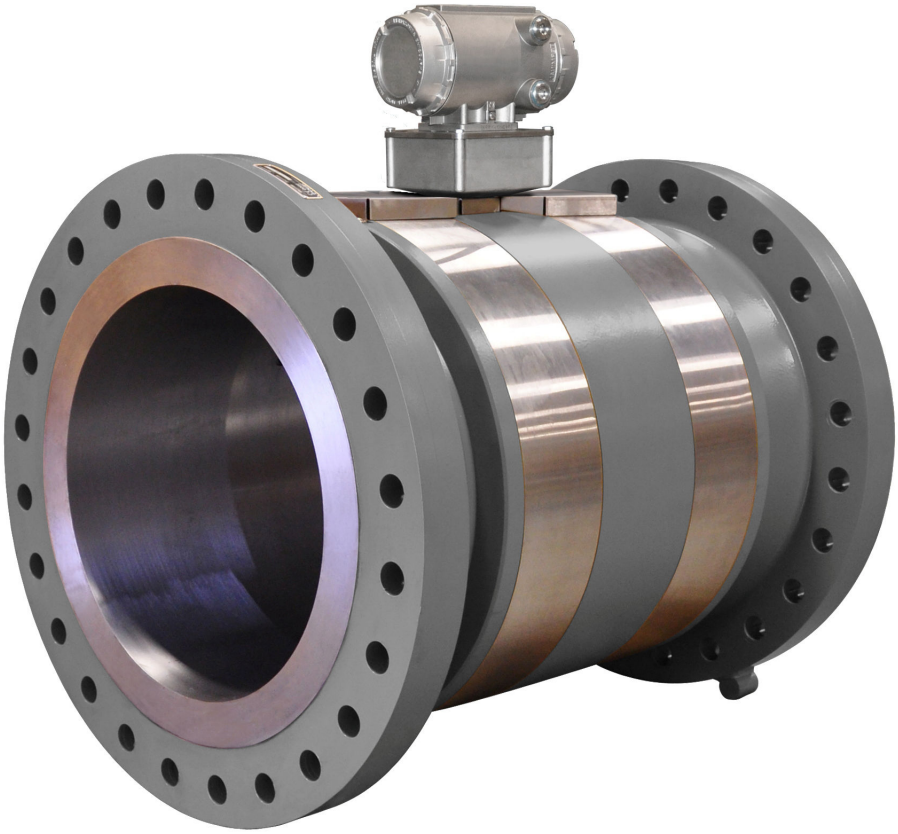
Installation manual
00825-0100-3812, Rev AC
February 2024

Rosemount™ 3812 Liquid Ultrasonic Flow Meter

for Direct and Remote Mount Meter Electronics



ROSEMOUNT™

EMERSON™

Safety and approval information

This Rosemount product complies with all applicable European directives when properly installed in accordance with the instructions in this manual. Refer to the EU Declaration of Conformity for directives that apply to this product. The EU Declaration of Conformity, with all applicable European directives, and the complete ATEX installation drawings and instructions are available on the Internet at Emerson.com or through your local Emerson support center.

Information affixed to equipment that complies with the Pressure Equipment Directive can be found on the Internet at Emerson.com.

For hazardous installations in Europe, refer to standard EN 60079-14 if national standards do not apply.

Other information

Full product specifications can be found in the product data sheet. Troubleshooting information can be found in the maintenance and troubleshooting manual.

Product data sheets and manuals are available on the Emerson website at Emerson.com.

Return policy

Follow Emerson procedures when returning equipment.

These procedures ensure legal compliance with government transportation agencies and help provide a safe working environment for Emerson employees. Emerson will not accept your returned equipment if you fail to follow Emerson procedures. Return procedures and forms are available on our website at Emerson.com or by phoning the Emerson Customer Service department.

Emerson Flow customer service

- Worldwide: flow.support@emerson.com
- Asia-Pacific: APflow.support@emerson.com

Contents

1 Introduction

1.1 General overview of Rosemount 3812 Liquid Ultrasonic Flow Meter

Rosemount 3812 Liquid Ultrasonic Flow Meters have direct mount or remote mount electronic options and various configurations that meet a broad range of customer requirements. Each meter comes fully assembled from Emerson. and all parts and assemblies are tested prior to shipment. Refer to the following documents for additional details:

- 00825-0300-3810 HART® Field Device Specification for Liquid Ultrasonic Flow Meters
- 00809-0100-7630 MeterLink™ Software for Rosemount Gas and Liquid Ultrasonic Flow Meters
- 00809-0100-3812 Rosemount Model 3812 Liquid Ultrasonic Flow Meter Maintenance and Troubleshooting Manual

The Rosemount 3812 Liquid Ultrasonic Flow Meter technology can be applied to allocation measurement and check metering applications as shown below.

1.2 Typical applications

- Allocation measurement
- Check metering
- Leak detection
- Line balancing
- Batch control
- Loading and off loading
- Offshore
  - Floating Production, Storage and Offshore Loading (FPSO)
  - Offshore Platforms
  - Barges
- Pipelines
  - Crude Oil pipelines
  - Refined product pipelines
- Terminals
  - Loading and off-loading (Ship, barge, truck, railcar, etc.)
  - Tank Farms
  - Cavern Storage

1.3 Features and benefits of this product

- Explosion-proof transmitter electronics enclosure with CPU Module, Power Supply, Intrinsic Safety Barrier Module
- Intrinsically safe transducer electronics enclosure with the Acquisition Module
- MeterLink (software for Rosemount Ultrasonic Flow Meters)
- HART® and AMS Suite: Intelligent Device Manager communications for PlantWeb™ architecture
- Direct mount or remote mount options electronics
- Reduce unaccounted measurement
- Increase energy savings
- Replaceable transducers while under pressure
- Extensive self diagnostics
- Immediate alarm reporting
- Auto-detected ASCII/RTU Modbus® communications protocol
- Interchangeable electronics modules
- Internet-ready communications
- Ethernet access
- Modbus TCP/IP
- Onboard LED status indicators
- Analog pressure and temperature inputs
- Local display and glass endcap (optional)

1.4 Acronyms, abbreviations, and definitions

Table 1-1: Acronyms, abbreviations and definitions

Acronym or abbreviation	Definition
°	Degree (angle)
°C	Degrees Celsius (temperature unit)
°F	Degrees Fahrenheit (temperature unit)
ADC	Analog-to-digital converter
AI	Analog input
AMS® Suite Device Manager	Asset Management Software - Device Manager
AO	Analog output
ASCII MODBUS	A Modbus protocol message framing format in which American Standard Code for Information Interchange (ASCII) characters are used to delineate the beginning and end of the frame.

Table 1-1: Acronyms, abbreviations and definitions *(continued)*

Acronym or abbreviation	Definition
boolean	A type of data point that can only take on values of TRUE or FALSE (generally TRUE is represented by a value of 1, FALSE is represented by a value of 0)
bps	Bits per second (baud rate)
cPoise	Centipoise (viscosity unit)
CPU	Central Processing Unit
CTS	Clear-to-Send (CTS); the RS-232C handshaking signal input to a transmitter indicating that it is okay to transmit data – i.e., the corresponding receiver is ready to receive data. Generally, the Request-to-Send (RTS) output from a receiver is input to the CTS input of a transmitter.
DAC	Digital-to-Analog Converter
MeterLink™	Ultrasonic Meter interface software
DI	Digital Input
Direct Mount	Transmitter electronics enclosure and base electronics enclosure is directly mounted to meter body
DO	Digital Output
DHCP	Dynamic Host Configuration Protocol
dm	Decimeter (10^{-1} meters, length unit)
ECC	Error Correction Code
EEPROM	Electrically-Erasable, Programmable Read-Only Memory
Flash	Non-volatile, programmable read-only memory
FODO	Output that is user configurable as either a frequency or digital output
HART® Communication Protocol	Highway Addressable Remote Transducer communications protocol
hr	hour (time unit)
Hz	Hertz (cycles per second, frequency unit)
I/O	Input/Output
IS	Intrinsically Safe
K	Kelvin (temperature unit)
kHz	Kilohertz (103 cycles per second, frequency unit)
LAN	Local Area Network
LED	Light-emitting diode
m	Meter (length unit)
m^3/d	Cubic meters per day (volumetric flow rate)
m^3/h	Cubic meters per hour (volumetric flow rate)

Table 1-1: Acronyms, abbreviations and definitions *(continued)*

Acronym or abbreviation	Definition
m^3/s	Cubic meters per second (volumetric flow rate)
mA	Milliamp (current unit)
MAC Address	Media Access Control (Ethernet Hardware Address -EHA)
microinch (µinch)	Microinch (10^{-6} in)
micron	Micrometer (10^{-6} m)
MMU	Memory Management Unit
MPa	Megapascal (equivalent to 10^6 Pascal) (pressure unit)
N/A	Not Applicable
Nm^3/h	Normal cubic meters per hour
NOVRAM	Non-volatile Random Access Memory
Pa	Pascal, equivalent to 1 newton per square meter (pressure unit)
Pa·s	Pascal Second (viscosity unit)
PC	Personal Computer
P/N	Part number
PS	Power supply (board)
psi	Pounds per square inch (pressure unit)
psia	Pounds per square inch absolute (pressure unit)
psig	Pounds per square inch gage (pressure unit)
R	Radius
rad	Radian (angle)
RAM	Random Access Memory
Remote Mount Option	Detaching the transmitter electronics enclosure and base electronics enclosure from meter body and mounting and affixing them with the mounting bracket to a pole or other structure.
RTS	Request-to-Send; the RS-232C handshaking signal output by a receiver when it is ready to receive data
RTU MODBUS	A Modbus protocol framing format in which elapsed time between received characters is used to separate messages. RTU stands for Remote Terminal Unit.
s	Second (time unit, metric)
SDRAM	Synchronous Dynamic Random Access Memory
sec	Second (time unit, U.S. customary)
TCP/IP	Transmission Control Protocol/Internet Protocol
time_t	Seconds since Epoch (00:00:00 UTC Jan. 1, 1970) (time unit)

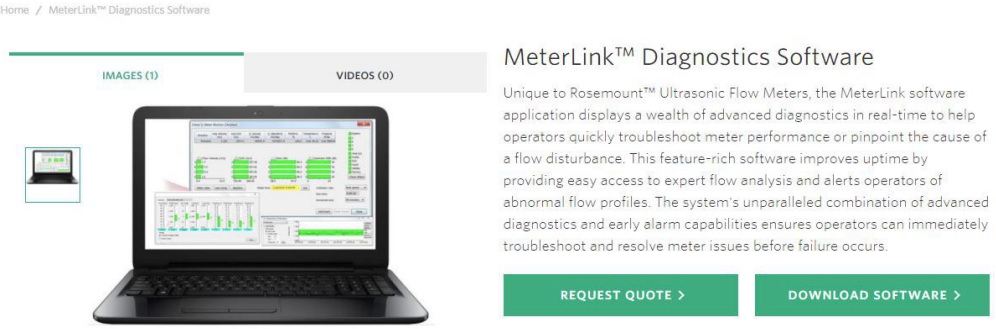
Table 1-1: Acronyms, abbreviations and definitions *(continued)*

Acronym or abbreviation	Definition
UDP	User Datagram Protocol
U.L.	Underwriters Laboratories, Inc. - product safety testing and certification organization
V	Volts (electric potential unit)
W	Watts (power unit)

1.5 MeterLink™ software

MeterLink™ software has robust features for setting communications parameters, calibrating your meter, collecting logs and reports and monitoring the meter health and alarm statuses. MeterLink may be downloaded at no charge from: Emerson.com/Meterlink.

Figure 1-1: MeterLink download and registration



Select the MeterLink software and firmware bundle appropriate for your meter. Complete the Online registration form and you will receive a confirmation email with a hyperlink directing you to the download site.

NOTICE

After the download, follow the instructions in the Readme file. Do not attempt to unzip the zipped firmware file. MeterLink unzips the compressed file using the **Tools → Program Download** utility.

Refer to the MeterLink Software for Gas and Liquid Ultrasonic Meters Quick Start Manual (00809-0100-7630) for installation instructions and to setup initial communications. You may download the manual here: Emerson.com/Meterlink.

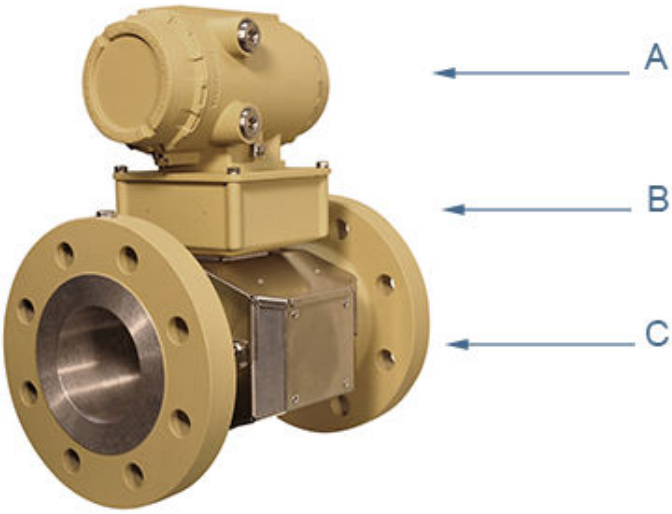
1.6 Rosemount 3812 Liquid Ultrasonic Flow meter design

The Rosemount 3812 Liquid Ultrasonic Flow Meter designs include a direct or remote mount electronics option and depending on the meter's outside diameter, have a shroud cover protecting the transducers and cable assemblies. See Table 2-1 and the list below for meter body shroud types. Shroud options are:

- split shroud

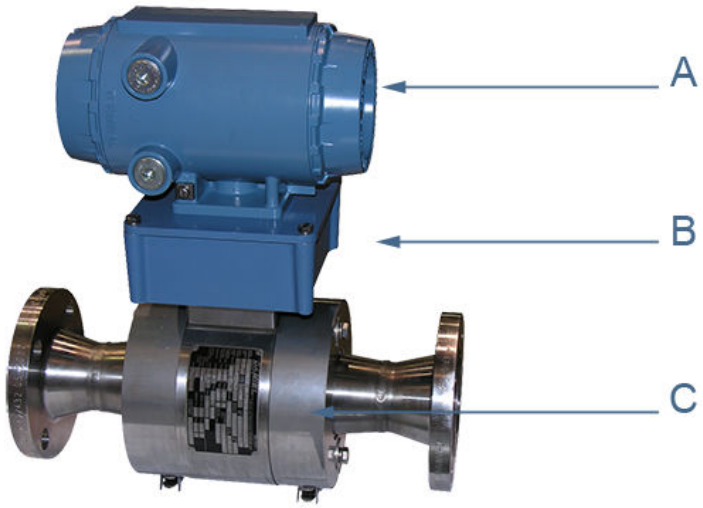
- bolted band shroud
- latched single band shroud
- clamped band shroud

Figure 1-2: Direct mount electronics assembly with split shroud



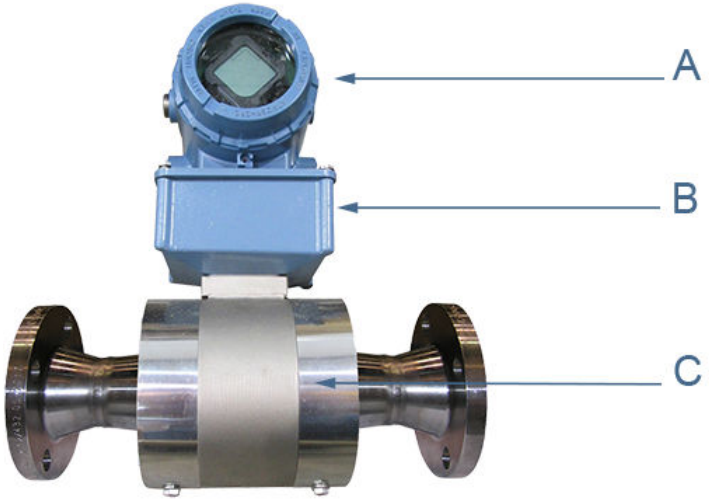
A. Explosion-proof transmitter enclosure (CPU Module, Power Supply, I.S. Barrier Board, Backplane board, and optional LCD Board with glass endcap)
B. Intrinsically-safe base enclosure includes Acquisition Module
C. Meter - body and split shroud for transducers and cables assemblies

Figure 1-3: Direct mount electronics with latched single band shrouds and remote display



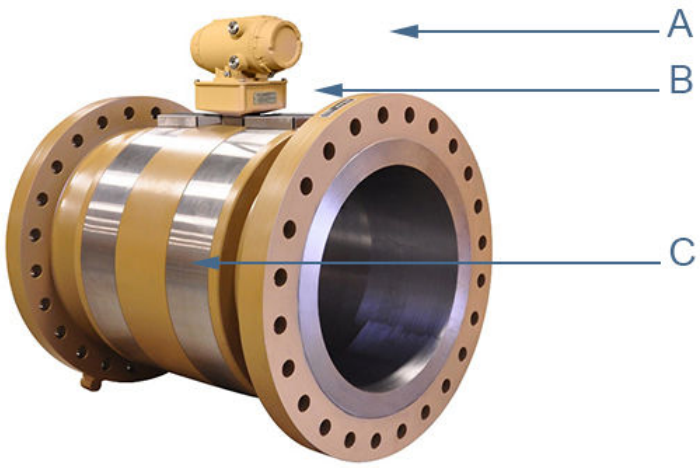
A. Explosion-proof transmitter enclosure (CPU Module, Power Supply, I.S. Barrier Board, Backplane board, and optional LCD Board with glass endcap)
B. Intrinsically-safe base enclosure includes Acquisition Module
C. Meter - body and latched band shrouds for transducers and cable assemblies

Figure 1-4: Direct mount electronics with bolted single band shrouds and local display



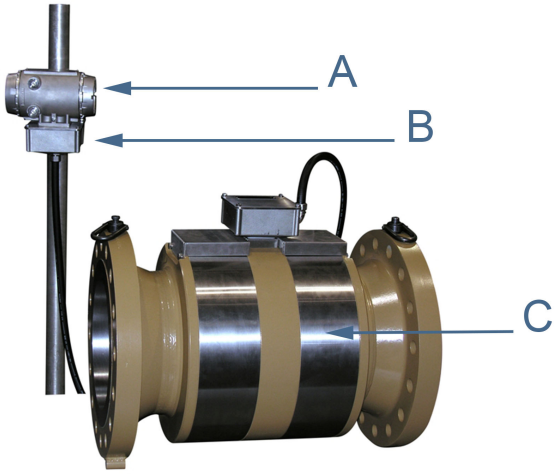
A. Explosion-proof transmitter enclosure (CPU Module, Power Supply, I.S. Barrier Board, Backplane board, and optional LCD Board with glass endcap)
B. Intrinsically-safe base enclosure includes Acquisition Module
C. Meter - body and latched band shrouds for transducers and cable assemblies

Figure 1-5: Direct mount electronics assembly with clamped band shrouds



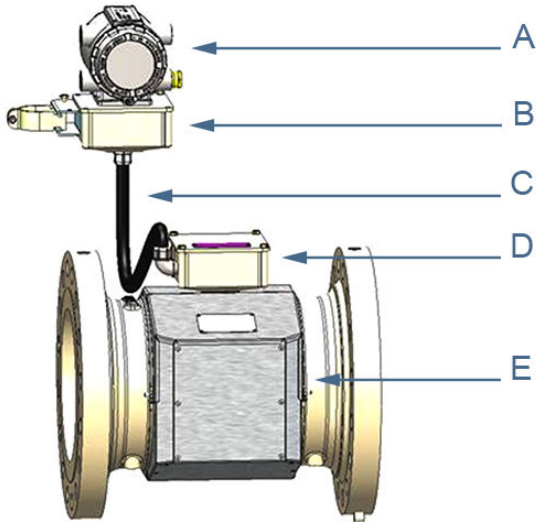
A. Explosion-proof transmitter enclosure (CPU Module, Power Supply, I.S. Barrier Board, Backplane board, optional LCD Board with glass endcap)
B. Intrinsically-safe base enclosure includes Acquisition Module
C. Meter - body and band shrouds for transducers and cable assemblies

Figure 1-6: Remote mount electronics assembly with clamped band shrouds



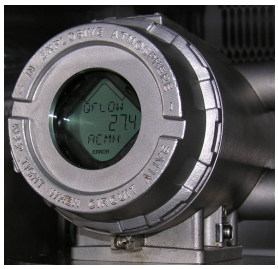
A. Explosion-proof transmitter enclosure (CPU Module, Power Supply, I.S. Barrier Board, Backplane board, and optional LCD Board with glass endcap)
B. Intrinsically-safe base enclosure includes Acquisition Module
C. Meter - body and band shrouds for transducers and cable assemblies

Figure 1-7: Remote mount electronics assembly with split shrouds



A. Explosion-proof transmitter enclosure (CPU Module, Power Supply, I.S. Barrier Board Backplane board, optional LCD Board with glass endcap)
B. Intrinsically-safe base enclosure includes Acquisition Module
C. Acquisition cable conduit
D. Junction box
E. Meter - body and split shrouds for transducer and cable assemblies

Figure 1-8: Optional local display and glass endcap



The Rosemount 3812 Liquid Ultrasonic Flow Meter is a two-path (four transducers) in-line meter designed to measure the difference in signal transit time with and against the flow across one or more measurement path(s). A signal transmitted in the flow direction travels faster than one transmitted against the flow direction. Each measurement path is defined by a transducer pair in which each transducer alternately acts as transmitter and receiver. The meter uses transit time measurements and transducer location information to calculate the mean velocity.

Computer simulations of various velocity profiles demonstrate that multiple measurement paths provide an optimum solution for measuring asymmetric flow. The Rosemount 3812 Liquid Ultrasonic Flow Meter utilizes two cross-bore, parallel-plane measurement paths, offers a high degree of repeatability, bi-directional measurement and superior low-flow capabilities without the compromises associated with conventional technologies.

The Rosemount 3812 Liquid Ultrasonic Flow Meter's U.L. safety listing is accomplished through the combination of an explosion-proof Transmitter Electronics Enclosure that

houses the CPU Module, Power Supply board, I.S. Barrier board, Backplane board and optional LCD Display board.

Note
The optional LCD Display requires firmware v1.04 and Uboot version, April 25, 2022.

The Base Electronics Enclosure is intrinsically safe and houses the Acquisition Module, the acquisition cable and wiring. The Intrinsically safe transducers and cable assemblies are designed for Class 1, Division 1, Groups C and D areas without need of further protection when installed in accordance with the field wiring diagram (refer to Rosemount drawing DMC-004936, see Engineering Drawings and Safety conditions).

1.7 Meter specifications

⚠ CAUTION

ESCAPING FLUIDS HAZARD
The purchaser of the meter is responsible for the selection of Rosemount components/ seals and materials compatible with the chemical properties of the measurement fluid.

Failure to select suitable meter components/seals may cause escaping fluids, resulting in injury or equipment damage.

Consult your Emerson Flow service representative to ensure you purchase the correct components and seals for your application.

Table 1-2: Meter specifications

Liquid Ultrasonic Flow Meter specifications	
Meter type	Number of paths • Two-path (four transducers) chordal design
Enclosure materials	• ASTM B26 Gr A356.0 T6 Aluminum — Chromate conversion coated with a polyurethane enamel • ASTM A351 Gr CF8M Stainless Steel — Passivated
Ultrasonic type	• Transit-time based measurement • Spool piece with integral mount transducers
Meter Performance	
Linearity	• ±0.30 percent of measured value over a 10:1 turndown (40 to 4 ft./s; 12.2 to 1.2 m/s)
Repeatability	• ±0.10 percent of reading in the specified velocity range
Velocity range	• 40.0 ft./s (12.2 m/s) (nominal) to 2.0 ft./s (0.6 m/s) • 48 fps (14.3 m/s) (over-range)

Table 1-2: Meter specifications *(continued)*

Liquid Ultrasonic Flow Meter specifications	
Body and Flange Pressure rating range	U.S. Customary Units sizes - 2, 3, 4, 6, 8, 10, 12, 14, 16, 18, 20, 24, 28, 30, and 36 (in.) • ANSI pressure classes 150 and 300, 600, 900 (per ANSI B16.5) • Carbon Steel • 316 Stainless Steel Metric Units sizes • DN 50, 75, 100, 150, 200, 250, 300, 350, 400, 450, 500, 600, 700, 750, and 900 • PN 20, 50, 100, 150 • Carbon Steel • 316 Stainless Steel Meter bore • Schedule 40 and Schedule 80 Maximum Pressures • Dependent on operating temperature
Flange types	ANSI classes - 150, 300, 600 and 900 • Raised face or RTJ
Specific Gravity	0.35 to 1.50
Accuracy Limits	Accuracy limits typically are: • ±2 percent without a flow calibration, ±0.3% with flow calibration
Minimum operating pressure	• 0 psig • 0 barg

Table 1-2: Meter specifications *(continued)*

Liquid Ultrasonic Flow Meter specifications	
Electronic specifications	
Power	Meter • 10.4 Vdc to 36 Vdc measured at the meter terminals • 11 W maximum power consumption Serial cable • Belden #9940 or equivalent (22 gauge) — Capacitance (pF/m) 121.397 (conductor to conductor) — Capacitance (pF/m) 219.827 (conductor to other conductor and shield) — Resistance (DC) DCR @ 20 °C (Ohm/km) 48.2307 — Nominal Outer shield resistance - DCR @ 20 °C (Ohm/km) 16.405 — Operating voltage - 300 V RMS (UL AWM Style 2464) — Current 2.4 Amps per conductor @ 25 °C (recommended) Ethernet cable • Cat-5 Standard 100 Mbps Frequency (see Table 3-1) • 22 AWG wire characteristics are as follows: — Capacitance = 20 pF/ft or 20 nF/1000 ft (between two wires) — Resistance = 0.0168 Ohms/ft or 16.8 Ohms/1000 ft. — Pull-up voltage is 24 Vdc
Temperature flameproof transmitter electronic enclosure and base electronic enclosure	• Ambient: -40 °F to 140 °F (-40 °C to 60 °C) • Storage: -58 °F to 185 °F (-50 °C to 85 °C) **Note** The transmitter electronics enclosure and base enclosure must be remote mounted if the operating temperature exceeds 140 °F (60 °C).

Table 1-2: Meter specifications *(continued)*

Liquid Ultrasonic Flow Meter specifications	
Transducers	• LT-10 and LT-11 Operating temperature range with NBR O-rings -58 °F to +275 °F (-50 °C to 135 °C) • LT-10 and LT-11 Operating temperature range with FKM O-rings -40 °F to +302 °F (-40 °C to +150 °C) **Note** The process temperature must not exceed the operating temperature range of the transducers. **Note** LT-10 transducers are designed for 4 inch to 10 inch meters. LT-11 transducers are designed for 12 inch and larger meters. **Note** The ultrasonic transducers are not intended for use across boundary walls of different hazardous area classifications. The transmitter electronics cannot be remote mounted from a Division 1 classification to a Division 2 area to meet an area classification.
Acquisition Cable	• Total cable length between the Acquisition Module and ultrasonic transducers must not exceed 15 feet (4.7 meters) when using the remote mount option (see Figure 1-7).
Communications specifications	
Connectivity protocols	One serial RS-232/RS-485 port (115 kbps baud rate) (Modbus RTU/ASCII) • (1) Serial Port A (RS-232/RS-485 Full Duplex/ RS-485 Half Duplex)
	One Ethernet Port (TCP/IP) 100 BaseT • Modbus TCP
Device compatibility	FloBoss 103, FloBoss S600 flow computer, ROC 107
Digital, analog, and frequency inputs	
Digital Input(s) (Selectable)	(1) Single polarity (for flow calibration gating - contact closure) • Single input for starting and stopping • Four pulse configurations available

Table 1-2: Meter specifications *(continued)*

Liquid Ultrasonic Flow Meter specifications	
Analog Input(s)	(2) 4-20 mA • AI-1 Temperature • AI-2 Pressure **Note** The analog-to-digital conversion accuracy is within ±0.05% of full scale over the operating temperature range. **Note** AI-1 and AI-2 are electronically isolated and operate in sink mode. The input contains a series resistance so HART® Communicators can be connected to configure sensors. A 24 Volt DC power supply is available to provide power to the sensors.

Table 1-2: Meter specifications *(continued)*

Liquid Ultrasonic Flow Meter specifications	
Digital, analog, and frequency outputs	
Frequency/Digital Output(s)	The meter has user-configurable selections for either a frequency output or Digital status (FODO) (Also see Frequency/Digital outputs.) (3) Frequency/Digital Outputs • FODO1 (four possible output configurations) • FODO2 (eight possible output configurations) • FODO3 (eight possible output configurations) Frequency or Digital Output parameter pairs (see Frequency/Digital outputs.) Frequency or Digital Outputs (FODO 1) source selections: • (FO1A, DO1A, FO1B, DO1B) Frequency or Digital Outputs (FODO 2) source selections • (FO1A, DO1A, FO1B, DO1B, FO2A, DO2A, FO2B, DO2B) Frequency or Digital Outputs (FODO 3) source selections • (FO1A, DO1A, FO1B, DO1B, FO2A, DO2A, FO2B, DO2B) Mode options: • Open Collector (requires external excitation supply voltage and pull-up resistor) • TTL (internally powered by the meter 0-5 Vdc signal) Channel B Phase options: • Lag forward, Lead reverse (Phase B lags Phase A while reporting forward flow, leads Phase A while reporting reverse flow) • Lead forward, Lag reverse (Phase B leads Phase A while reporting forward flow, lags Phase A while reporting reverse flow) Phase A and Phase B output (based on flow direction) • Reverse flow - Output only reports flow in the reverse direction. For frequency outputs, Phase B of the output is 90 degrees out of phase with Phase A. • Forward flow - Output only reports flow in the forward direction. For frequency outputs, Phase B of the output is 90 degrees out of phase with Phase A. • Absolute - Output reports flow in both directions. For frequency outputs, Phase B of the output is 90 degrees out of phase with Phase A.

Table 1-2: Meter specifications *(continued)*

Liquid Ultrasonic Flow Meter specifications	
	• Bidirectional - Output reports flow on Phase A only in the forward direction and on Phase B only in the reverse direction. Maximum frequency for the frequency outputs: • 1000Hz • 5000Hz
Analog Output(s)	• (1) 4-20 mA independently configurable analog output (HART®) • (1) 4-20 mA independently configurable analog output (conventional) The analog output zero scale offset error is within ±0.1 percent of full scale and gain error is within ±0.2 percent of full scale. The total output drift is within ±50 ppm of full scale per °C.

1.8 Pre-installation considerations

- Pipeline equipment code compliance, ANSI, ASME, etc.
- Proper inlet/outlet meter tube piping for reasonable stable flow to the settling chamber (first meter tube spool upstream of the meter).
- Electrical safety compliance: UL, CSA, ATEX, IECEx etc.
- Civil and structural good practices compliance
- Contractual agreements or governmental compliance (or both)
- In-situ performance test procedures
- Field tested advanced meter health and flow dynamics diagnostics
- Data collection and retention procedures

1.9 Safety conditions

The Rosemount 3812 Liquid Ultrasonic Flow Meter is suitable for use in U.L. Class 1, Division 1, Group C and D hazardous locations.

⚠ WARNING

DANGER TO PERSONNEL AND EQUIPMENT
Observe all precautionary labels posted on the equipment and safety messages throughout the meter documentation.

Failure to comply may result in injury to personnel or cause damage to the equipment.

Rosemount 3810 Series Liquid Ultrasonic Meters are approved to the ATEX Directive 94/9/EC.

Refer to the 3810 Series Systems Wiring Diagram, Sheet 3 (DMC-004936) for the certification tag (see Engineering Drawings).

Rosemount 3810 Series Liquid Ultrasonic Meters are INMETRO certified. Refer to the 3810 Series Liquid Ultrasonic Flow Meter Tag, INMETRO Certification drawing DMC-006173.

Certificate number: NCC 11.0163 X

Marking: Ex d ia IIB T4 Gb IP66 W

Electrical parameters: Refer to Meter specifications, Table 1-2.

Special conditions for safe use

- Explosion proof joint dimensions are compliant with the Brazilian Association of technical standard: ABNT NBR IEC 60079-1, Table 3.
- The enclosure for the explosion proof transmitter and intrinsically safe barrier must be remote mounted (Refer to Meter specifications, Table 1-2) if the operating temperature exceeds 140 °F (60 °C).
- Cable length (refer to Meter specifications, Table 1-2).

1.10 Certifications and approvals

Rosemount 3810 Series Liquid Ultrasonic Flow Meters have electrical, metrology, intrinsic safety and Pressure Equipment Directive certifications, approvals and lab testing and calibration certifications by the agencies listed below. Refer to the nameplate tag on the meter body, the wiring diagram (Drawing DMC-0004936) in Engineering Drawings and observe all safety precautions. Rosemount 3810 Series Liquid Ultrasonic Flow Meters operate within the pressure and temperature range of the device (also see Meter specifications).

The Rosemount 3810 Series Liquid Ultrasonic Flow Meters certifications and approvals are available from Emerson.

- ATEX (British Approval Service for Electrical Equipment in Flammable Atmospheres)
- IECEx (International Electrotechnical Commission for explosive atmospheres)
- U.L. (Underwriter Laboratories)
- U.L.C. (Underwriter Laboratories of Canada)
- PED (BSI Group) British Standards Institution
- INMETRO (National Institute of Metrology, Quality and Technology)
- Demko (Dansk Elektrisk Materiel Kontrol - Danish Electrical Equipment Supervision)
- GOST R (Government Standard Russia)
- L.A.B. (Laboratory Accreditation Bureau) ISO/IEC 17025:2005

1.11 FCC compliance

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment.

This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

NOTICE

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

2 Mechanical Installation

2.1 Meter piping, lifting and mounting

Refer to the following sections for piping recommendations, lifting with hoist rings and slings, mounting in cooled pipelines and safety warnings and precautions.

⚠ WARNING

CUTTING HAZARD
Sharp edges may be present on the meter.

Wear appropriate personal protective equipment when working on the meter.

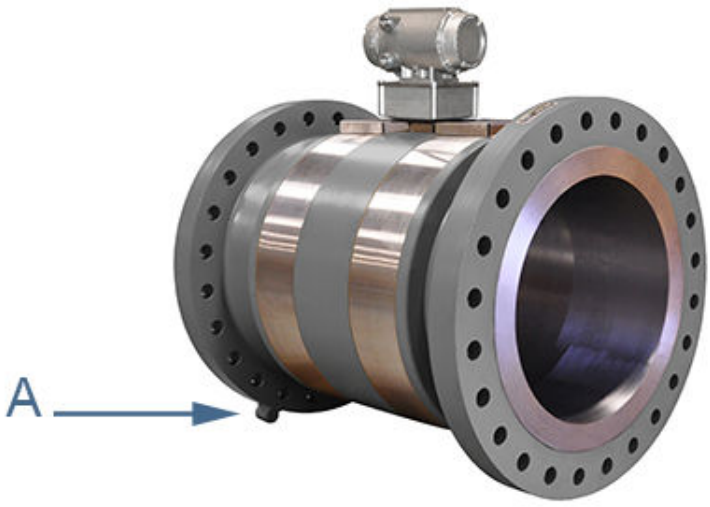
Failure to comply can cause serious injury to personnel.

⚠ WARNING

CRUSHING HAZARD

Do not remove flange stabilizers.

Attempting to do so may allow the meter to roll, resulting in serious injury or equipment damage.



A. Flange stabilizers

⚠ CAUTION

SURFACE TEMPERATURE HAZARD
Meter body and piping may be extremely hot or cold.

Wear appropriate personal protective equipment when coming in contact with the meter.

Failure to comply may result in injury.

⚠ CAUTION

TRIPPING HAZARD
Clear all obstacles or obstructions from the work area when transporting, installing or removing the meter.

Failure to comply may cause injury to personnel.

⚠ CAUTION

TRANSPORTATION HAZARD
When moving the meter, do not insert the forks of a forklift into the bore.

Inserting the forks may cause the meter to become unstable, resulting in injury to personnel or damage to the bore and sealing face.

Consult your Emerson Flow Service representative to ensure you purchase the correct components and seals for your application.

2.2 Meter components

⚠ WARNING

FLUID CONTENTS MAY BE UNDER PRESSURE

When the meter is under pressure, DO NOT attempt to remove or adjust the transducer housing.

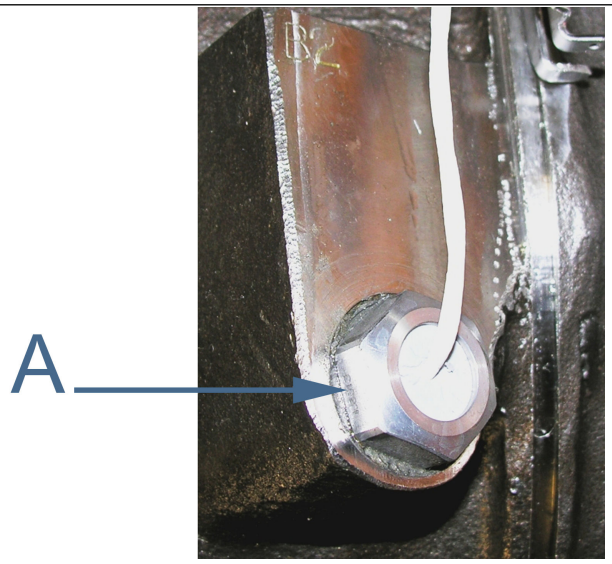
Attempting to do so may release pressurized fluid, resulting in serious injury for personnel or equipment damage.

⚠ WARNING

FLUID CONTENTS MAY BE HAZARDOUS

The meter must be fully depressurized and drained before attempting to remove the transducer housing. If fluid begins to leak from the transducer housing, immediately reinstall it.

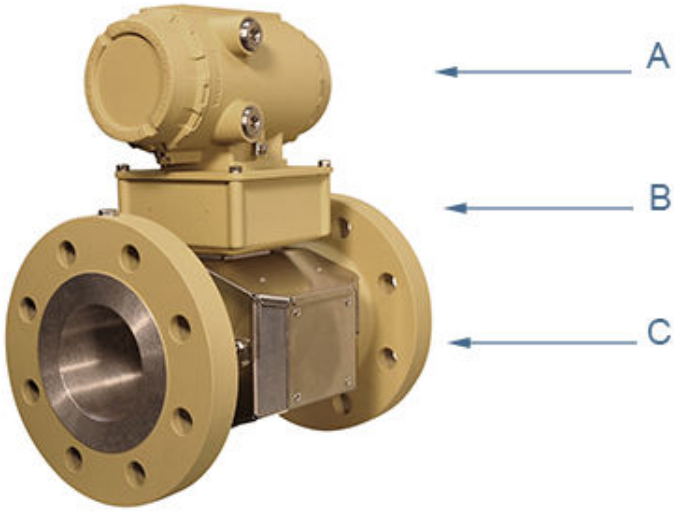
Failure to comply may cause serious injury to personnel or equipment damage.



A. Transducer housing and meter body joint

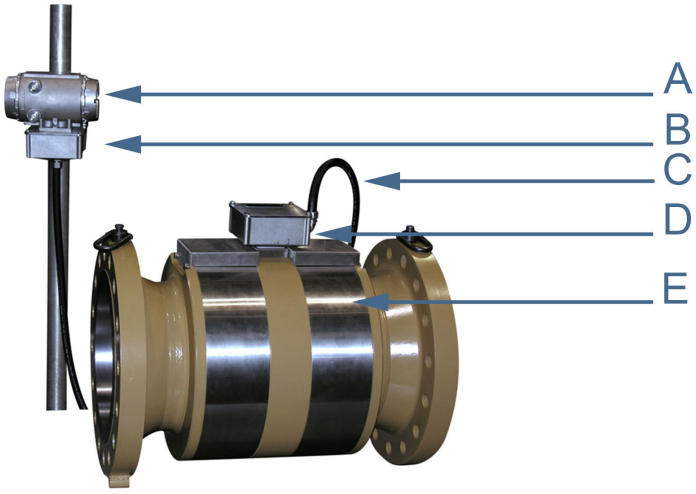
Rosemount Liquid Ultrasonic Flow Meters are assembled, configured, and tested at the factory. The meter components include the transmitter electronics enclosure, the base electronics enclosure, the meter body with shroud covers for the transducers and cable assemblies and a direct or remote mount option.

Figure 2-1: Direct mount meter electronics assembly with split shroud



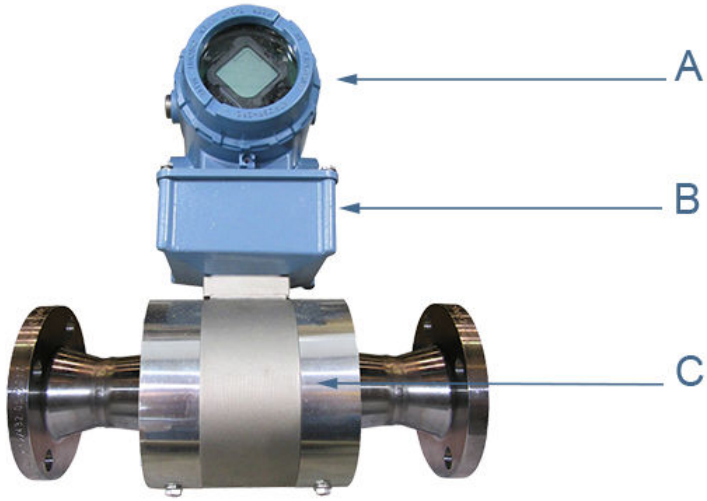
A. Direct mount- explosion-proof transmitter enclosure (CPU Module, Power Supply, I.S. Barrier Board, Backplane Board, and optional LCD Display Board with glass end cap)
B. Intrinsically-safe base enclosure includes Acquisition Module
C. Meter-body and split shroud cover for transducers and cables assemblies

Figure 2-2: Remote mount meter electronics assembly with split shroud



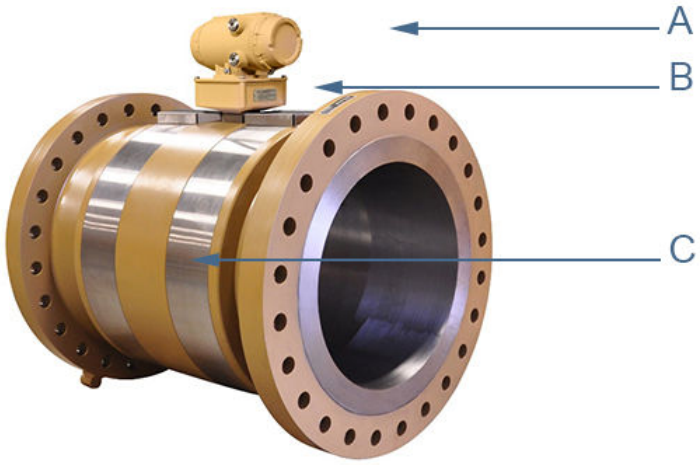
A. Remote mount explosion-proof transmitter enclosure (CPU Module, Power Supply, I.S. Barrier Board, Backplane Board and optional LCD Display Board)
B. Intrinsically-safe base enclosure includes Acquisition Module
C. Acquisition cable conduit
D. Junction box with acquisition cable terminal blocks
E. Meter-body and split shroud cover for transducer assemblies and cables

Figure 2-3: Direct mount meter electronics with bolted band shrouds



A. Explosion-proof transmitter enclosure (CPU Module, Power Supply, I.S. Barrier Board, Backplane Board and optional LCD Board with glass end cap)
B. Intrinsically-safe base enclosure includes Acquisition Module
C. Meter-body and split shroud cover for transducers and cables assemblies

Figure 2-4: Direct mount meter electronics assembly with clamped band shrouds



A. Explosion-proof transmitter enclosure (CPU Module, Power Supply, I.S. Barrier Board and Backplane Board).
B. Intrinsically-safe base enclosure includes Acquisition Module
C. Meter-body and split shroud cover for transducers and cables assemblies

Table 2-1: 3812 Ultrasonic Meter shrouds options per ANSI pressure rating

Meter body size	ANSI pressure rating	Shroud type
2 - 3-in.	150 and 300	Bolted band shroud or latched band shroud

Table 2-1: 3812 Ultrasonic Meter shrouds options per ANSI pressure rating *(continued)*

Meter body size	ANSI pressure rating	Shroud type
4 - 10-in.	150 and 300	Split shroud or latched band shroud
	600 and 900	Clamped band shroud
12-in. and larger	150, 300, 600, 900	Clamped band shroud

2.3 Piping recommendations

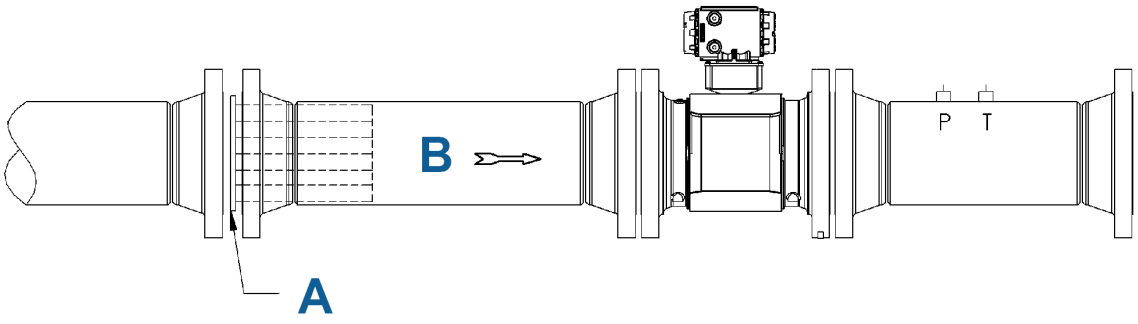
⚠ WARNING

BURST HAZARD

Before pipeline cleaning and maintenance (“pigging operations”), remove straightening vanes or flow conditioners.

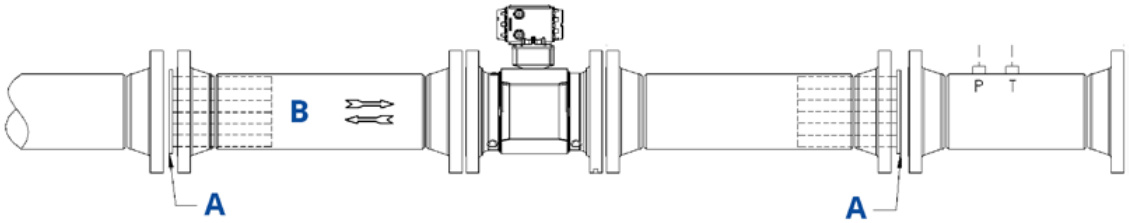
Failure to comply may cause excessive pressure in the meter system, resulting in death, serious injury or equipment damage.

Figure 2-5: 3812 Ultrasonic Flow Meter with flow conditioner for unidirectional flow



A. Flow conditioner straightening device
B. Flow

Figure 2-6: 3812 Ultrasonic Flow Meter with flow conditioner for bidirectional flow



A. Flow conditioner straightening device
B. Flow

Sunshields, provided by the customer, may be required to prevent exceeding the process fluid temperature when the meter is mounted in a location with extremely hot climates.

⚠ CAUTION

SUNSHIELD PROTECTION

Install a sunshield to prevent prolonged exposure to direct sunlight in extreme climates.

Failure to shield the meter may result in exceeding the process temperature range and damage transmitter electronics.

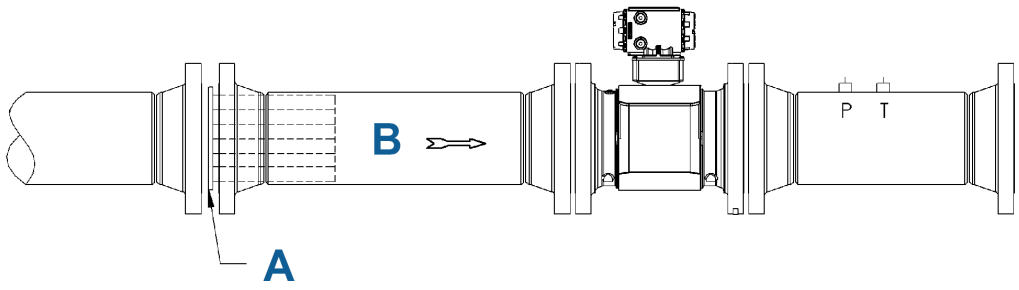
NOTICE

For optimal flow measurement conditions, Emerson suggests the piping configurations below. Regardless of the configuration selected, the user agrees to accept full responsibility for the site piping design and installation.

Flow conditioning is recommended for best measurement results.

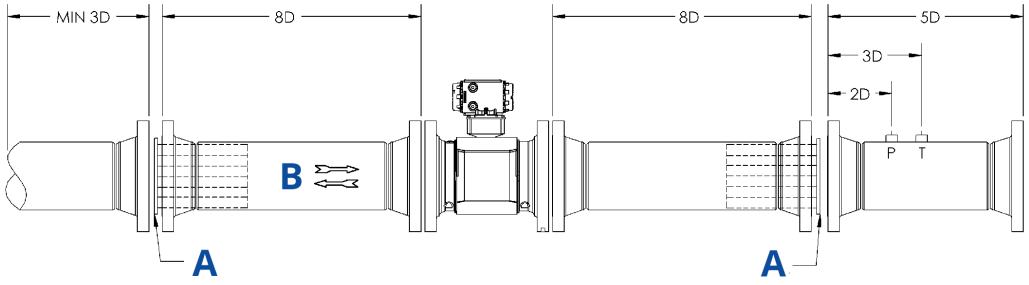
- Honed or un-honed meter tube(s)
- Flow direction (uni-directional or bi-directional)
- Correct meter size selection - Too low may cause poor flow stability (thermal convection or too fast may cause erosion problems and resonance, cracks or failure of probes or thermowells (approximately 0.6 to 12 m/sec or 2 to 40 ft/sec).
- Space availability for meter lengths (to allow inlet piping customization)
- Concentric alignment pins or flange concentricity technique considerations

Figure 2-7: Piping recommendations uni-directional flow



A. Flow conditioner straightening device
B. Flow

Figure 2-8: Piping recommendations bi-directional flow



1. Flow conditioner straightening device
2. Flow

All pipe lengths are minimum:

- D = Nominal pipe size in inches (i.e. 6-in pipe size; 10 D = 60-in)
- P = Pressure measurement location
- T = Temperature measurement location

Refer to the ultrasonic meter product data sheet for piping information. The Liquid Ultrasonic Flow Meter Datasheet may be downloaded from the Emerson website: Rosemount 3812 Two-Path Liquid Ultrasonic Flow Meter product data sheet

NOTICE

To access the product datasheet, select the Rosemount Liquid Ultrasonic Flow Meter link, click the Documentation tab, expand the Data Sheets - Bulletins - Catalogs tab, then select the Data Sheet.

Meter tube dimensions with tube bundle or profiler plate for uni-directional and bi-directional flow, the minimum straight pipe length is as follows:

Table 2-2: Piping recommendation for uni-directional or bi-directional flow

Uni-Directional Flow	Bi-Directional Flow
8D up stream (with a flow conditioner)	8D up stream (with a flow conditioner)
8D up stream (no flow conditioner)	8D up stream (no flow conditioner)
5D in front of flow conditioners if used	5D in front of flow conditioners if used

- The bore of the mating piping should be within 1% of the meter inside diameter.
- The meter is provided with dowel pins to align the meter body bore with the bore of the mating piping.
- The Rosemount Liquid Ultrasonic Flow Meter should be mounted in horizontal piping with the chord paths horizontal.

⚠ CAUTION

FAULTY METER INSTALLATION
Correctly install the equipment. If meter bodies are mounted or oriented differently than specified above, debris may collect in the transducer ports.

Failure to comply may cause equipment damage or adversely affect the transducer signals.

- Normally, the meter body is installed so that the electronics assembly is on the top of the meter. If there is insufficient space above the piping for this arrangement, the meter can be ordered with extra long transducer cables for remote mounting or the meter housing can be installed with the electronics assembly on the bottom.
- The mating piping should include temperature and pressure measurement connections located a minimum of two nominal pipe diameters length down stream of the meter, or per API MPMS 5.8.

2.4 Meter safety for hoist rings and lifting slings

A Rosemount Liquid Ultrasonic Flow Meter can be safely lifted and maneuvered into and out of a meter run for installation or service by obeying the following instructions.

⚠ WARNING

FALLING AND CRUSHING HAZARD
Lifting a Rosemount Ultrasonic Meter with Other Equipment

The following lifting instructions are for installation and removal of the Rosemount 3812 Liquid Ultrasonic Meter ONLY. The instructions below do not address lifting the Rosemount Ultrasonic Meter while it is attached, bolted, or welded to meter tubes, piping, or other fittings.

The operator must refer to their company's hoisting and rigging standards, or the "DOE-STD-1090-2004 Hoisting and Rigging" standard if such company standards do not exist, for lifting and maneuvering any assembled meter tube and associated piping.

Using these instructions to maneuver the Rosemount Ultrasonic Meter while it is still attached, bolted, or welded to a meter tube, piping, or other fitting can result in death, serious injury or equipment damage.

⚠ WARNING

CRUSHING HAZARD
During meter installation or removal, always place the unit on a stable platform or surface that supports its assembled weight. Provide support for the dual transmitter electronics assemblies during installation and removal.

Failure to comply can cause the meter to roll and the electrical wiring conduit connections to be severed, resulting in serious injury or equipment damage.

NOTICE

Prior to lifting the unit, refer to the Rosemount 3812 Liquid Ultrasonic Flow Meter nameplate or outline dimensional (general arrangement) drawing for the assembled weight.

When lifting a Rosemount Ultrasonic Meter by itself, Emerson recommends two methods. These methods are:

- Using appropriately rated Safety Engineered Swivel Hoist Rings installed in the Rosemount Ultrasonic Meter end flanges.
- Using appropriately rated lifting slings positioned at designated areas of the Rosemount Ultrasonic Meter.

Both methods must be used in conjunction with all appropriate company hoisting and rigging standards or the DOE-STD-1090-2004 HOISTING AND RIGGING standard if such company standards do not exist. Refer to the following sections for more information on these two methods.

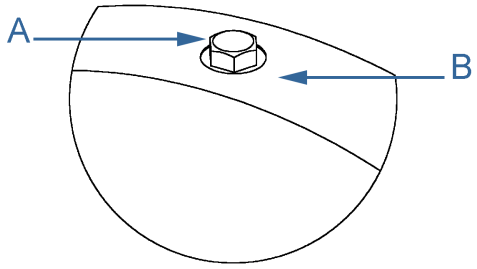
2.4.1 Use of appropriate safety engineered swivel hoist rings in meter end flanges

Rosemount Ultrasonic Meters come equipped with a tapped hole located on the top of each meter body end flange. A flat machined surface surrounds each tapped hole (see Figure 2-9). This feature provides complete surface contact ONLY between the meter flange and an OSHA compliant Safety Engineered Swivel Hoist Ring as shown in Figure 2-10.

Operators SHALL NOT use Eye Bolts (see Figure 2-10) in the Rosemount 3812 Liquid Ultrasonic Meter flange tapped holes to aid in lifting or maneuvering the unit.

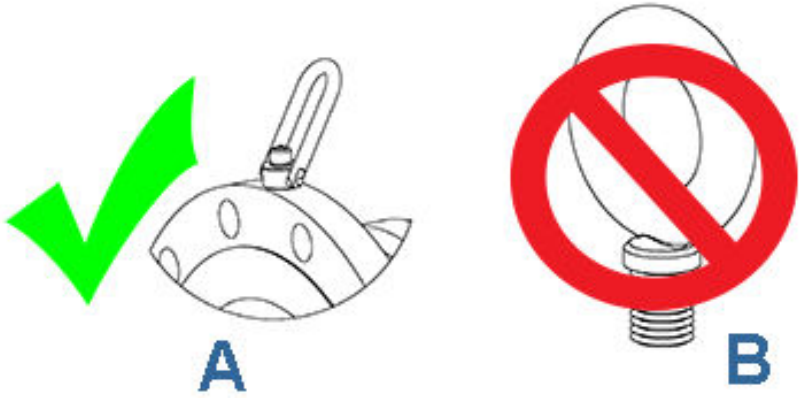
Operators SHALL NOT use other Hoist Rings that do not fully seat flush with the counter bore on the top of the meter flanges.

Figure 2-9: Meter end flange with tapped flat-counterbore hole for hoist ring



A. Plug bolt
B. Flat counterbore surface

Figure 2-10: Safety approved hoist ring and non-compliant eye bolt



A. Safety engineered swivel hoist ring
B. Eye bolt

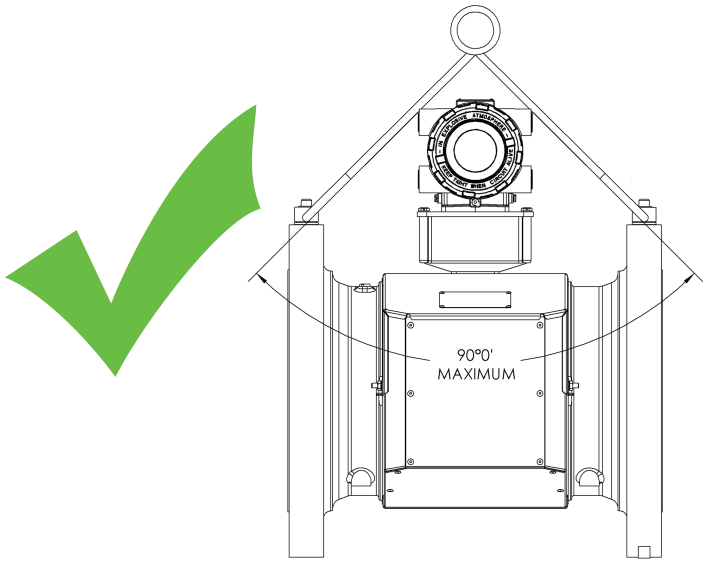
Safety precautions using safety engineered swivel hoist rings

Read and follow the safety precautions listed below:

Procedure

1. Meters must only be lifted by personnel properly trained in the safe practices of rigging and lifting.
2. Remove the plug bolts installed in the tapped holes on the top of the flanges. Do not discard the bolts as they must be reinstalled once the lifting operation is complete to prevent corrosion of the tapped holes.
3. Ensure the tapped holes on the meter are clean and free of debris before installing the hoist rings.
4. Use only the safety engineered swivel hoist rings that are rated for lifting the meter. Do not use any other type of hoist rings with the same screw size or heavy duty hoist rings. The meter tapping and counter bore size are suitable only for the hoist rings specified by Emerson.
5. When installing a hoist ring, make sure the base surface of the hoist ring fully contacts the machined flat surface of the tapped hole. If the two surfaces do not come in contact then the hoist ring will not hold its full rated load. Torque the hoist ring attachment bolts to the limit indicated on the hoist rings.
6. After installation of the hoist rings, always check that the ring rotates and pivots freely in all directions.
7. NEVER attempt to lift the meter using only one hoist ring.
8. Always use separate slings to each hoist ring. NEVER reeve one sling through both hoist rings. The slings must be of equal length. Each sling must have a load rating that equals or exceeds the hoist ring load rating. The angle between the two slings going to the hoist rings must never exceed 90 degrees or the load rating of the hoist rings will be exceeded.

Figure 2-11: 90 Degree angle between slings

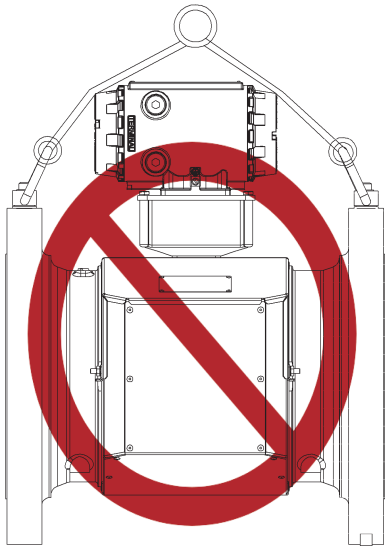


9. *Direct mount option*: NEVER allow the slings to contact the electronics enclosure. Damage to the enclosure may occur. Use a spreader bar with the slings to prevent contact with the electronics enclosure and the base enclosure (see Figure 2-13). If the slings do come in contact with the electronic enclosure then remove the four bolts holding the enclosure to its base and temporarily remove the head from the meter during the lifting operation. You will need to unplug the cable on the Acquisition Module. Two screws hold this cable in place. Once the lifting operation is complete, reattach and secure the electronics cable on the Acquisition Module, return the electronics enclosure to its original position, replace the bolts, and secure the enclosure in place.

⚠ CAUTION

CRASHING HAZARD
Lifting the meter with the upper enclosure installed, but without the bolts installed, may cause the electronics to fall and cause personal injury or equipment damage.

Figure 2-12: Sling contacting electronics enclosure



10. *Remote mount option*: Always use separate slings for each hoist ring. NEVER reeve one sling through both hoist rings. The slings must be of equal length. Each sling must have a load rating that equals or exceeds the hoist ring load rating. The angle between the two slings going to the hoist rings must never exceed 90 degrees or the load rating of the hoist rings will be exceeded.

⚠ CAUTION

EQUIPMENT DAMAGE HAZARD
DO NOT drag the transmitter electronics enclosure during lifting operation. Support the transmitter electronics while lifting the meter body.

Failure to comply may cause damage to the equipment.

NOTICE

Remove conduit tie wraps from the junction box prior to powering the meter. Tie wraps placed on the junction box conduit for protection during shipping must be removed before the meter is powered.

11. NEVER apply shock loads to the meter. Always lift the meter gradually. If shock loading ever occurs, the hoist ring must be inspected per manufacturer's recommendations prior to be placed in any further service. If a proper inspection cannot be performed, discard the hoist ring.
12. NEVER lift with any device, such as hooks, chains, or cables that could create side pulls that could damage the ring of the hoist ring.
13. NEVER lift more than the ultrasonic meter assembly including electronics and transducers with the hoist rings. The only exception is that it is safe to lift the meter with one ASME B16.5 or ASME B16.47 blind flange bolted to each end flange of the meter. NEVER use the hoist rings on the meter to lift other components such as meter tubes, piping or fittings attached to the meter. Doing so will exceed the load rating of the hoist rings.

14. Remove the hoist rings from the meter after lifting is completed and store them in an appropriate case or container per their manufacturer's recommendation.
15. Apply heavy lubricant or anti-seize to the threads of the plug bolts and reinstall the plug bolts to keep the tapped holes free of debris and to prevent corrosion.

Obtain safety engineered swivel hoist rings

A list of approved manufacturers of safety engineered hoist rings is below:

- American Drill Bushing
- Carr Lane

Select an approved supplier from the list below. These vendors can supply the safety engineered hoist rings. This is not intended to be a complete list.

- Fastenal
- Reid Supply

The appropriate hoist rings can also be purchased directly from Emerson. The following table provides part number for reference:

Table 2-3: Hoist ring part number lookup table

Rosemount Part number(1)	Hoist ring thread size & load rating(1)	American Drill Bushing Co. P/N(1)	Carr Lane Manufacturing Co. P/N(1)
1-504-90-091	3/8 in.-16UNC, 1000 lb.	23053	CL-1000-SHR-1
1-504-90-092	½ in.-13UNC, 2500 lb.	23301	CL-23301-SHR-1
1-504-90-093	¾ in. -10UNC, 5000 lb.	23007	CL-5000-SHR-1
1-504-90-094	1 in. -8UNC, 10000 lb.	23105	CL-10000-SHR-1
1-504-90-095	1.5 in. -6UNC, 24000 lb.	23202	CL-24000-SHR-1

(1) The part numbers include only one hoist ring. Two hoist rings are required per meter.

Size needed for engineered swivel hoist ring

To determine the size of the hoist rings required for your meter, use the table below for the 3812 Liquid Ultrasonic Meter. The part number shown in Table 2-4 is appropriately rated for the ANSI rating of your meter.

Table 2-4: Hoist ring lookup table for Rosemount 3812 Liquid Ultrasonic Flow Meters

ANSI 150	ANSI 300	Part Number
4 in. - 10 in. (101.6 mm - 254 mm)	4 in. - 10 in. (101.6 mm - 254 mm)	1-504-90-091

2.4.2 Use of appropriately rated lifting slings

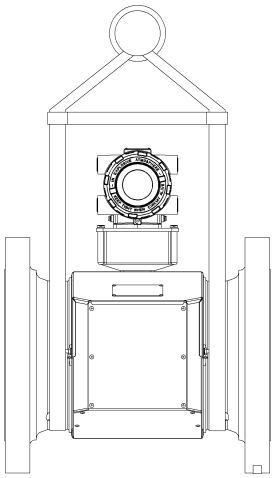
The following instructions are intended to provide general guidelines for proper lifting slings of the Rosemount 3812 Ultrasonic Meter by itself. These instructions are intended to be followed in addition to your company's standards or the DOE-STD-1090-2004 Hoisting and Rigging standard if such company standards do not exist.

Safety precautions using appropriate rated lifting slings

Procedure

1. Only personnel properly trained in the safe practices of rigging and lifting are allowed to perform lifting operations.
2. NEVER attempt to lift the meter by wrapping slings around the electronics enclosures.
3. NEVER attempt to lift the meter using only one sling around the meter. Always use two slings wrapped around each end of the body as shown in Figure 2-13. A choker style sling is recommended.

Figure 2-13: Correct sling attachment with spreader bar

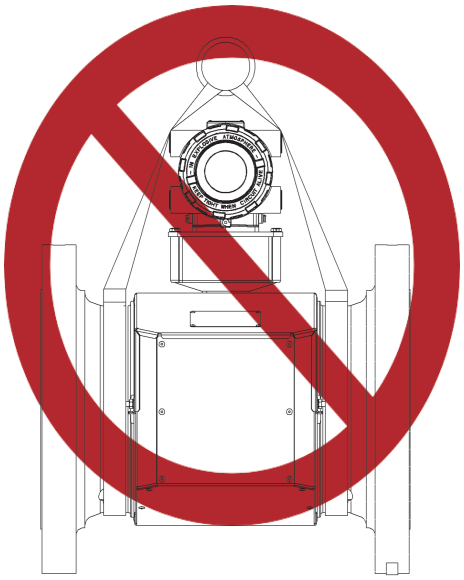


4. Visually inspect the slings prior to use for any signs of abrasion or other damage. Refer to the sling manufacturer's procedures for proper inspection of the particular sling you are using.
5. Only use slings with ratings that exceed the weight to be lifted. Reference your company's standards for safety factors that must be included when calculating the load rating.
6. **NOTICE**

   NEVER allow the slings to contact the electronics enclosure or the transducer shrouds. Damage to the meter may occur.

   If the slings do come in contact with the electronics or the shroud, temporarily remove the head from the meter during the lifting operation (remove the four bolts holding the enclosure to its base and unplug the cable from the Acquisition Module. Two screws hold this cable in place.) Use a spreader-bar on the sling (see Figure 2-13) to prevent contact with the electronics or the transducer shroud.
7. Once the lifting operation is complete, reattach and secure the electronics cable to J3 on the Acquisition Module, return the electronics enclosure to its original position, replace the bolts, and secure the enclosure in place. Lifting the meter with the upper enclosure installed but with out the bolts installed, may cause the electronics to fall and cause personal injury or electronics damage.

Figure 2-14: Incorrect sling attachment



8. NEVER apply shock loads to the meter. Always lift the meter gradually. If shock loading ever occurs, the slings must be inspected per manufacturer's procedures prior to being placed in any further service.

2.5 Mounting requirements in heated or cooled pipelines

The ambient operating temperature of the 3812 Liquid Allocation electronics (i.e. Flameproof enclosure and Intrinsically safe base enclosure) is -40 °F to 140 °F (-40 °C to 60 °C).

If the meter is installed into a pipeline which is heated or cooled outside this temperature range, it is necessary to remove the Transmitter Electronics enclosure from the meter body (i.e. Spool piece acting as process fluid conduit) and mount it next to the meter body on a pipe stand or other rigid structure. The process temperature must also not exceed the operating temperature range of the transducers. LT-10 and LT-11 operating temperature range -58 °F to 275 °F (-50 °C to 135 °C) with NBR O-rings and operating temperature range -40 °F to 302 °F with FKM O-rings (-40 °C to 150 °C).

⚠ CAUTION

SURFACE TEMPERATURE HAZARD

The meter body and piping may be extremely hot or cold. Wear appropriate personal protective equipment when coming in contact with the meter.

Failure to comply may result in injury.

3 Electrical Installation

3.1 Cable length TTL mode

When the “TTL” mode is selected, the maximum cable length is 2,000 ft.

3.2 Cable length Open Collector mode

For the “open collector” mode, the maximum cable length depends on the cable parameters, pull-up resistance used, the maximum frequency to output, and frequency input parameters being driven. The following table provides estimated cable lengths for different pull-up resistor values and different Max Frequency settings in the meter using the following cable parameters. The table also provides an estimated cable voltage drop which indicates how much voltage will be across the cabling and effectively indicates to what voltage level the frequency input can be pulled down to by the frequency output.

If the voltage drop is higher than the voltage required for the frequency input to see a low state, then the configuration will most likely not work for your system. Performance of frequency outputs will vary from this table with setup and frequency input being driven.

Table 3-1: Configurations for open collector frequency outputs

Cable	Cable resistance	Cable	Pull-up resistance	Total	Maximum frequency	Sink	Cable voltage drop
Length	(2 Conductors)	Capacitance	Resistance	Resistance	Frequency	Current	(2 Conductors)
(x1000 ft.)	Ω	nF	Ω	Ω	(Hz)	(A)	Vdc
0.5	16.8	10.00	1000	1016.8	5000	0.024	0.397
1	33.6	20.00	1000	1033.6	1000	0.023	0.780
2	67.2	40.00	1000	1067.2	1000	0.022	1.511
4	134.4	80.00	1000	1134.4	1000	0.021	2.843
0.5	16.8	10.00	500	516.8	5000	0.046	0.780
1	33.6	20.00	500	533.6	5000	0.045	1.511
1.7	57.12	34.00	500	557.12	5000	0.043	2.461
6.5	218.4	130.00	500	718.4	1000	0.033	7.296

The 22 AWG wire characteristics are as follows:

- Capacitance = 20 pF/ft. or 20 nF/1000 ft. (between two wires)
- Resistance = 0.0168 Ohms/ft. or 16.8 Ohms/1000 ft.
- Pull-up voltage is 24 Vdc

3.3 Grounding meter electronics

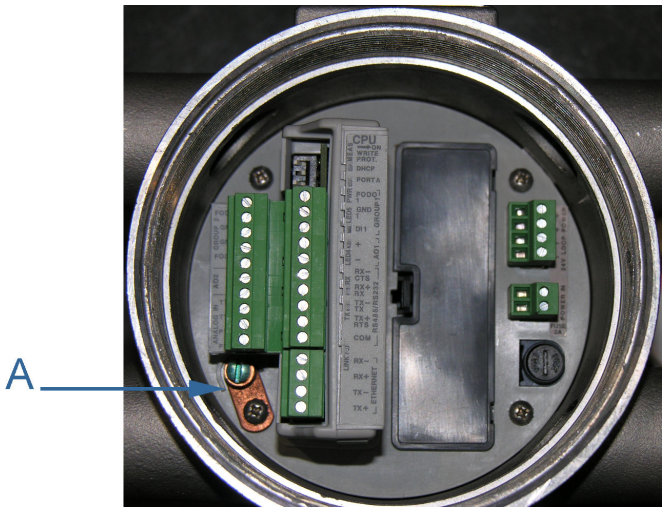
Rosemount 3812 Liquid Ultrasonic Flow Meter electronics should be internally grounded for intrinsically safe operations. Connect a wire to the chassis ground lug installed inside

the Transmitter Electronics Enclosure as the primary ground. A secondary ground is located outside of the Transmitter Electronics Enclosure (see Figure 3-2). Digital grounds should never be connected to chassis ground.

NOTICE

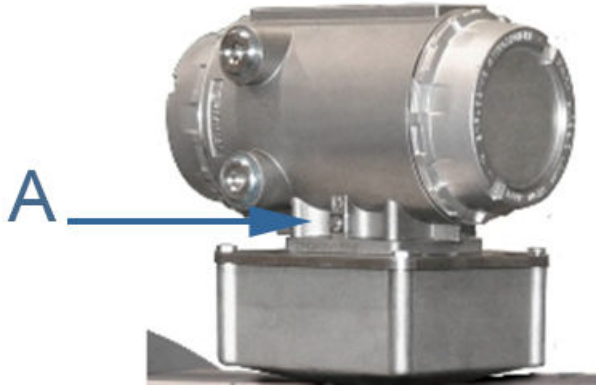
The internal grounding terminal shall be used as the primary equipment ground. The external terminal is only a supplemental bonding connection where local authorities permit or require such a connection.

Figure 3-1: Internal Transmitter Electronics Enclosure chassis ground



A. Transmitter Electronics Enclosure internal ground lug

Figure 3-2: External ground lug



A. External ground lug

3.4 Conduit seals

Rosemount 3812 Liquid Ultrasonic Meters require conduit seals for installations in hazardous environments. Adhere to safety instructions to protect personnel and equipment.

⚠ WARNING

HAZARDOUS VOLTAGE INSIDE
Do not open the Transmitter Electronics Enclosure when an explosive gas atmosphere is present. Disconnect equipment from supply circuit before opening.

Failure to remove power may result in death or serious injury.

⚠ WARNING

EXPLOSION HAZARD
Substitution of components may impair intrinsic safety. Do not disconnect equipment unless power has been removed or the area is known to be nonhazardous.

Failure to comply may result in death or serious injury.

3.4.1 Startup for systems using explosion-proof conduit

Procedure

1. Assemble flexible conduit (recommended by Emerson) to the Transmitter Electronics Enclosure. A conduit seal fitting is required within 18 in. (457 mm) of the enclosure.
2. Ensure all power to field wiring is turned **OFF**.

   ⚠ WARNING

   HAZARDOUS VOLTAGE INSIDE
   Do not open the Transmitter Electronics Enclosure when an explosive gas atmosphere is present. Disconnect equipment from supply circuit before opening.

   Failure to remove power may result in death or serious injury.

3. Remove the end cap nearest the conduit entry to gain access to the transmitter electronics.
4. Pull the wires.
5. Complete the field connection wiring according to the system wiring diagram (see Engineering Drawings).
6. Apply electrical power to the system to ensure the field connections are working correctly. Allow the system to run for the time specified by the customer (usually one week) and an electrician have fully tested the connections. After the Acceptance Test is witnessed and approved, seal the conduit.
7. Power down the system and apply the sealing compound to the conduit and allow to set in accordance with manufacturer specifications.
8. Install the security latches and wire seals on the Transmitter Electronics Enclosure end caps (see Direct or remote mount transmitter electronics enclosure seal).
9. If required, install the wire seals on the Base Enclosure hex head bolts and on the Shroud covering the meter body (see Base enclosure security seals).
10. Install the security wire seals on the shrouds covering the transducers and cables. Refer to the section appropriate for your meter design:
    - Section 3.7.4 “Bolted band shroud security seals”
    - Section 3.7.5 “Clamped band shroud security seals”
    - Section 3.7.6 “Split shroud security seals”

- Section 3.7.7 “Latched band shroud security seals”

11. Re-apply electrical power to the system.
12. Set or configure the meter using MeterLink. For additional installation information refer to the system wiring diagram (see Engineering Drawings), *MeterLink Software for Gas and Liquid Ultrasonic Meters Quick Start Manual* (00809-0100-7630). Use the MeterLink Field Setup Wizard to complete the configuration. Also see, Field Setup Wizard using MeterLink in this manual.

3.4.2 Startup for systems using flame-proof cable

Procedure

1. Check to make certain that all field wiring power is turned **OFF**.
2. Remove the end cap nearest the cable entries to gain access to the transmitter electronics.
3. Install the cable and cable gland.
4. Complete the field connection wiring.
5. Connect a flow computer to the communications line on the Rosemount 3812 Liquid Ultrasonic Flow Meter.
6. Apply electrical power to the system to ensure the field connections are working correctly. Allow the system to run for the time specified by the customer (usually one week) and an electrician have fully tested the connections. After the Acceptance Test is witnessed and approved, seal the conduit.
7. Power down the system and apply the sealing compound to the conduit and allow to set in accordance with manufacturer specifications.
8. If required, install the security latches and wire seals on the Transmitter Electronics Enclosure end caps (see Direct or remote mount transmitter electronics enclosure seal).
9. Install the wire seals on the Base Enclosure hex head bolts and on the Shroud covering the meter body (see Base enclosure security seals).
10. Install the security wire seals on the shrouds covering the transducers and cables. Refer to the section appropriate for your meter design:
    - Section 3.7.4 “Bolted band shroud security seals”
    - Section 3.7.5 “Clamped band shroud security seals”
    - Section 3.7.6 “Split shroud security seals”
    - Section 3.7.7 “Latched band shroud security seals”
11. Connect electrical power to the system.
12. Set or configure the software using MeterLink. For additional installation information, refer to the system wiring diagram (see Engineering Drawings), *MeterLink Software for Gas and Liquid Quick Start Manual* (00809-0100-7630). Use the MeterLink Field Setup Wizard to complete the meter configuration. Also see, Field Setup Wizard using MeterLink in this manual.

3.5 Wiring and I/O

MeterLink™ uses the TCP/IP protocol to communicate with the 960-24™ MSTS electronics instead of Modbus ASCII or RTU. The TCP/IP protocol only works across either Ethernet, RS-485 full duplex (i.e., four-wire), or RS-232. MeterLink can communicate with multiple

meters if they are multi-dropped using four-wire full duplex RS-485 mode. The meter electronics is HART® capable and provides communication flexibility with Rosemount 3812 Liquid Ultrasonic Flow Meters.

The HART® output provides communication with other field devices (e.g., AMS Trex Field Communicator and AMS Device Manager Software) and ultimately, communicates key diagnostic information through PlantWeb™ architecture.

NOTICE

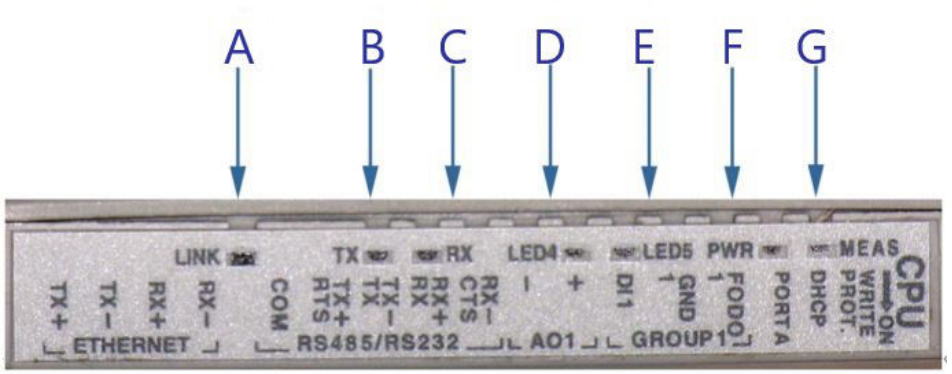
If not using Ethernet, a full duplex serial connection is necessary for MeterLink to communicate with a Rosemount 3812 Liquid Ultrasonic Meter.

The meter's electronics auto-detects the protocol used and automatically switches between TCP/IP, Modbus ASCII, and Modbus RTU so it is not necessary to make any meter configuration changes to change the protocol.

3.5.1 CPU Module labeling and LED indicators

The meter's metrology mode and the status of the data transfer from the Acquisition Module to the CPU Module is indicated via Light-Emitting Diode (LED) status indicators. The Write PROT. switch prevents overwriting the meter's configuration.

Figure 3-3: CPU Module labeling and LED indicators



A. Link (Eth1 Link) - User Ethernet connection
B. TX (RS-485/RS-232) - Transmitting data
C. RX (RS-485/RS-232) - Receiving data
D. LED 4 - Not used
E. LED 5 - Not used
F. Power
G. Acquisition/Measurement mode

Table 3-2: CPU Module labeling and LED functions

CPU Module labeling and LED functions	Function	Switch position indicator or LED
WRITE PROT.	• Write-protect mode - With switch in the **ON** position (default setting) protects configuration and firmware overwrites. • To write configuration changes or download firmware to the meter, change the switch to the **OFF** position.	Switch position • **ON** - (Default setting) Enables write-protection of the configuration and firmware • **OFF** - Enables writing configuration changes or downloading firmware
DHCP	• Dynamic Host Protocol Server - Enables you to communicate with a Rosemount meter that is not connected to a network. • When the CPU Module switch is in the **ON** position, the meter is enabled to act as a DHCP server for a single DHCP client connected to the Ethernet port using a crossover cable. **Note** This should be used for peer to peer connections only. • When the connection is made, select to use the Meter Name in the meter instead of the Meter Directory Name in order to keep all log files and configurations separate from each meter.	Switch position • **ON** - The meter is enabled to act as a DHCP server for a single DHCP client • **OFF** - Disables the DHCP server
PORT A	• PORT A override - RS-232 serves as an override during meter commissioning to establish communications and in the event the user cannot communicate with the meter due to an inadvertent communication configuration change. The override period is for two minutes. • Supports: — Auto-detected ASCII (Start bit 1, Data Bit 7, Parity Odd/Even, Stop Bit 1) — RTU (Start Bit 1, Data Bit 8, Parity none, Stop Bit 1). — Modbus protocols • RS-232 Baud rate = 19,200 • Modbus ID = 32	Switch position • **ON** - Enables RS-232 PORT A override • **OFF** - (Default setting) Disables RS-232 PORT A

Table 3-2: CPU Module labeling and LED functions *(continued)*

CPU Module labeling and LED functions	Function	Switch position indicator or LED
MEAS	System color indicates metrology mode • Acquisition mode • Measurement mode	LED status • Red flashing LED • Solid red the Acquisition Module not communicating with the CPU Module • Green flashing LED
PWR	• 3.3 V Power Indicator	• Solid green
LED 4	• Not used	-
LED 5	• Not used	-
RX	• RX signal (Port A for RS485 or RS232 communication) receiving data	• Flashing green (when receiving data)
TX	• TX signal (Port A for RS485 or RS232 communication) transmitting data	• Flashing green (when transmitting data)
LINK	• ETH1Link user Ethernet connection	• Solid green

Ethernet communications

The Ethernet port IP address, subnet mask, and gateway address are software-configurable. In addition, a meter can be configured to act as a DHCP (Dynamic Host Configuration Protocol) server to assign an IP address to a PC or laptop running MeterLink™. The DHCP server facility is not intended to act as a general purpose DHCP server for a wider network. To this end, no user control is provided over the class or range of IP addresses the unit provides. A standard twisted pair (Cat-5) cable should be used for Ethernet wiring.

It is strongly recommended that the meter be configured using an independent (off-network) single host. After configuration of the Rosemount 3812 Liquid Ultrasonic Flow Meter, the DHCP option must be turned off if used on a LAN/WAN.

⚠ CAUTION

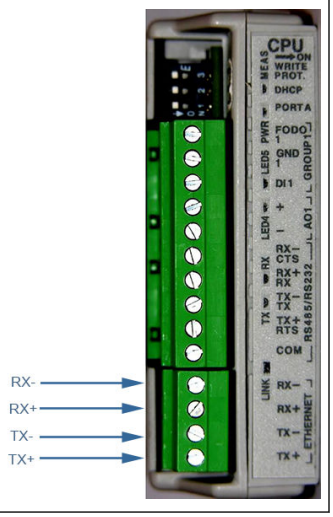
RESTRICT ETHERNET AND SERIAL CONNECTIVITY USAGE
User is responsible for ensuring that physical access and Ethernet or electronic access to the Rosemount 3812 Liquid Ultrasonic Flow Meter is appropriately controlled and any necessary security precautions, such as, establishing a firewall, setting password permissions and/or implementing security levels.

Failure to restrict Ethernet and communication access to the Rosemount 3812 Liquid Ultrasonic Flow Meter can result in, among other things, unauthorized access, system corruption, and/or data loss.

Use ethernet cable (P/N 1-360-01-596) to connect the PC to the meter.

Table 3-3: Ethernet cable to PC communication

Ethernet communication	
Wire color	CPU
White w/ Orange Stripe	TX+
Orange w/ White Stripe	TX -
White w/ Green Stripe	RX+
Green w/ White Stripe	RX -



A DIN 41612 48-pin connector is the interface from the CPU Module to the CPU Module to the Field Connection Board (male end located on the back of the Field Connection Board).

Serial connections

Use serial cable (P/N 3-2500-401) to connect to a PC running MeterLink™. The cable is designed for RS-232 communications which is the serial Port A default configuration (see Engineering Drawings field wiring diagram, Drawing DMC-005558). The DB-9 end of the cable plugs directly into the PC running MeterLink. The three wires on the other end of the cable connect to the CPU Module. The RED wire goes to RX, the WHITE wire goes to TX, and the BLACK wire goes to COM for the RS-485/RS-232 terminals (Table 3-4 for Port A wiring).

When Belden wire No. 9940 or equivalent is used, the maximum cable length for RS-232 communications at 9600 bps is 88.3 meters (250 ft.) and the maximum cable length for RS-485 communication at 57600 bps is 600 meters (1970 ft.).

Port A supports a special override mode which forces the port to use known communication values (19200 baud, address 32, RS-232). Note that the protocol is auto-detected. This mode is expected to be used during meter commissioning (to establish initial communication) and in the event that the user cannot communicate with the meter (possibly due to an inadvertent communication configuration change). Alternately, when using MeterLink with an Ethernet port, use Ethernet cable (P/N 1-360-01-596) to connect the PC.

Table 3-4: Serial Port A parameters

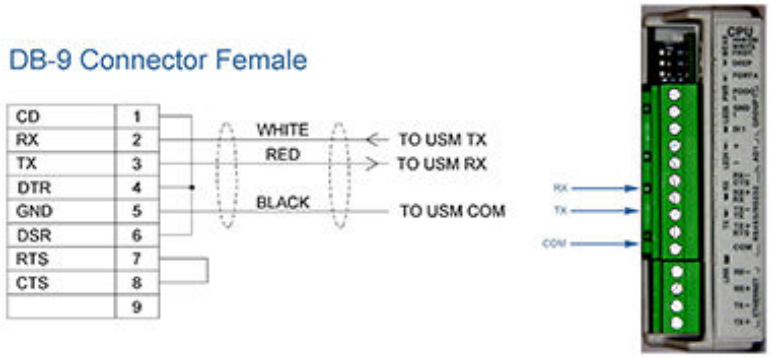
Port/Communication	Description	Common features
Port A (Standard) • RS-232 • RS-485 Half Duplex • RS-485 Full Duplex	• Typically used for general communications with a flow computer, RTU (Modbus slave) and radios. • Special override mode to force port configuration to known settings. • Supports RTS/CTS handshaking with software-configurable RTS on/off delay times. • Factory default is RS-232, Address 32, 19200 baud.	Communications via MeterLink using RS-232 or RS-485 Full Duplex • Software configurable Modbus Address (1-247) • Auto-detects TCP/IP and ASCII or RTU Protocol — ASCII Protocol: Start Bits = 1, Data Bits=7(1) — Parity: odd or even 1, Stop Bits = 1(1) — Baud Rates: 1200, 2400, 9600, 19200, 38400, 57600, 115000 bps — RTU Protocol: Start Bits = 1, Data Bits = 8(1) — Parity: none, Stop Bits = 1(1) — Baud Rates: 1200, 2400, 9600,19200, 38400, 57600, 115000 bps
Ethernet	• Preferred port for diagnostic communication via MeterLink • 10 Mbps/100 Mbps	• Modbus TCP/IP

(1) Denotes auto-detected protocols.

NOTICE

If not using Ethernet, a full duplex serial connection is necessary for MeterLink to communicate with a Rosemount 3812 Liquid Ultrasonic Meter.

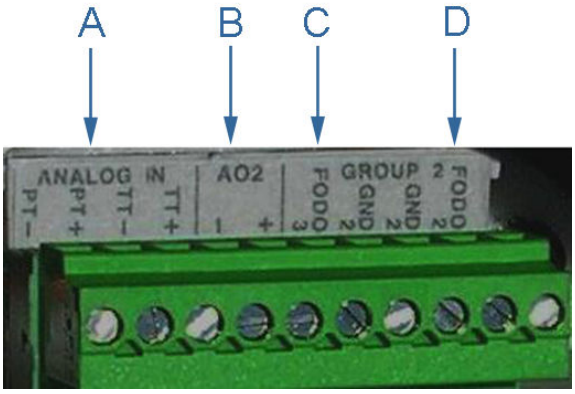
Figure 3-4: PC to meter serial connection wiring



3.6 Rosemount Ultrasonic Meters I/O connections

The 3812 Liquid Ultrasonic Flow Meter provides I/O connections on the CPU Module.

Figure 3-5: CPU Module I/O connections



A. Analog Input - temperature and pressure connections
B. Analog Output(2) 4-20 mA output
C. Frequency/Digital Output 3
D. Frequency/Digital Output 2

3.6.1 Frequency/Digital outputs

The meter has three user-configurable selections for configuring either a Frequency Output or Digital Output (FODO).

- FODO1 (four possible parameter configurations)
- FODO2 (eight possible parameter configurations)
- FODO3 (eight possible parameter configurations)

Frequency or Digital Outputs (FODO 1) source

- FO1A, DO1A, FO1B, DO1B
- Frequency output 1A is based on frequency content (Actual - Uncorrected Flow Rate)
- Frequency output 1B is based on frequency content and Frequency 1B Phase
- Digital output 1A is based on Digital output1A content (Frequency1A Validity and Flow Direction)

Frequency or Digital Outputs (FODO 2) source

- FO1A, DO1A, FO1B, DO1B, FO2A, DO2A, FO2B, DO2B
- Frequency output 1A is based on frequency content (Actual - Uncorrected Flow Rate)
- Frequency output 1B is based on frequency content and Frequency 1B Phase
- Frequency output 2A is based on frequency content (Actual - Uncorrected Flow Rate)
- Frequency output 2B is based on frequency content and Frequency 2B Phase
- Digital output 1A is based on Digital output1A content (Frequency 1A Validity and Flow Direction)

- Digital output 2A is based on Digital output2A content (Frequency 1A Validity and Flow Direction)
- Digital output 2A is based on Digital output 2A content (Frequency 2A Validity and Flow Direction)
- Digital output 2B is based on Digital output 2B content (Frequency 2B Validity and Flow Direction)

Frequency or Digital Outputs (FODO 3) source

- FO1A, DO1A, FO1B, DO1B, FO2A, DO2A, FO2B, DO2B
- FO1A, DO1A, FO1B, DO1B, FO2A, DO2A, FO2B, DO2B
- Frequency output 1A is based on frequency content (Actual - Uncorrected Flow Rate)
- Frequency output 1B is based on frequency content and Frequency 1B Phase
- Frequency output 2A is based on frequency content (Actual - Uncorrected Flow Rate)
- Frequency output 2B is based on frequency content and Frequency 2B Phase
- Digital output 1A is based on Digital output1A content (Frequency 1A Validity and Flow Direction)
- Digital output 2A is based on Digital output2A content (Frequency 1A Validity and Flow Direction)
- Digital output 2A is based on Digital output 2A content (Frequency 2A Validity and Flow Direction)
- Digital output 2B is based on Digital output 2B content (Frequency 2B Validity and Flow Direction)

Mode options

- Open Collector (requires external excitation supply voltage and pull-up resistor)
- TTL (internally powered by the meter 0-5 VDC signal)

Channel B Phase options

- Lag forward, Lead reverse (Phase B lags Phase A while reporting forward flow, leads Phase A while reporting reverse flow)
- Lead forward, Lag reverse (Phase B leads Phase A while reporting forward flow, lags Phase A while reporting reverse flow)

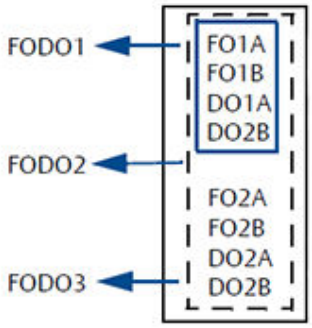
Phase A and Phase B output (based on flow direction)

- Reverse flow - output only reports flow in the reverse direction. For frequency outputs, Phase B of the output is 90 degrees out of phase with Phase A.
- Forward flow - output only reports flow in the forward direction. For frequency outputs, Phase B of the output is 90 degrees out of phase with Phase A.
- Absolute - output reports flow in both directions. For frequency outputs, Phase B of the output is 90 degrees out of phase with Phase A.
- Bi-directional - output reports flow on Phase A only in the forward direction and on Phase B only in the reverse direction.

Maximum frequency for the frequency outputs

- 1000 Hz
- 5000 Hz

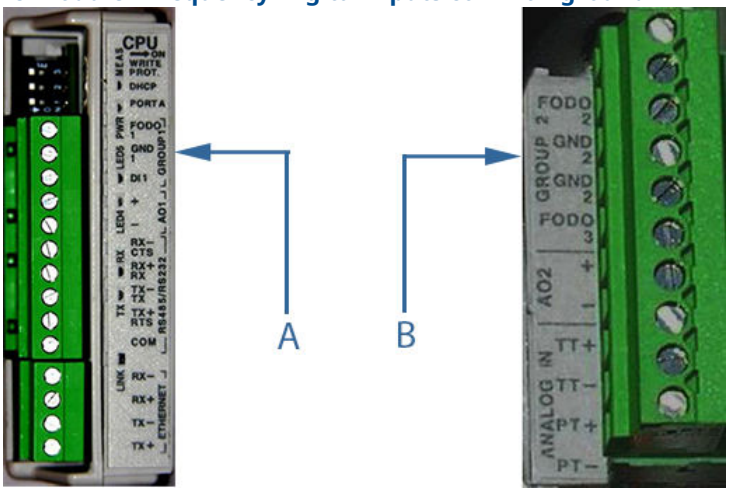
Table 3-5: Frequency/Digital Outputs possible configurations

Frequency/Digital output		Source configuration
Frequency/Digital Output 1(1)	• Frequency output 1A • Frequency output 1B • Digital output 1A • Digital output 1B	
Frequency/Digital Output 2(2)	• Frequency output 1A • Frequency output 1B • Digital output 1A • Digital output 1B	
Frequency/Digital Output 3(2)	• Frequency output 2A • Frequency output 2B • Digital output 2A • Digital output 2B	

(1) Solid blue line denotes valid selection for Frequency/Digital Output 1.
(2) Black dashed-line denotes valid selections for Frequency/Digital Output 2 and Frequency/Digital Output 3.

Output for FODO1 and Digital Output1 (Group 1 on the CPU Module) share a common ground and have 50 V isolation. FODO2 and FODO3 (Group 2 on the CPU Module) share a common ground and have 50 V isolation. This allows an output to be connected to a different flow computer. The outputs are opto-isolated from the CPU Module and have a withstand voltage of at least 500 V rms dielectric.

Figure 3-6: CPU Module - Frequency/Digital inputs common ground



A. FODO1 and Digital input1 - Shared common ground (Group 1)
B. FODO2 and FODO3 - Shared common ground (Group 2)

3.6.2 Analog input settings

The The 960-24 MSTS has the capability to sample analog temperature (Analog Input 1) and pressure (Analog Input 2) with 4-20 mA signals. These analog input signals are configured to sink. The two independent analog input circuits are configured for conventional 4-20 mA service. Also, 24 VDC isolated power supply connection is provided for an external power source. Refer to the Field wiring diagram DMC-004936 in Engineering Drawings.

3.6.3 Analog output settings

The 960-24™ MSTS provides two 4-20 mA analog output signals that are software configurable for either sink or source current (see Engineering Drawings, drawing DMC-004936).

Full HART® functionality is provided so that any commercially available HART® transmitter which meets the specifications of the HART® Communications Foundation can be connected to the Rosemount 3812 Liquid Ultrasonic Flow Meter.

Analog Output 2 (AO2) is user-configurable as a conventional 4-20 mA output.

3.6.4 Digital input

The Rosemount 3812 Liquid Ultrasonic Flow Meter provides one digital input that can be used as a general purpose input or used for synchronizing calibration (for flow calibration gating-contact closure). The meter records the volume seen between switch closures. The polarity of the input is configured as normal or inverted polarity.

- Polarity is determined by the **IsDI1ForCalActiveLow** and the gating edge is determined by the **IsDI1ForCalStateGated** (calibrate edge gated or calibrate state gated).
- Calibration is started via an inactive>active state change.

The digital input must be configured via the MeterLink **Tools** → **Edit/Compare Configuration** page.

3.6.5 DHCP server switch settings

The meter can be configured to act as a DHCP server. The DHCP server is enabled/disabled via CPU Module DHCP switch as follows:

Table 3-6: DHCP server switch settings

CPU Module switch	DHCP server disabled	DHCP server enabled
DHCP	OFF	ON

3.6.6 Configuration protect switch settings

The meter's configuration parameters and firmware can be protected against changes via CPU Module Write PROT. switch as follows:

Table 3-7: Configuration protect switch settings

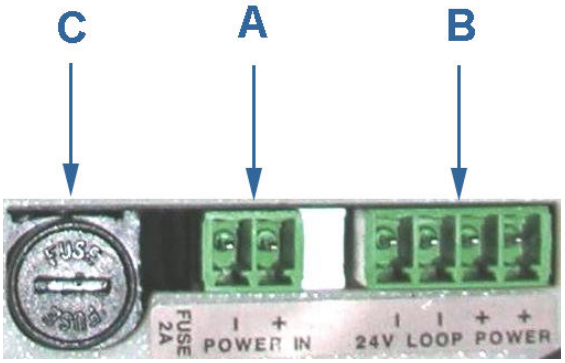
CPU Module switch	Configuration protected	Configuration unprotected
WRITE PROT.	ON (default)	OFF

A complete list of write-protected parameters is in Engineering Drawings.

3.6.7 External power source connection and fuse

Located inside the Transmitter Electronics Enclosure is a connector for a user-provided external power source, a 2 Ampere fuse and a 24 V loop power connection for ultrasonic meter analog outputs, generator temperature or pressure transmitter devices. The current is limited to 88 mA.

Figure 3-7: CPU Module power source connections



A. Power In connector (main power)
B. 24 V Loop power
C. 2 Ampere fuse (used for the main power input)

3.7 Security seal installation

Security seals protect the integrity of the meter metrology and prevent tampering with transducer assemblies. The following sections detail how to properly seal the Rosemount 3812 Liquid Ultrasonic Flow Meter after commissioning. The security seal wires are commercially available.

⚠ WARNING

CUTTING HAZARD
Sharp edges may be present on the meter.

Wear appropriate personal protective equipment when working on the meter.

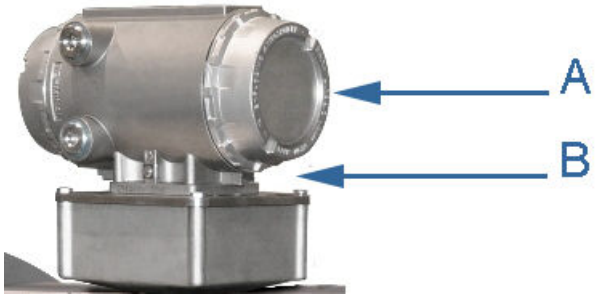
Failure to comply can cause serious injury to personnel.

Be sure to set the **WRITE PROT**. switch on the CPU Module to the **ON** position prior to sealing the enclosure.

3.7.1 Direct or remote mount transmitter electronics enclosure seal

Use the following instructions to install the security seal wires on the Transmitter Electronics Enclosure.

Figure 3-8: Transmitter electronics enclosure security latch

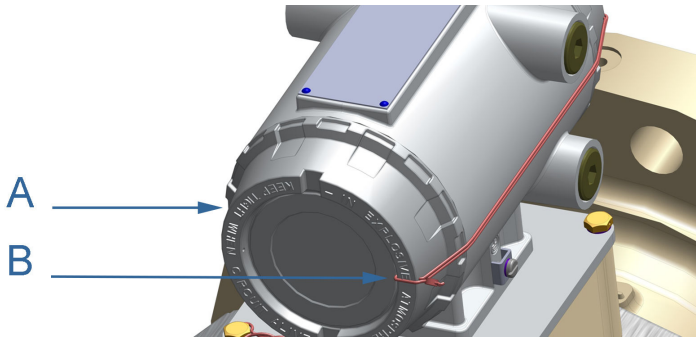


A. Transmitter Electronics Enclosure end cap
B. Security latch

Procedure

1. Rotate the end cap clockwise fully closing and compressing the end cap seal. Install the Security latch using a 3 mm Allen wrench.
2. Install the security seal wire into and through one of the two holes in the end cap. Choose holes that minimize counterclockwise rotation of the end cap when the security wire is taut (maximum wire diameter 0.078 inch; 2.0 mm).

Figure 3-9: Direct or remote mount Transmitter Electronics Enclosure security seals



A. Transmitter Electronics Enclosure end cap
B. Security wire seals

3. Adjust the security wire, removing all slack and thread into the lead seal.
4. Cut wire ends to remove excess wire.

   This completes the direct or remote Transmitter Electronics Enclosure seal installation procedure.

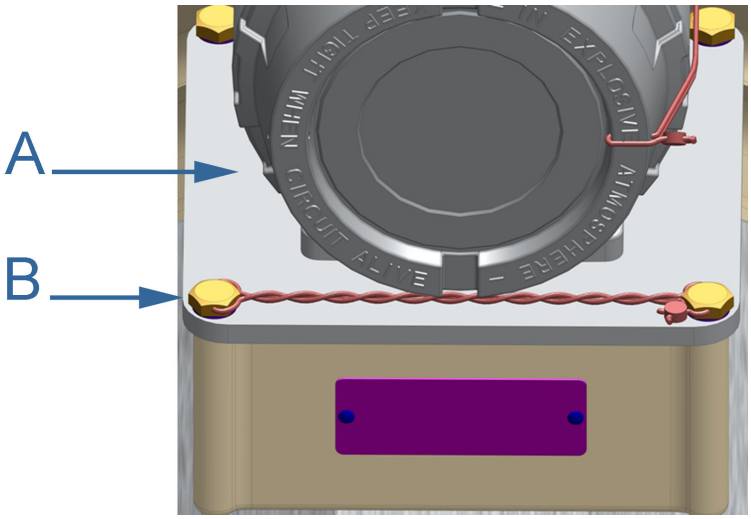
3.7.2 Base enclosure security seals

Use the following instructions to install the security seal wire on the Base Enclosure.

Procedure

1. Install security wire seal into and through two of the four the holes in the socket head screws on the Base Enclosure cover (maximum wire diameter 0.078 inch; 2.0 mm).

Figure 3-10: Base Enclosure security seals



A. Base enclosure
B. Security wire seals

2. Position the wire to prevent counterclockwise rotation of the screws when the seal wire is taut.
3. Twist and adjust wire removing all slack and seal.
4. Cut wire ends to remove excess wire.

   This completes Base Enclosure security seal installation procedure.

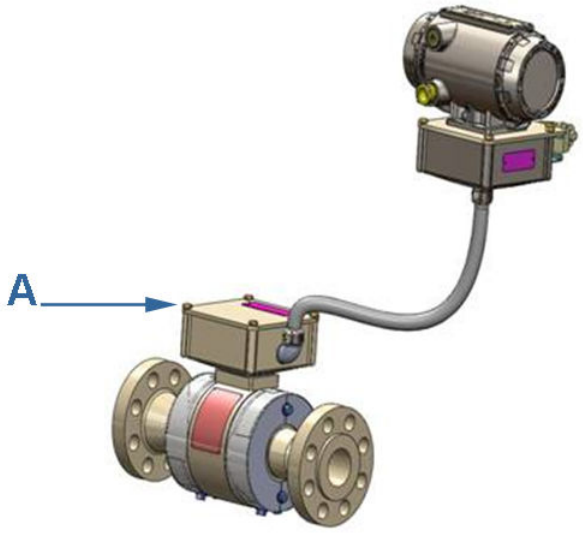
3.7.3 Seal the Junction Box remote mount electronics option

Use the following instructions to install the security seal wire on the junction box, if required.

Procedure

1. Install security wire seal into and through two of the four the holes in the socket head screws on the Junction Box cover (maximum wire diameter 0.078 inch; 2.0 mm).

Figure 3-11: 3812 Remote mount transmitter electronics option



A. Junction Box socket head screws

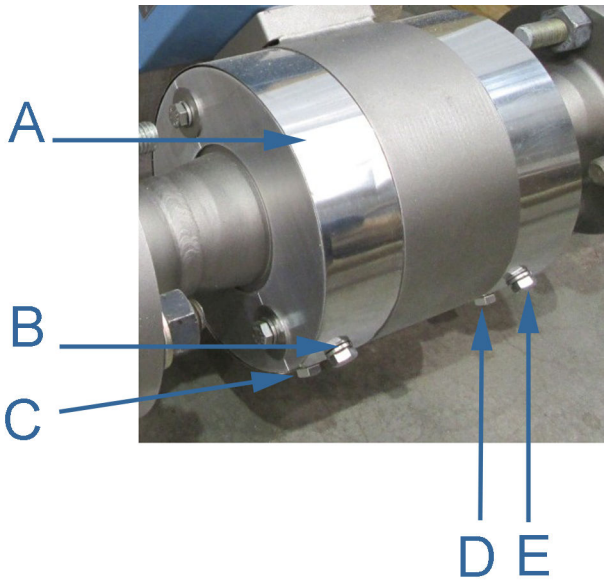
2. Position the wire to prevent counterclockwise rotation of the screws when the seal wire is taut.
3. Twist and adjust wire removing all slack and seal.
4. Cut wire ends to remove excess wire.

   This completes installing security seals on the Junction Box.

3.7.4 Bolted band shroud security seals

If required, use the following instructions to install bolted band shrouds security wire seals.

Figure 3-12: Bolted band shroud security seals - bottom view



A. Band shroud
B. Left front shroud bolt ¼-in. - 20
C. Left back shroud bolt ¼-in. - 20
D. Right back shroud bolt ¼-in. - 20
E. Right front shroud bolt ¼-in. - 20

Procedure

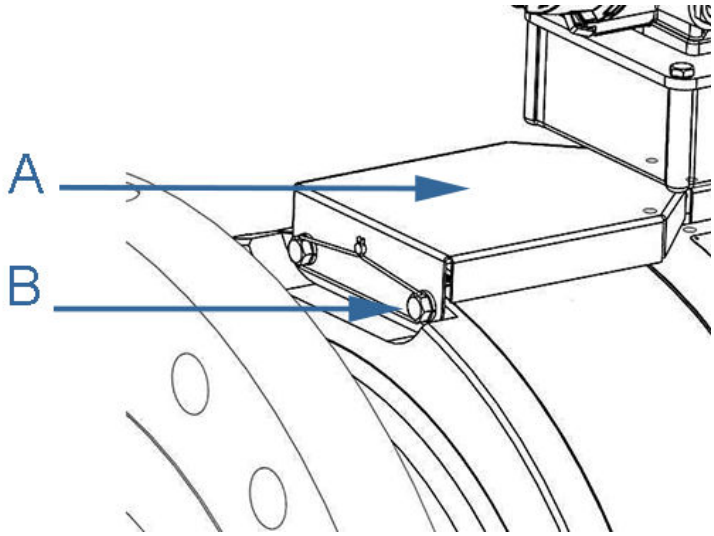
1. Beneath the meter, install the security wires into and through the left front bolt (Item B) and feed through the holes in the right back bolt (Item D).
2. Repeat wire installation through the right front bolt (Item E) to the left rear bolt (Item C) as shown in Figure 3-12. The maximum wire diameter is 0.078 inch; 2.0 mm.
3. Position the wire to prevent counterclockwise rotation of the bolts when the seal wire is taut.
4. Adjust the security wire, removing all slack and thread into the lead seal.
5. Cut wire ends to remove excess wire.

   This completes the bolted band shroud security seal installation procedure.

3.7.5 Clamped band shroud security seals

Use the following instructions to install the security seal wires, if required, on the two top end shrouds covering the worm screw clamps. This procedure applies to clamped band shroud meters.

Figure 3-13: Clamped shroud security seals



A. Top end shroud
B. Security wire seals

Procedure

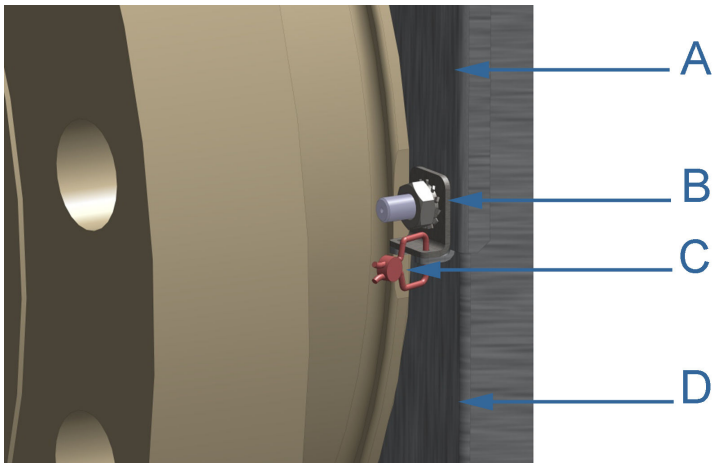
1. Install the security seal wire into and through the two bolt holes on the top end shrouds (maximum wire diameter 0.078 inch; 2.0 mm). Position the wire to prevent counterclockwise rotation of the screws when the seal wire is taut.
2. Remove all slack and seal.
3. Repeat previous step for the other top end shroud.
4. Cut wire ends to remove excess wire.

   This completes the clamped band shroud security seal installation procedure.

3.7.6 Split shroud security seals

Use the following instructions to install the security seal wires on the split shroud covering the meter body and transducer assemblies.

Figure 3-14: Split shroud security seals



A. Upper split shroud
B. Split shroud clamp
C. Security wire seals
D. Lower split shroud

Procedure

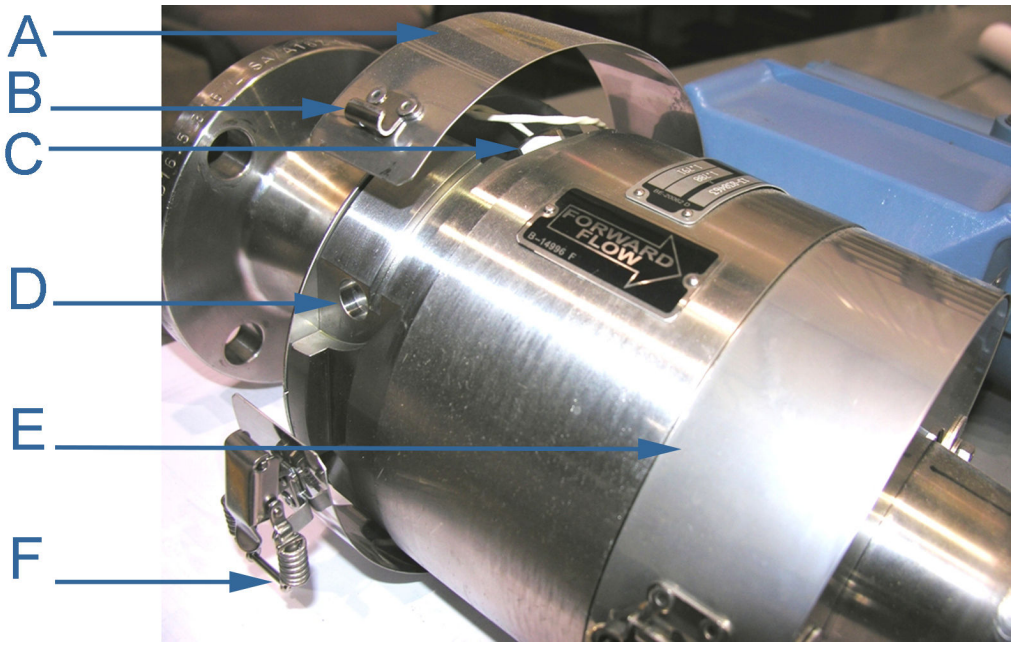
1. Install the security seal wire into and through the holes in the split shroud clamp bent tab and the upper split shroud bent tab. (maximum wire diameter 0.078 inch; 2.0 mm).
2. Remove all slack and seal.
3. Cut wire ends to remove excess wire.
4. Repeat these steps for the other split shroud clamps.

   This completes the split shroud security seal installation procedure.

3.7.7 Latched band shroud security seals

Use the following instructions to install the security seal wires on the latched band shrouds covering the meter body and transducer assemblies.

Figure 3-15: Latched band shroud assembly

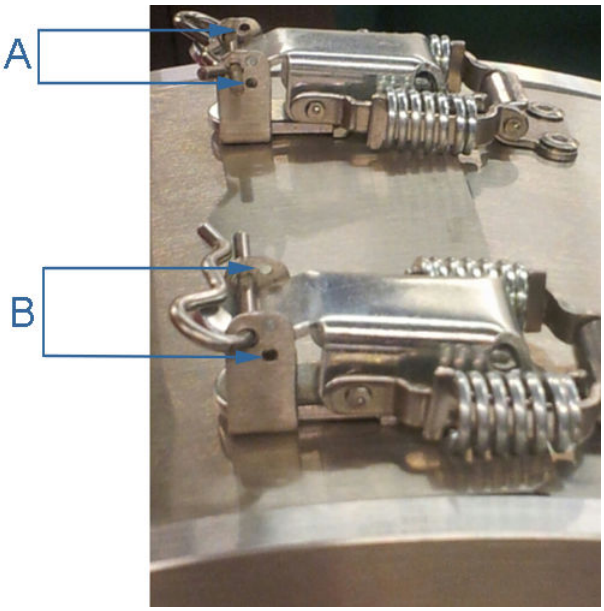


A. Band shroud
B. Stainless steel strike
C. Transducer cable
D. Meter body recess for pop rivet allowance
E. Meter body shoulder
F. Shroud latch

Procedure

1. Install the security seal wire into and through the holes in one of the shroud latches (maximum wire diameter 0.078 inch; 2.0 mm).

Figure 3-16: Shroud latch holes for security wire seals



A. Left shroud latch holes for security wire seals
B. Right shroud holes for security wires

2. Remove all slack and seal.
3. Cut wire ends to remove excess wire.
4. Repeat these steps for the other shroud latch.

   This completes the split shroud security seal installation procedure.

3.7.8 Seal conduit ports

The unit should be properly sealed with a sealing compound after electrical connections have been tested according to the customer's Best Practices schedule. Some areas require a witnessed Acceptance Test for the installed system and require that the meter run for a predetermined length of time (approximately one to two weeks) before the unit is sealed. This allows time to verify all electrical connections are correct, that the meter is accurately measuring flow and that the meter meets the customer's installation requirements. See Startup for systems using explosion-proof conduit and Startup for systems using flame-proof cable.

4 Configuration

After the mechanical and electrical installation is complete and connectivity is established, use the *MeterLink Software for Gas and Liquid Ultrasonic Meters Quick Start Manual* (00809-0100-7630) to setup initial communications with the meter.

4.1 Set up MeterLink

Procedure

1. Follow the instructions in the *MeterLink™ Software for Gas and Liquid Ultrasonic Meters Quick Start Manual* (00809-0100-7630) to setup software communications with the meter.
2. Select **File** → **Program Settings** and customize the user-preferences (for example, User name, Company name, display units, Liquid Meter volume units, and other interface settings).
3. Connect to your meter. If your meter is not shown in the list, select **Edit Meter Directory** and setup the connections properties.

4.1.1 Field Setup Wizard using MeterLink

Procedure

1. Use the **Field Setup Wizard-Startup** and select the checkboxes that allow proper configuration for your meter (Temperature, Pressure, Meter Corrections, and Meter Outputs).

   Selections on this page will affect other configuration selections. Select **Next** to continue to General setup.

2. Use **General setup** to configure the meter's system units (U.S Customary or Metric units) volume units, flow rate time, low flow cutoff, contract hour and enable reverse flow.

   Select **Next** to continue to Frequency Outputs.

   Note
   The Meter's Units system configured on the General Page affect the units for the optional Local Display items.

3. Configure Frequency output 1 and Frequency output 2 content (Rosemount Liquid Ultrasonic Meters content is Uncorrected flow rate), flow direction, Channel B phase, maximum frequency output (Hertz) and Full scale volumetric flow rate. Click **Next** to continue to Meter Digital Outputs.

   Note
   Frequency outputs 1 and Digital outputs 1 are paired together meaning the Digital outputs 1 will report the status for the parameter for Frequency outputs 1. Similarly, Frequency outputs 2 and Digital outputs 2 are paired together. Additionally, each Frequency output has an A and B output phase.

4. Select the **Meter Digital Output** parameters for Digital output 1A, Digital output 1B, Digital output 2A and Digital output 2B based on Frequency validity or flow direction. Configure Frequency output 1 and Frequency output 2 content (Rosemount Liquid Ultrasonic Meters content is Uncorrected flow rate), flow

direction, Channel B phase, maximum frequency output (Hertz) and Full scale volumetric flow rate.

If the output of the ultrasonic meter is reversed from what a flow computer is expecting, select **Inverted Operation**. This changes the digital output from a HIGH for a TRUE condition to output a LOW for a TRUE condition. Click **Next** to continue to Current Outputs.

5. Current Outputs are based on Uncorrected (Actual) flow rate content, flow direction (Forward, Reverse or Absolute) and Full scale volumetric flow rate used with output (20 mA maximum).

   Alarm action parameters determines the state the output will drive during an alarm condition (High 20 mA, Low - 4 mA, Hold last value, Very low - 3.5, Very high 20.5 mA or None). Click **Next** to continue to HART® Output(s) parameters.

6. HART Output parameters include four Dynamic process variables (Primary, Secondary, Third and Fourth variable). The Primary variable is set to match the Content set for Current output 1.

   If a second current output is available, the Secondary variable is set to match the Content set for Current output 1, Identification and HART units (volume units, Flow rate time units, Velocity units, Pressure and Temperature units). Select **Next** to continue to Temperature and Pressure.

7. Set the temperature and pressure scaling for analog inputs, enter fixed values, and set alarm limits for both.
8. Select **Finish** to write the configuration settings to the meter.
9. Configure the parameters for the local display. Use the drop-down arrow in the Display Items list box and select or modify the Display items, the Display units and the Scroll delay.

4.1.2 Display items

The valid labels, descriptions and units for the display items are shown below:

Table 4-1: Local display labels, descriptions and valid units

Local Display labels, descriptions and units	
QFLOW — Uncorrected volume flow rate	
	• BBL – Barrels • GAL – Gallons • L – Liters • CM – Cubic Meters • MCM – Thousand Cubic Meters
TDYVL — Current day's forward uncorrected volume	
	• +BBL – Barrels • +GAL – Gallons • +L – Liters • +CM – Cubic Meters • +MCM – Thousand Cubic Meters
TDYVL — Current day's reverse uncorrected volume	

Table 4-1: Local display labels, descriptions and valid units *(continued)*

Local Display labels, descriptions and units	
	• -BBL – Barrels • -GAL – Gallons • -L – Liters • -CM – Cubic Meters • -MCM – Thousand Cubic Meters
YSTVL — Previous day's forward uncorrected volume	
	• +BBL – Barrels • +GAL – Gallons • +L –Liters • +CM – Cubic Meters • +MCM – Thousand Cubic Meters
YSTVL — Previous day's reverse uncorrected volume	
	• -BBL – Barrels • -GAL – Gallons • -L – Liters • -CM – Cubic Meters • -MCM – Thousand Cubic Meters
TOTVL — Forward uncorrected volume	
	• +BBL – Barrels • +GAL – Gallons • +L – Liters • +CM – Cubic Meters • +MCM – Thousand Cubic Meters
TOTVL — Reverse uncorrected volume	
	• -BBL – Barrels • -GAL – Gallons • -L – Liters • -CM – Cubic Meters • -MCM – Thousand Cubic Meters
VEL — Average flow velocity	
	• Ft/S – Feet per second • M/S – Meters per second
SOS — Average sound velocity	
	• Ft/S – Feet per second • M/S – Meters per second

Table 4-1: Local display labels, descriptions and valid units *(continued)*

Local Display labels, descriptions and units	
TEMP — Flow-condition temperature	
	• DEGF – Degrees Fahrenheit • DEGC – Degrees Celsius
PRESS — Flow-condition pressure	
	• PSI – Pound per square inch • MPA – Megapascals
FRQ1A — Frequency channel 1A	
	• HZ – Hertz
FRQ1B — Frequency channel 1B	
	• HZ – Hertz
KFCT1 — Frequency 1 K-factor	
	• BBL – Barrels • GAL – Gallons • L – Liters • CM – Cubic Meters • MCM – Thousand Cubic Meters
FRQ2A — Frequency channel 2A	
	• HZ – Hertz
FRQ2B — Frequency channel 2B	
	• HZ – Hertz
KFCT2 — Frequency 2 K-factor	
	• BBL – Barrels • GAL – Gallons • L – Liters • CM – Cubic Meters • MCM – Thousand Cubic Meters
AO1 — Analog Output 1 current	
	• MA – Milliamperes
AO2 — Analog Output 2 current	
	• MA – Milliamperes

Note
When connected to a meter with the optional local display, reverse flow direction is indicated with a minus sign (negative) before the value(s) shown on the display.

4.1.3 Display units

The Meter volume units displayed are either U.S. Customary or Metric. To modify the Display Units, configure the Meter units system in the **Field Setup Wizard → General Page.**

- U.S. Customary volume unit selections are:
  - Barrels
  - Gallons
- Metric volume unit selections are:
  - Cubic meters
  - Cubic liters
- Display units preceded by a plus or minus sign indicate forward and reverse flow direction.
- The Local Display Flow rate time units are modifiable by selecting the drop-down arrow and clicking the time unit in the list box.
- Valid flow rate time units selections are:
  - second
  - minute
  - hour
  - day

4.1.4 Scroll delay

The Scroll Delay is the time interval for the selected display items to be shown on the Local Display. The default scroll delay setting is five seconds. Click the spin box up or down arrow to increase or decrease the length of time an item displays.

Procedure

1. Select **Finish** to write the configuration settings to the meter.
2. Save the meter configuration file, collect a Maintenance log and Waveforms to document the “As Left” settings.

4.2 Using AMS Device Manager to configure the meter

This procedure assumes you have AMS Device Manager installed on the host computer and have downloaded the latest Rosemount Liquid Ultrasonic Meter Device Description (DD).

If not installed, click the link below to download the AMS device installation tool kit:

Emerson.com/SoftwareDownloadsDrivers

4.2.1 Installing AMS Device Description

Procedure

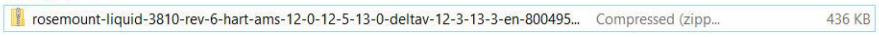
1. Use the link above to search for the Device Description (DD) for your Rosemount 3810 Series Liquid Ultrasonic Flow Meter.
2. Use the drop-down menu and select **Emerson - Rosemount**.

3. Next, select the Device, **Liquid 3810 Series**, from the drop-down menu.
4. Choose the Device Revision1, from the drop-down menu.
5. Next, select HART® from the Communication Protocol menu.
6. Select **AMS Device Manager** for the Host System.
7. Select the **Host System Revision 14.5**.
8. Verify your search parameters are correct, as shown below:

Figure 4-1: AMS Device Description search result

9. Click **Search Now**.
10. Click the Rosemount Industries Liquid 3810 Series Rev 1 hyperlink. The file download dialog displays. Click the **Save** button to save the files to your host system. You may use the default download location or change the directory.

Figure 4-2: AMS file download



11. Click the **Save** button to complete the file download.
12. Click **Open** or **Open Folder** to view the downloaded files.
13. Establish power to the meter and wiring to Analog Input 1 for HART® communication.
14. Start the AMS Device Manager using a laptop or PC.
15. Enter login credentials and click **OK** to launch the application.
16. Click the **Configure** tab, and then select one:
    - Guided Setup
    - Manual Setup
    - Alert Setup

Figure 4-3: AMS Device Manager

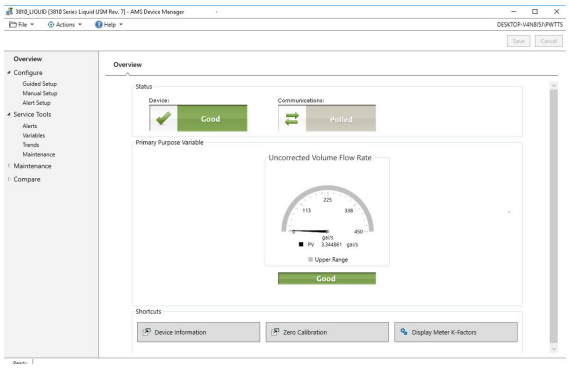
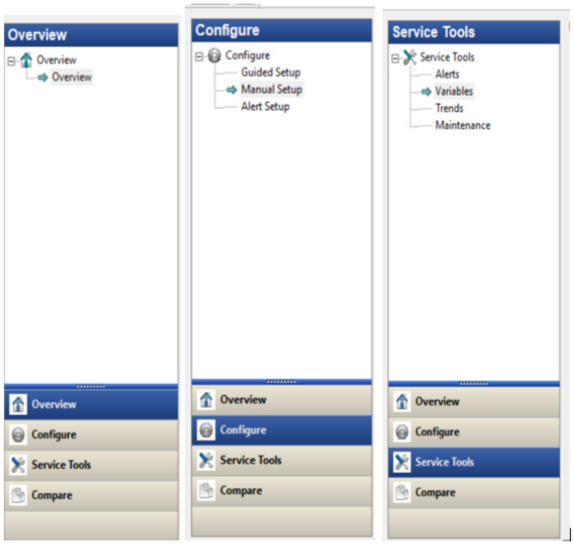


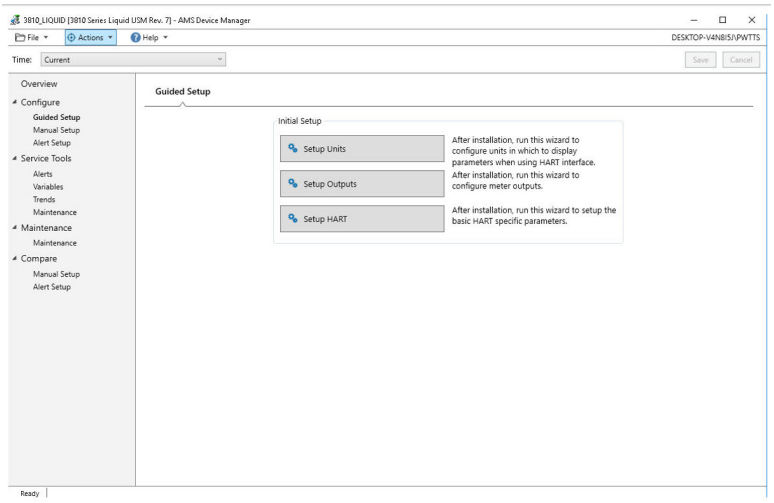
Figure 4-4: AMS Device Manager - Overview



4.2.2 AMS Device Manager - Guided Setup

The Guided setup wizard provides configuration parameter settings for the meter. The Guided Setup is a subset of the Manual Setup parameters.

Figure 4-5: AMS Device Manager - Guided Setup



Note
Before writing configuration changes to your meter, make sure you have saved the Configuration file and Maintenance log.

Procedure

1. Disable the Write Protect switch in the CPU Module to write any of the following configuration parameters to your meter.

2. Click the **Setup Units** tab to configure the system units (U.S. Customary or Metric units), Volume units, Flow rate time units, Velocity units, Pressure units and Temperature units. Click **Apply** to write the parameters to the meter.
3. Click the **Setup Outputs** tab to configure the Device Variables Mapping, Units, Frequency/Digital outputs, Frequency and Digital Outputs 1 and 2, Analog outputs, Digital Input, Pressure and Temperature.
    a. ***Analog output 1 (HART)*** - Content (Primary Variable) displays Uncorrected Flow Rate and is a read-only attribute. Configure Direction (flow), Lower Range value, Upper range value and Alarm Action and view the HART® Parameters Tag, Date, Descriptor, Message, Final Assembly Number Poll Address, Number of Response Preambles.
    b. ***Analog Output 2*** - Content (Secondary Variable) displays Uncorrected Flow Rate and has a read-only attribute. Configure Direction (flow), Lower Range value, Upper range value and Alarm Action. Map the Third and Four variables using the Manual Setup wizard. Selections include Uncorrected Volume Flow Rate, Average flow velocity, Average sound velocity, Pressure, and Temperature.
4. After all of the data shown below is entered, click **Apply** to write the parameters to the meter.
    a) Click the **Frequency/Digital Outputs** tab to configure Frequency/Digital Output 1, 2 and 3 Source and drive Mode. Select the Source for each Frequency/Digital output and select the desired drive Mode. The Mode options are Open Collector which requires an external excitation voltage and pull-up resistor or TTL mode which outputs a 0-5 Vdc signal (each Frequency output has an A and B output phase).

    Note
    If changes are made to any Source variable on this page, apply the changes and navigate to the **Guided Setup** page. Navigate back to the **Manual Setup** for the changes to be reflected in other Manual Setup pages.

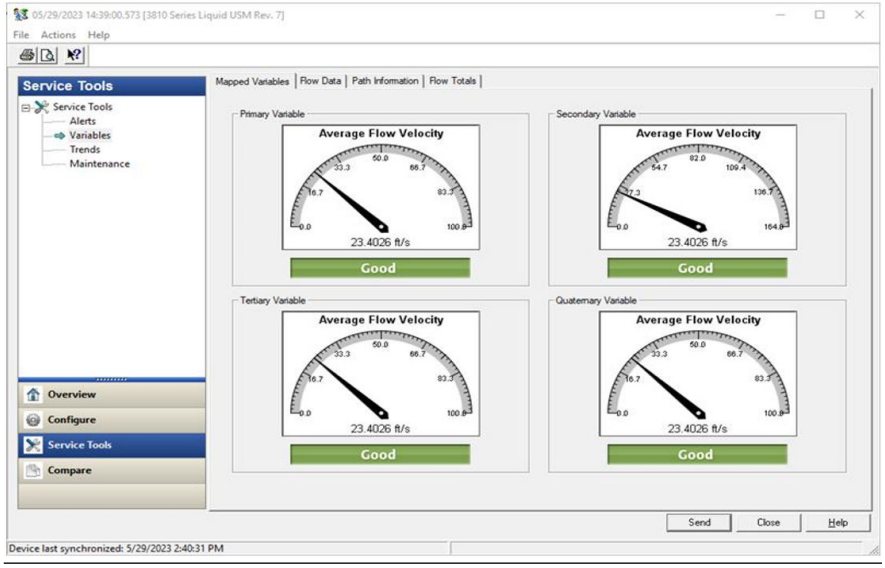
    b) Click the **Frequency and Digital Output 1** tab to configure the Content, (flow) Direction, Channel B Phase frequency output, Lag forward, Lead Reverse or Lead Forward, Lag Reverse (Phase B lags Phase A while reporting forward flow and lead Phase A while reporting reverse flow or the opposite), Digital Output 1 Channel A Content and Polarity, Channel B Content and Polarity, Maximum Frequency, and Lower and Upper Range Units of Measure.
    c) Click the **Frequency and Digital Output 2** tab and repeat Step 3 to configure Frequency and Digital Output 2 parameters.
5. Click **Setup HART** to configure the HART® parameters (tag, date, descriptor, message text, Final Assembly number, Poll address and number of response preambles are displayed). After all of the data is entered, click **Apply** to write the parameters to the meter.
6. On the **Overview** page, click **Alert Setup** and select the **Flow Analysis** tab and enable Reverse Flow. Click the **OK** button to return to the **Overview** page.
7. On the **Overview** page, click the **Service Tools** tab and select the **Variables** tab. The Flow Data, Path Information, Flow Totals, and All Variables data is populated after you are connected to the meter.
    a) Click the **Flow Data** tab and view the Flow Direction (Forward or Reverse), Average Flow and Average Sound Velocities values.

b) Click the **Path Information** tab and view the Chord performance, Gain, SNR (Signal to Noise Ratio) Signal strength (mV), and Noise (mV).

c) Click the **Flow Totals** tab to view the volume totals (forward and reverse uncorrected volume).

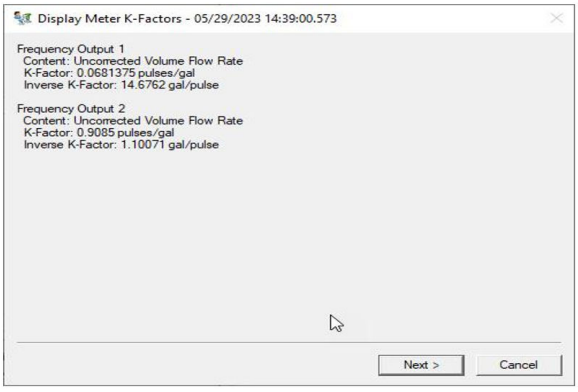
d) Click the **All Variables** tab to view a graphical display of the Primary, Secondary, Third and Fourth Variables.

Figure 4-6: AMS Device Manager - Service Tools All Variables status indicators



8. Click **OK** to return to the Overview page.
9. Enable the Write Protect switch on the CPU Module to protect the meter's configuration.
10. From the **Overview** window, click **Display Meter K-Factors**. K-Factors are a read-only values calculated from the Full scale volumetric flow rate used with frequency outputs and the Maximum frequency for frequency output.

Figure 4-7: Display Meter K-Factors

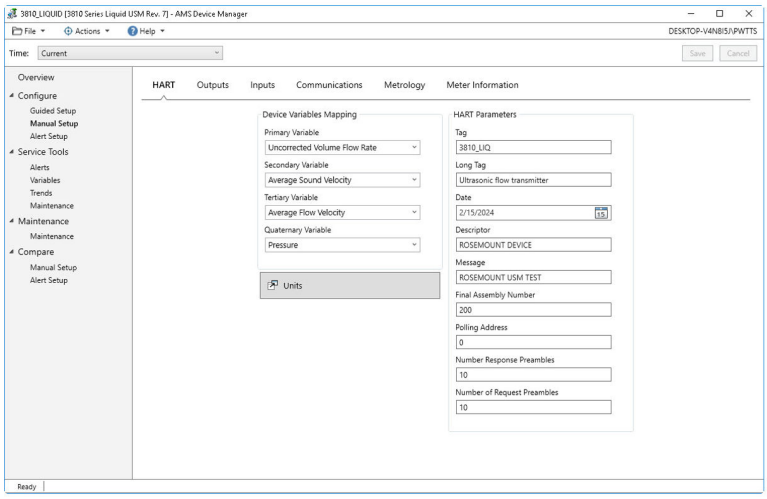


11. Click **Next** to return to the **Device Manager Overview** page.

4.2.3 AMS Device Manager - Manual Setup

Use the Manual Setup wizard to configure the meter's parameters. See Figure 4-3 and Figure 4-4 and from the AMS Device Manager Configure menu, click **Manual Setup**.

Figure 4-8: AMS Device Manager - Configure Manual Setup



Procedure

1. If installed, remove security wires from the endcap and the Bracket/Cover hex head bolts that secures the Base Enclosure.
2. Disable the Write Protect switch in the CPU Module to write any of the following configuration parameters to your meter.
3. Click the **HART** tab. The Primary and Secondary variables are read-only and are configured for Uncorrected Flow Rate. The Third and Fourth variable configuration choices include Pressure and Temperature.
4. Click the **Units** button in **HART** tab (see AMS Device Manager - Guided Setup, Step 1).
5. Click the **Analog Output 1** button in **Outputs** tab (see AMS Device Manager - Guided Setup, Step 3a).
6. Click the **Analog Output 2** button in **Outputs** tab. Follow the configuration instructions in the AMS Device Manager - Guided Setup, Step 3b. The read-only Secondary variable Content, Uncorrected Flow Rate, displays. Use the drop-down arrow and select the (flow) Direction - Forward or Reverse. Enter a Lower and Upper Range limit. Set the Alarm Action parameters. Click **Apply**, after you enter the data to write the parameters to the meter.
7. Click the **Frequency/Digital Outputs** button in **Outputs** tab. Follow the configuration instructions in the AMS Device Manager - Guided Setup, Step 4a).

   Note
   If changes are made to any Source variable on this page, apply the changes and navigate to the **Guided Setup** page. Navigate back to the **Manual Setup** for the changes to be reflected in other **Manual Setup** pages.

   a) Click **Apply**, after you enter the data to write the parameters to the meter.

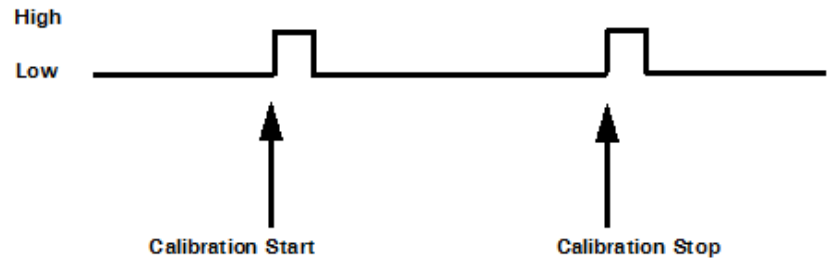
8. Click the **Frequency and Digital Output 2** tab. Follow the instructions in the AMS Device Manager - Guided Setup, Step 4c to configure the Frequency and Digital

Output 2 parameters. Click **Apply**, after you enter the data to write the parameters to the meter.

9. Click the **Analog Input 1 (Temperature)** button in the **Inputs** tab. Configure the input parameters including: Source (Live Analog or Fixed), Min and Max input limits corresponding to 4 mA and 20 mA respectively and the Low and High alarm limits. Click **Apply**, after you enter the data to write the parameters to the meter.
10. Click the **Analog Input 2 (Pressure)** button in the **Inputs** tab. Configure the input parameters including: Source (Live Analog or Fixed), Min and Max input limits corresponding to 4 mA and 20 mA respectively and the Low and High alarm limits. Select either **Gage** or **Absolute** for the type of pressure reading desired. If a live pressure transmitter is connected, select the type of reading the transmitter outputs. If **Absolute** is selected, you must also enter the Atmospheric pressure. Click **Apply**, after you enter the data to write the parameters to the meter.
11. Click the **Digital Input** button in the **Inputs** tab. The default Digital Input 1 polarity is set to Normal for general purpose or set to Inverted when used for calibration. Click **Apply**, after you choose the calibration data to write the parameters to the meter.
    a. Calibration Polarity configuration parameter selections are:
       - Digital Input 1 Calibrate Active High
       - Digital Input 1 Calibrate Active Low

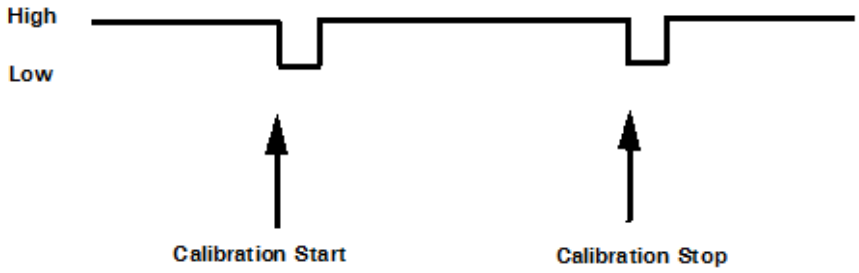
    b. Calibration Gating configuration parameter selections are:
       - Edge gated, active high

Figure 4-9: Gating configuration parameter Edge gated, active high



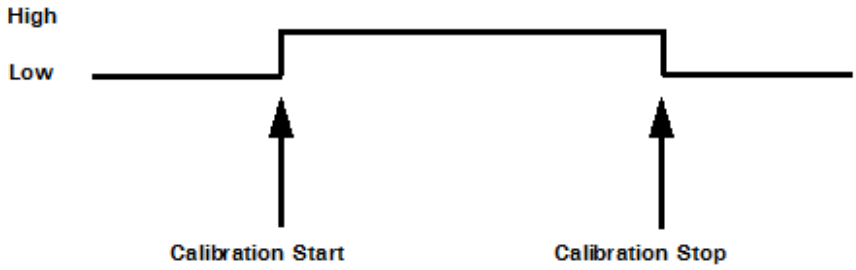
- Edge gated, active low

Figure 4-10: Gating configuration parameter Edge gated, active low



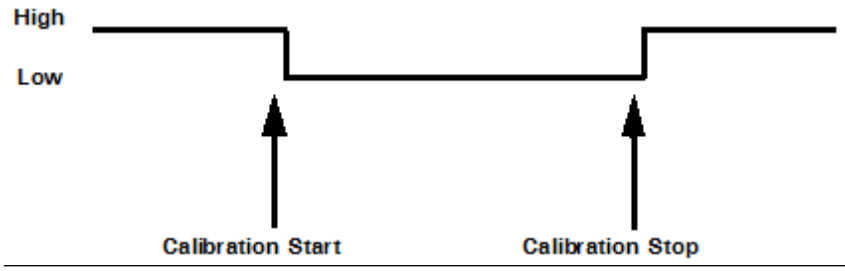
- State gated, active high

Figure 4-11: Gating configuration parameter State gated, active high



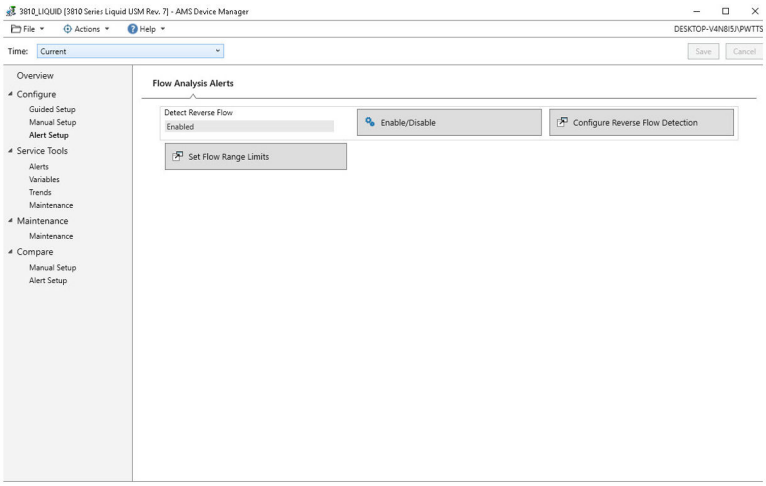
- State gated, active low

Figure 4-12: Gating configuration parameter State gated, active low



12. Click the **Alert Setup** tab (from the main Configuration page).

Figure 4-13: Configure Flow Analysis Alert



13. Click the **Flow Analysis Alerts** tab to select Configure Reverse Flow Detection, if desired. The default setting is **Disabled**. Click the **Disabled** button to send the feature command to the meter. Check for a response error. If no error response is received, click the **Enable** button.
    a) Enter the minimum reverse flow velocity above which to accumulate flow in the reverse direction for this alert. Enter a positive value for the Reverse Flow Zero Cutoff. Click the **Next** button to write the values to the meter. Check for an error response. If no error response is received, click the **Next** button. The

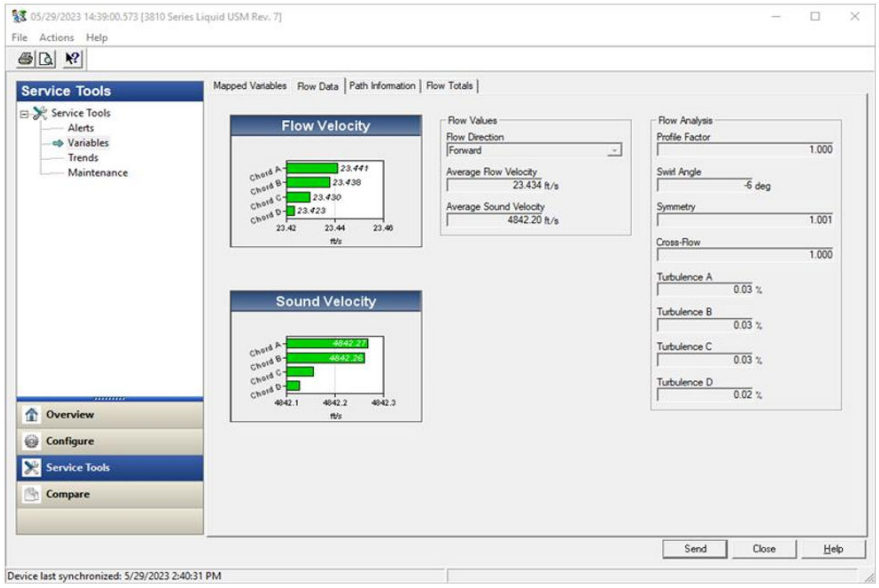
Detect Reverse Flow enabled page displays. Click the **Next** button to display Detect Reverse Flow disabled.

b) If an error message is returned, click the **Next** button to display the Method Complete page.

c) Click the **Set Flow Range Limits** button and enter a positive value for the Flow Analysis Lower Velocity Range and the Upper Velocity Range Limits. When the velocity is outside of the limit parameters, an alert is triggered. Click the **Next** button to display the Method Complete page.

14. Click the **Service Tools** tab to access the device alerts, variables, trends and maintenance statuses or to edit the configuration parameters.
    a) Click the **Service Tools** → **Alerts** tab. If an alert condition exists, the alert type and description displays. Recommended actions are listed to assist you in a resolution. After you resolve the alert condition, click the **Acknowledge** button to clear the alert. Click **Apply** to write the changes to the meter. If no alert condition is active, click **OK** to close the device window.

Figure 4-14: AMS Device Manager - Service Tools Alerts

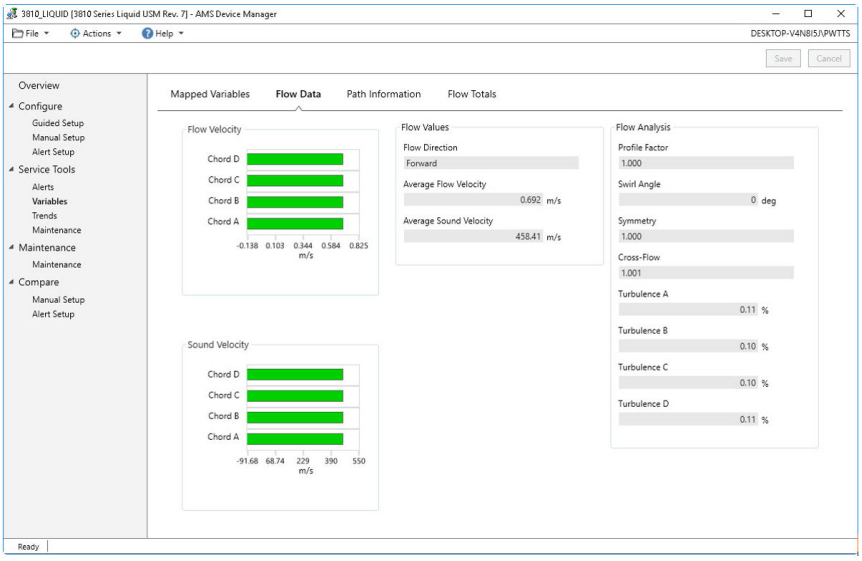


b) If you change the device configuration, a confirmation dialog displays and prompts you to write the changes to the meter. Click **Yes** to write the changes to the meter or click **No** to cancel pending changes.

Figure 4-15: Configuration changes dialog

c) Click the **Service Tools** → **Variables** tab. The Variables page displays tabs for the device's Flow Data, Path Information, Flow Totals, and All Variables.

Figure 4-16: AMS Device Manager - Service Tools



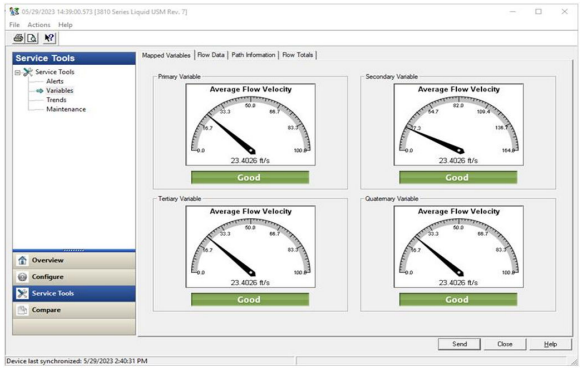
d) The **Service Tools** → **Flow Data** page includes charts for flow and sound velocities. The flow values (flow direction, average flow velocity and average sound velocity) parameters are displayed for the connected device.

e) Click **Service Tools** → **Variables** → **Path Information** tab to view the device's chord performance (percent), Gain (dB), SNR (dB), Signal (mV) and Noise (mV).

f) Click **Service Tools** → **Variables** → **Flow Totals** to view the volume totals (Forward and reverse Uncorrected Volume) parameters for the connected device.

g) Click **Service Tools** → **Variables** → **All Variables** tab to view Primary, Secondary, Third and Fourth Variable parameter status.

Figure 4-17: AMS Device Manager - Service Tools All Variables status indicators

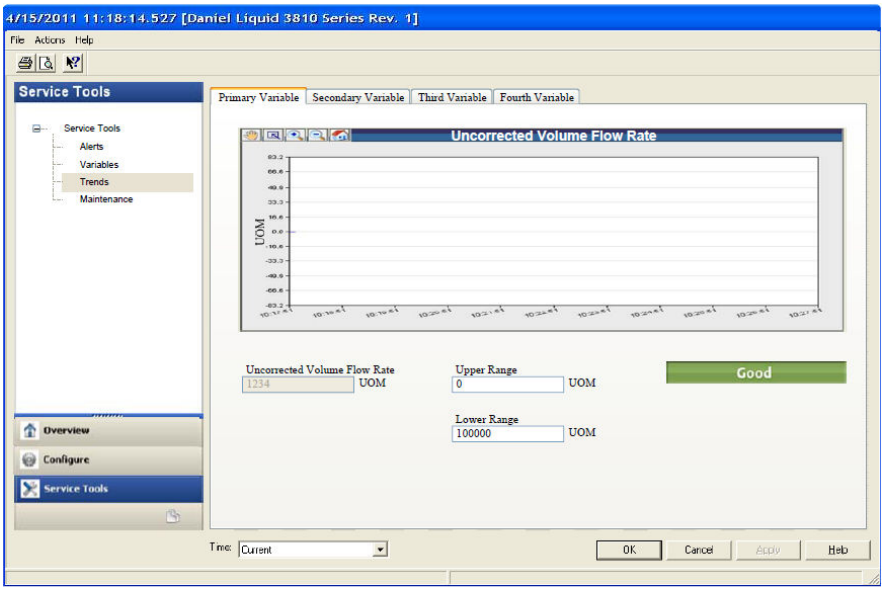


Gauges display each variable's status as good or bad. If a status is bad refer to the Service Tools Alerts page for recommended actions to resolve the alert condition. Also refer to the Field Device Specification manual (00825-0300-3810) for Commands 48 and 140 details.

Important
Alerts are triggered for Command 48 Additional device status and Command 140 detailed status information. Alerts are grouped as Failed - Fix Now, Maintenance - Fix Soon and Advisory according to the severity level; 1-6. Severity 1 is the highest and 6 is the lowest level.

h) Click the **Service Tools** → **Trends** tab to display the device variables (uncorrected volume flow rate, pressure and temperature) trends.

Figure 4-18: AMS Device Manager - Service Tools Trends



Primary and Secondary variables display real-time uncorrected volume flow rate trends. The third and fourth variables charts display trends for temperature and pressure.

15. Click the **Service Tools** → **Routine Maintenance** tab. Click **Analog Output 1 Trim** to perform a digital to analog trim adjustment of the first milliampere output. The 4 mA and 20 mA output current values should equal the plant's standard values.
    a) Click **Yes** to confirm the configuration changes. Repeat this step to trim Analog Output 2 current.
    b) Click **Apply** to write the output trim values to the meter.
    c) Click **OK** to navigate back to the Service Tools page.
16. Click the **Service Tools** → **Zero Calibration** tab. See AMS Device Manager - Guided Setup: Step 7 to configure the zero flow parameters.
17. After you have changed and written the configuration changes to the meter do the following:
    a) Enable the Write Protect switch on the CPU Module to protect the meter's configuration.
    b) Replace the end cap and if required, apply security seals through the endcap holes and through the hex head bolts that secure the Bracket/Cover to the Base enclosure.

Note
The next time you connect to the device using MeterLink, the Monitor page will display a Meter status alarm that the configuration has changed and remains latched until acknowledged. Click **Ack** (acknowledge) to clear the alarm.

4.3 Using a Field Communicator to configure the meter

Important
Follow all guidelines and precautions described in the Field Communicator User Manual and in the 3812 Liquid Ultrasonic Flow Meter documentation when working in a hazardous area.

Prerequisites

- Emerson Field Communicator software, license, installation guide and user manual available on the One Emerson website: Emerson.com/FieldCommunicators
- Rosemount HART® Device Description (HART DD) installed for the meter
- Network configured for a Field Communicator
- System wiring diagram drawing number DMC-004936 (see Engineering Drawings)
- Power supply

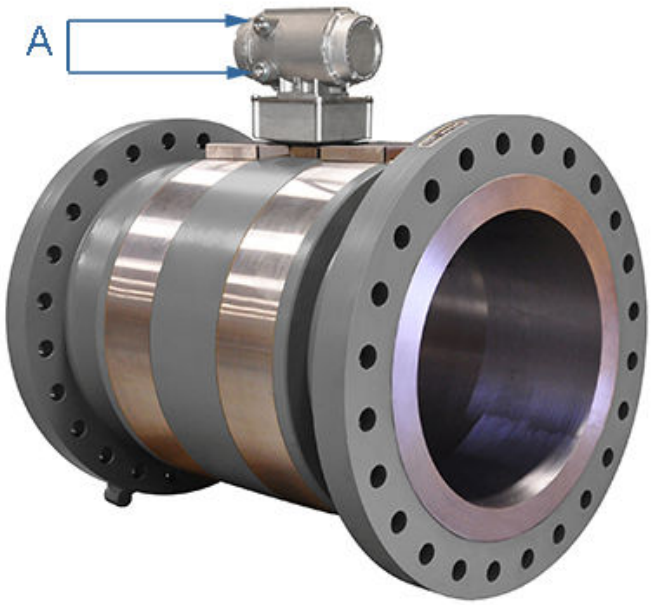
Procedure

1. Remove electrical power to the meter. If installed, remove the end cap security latches and seals and then, remove the end cap.
2. Refer to the Field Communicator Users Manual wiring diagrams and commissioning instructions provided with your handheld device. Register the product to activate the end user license.
3. Fully charge the Field Communicator battery prior to use.

   Important
   Do not change the battery in a hazardous area environment. The power supply is not intrinsically safe.

4. On the meter, run the wires through the field wiring conduit and into the transmitter electronics enclosure.

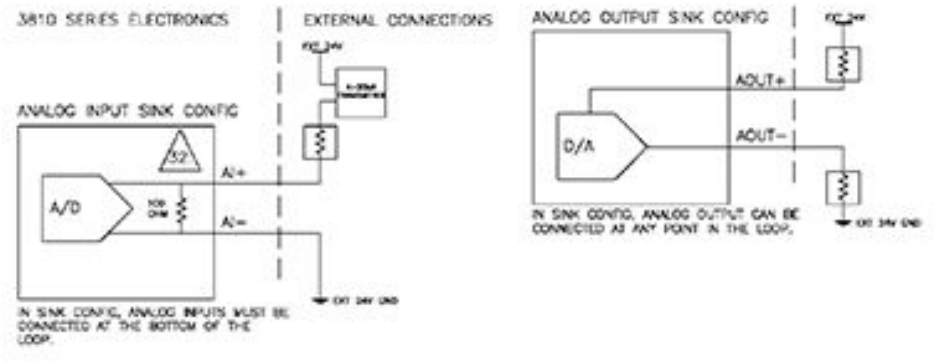
Figure 4-19: 3812 transmitter field wiring conduit entries



A. Field wiring conduit entries (4)

5. Wire Analog Input 1 (AI1) and Analog Output 1 (AO1) as shown in Figure 4-20 and Engineering Drawings, drawing DMC-004936.

Figure 4-20: Field Communicator wiring diagram for the 3810 Meter



6. Use the leads provided with the Field Communicator to connect to your device.
7. Press and hold the **Power** button on the Field Communicator until the green light blinks.
8. Use the touch screen on the Field Communicator, the keypad or use the stylus to navigate through the device menus.
9. Refer to the Menu tree in Section D.1.1 of the Rosemount HART Field Device Specification manual (00825-0300-3810) for the device fast key sequences. Included in the menu tree are:

- Diagram Page 1 - 3810 Series Root Menu; Overview, **Configure** → **Manual Setup**
- Diagram Page 2 - **Configure** → **Manual Setup** (continued) and **Alerts Setup**
- Diagram Page 3 - **Service Tools** → **Alerts** and Variables
- Diagram Page 4 - **Service Tools** → **Variables** (continued), **Service Tools** → **Trends**, and **Service Tools** → **Maintenance**

10. If you encounter problems, refer to the contact information on the back cover of this manual or the contacts included in the Field Communicator Users Manual.

4.4 Security seals for the meter

For the integrity of the meter metrology and to prevent tampering with the transmitter electronics and transducer assemblies, attach security latches to the Shroud covering the transducer assemblies and install security wires on the Transmitter Electronics Enclosure end caps, the Base Enclosure hex head bolts, the Shroud clamps and the shroud latches (see Security seal installation).

Pour the conduit ports sealing compound according to the customer's requirements (e.g., after approximately one to two weeks of run time). Also, see Startup for systems using explosion-proof conduit and see Startup for systems using flame-proof cable.

4.5 Configure users and network security

Starting with Rosemount 3810 Series Firmware v1.60, the meter must authenticate any user making a connection to the meter using MeterLink. MeterLink will prompt for a username and password that will be authenticated by the meter before a successful connection is established. While the default password is unique to each meter, it is highly recommended to be changed at meter startup. For added security, the default username, administrator, can be changed as well. See Manage Users in the *Rosemount 3810 Series Liquid Ultrasonic Flow Meters: Operations Manual* (00809-0200-3810) for more details on setting up users, user types and passwords using the **Meter** → **Manage Users** dialog box in MeterLink.

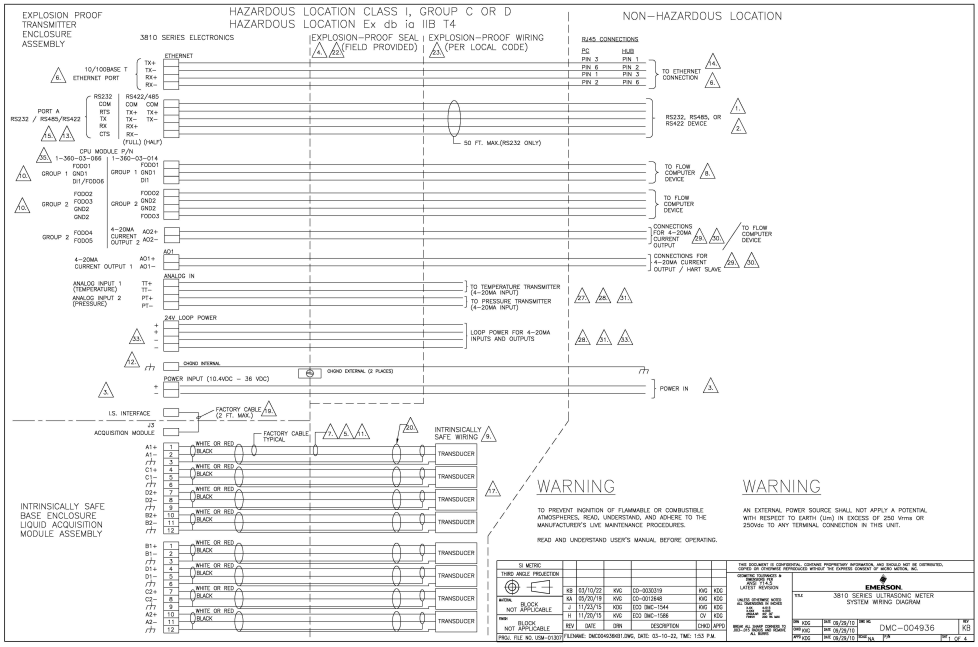
If the Rosemount 3810 Series Electronics will be connected to a network, please read the security recommendations found in Cybersecurity and network communications in the *Rosemount 3810 Series Liquid Ultrasonic Flow Meters: Operations Manual* (00809-0200-3810).

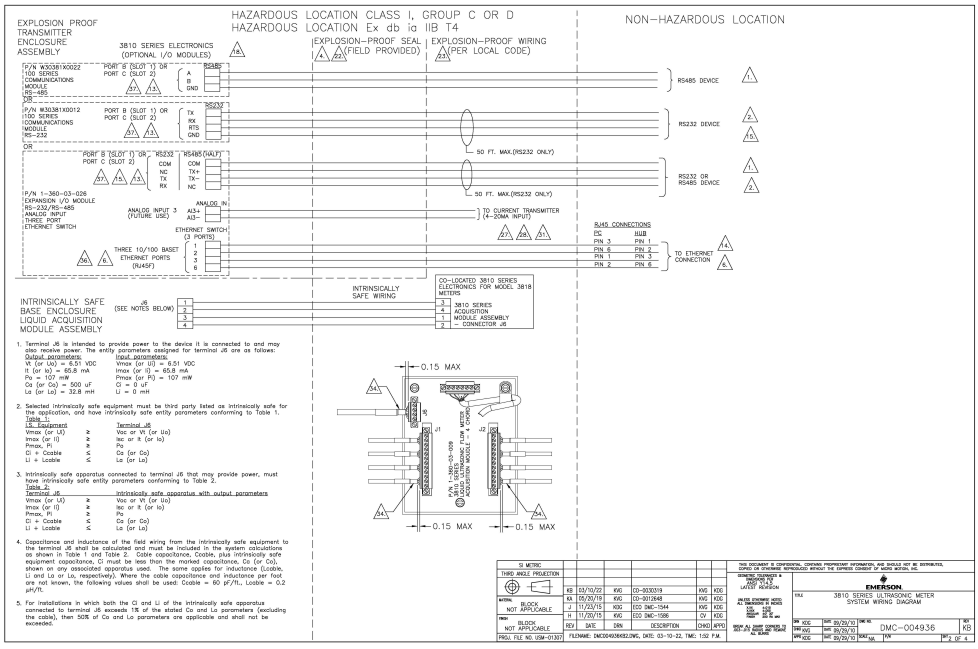
A Engineering Drawings

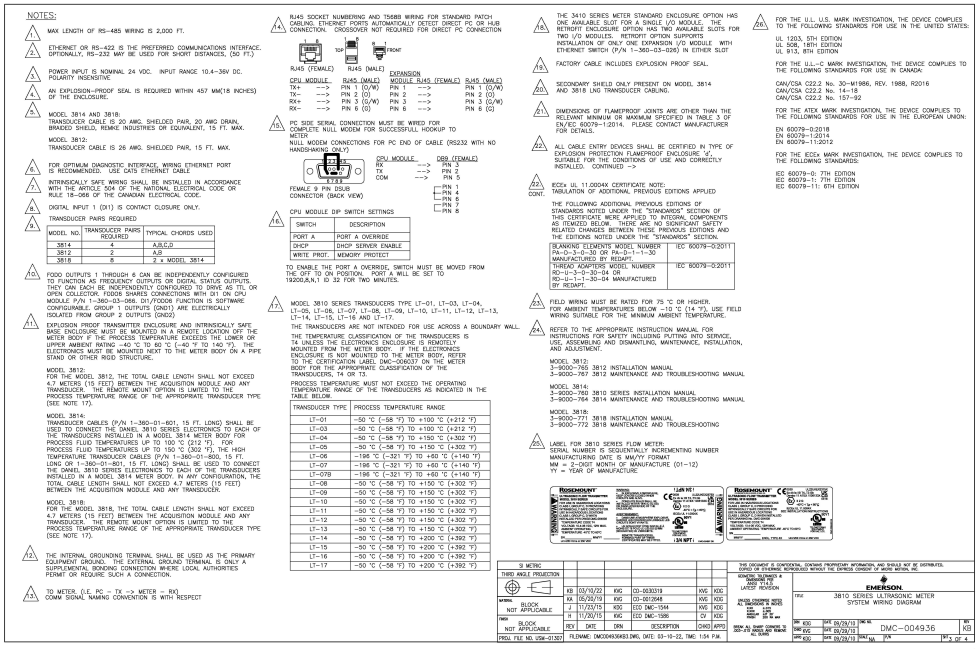
A.1 Rosemount 3812 Liquid Ultrasonic Flow Meter drawings

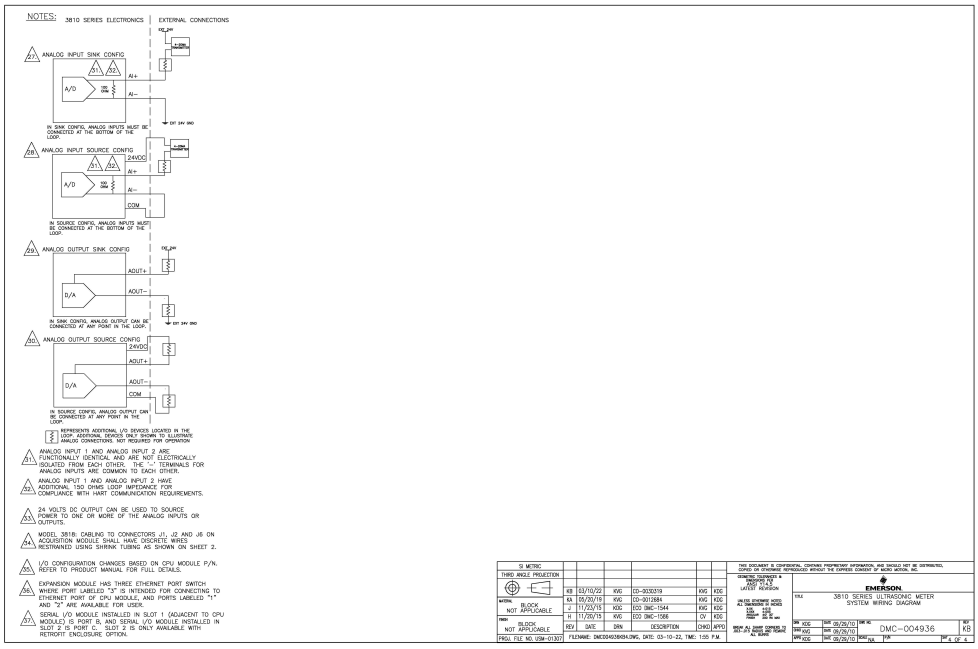
This appendix contains the following engineering drawing(s) for the ultrasonic meter:

DMC-004936	3810 Series Ultrasonic Meter System Wiring Diagram




HAZARDOUS LOCATION CLASS I, GROUP C OR D
HAZARDOUS LOCATION Ex db ia IIB T4
NON-HAZARDOUS LOCATION
EXPLOSION PROOF TRANSMITTER ENCLOSURE ASSEMBLY
3810 SERIES ELECTRONICS (OPTIONAL I/O MODULES)
EXPLOSION-PROOF SEAL (FIELD PROVIDED)
EXPLOSION-PROOF WIRING (PER LOCAL CODE)
RS485 DEVICE
RS232 DEVICE
RS232 OR RS485 DEVICE
50 FT. MAX.(RS232 ONLY)
TO CURRENT TRANSMITTER (4-20MA INPUT)
RJ45 CONNECTIONS
TO ETHERNET CONNECTION
INTRINSICALLY SAFE BASE EXCLOSURE LIQUID ACQUISITION MODULE ASSEMBLY
INTRINSICALLY SAFE WIRING
CO-LOCATED 3810 SERIES ELECTRONICS FOR MODEL 3818 METERS
3810 SERIES ACQUISITION MODULE ASSEMBLY
0.15 MAX
0.15 MAX
0.15 MAX
EMERSON.
3810 SERIES ULTRASONIC METER SYSTEM WIRING DIAGRAM
DMC-00049.36
PROJ. FILE NO. USM-01307
FILENAME: DMC00492683.DWG, DATE: 03-10-22, TIME: 1:52 P.M.


NOTES:
MAX LENGTH OF RS-485 WIRING IS 2,000 FT.
ETHERNET OR RS-422 IS THE PREFERRED COMMUNICATIONS INTERFACE. OPTIONALLY, RS-232 MAY BE USED FOR SHORT DISTANCES, (50 FT.)
POWER INPUT IS NOMINAL 24 VDC. INPUT RANGE 10.4-36V DC. POLARITY INSENSITIVE
AN EXPLOSION-PROOF SEAL IS REQUIRED WITHIN 457 MM(18 INCHES) OF THE ENCLOSURE.
MODEL 3814 AND 3818:
TRANSDUCER CABLE IS 20 AWG, SHIELDED PAIR, 20 AWG DRAIN, BRAIDED SHIELD, REMKE INDUSTRIES OR EQUIVALENT, 15 FT. MAX.
MODEL 3812:
TRANSDUCER CABLE IS 26 AWG, SHIELDED PAIR, 15 FT. MAX.
FOR OPTIMUM DIAGNOSTIC INTERFACE, WIRING ETHERNET PORT IS RECOMMENDED. USE CAT5 ETHERNET CABLE
INTRINSICALLY SAFE WIRING SHALL BE INSTALLED IN ACCORDANCE WITH THE ARTICLE 504 OF THE NATIONAL ELECTRICAL CODE OR RULE 18-068 OF THE CANADIAN ELECTRICAL CODE.
DIGITAL INPUT 1 (DI1) IS CONTACT CLOSURE ONLY.
TRANSDUCER PAIRS REQUIRED
MODEL NO. | TRANSDUCER PAIRS REQUIRED | TYPICAL CHORDS USED
3814 | 4 | A,B,C,D
3812 | 2 | A,D
3818 | 8 | 2 x MODEL 3814
FOOD OUTPUTS 1 THROUGH 6 CAN BE INDEPENDENTLY CONFIGURED TO FUNCTION AS FREQUENCY OUTPUTS OR DIGITAL STATUS OUTPUTS. THEY CAN EACH BE INDEPENDENTLY CONFIGURED TO DRIVE AS TTL OR OPEN COLLECTOR. FOOD5 SHARES CONNECTIONS WITH DI1 ON CPU MODULE P/N 1-360-03-0066. DI1/FOOD5 FUNCTION IS SOFTWARE CONFIGURABLE. GROUP 1 OUTPUTS (GND1) ARE ELECTRICALLY ISOLATED FROM GROUP 2 OUTPUTS (GND2)
EXPLOSION PROOF TRANSMITTER ENCLOSURE AND INTRINSICALLY SAFE BASE EXCLOSURE LIQUID ACQUISITION MODULE ASSEMBLY MUST BE LOCATED OFF THE METER BODY IF THE PROCESS TEMPERATURE WILL EXCEED THE LOWER OR UPPER AMBIENT RATING -40 °C TO 60 °C (-40 °F TO +140 °F). THE ELECTRONICS MUST BE MOUNTED NEXT TO THE METER BODY ON A PIPE STAND OR OTHER RIGID STRUCTURE.
MODEL 3812:
FOR THE MODEL 3812, THE TOTAL CABLE LENGTH SHALL NOT EXCEED 4.7 METERS (15 FEET) BETWEEN THE ACQUISITION MODULE AND ANY TRANSDUCER. THE REMOTE MOUNT OPTION IS LIMITED TO THE PROCESS TEMPERATURE RANGE OF THE APPROPRIATE TRANSDUCER TYPE (SEE NOTE 17).
MODEL 3814:
TRANSDUCER CABLES (P/N 1-360-01-601, 15 FT. LONG) SHALL BE USED TO CONNECT THE DANIEL 3810 SERIES ELECTRONICS TO EACH OF THE TRANSDUCERS INSTALLED IN A MODEL 3814 METER BODY FOR PROCESS FLUID TEMPERATURES UP TO 100 °C (212 °F). FOR PROCESS FLUID TEMPERATURES UP TO 150 °C (302 °F), THE HIGH TEMPERATURE TRANSDUCER CABLES (P/N 1-360-01-800, 15 FT. LONG OR 1-360-01-801, 15 FT. LONG) SHALL BE USED TO CONNECT THE DANIEL 3810 SERIES ELECTRONICS TO EACH OF THE TRANSDUCERS INSTALLED IN A MODEL 3814 METER BODY. IN ANY CONFIGURATION, THE TOTAL CABLE LENGTH SHALL NOT EXCEED 4.7 METERS (15 FEET) BETWEEN THE ACQUISITION MODULE AND ANY TRANSDUCER.
MODEL 3818:
FOR THE MODEL 3818, THE TOTAL CABLE LENGTH SHALL NOT EXCEED 4.7 METERS (15 FEET) BETWEEN THE ACQUISITION MODULE AND ANY TRANSDUCER. THE REMOTE MOUNT OPTION IS LIMITED TO THE PROCESS TEMPERATURE RANGE OF THE APPROPRIATE TRANSDUCER TYPE (SEE NOTE 17).
THE INTERNAL GROUNDING TERMINAL SHALL BE USED AS THE PRIMARY EQUIPMENT GROUND. THE EXTERNAL GROUND TERMINAL IS ONLY A SUPPLEMENTAL BONDING CONNECTION WHERE LOCAL AUTHORITIES PERMIT OR REQUIRE SUCH A CONNECTION.
TO METER. (I.E. PC – TX --> METER – RX) COMM SIGNAL NAMING CONVENTION IS WITH RESPECT
RJ45 SOCKET NUMBERING AND T568B WIRING FOR STANDARD PATCH CABLING. ETHERNET PORTS AUTOMATICALLY DETECT DIRECT PC OR HUB CONNECTION. CROSSOVER NOT REQUIRED FOR DIRECT PC CONNECTION
RJ45 (FEMALE) RJ45 (MALE)
CPU MODULE RJ45 (MALE) EXPANSION MODULE RJ45 (FEMALE) RJ45 (MALE)
PC SIDE SERIAL CONNECTION MUST BE WIRED FOR COMPLETE NULL MODEM FOR SUCCESSFULL HOOKUP TO METER
NULL MODEM CONNECTIONS FOR PC END OF CABLE (RS232 WITH NO HANDSHAKING ONLY)
CPU MODULE DB9 (FEMALE)
FEMALE 9 PIN DSUB CONNECTOR (BACK VIEW)
CPU MODULE DIP SWITCH SETTINGS
SWITCH | DESCRIPTION
PORT A | PORT A OVERRIDE
DHCP | DHCP SERVER ENABLE
WRITE PROT. | MEMORY PROTECT
TO ENABLE THE PORT A OVERRIDE, SWITCH MUST BE MOVED FROM THE OFF TO ON POSITION. PORT A WILL BE SET TO 19200,8,N,1 ID 32 FOR TWO MINUTES.
MODEL 3810 SERIES TRANSDUCERS TYPE LT-01, LT-03, LT-04, LT-05, LT-06, LT-07, LT-08, LT-09, LT-10, LT-11, LT-12, LT-13, LT-14, LT-15, LT-16 AND LT-17.
THE TRANSDUCERS ARE NOT INTENDED FOR USE ACROSS A BOUNDARY WALL.
THE TEMPERATURE CLASSIFICATION OF THE TRANSDUCERS IS T4 UNLESS THE ELECTRONICS ENCLOSURE IS REMOTELY MOUNTED FROM THE METER BODY. IF THE ELECTRONICS ENCLOSURE IS NOT MOUNTED TO THE METER BODY, REFER TO THE CERTIFICATION LABEL DMC-00803? ON THE METER BODY FOR THE APPROPRIATE CLASSIFICATION OF THE TRANSDUCERS, T4 OR T3.
PROCESS TEMPERATURE MUST NOT EXCEED THE OPERATING TEMPERATURE RANGE OF THE TRANSDUCERS AS INDICATED IN THE TABLE BELOW.
TRANSDUCER TYPE | PROCESS TEMPERATURE RANGE
LT-01 | -50 °C (-58 °F) TO +100 °C (+212 °F)
LT-03 | -50 °C (-58 °F) TO +100 °C (+212 °F)
LT-04 | -50 °C (-58 °F) TO +150 °C (+302 °F)
LT-05 | -50 °C (-58 °F) TO +150 °C (+302 °F)
LT-06 | -196 °C (-321 °F) TO +60 °C (+140 °F)
LT-07 | -196 °C (-321 °F) TO +60 °C (+140 °F)
LT-07B | -196 °C (-321 °F) TO +60 °C (+140 °F)
LT-08 | -50 °C (-58 °F) TO +150 °C (+302 °F)
LT-09 | -50 °C (-58 °F) TO +150 °C (+302 °F)
LT-10 | -50 °C (-58 °F) TO +150 °C (+302 °F)
LT-11 | -50 °C (-58 °F) TO +150 °C (+302 °F)
LT-12 | -50 °C (-58 °F) TO +150 °C (+302 °F)
LT-13 | -50 °C (-58 °F) TO +150 °C (+302 °F)
LT-14 | -50 °C (-58 °F) TO +200 °C (+392 °F)
LT-15 | -50 °C (-58 °F) TO +200 °C (+392 °F)
LT-16 | -50 °C (-58 °F) TO +200 °C (+392 °F)
LT-17 | -50 °C (-58 °F) TO +200 °C (+392 °F)
THE 3410 SERIES METER STANDARD ENCLOSURE OPTION HAS ONE AVAILABLE SLOT FOR A SINGLE I/O MODULE. THE RETROFIT ENCLOSURE OPTION HAS TWO AVAILABLE SLOTS FOR TWO I/O MODULES. RETROFIT OPTION SUPPORTS INSTALLATION OF ONLY ONE EXPANSION I/O MODULE WITH ETHERNET SWITCH (P/N 1-360-03-026) IN EITHER SLOT
FACTORY CABLE INCLUDES EXPLOSION PROOF SEAL.
SECONDARY SHIELD ONLY PRESENT ON MODEL 3814 AND 3818 LNG TRANSDUCER CABLING.
DIMENSIONS OF FLAMEPROOF JOINTS ARE OTHER THAN THE RELEVANT MINIMUM OR MAXIMUM SPECIFIED IN TABLE 3 OF EN/IEC 60079-1:2014. PLEASE CONTACT MANUFACTURER FOR DETAILS.
ALL CABLE ENTRY DEVICES SHALL BE CERTIFIED IN TYPE OF EXPLOSION PROTECTION FLAMEPROOF ENCLOSURE 'd', SUITABLE FOR THE CONDITIONS OF USE AND CORRECTLY INSTALLED. CONTINUED -->
IECEx UL 11.0004X CERTIFICATE NOTE: TABULATION OF ADDITIONAL PREVIOUS EDITIONS APPLIED
THE FOLLOWING ADDITIONAL PREVIOUS EDITIONS OF STANDARDS NOTED UNDER THE "STANDARDS" SECTION OF THIS CERTIFICATE WERE APPLIED TO INTEGRAL COMPONENTS AS ITEMIZED BELOW. THERE ARE NO SIGNIFICANT SAFETY RELATED CHANGES BETWEEN THESE PREVIOUS EDITIONS AND THE EDITIONS NOTED UNDER THE "STANDARDS" SECTION.
BLANKING ELEMENTS MODEL NUMBER PA-D-3-0-30 OR PA-D-1-1-30 MANUFACTURED BY REDAPT. | IEC 60079-0:2011
THREAD ADAPTERS MODEL NUMBER RD-U-3-0-30-04 OR RD-U-1-1-30-04 MANUFACTURED BY REDAPT. | IEC 60079-0:2011
FIELD WIRING MUST BE RATED FOR 75 °C OR HIGHER. FOR AMBIENT TEMPERATURES BELOW -10 °C (14 °F), USE FIELD WIRING SUITABLE FOR THE MINIMUM AMBIENT TEMPERATURE.
REFER TO THE APPROPRIATE INSTRUCTION MANUAL FOR INSTRUCTIONS FOR SAFETY INCLUDING PUTTING INTO SERVICE, USE, ASSEMBLING AND DISMANTLING, MAINTENANCE, INSTALLATION, AND ADJUSTMENT.
MODEL 3812:
3-9000-765 3812 INSTALLATION MANUAL
3-9000-767 3812 MAINTENANCE AND TROUBLESHOOTING MANUAL
MODEL 3814:
3-9000-760 3810 SERIES INSTALLATION MANUAL
3-9000-764 3814 MAINTENANCE AND TROUBLESHOOTING MANUAL
MODEL 3818:
3-9000-771 3818 INSTALLATION MANUAL
3-9000-772 3818 MAINTENANCE AND TROUBLESHOOTING
LABEL FOR 3810 SERIES FLOW METER:
SERIAL NUMBER IS SEQUENTIALLY INCREMENTING NUMBER
MANUFACTURING DATE IS MM/YY FORMAT
MM = 2-DIGIT MONTH OF MANUFACTURE (01-12)
YY = YEAR OF MANUFACTURE
FOR THE U.L. U.S. MARK INVESTIGATION, THE DEVICE COMPLIES TO THE FOLLOWING STANDARDS FOR USE IN THE UNITED STATES:
UL 1203, 5TH EDITION
UL 508, 18TH EDITION
UL 913, 8TH EDITION
FOR THE U.L.-C MARK INVESTIGATION, THE DEVICE COMPLIES TO THE FOLLOWING STANDARDS FOR USE IN CANADA:
CAN/CSA C22.2 No. 30-M1986, REV. 1988, R2016
CAN/CSA C22.2 No. 14-18
CAN/CSA C22.2 No. 157-92
FOR THE ATEX MARK INVESTIGATION, THE DEVICE COMPLIES TO THE FOLLOWING STANDARDS FOR USE IN THE EUROPEAN UNION:
EN 60079-0:2018
EN 60079-1:2014
EN 60079-11:2012
FOR THE IECEx MARK INVESTIGATION, THE DEVICE COMPLIES TO THE FOLLOWING STANDARDS:
IEC 60079-0: 7TH EDITION
IEC 60079-1: 7TH EDITION
IEC 60079-11: 6TH EDITION
EMERSON.
3810 SERIES ULTRASONIC METER SYSTEM WIRING DIAGRAM
DMC-00049.36
PROJ. FILE NO. USM-01307
FILENAME: DMC00493683.DWG, DATE: 03-10-22, TIME: 1:54 P.M.


NOTES:
3810 SERIES ELECTRONICS
EXTERNAL CONNECTIONS
ANALOG INPUT SINK CONFIG
ANALOG INPUT SOURCE CONFIG
ANALOG OUTPUT SINK CONFIG
ANALOG OUTPUT SOURCE CONFIG
EMERSON.
3810 SERIES ULTRASONIC METER
SYSTEM WIRING DIAGRAM
DMC-004936

B Open Sources licenses

B.1 List of Open Source licenses

For a copy of the source code covered under the open source licenses indicated in this appendix, please contact flow.support@emerson.com.

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For more details about GNU GPL (General Public License), follow the link below:

www.gnu.org

Micro Motion, Inc. uses GPL version 2.

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www.gnu.org/licenses/quick-guide-gplv3.html

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Version 2, June 1991

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c) Accompany it with the information you received as to the offer to distribute corresponding source code. (This alternative is allowed only for noncommercial distribution and only if you received the program in object code or executable form with such an offer, in accord with Subsection b above.)

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00825-0100-3812
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