density (Ax + B)

Menu Path	Parameter Name	Security Level	Range	Nominal	Description
Factory Settings	3rd Reflected Diagnostic	4	Off On	Off	Controls 3rd reflected diagnostic WARNING: This function should be Off for normal meter operation

Menu Path	Parameter Name	Security Level	Range	Nominal	Description
Calibration Menu					
Flow Calibration	Flow Rate Node	4	(no limits)	Per calibration	Flow rate for this calibration node, 16 nodes available
Flow Calibration	Node Meter Factor	4	0.9 1.1	Per calibration	Meter factor for this calibration node, 16 nodes available

Menu Path	Parameter Name	Security Level	Range	Nominal	Description
Fluid Corrections Menu					
Fluid Corrections	Fluid Correction Mode	3	None API 2004 Live Dens (liquid only) API 2004 Ref Dens (liquid Only) GOST 30319.2-2015 (gas only)	User Defined	Selects the Fluid Correction method to be utilized to standard conditions
Fluid Corrections	Temperature Input Source	3	None Fallback 4-20 mA Input #1 (fallback mode) 4-20 mA Input #1 (hold mode) 4-20 mA Input #2 (fallback Mode) 4-20 mA Input #2 (hold mode) RTD Input (fallback mode) RTD Input (hold mode) Modbus (fallback mode) Modbus (hold mode)	User Defined	Temperature used for Fluid Correction Calculations None: No source used, disables fluid corrections Fallback: Always uses the user defined Temperature value that is set in the "Modes" Menu under the Line Temperature Fallback Value parameter. Analog or Modbus Fallback Mode: Utilize the selected live input's and uses the user defined fallback value if a failure is detected. Analog or Modbus Hold Mode: will use the last know "Good Value" if a input failure is detected.
Fluid Corrections	Temperature Input Units	3	None K °C °F °R	User Defined	Selects the Engineering units to be used for the correction calculations.

Menu Path	Parameter Name	Security Level	Range	Nominal	Description
Fluid Corrections	Pressure Input Source	3	None Fallback 4-20 mA Input #1 (fallback mode) 4-20 mA Input #1 (hold mode) 4-20 mA Input #2 (fallback Mode) 4-20 mA Input #2 (hold mode) Modbus fallback mode) Modbus (hold mode)	User Defined	Pressure used for Fluid Correction Calculations. None: No source used, disables fluid corrections Fallback: Always uses the user defined Pressure value that is set in the "Modes" Menu under the Line Pressure Fallback Value parameter. Analog or Modbus Fallback Mode: Utilize the selected live input's and uses the user defined fallback value if a failure is detected. Analog or Modbus Hold Mode: Will use the last know "Good Value" if a input failure is detected.
Fluid Corrections	Pressure Input units	3	None Pa Nm^2 kPa Mpa bar lbf/in^2 psi Pa (gauge) bar (gauge) Mpa (gauge) lbf/in^2 (gauge) psi (gauge)	User Defined	Selects the Engineering units to be used for the correction calculations.
Fluid Corrections	Density Input Source	3	None Fallback 4-20 mA Input #1 (fallback mode) 4-20 mA Input #1 (hold mode) 4-20 mA Input #2 (fallback Mode) 4-20 mA Input #2 (hold mode) Modbus fallback mode) Modbus (hold mode) Density Estimation	User Defined	None - No source detected Fallback - Always uses the user defined value. Analog or Modbus Fallback Mode - Utilize the selected live input's and uses the user defined fallback value if a failure is detected. Hold will use the last know "Good Value" if a input failure is detected.
Fluid Corrections	Density Input Units	3	None kg/m^3 g/cm^3 lb/ft^3	User Defined	Selects the Engineering units to be used by the meter.

Menu Path	Parameter Name	Security Level	Range	Nominal	Description
Fluid Corrections	API Thermal Expansions Coeff	3	Numeric Value	User Defined	Only used with selection "C" special in the API selection (Liquids Only)
Fluid Corrections	Reference Density	3	Numeric Value	User Defined	Sets the density used at reference conditions
Fluid Corrections	Reference Temperature	3	Numeric Value	User Defined	Sets the temperature used at reference conditions
Fluid Corrections	API Commodity Selection	3	None (factor =1.0000) A - Generalized Crude Oils B - Generalized Refined Product C - Special (thermal exp) D - Generalized Lube Oils	User Defined	Selects the appropriate API Table (liquids only)
Fluid Corrections	Reference Pressure	3	Numeric Value	User Defined	Sets the pressure used at reference conditions
Fluid Corrections	Reference Density Input Source	3	Fallback Modbus (fallback mode) Modbus (hold mode)	User Defined	Set the source of the Density input Fallback - Always uses the user defined value. Modbus Fallback Mode - Utilize the selected live Modbus input and uses the user defined fallback value if a Modbus communication error is detected. Modbus (Hold Mode) - Utilizes the selected live Modbus input and will use the last know "Good Value" if a Modbus communication error is detected.
Fluid Corrections	Vapor Pressure Fallback	3	Numeric Value	User Defined	Sets the value for Vapor Pressure Fallback Value

Menu Path	Parameter Name	Security Level	Range	Nominal	Description
Gas Composition Menu					
Gas Composition	Gas Composition Input Source	3	Fallback Modbus (fallback mode) Modbus (hold mode)	User Defined	Sets the source for gas composition value
Gas Composition	Nitrogen Mole Fraction	3	Numeric Value	User Defined	Sets the fallback value
Gas Composition	Carbon Dioxide Mole Fraction	3	Numeric Value	User Defined	Sets the fallback value
Gas Composition	Methane Mole Fraction	4	Numeric Value	User Defined	Sets the fallback value

Menu Path	Parameter Name	Security Level	Range	Nominal	Description
Gas Composition	Ethane Mole Fraction	4	Numeric Value	User Defined	Sets the fallback value
Gas Composition	Propane Mole Fraction	4	Numeric Value	User Defined	Sets the fallback value
Gas Composition	Butane Mole Fraction	4	Numeric Value	User Defined	Sets the fallback value
Gas Composition	Isobutane Mole Fraction	4	Numeric Value	User Defined	Sets the fallback value
Gas Composition	Pentane Mole Fraction	4	Numeric Value	User Defined	Sets the fallback value
Gas Composition	Isopentane Mole Fraction	4	Numeric Value	User Defined	Sets the fallback value
Gas Composition	Hexane Mole Fraction	4	Numeric Value	User Defined	Sets the fallback value
Gas Composition	Heptane Mole Fraction	4	Numeric Value	User Defined	Sets the fallback value
Gas Composition	Octane Mole Fraction	4	Numeric Value	User Defined	Sets the fallback value
Gas Composition	Nonane Mole Fraction	4	Numeric Value	User Defined	Sets the fallback value
Gas Composition	Decane Mole Fraction	4	Numeric Value	User Defined	Sets the fallback value
Gas Composition	Hydrogen Mole Fraction	4	Numeric Value	User Defined	Sets the fallback value
Gas Composition	Oxygen Mole Fraction	4	Numeric Value	User Defined	Sets the fallback value
Gas Composition	Carbon Monoxide Mole Fraction	4	Numeric Value	User Defined	Sets the fallback value
Gas Composition	Water Mole Fraction	4	Numeric Value	User Defined	Sets the fallback value
Gas Composition	Hydrogen Sulfide Mole Fraction	4	Numeric Value	User Defined	Sets the fallback value
Gas Composition	Helium Mole Fraction	4	Numeric Value	User Defined	Sets the fallback value
Gas Composition	Argon Mole Fraction	4	Numeric Value	User Defined	Sets the fallback value

Menu Path	Parameter Name	Security Level	Range	Nominal	Description
Inputs and Outputs Menu					

Menu Path	Parameter Name	Security Level	Range	Nominal	Description
Inputs and Outputs	An In Engineering Value at Max	4	(no limits)	Per commissioning requirements	Engineering value to use at the maximum electrical input range.
Inputs and Outputs	An In Engineering Value at Min	4	(no limits)	Per commissioning requirements	Engineering value to use at the minimum electrical input range.
Inputs and Outputs	An In High Limit	4	12 mA 22 mA	22 mA	Electrical input above this limit will not be allowed.
Inputs and Outputs	An In Low Limit	4	3.8 mA 12 mA	3.8 mA	Electrical input below this limit will not be allowed.
Inputs and Outputs	An In Cal Factor A	4	Numeric Value	Per calibration	Calibration Factor A. Up to three analog inputs
Inputs and Outputs	An In Cal Factor B	4	Numeric Value	Per calibration	Calibration Factor B. Up to three analog inputs
Inputs and Outputs	An In Alarm Hysteresis	4	0% 10%	1%	Hysteresis for alarm trigger points. Up to three analog inputs
Inputs and Outputs	An In High Alarm Point	4	4 mA 22 mA	20.1 mA	High alarm trigger point. Up to three analog inputs
Inputs and Outputs	An In Low Alarm Point	4	3.8 mA 20 mA	3.9 mA	Low alarm trigger point. Up to 3 analog inputs
Inputs and Outputs	Digital Output Function	4	Quadrature (I,Q) Pulse Forward, Pulses Reverse Pulse (bi-di), Flow Dir Pulse (bi-di), Flow Dir(inv)	Default: quadrature	Digital output function
Inputs and Outputs	Pulse Output Factor	4	100 p/m3 100000 p/m3	Depends on meter size and max flow rate	Factor relating meter measurement volume to pulses. (max output frequency is 10 kHz)

Menu Path	Parameter Name	Security Level	Range	Nominal	Description
Inputs and Outputs	Pulse Output Mode	4	Pulse Accounting Mode Frequency Mode Pulse Accounting Full PID Mode	User Defined (Default: Pulse Accounting Full PID Mode)	Pulse Accounting Mode: this mode counts pulses going out, volume deltas coming in, and makes adjustments to the frequency to keep the "accumulators balanced". There is limited frequency smoothing so the output frequency can be erratic under certain flow conditions. Frequency Mode: Provides very little time delay from measurement to pulse output, however long term drift is possible. Pulse Accounting Full PID Mode: is an improved version of pulse accounting mode, and all of volume is accounted for in the pulse output. The PID loop may be tuned to vary the dynamic response of the pulse output per user requirements (for example, fast or slow response). As this is a newer algorithm it is the preferred mode.
Inputs and Outputs	Reverse Flow Handling	4	Bidirectional Forward only Reverse only	Default: forward only	Pulse output behavior during reverse flow
Inputs and Outputs	An Out Function	4	Flow rate Viscosity Density Reynolds number Standard Volume Flow Rate	Default: flow rate	Analog output function
Inputs and Output	An Out Max Engineering Value	4	-1000000 1000000	Depends on output variable selected	Upper engineering value
Inputs and Outputs	An Out Min Engineering Value	4	-1000000 1000000	Depends on output variable selected	Lower engineering value
Inputs and Outputs	An Out Cal Factor A	4	3000 5000	Depends on electronics tolerances	Hardware calibration factor (Ax+B)
Inputs and Outputs	An Out Cal Factor B	4	-50000 50000	Depends on electronics tolerances	Hardware calibration factor (Ax+B)
Inputs and Outputs	RTD In Temperature Offset	4	-10 °C +10 °C	0 °C	Temperature offset to apply to the measured temperature.
Inputs and Outputs	RTD Input High Limit	4	100 ohms 168.4783 ohms	168.4783 ohms	Electrical input above this limit will not be allowed.

Menu Path	Parameter Name	Security Level	Range	Nominal	Description
Inputs and Outputs	RTD Input Low Limit	4	76.3278 ohms 100 ohms	76.3278 ohms	Electrical input below this limit will not be allowed.
Inputs and Outputs	Pulser Frequency Limit	4	Numeric Value Valid Range 500Hz to 15,000Hz	User Defined	Maximum Pulser output Frequency
Inputs and Outputs	Flow Direction Dead band	4	Numeric Value dead band volume	User Defined	Used when in Bi-Directional Mode to create a dead band volume between forward nd Reverse directions
Inputs and Outputs	Pulser PID Gain	4	Numeric Value	User Defined	Only used when the Pulse Output Mode is set for "Pulse Accounting Full PID".
Inputs and Outputs	Pulser PID Reset	4	Numeric Value	User Defined	Only used when the Pulse Output Mode is set for "Pulse Accounting Full PID".
Inputs and Outputs	Pulser PID Rate	4	Numeric Value	User Defined	Only used when the Pulse Output Mode is set for "Pulse Accounting Full PID".
Inputs and Outputs	An Out Fail Setting	4	Fail high when bad Fail low when bad Fail high when uncertain or bad Fail low when uncertain or bad	User Defined	If an analog failure is detected the unit defaults to the condition selected
Inputs and Outputs	Pulse Output Function	4	Volume at Line Conditions Volume at Standard Conditions	User Defined	Sets the pulse outputs to the volume type selected

Menu Path	Parameter Name	Security Level	Range	Nominal	Description
Limits Menu					
Limits	Max Velocity of Sound	3	300 m/s 4000 m/s	Depends on meter type	Alarm when measured velocity of sound exceeds this value.
Limits	Min Velocity of Sound	3	300 m/s 4000 m/s	Depends on meter type	Alarm when measured velocity of sound falls below this value.
Limits	Min Signals Used	3	1 % 99 %	50% typ.	Alarm when percentage of signals used falls below this value.
Limits	Max RX Gain	3	-12 dB 48 dB	30 db typ.	Alarm when receiver gain exceeds this value.
Limits	Max RX Gain Difference	3	0 dB 64 dB	10 dB typ	Alarm when the gain on an individual path differs more than this value compared to the median gain.
Limits	Max VOS Deviation	3	0 m/s 1000 m/S	Depends on meter type	Alarm when the velocity of sound on an individual path differs more than this value compared to the median velocity of sound.
Limits	Min Signal to Noise Ratio	3	0 dB 60 dB	20 dB typ.	Alarm when the used signal to noise ratio falls below this value.
Limits	Max Turbulence Level	3	0% 50%	20% typ.	Alarm when the turbulence level exceeds this value.
Limits	Max Swirl/ Crossflow Deviation	3	0% 70%	10%	Alarm when the transversal flow exceeds this value.
Limits	Max flow rate	3	5 m/s 40 m/s	Depends on meter type	Alarm when the flow velocity exceeds this value.
Limits	Min flow rate	3	-40 m/s -5 m/s	Depends on meter type	Alarm when the flow velocity falls below this value.
Limits	Max Profile Flatness Deviation	3	0% 50%	20%	Alarm when the profile flatness deviates this amount.
Limits	Max Profile Symmetry Deviation	3	0% 50%	10%	Alarm when the profile symmetry deviates this amount.
Limits	Low Flow Cutoff	4	0 m/s 10 m/s	0.2 m/s	Below this velocity limit, flow will be registered as zero.
Limits	Enable Confidence Alarms	4	Numeric Value	User Defined	8 bit mask
Limits	Flow Rate Cutoff Selector	4	Apply cutoff No Cutoff	User Defined	Enable / Disable low flow cut off

Menu Path	Parameter Name	Security Level	Range	Nominal	Description
Limits	Accumulator Low Flow Cutoff	4	Numeric Value Min. Value 0.100 m/s	User Defined	Velocity at which cutoff is applied WARNING: Do not set below 0.100 m/s

Menu Path	Parameter Name	Security Level	Range	Nominal	Description
Meter Body Menu					
Meter Body	Path Length	4	50 mm 1500 mm	Factory set, is dependent on meter size	Length measured between transducer faces (one parameter for each path)
Meter Body	Path Angle	4	40 degrees 60 degrees and -40 degrees -60 degrees	Factory set, dependent on path configuration of meter spool	Angle between transducer path and flow direction (one parameter for each path)
Meter Body	Lateral Path Position	4	-1.0 1.0	Factory set, dependent on path configuration of meter spool	Lateral level of each path: -1=bottom, zero=center, 1=top (one parameter for each path)
Meter Body	Internal Diameter	4	70 mm 1500 mm	Factory set, dependent on meter size	Average spool internal diameter at reference temperature.
Meter Body	Wall Thickness	4	20 mm 100 mm	Factory set, dependent on meter construction	Average thickness of the spool wall; used for p/t correction of spool dimensions.
Meter Body	Material	4	Carbon steel, Stainless steel, Duplex	Factory set, dependent on meter construction	Material of spool construction; used for p/t correction of spool dimensions.
Meter Body	Reference Temperature	4	15 °C 30 °C	Factory set, dependent on ambient conditions	Temperature of the spool when the path lengths and inner diameter were measured.
Meter Body	Diameter Compensation Mode	4	None ISO 17089-1	None	Specifies if spool compensation algorithm is to be used use for pressure and temperature correction of spool dimensions.
Meter Body	Meter Type	4	MPU 200 MPU 600 MPU 800 MPU 1200 MPU 1600 Ultra 4 Ultra 5 Ultra 6 Ultra 8	Factory set, dependent on meter construction and application, Liquid or Gas	Select for Gas or Liquid Meter MPU = Gas Ultra = Liquid Meter type and configuration; select from list.
Meter Body	Spool Serial Number	4	up to 32 characters	Factory set	Serial number assigned to the meter body

Menu Path	Parameter Name	Security Level	Range	Nominal	Description
Modes Menu					
Modes	Disable Path	4	0 or 1	0 (enabled)	Disable this path (will be substituted). (one parameter for each path)
Modes	Manual (force) Values	3	Off On	Off	Controls whether manual values are allowed to be used.
Modes	Line Temperature Input Mode (Source)	4	Fallback 4-20mA input #1 4-20mA input #2 RTD input Modbus	Default: Fallback	Input source for line temperature used in the Meter Diameter Compensation Mode calculation. **NOTE:** If input source fails (RTD, 4-20 mA or Modbus) the value will revert to Fallback Value. May be set to the same input source as the Fluid Correction Temperature input to use same temperature source.
Modes	Line Temperature Fallback Value	4	-40 °C 150 °C	20 °C typ.	Temperature Fallback value. This value is used for Meter Spool corrections and for the Fallback Temperature value from the Fluid Corrections menu.
Modes	Line Pressure Input Mode (Source)	4	Fallback 4-20mA input #1 4-20mA input #2 Modbus	Default: Fallback	Input source for line pressure used in the Meter Diameter Compensation Mode calculation. **NOTE:** If input source fails (4-20 mA or modbus) the value will revert to Fallback Value. May be set to the same input source as the Fluid Correction Pressure input to use same pressure source.
Modes	Line Pressure Fallback Value	4	0 bar(a) 250 bar(a)	5 bar(a) typ.	Pressure Fallback value. This value is used for Meter Spool corrections and for the Fallback Pressure value from the Fluid Corrections menu.
Modes	Electronic Sealing Mode	5	No alarm OIML (Weights and Measures)	Default is “no alarm”	Electronic seal mode; determines meter behavior on sealed and unsealed conditions. If Set to "OIML" and the Electronic Seal State is open, the measurements are not legal for trade.
Modes	Electronic Seal State	4	Open Sealed	Default: open	Electronic seal state
Modes	Diagnostic Mode	4	Off External Loopback Internal Loopback Digital Loopback	Off User Defined (Used for diagnostics or demonstration only)	**WARNING:** Must be set to "Off" for legal measurements. Other settings are for diagnostic purposes and flow simulation. When enabled, a "loopback enabled" warning Icon will be displayed on the browser page.

Menu Path	Parameter Name	Security Level	Range	Nominal	Description
Modes	Loopback Mode Flow Velocity	4	Numeric Value m/s	User Defined	Flow velocity created when in loopback mode
Modes	Loopback Mode Velocity of Sound	4	Numeric Value m/s	User Defined	Velocity of sound used to create flow when in loopback mode
Modes	Loopback Mode Profile	4	Turbulent Laminar Swirl Cross Flow Asymmetric Flow	User Defined	Flow profiles simulated when in Loopback flow simulation mode
Modes	Line Temperature Input Units	4	None K °C °F °R	User Defined (Default: °C)	Spool compensation temperature inputs units of measure conversion. None - means no units of conversion will take place. If RTD is selected set to None.
Modes	Line Pressure Input Units	4	None Pa Nm^2 kPa Mpa bar lbf/in^2 psi Pa (gauge) bar (gauge) Mpa (gauge) lbf/in^2 (gauge) psi (gauge)	User Defined (Default: bar (abs))	Spool compensation pressure inputs units of measure conversion. None - means no units of conversion will take place.

Menu Path	Parameter Name	Security Level	Range	Nominal	Description
Signal Menu					
Signal	Signal Type	4	Burst Chirp Burst, using BP Filter	Depends on meter type	Type of signal to use
Signal	Signal Filter Kernel Length	4	1 1000	Depends on transducer type	Size of the filter kernel to use (in samples)
Signal	Signal Frequency	4	50 kHz 3000 kHz	Depends on transducer type	Signal frequency (or starting frequency)
Signal	Signal End Frequency	4	50 kHz 3000 kHz	Depends on transducer type	Signal ending frequency (chirp signals only)
Signal	Signal Length	4	0.3 us 260 us	Depends on transducer type	Signal length (duration)

Menu Path	Parameter Name	Security Level	Range	Nominal	Description
Signal	Bursts	4	1 3 5 7 11 13	Depends on transducer type	Number of bursts (burst signals only)
Signal	Burst Interval	4	100 2000	Depends on transducer type	Distance between bursts in samples (Used when burst signal is selected)
Signal	Low Pass Filter Frequency	4	50 kHz 3200 kHz	Depends on transducer type	Low pass filter frequency -3dB point
Signal	High Pass Filter Frequency	4	50 kHz 3200 kHz	Depends on transducer type	High pass filter frequency -3dB point
Signal	Delay Between Firings	4	0 us 100000 us	0 us	Additional delay added between ultrasonic burst transmissions
Signal	Level Control Setpoint	4	0.2 V 0.8 V	0.5 V	Signal level the control algorithm will attempt to maintain
Signal	Detection Method	4	Single Multiple Zero cross Auto Zero cross Single Zero cross Multiple	Depends on transducer type and signal selections	Method used to detect the signal
Signal	Number of Zero Crossings	4	1 20	Depends on transducer type	Number of Zero Crossings
Signal	Manual TX Gain	4	-40 dB 0 dB	Depends on transducer type	Manual setting for ultrasonic transmit gain, 0.0 dB is max, negative values attenuate.
Signal	TX Signal Processing	4	None Hamming Window	Depends on transducer type	Factory set for Transducer type used
Signal	Travel Time Deviation Limit	4	Numeric Value	Depends on transducer type	Factory set for Transducer type used
Signal	TX Gain Mode	4	Use Manual Setting Automatic	Manual	Factory set for Transducer type used
Signal	RX Gain Setpoint	4	Numeric Value Gain value entered in dB	Not used in manual mode	Factory set for Transducer type used
Signal	TX Gain High Limit	4	Numeric Value Gain value entered in dB	Not used in manual mode	Factory set for Transducer type used

Menu Path	Parameter Name	Security Level	Range	Nominal	Description
Signal	TX Gain Low Limit	4	Numeric Value Gain value entered in dB	Not used in manual mode	Factory set for transducer type used
Signal	Signal Offset A	4	Numeric Value Value entered in fractional periods	Depends on transducer type	Factory setting
Signal	Threshold Level	4	Numeric Value	Depends on transducer type	Factory set for transducer type used
Signal	Threshold Method	4	Mode 0 = standard, 1 = extended	Depends on transducer type	Factory set for transducer type used

Menu Path	Parameter Name	Security Level	Range	Nominal	Description
Transducer Menu					
Transducer	Upstream Port Number	4	0 15	Depends on path configuration of meter spool	Upstream transducer electrical port number. (one parameter for each path)
Transducer	Downstream Port Number	4	0 15	Depends on path configuration of meter spool	Downstream transducer electrical port number. (one parameter for each path)
Transducer	Transducer Delay	4	-3.0 us +15.0 us	Depends on transducer type	Transducer delay value (node 1 if multiple nodes are programmed). (one parameter for each path)
Transducer	Transducer Delay (node 2)	4	-3.0 us +15.0 us	Depends on transducer type	Transducer delay value (node 2). (one parameter for each path)
Transducer	Transducer Delay (node 3)	4	-3.0 us +15.0 us	Depends on transducer type	Transducer delay value (node 3). (one parameter for each path)
Transducer	Node Pressure	4	0 bar(a) 250 bar(a)	Per transducer calibration	Node calibration point pressure
Transducer	Node Temperature	4	-40 °C 150 °C	Per transducer calibration	Node calibration point temperature
Transducer	Transducer Phase	4	Numeric Value Angular Degrees	Per transducer calibration	Phase adjustment Up to 8 Paths
Transducer	Transducer Pair Delta T	4	Numeric Value Entry in microseconds	Per transducer calibration	Delta T between downstream and Upstream Transit times Up to 8 paths

Menu Path	Parameter Name	Security Level	Range	Nominal	Description
Transducer	Transducer Type	4	Long with matching layer Long without matching layer Short with matching layer Short without matching layer	Depends on transducer type	Type of transducer installed
Transducer	Number of Trans Cal Nodes	4	0 3	0	Number of transducer calibration nodes
Transducer	Correction Mode	4	Resonant Frequency Method Pressure/Temperature Method None Interpolation Temp	Interpolation temp	Mode selection for transducer delay correct algorithm. Correction of transducer delay based on temperature and pressure

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