Installation Manual
Part Number 3-9000-771Revision A
May 2012

Daniel™ 3818 LNG Liquid Ultrasonic Meter

For Cryogenic Liquefied Natural Gas Applications

DANIEL™

EMERSON.
Process Management

Important Safety Instructions

Daniel Measurement and Control, Inc. (Daniel) designs, manufactures and tests products to function within specific conditions. Because these products are sophisticated technical instruments, it is important that the owner and operation personnel strictly adhere both to the information printed on the product nameplate and to all instructions provided in this manual prior to installation, operation, and maintenance.

⚠WARNING

Failure to follow the Installation, operation or maintenance instructions for a Daniel product could lead to serious injury or death from explosion or exposure to dangerous substances. To reduce this risk:

- Comply with all information on the product, in this manual, and in any local and national codes that apply to the product.
- Do not allow untrained personnel to work with this product.
- Use Daniel parts and work procedures specified in this manual.

Daniel also urges you to integrate this manual into your training and safety program.

BE SURE ALL PERSONNEL READ AND FOLLOW THE INSTRUCTIONS IN THIS MANUAL AND ALL NOTICES AND PRODUCT WARNINGS.

Product owners (Purchasers):

- Use the correct product for the environment and pressures present. See technical data for limitations. If you are unsure, discuss your needs with your Daniel representative.
- Inform and train all personnel in the proper installation, operation, and maintenance of this product.
- To ensure safe and proper performance, only informed and trained personnel should install, operate, repair and maintain this product.
- Verify that this is the correct instruction manual for your Daniel product. If this is not the correct documentation, contact Daniel at 1-713-827-6314. You may also download the correct manual from:

  http://www.daniel.com

- Save this instruction manual for future reference.
- If you resell or transfer this product, it is your responsibility to forward this instruction manual along with the product to the new owner or transferee.
- ALWAYS READ AND FOLLOW THE INSTALLATION, OPERATIONS, MAINTENANCE AND TROUBLESHOOTING MANUALS AND ALL PRODUCT WARNINGS AND INSTRUCTIONS.
- Do not use this equipment for any purpose other than its intended service. This may result in property damage and/or serious personal injury or death.

Product operation (Personnel):

- To prevent personal injury, personnel must follow all instructions of this manual prior to and during operation of the product.
- Follow all warnings, cautions, and notices marked on, and supplied with, this product.
- Verify that this is the correct instruction manual for your Daniel product. If this is not the correct documentation, contact Daniel at 1-713-827-6314. You may also download the correct manual from:

  http://www.daniel.com

- Read and understand all instructions and operating procedures for this product.
- If you do not understand an instruction, or do not feel comfortable following the instructions, contact your Daniel representative for clarification or assistance.
- Install this product as specified in the INSTALLATION section of this manual per applicable local and national codes.
- Follow all instructions during the installation, operation, and maintenance of this product.
- Connect the product to the proper pressure sources when and where applicable.
- Use only replacement parts specified by Daniel. Unauthorized parts and procedures can affect this product's performance, safety, and invalidate the warranty. "Look-a-like" substitutions may result in deadly fire, explosion, release of toxic substances or improper operation.
- Save this instruction manual for future reference.

Signal words and symbols used in this manual

Pay special attention to the following signal words, safety alert symbols and statements:

⚠ DANGER

Indicates a hazardous situation which, if not avoided, will result in death or serious injury.

⚠WARNING

Indicates a hazardous situation which, if not avoided, could result in death or serious injury.

⚠CAUTION

Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

NOTICE

Used to address practices associated with possible equipment damage and miscellaneous practices not related to personal injury.

⚠ Safety alert symbol

This is a safety alert symbol. It is used to alert you to potential physical injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

Daniel Measurement and Control, Inc.

Daniel™ 3818 Liquid Ultrasonic Flow Meters

NOTICE

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DANIEL AND THE DANIEL LOGO ARE REGISTERED TRADEMARKS OF DANIEL INDUSTRIES, INC. THE EMERSON LOGO IS A TRADEMARK AND SERVICE MARK OF EMERSON ELECTRIC CO.

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Warranty

1. LIMITED WARRANTY: Subject to the limitations contained in Section 2 herein, Daniel Measurement & Control, Inc. ("Daniel") warrants that the licensed firmware embodied in the Goods will execute the programming instructions provided by Daniel, and that the Goods manufactured by Daniel will be free from defects in materials or workmanship under normal use and care and Services will be performed by trained personnel using proper equipment and instrumentation for the particular Service provided. The foregoing warranties will apply until the expiration of the applicable warranty period. Goods are warranted for twelve (12) months from the date of initial installation or eighteen (18) months from the date of shipment by Daniel, whichever period expires first. Consumables and Services are warranted for a period of 90 days from the date of shipment or completion of the Services. Products purchased by Daniel from a third party for resale to Buyer ("Resale Products") shall carry only the warranty extended by the original manufacturer. Buyer agrees that Daniel has no liability for Resale Products beyond making a reasonable commercial effort to arrange for procurement and shipping of the Resale Products. If Buyer discovers any warranty defects and notifies Daniel thereof in writing during the applicable warranty period, Daniel shall, at its option, correct any errors that are found by Daniel in the firmware or Services or repair or replace F.O.B. point of manufacture that portion of the Goods or firmware found by Daniel to be defective, or refund the purchase price of the defective portion of the Goods/Services. All replacements or repairs necessitated by inadequate maintenance, normal wear and usage, unsuitable power sources or environmental conditions, accident, misuse, improper installation, modification, repair, use of unauthorized replacement parts, storage or handling, or any other cause not the fault of Daniel are not covered by this limited warranty, and shall be at Buyer's expense. Daniel shall not be obligated to pay any costs or charges incurred by Buyer or any other party except as may be agreed upon in writing in advance by Daniel. All costs of dismantling, reinstallation and freight and the time and expenses of Daniel's personnel and representatives for site travel and diagnosis under this warranty clause shall be borne by Buyer unless accepted in writing by Daniel. Goods repaired and parts replaced by Daniel during the warranty period shall be in warranty for the remainder of the original warranty period or ninety (90) days, whichever is longer. This limited warranty is the only warranty made by Daniel and can be amended only in a writing signed by Daniel. THE WARRANTIES AND REMEDIES SET FORTH ABOVE ARE EXCLUSIVE. THERE ARE NO REPRESENTATIONS OR WARRANTIES OF ANY KIND, EXPRESS OR IMPLIED, AS TO MERCHANTABILITY, FITNESS FOR PARTICULAR PURPOSE OR ANY OTHER MATTER WITH RESPECT TO ANY OF THE GOODS OR SERVICES. Buyer acknowledges and agrees that corrosion or erosion of materials is not covered by this warranty.

2. LIMITATION OF REMEDY AND LIABILITY: DANIEL SHALL NOT BE LIABLE FOR DAMAGES CAUSED BY DELAY IN PERFORMANCE. THE REMEDIES OF BUYER SET FORTH IN THIS AGREEMENT ARE EXCLUSIVE. IN NO EVENT, REGARDLESS OF THE FORM OF THE CLAIM OR CAUSE OF ACTION (WHETHER BASED IN CONTRACT, INFRINGEMENT, NEGLIGENCE, STRICT LIABILITY, OTHER TORT OR OTHERWISE), SHALL DANIEL'S LIABILITY TO BUYER AND/OR ITS CUSTOMERS EXCEED THE PRICE TO BUYER OF THE SPECIFIC GOODS MANUFACTURED OR SERVICES PROVIDED BY DANIEL GIVING RISE TO THE CLAIM OR CAUSE OF ACTION. BUYER AGREES THAT IN NO EVENT SHALL DANIEL'S LIABILITY TO BUYER AND/OR ITS CUSTOMERS EXTEND TO INCLUDE INCIDENTAL, CONSEQUENTIAL OR PUNITIVE DAMAGES. THE TERM "CONSEQUENTIAL DAMAGES" SHALL INCLUDE, BUT NOT BE LIMITED TO, LOSS OF ANTICIPATED PROFITS, REVENUE OR USE AND COSTS INCURRED INCLUDING WITHOUT LIMITATION FOR CAPITAL, FUEL AND POWER, AND CLAIMS OF BUYER'S CUSTOMERS.

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Section 1: Introduction

Daniel 3818 LNG Liquid Ultrasonic Flow Meters have various configurations that meet a broad range of customer requirements. Each meter comes fully assembled from Daniel™ Measurement and Control, Inc. and all parts and assemblies are tested prior to shipment.

Refer to the following documents for additional details:

- P/N 3-9000-762 HART® Field Device Specification Guide Liquid Ultrasonic Meter
- P/N 3-9000-772 Daniel 3818 LNG Liquid Ultrasonic Flow Meter Maintenance and Troubleshooting Manual

1.1 Typical Applications

- Custody transfer measurement
- Allocation measurement
- LNG applications
  - LNG liquefaction to storage (loading terminals)
  - LNG liquefaction loading (loading terminal)
  - LNG receiving to storage (receipt terminal)
  - LNG storage to regasification (receipt terminal)

1.2 Features and benefits:

- Two remote mountable explosion-proof transmitter electronics enclosures with CPU Module, Power Supply, Intrinsic Safety Barrier Module and Backplane
- Two remote mountable intrinsically safe transmitter electronics enclosures with the Acquisition Module
- Transducer housings seal-welded to meter body to eliminate leak potential
- Meter body insulated and shroud assembly covering transducers and cabling
- HART® and AMS Suite: Intelligent Device Manager communications for PlantWeb™ architecture
- Suitable for measuring process fluid temperature ranges from -196 °C (-321 °F) to +60 °C (140 °F)
- Reduce unaccounted measurement
- Extensive self diagnostics
- Immediate alarm reporting
- Auto-detected ASCII/RTU Modbus communications protocol

- Internet-ready communications
- Ethernet access
- Modbus TCP/IP
- On-board LED status indicators
- Analog pressure and temperature inputs
- Daniel MeterLink™ (a Windows®-based interface software)

1.3 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 ASCII characters are used to delineate the beginning and end of the frame. ASCII stands for American Standard Code for Information Interchange.
Backplane board	Backplane board for CPU board, I.S Barrier board, Power Supply, and Acquisition cable connections
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; 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 Clear-to-Send (CTS) input of a transmitter.
DAC	Digital-to-Analog Converter
Daniel MeterLink™	Daniel Ultrasonic Meter interface software
DI	Digital Input
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
f^3	cubic foot
f^3/s	Cubic foot per second

Table 1-1 Acronyms, abbreviations and definitions

Acronym or abbreviation	Definition
f^3/min	Cubic foot per minute
FODO	Output that is user configurable as either a frequency or digital output
Gal	Gallon
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 (10^3 cycles per second, frequency unit)
LAN	Local Area Network
LED	llght-emitting Diode
L	Liters
m	meter (length unit)
m^3/d	cubic meters per day (volumetric flow rate)
m^3/h	cubic meters per hour (volumetric flow rate)
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

Table 1-1 Acronyms, abbreviations and definitions

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

1.4 Daniel MeterLink software

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

http://www2.emersonprocess.com/en-US/brands/daniel/Flow/ultrasonics/Pages/MeterLink.aspx

Figure 1-1 Daniel 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 conformation 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. Daniel MeterLink unzips the compressed file using the **Tools>Program Download** utility.

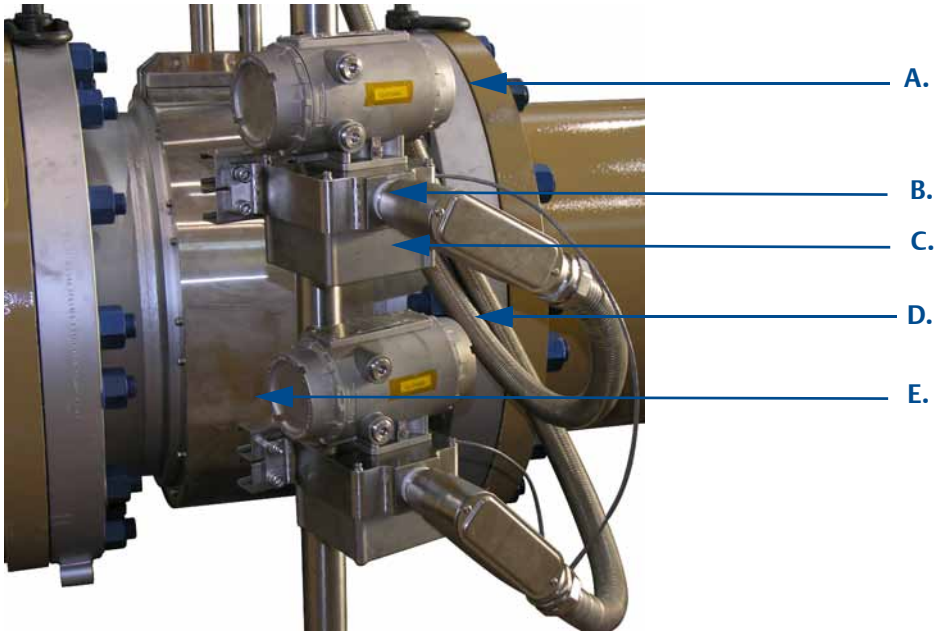
Refer to the *Daniel MeterLink Software for Gas and Liquid Ultrasonic Meters Quick Start Manual* (P/N 3-9000-763) for installation instructions and to setup initial communications. You may download the manual from the Daniel MeterLink web page:

http://www2.emersonprocess.com/en-US/brands/daniel/Flow/ultrasonics/Pages/MeterLink.aspx

1.5 3818 LNG Liquid Ultrasonic Flow Meter design

The Daniel 3818 LNG Liquid Ultrasonic Flow Meter is a remote mount, dual transmitter electronics, eight-path (sixteen 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 with the direction of flow 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.

Figure 1-2 3818 LNG Meter with remote mount electronics and band shroud assembly



A. Explosion-proof transmitter enclosure (CPU Module, Power Supply, I.S. Barrier Board, and Backplane Bd.)
B. Bracket cover with synchronization cable
C. Intrinsically-safe base enclosure includes Acquisition Module
D. Rigid and flexible conduit for transducer cables
E. Meter - body and shroud cover for transducers and cables assemblies

Computer simulations of various velocity profiles demonstrate that eight measurement paths provide an optimum solution for measuring asymmetric flow. The Daniel 3818 LNG Liquid Ultrasonic Flow Meter utilizes eight cross-bore, parallel-plane measurement paths to offer a high degree of accuracy, repeatability, and superior low-flow capabilities without the compromises associated with conventional technologies. The meter is comprised of two 3810 Transmitter Electronics, designated as co-located primary (master) and secondary (slave) electronics. A synchronization cable connects the primary and secondary Acquisition Modules at the J6 terminal block and the liquid ultrasonic flow meter firmware controls the transducers firing sequencing. The Daniel 3818 LNG Liquid Ultrasonic Flow Meter with the 30" diameter meter body utilizes 60 degree port angles with LT-07 transducers.

These features make the Daniel 3818 LNG Liquid Ultrasonic Flow Meter the best choice for cryogenic custody transfer applications as shown in the following sections of this manual.

The Daniel 3818 LNG Liquid Ultrasonic Flow Meter's U.L. safety listing is accomplished through the combination of a remote mounted, explosion-proof Transmitter Electronics Enclosure that houses the CPU Module, I.S. Barrier Module, Power Supply Board, and the Backplane Board. The flameproof Base Electronics Enclosure houses the Acquisition Module and the acquisition board cable connections. 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 Daniel drawing DMC - 004936, see Appendix A) and the meter body (spool piece).

1.6 Meter specifications

Specifications for Daniel 3818 LNG Liquid Ultrasonic Flow Meters are below:

Table 1-2 Meter specifications

Liquid meter specifications	
Meter type	Number of paths: • Eight path (sixteen transducer) chordal design
	Ultrasonic type: • Transit-time based measurement • Spool piece with integral mount transducers
Meter performance	
Linearity	• ± 0.15% of measured value over a 10:1 turndown • ± 0.20% of measured value over a 20:1 turndown
Repeatability	• ±0.02% of reading in the specified velocity range
Velocity range	• 2.0 fps (0.6 m/s) to 40.0 fps (12.2 m/s) (nominal) 48 fps (14.3 m/s) (over-range)
Upper Viscosity Limit	• 150 centipoise (Transducers LT-07)
Body and Flange Pressure rating range	U.S. Customary Units - Meter size 30 (Raised face, RTJ or Companion) • Line sizes: – 30” (DN 900) • ANSI pressure classes (per ANSI B16.5): – 300 ANSI / PN 50 • Body and flange material and temperature rating: – 316 Stainless steel (forged) body and flanges: (-196° C to 60° C) • Maximum Pressures – Dependent on operating temperature • Minimum Pressures – 0 psig 0 barg
Flange types	• Raised face for: • ANSI class - 300
Specific Gravity	• 0.35 to 1.50
Accuracy Limits	• Accuracy limits typically are: – ± 2% without a flow calibration

Table 1-2 Meter specifications

Electronic specifications	
Power Temperature flameproof Transmitter Electronic Enclosure and Base Electronics Enclosure	Meter • 10.4 VDC to 36 VDC • 11 W typical 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 100Mbps Frequency (see Table 3-5) • 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
Transducers	• LT-07 • Operating Temperature Range -321 °F to +140 °F (-196 °C to 60 °C)
Communications specifications	
Connectivity protocols	One serial RS-232/RS-485 ports (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 • Up to 10 Mbps • 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
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

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 Section 3.6.1) (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 Section 3.6.1) 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. • 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)	• (2) 4-20 mA independently configurable analog outputs The analog output zero scale offset error is within ±0.1% of full scale and gain error is within ±0.2% of full scale. The total output drift is within ±50 ppm of full scale per °C.

1.7 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, ULC, 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
- All piping and the meter body must be sufficiently insulated for bubble-free flow through the meter

1.8 Safety

The Daniel 3818 LNG Liquid Ultrasonic Flow Meter is suitable for use in U.L. Class 1, Division 1, Group C and D hazardous locations.

⚠WARNING

EXPLOSION OR FIRE HAZARD

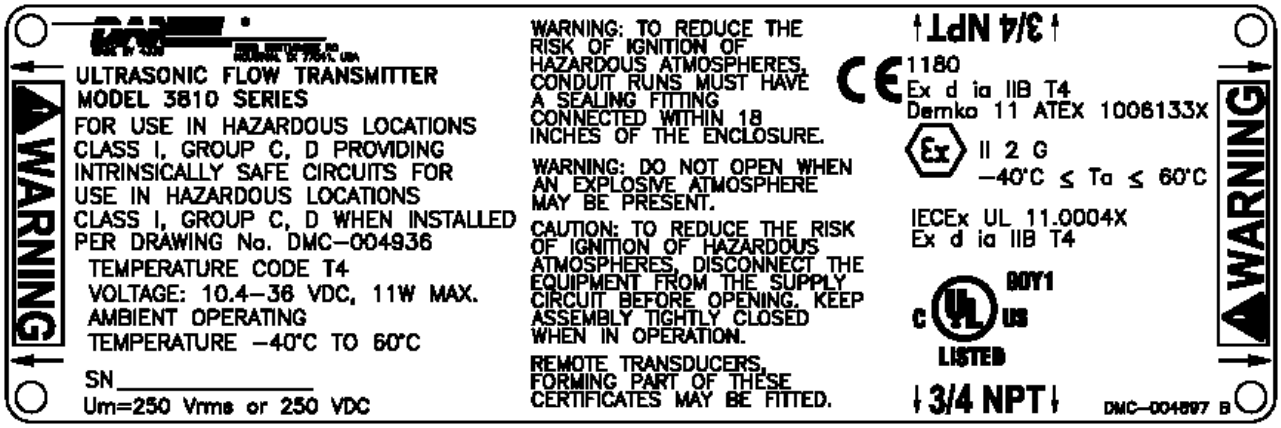
Read and follow the instructions below:

- **Conduit runs must have a sealing fitting within 457mm (18 inches) of the enclosure to reduce the risk of an explosion or a fire.**
- **During operation, keep covers tightly closed. DO NOT open the transmitter electronics enclosures when an explosive atmosphere may be present.**
- **During equipment maintenance, disconnect power before opening the transmitter electronics enclosures. Clean cover joints before replacing.**
- **DO NOT substitute meter components. Substituting components may compromise the intrinsic safety of the device.**

Failure to follow these safety instructions may result in severe injury to personnel or cause damage to the equipment.

The Daniel 3810 Series Liquid Ultrasonic Meter is approved to the ATEX Directive 94/9/E

Figure 1-3 Daniel 3810 Series Liquid Ultrasonic Meter ATEX approval



1.9 Certifications and approvals

Daniel 3818 LNG Liquid Ultrasonic Flow Meters have electrical, metrology, intrinsic safety and Pressure Equipment Directive certifications and approvals by the agencies listed below. Refer to the nameplate tag on the meter body, the wiring diagram (P/N DMC - 004936) in Appendix A and observe all safety precautions. Daniel 3810 Series Liquid Ultrasonic Flow Meters operate within the pressure and temperature range of the device (also see Section 1.6 for meter specifications).

Standards

- US
- Canada
- Europe
  - Explosive Atmospheres (ATEX)
  - International Electro-technical Commission (IECEx)
  - Pressure Equipment Directive (PED)
  - Electromagnetic Compatibility (EMC)
  - International Organization of Legal Metrology (OIML)

Approval Agencies

- UL
- ULC
- DEMKO
- NMi
- INMETRO
- NEPSI
- GOSTR

IMPORTANT
Please consult Daniel for a complete metrology approvals list.

1.10 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.

Section 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.

⚠CAUTION

SURFACE TEMPERATURE HAZARD

The meter body and piping may be extremely cold.

Wear appropriate personal protective equipment when coming in contact with the meter. Failure to do so 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 clear the work area may cause injury to personnel.

⚠WARNING

CUTTING HAZARD

Sharp edges may be present on the meter.

Wear appropriate personal protective equipment when working on the meter. Failure to do so may cause serious injury.

⚠CAUTION

TRANSPORTATION HAZARD

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

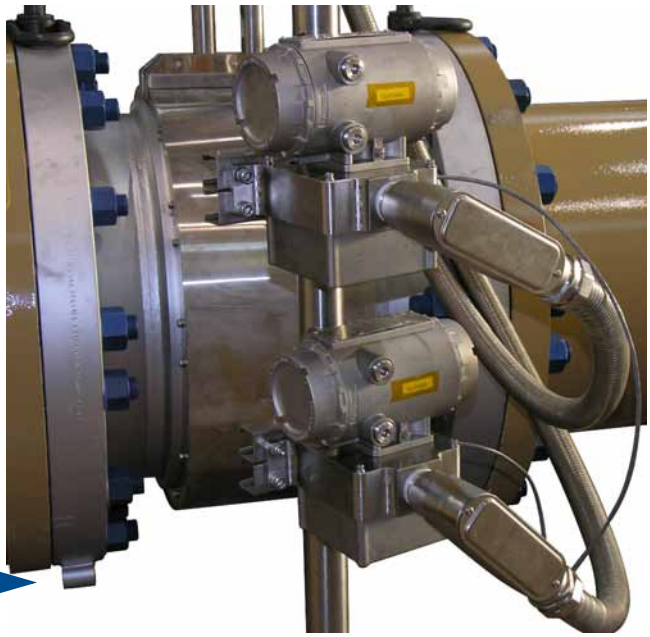
inserting the forks may cause the meter to become unstable, resulting in injury or damage to the bore and sealing face.

⚠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

ESCAPING FLUIDS HAZARD

The purchaser of the meter is responsible for the selection of Daniel 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.

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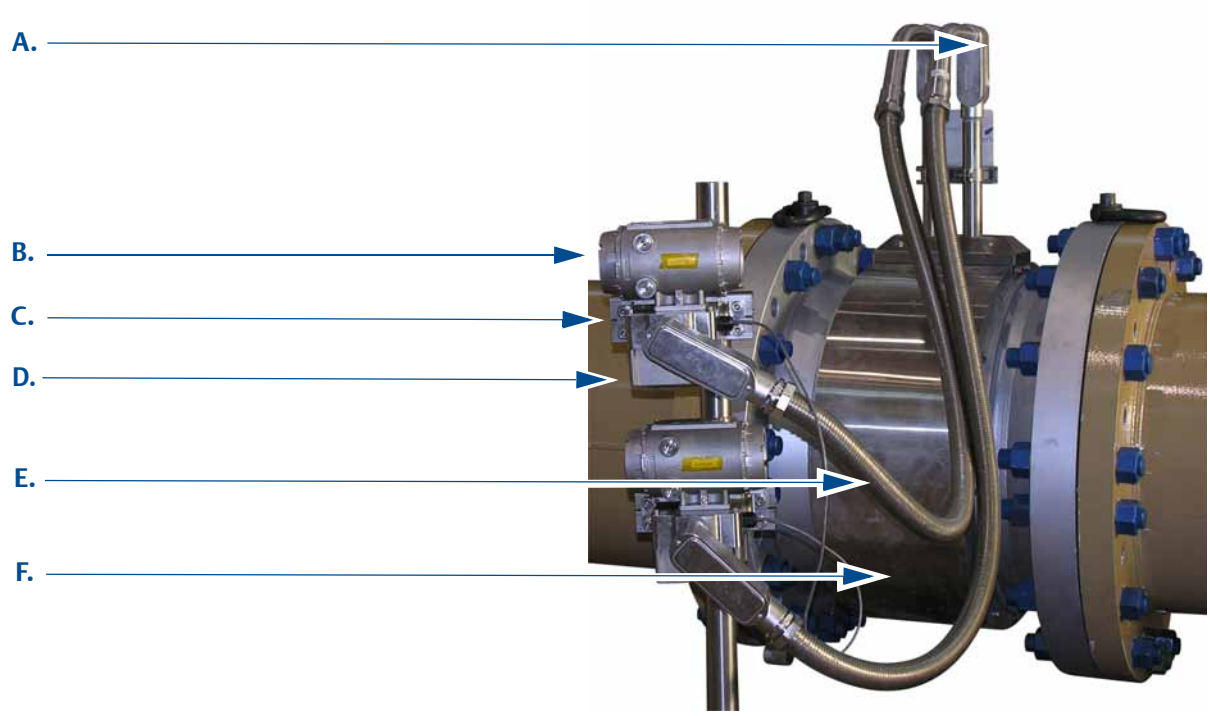
2.2 Meter components

Daniel 3818 LNG Liquid Ultrasonic Flow Meters are assembled, configured, and tested at the factory. The meter components include the remote mount co-located Transmitter Electronics Enclosures, the Base Electronics Enclosure and the Meter Body with transducer assemblies.

Figure 2-1 Daniel 3818 Liquid Ultrasonic Flow Meter assembly



A. LB Conduit outlet body assembly
B. Explosion-proof co-located transmitter enclosures (CPU Module, Power Supply, I.S. Barrier Board, Backplane Board)
C. Cover/Bracket for 3818 base enclosure
D. Intrinsically-safe base enclosures includes Acquisition Module
E. Flexible and rigid conduit for transducer cables
F. Meter body with band shroud covering transducers, cables and insulation

⚠WARNING

EXPLOSION OR FIRE HAZARD

Read and follow the instructions below:

- **Conduit runs must have a sealing fitting within 457mm (18 inches) of the enclosure to reduce the risk of an explosion or a fire.**
- **During operation, keep covers tightly closed. DO NOT open the transmitter electronics enclosures when an explosive atmosphere may be present.**
- **During equipment maintenance, disconnect power before opening the transmitter electronics enclosures. Clean cover joints before replacing.**
- **DO NOT substitute meter components. Substituting components may compromise the intrinsic safety of the device.**

Failure to follow these safety instructions may result in severe injury to personnel or cause damage to the equipment.

2.3 Piping recommendations

Recommendations for best measurement results:

- Honed or un-honed meter tube(s)
- Flow direction (unidirectional or bidirectional)
- 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 .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

NOTICE

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

Figure 2-2 Piping recommendations unidirectional flow

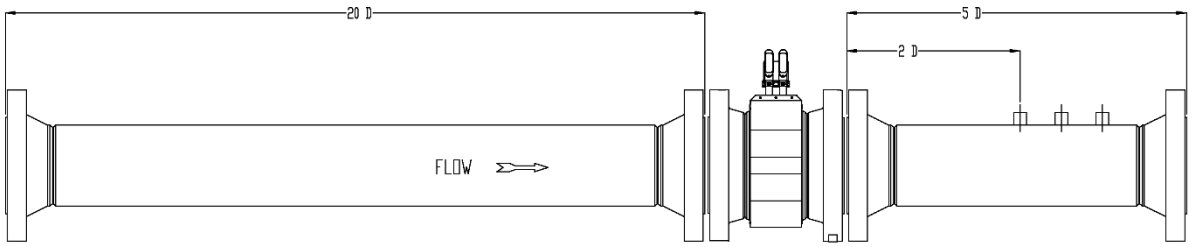
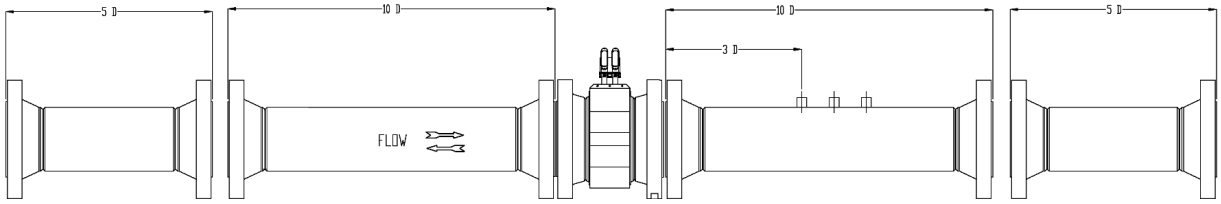


Figure 2-3 Piping recommendations bidirectional flow



All pipe lengths are minimum:

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

important

Flow conditioners are **NOT** recommended for 3818 LNG Liquid Ultrasonic Flow Meters based on low flow rate conditions in liquefied natural gas applications.

- 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 Daniel 3818 LNG 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 which could adversely affect the transducer signals, or cause equipment damage.

- The dual transmitter electronics assemblies are remote mounted.
- 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 Field hydrostatic pressure testing

The Daniel 3818 LNG Liquid Ultrasonic Flow Meter can be hydro-tested without any special preparations. The transducers are not exposed to the process pressure and can remain installed in the meter.

The liquid ultrasonic meter pressure containing parts include but are not limited to the transducer housings. These pressure containing parts are pressure tested while attached to the meter body as a completed ultrasonic meter assembly.

The hydrostatic test is verification of the pressure containing capability of the liquid ultrasonic meter pressure containing parts and the seals that seal them. Perform a visual inspection of the meter and visually inspect the meter and leak test the flanges.

⚠CAUTION

LEAKAGE OR PRESSURE CONTAINING PARTS FAILURE

Use precautions to eliminate hazards to personnel in the event of leakage or failure of the liquid ultrasonic meter pressure containing parts or failure of the test equipment and to prevent over-pressurization during the test procedure.

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

2.5 Meter safety for hoist rings and lifting slings

A Daniel 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

HOISTING AND LIFTING HAZARD

Lifting a Daniel Ultrasonic Meter with Other Equipment

The following lifting instructions are for installation and removal of the Daniel 3818 LNG Liquid Ultrasonic Meter **ONLY**. The instructions below do not address lifting the Daniel ultrasonic meter while it is attached, bolted, or welded to meter tubes, piping, or other fittings.

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

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.

⚠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 do so could allow 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 Daniel 3818 LNG Liquid Ultrasonic Flow Meter nameplate or outline dimensional (general arrangement) drawing for the assembled weight.

When lifting an ultrasonic meter by itself, Daniel recommends two methods. These methods are:

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

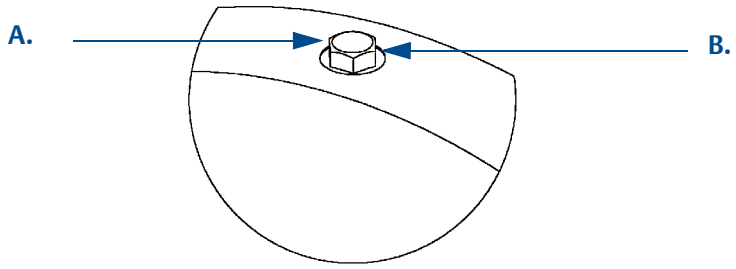
2.5.1 Use of appropriate safety engineered swivel hoist rings in meter end flanges

Daniel 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. This feature provides complete surface contact **ONLY** between the meter flange and an OSHA compliant Safety Engineered Swivel Hoist Ring as shown in Figure 2-5.

Operators **SHALL NOT** use eye bolts (see Figure 2-5) in the Daniel 3818 LNG 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.

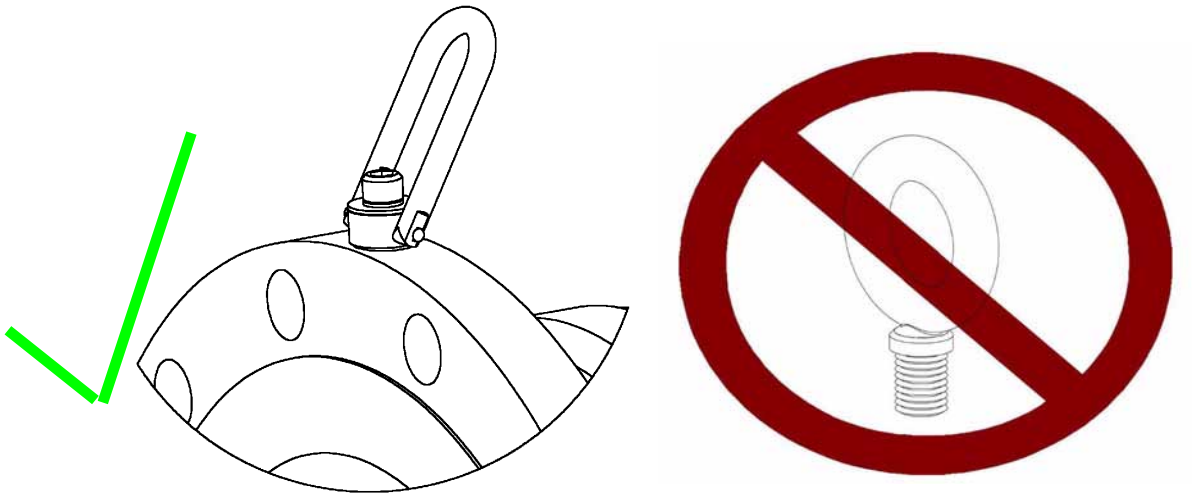
Figure 2-4 Meter end flange with tapped flat-counterbore hole for hoist ring



A. Plug Bolt

B. Flat Counterbore Surface

Figure 2-5 Safety approved hoist ring and non-compliant eye bolt



Safety engineered swivel hoist ring

Eye bolt

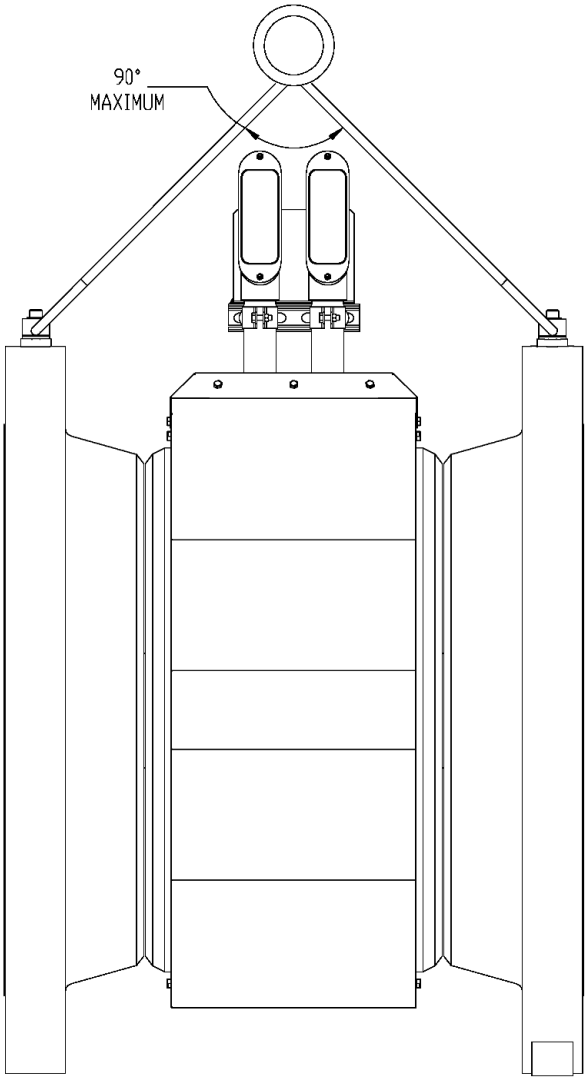
Safety precautions using safety engineered swivel hoist rings

Read and follow the safety precautions listed below:

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. Make sure 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 Daniel.
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.

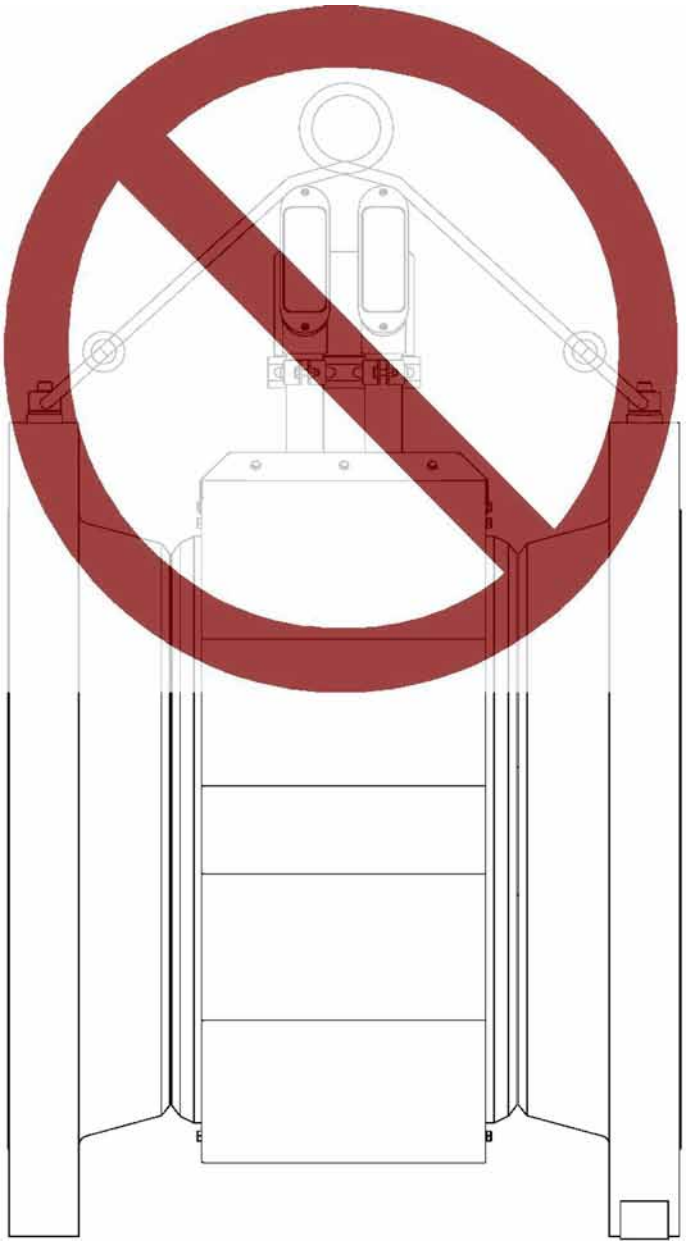
Figure 2-6 90 Degree angle between slings



9. **Always** provide support for the dual transmitter electronics during the lifting operation. Lifting the meter without supporting the electronics, may cause the electronics to fall and cause personal injury or equipment damage.

   NEVER allow the slings connected to the hoist rings contact the LB conduit bodies. Damage to the enclosure may occur. Once the lifting operation is complete, attach and secure the electronics to the pipe stand or other rigid structure with the mounting bracket and bolts.

Figure 2-7 Incorrect sling attachment



10. **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.
11. **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.
12. **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.
13. 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.
14. 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.

How to obtain safety engineered swivel hoist rings

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

- American Drill Bushing Company(www.americandrillbushing.com)
- Carr Lane Manufacturing Company (www.carrlane.com)

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 (www.fastenal.com)
- Reid Supply (http://www.reidsupply.com/)

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

Table 2-1 Hoist ring part number

Daniel part number[1]	Hoist ring thread size & load rating[1]	American Drill Bushing Co. P/N[1]	Carr Lane Manufacturing Co. P/N [1]
1-504-90-094	1"-8UNC, 10000 lb.	23105	CL-10000-SHR-1

1. *Note: The part number only includes one hoist ring. Two hoist rings are required for the meter.*

What size safety engineered swivel hoist ring do you need?

To determine the size of the hoist rings required for your meter, use the table below for the 3818 LNG Liquid Ultrasonic Meter. The part number shown in Table 2-2 is appropriately rated for the ANSI rating of your meter.

Table 2-2 Hoist ring table for Daniel 3818 LNG Liquid Ultrasonic Flow Meters

ANSI 300	Daniel Part Number
30”	1-504-90-094

2.5.2 Appropriately rated lifting slings

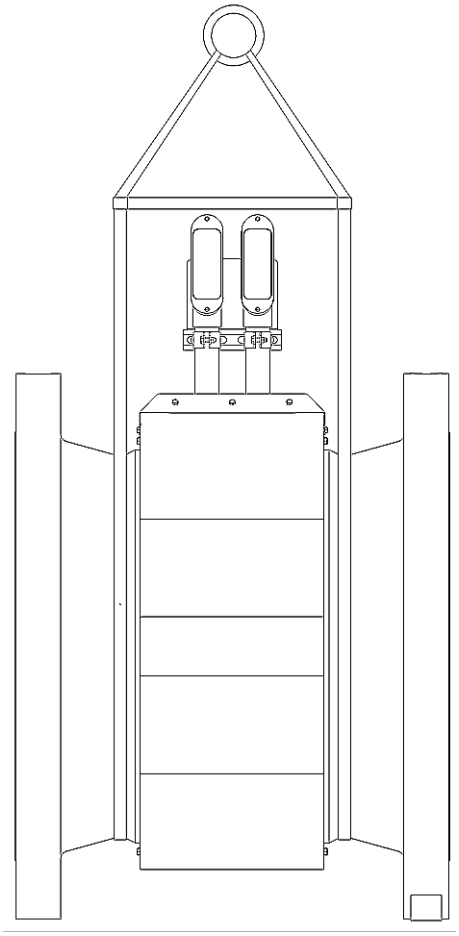
The following instructions are intended to provide general guidelines for proper lifting slings of the Daniel 3818 Ultrasonic meter by itself. These instructions are intended to be followed in addition to your company's standards or the DOE-STD-1090-2004 Hoisting and Rigging standard if such company standards do not exist.

Safety precautions using appropriate rated lifting slings

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 or the conduit piping.

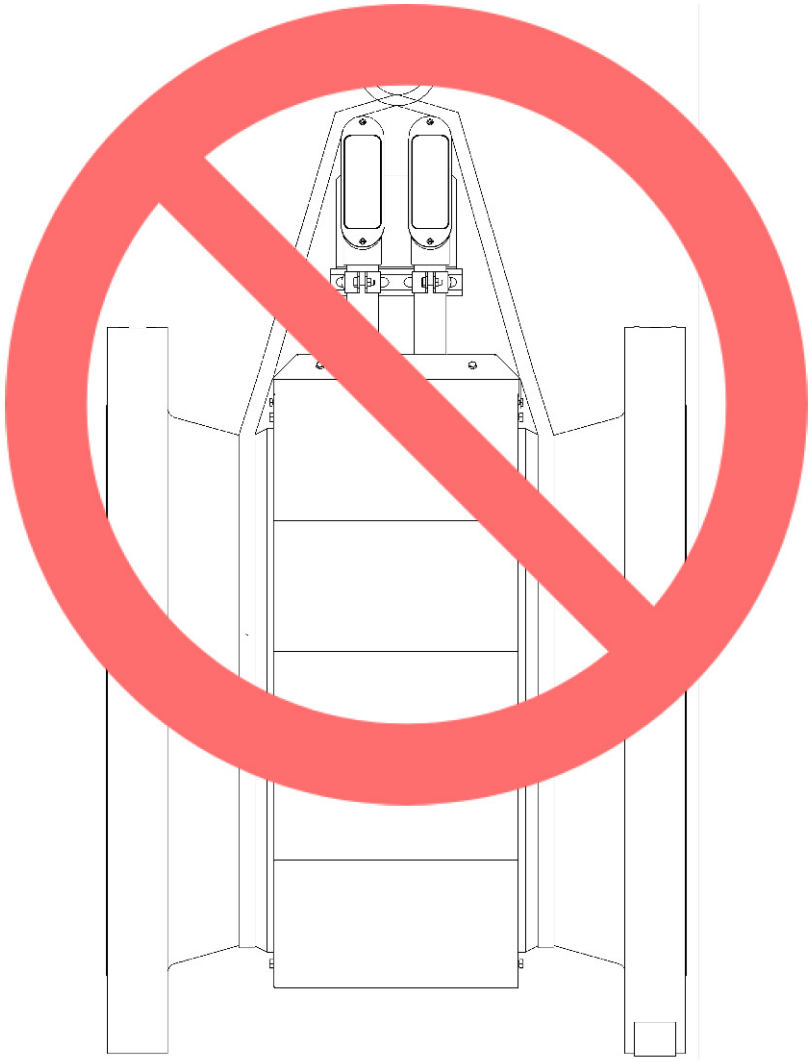
3. **NEVER** attempt to lift the meter using only one sling around the meter. Always use two slings wrapped around each end of the body as shown below. A choker style sling is recommended.

Figure 2-8 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. Provide support for the transmitter electronics assemblies during lifting operations.
7. Once the lifting operation is complete, attach and secure the electronics to the pipe stand or other rigid structure using the mounting bracket bolts. Lifting the meter without supporting the transmitter enclosures, may cause the electronics to fall and cause personal injury or electronics damage.

Figure 2-9 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.

2.6 Mounting requirements in Liquefied Natural Gas pipelines

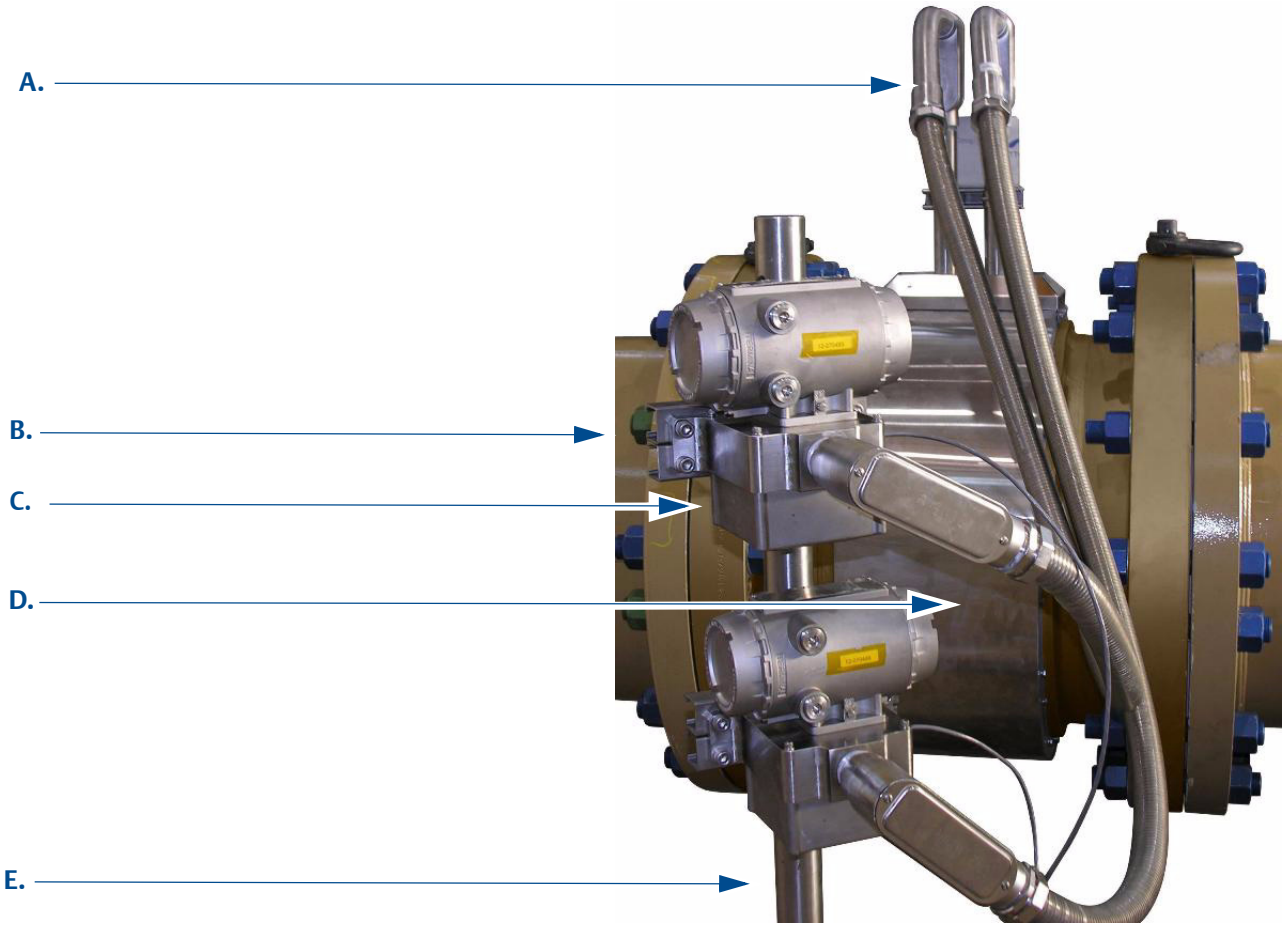
NOTICE

install sufficient insulation over the meter assembly, shrouds and adjoining upstream and downstream piping. The thickness and type of insulation used is to be determined by the customer for the ambient conditions. For accurate flow meter operation the liquefied natural gas fluid flowing within the meter must be liquid without any gas pockets or bubbles. The insulation installed must be adequate to insure bubble free liquid flow is achieved at all flow rates and ambient conditions.

The ambient operating temperature of the Daniel 3818 LNG Liquid Ultrasonic Flow Meter electronics (i.e. Flameproof enclosure and Intrinsically safe base enclosure) is -40° C (-40° F) to +60° C (+140° F). The 3818 LNG Liquid Ultrasonic Flow meter electronics are remote mounted on a vertical or horizontal two (2) inch pipe which is securely installed and rigid.

Transducer cables (P/N 1-504-90-128, 15 ft. long maximum) are connected to the Daniel 3818 LNG Liquid Ultrasonic Flow Meter electronics and then routed to the transducers installed in the meter body.

Figure 2-10 Transducer cabling conduit



A.Rigid and flexible conduit for routing cables from transducers to Acquisition Module
B.Pipe strut clamp and channel assembly securing electronics to 2 inch vertical pole or horizontal rail
C. Acquisition Module to transducer connections
D. 3818 LNG meter body with shrouds
E. Customer supplied vertical pole (2 inch pipe). May be horizontal rail. Must be securely installed and rigid.

The process temperature must not exceed the operating temperature range of the LT-07 transducers. These transducers have an operating range from -196° C (-321° F) to +60° C (+140° F).

⚠CAUTION

SURFACE TEMPERATURE HAZARD.

The meter body and piping may be extremely cold.

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

Failure to do so may result in injury.

Section 3: Electrical installation

3.1 Cable length TTL mode

The maximum cable length is 2000 feet when the “TTL” mode is selected.

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)
(x1000ft)	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

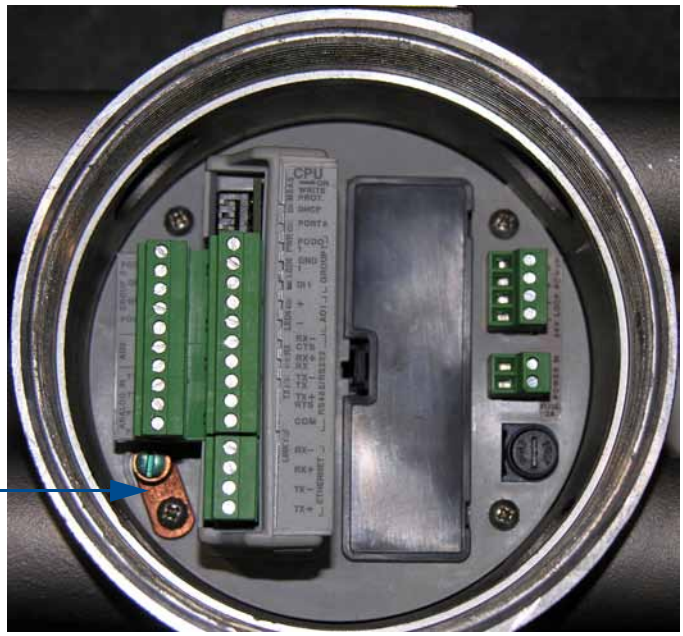
3.3 Grounding meter electronics

Daniel 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.

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.

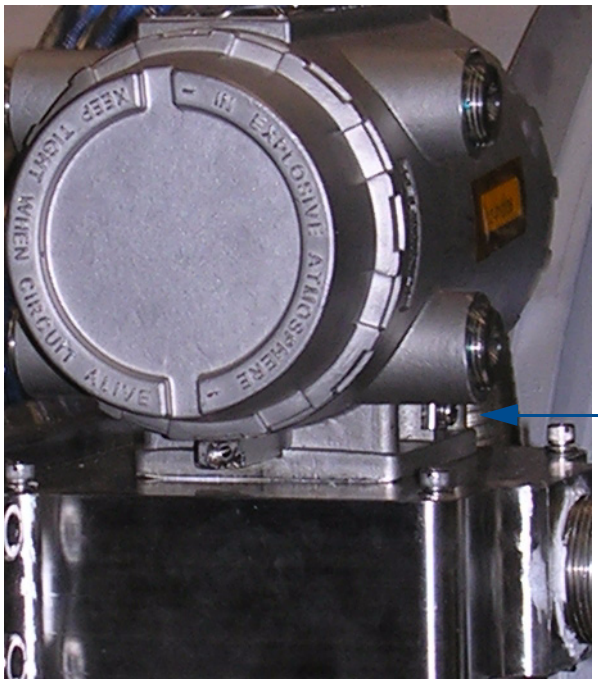
Figure 3-1 Internal Transmitter Electronics Enclosure chassis ground



A. Transmitter Electronics Enclosure internal ground lug

Secondary grounds are located outside of the Transmitter Electronics Enclosure (see Figure 3-2).

Figure 3-2 External ground lug



A. External ground lug

3.4 Conduit seals

Daniel 3818 LNG Liquid Ultrasonic Meters require conduit seals for installations in hazardous environments. Adhere to safety instructions to protect personnel and equipment.

⚠WARNING

HAZARDOUS VOLTAGE

Do not open the Transmitter Electronics Enclosure in a flammable gas area. Disconnect power before servicing.

Do not disconnect equipment unless power has been removed or the area is known to be a non-hazardous. Failure to follow these instructions may result in serious injury or death.

⚠WARNING

EXPLOSION HAZARD

Substitution of components may impair the intrinsic safety and cause ignition of flammable or combustible atmospheres. Disconnect power before servicing.

Failure to remove power and use Daniel approved components may cause serious injury.

3.4.1 Startup for systems using explosion-proof conduit

1. Assemble conduit to the Transmitter Electronics Enclosure. A conduit seal is required within 18 inches (457 mm) of the enclosure.
2. Check to make certain that all power to field wiring is turned **OFF**.

⚠WARNING

HAZARDOUS VOLTAGE INSIDE

Do not open in flammable gas area. Disconnect all power to the meter.

Failure to follow the instructions in this manual may result in serious injury or death.

3. Check the serial number tag on top of the Transmitter Electronics Enclosure. Remove the end cap with the serial tag marked with **_H1**(nearest its conduit entry) to gain access to the transmitter electronics.
4. Pull the wires into the enclosure.
5. Complete the field connection wiring according to the system wiring diagram (see Appendix A).
6. Repeat Step 2 through Step 5 for the Transmitter Electronics Enclosure with the serial tag marked with **_H2.**
7. Apply electrical power to the system to ensure the field connections are working correctly. Replace the end caps and allow the system to run for the time specified by the customer (usually one week) and an electrician has fully tested the connections. After the Acceptance Test is witnessed and approved, seal the conduit.
8. Power down the system and apply the sealing compound to the conduit and allow to set in accordance with manufacturer specifications.
9. If required, install the security latches and wire seals on the Transmitter Electronics Enclosure end caps (see Section 3.6.8 and see Figure 3-9).
10. If required, install the wire seals through the socket head bolts on the Base Enclosure (see Section 3.6.8).
11. Connect electrical power to the system.
12. Set or configure the meter using Daniel MeterLink. For additional installation information refer to the system wiring diagram (see Appendix A), Daniel MeterLink Quick Start Manual (P/N 3-9000-763). Use the Daniel MeterLink Field Setup Wizard to complete the configuration. Also see, Section 4.1in this Manual.

3.4.2 Startup for systems that use flame-proof cable

⚠WARNING

HAZARDOUS VOLTAGE INSIDE

Do not open in flammable gas area. Disconnect all power to the meter.

Failure to follow the instructions in this manual may result in serious injury or death.

1. Check to make certain that all field wiring power is turned **OFF**.
2. Check the serial number tag on top of the Transmitter Electronics Enclosure. Remove the end cap with the serial tag marked with **_H1**(nearest its conduit entry) 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 Daniel Liquid Ultrasonic Flow Meter.
6. Repeat Step 2 through Step 5 for the Transmitter Electronics Enclosure with the serial number tag marked with **_H2.**
7. Apply electrical power to the system to ensure the field connections are working correctly. Replace the end caps and allow the system to run for the time specified by the customer (usually one week) and an electrician has fully tested the connections.
8. If required, install the security latches and wire seals on the Transmitter Electronics Enclosure end caps (see Section 3.6.8 and Figure 3-9).
9. Install the wire seals through the socket head bolts on the Base Enclosure (see Section 3.6.8 and Figure 3-10 and the junction box).
10. Make sure the safety latches are installed on the Transmitter Electronics Enclosure.
11. Set or configure the software using Daniel MeterLink. For additional installation information refer to the system wiring diagram (see Appendix A), Daniel MeterLink Quick Start Manual (P/N 3-9000-763). Use the Daniel MeterLink Field Setup Wizard to complete the meter configuration. Also see, Section 4.1in this Manual.

3.5 Wiring and I/O

Daniel MeterLink uses the TCP/IP protocol to communicate with the 3818 LNG Liquid Ultrasonic Flow Meter electronics instead of Modbus ASCII or RTU. The TCP/IP protocol only works across either Ethernet, RS-485 full duplex (i.e., 4-wire), or RS-232. Daniel MeterLink can communicate with multiple meters if they are multi-dropped using 4-wire full duplex RS-485 mode. The meter electronics is HART capable and provides communication flexibility with Daniel 3818 LNG Liquid Ultrasonic Flow Meters.

The HART® output provides communication with other field devices (e.g., 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 Daniel MeterLink to communicate with a Daniel 3818 Liquid Ultrasonic Meter.

The Daniel 3818 LNG Liquid Ultrasonic Flow Meter has two 3814 electronics enclosures and 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.

Two sets of transmitter electronics (co-located) are provided with the Daniel 3818 LNG Liquid Ultrasonic Flow Meter. The Primary (master) electronics are in the upstream enclosure with the serial tag marked **_H1**. The Secondary (slave) electronics are in the downstream enclosure with the serial tag marked **_H2**.

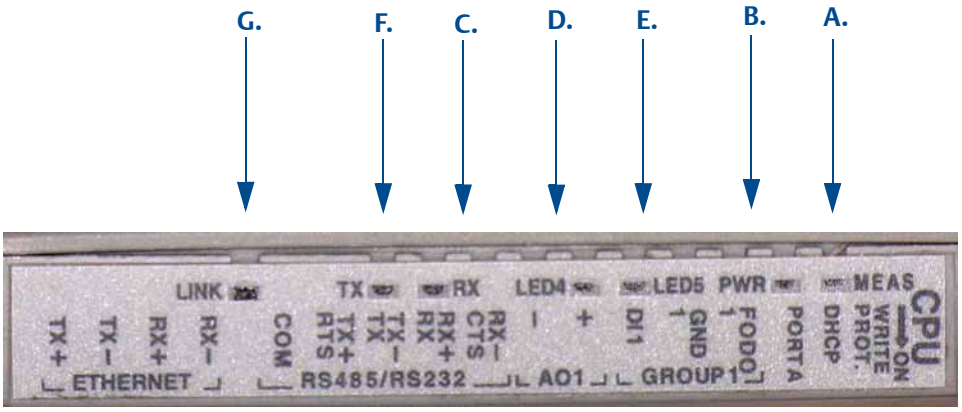
Note:

Daniel recommends running conduit and field wiring to each of the co-located Transmitter Electronics Enclosures and wiring each of the meters.

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. Acquisition/Measurement mode
B. Power
C. RX (RS-485/RS-232) - receiving data
D. LED 4 - not used
E. LED 5 - not used
F. TX (RS-485/RS-232) - transmitting data
G. Link (Eth1 Link) - user Ethernet connection

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 Daniel 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. 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
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	• 3.3V 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 Daniel 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 Daniel 3818 LNG Liquid Ultrasonic Flow Meter, the DHCP option must be turned off if used on a LAN/WAN.

CAUTION

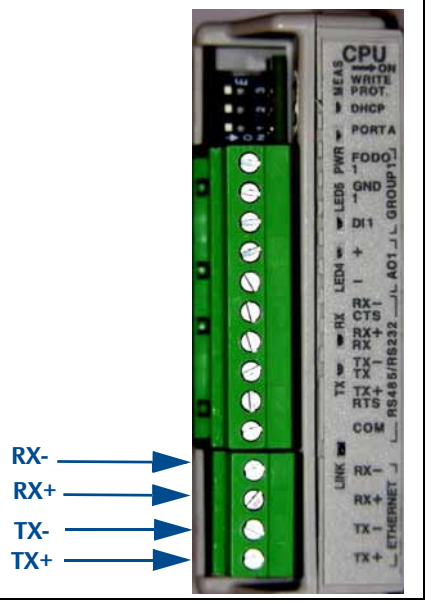
RESTRICT ETHERNET AND SERIAL CONNECTIVITY USAGE

Failure to restrict Ethernet and communication access to the Daniel 3818 LNG Liquid Ultrasonic Flow Meter can result in, among other things, unauthorized access, system corruption, and/or data loss.

User is responsible for ensuring that physical access and Ethernet or electronic access to the Daniel 3818 LNG 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.

Use ethernet cable (Daniel P/N 3-3400-079) 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 Backplane Board (male end located on the back of the Backplane Board).

Serial connections

Use serial cable (Daniel P/N 3-2500-401) to connect to a PC running Daniel MeterLink. The cable is designed for RS-232 communications which is the serial Port A default configuration (see Appendix A field wiring diagram, Daniel Drawing DMC-004936). The DB-9 end of the cable plugs directly into the PC running Daniel 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 treenails (Table 3-4 for Port A wiring).

When Beldon 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 Daniel MeterLink™ with an Ethernet port, use Ethernet cable (Daniel P/N 3-3400-079) 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 Daniel 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 Daniel MeterLink • 10 Mbps/100 Mbps	• Modbus TCP/IP

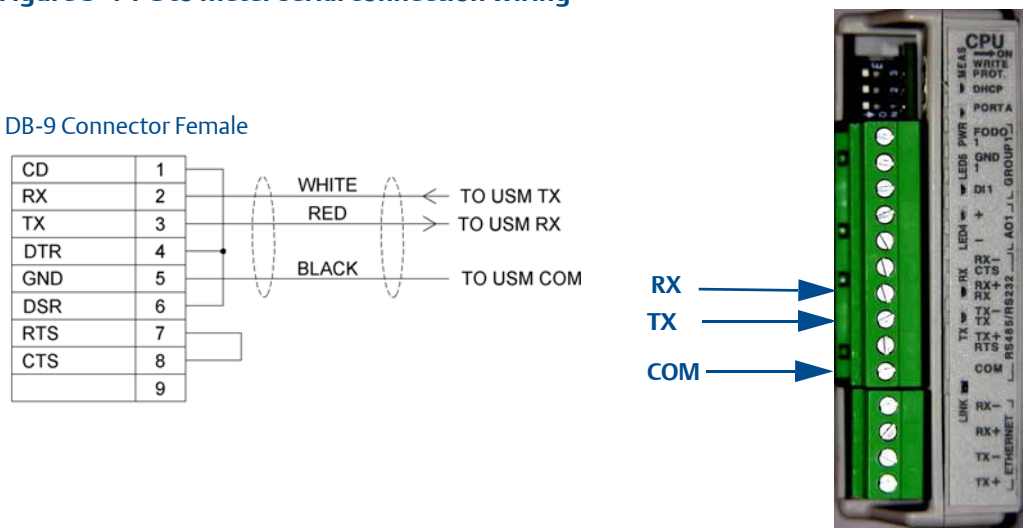
1. *Denotes auto-detected protocols*

.

NOTICE

If not using Ethernet, a full duplex serial connection is necessary for Daniel MeterLink to communicate with a Daniel 3814 Liquid Ultrasonic Flow Meter.

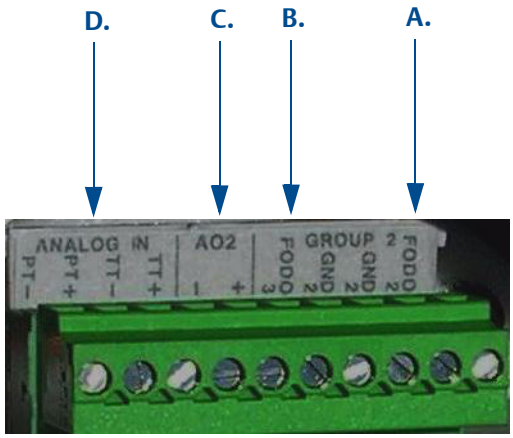
Figure 3-4 PC to meter serial connection wiring



3.6 Daniel Ultrasonic Meters I/O connections

The 3818 LNG Liquid Ultrasonic Flow Meter provides I/O connections on the CPU Module.

Figure 3-5 CPU Module I/O connections



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

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 1 B 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)

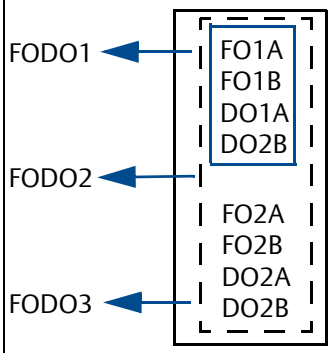
Phase A and Phase B output (based on flow direction)

- 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.
- 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

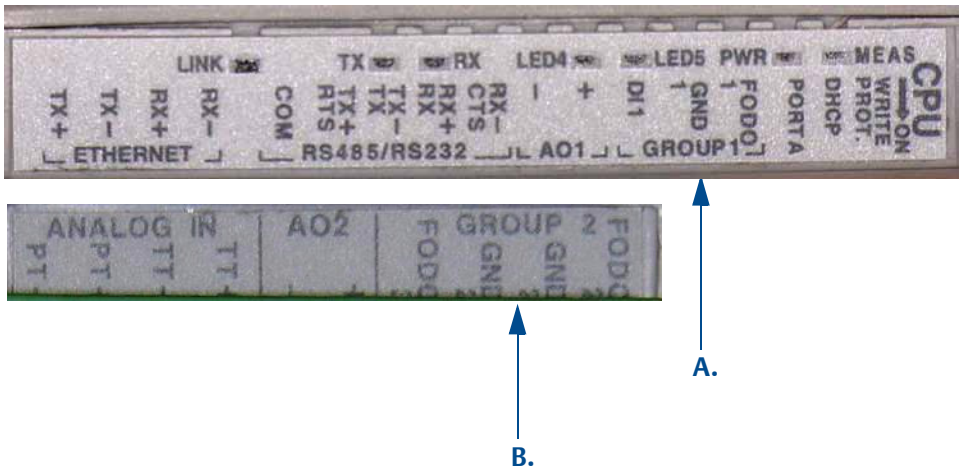
Table 3-5 Frequency/Digital Outputs possible configurations

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] or Frequency /Digital Output 3[2]	• Frequency output 1A • Frequency output 1B • Digital output 1A • Digital output 1B • 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 50V isolation. FODO2 and FODO3 (Group 2 on the CPU Module) share a common ground and have 50V 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 500V 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 3818 LNG Liquid Ultrasonic Flow Meter 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, 24VDC isolated power supply connection is provided for an external power source. Refer to the Field wiring diagram DMC-004936 in Appendix A.

3.6.3 Analog output settings

The 3818 LNG Liquid Ultrasonic Flow Meter provides two 4-20 mA analog (current) output signals that are software configurable.

Analog Output 1 (AO1) may used for HART slave communications with the current driven in sink mode (see Appendix A Daniel 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 Daniel Liquid Ultrasonic Flow Meter.

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

Both Analog outputs have an additional 150 Ohms loop impedance to meet the HART Communications requirements. The 24VDC isolated power supply can be used to power the loop.

3.6.4 Digital Input

The 3818 LNG 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 and stopped via an active>inactive state change.

The digital input must be configured via the Daniel 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

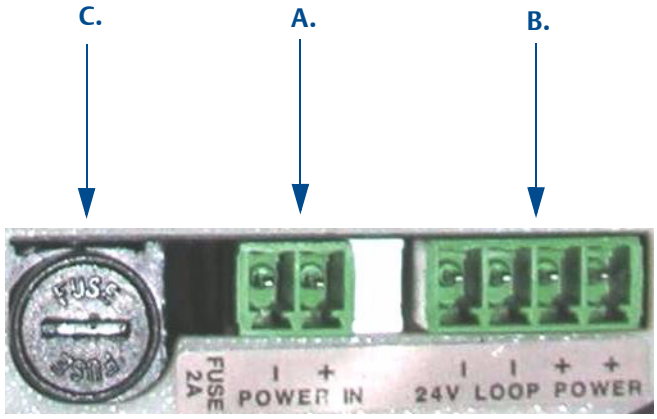
CPU Module switch	Configuration protected	Configuration unprotected
WRITE PROT.	ON	OFF

A complete list of write-protected parameters are in Appendix A.

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 24V loop power connection for ultrasonic meter analog outputs, temperature or pressure transmitter devices. The current is limited to 88mA.

Figure 3-7 CPU Module power source connections



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

3.6.8 Securing the meter

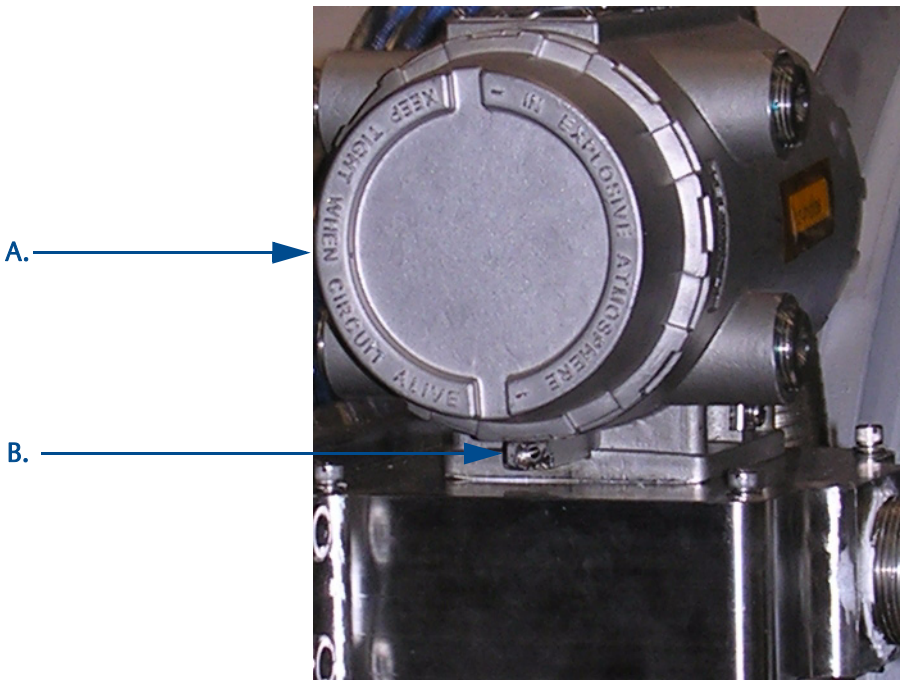
Security seals protect the integrity of the meter metrology and prevent tampering with transducer assemblies. The following sections detail how to properly seal the Daniel 3818 LNG Liquid Ultrasonic Flow Meter after commissioning. The security seal wires are commercially available.

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

Sealing the Transmitter Electronics Enclosure

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

Figure 3-8 Transmitter electronic enclosure security latch

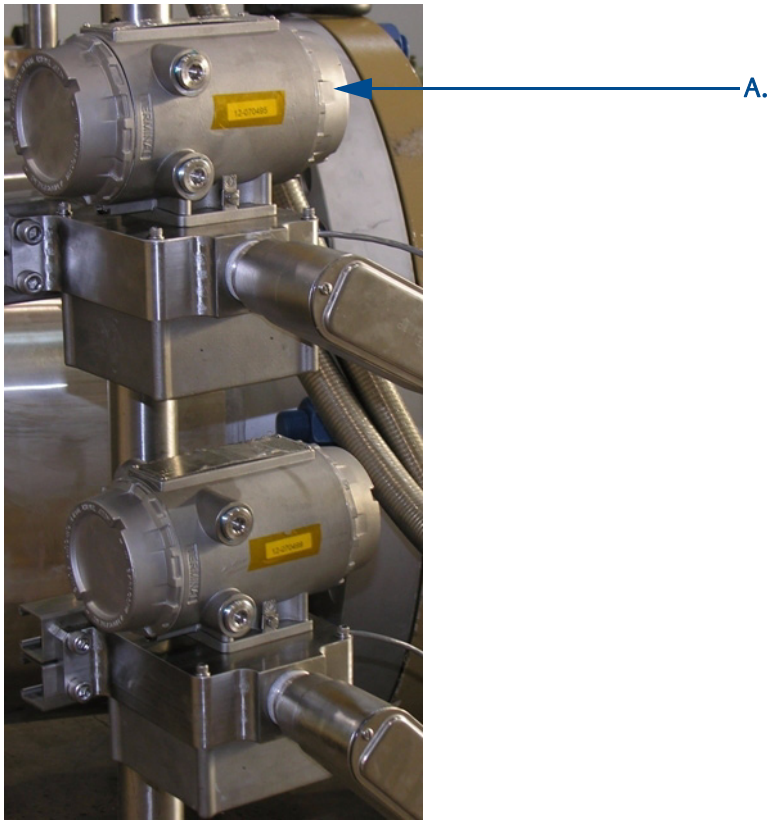


A. Transmitter Electronics Enclosure end cap
B. Security latch

Procedure

1. Rotate the end cap on Transmitter Electronics Enclosure **_H1** clockwise fully closing and compressing the end cap seal. Install the Security latch using a 3mm 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 .078 inch; 2.0mm).

Figure 3-9 Transmitter Electronics Enclosure security seal installation



A. Transmitter Electronics Enclosure end cap

3. Adjust the security wire, removing all slack and thread into the lead seal.
4. Repeat Step 1 through Step 3 for the **_H2** electronics enclosure.
5. Cut wire ends to remove excess wire.

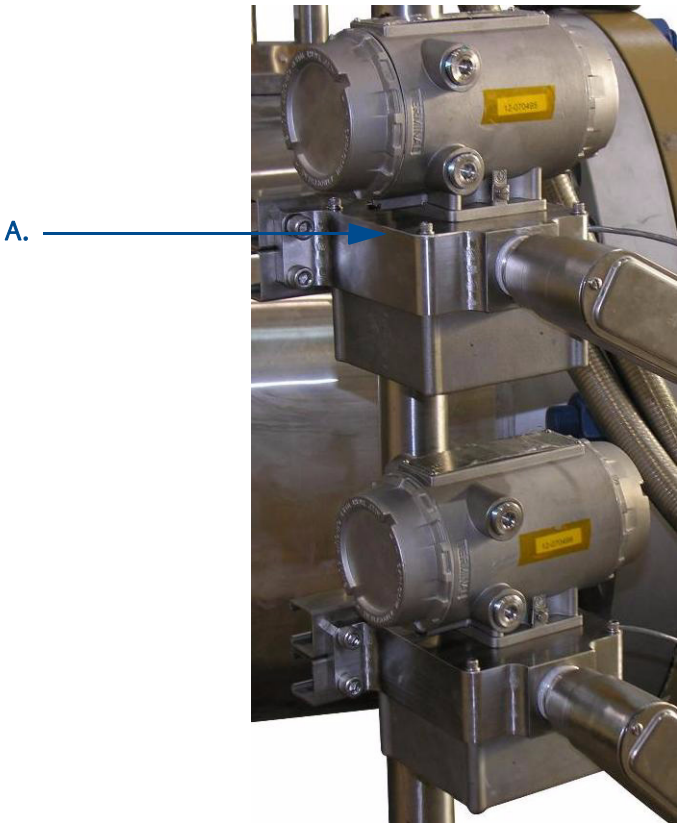
Base Enclosure Security Seals

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

Procedure

1. Install security wire seal into and through the hole in the socket head screw on the Base Enclosure Bracket/Cover (maximum wire diameter .078 inch; 2.0mm).

Figure 3-10 Base Enclosure wire seal installation



A. Base Enclosure cover and socket head screws

2. Position the wire to prevent counterclockwise rotation of the screws when the seal wire is taut. Feed the security wire beneath the Transmitter Electronics Enclosure and through the adjacent socket head screw. Twist the wire, removing all slack and seal.
3. Cut wire ends to remove excess wire.

3.6.9 Sealing the unit

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 Section 3.4.1 and Section 3.4.2

Section 4: Configuring a 3818 LNG Meter

After the mechanical and electrical installation is complete and connectivity with the meter is established, use the *Daniel MeterLink Software for Gas and Liquid Ultrasonic Meters Quick Start Manual* (P/N 3-9000-763) for the initial software installation.

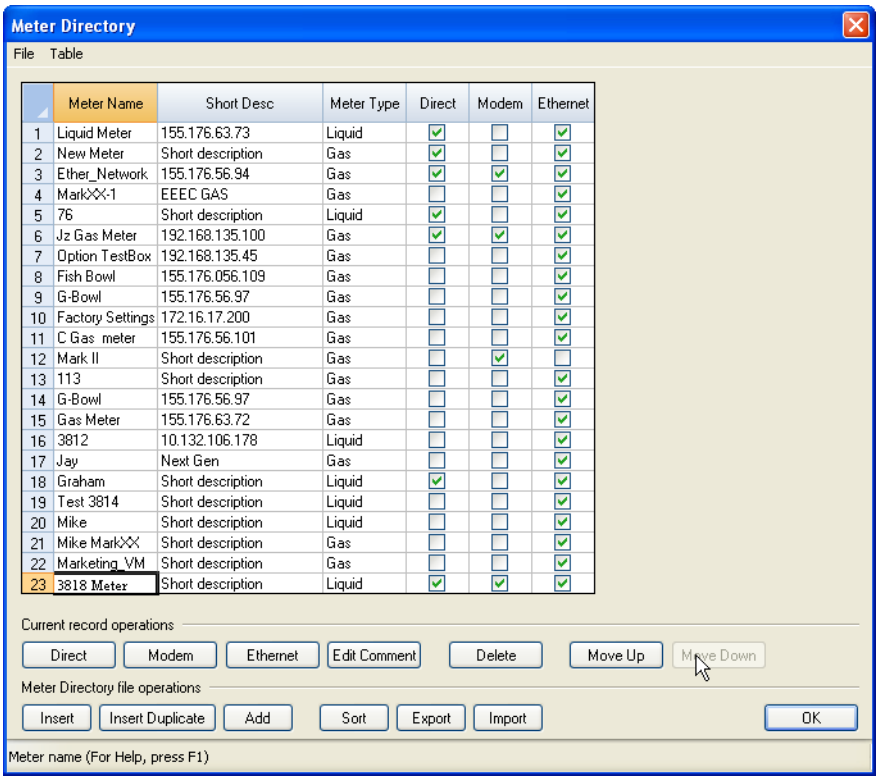
4.1 Using Daniel MeterLink to configure the meter

Setup a direct connection using a serial cable or an Ethernet connection. Launch Daniel MeterLink and edit the Meter Directory settings. Click the Add button and input the Meter Name, a short description, meter type, and enable the checkbox for your connection type (Direct, Modem, or Ethernet). See Section 3, Serial connections and Ethernet communications.

Once connected, you will configure the operational parameters of the meter.

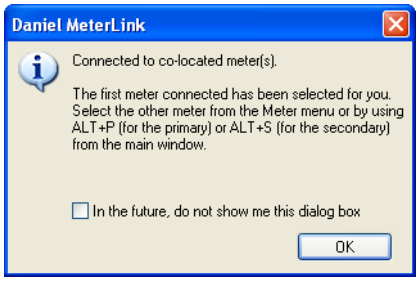
You are required to establish communications with the Primary meter (the electronics for the Primary meter is designated by the tag's serial number followed by _H1 and the Secondary meter is _H2) by entering both of the IP Addresses in the Daniel MeterLink - Meter Directory. Configure the communications parameters to establish the connection with the primary electronics.

Figure 4-1 Daniel MeterLink - Meter Directory



After you connect to the meter, a message box displays indicating you are connected to the co-located Primary meter. To view the status of the Secondary meter, from the Daniel MeterLink main window press Alt+S.

Daniel MeterLink co-located meter dialog



Procedure

1. Review the software operating system, hardware and peripheral requirements.
2. Follow the installation instructions for your operating system (Windows® XP, Windows Vista® or Windows®7).

IMPORTANT

Daniel MeterLink does not support the Window® 2000 operating system.

3. Configure a direct connection driver for first time modem configuration for Daniel MeterLink communications.
4. Select the Daniel MeterLink desktop icon and complete the information in the Registration Wizard to obtain important updates and technical support.
5. Select **File>Program Settings** and customize the user-preferences (e.g. User name, Company name, display units, Liquid Meter volume units and other interface settings)
6. Connect to your meter. If your meter is not shown in the list, select **Edit Meter Directory** and setup the connection properties.
7. Run the Field Setup Wizard.

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

   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. Select **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 (20mA maximum). Alarm action parameters determines the state the output will drive during an alarm condition (High 20mA, Low - 4 mA, Hold last value, Very low - 3.5, Very high 20.5 mA or None). Select **Next** to continue to HART® Output(s).
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. Save the meter configuration file and collect a Maintenance log.
10. Disconnect from the meter using the tool bar icon,  , or the **Meter|Diconnect** menu path and close the Daniel MeterLink application and prepare to seal the meter.

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 Daniel Liquid Ultrasonic Meter Device Description (DD).

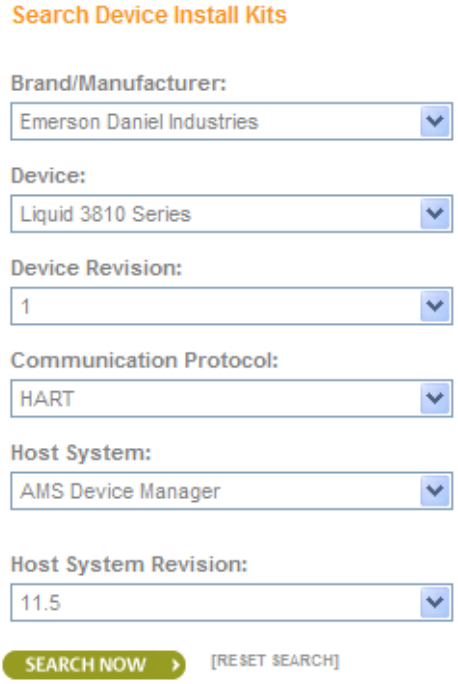
If not installed, click the link below to download the AMS device installation tool kit.

http://www2.emersonprocess.com/en-US/documentation/deviceinstallkits/Pages/deviceinstallkitsearch.aspx

Procedure - installing AMS Device Description

1. Use the link above to search for the Device Description (DD) for your Daniel 3810 Series Liquid Ultrasonic Flow Meter.
2. Use the pull-down menu and select the Brand/Manufacturer - **Emerson Daniel Industries**.
3. Next select the Device, **Liquid 3810 Series** from the pull-down menu.
4. Choose the **Device Revision1**, from the pull-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 11.5**.
8. Verify your search parameters are correct, as shown below.

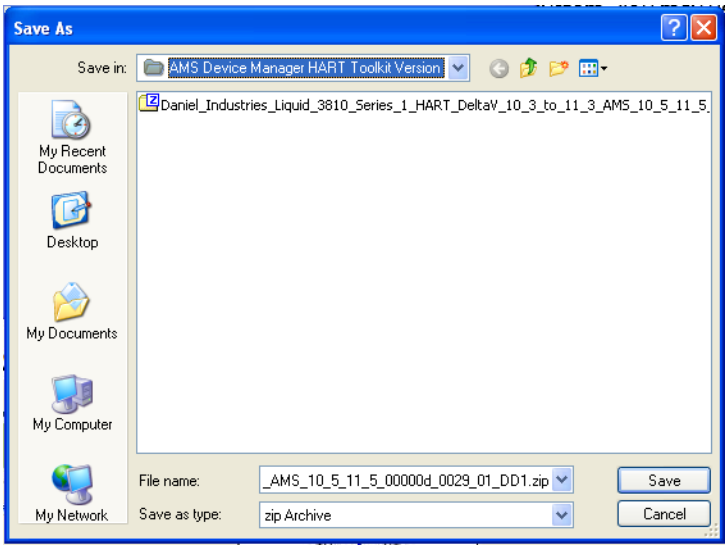
Figure 4-2 AMS Device Description search



9. Click the **Search Now** button.

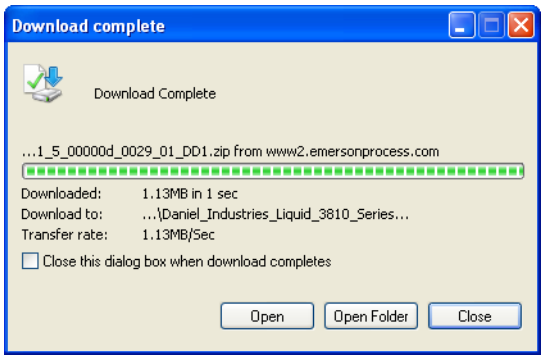
10. Click the **Daniel Industries Liquid 3810 Series Rev 1** hyperlink. The file download dialog displays. Click the **Save** button to save the files to your host system. You may use the default download location or change the directory.

11. **AMS file download options**



12. Click the **Save** button to complete the file download.

Figure 4-3 AMS file download complete



13. Click **Open** or **Open Folder** to view the downloaded files.
14. Establish power to the meter and wiring to Analog Input 1 for HART communication.
15. Start the AMS Device Manager using a laptop or PC.
16. Enter login credentials and click **OK** to launch the application.

17. Click the Configure tab, and then select **Guided Setup**, **Manual Setup** or **Alert Setup**.

Figure 4-4 AMS Device Manager

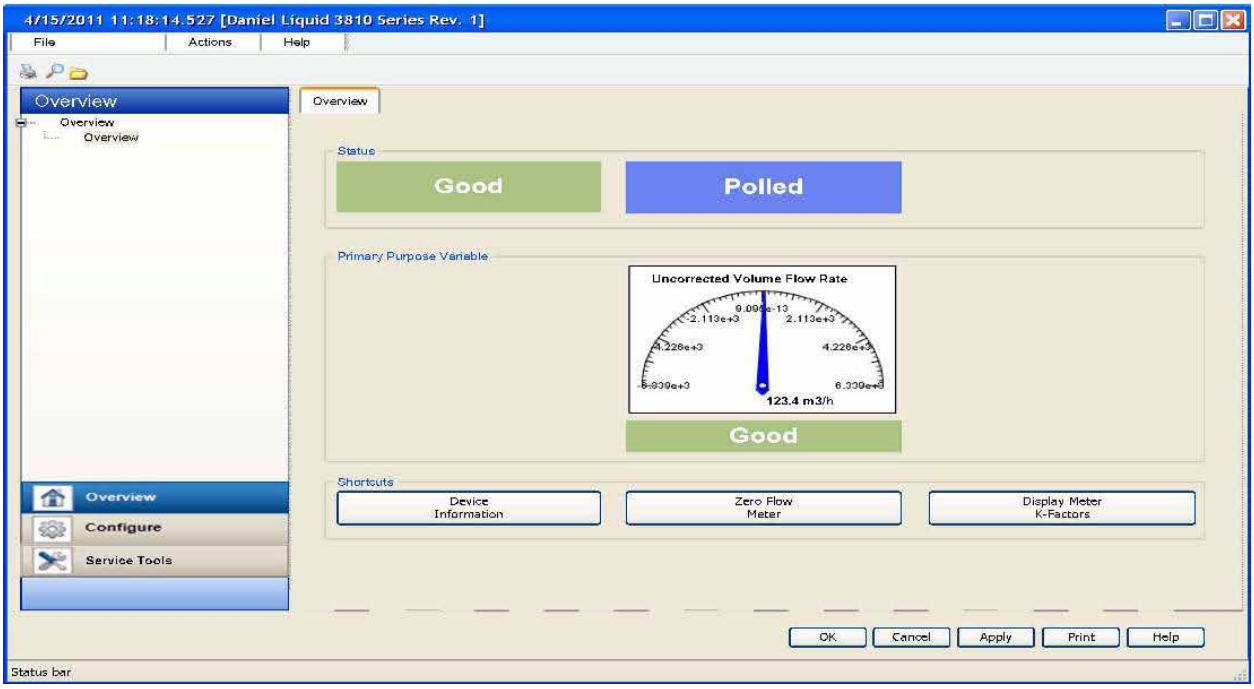
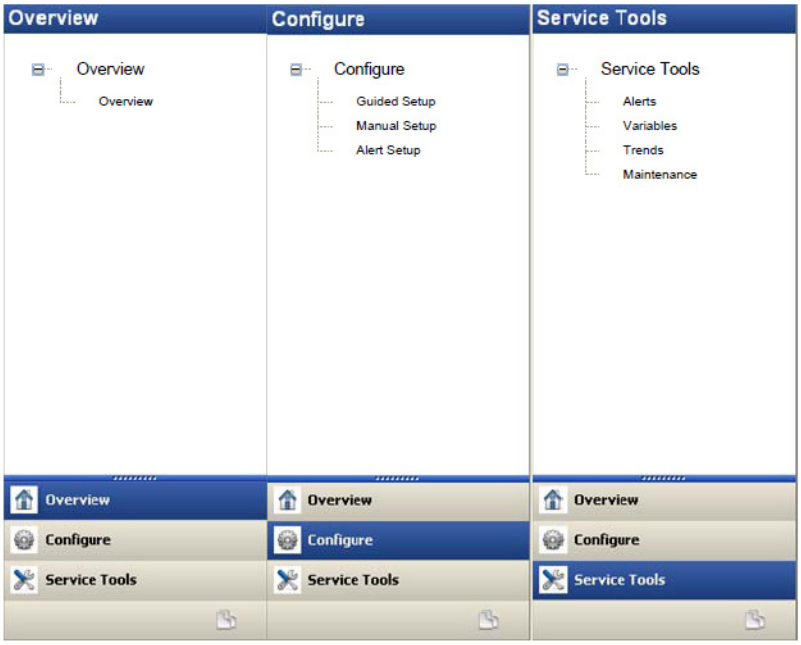


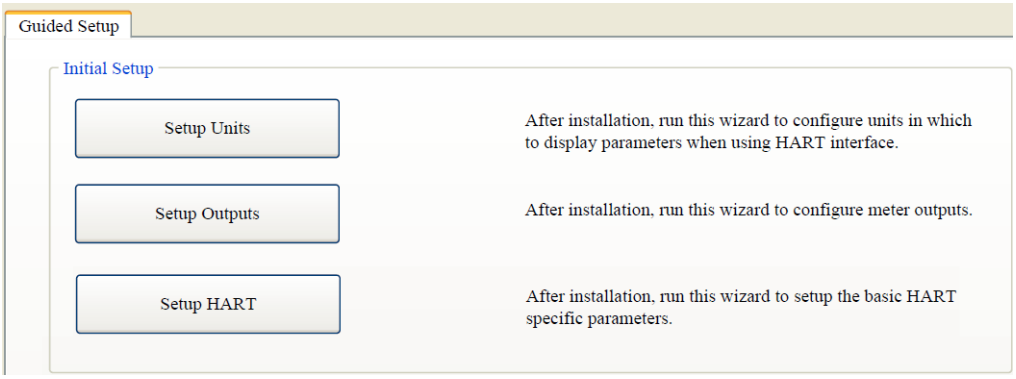
Figure 4-5 AMS Device Manager - Overview



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 4-6 AMS Device Manager - Guided Setup



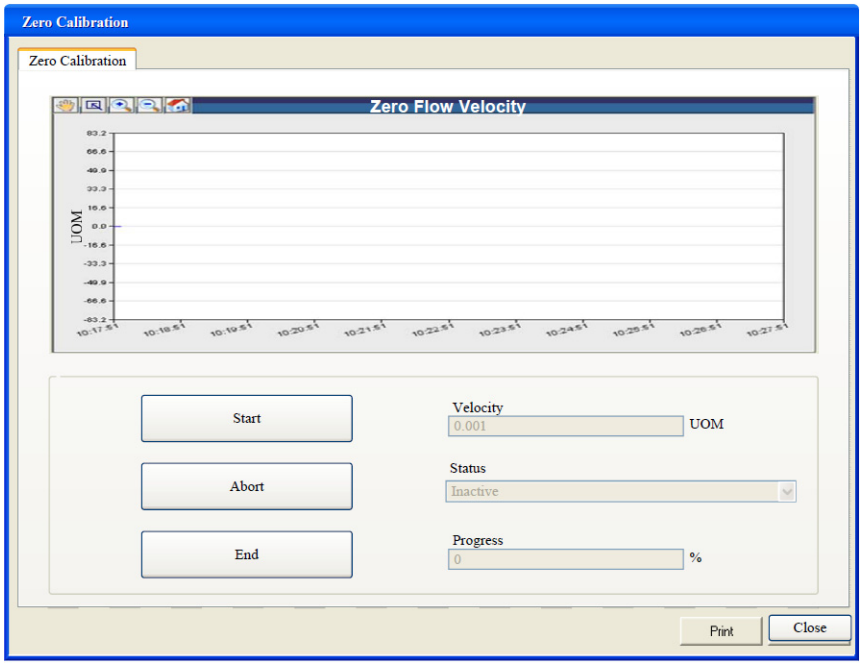
Note: Before writing configuration changes to your meter, make sure you have saved the Configuration file and Maintenance log.

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, 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). (**Refresh 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 3b 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. From the AMS Device Manager Overview page, click **Zero Flow Meter**. Set the low flow volume threshold cutoff. If the average flow velocity for a batch is below this value, the volume accumulated is set to zero.

Figure 4-7 AMS Device Manager - Zero Flow

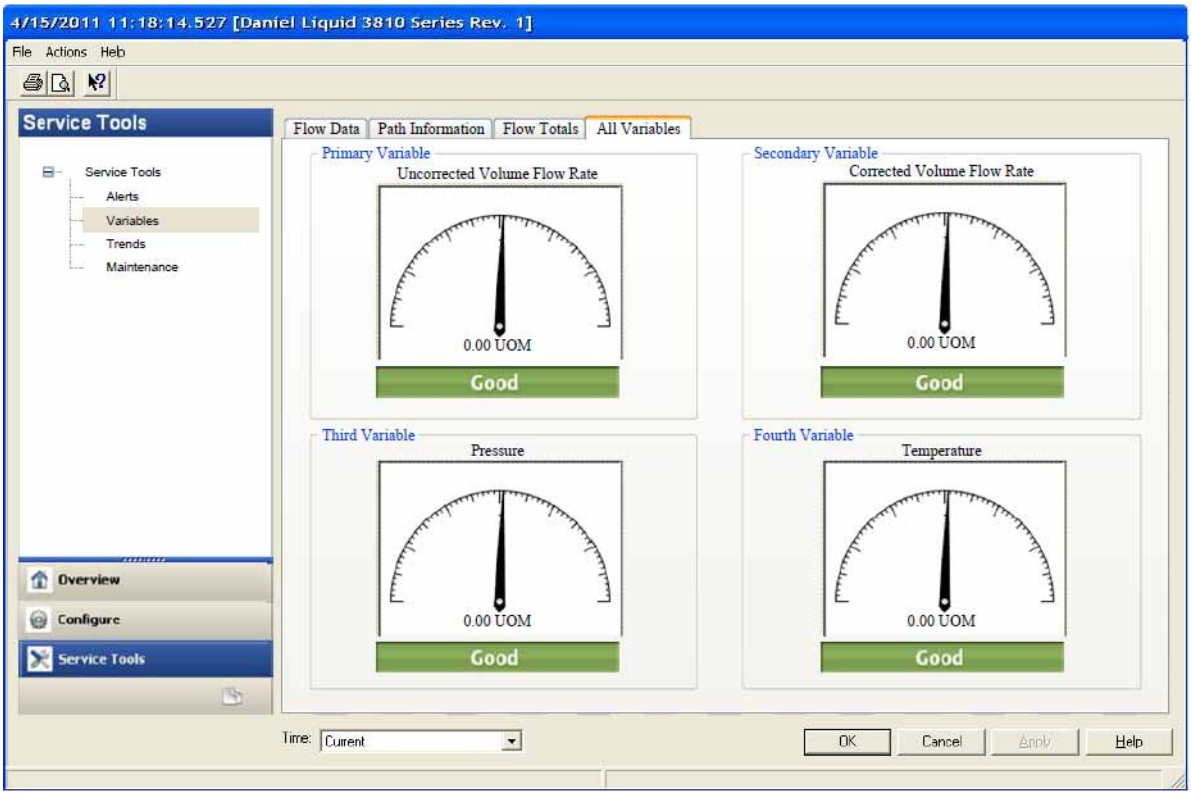


a. Click **Start** to activate the zero flow calibration. The default duration is four minutes. The status bar indicates the per cent complete. Wait for the
b. When the per cent status shows *Completed Successfully,* select **End Zero** to process the results.
c. If you have started the zero flow calibration, select **Abort Zero** to stop the calibration process without updating the zero flow velocity offset.
d. Click the **Next** button to display the zero flow velocity offset units of measure.
e. If the one of the following error conditions exists, AMS Device Manager displays an error message and does not update the zero flow velocity offset:
   — if the meter has a chord failure
   — if the velocity offset is too large
   — if the estimated maximum deviation is too large
f. Click **Exit** to return to the AMS Device Manager - Overview page.

7. On the Overview page, click **Alert Setup** and select the **Flow Analysis** tab and enable Reverse Flow (this currently the only parameter available for 3818 LNG Liquid Ultrasonic Flow Meters). Click the **OK** button to return to the Overview page.
8. 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).

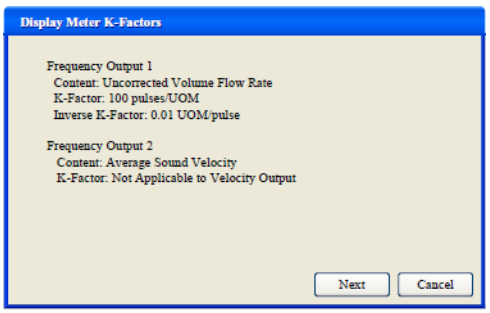
d. Click the **All Variables** tab to view a graphical display of the Primary, Secondary, Third and Fourth Variables.

Figure 4-8 AMS Device Manager - Service Tools All Variables status indicators



9. Click the **OK** button to return to the Overview page.
10. Enable the Write Protect switch on the CPU Module to protect the meter's configuration.
11. 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 4-9 Display Meter K-Factors

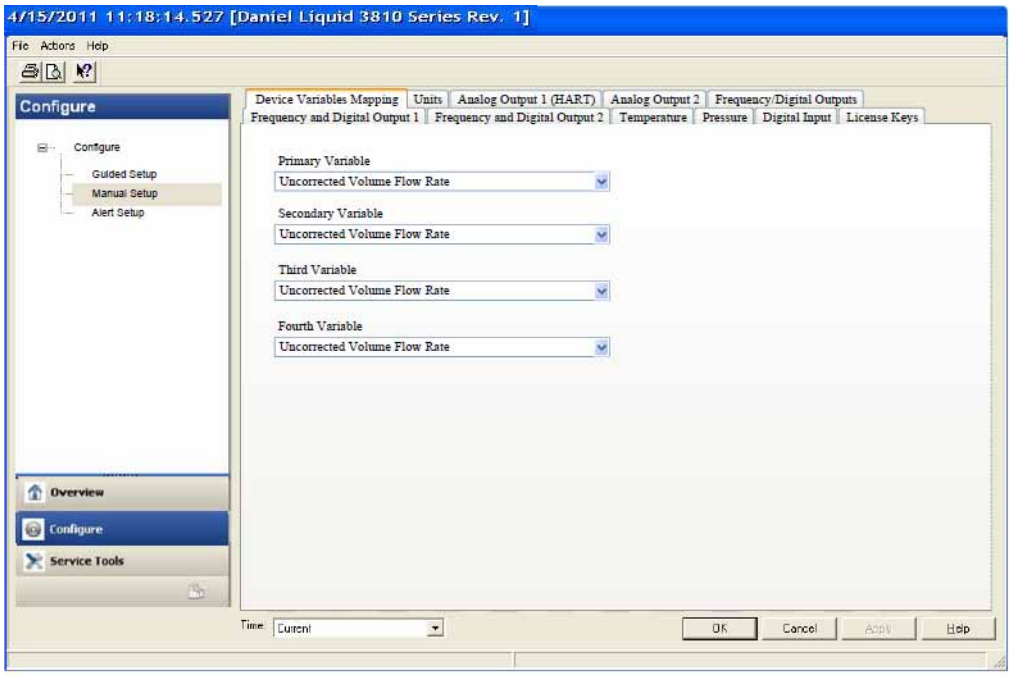


Click **Next** to return to the Device Manager Overview page.

AMS Device Manager - Manual Setup

Use the **Manual Setup** wizard to configure the meter's parameters. See Figure 4-4 and Figure 4-5 and from the AMS Device Manager Configure menu click **Manual Setup**.

Figure 4-10 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.

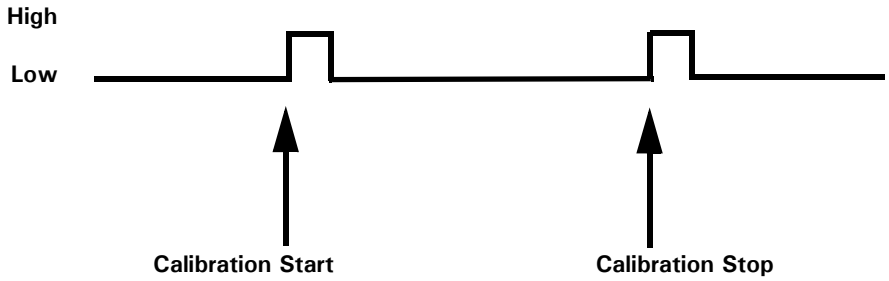
1. Disable the Write Protect switch in the CPU Module to write any of the following configuration parameters to your meter.
2. Click the **Device Variables Mapping** tab. The Primary and Secondary variables are read only and are configured for Uncorrected Flow Rate. The Third and Fourth variable configuration choices include Pressure and Temperature.
3. Click the **Units** tab (see AMS Device Manager - Guided Setup, Step 1).
4. Click the **Analog Output 1 (HART)** tab (see AMS Device Manager - Guided Setup, Step 2a.).
5. Click the **Analog Output 2** tab. Follow the configuration instructions in the AMS Device Manager - Guided Setup, Step 2b. 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.

6. Click the **Frequency/Digital** Outputs tab. Follow the configuration instructions in the AMS Device Manager - Guided Setup, Step 3 a.). (**Refresh 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). Click **Apply**, after you enter the data to write the parameters to the meter.
7. Click the **Frequency and Digital Output 1** tab. Follow the configuration instructions in the AMS Device Manager - Guided Setup, Step 3b. 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 3c 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 **Temperature** 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 **Pressure** 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** 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:

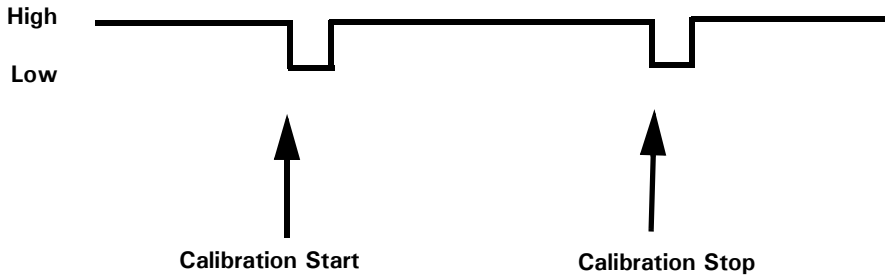
— Edge gated, active high

Figure 4-11 Gating configuration parameter Edge gated, active high



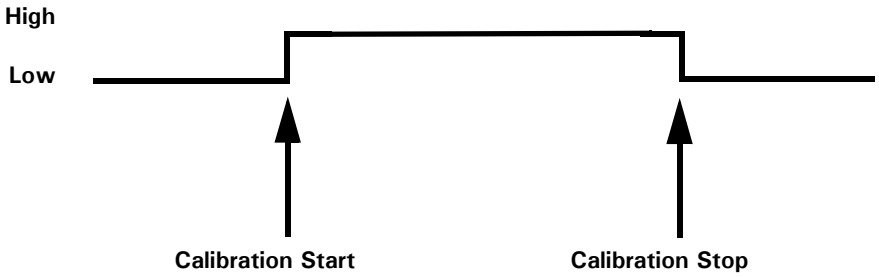
— Edge gated, active low

Figure 4-12 Gating configuration parameter Edge gated, active low



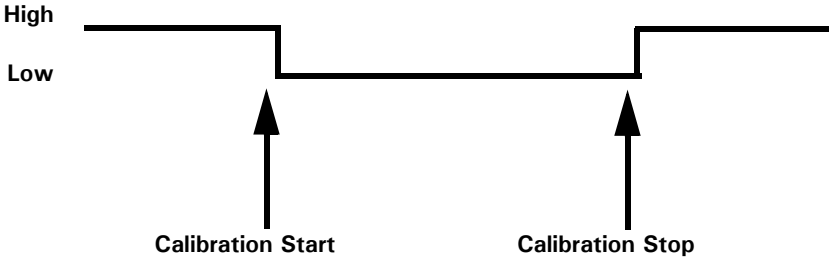
— State gated, active high

Figure 4-13 Gating configuration parameter State gated, active high



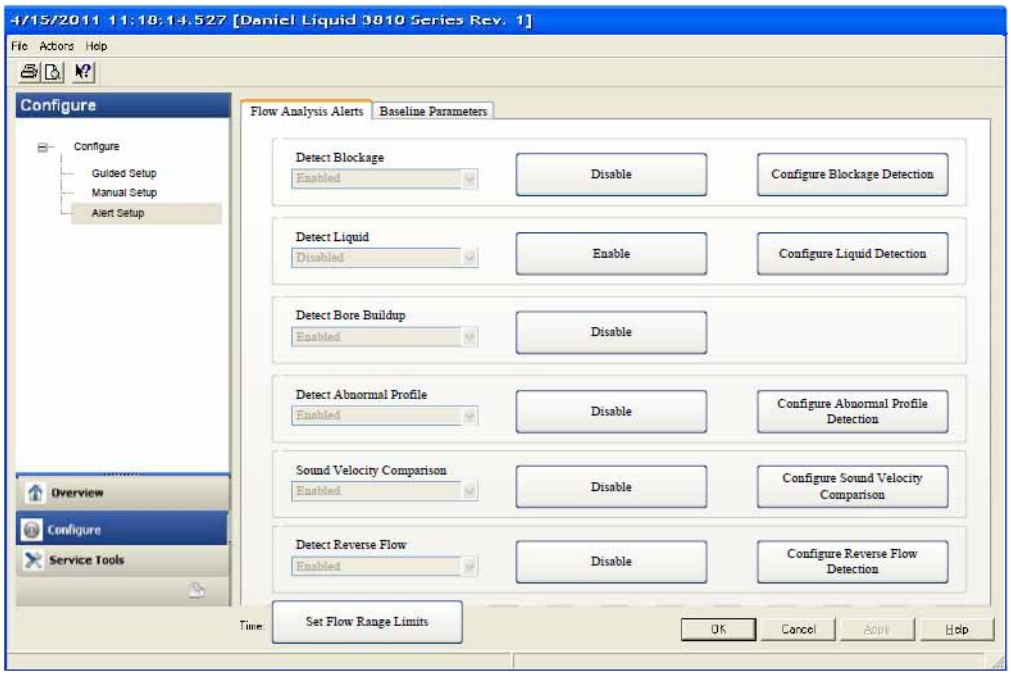
— State gated, active low

Figure 4-14 Gating configuration parameter State gated, active low



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

Figure 4-15 Configure Flow Analysis Alert



13. Click the **Flow Analysis** 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.

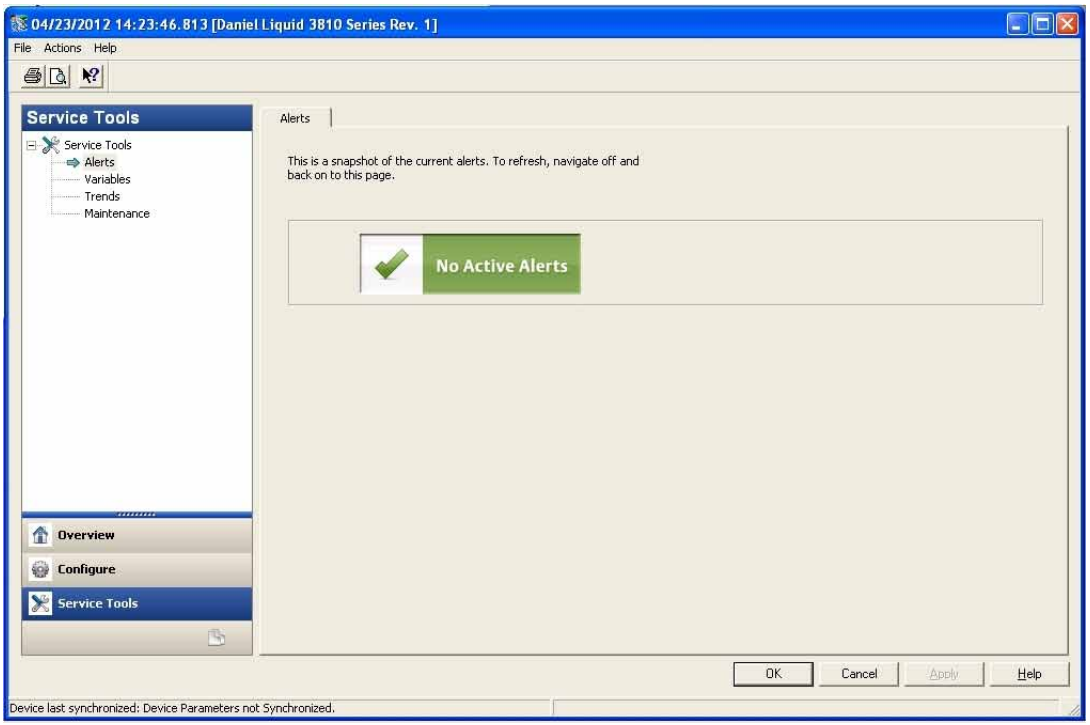
    b. If an error message is returned, click the **Next** button to display the Method Complete page.

    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 4-16 AMS Device Manager - Service Tools Alerts

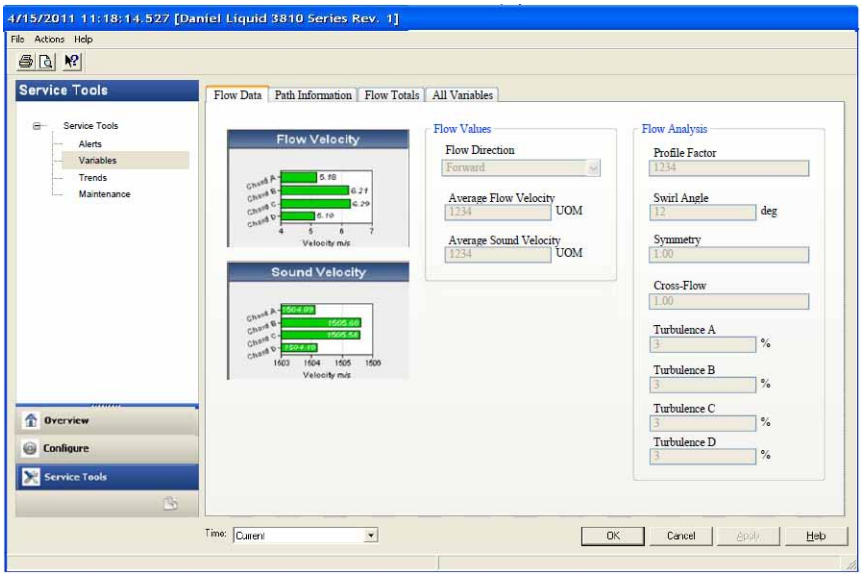


    b. If you change the device configuration, a confirmation dialog displays and prompts you to write the changes to the meter. Click **Yes** to write the changes to the meter or click **No** to cancel pending changes.

Figure 4-17 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 4-18 AMS Device Manager - Service Tools



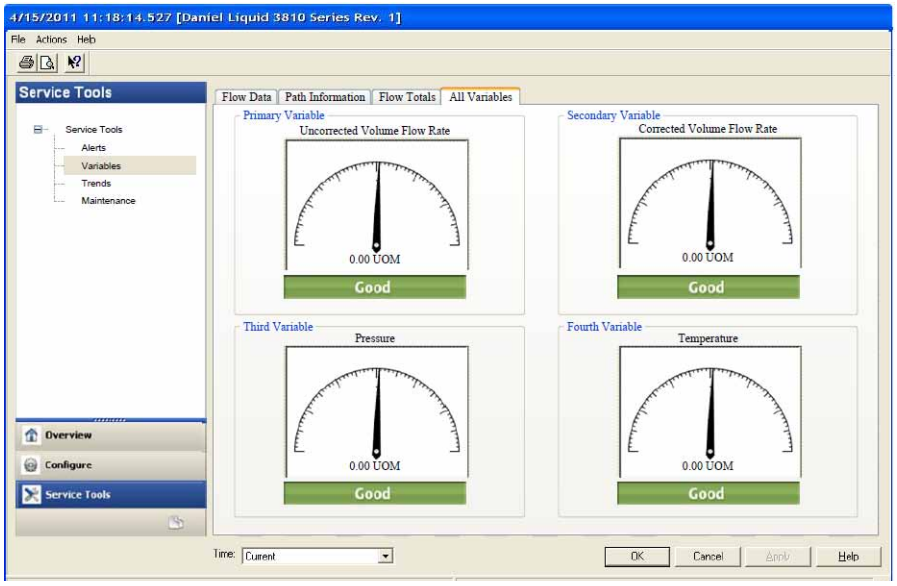
d. The **Service Tools | Flow Data** page includes charts for flow and sound velocities. The flow values (flow direction, average flow velocity and average sound velocity) parameters are displayed for the connected device.

e. Click **Service Tools | Variables | Path Information** tab to view the device's chord performance (%), 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 4-19 AMS Device Manager - Service Tools All Variables



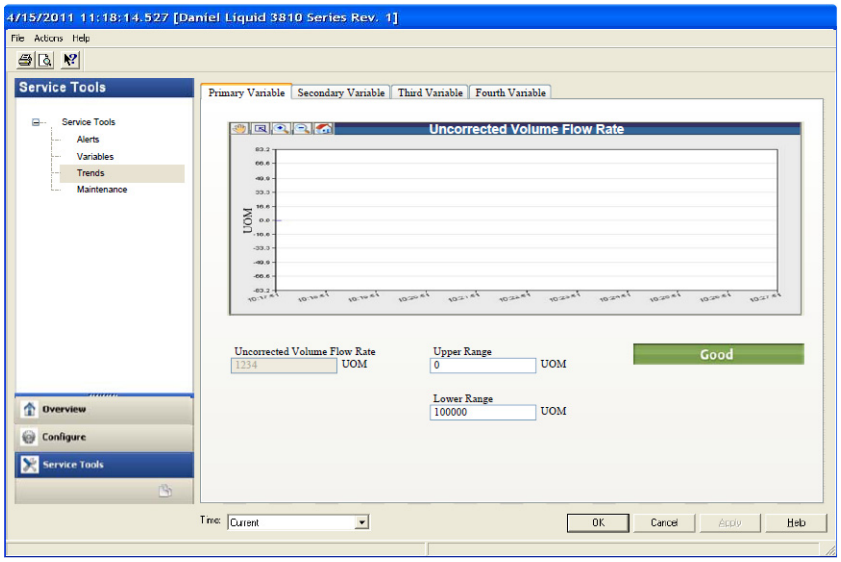
Gauges display each variable's status as good or bad. If a status is bad refer to the Service Tools Alerts page for recommended actions to resolve the alert condition. Also refer to the Field Device Specification manual (P/N 3-9000-762) for Commands 48 and 140 details.

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 4-20 AMS Device Manager - Service Tools Trends



Primary and Secondary variables display real-time uncorrected volume flow rate trends. The third and fourth variables charts displays 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 milliamp output. The 4mA and 20mA output current values should equal the plant's standard values. Click **Yes** to confirm the configuration changes. Repeat this step to trim Analog Output 2 current. Click **Apply** to write the output trim values to the meter. 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 6. 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 Daniel MeterLink, the Monitor page displays a Meter status alarm that the configuration has changed and remains latched until acknowledged. Click the **Ack** (acknowledge) button 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 3818 LNG Liquid Ultrasonic Flow Meter documentation when working in a hazardous area.

Installation Requirements

- Emerson Field Communicator software, license, installation guide and user manual available on the Emerson Asset Optimization Field Communicator website:

http://www2.emersonprocess.com/en-US/brands/Field-Communicator/Pages/Documentation.aspx

- Daniel HART Device Description (HART DD) installed for the meter
- Network configured for a Field Communicator
- Daniel Field Device Specification Manual (P/N 3-9000-762) available on the Daniel website

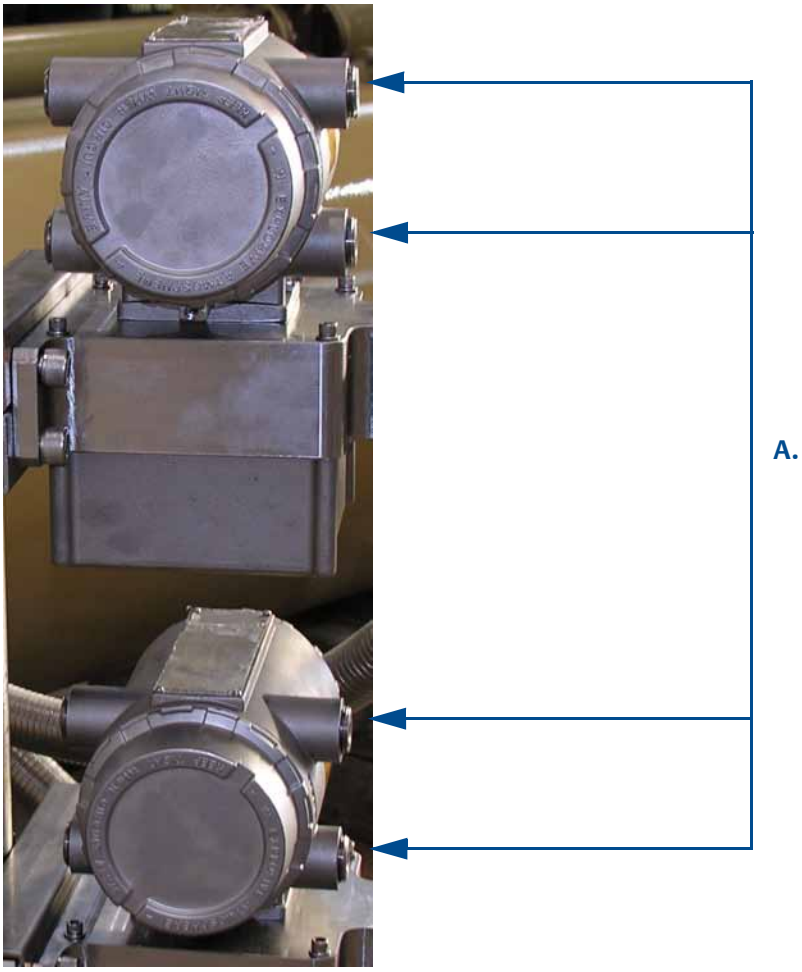
http://www2.emersonprocess.com/en-US/brands/daniel/Flow/ultrasonics/Pages/Ultrasonic.aspx

- System wiring diagram drawing number DMC - 004936 (see Appendix A)
- Power supply

Procedure

1. Remove electrical power to the meter. If installed, remove the endcap security latches and seals and then, remove the endcap.
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.

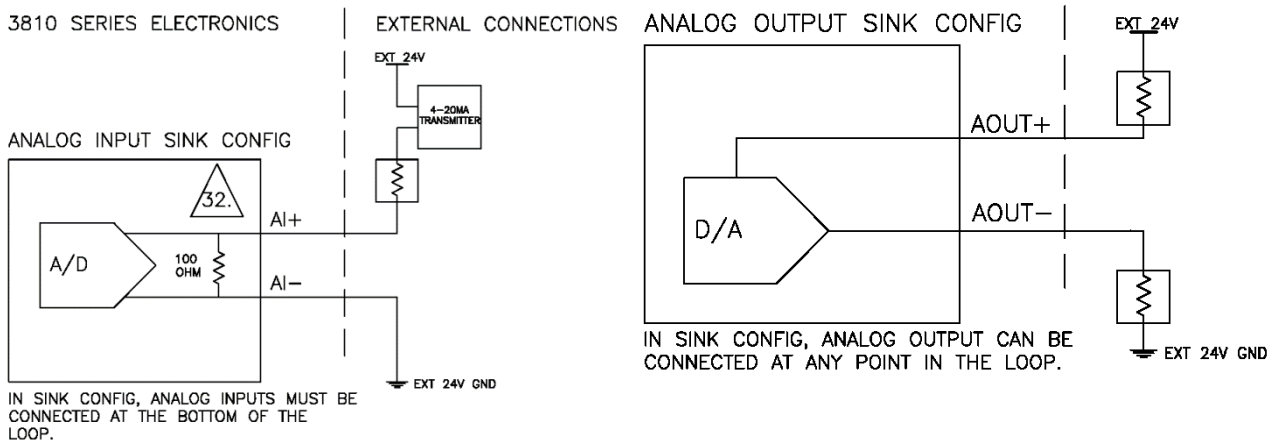
Figure 4-21 3818 transmitter field wiring conduit entries



A. Field wiring conduit entries (8)

5. Wire Analog Input 1 (AI1) and Analog Output 1 (AO1) as shown in Figure 4-22.

Figure 4-22 Field Communicator wiring diagram for the 3818 LNG 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 Daniel HART Field Device Specification manual (P/N 3-9000-762) 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 on the end caps and install security wires on the Transmitter Electronics Enclosure end caps, the Bracket/Cover cap head screws. See Section 3.6.8 and Section 3.6.9.

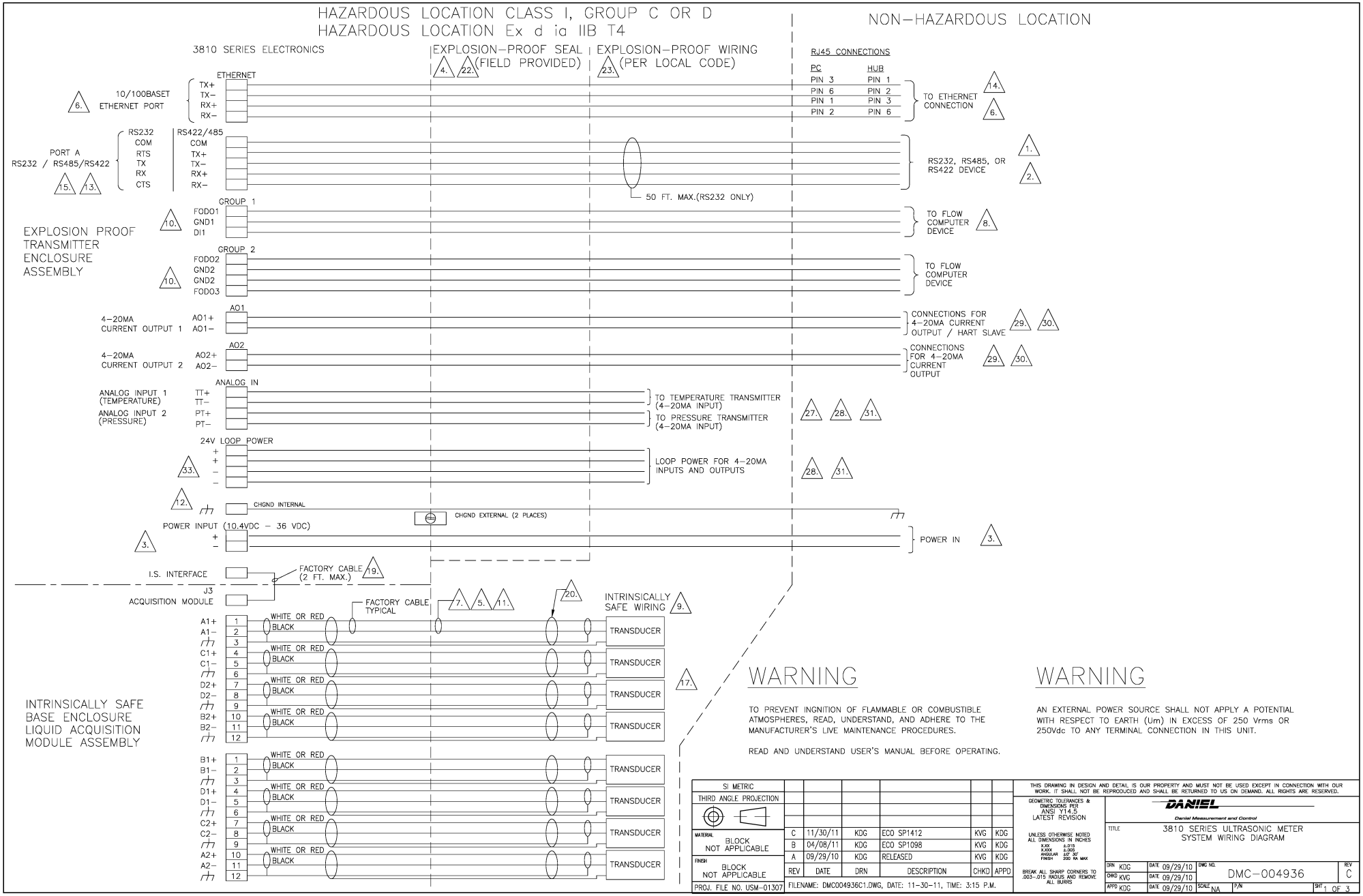
Seal the conduit ports with sealing compound according to the customer's requirements (e.g., after approximately one to two weeks of run time). Also, see Section 3.4.1.

Appendix A: Engineering drawings

A.1 Daniel 3818 LNG Liquid Ultrasonic Flow Meter drawings

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

DMC-004936 Daniel 3818 LNG Liquid Ultrasonic Flow Meter System Wiring Diagram



WARNING

TO PREVENT INGNITION OF FLAMMABLE OR COMBUSTIBLE ATMOSPHERES, READ, UNDERSTAND, AND ADHERE TO THE MANUFACTURER'S LIVE MAINTENANCE PROCEDURES.

READ AND UNDERSTAND USER'S MANUAL BEFORE OPERATING.

WARNING

AN EXTERNAL POWER SOURCE SHALL NOT APPLY A POTENTIAL WITH RESPECT TO EARTH (Um) IN EXCESS OF 250 Vrms OR 250Vdc TO ANY TERMINAL CONNECTION IN THIS UNIT.

REV	DATE	DRN	DESCRIPTION	CHKD	APPD
C	11/30/11	KDG	ECO SP1412	KVG	KDG
B	04/08/11	KDG	ECO SP1098	KVG	KDG
A	09/29/10	KDG	RELEASED	KVG	KDG

SI METRIC
THIRD ANGLE PROJECTION
MATERIAL: BLOCK NOT APPLICABLE
FINISH: BLOCK NOT APPLICABLE
PROJ. FILE NO. USM-01307
FILENAME: DMC004936C1.DWG, DATE: 11-30-11, TIME: 3:15 P.M.

GEOMETRIC TOLERANCES & DIMENSIONS PER ANSI Y14.5 LATEST REVISION

UNLESS OTHERWISE NOTED ALL DIMENSIONS IN INCHES
X.XX ±.015
X.XXX ±.005
ANGULAR ±0° 30'
FINISH 200 RA MAX

BREAK ALL SHARP CORNERS TO .003-.015 RADIUS AND REMOVE ALL BURRS

DANIEL
Daniel Measurement and Control

TITLE: 3810 SERIES ULTRASONIC METER SYSTEM WIRING DIAGRAM

DRN KDG	DATE 09/29/10	DWG NO. DMC-004936	REV C
CHKD KVG	DATE 09/29/10		
APPD KDG	DATE 09/29/10	SCALE NA P/N	SHT 1 OF 3

HAZARDOUS LOCATION CLASS I, GROUP C OR D
HAZARDOUS LOCATION Ex d ia IIB T4

NON-HAZARDOUS LOCATION

EXPLOSION-PROOF SEAL (4.) (22.) (FIELD PROVIDED)

EXPLOSION-PROOF WIRING (23.) (PER LOCAL CODE)

3810 SERIES ELECTRONICS (OPTIONAL EXPANSION MODULES) (18.)

EXPLOSION PROOF TRANSMITTER ENCLOSURE ASSEMBLY

P/N W30381X0022
100 SERIES COMMUNICATIONS MODULE RS-485

PORT B (13.)

RS485
A
B
GND

RS485 DEVICE (1.)

OR

P/N W30381X0012
100 SERIES COMMUNICATIONS MODULE RS-232

PORT B (13.)

RS232
TX
RX
RTS
GND

RS232 DEVICE (2.) (15.)

50 FT. MAX.(RS232 ONLY)

INTRINSICALLY SAFE BASE ENCLOSURE LIQUID ACQUISITION MODULE ASSEMBLY

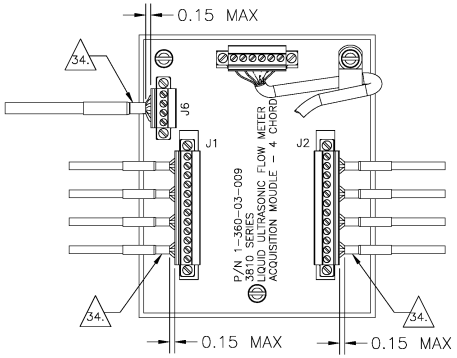
J6 (SEE NOTES BELOW)

1
2
3
4

INTRINSICALLY SAFE WIRING

CO-LOCATED 3810 SERIES ELECTRONICS FOR MODEL 3818 METERS

3 — 3810 SERIES ACQUISITION MODULE ASSEMBLY — CONNECTOR J6 — 1
4 — 2



1. Terminal J6 is intended to provide power to the device it is connected to and may also receive power. The entity parameters assigned for terminal J6 are as follows:

Output parameters:	Input parameters:
Vt (or Uo) = 6.51 VDC	Vmax (or Ui) = 6.51 VDC
It (or Io) = 65.8 mA	Imax (or Ii) = 65.8 mA
Po = 107 mW	Pmax (or Pi) = 107 mW
Ca (or Co) = 500 uF	Ci = 0 uF
La (or Lo) = 32.8 mH	Li = 0 mH

2. Selected intrinsically safe equipment must be third party listed as intrinsically safe for the application, and have intrinsically safe entity parameters conforming to Table 1.

Table 1:

I.S. Equipment		Terminal J6
Vmax (or Ui)	≥	Voc or Vt (or Uo)
Imax (or Ii)	≥	Isc or It (or Io)
Pmax, Pi	≥	Po
Ci + Ccable	≤	Ca (or Co)
Li + Lcable	≤	La (or Lo)

3. Intrinsically safe apparatus connected to terminal J6 that may provide power, must have intrinsically safe entity parameters conforming to Table 2.

Table 2:

Terminal J6		Intrinsically safe apparatus with output parameters
Vmax (or Ui)	≥	Voc or Vt (or Uo)
Imax (or Ii)	≥	Isc or It (or Io)
Pmax, Pi	≥	Po
Ci + Ccable	≤	Ca (or Co)
Li + Lcable	≤	La (or Lo)

4. Capacitance and inductance of the field wiring from the intrinsically safe equipment to the terminal J6 shall be calculated and must be included in the system calculations as shown in Table 1 and Table 2. Cable capacitance, Ccable, plus intrinsically safe equipment capacitance, Ci must be less than the marked capacitance, Ca (or Co), shown on any associated apparatus used. The same applies for inductance (Lcable, Li and La or Lo, respectively). Where the cable capacitance and inductance per foot are not known, the following values shall be used: Ccable = 60 pF/ft., Lcable = 0.2 µH/ft.

5. For installations in which both the Ci and Li of the intrinsically safe apparatus connected to terminal J6 exceeds 1% of the stated Ca and Lo parameters (excluding the cable), then 50% of Ca and Lo parameters are applicable and shall not be exceeded.

REV	DATE	DRN	DESCRIPTION	CHKD	APPD
C	11/30/11	KDG	ECO SP1412	KVG	KDG
B	04/08/11	KDG	ECO SP1098	KVG	KDG
A	09/29/10	KDG	RELEASED	KVG	KDG

SI METRIC
THIRD ANGLE PROJECTION
MATERIAL: BLOCK NOT APPLICABLE
FINISH: BLOCK NOT APPLICABLE
PROJ. FILE NO. USM-01307
FILENAME: DMC004936C2.DWG, DATE: 11-30-11, TIME: 3:15 P.M.

GEOMETRIC TOLERANCES & DIMENSIONS PER ANSI Y14.5 LATEST REVISION

UNLESS OTHERWISE NOTED ALL DIMENSIONS IN INCHES
X.XX ±.015
X.XXX ±.005
ANGULAR ±0° 30'
FINISH 200 RA MAX

BREAK ALL SHARP CORNERS TO .003-.015 RADIUS AND REMOVE ALL BURRS

DANIEL
Daniel Measurement and Control

TITLE: 3810 SERIES ULTRASONIC METER SYSTEM WIRING DIAGRAM

DRN KDG	DATE 09/29/10	DWG NO. DMC-004936	REV C
CHKD KVG	DATE 09/29/10		
APPD KDG	DATE 09/29/10	SCALE NA P/N	SHT 2 OF 3

NOTES:

1. MAX LENGTH OF RS-485 WIRING IS 2,000 FT.

2. ETHERNET OR RS-422 IS THE PREFERRED COMMUNICATIONS INTERFACE. OPTIONALLY, RS-232 MAY BE USED FOR SHORT DISTANCES, (50 FT.)

3. POWER INPUT IS NOMINAL 24 VDC. INPUT RANGE 10.4-36V DC. POLARITY INSENSITIVE

4. AN EXPLOSION-PROOF SEAL IS REQUIRED WITHIN 457 MM(18 INCHES) OF THE ENCLOSURE.

5. 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.

6. FOR OPTIMUM DIAGNOSTIC INTERFACE, WIRING ETHERNET PORT IS RECOMMENDED. USE CAT5 ETHERNET CABLE

7. INTRINSICALLY SAFE WIRING SHALL BE INSTALLED IN ACCORDANCE WITH THE ARTICLE 504 OF THE NATIONAL ELECTRICAL CODE OR RULE 18-066 OF THE CANADIAN ELECTRICAL CODE.

8. DIGITAL INPUT 1 IS CONTACT CLOSURE ONLY.

9. TRANSDUCER PAIRS REQUIRED

MODEL NO.	TRANSDUCER PAIRS REQUIRED	TYPICAL CHORDS USED
3814	4	A,B,C,D
3812	2	A,B
3818	8	2 x MODEL 3814

10. FODO OUTPUTS 1 THROUGH 3 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.

11. EXPLOSION PROOF TRANSMITTER ENCLOSURE AND INTRINSICALLY SAFE BASE ENCLOSURE MUST BE MOUNTED IN A REMOTE LOCATION OFF THE METER BODY IF THE PROCESS TEMPERATURE EXCEEDS 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).

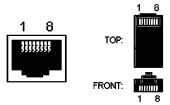
MODEL 3814:
TRANSDUCER CABLES (P/N 1-360-01-601, 15 FT. LONG) SHALL BE USED TO CONNECT THE DANIEL 3810 SERIES ELECTRONICS TO EACH OF THE TRANSDUCERS INSTALLED IN A MODEL 3814 METER BODY FOR PROCESS FLUID TEMPERATURES UP TO 100 °C (212 °F). FOR PROCESS FLUID TEMPERATURES UP TO 150 °C (302 °F), THE HIGH 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).

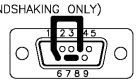
12. THE INTERNAL GROUNDING TERMINAL SHALL BE USED AS THE PRIMARY EQUIPMENT GROUND. THE EXTERNAL GROUND TERMINAL IS ONLY A SUPPLEMENTAL BONDING CONNECTION WHERE LOCAL AUTHORITIES PERMIT OR REQUIRE SUCH A CONNECTION.

13. COMM SIGNAL NAMING CONVENTION IS WITH RESPECT TO METER. (I.E. PC - TX -> METER - RX)

14. RJ45 SOCKET NUMBERING



15. 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)



FEMALE 9 PIN DSUB CONNECTOR (BACK VIEW)

CPU MODULE		DB9 (FEMALE)
RX	-->	PIN 3
TX	-->	PIN 2
COM	-->	PIN 5
		PIN 1
		PIN 4
		PIN 6
		PIN 7
		PIN 8

16. 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.

17. MODEL 3810 SERIES TRANSDUCERS TYPE LT-01, LT-03, LT-04, LT-05, LT-07, LT-08, LT-09, LT-10, AND LT-11.

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-006037 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-07	-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)

18. THE 3810 SERIES METER HAS ONE AVAILABLE SLOT FOR AN EXPANSION MODULE.

19. FACTORY CABLE INCLUDES EXPLOSION PROOF SEAL.

20. SECONDARY SHIELD ONLY PRESENT ON MODEL 3814 AND 3818 LNG TRANSDUCER CABLING.

21. DIMENSIONS OF FLAMEPROOF JOINTS ARE OTHER THAN THE RELEVANT MINIMUM OR MAXIMUM SPECIFIED IN TABLE 3 OF EN/IEC 60079-1:2007. PLEASE CONTACT MANUFACTURER FOR DETAILS.

22. ALL CABLE ENTRY DEVICES SHALL BE CERTIFIED IN TYPE OF EXPLOSION PROTECTION FLAMEPROOF ENCLOSURE 'd', SUITABLE FOR THE CONDITIONS OF USE AND CORRECTLY INSTALLED.

23. 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.

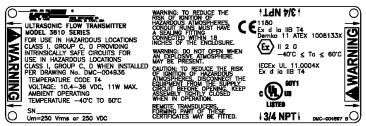
24. REFER TO THE APPROPRIATE INSTRUCTION MANUAL FOR INSTRUCTIONS FOR SAFETY INCLUDING PUTTING INTO SERVICE, USE, ASSEMBLING AND DISMANTLING, MAINTENANCE, INSTALLATION, AND ADJUSTMENT.

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

25. LABEL FOR 3810 SERIES FLOW METER:
DATE CODE IS INCLUDED IN THE SERIAL NUMBER. SERIAL NUMBER FORMAT SHALL BE "YY-WWXXXX" WHERE:
YY = 2-DIGIT YEAR OF MANUFACTURE
WW = WEEK OF MANUFACTURE (01-52)
XXXX = SEQUENTIALLY INCREMENTING NUMBER



26. FOR THE U.L. U.S. MARK INVESTIGATION, THE DEVICE COMPLIES TO THE FOLLOWING STANDARDS FOR USE IN THE UNITED STATES:

UL 1203, 4TH EDITION
UL 508, 17TH EDITION
UL 913, 7TH 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. 1988-11
CAN/CSA C22.2 No. 14-10
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:

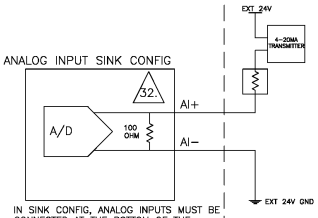
EN 60079-0:2006
EN 60079-1:2007
EN 60079-11:2007

FOR THE IECEx MARK INVESTIGATION, THE DEVICE COMPLIES TO THE FOLLOWING STANDARDS:

IEC 60079-0:2004
IEC 60079-1:2007
IEC 60079-11:2006

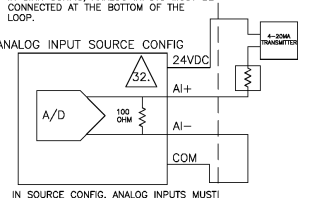
3810 SERIES ELECTRONICS | EXTERNAL CONNECTIONS

27. ANALOG INPUT SINK CONFIG



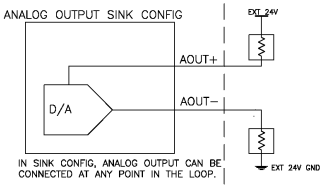
IN SINK CONFIG, ANALOG INPUTS MUST BE CONNECTED AT THE BOTTOM OF THE LOOP.

28. ANALOG INPUT SOURCE CONFIG



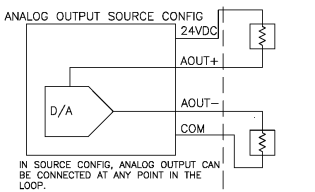
IN SOURCE CONFIG, ANALOG INPUTS MUST BE CONNECTED AT THE BOTTOM OF THE LOOP.

29. ANALOG OUTPUT SINK CONFIG



IN SINK CONFIG, ANALOG OUTPUT CAN BE CONNECTED AT ANY POINT IN THE LOOP.

30. ANALOG OUTPUT SOURCE CONFIG



IN SOURCE CONFIG, ANALOG OUTPUT CAN BE CONNECTED AT ANY POINT IN THE LOOP.

REPRESENTS ADDITIONAL I/O DEVICES LOCATED IN THE LOOP. ADDITIONAL DEVICES ONLY SHOWN TO ILLUSTRATE ANALOG CONNECTIONS. NOT REQUIRED FOR OPERATION

31. ANALOG INPUT 1 AND ANALOG INPUT 2 ARE FUNCTIONALLY IDENTICAL AND ARE NOT ELECTRICALLY ISOLATED FROM EACH OTHER.

32. ANALOG INPUT 1 AND ANALOG INPUT 2 HAVE ADDITIONAL 150 OHMS LOOP IMPEDANCE FOR COMPLIANCE WITH HART COMMUNICATION REQUIREMENTS.

33. 24 VOLTS DC OUTPUT CAN BE USED TO SOURCE POWER TO ONE OR MORE OF THE ANALOG INPUTS OR OUTPUTS.

34. MODEL 3818: CABLING TO CONNECTORS J1, J2 AND J6 ON ACQUISITION MODULE SHALL HAVE DISCRETE WIRES RESTRAINED USING SHRINK TUBING AS SHOWN ON SHEET 2.

SI METRIC
THIRD ANGLE PROJECTION

MATERIAL: BLOCK NOT APPLICABLE
FINISH: BLOCK NOT APPLICABLE
PROJ. FILE NO. USM-01307

REV	DATE	DRN	DESCRIPTION	CHKD	APPD
C	11/30/11	KDG	ECO SP1412	KVG	KDG
B	04/08/11	KDG	ECO SP1098	KVG	KDG
A	09/29/10	KDG	RELEASED	KVG	KDG

FILENAME: DMC004936C3.DWG, DATE: 11-30-11, TIME: 3:15 P.M.

GEOMETRIC TOLERANCES & DIMENSIONS PER ANSI Y14.5 LATEST REVISION

UNLESS OTHERWISE NOTED ALL DIMENSIONS IN INCHES
X.XX ±.015
X.XXX ±.005
ANGULAR ±0°30'
FINISH 250 RA MAX

BREAK ALL SHARP CORNERS TO .003-.015 RADIUS AND REMOVE ALL BURRS

DANIEL
Daniel Measurement and Control

TITLE: 3810 SERIES ULTRASONIC METER SYSTEM WIRING DIAGRAM

DRN KDG	DATE 09/29/10	DWG NO. DMC-004936	REV C
CHKD KVG	DATE 09/29/10		
APPD KDG	DATE 09/29/10	SCALE NA	P/N

SHT 3 OF 3

Appendix B: Open source licenses

Source code for executable files or libraries included in this product is provided per the indicated license in the table below. Hyperlinks to the controlling organization's websites are included in Section B.1 through Section B.4.

Table B-1 Open source licences

Package	File specification	License	Summary
base_libs-1.2-1	base_libs	LGPL	Base Libraries (from toolchain)
busybox-1.1.3-1	busybox	GPL	A small executable that replaces many UNIX utilities
dev-1.1-1	dev	GPL	Device files for a small embedded system
devmem2-1.0-1	devmem2	GPL	Simple program to read/write from/to any location
ethtool-3-1	ethtool	GPL	Ethernet settings tool for PCI Ethernet cards
fake-provides-1.0-5	fake-provides	GPL	Fake provides to satisfy package dependencies
gdb-6.6cs-1	gdb	GPL	Gdb - GNU Source level debugger for C, C++
kernel-2.6.37-6	kernel-2.6.37-mpc8313erd	GPL	Linux kernel (core of the Linux operating system)
libpcap-0.8.3-1	libpcap	BSD	A system-independent interface for user-level pa
libtermcap-2.0.8-31_1	libtermcap	LGPL	A basic system library for accessing the termcap
lwIP		BSD	A lightweight TCP/IP stack
merge-0.1-1	merge	GPL	Merge files for an embedded root filesystem
modeps-1.0-1	modeps	GPL	Generate module dependency file
mtd-utils-20060302-1	mtd-utils	GPL	Memory Technology Device tools
net-tools-1.60-1	net-tools	GPL	Basic networking tools
ppp-2.4.4-1	ppp	BSD	Like a Point-to-Point Protocol daemon
skell-1.16-2	skell	GPL	Skelleton files for an embedded root filesystem
sqlite-3.6.22-1	sqlite	Public domain	SQLite is a C library that implements an embeddable SQL database

Package	File specification	License	Summary
strace-4.5.14-1	strace	BSD	trace system calls associated with a running pro
sysconfig-1.2-1	sysconfig	GPL	System configuration package
sysfsutils-2.1.0-1	sysfsutils	GPL/LGPL	sysfs utilities
tcpdump-3.8.3-1	tcpdump	BSD	A network traffic monitoring tool
termcap-1.2-1	termcap	BSD	minimal /etc/termcap needed by minicom etc
u-boot-1.3.0-1	u-boot-1.3.0-mpc8313erdb	GPL	Universal Bootloader firmware
ubi-utils-1.4.2-1	ubi-utils	GPL	Tools for maintaining Unsorted Block Image Device
vsftpd-2.2.2-1	vsftpd	GPL	vsftpd - Very Secure Ftp Daemon
zlib-1.2.3-2	zlib	zlib	Distribution zlib compression utilities and libraries

Follow the link below to the Daniel® Liquid Ultrasonic Products GPL webpage for additional open source information and zipped source code files.

http://www2.emersonprocess.com/en-US/brands/daniel/Pages/GPL3810.aspx

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http://www.gnu.org/

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http://www.gnu.org/licenses/old-licenses/gpl-2.0.html

The GNU GPL is currently version 3

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

For older versions of the GNU General Public License, follow the link below:

http://www.gnu.org/licenses/old-licenses/old-licenses.html#GPL

See GPL license on the following pages.

The GNU General Public License (GPL)

Version 2, June 1991

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Appendix C: Index

C.1 Manual index

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P

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Numerics

DANIEL™ Measurement and Control, Inc.

Returned Material Authorization

Repair Form for Used Equipment
Including Decontamination/Cleaning Statement

A Return Material Authorization (RMA) number must be obtained prior to returning any equipment for any reason. Download the RMA form from the Support Services web page by selecting the link below.

http://www2.emersonprocess.com/EN-US/BRANDS/DANIEL/SUPPORT-SERVICES/Pages/Support-Services.aspx

1. Return Material Authorization (RMA) Number_____
2. Equipment to be returned:
   Model Number _____Serial Number_____
3. Reason for return:
   _____
   _____
   _____
   _____
   _____

Decontamination/Cleaning Fluids Process

A. List each substance in which the equipment was exposed. Attach additional documents if necessary.

Common Name	CAS# if Available	Used for Hazardous Waste (20 CFR 261)		EPA Waste Code if used for hazardous waste
		[ ] Yes	[ ] No	
		[ ] Yes	[ ] No	
		[ ] Yes	[ ] No	
		[ ] Yes	[ ] No	
		[ ] Yes	[ ] No	
		[ ] Yes	[ ] No	

B. Circle any hazards and/or process fluid types that apply:

Infectious	Radioactive	Explosive	Pyrophoric	Poison Gas	
Cyanides	Sulfides	Corrosive	Oxidizer	Flammable	Poison
Carcinogen	Peroxide	Reactive-Air	Reactive-Water	Reactive-Other (list):	

Other Hazard Category (list):

C. Describe decontamination/cleaning process. Include MSDS description for substances used in decontamination and cleaning processes. Attach additional documents if necessary.

Shipping Requirements

Failure to comply with this procedure will result in the shipment being refused.

1. Write the RMA number on the shipping package.
2. Inside the package include one copy of this document and all required Material Safety Data Sheets (MSDS)
3. Outside of the package attach one copy of this document and all required Material Safety Data Sheets (MSDS).

THIS EQUIPMENT, BEING RETURNED "FOR REPAIR," HAS BEEN COMPLETELY DECONTAMINATED AND CLEANED. ALL FOREIGN SUBSTANCES HAVE BEEN DOCUMENTED ABOVE AND MSDS SHEETS ARE ATTACHED.

By_____ _____
(Signature) (Print name)

Title:_____ Date:_____

Company:_____

Phone: _____ Fax:_____

Daniel Gas and Liquid Ultrasonic Flow Meters power PlantWeb by communicating health and process variable information via the HART® protocol and are core components of the PlantWeb digital plant architecture.

Emerson Process Management
Daniel Measurement and Control, Inc.
11100 Brittmoore Park Drive
Houston, TX 77041
T+1 713-467-6000
F+1 713-827-4805
www.emerson.com

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