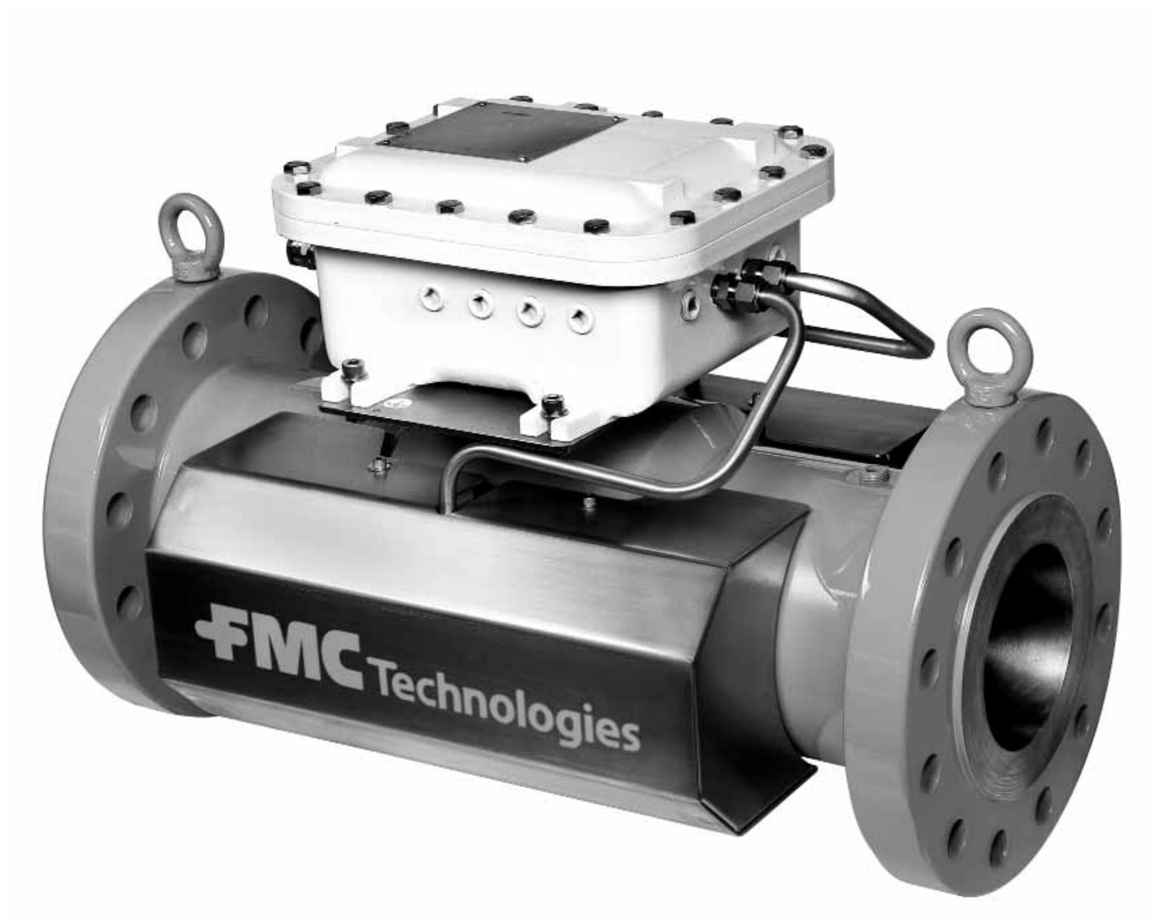
Ultrasonic Liquid Flowmeter

Smith Meter® Ultra™ Series

Installation/Operation/Maintenance

Issue/Rev. 0.5 (8/12)

Bulletin MNLS001



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Customer Support

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Overview

The Smith Meter® Ultra6™ Liquid Flowmeter is a six path ultrasonic meter with Signal Processing Unit (SPU) for custody transfer of petroleum products. The Smith Meter® Ultra4™ is a four path ultrasonic meter for custody and non-custody transfer measurement of petroleum products. The Ultra6 and Ultra4 are new additions to the Smith Meter family of high accuracy ultrasonic metering products which also includes the MPU 1200, 800, 600 and 200 gas flowmeters. All these meters share the same technology and the Ultra6 has the same principles of operation as the world leading MPU 1200 and the Ultra4 has the same technology as the MPU 800 in terms of path configuration, electronics and signal processing.

Principle of Operation

The Smith Meter Ultra6 and Ultra4 function is based on the well-established acoustic transit time principle. The measurement principle utilizes the fact that the direction and propagation velocity of an ultrasonic pulse will be modified by the flowing medium. An ultrasonic pulse propagating with the flow will experience an increase in velocity while an ultrasonic pulse propagating against the flow will experience a decrease in velocity. Turbulence and noise generated frequencies are filtered.

The Ultra6 and Ultra4 measure the transit time of the ultrasonic signal that is transmitted. The start of the transmission and arrival of the correct signal is detected by the software.

The Ultra6 and Ultra4 transducers are non-intrusive and flush mounted ensuring minimum risk of clogging by residues in the flow. The transducer is fully encapsulated and the transducer housing is manufactured in titanium.

Ultra6 and Ultra4 Features

- **Custody Transfer Accuracy –** The Ultra6 and Ultra4 combine the latest in ultrasonic design, sensitivity analysis, integration methods and signal processing optimization to deliver accurate custody transfer measurement.
- **Measurement Stability –** The Ultra6 unique 6 path configuration and integration algorithms give superior flow profile correction and compensation for swirl and cross-flow over a wide range of operating conditions.
- **Field Proven Electronics –** The Ultra6 and Ultra4 utilize Smith Meter's decades of proven know-how in ultrasonic measurement and microprocessor-based instrumentation for harsh outside petroleum applications.
- **Excellent Noise Immunity –** The Ultra6 and Ultra4 are able to tolerate substantially higher ultrasonic noise levels than most other ultrasonic meters – up to 20 times less sensitive to outside interference.
- **Real-Time Diagnostics –** WinScreen software provides real-time logs, trends, signal performance and parameter reports for operational, diagnostics and maintenance purposes. The user-friendly, Windows-based program displays meter information, including flow regime visualization, on one screen.
- **In-line Transducer Replacement –** The Ultra6 and Ultra4 transducer housings are separate from the transducers, allowing the transducers to be changes without special tooling and without shutting down the process.
- **Automatic Compensation for Path Loss –** In the unlikely event that a transducer should fail, the Ultra6 and Ultra4 can be programmed to automatically compensate for the loss in path information with reduced accuracy in addition to advising the operator than an alarm is present.
- **Reciprocity –** Optimum transducer and electronics design ensures full reciprocity and zero influences on linearity, independent of pressure, temperature and transducer aging.

Applications

Measurement of hydrocarbon liquids for:

- Custody Transfer
- Allocation
- Leak Detection
- Inventory Control
- Off-loading and On-loading

Specifications

See Specification Bulletins SSLS001 and SSLS002

Ultra⁶/Ultra⁴ Architecture

The Ultra⁶ and Ultra⁴ liquid flowmeters consists of the following components:

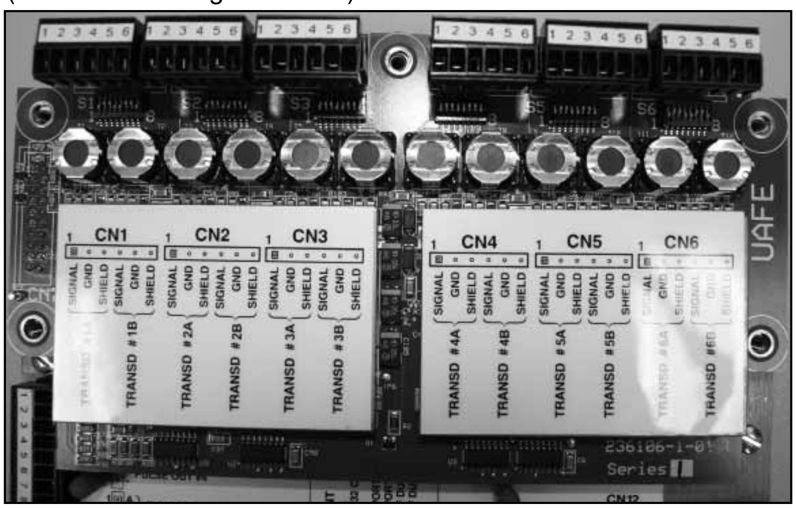
- Meter Body
- (12)/(8) Transducers
- (12)/(8) Transducer Adapters
- (12)/(8) Conduit Unions
- (12)/(8) M.I. (Mineral Insulated) Cables
- Electronics Assembly consisting of:
  - – Electronics Enclosure
  - – UACF (Ultrasonic AC Filter) Board
  - – UAFE (Ultrasonic Analog Front End) Board
  - – UDSP (Ultrasonic Digital Signal Processing) Board

Ultra⁶/Ultra⁴ New Style Architecture

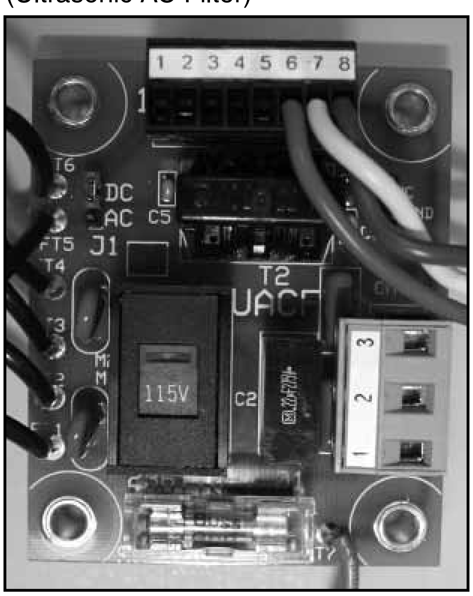
The Ultra⁶ and Ultra⁴ liquid flowmeters consists of the following components:

- Meter Body
- (12)/(8) Transducers
- (12)/(8) Transducer Mounts
- (12)/(8) Thread Adapter
- (2) Cable Manifolds
- Electronics Assembly consisting of:
  - – Electronics Enclosure
  - – UACF (Ultrasonic AC Filter) Board
  - – UAFE (Ultrasonic Analog Front End) Board
  - – UDSP (Ultrasonic Digital Signal Processing) Board

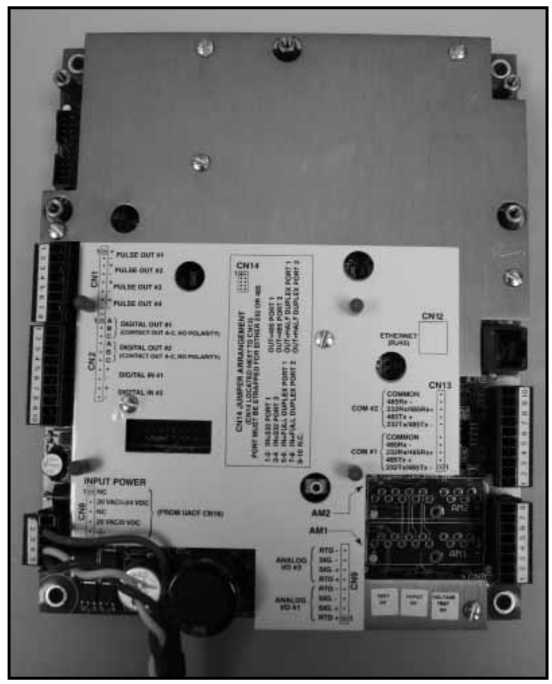
UAFE
(Ultrasonic Analog Front End)



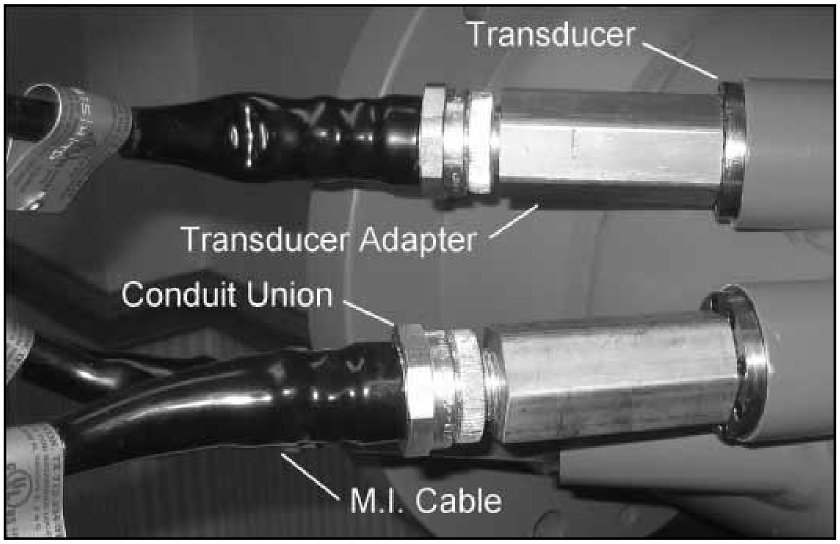
UACF
(Ultrasonic AC Filter)

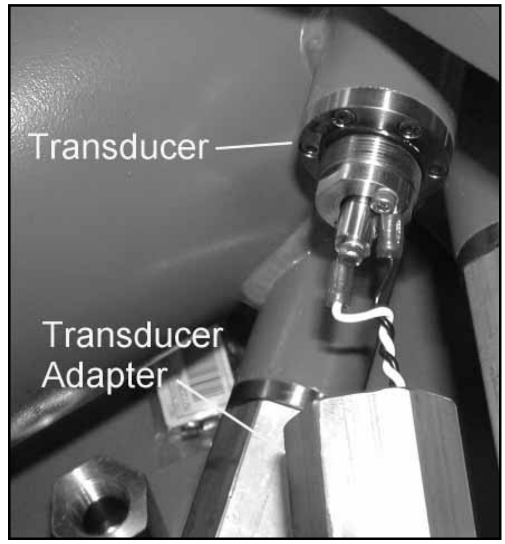


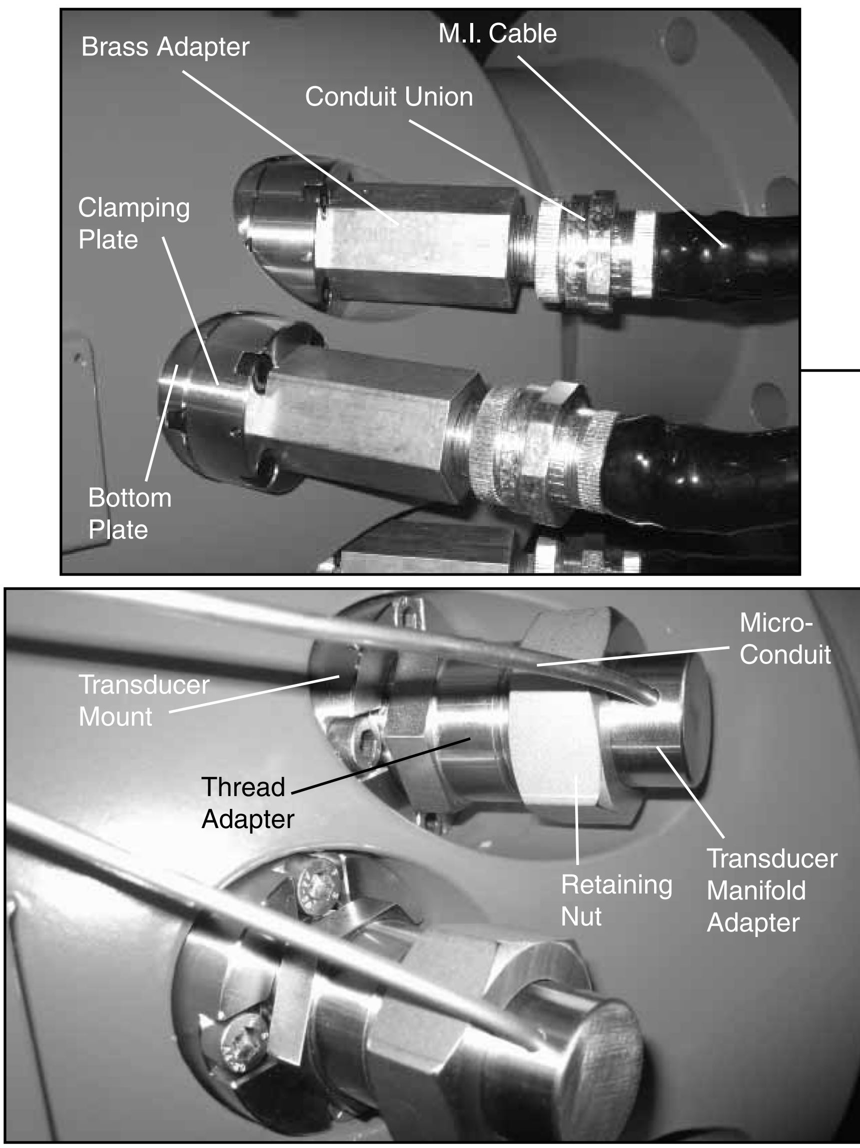
UDSP
(Ultrasonic Digital Signal Processor)



(Older Style – Welded Housing)







(Newer Style – Forged Housing)

Receipt of Equipment

When the equipment is received, the outside packing case should be checked immediately for any shipping damage. If the packing case has been damaged, the local carrier should be notified at once regarding his liability. Carefully remove the unit from its packing case and inspect for damaged or missing parts.

If damage has occurred during shipment or parts are missing, a written report should be submitted to the Customer Service department by using the contact information at the beginning of this manual.

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

Pre-Installation Inspection

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

The Ultra^6 and Ultra^4 are precise measuring instruments and should be treated as such. Install the unit carefully. When transporting the meter, make certain it is not subjected to any severe shock as electronic components may be damaged. Cover flange openings to protect the internal diameter of the meter body. Lift the meter only by the lifting eyes located on each flange. DO NOT lift or move the meter by way of the cabling or conduit system. DO NOT lift or move the meter by inserting a forklift tine into the internal diameter of the meter.

Mechanical Installation

General

Warning: Care must be taken in the installation of the Ultra^6 and Ultra^4. The installer must comply with all national, regional and local codes.

Installation of the Ultra^6 and Ultra^4 should follow good piping practices, such as alignment of the pipe center lines. Align the piping and mating flanges before installing the meter. A temporary, straight pipe spool can be used to align the process piping prior to meter installation. Piping connections must be properly aligned to minimize compressive, tensile or torsional stresses placed on the meter. Do not use the meter to align the piping. Select gasket, bolt and nut materials that are compatible with the application environment. Comply with appropriate bolting torque specifications. Pipe supports should be installed to provide sufficient support of the process piping upstream and downstream of the meter, in accordance with good piping practices.

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

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

Strainer

Although the Ultra^6 and Ultra^4 do not have any moving parts and is non-intrusive to the flow stream, it is advisable to install a strainer upstream of the meter to protect not only the meter but also other components such as the flow conditioner and flow control valve. For most pipeline installations, a 4 mesh basket will provide adequate protection.

Flow Conditioner

The Ultra^6 automatically compensates for velocity profile, swirl and cross-flow. It is, however, still susceptible to systematic abnormalities due to installation effects and the resultant changes in flow profile.

To minimize the effects of these profile abnormalities, it is recommend that both the Ultra^6 and Ultra^4 be installed with either 20 diameters of straight pipe or 10 diameters of straight pipe with a high performance flow conditioner (HPFC) upstream of the meter. (See Bulletin SS02018 for additional information.) It is also recommended that there be a minimum of 5 diameters of straight pipe directly downstream of the Ultra^6 and Ultra^4.

The Smith Meter HPFC and the Ultra^6 and Ultra^4 are doweled to provide precise and repeatable alignment. If the dowels are removed after installation, the holes should be packed with grease to prevent corrosion.

Electrical Installation

General

The Ultra^6 and Ultra^4 electronics are mounted in a Flame Proof (Explosion Proof) enclosure which is then mounted on top of the Ultra^6 and Ultra^4 housing. Transducers are then wired into the electronics enclosure by means of cabling system. The Ultra^6 and Ultra^4 electronics perform all signal processing and calculations and outputs the indicated flow rate to a flow computer via a square wave pulse output. Modbus or TCP/IP Ethernet communications can also be used to communicate flow rate as well as historical data and diagnostic information to other ancillary systems such as a P.C. or a PLC system.

The cable, conduit and conduit fittings must meet installation requirements, such as hazardous area classifications, humidity, temperature, voltage, current and others. All conduit connections must be installed with approved conduit seals installed within the required distance per the applicable electrical code(s).

If the Ultra^6 and Ultra^4 are **NOT** connected to a flow computer using Ethernet or Serial Communications then FMC strongly recommends that either an Ethernet or Serial RS-485 cable is connected to the meter and is fed into the closest control room. The cable does not need to be connected to any device but be available there for connection by any Weights & Measures official. This way there will be no need to open up the Ultra^6 and Ultra^4 electronics in the field for verification of all the metrological parameters.

For ATEX & IEC Ex Installations:

For systems utilizing cable glands the cable entry must be in accordance to IEC 60079-1 section 13.1. The gland and / or thread adapter must be or Ex ‘d’ certified. The cable end must be securely installed and, depending on the cable type, be properly protected from mechanical damage.

For systems utilizing rigid conduit the conduit entry must be in accordance to EN 50018:2000 sections 13.2 / IEC 60079-1 section 13.1, an Ex certified stopping box (sealing device) must be used immediately at the entrance of the enclosure. (i.e.: within 50 mm)

Any unused entry must be suitably blocked with an Ex certified plug.

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

Alternately, the J-Box Manifold Adaptor will provide a minimum 0.9245 in. (23.482 mm) O.D. for interface with an enclosure covered by ATEX Certificate DEMKO 12 ATEX 1204991X & IEC Ex UL 12.0025X with the following dimensions:

Maximum Diametrical Clearance = 0.003 in.

Minimum Length = 0.5 in.

This joint is held in place by use of a two Allen head cap screws, DIN 912-A4-70 or DIN 912-A2-70, inserted through the Retaining Flange and threaded into the flameproof enclosure. This joint will be factory made and the two ATEX certified products will always be shipped together.

Contact manufacturer at address listed for information on the dimensions of the flameproof joints.

For North American installations:

Conduit connections must be in accordance to:

USA – National Electric Code (NFPA 70)

Canada – Canadian Electric Code (CSA C22.1),

A listed seal off box must be used immediately at the entrance of the enclosure. (i.e.: within 3 inches)

Any unused entry must be suitably blocked with a suitable listed plug.

All installations notes:

Caution: To prevent ignition of hazardous atmospheres, disconnect form supply circuit before opening. Keep tightly closed when circuits are in operation.

Warning: Contains internal battery-powered circuit. To prevent ignition of hazardous atmospheres, do not open enclosure unless area is known to be non-hazardous.

Two-wire shielded, twisted pair cables (22 AWG or larger wire) are recommended for connections between the Ultra[6] and Ultra[4] outputs and any peripheral device. Maximum wire length for 22 AWG is 1000 feet (305 meters). The shield drain wire should be terminated to ground at the receiving device only.

Power Supply

The Ultra[6] and Ultra[4] are designed to be powered by 115 VAC, 230 VAC or 24 VDC. See specification sheets SSLS001 and SSLS002 for additional information.

The UACF board (mounted inside the electronics cover) must be configured to match the power input to the Ultra[6] and Ultra[4].

For AC Input power:

1. Set jumper J1 between pins 1 and 2 for AC input power
2. Select AC input voltage level (115 or 230 VAC) with switch SW1
3. Connect input power cable to connector CN15

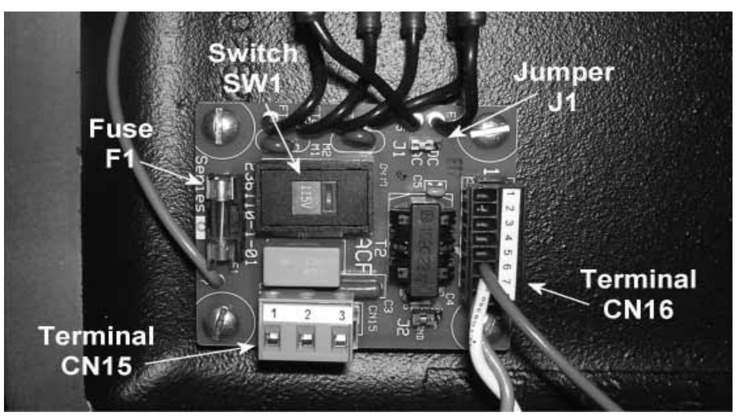
AC Input Wire	Terminal
L1	CN15-1
L2 / N	CN15-2
Earth Ground	CN15-3

For DC Input power:

1. Set jumper J1 between pins 2 and 3 for DC input power
2. Connect input power cable to connector CN16

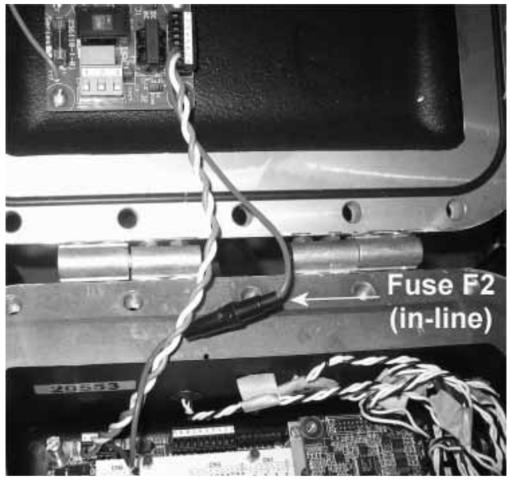
DC Input Wire	Terminal
24 VDC (+)	CN16-1
24 VDC (-)	CN16-2

The Ultra[6] and Ultra[4] utilize two fuses for power protection. The first fuse is located on the UACF board and is labeled fuse F1. This fuse is only active when the Ultra[6] and Ultra[4] are being supplied AC power. Fuse F1 is a time-delay fuse rated for 200 mA at 250 VAC.



The second fuse, F2, is located in-line between the UACF and the UDSP board. This fuse provides protection during both AC and DC operation of the Ultra[6] and Ultra[4]. Fuse F2 is a time-delay fuse rated for 1A at 250 VAC.

Replacement fuses **must** be the same ratings in order to provide proper protection to the Ultra[6] and Ultra[4] electronics.



Input / Output Wiring

The Ultra[6] and Ultra[4] have the following inputs and outputs:

- Digital I/O
  - 2 Digital Inputs
  - 2 Digital Outputs
  - 4 Digital Pulse Outputs
- Analog I/O
  - 2 Analog I/O points – Configurable via modules as:
    4-20 mA Input
    4-20 mA Output
    1-5 VDC Input
    1-5 VDC Output
- Communications
  - 1 ANSI/IEEE 802.3 Ethernet port
  - 2 Selectable Ports
    EIA-232
    EIA-485
      Half-Duplex (2 wire)
      Full-Duplex (4 wire)

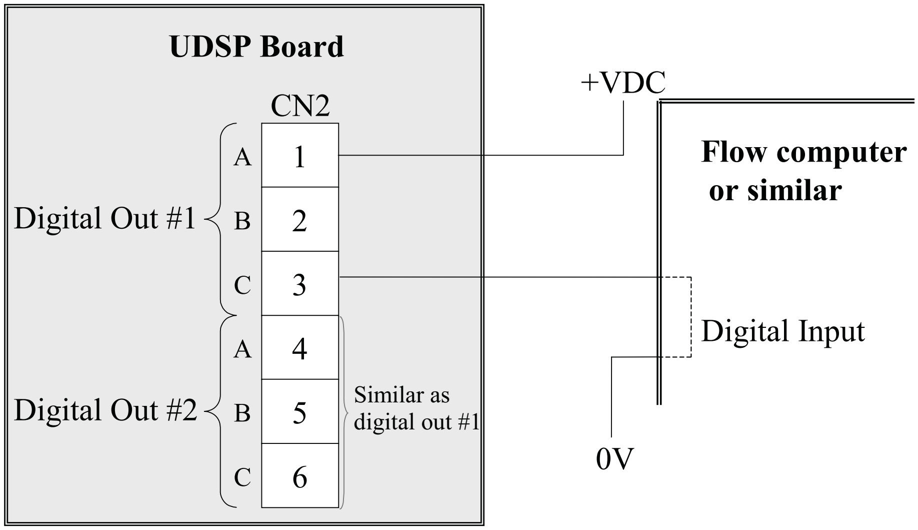
Note: *Reference specification sheets **SSLS001** and **SSLS002** for technical specifications of the I/O.*

Digital I / O

Connections for the digital I/O are made on the UDSP board using terminal CN2:

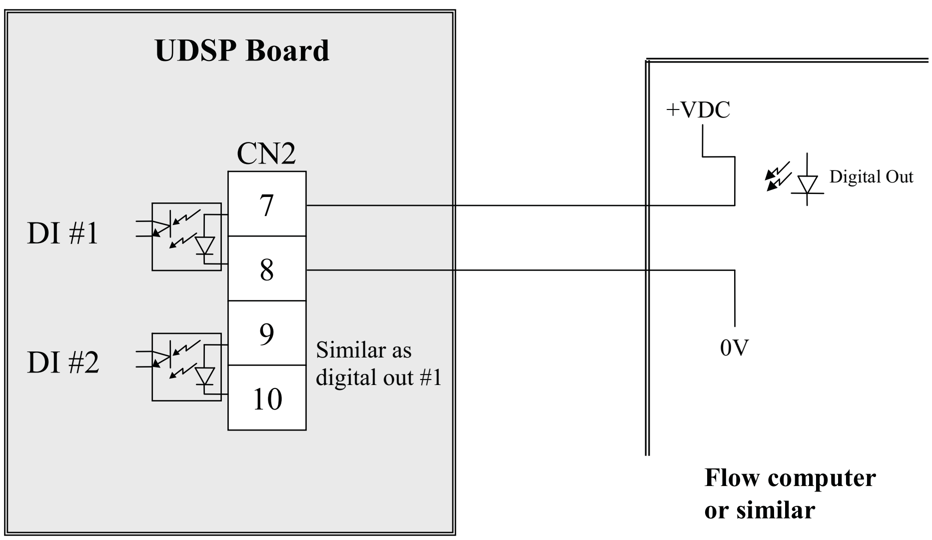
Digital I/O	Connection Point
Digital Out #1	CN2 – Terminal 1 – 3
Digital Out #2	CN2 – Terminal 4 – 6
Digital In #1	CN2 – Terminal 7 – 8
Digital In #2	CN2 – Terminal 9 – 10

Digital Ouputs



Digital outputs are optically isolated solid state relays that are normally open when power is removed from the meter.

Digital Inputs



Digital inputs are current limited and optically isolated.

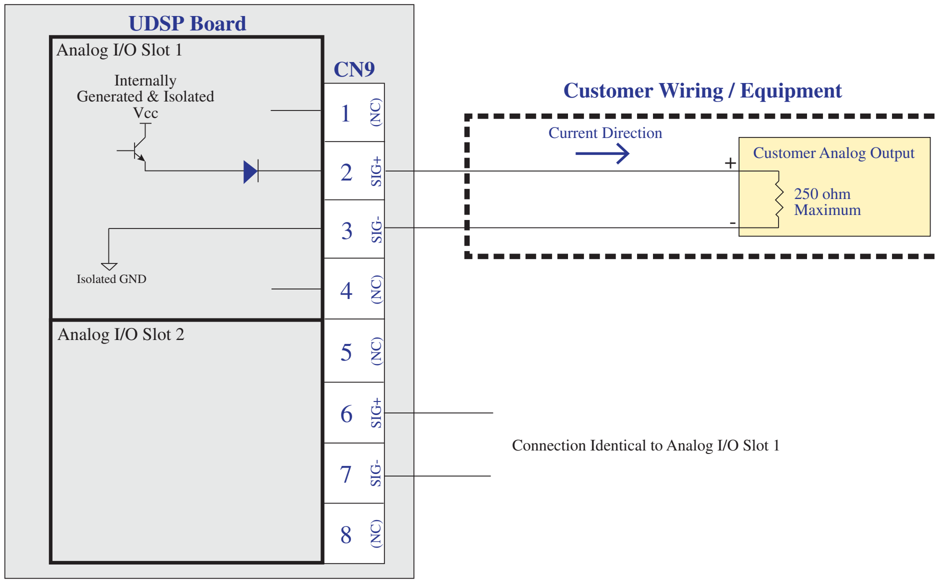
Analog I / O

Connections for the 2 Analog I/O modules are made on the UDSP board using terminal CN9:

Analog I/O	Connection Point
Analog I/O #1	CN9 – Terminal 1 – 4
Analog I/O #2	CN9 – Terminal 5 – 8

Analog modules are available in the configurations given above. Reference specification sheets **SSLS001** and **SSLS002**.

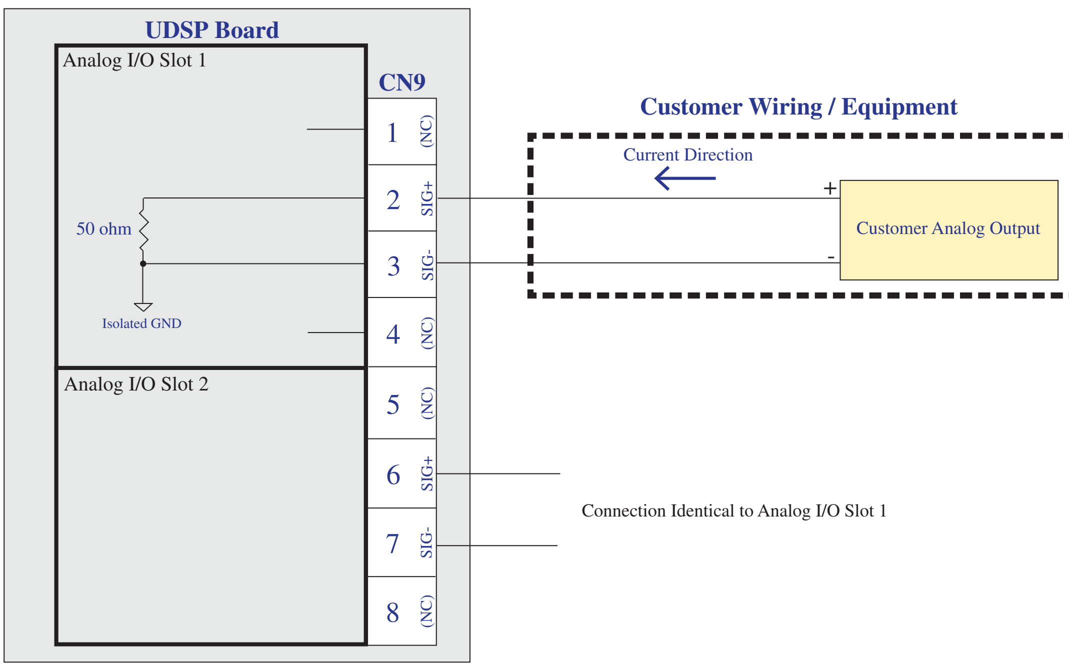
Current Output Module



Analog output module, type 4-20mA, must be mounted in the used slot.

Note: *The analog output module supplies current for the loop.*

Current Input Module



Analog input module, type 4-20mA, must be mounted in the used slot.

Note: *Customer Analog Output must supply power for the current loop.*

Communications

The 10/100 base-T Ethernet connection is made using socket CN12.

Connections for the 2 configurable communications ports are made using terminal CN13:

Comm. Port	Connection Point
Comm. #1	CN13 – Terminal 1 – 5
Comm. #2	CN13 – Terminal 1 – 10

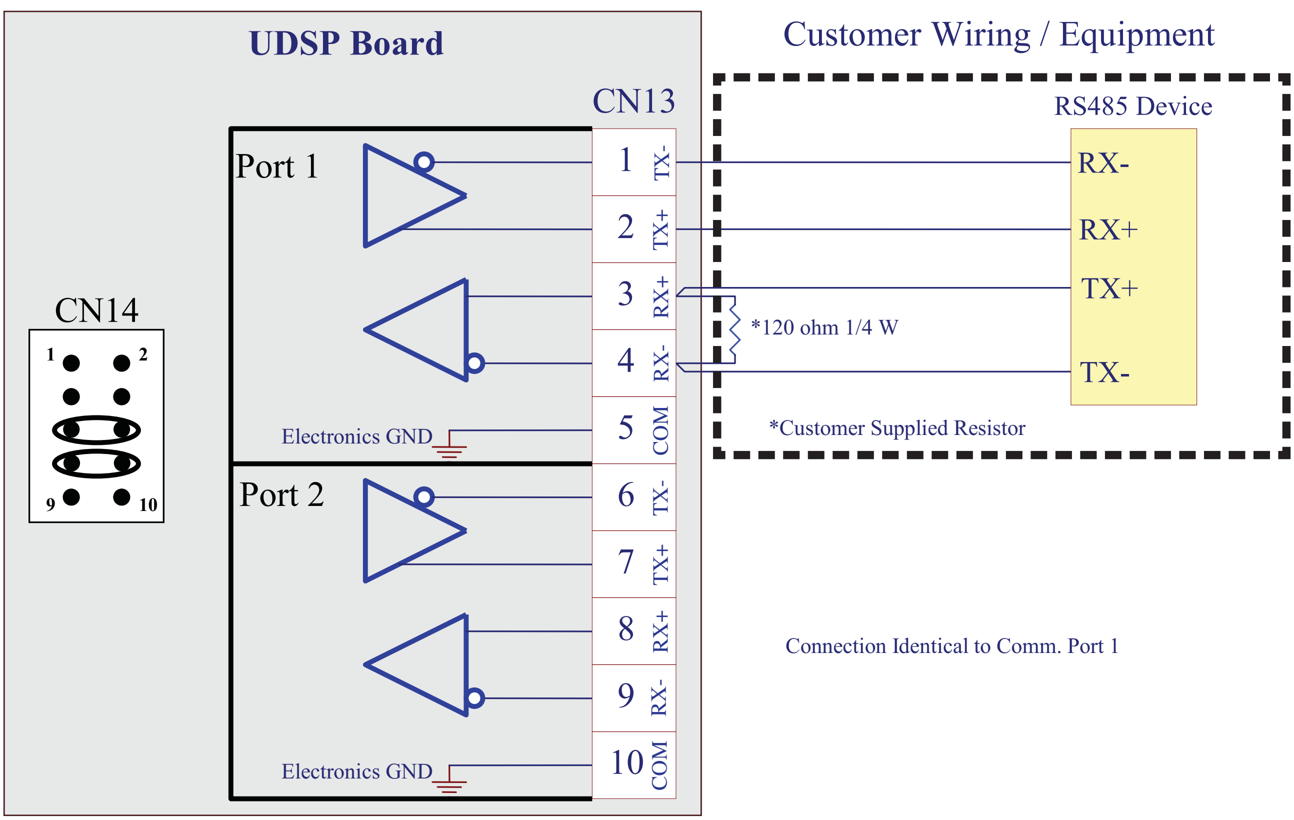
The two RS232/485 communication ports must be configured in software via WinScreen **AND** in hardware using jumper CN14 located next to terminal CN13 per the following table:

CN14 JUMPER ARRANGEMENT
(CN14 LOCATED NEXT TO CN13
PORT MUST BE STRAPPED FOR EITHER 232 OR 485

CN14

1-2	IN=232 PORT 1	OUT=485 PORT 1
3-4	IN=232 PORT 2	OUT=485 PORT 2
5-6	IN=FULL DUPLEX PORT 1	OUT=HALF DUPLEX PORT 1
7-8	IN=FULL DUPLEX PORT 2	OUT=HALF DUPLEX PORT 2
9-10	N.C.	

RS485 Full Duplex



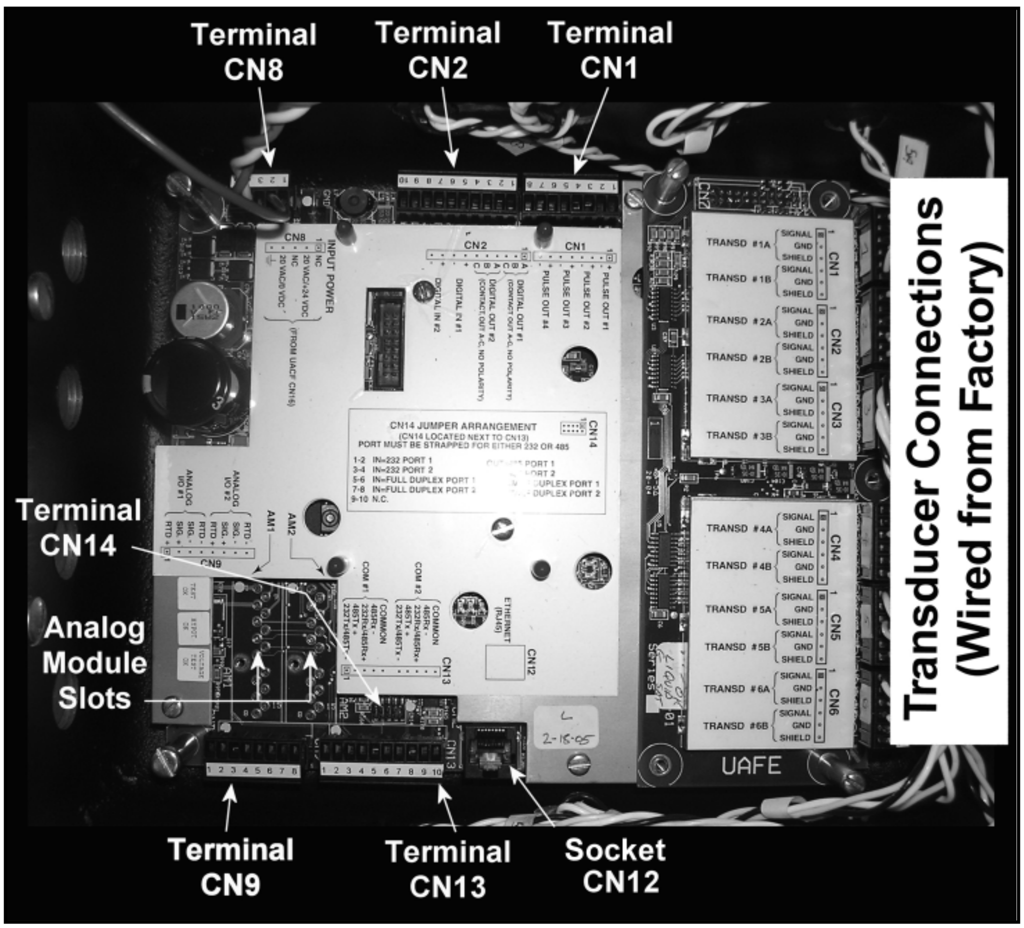
Pulse Output

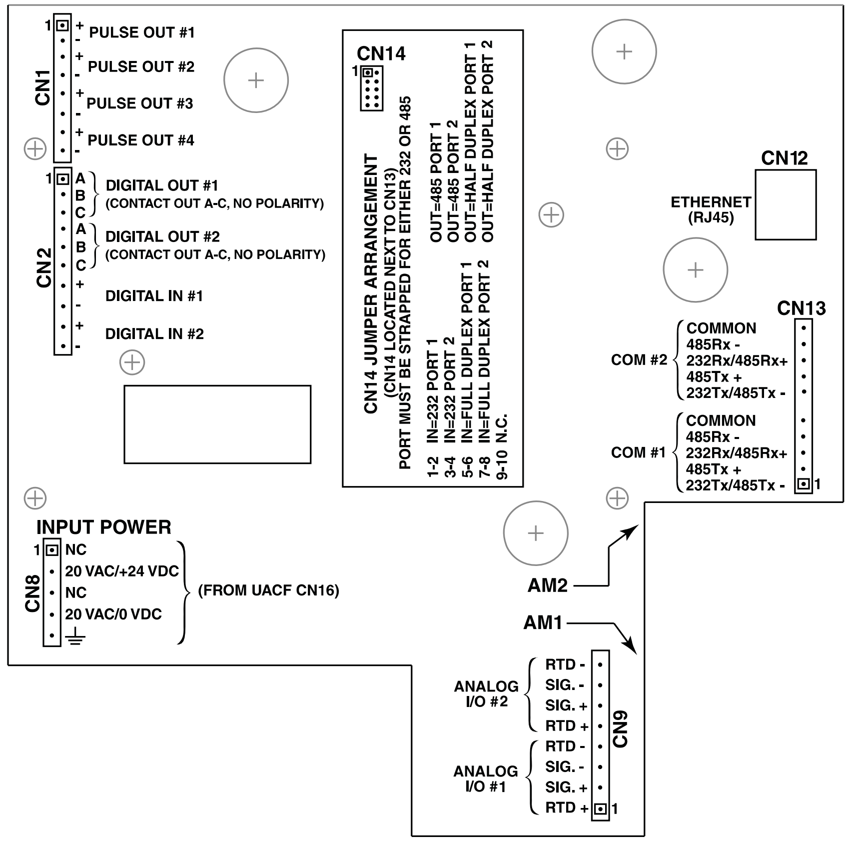
The pulse output connections are made using terminal CN1 as follows:

Pulse Output	Connection Point
Pulse Out #1	CN1 – Terminal 1 – 2
Pulse Out #2	CN1 – Terminal 3 – 4
Pulse Out #3	CN1 – Terminal 5 – 6 (Reverse Flow)
Pulse Out #4	CN1 – Terminal 7 – 8 (Reverse Flow)

The pulse output is an open collector type output and thus will require a “pull-up” resistor in order to function properly unless the receiving instrument has a current-limiting resistor built in as in the case of the Smith Meter® microFlow.net™. The resistor must be sized appropriately to limit current to 10 mA through the output circuit.

The location of the connection points for the above mentioned input / output is shown on the following photo:




CN1
PULSE OUT #1
PULSE OUT #2
PULSE OUT #3
PULSE OUT #4
CN2
DIGITAL OUT #1
(CONTACT OUT A-C, NO POLARITY)
DIGITAL OUT #2
(CONTACT OUT A-C, NO POLARITY)
DIGITAL IN #1
DIGITAL IN #2
CN14
CN14 JUMPER ARRANGEMENT
(CN14 LOCATED NEXT TO CN13)
PORT MUST BE STRAPPED FOR EITHER 232 OR 485
1-2 IN=232 PORT 1 OUT=485 PORT 1
3-4 IN=232 PORT 2 OUT=485 PORT 2
5-6 IN=FULL DUPLEX PORT 1 OUT=HALF DUPLEX PORT 1
7-8 IN=FULL DUPLEX PORT 2 OUT=HALF DUPLEX PORT 2
9-10 N.C.
CN12
ETHERNET
(RJ45)
CN13
COM #2
COMMON
485Rx -
232Rx/485Rx+
485Tx +
232Tx/485Tx -
COM #1
COMMON
485Rx -
232Rx/485Rx+
485Tx +
232Tx/485Tx -
INPUT POWER
CN8
NC
20 VAC/+24 VDC
NC
20 VAC/0 VDC
(FROM UACF CN16)
AM2
AM1
ANALOG I/O #2
ANALOG I/O #1
RTD -
SIG. -
SIG. +
RTD +
CN9

Meter Start-up

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

- Meter has been properly installed in the piping and all connections are free from leaks.
- Power settings (voltage switch SW1 and/or jumper J1) have been set properly.
- Input / Output connections have been checked for proper wiring and connection integrity.
- All conduit and/or gland connections are in adherence to applicable electrical codes.

When power is applied to the Ultra^6 and Ultra^4, they will go through a boot sequence and will then begin measurement automatically. This process takes approximately 30 seconds. If flow is present, the pulse output will begin and the associated flow computer should begin totalizing.

If power is interrupted for a period of less than 20 ms during operation, the meter will continue operating with no loss of measurement. If power is lost for more than 100 ms during operation, the Ultra^6 and Ultra^4 will go through an orderly shutdown with no loss of historical data. Once power is re-supplied, the Ultra^6 and Ultra^4 will go through the power-on boot sequence and will resume measurement.

Winscreen Interface

Before commissioning the meter, the Winscreen PC program will be required to be installed on a PC and communications established between the PC and the meter to verify all relevant parameters.

The Ultra^6 and Ultra^4 will be supplied from the factory with an initial program in place. A CD will also be supplied containing a copy of the meter's initial parameter database, raw signal logs and a copy of the Winscreen interface program.

Winscreen is the primary tool to interface with the meter to program the Ultra^6 and Ultra^4, view real-time run data, view historical information, troubleshoot the meter and gather trendlog data.

Refer to Winscreen manual **MN0A001** for detailed information on tasks completed using Winscreen as the interface to the Ultra^6 and Ultra^4.

Verification and Proving

The Ultra^6 and Ultra^4 will be flow tested at the manufacturer's location on a standard hydrocarbon fluid to verify correct performance before being delivered. Upon request a calibration at a third party facility can also be performed.

The performance criteria used will be the +/-0,027% uncertainty requirement as described in API MPMS Chapter 5.8.

There are two general ways of calibrating or proving liquid ultrasonic meters – in a lab or on site in the field. As per API MPMS Chapter 5.8 FMC recommends on-site proving.

If lab proving is chosen the Ultra^6 and Ultra^4 should be re-calibrated at least every 5 years or if the meter diagnostics suggests something is wrong and major components are replaced. By major components is meant 4 or more transducers or the spool piece. 3 or less transducers or any electronic board does not require a re-calibration.

If on site proving is chosen then the prover method should be chosen in accordance with API MPMS Chapter 5.8. Whether a prover is used or transfer proving is used with a master meter FMC recommend that a new proving should be performed whenever the fluid thru the meter is changed.

Note: *An updated copy of the meter database should always be kept on file in the event the Ultra[6] or Ultra[4] would need to be re-programmed after maintenance has been performed. Refer to Winscreen manual **MN0A001** for detailed information.*

Since the Ultra[6] and Ultra[4] have no moving parts and is non-intrusive to the flow stream maintenance requirements are minimal.

As long as the meter is in operation, major faults can be revealed by proving the meter or utilizing a user supplied PC loaded with the Winscreen monitoring program connected to the communications port of the Ultra[6] and Ultra[4].

Note: *It is recommended that a PC loaded with Winscreen is available during meter operations.*

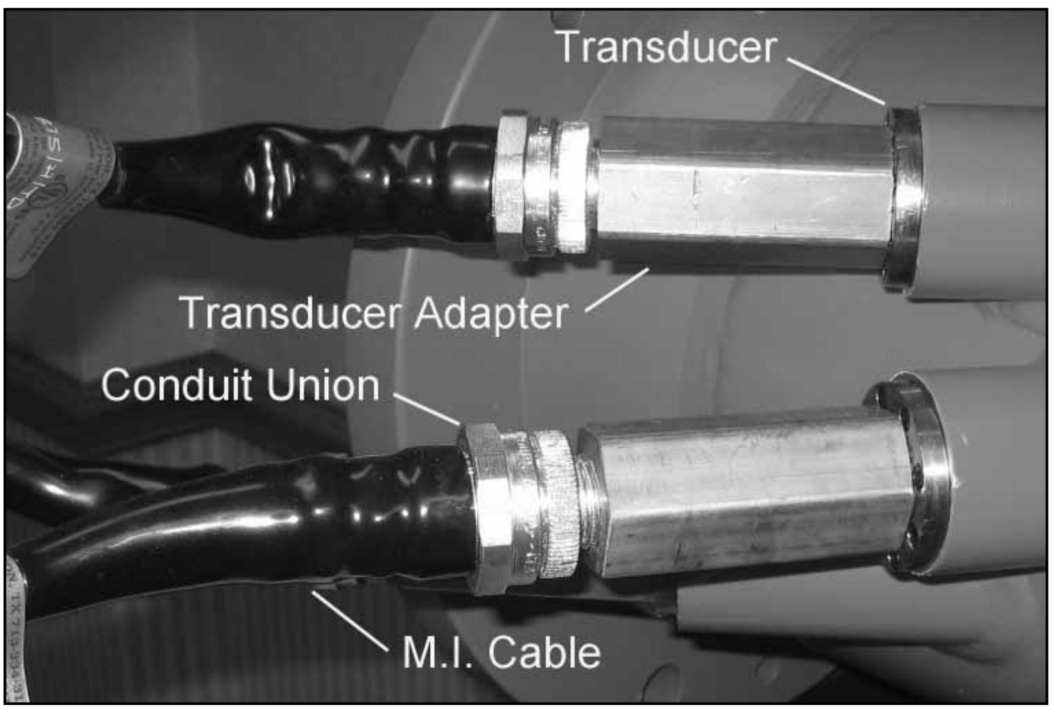
Before beginning any maintenance procedure, the diagnostic tools in Winscreen should be used to properly diagnose the failure.

Transducer Replacement – Inner Transducer

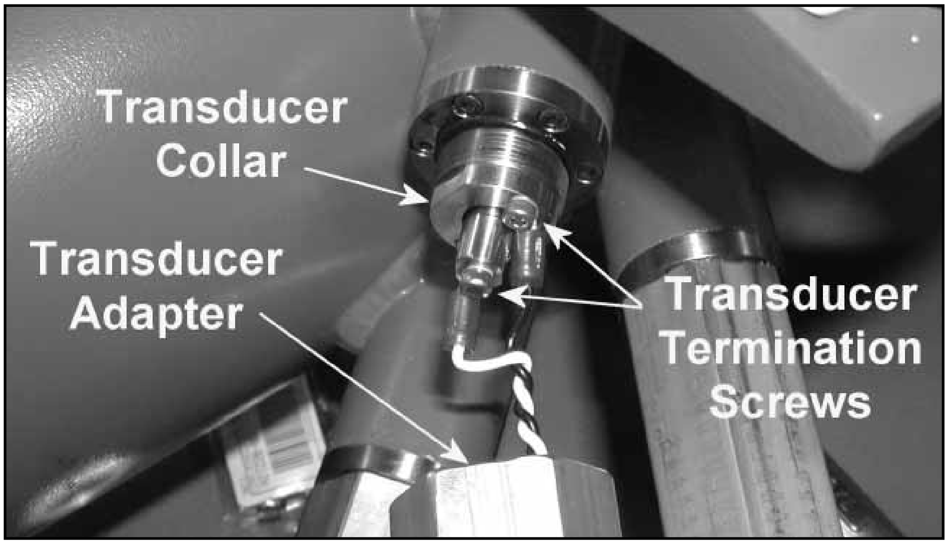
In the unlikely event that a transducer should experience a failure, the inner transducer assembly may be removed and replaced without stopping the process flow and removing the meter from the piping. The meter must be powered off during the inner transducer replacement process.

To change the inner transducer (welded on nozzle style), follow the following steps:

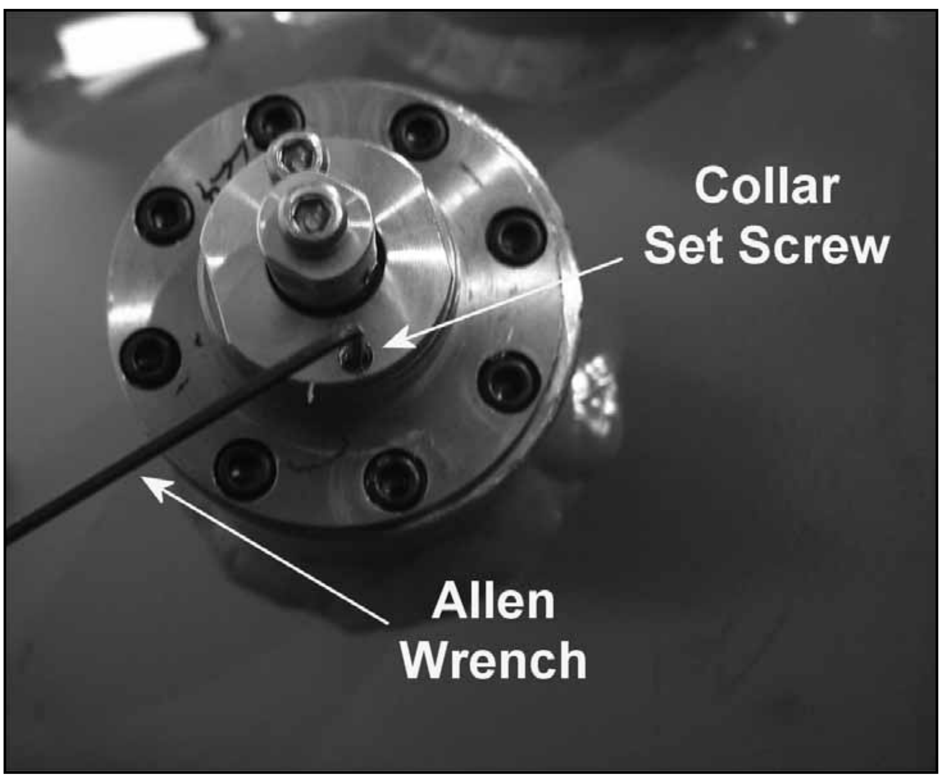
1. Separate conduit union to expose the conduit wiring leads.



2. Remove brass transducer adapter to expose transducer termination screws.

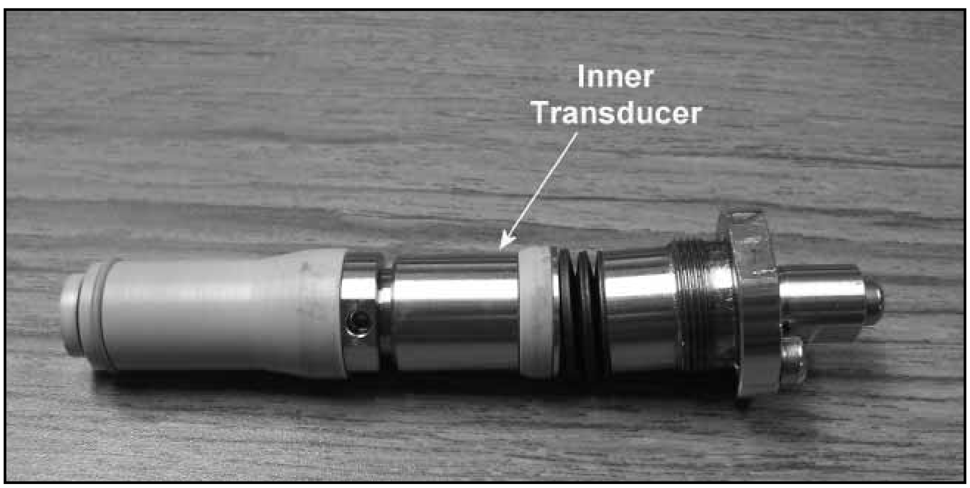


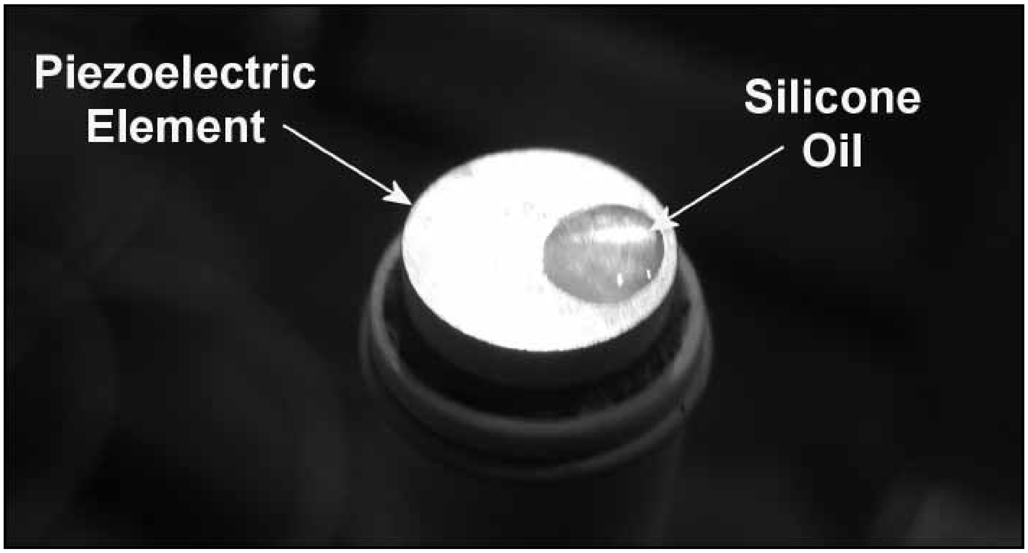
3. Remove the transducer termination screws noting that the white wire is attached to the transducer center electrode and the black wire is attached to the transducer collar which is the case ground.



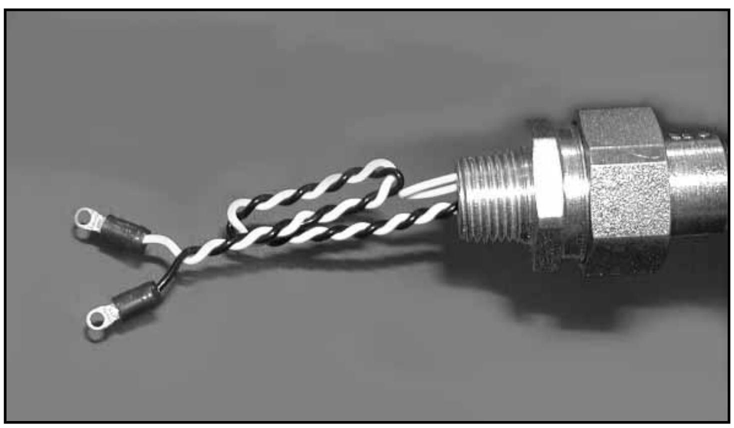
4. Loosen the set screw on the transducer collar.

5. Using a small wrench, hold the center electrode stationary while loosening the transducer collar.
6. Once the transducer collar is disengaged, slide the old inner transducer out of the transducer well and mark it as failed.





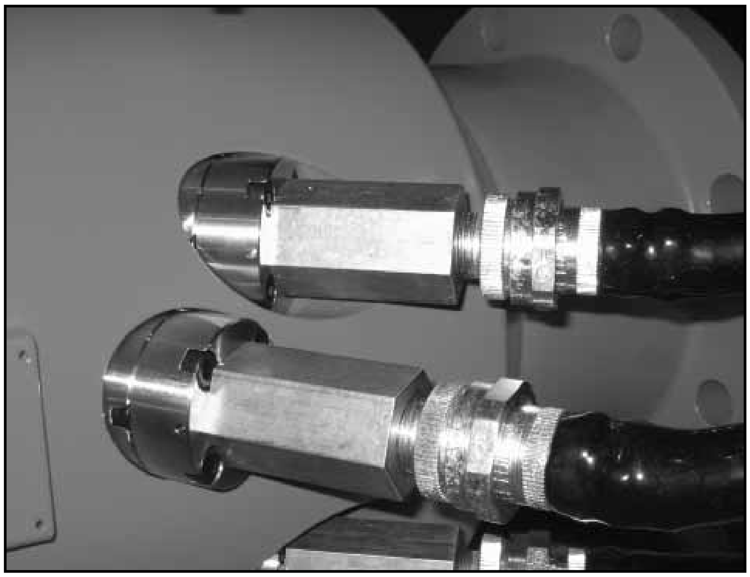
7. Apply a drop of pure silicone oil to the tip of the new inner transducer to ensure a good acoustic coupling between the piezo-electric crystal and the bottom of the transducer well.
8. Again using a small wrench, hold the center electrode stationary while tightening the transducer collar of the new inner transducer.
9. Tighten the set screw on the transducer collar.
10. Fold excess wiring as shown and insert through transducer adapter.



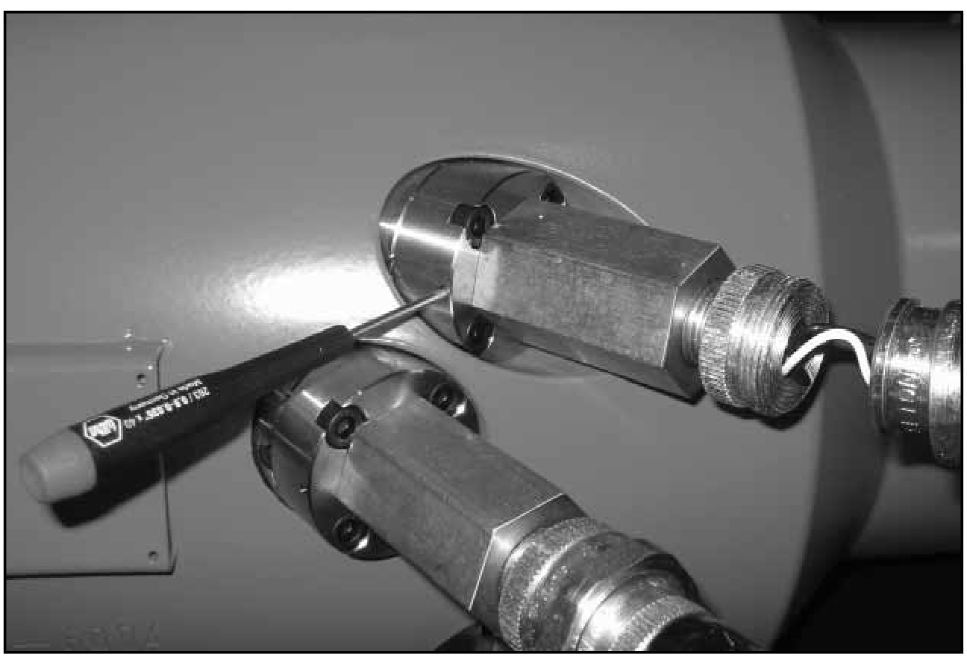
11. Re-attach the transducer wiring to the termination screws making sure that the white wire is attached to the center electrode and the black wire is attached to the transducer collar.
12. Re-install transducer adapter onto transducer external threads.
13. Re-connect and tighten conduit union making sure not to pinch the transducer wiring in the connection.

To change the inner transducer (with Bottom Plate and Clamping Plate), follow the following steps:

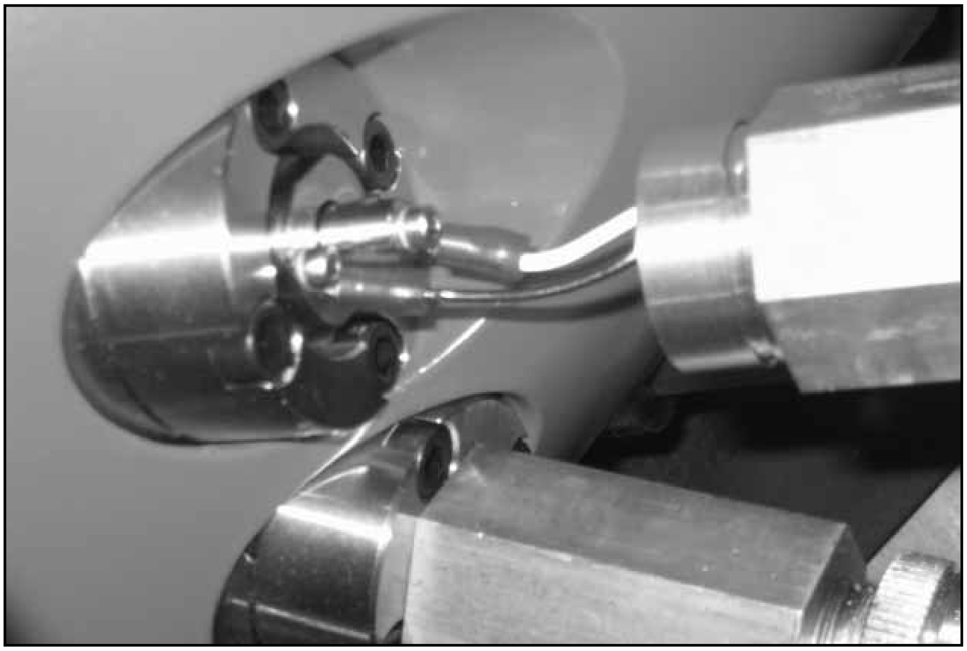
1. Separate conduit union to expose the conduit wiring lead.



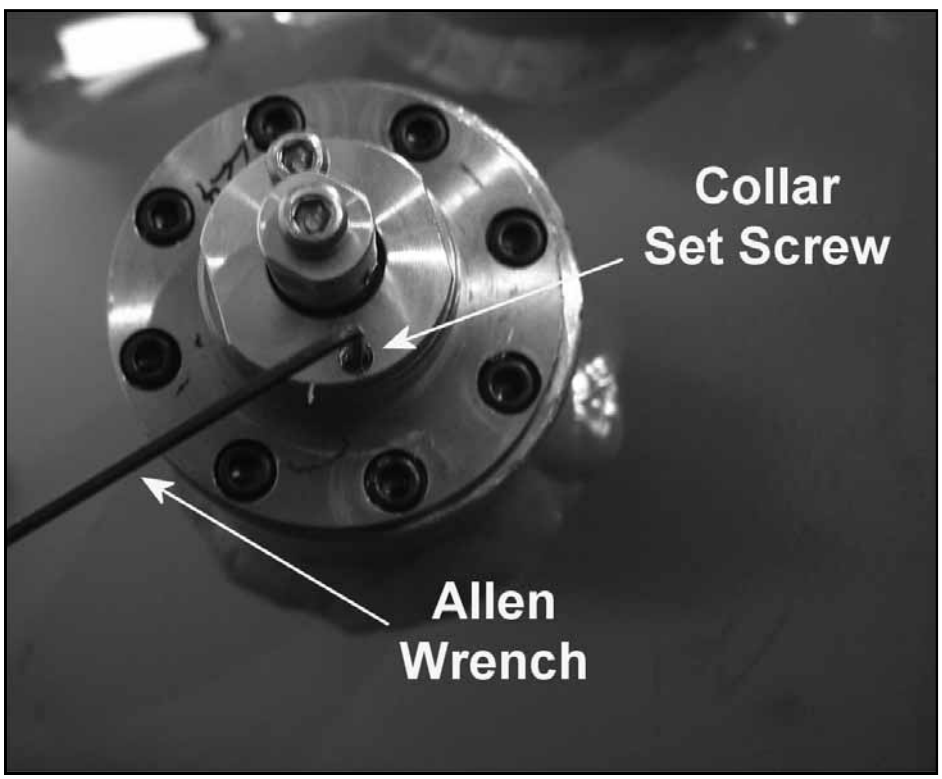
2. Remove the set screw.



3. Remove brass transducer adapter to expose transducer termination screws.



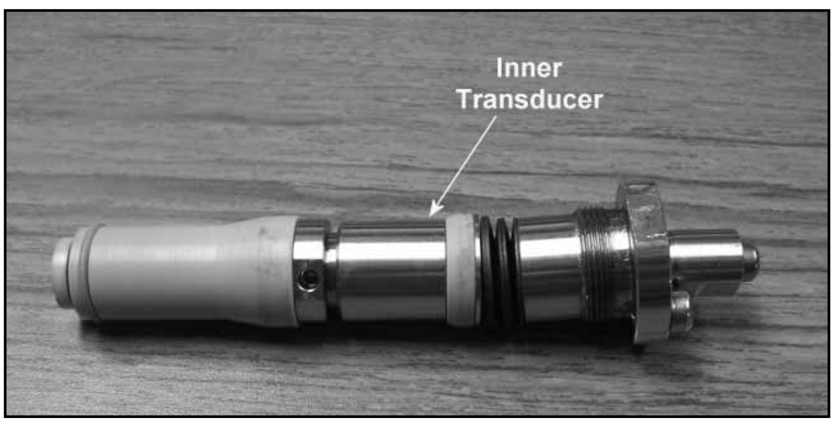
4. Remove the transducer termination screws noting that the white wire is attached to the transducer center electrode and the black wire is attached to the transducer collar which is the case ground.



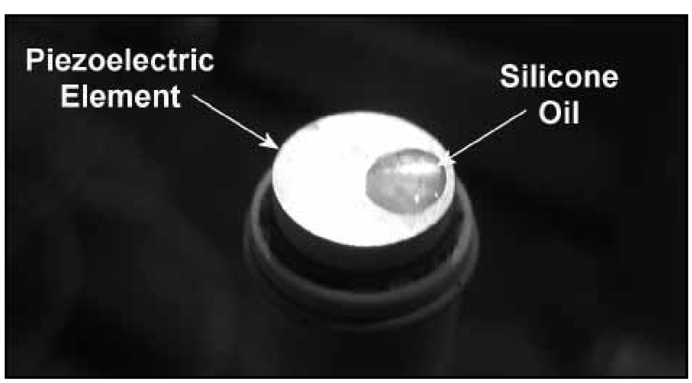
5. Loosen the set screw on the transducer collar.

6. Using a small wrench, hold the center electrode stationary while loosening the transducer collar.

7. Once the transducer collar is disengaged, slide the old inner transducer out of the transducer well and mark it as failed.



8. Apply a drop of pure silicone oil to the tip of the new inner transducer to ensure a good acoustic coupling between the piezo-electric crystal and the bottom of the transducer well.



10. Tighten the set screw on the transducer collar.

11. Fold excess wiring as shown and insert through transducer adapter.

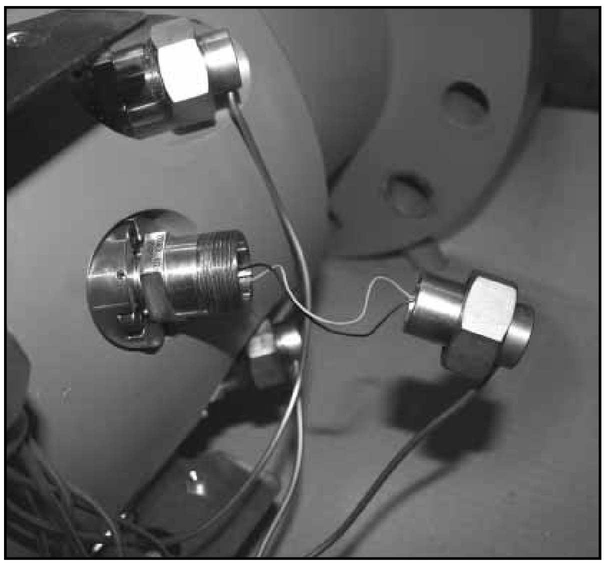
12. Re-attach the transducer wiring to the termination screws making sure that the white wire is attached to the center electrode and the black wire is attached to the transducer collar.

13. Re-install the transducer adapter onto the transducer external threads.

14. Re-connect and tighten conduit union making sure not to pinch the transducer wiring in the connection.

To change the inner transducer (with Thread adapter and cable manifold), follow the following steps:

1. Separate the retaining nut of the micro-conduit manifold to expose the wiring lead.



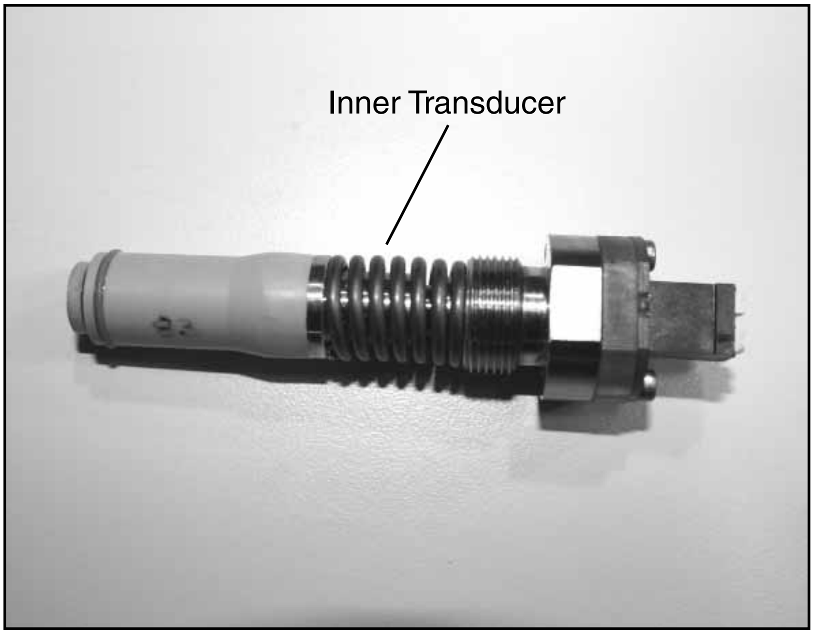
2. Compress the spring cage connector to release the wiring leads from the terminal block.

3. Remove the set screw (M2) which secures the thread adapter.

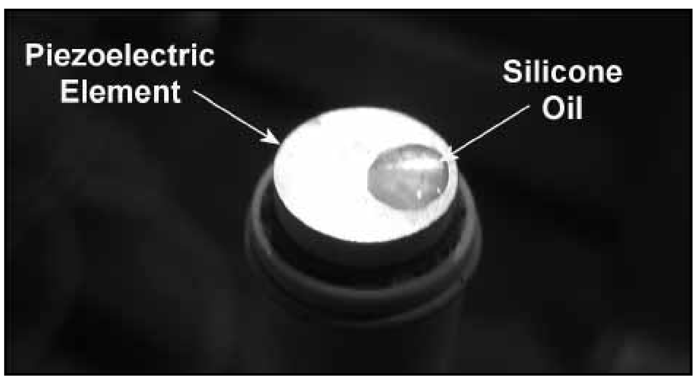
4. Using a deep well socket or wrench, remove the thread adapter.

5. Using a small wrench, loosen the transducer.

6. Once the transducer is disengaged, slide the old inner transducer out of the transducer well and mark it as failed.



7. Apply a drop of pure silicone oil to the tip of the new inner transducer to ensure a good acoustic coupling between the piezo-electric crystal and the bottom of the transducer well.



8. Again, using a small wrench, tighten the new inner transducer.

9. Re-attach the thread adapter to the transducer external threads.

10. Insert the set screw (M2) to secure the thread adapter.

11. Re-attach the wire leads by compressing the spring cage connector to allow for easy insertion of the wire leads. Make sure that the black wire is connected to the ground port and the colored wire is attached to the signal port.

12. Tuck excess wiring into transducer manifold adapter.

13. Re-attach the retaining nut to the thread adapter paying attention not to pinch any wires.

Transducer Replacement – Complete Transducer

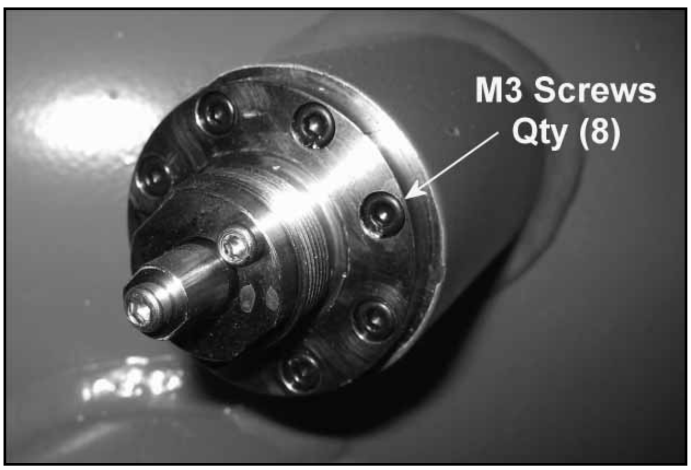
WARNING: If the outer transducer housing needs to be removed for any reason, the meter must be de-pressurized and drained of all product before proceeding.

If the complete transducer needs to be changed, flow must be stopped. The meter must be powered off during the entire procedure.

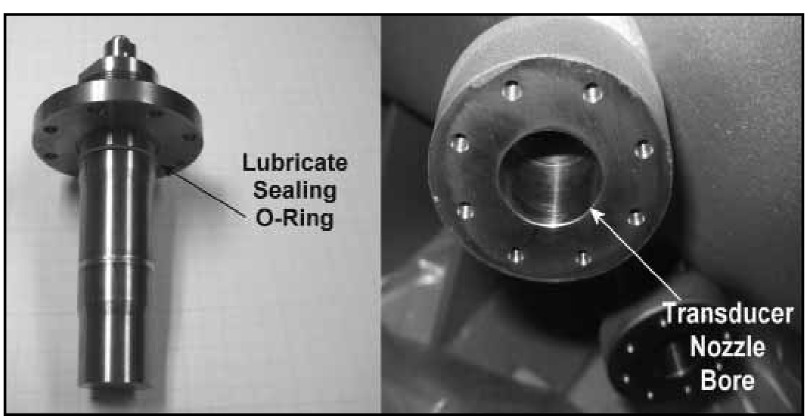
To change the complete transducer, follow the following steps:

1. Separate conduit union to expose the conduit wiring leads. (Reference procedure for inner transducer replacement)
2. Remove brass transducer adapter to expose transducer termination screws. (Reference procedure for inner-transducer replacement)
3. Remove the transducer termination screws noting that the white wire is attached to the transducer center electrode and the black wire is attached to the transducer collar which is the case ground. (Reference procedure for inner transducer replacement)

WARNING: The meter MUST be de-pressurized and drained of all product before proceeding with step #4.



4. Remove (8) M3 screws that secure the transducer into the meter body transducer nozzle.
5. Lubricate the sealing o-ring on the new transducer and the bore of the meter body transducer nozzle with petroleum jelly to ensure it is not damaged during assembly.



6. Install the new transducer into the meter body transducer nozzle and align the through holes in the transducer flange with the threaded holes in the nozzle.
7. Re-install (8) M3 screws to secure the transducer into the meter body.
8. Fold excess wiring and insert through transducer adapter. (Reference procedure for inner transducer replacement)
9. Re-attach the transducer wiring to the termination screws making sure that the white wire is attached to the center electrode and the black wire is attached to the transducer collar. (Reference procedure for inner transducer replacement)
10. Re-install transducer adapter onto transducer external threads. (Reference procedure for inner transducer replacement)
11. Re-connect and tighten conduit union making sure not to pinch the transducer wiring in the connection. (Reference procedure for inner transducer replacement)

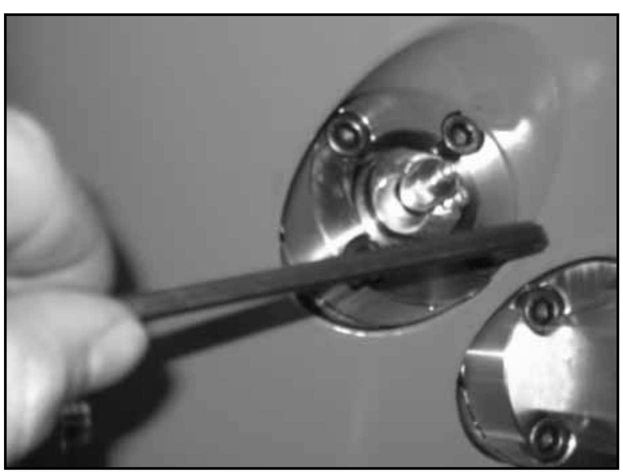
After the transducer has been replaced, the path length may need to be changed in the meter database through Winscreen. The actual path length can be calculated based on the face-to-face distance of the transducer nozzles and the flange-to-face length of the original and replacement transducers. The face-to-face distance of the transducer nozzles and the flange-to-face length of the original transducer will be included in the data packet originally supplied with the meter. The flange-to-face length of the replacement transducer will be included with the replacement transducer. For assistance, contact us at using the information given in section I of this manual. For additional details on changing parameters in the meter database, refer to Winscreen manual MN0A001.

WARNING: If the outer transducer housing needs to be removed for any reason, the meter must be de-pressurized and drained of all product before proceeding.

If the complete transducer needs to be changed, flow must be stopped. The meter must be powered off during the entire procedure.

To change the complete transducer (with Bottom Plate and Clamping Plate), follow the following steps:

1. Separate conduit union to expose the conduit wiring leads. (Reference procedure for inner transducer replacement)
2. Remove set screw. (Reference procedure for inner transducer replacement)
3. Remove brass transducer adapter to expose transducer termination screws. (Reference procedure for inner transducer replacement)
4. Remove the transducer termination screws noting that the white wire is attached to the transducer center electrode and black wire is attached to the transducer collar which is the case ground. (Reference procedure for inner transducer replacement)
5. Remove (4) M6 screws that secure the transducer in-between the bottom plate and the clamping plate.



6. Remove the transducer leaving the bottom plate attached to the meter. (Bottom plate can be removed at this time if replacement of o-ring is desired)
7. Lubricate the sealing o-ring on the new transducer and the bore of the bottom plate with an appropriate lubricate to ensure it is not damaged during assembly.

8. Install the new transducer into the bottom plate and align the (4) notches of the transducers with the threaded holes in the bottom plate.
9. Re-install the (4) M6 screws to secure the transducer into the bottom plate paying close attention to leave access to the set screw hole of the clamping plate.
10. Fold excess wiring and insert through transducer adapter. (Reference procedure for inner transducer replacement)
11. Re-install the set screw to secure the brass adapter.

After the transducer has been replaced, the path length may need to be changed in the meter database through Winscreen. The actual path length can be calculated based on the face-to-face distance of the transducer nozzles and the flange-to-face length of the original and replacement transducers. The face-to-face distance of the transducer nozzles and the flange-to-face length of the original transducer will be included in the data packet originally supplied with the meter. The flange-to-face length of the replacement transducer will be included with the replacement transducer. For assistance, contact us at using the information given in section I of this manual. For additional details on changing parameters in the meter database, refer to Winscreen manual MN0A001.

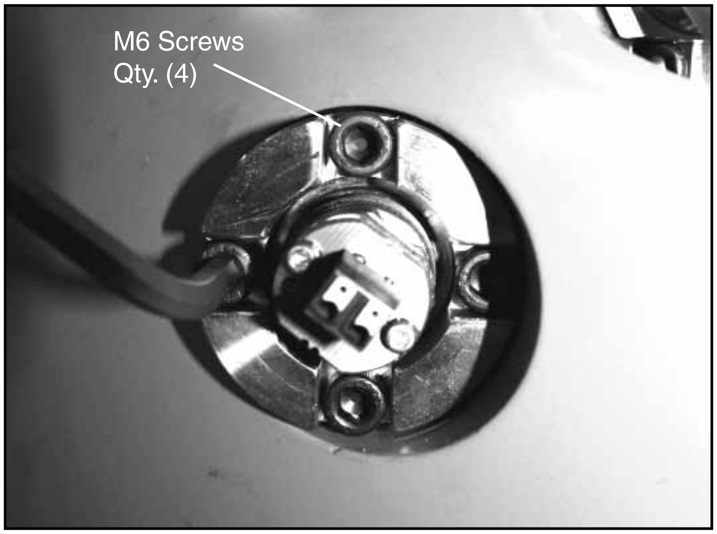
WARNING: If the outer transducer housing needs to be removed for any reason, the meter must be de-pressurized and drained of all product before proceeding.

If the complete transducer needs to be changed, flow must be stopped. The meter must be powered off during the entire procedure.

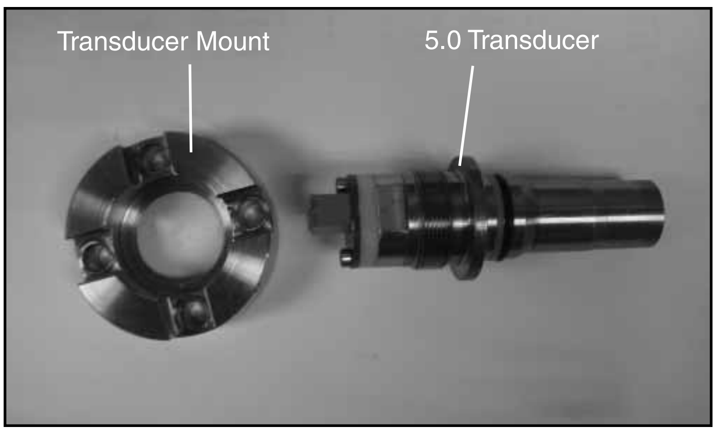
To change the complete transducer (with Thread Adapter and Cable Manifolds), follow the following steps:

1. Separate the retaining nut of the micro-conduit manifold to expose the wiring lead. (Reference procedure for inner transducer replacement)
2. Compress the spring cage connector to release the wiring leads from the terminal block. (Reference procedure for inner transducer replacement)
3. Remove set screw (M2X3) which secures the thread adapter. (Reference procedure for inner transducer replacement)

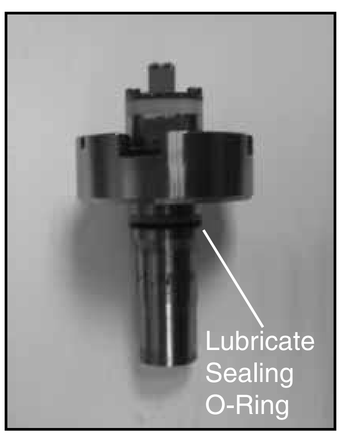
4. Using a deep well socket or wrench, remove the thread adapter. (Reference procedure for inner transducer replacement)
5. Remove (4) M6 screws that secure the transducer into the meter body.



6. Separate the transducer from the transducer mount.



7. Lubricate the sealing o-ring on the new transducer and the bore of the bottom plate with an appropriate lubricate to ensure it is not damaged during assembly.



8. Install the new transducer into the meter body transducer bore and align the through holes in the transducer mount with the threaded holes in the housing.
9. Re-install (4) M6 screws to secure the transducer into the meter body.
10. Re-attach the thread adapter to the transducer external threads.
11. Insert the set screw (M2X3) to secure the thread adapter.
12. Re-attach the wire leads by compressing the spring cage connector to allow for easy insertion of the wire leads. Make sure that the black wire is connected to the ground port and the colored wire is attached to the signal port.
13. Tuck excess wiring into transducer manifold adapter.
14. Re-attach the retaining nut to the thread adapter paying attention not to pinch any wires.

After the transducer has been replaced, the path length may need to be changed in the meter database through Winscreen. The actual path length can be calculated based on the face-to-face distance of the transducer nozzles and the flange-to-face length of the original and replacement transducers. The face-to-face distance of the transducer nozzles and the flange-to-face length of the original transducer will be included in the data packet originally supplied with the meter. The flange-to-face length of the replacement transducer will be included with the replacement transducer. For assistance, contact us at using the information given in section I of this manual. For additional details on changing parameters in the meter database, refer to Winscreen manual MN0A001.

Replacement of Electronic Boards

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

UAFE Board Replacement

The UAFE (Ultrasonic Analog Front End) board converts the digital ultrasonic signal to an analog signal that is carried to the sending transducer. The receiving transducer receives the signal which is then carried to the UAFE board and is converted back to a digital signal that is recognized by the on-board microprocessor.

To replace the UAFE board, follow these steps:

1. Remove the transducer connector hold-down bracket.
2. Remove the transducer cable connectors CN1 through CN6 for the Ultra^6; CN1 through CN4 for the Ultra^4.
3. Remove the (5) screws on the UAFE board with a screwdriver and gently pull the UAFE board out of the socket on the UDSP board.
4. Repeat this procedure in reverse order to install a new UAFE board.

Replacement of the UAFE board should be followed by a "zero" procedure to re-calculate the transducer delay times, which includes the processing time taken by the UAFE board. Refer to Winscreen manual MN0A001 for details on this process.

UDSP Board Replacement

The UDSP (Ultrasonic Digital Signal Processing) board is the heart of the Ultra^6 and Ultra^4 ultrasonic meters. The UDSP board measures the ultrasonic transit times, performs flow calculations, reads & writes the values into memory and enables communications.

To replace the UDSP board, follow these steps:

1. Remove the UAFE board as described above.
2. Remove all connectors plugged on to the UDSP board.
3. Remove the (4) screws on the UDSP board with a screwdriver and lift the UDSP board out of the electronics enclosure.
4. Repeat this procedure in reverse order to install a new UAFE board.

After replacement of the UDSP board, you must perform the following actions:

1. Configure UDSP board with correct IP network address.
2. Load current DSP and CP software files.
3. Load meter with saved meter database file. (If unavailable, meter must be re-programmed manually.)

Refer to Winscreen manual MN0A001 for details on these processes.

When downloading updated revisions of the software to the Ultra[6] and Ultra[4] meters, it must be ensured that the correct version is used for the application.

The file name contains the revision of the software and if it is an MID type or normal version.

If required by the local authorities having jurisdiction to be the MID type, the meter will be required to be protected with physicals seals and the internal hardware lock (Jumper).

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

When the hardware lock is open, the meter software can be uploaded (flashed) normally using the Winscreen PC Tool, however it should be noted that the meter will be inhibited from making legal measurements while in this condition.

The MID operating mode can be verified in the version block in the database.

Returned Goods Policy

A Return Material Authorization (RMA) number must be obtained prior to returning any equipment to FMC Technologies Measurement Solutions, Inc. for any reason. An RMA number can be obtained by contacting Customer Service via the information given in Section I of this manual.

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

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

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

* For Ultra^4, disregard objects for paths 5 and 6.

Version Information

Description	Winscreen Object #	Modbus Register	Unit SI	Unit US
UDSP Serial Number	250	500	–	–
Serial number of the UDSP board. This is the mainboard in the electronics containing all digital electronics.				
UAFE Serial Number	251	502	–	–
Serial number of the UAFE board. This is a piggy-backboard in the electronics containing the analog front end to the transducers.				
UACF Serial Number	252	504	–	–
Serial number of the UACF board. The power supply board in the electronics is placed under the lid of the box.				
CP Software version	253	506	–	–
Version number of the CP software on the board. The CP (Communication Processor) handles all communication and IO except pulse and digital I/O.				
CP Software date	254	508	–	–
The date the CP software was build.				
CP Software build no.	255	510	–	–
The build number of the CP software. This is a running number that is incremented by one for each build.				
CP Software check sum	256	512	–	–
The checksum is a unique number to simplify identification of software changes				
DSP Software version	257	514	–	–
Version number of the DSP software on the board. The DSP (Digital Signal Processor) does all the flow measurements.				
DSP Software type	258	516	–	–
This number is used to identify what type of software is running on the board. 1200=MPU1200, 600=MPU600, 200=MPU200, 11200=Ultra6, 10800=Ultra4				
DSP Software date	259	518	–	–
The date the DSP software was build.				
DSP Software build no.	260	520	–	–
The build number of the CP software. This is a running number that is incremented by one for each build.				
DSP Software check sum	261	522	–	–
The check sum is a unique number to simplify identification of software changes.				
AVR Software version	262	524	–	–
Version number of the AVR software on the board. The AVR handles pulse generation and digital I/O.				
AVR Software check sum	263	526	–	–
The check sum is unique number to simplify identification of software changes.				
MID Protection Mode	264	528	–	–
Identifies if MID protection mode is engaged.				
Hardware Lock	265	530	–	–
Identifies if the hardware jumper is locking the meter. Locked=Read only, Open=Read and Write possible.				
Database check sum	266	532	–	–
The check sum is a unique number to simplify identification of database changes.				
MAC Address	267	534	–	–
The unique MAC of the ethernet interface on the UDSP board.				
IP Address	268	536	–	–
The IP address of the meter. Identifies the meter in an TCP/IP network (normally via Ethernet). All clients (PC's) need to be in the same subnet as the meter.				
Subnet Mask	269	538	–	–
The subnet mask specifies the type of subnet. (Normal value is 255.255.255.0, class C network).				
Gateway Address	270	540	–	–
The gateway address specifies the address of the router in the network in case meter and clients are on different networks.				

Modes

Description	Winscreen Object #	Modbus Register	Unit SI	Unit US
Run Mode	700	1400	–	–
Nominal Value: Run, Selection: Config/Run				
Specifies the execution mode of the measurements. 0=Config Mode, No calculations are performed. Output of meter is zero. 1=Run mode (Default), Meter is running and measuring normally.				
Temp/Press compensation of diameter	701	1402	–	–
Nominal Value: Mode B, Selection: None/ModeA/ModeB				
Specifies type of P/T compensation of ID, Path length and Path angle. 0=None 1=Mode A, Tank model. 2=Mode B, Pipe model (Default).				
Disable Path	703	1406	–	–
Nominal Value: None				
Disables selected paths. No measurements will be performed on these paths.				
Enable manual values	704	1408	–	–
Nominal Value: Off				
Enables usage of manual values (600-657).				
Unit mode	705	1410	–	–
Nominal Value: Metric				
Selects between metric or imperial units. Warning! Should always be performed from the tools menu to also convert parameter values.				
Line Pressure Selector	706	1412	–	–
Nominal Value: Fallback, Selection: Fallback/Analog/Modbus				
Selects the source of the value (Fallback/Analog/Modbus).				
Line Temperature Selector	707	1414	–	–
Nominal Value: Fallback, Selection: Fallback/Analog/Modbus				
Selects the source of the value (Fallback/Analog/Modbus).				

Dimensions

Description	Winscreen Object #	Modbus Register	Unit SI	Unit US
Internal Pipe Diameter	400	800	mm	in
Nominal value depends on meter size, Range 80-1500mm				
The average diameter of the meter.				
Transducer Path Length 1	401	802	mm	in
Nominal value depends on meter size, Range 80-1500mm				
The distance between the transducer tips.				
Transducer Path Length 2	402	804	mm	in
Nominal value depends on meter size, Range 80-1500mm				
The distance between the transducer tips.				
Transducer Path Length 3	403	806	mm	in
Nominal value depends on meter size, Range 80-1500mm				
The distance between the transducer tips.				

Dimensions – Continued

Description	Winscreen Object #	Modbus Register	Unit SI	Unit US
Transducer Path Length 4	404	808	mm	in
Nominal value depends on meter size, Range 80-1500mm				
The distance between the transducer tips.				
Transducer Path Length 5	405	810	mm	in
Nominal value depends on meter size, Range 80-1500mm				
The distance between the transducer tips.				
Transducer Path Length 6	406	812	mm	in
Nominal value depends on meter size, Range 80-1500mm				
The distance between the transducer tips.				
Transducer Path Angle 1	407	814	degree	degree
Typical Value Range: 40-60Deg.				
Angle between the transducer path and flow direction.				
Transducer Path Angle 2	408	816	degree	degree
Typical Value Range: 40-60Deg.				
Angle between the transducer path and flow direction.				
Transducer Path Angle 3	409	818	degree	degree
Typical Value Range: 40-60Deg.				
Angle between the transducer path and flow direction.				
Transducer Path Angle 4	410	820	degree	degree
Typical Value Range: 40-60Deg.				
Angle between the transducer path and flow direction.				
Transducer Path Angle 5	411	822	degree	degree
Typical Value Range: 40-60Deg.				
Angle between the transducer path and flow direction.				
Transducer Path Angle 6	412	824	degree	degree
Typical Value Range: 40-60Deg.				
Angle between the transducer path and flow direction.				
Wall thickness spool piece	413	826	mm	in
Nominal value depends of meter construction, Range: 20-100mm				
Average thickness of the walls in the spool piece. This thickness is used to correctly adjust the dimensions of the meter due to pressure and temperature.				
Measurement Ref. Temperature	414	828	°C	°F
Typical Value Range: 15-30˚C				
Temperature in the spool piece when ID and path lengths were measured. Used for P/T correction of dimensions.				
Meter pipe material	415	830	–	–
Carbon Steel / Stainless Steel / Duplex Steel				
Material in spool piece. Used for P/T correction of dimensions.				
Used Linear Thermal expansion coeff	108	216	°C	°F
The used coefficient for temperature expansion of the spool piece and path lengths / angles based on the selected material in object 415.				
Used pressure expansion coeff	109	218	Pas	Pas
The used coefficient for pressure expansion of the spool piece and path lengths / angles based on the selected material in object 415.				

Setup

Description	Winscreen Object #	Modbus Register	Unit SI	Unit US
Additional delay between firings	420	840	us	us
Nominal Value: 0.0, Range: 0.00-10000us				
Additional delay between the ultrasonic firings to prevent reflections to influence the transit times. If the number is negative, it is only used for velocities below 4m/s.				
Signal AD value Setpoint	422	844	–	–
Nominal Value: 2.0, Range: 0.0-5.0				
The setpoint of the received signal amplitude for the gain controller. Range 0-5. Gain controller adjust the gain (object 38-49) to get the average signal amplitude close to the setpoint.				
Tx Gain (0=Auto Gain)	423	846	–	–
Nominal 0(Auto), Range: 0-100				
The amplitude in % on the transmitted signal. Reducing the transmitted signal strength reduces the risk of signal saturation (important on high pressures at small meters.)				
Max Number of Signals	426	852	–	–
Nominal Value: 10, Range: 0-60				
The max number of signal averaged for each measurement round.				

Rate Calibration

Description	Winscreen Object #	Modbus Register	Unit SI	Unit US
Rate Correction factor A (Pos Dir)	416	832	–	–
Nominal Value: 1.0, Range: 0.95-1.05				
Adjustment factors of the measured flow rate for positive flow direction. Correction formula Q = Ax+B, where x is the originally measured flowrate. A and B factors usually found after flow calibration of the meter.				
Rate Correction factor B (Pos Dir)	417	834	m^3/h	bph
Nominal Value: 0.0, Range: -2.0 - +2.0 m3/h				
Adjustment factors of the measured flow rate for positive flow direction. Correction formula Q = Ax+B, where x is the originally measured flowrate. A and B factors usually found after flow calibration of the meter.				
Rate Correction factor A (Neg Dir)	418	836	–	–
Nominal Value: 0.0, Range: -2.0 - 2.0 m3/h				
Adjustment factors of the measured flow rate for negative flow direction. Correction formula Q = Ax+B, where x is the originally measured flowrate. A and B factors usually found after flow calibration of the meter.				
Rate Correction factor B (Neg Dir)	419	838	m^3/h	bph
Adjustment factors of the measured flow rate for negative flow direction. Correction formula Q = Ax+B, where x is the originally measured flowrate. A and B factors usually found after flow calibration of the meter.				
Rate Calibr. point 1 Flow rate	527	1054	m^3/h	bph
Range: -50000 - +50000 m3/h				
Identifies the flow rate for this calibration point.				
Rate Calibr. point 1 K-Factor	528	1056	–	–
Range: 0.95 - 1.05 m3/h				

Rate Calibration – Continued

Description	Winscreen Object #	Modbus Register	Unit SI	Unit US
Rate Calibr. point 2 Flow rate	529	1058	m^3/h	bph
Range: -50000 - +50000 m3/h				
Identifies the flow rate for this calibration point.				
Rate Calibr. point 2 K-Factor	530	1060	–	–
Range: 0.95 - 1.05 m3/h				
Rate Calibr. point 3 Flow rate	531	1062	m^3/h	bph
Range: -5000 - +50000 m3/h				
Identifies the flow rate for this calibration point.				
Rate Calibr. point 3 K-Factor	532	1064	–	–
Range: 0.95 - 1.05 m3/h				
Rate Calibr. point 4 Flow rate	533	1066	m^3/h	bph
Range: -50000 - +50000 m3/h				
Identifies the flow rate for this calibration point.				
Rate Calibr. point 4 K-Factor	534	1068	–	–
Range: 0.95 - 1.05 m3/h				
Rate Calibr. point 5 Flow rate	535	1070	m^3/h	bph
Range: -50000 - +50000 m3/h				
Identifies the flow rate for this calibration point				
Rate Calibr. point 5 K-Factor	536	1072	–	–
Range: 0.95 - 1.05 m3/h				
Rate Calibr. point 6 Flow rate	537	1074	m^3/h	bph
Range: -50000 - +50000 m3/h				
Identifies the flow rate for this calibration point.				
Rate Calibr. point 6 K-Factor	538	1076	–	–
Range: 0.95 - 1.05 m3/h				
Rate Calibr. point 7 Flow rate	539	1078	m^3/h	bph
Range: -50000 - +50000 m3/h				
Identifies the flow rate for this calibration point.				
Rate Calibr. point 7 K-Factor	540	1080	–	–
Range: 0.95 - 1.05 m3/h				
Rate Calibr. point 8 Flow rate	541	1082	m^3/h	bph
Range: -50000 - +50000 m3/h				
Identifies the flow rate for this calibration point.				
Rate Calibr. point 8 K-Factor	542	1084	–	–
Range: 0.95 - 1.05 m3/h				
Rate Calibr. point 9 Flow rate	543	1086	m^3/h	bph
Range: -50000 - +50000 m3/h				
Identifies the flow rate for this calibration point.				
Rate Calibr. point 9 K-Factor	544	1088	–	–
Range: 0.95 - 1.05 m3/h				

Rate Calibration – Continued

Description	Winscreen Object #	Modbus Register	Unit SI	Unit US
Rate Calibr. point 10 Flow rate	545	1090	m^3/h	bph
Range: -50000 - +50000 m3/h				
Identifies the flow rate for this calibration point.				
Rate Calibr. point 10 K-Factor	546	1092	–	–
Range: 0.95 - 1.05 m3/h				
Rate Calibr. point 11 Flow rate	547	1094	m^3/h	bph
Range: -50000 - +50000 m3/h				
Identifies the flow rate for this calibration point.				
Rate Calibr. point 11 K-Factor	548	1096	–	–
Range: 0.95 - 1.05 m3/h				
Rate Calibr. point 12 Flow rate	549	1098	m^3/h	bph
Range: -50000 - +50000 m3/h				
Identifies the flow rate for this calibration point.				
Rate Calibr. point 12 K-Factor	550	1100	–	–
Range: 0.95 - 1.05 m3/h				
Rate Calibr. point 13 Flow rate	551	1102	m^3/h	bph
Range: -50000 - +50000 m3/h				
Identifies the flow rate for this calibration point.				
Rate Calibr. point 13 K-Factor	552	1104	–	–
Range: 0.95 - 1.05 m3/h				
Rate Calibr. point 14 Flow rate	553	1106	m^3/h	bph
Range: -50000 - +50000 m3/h				
Identifies the flow rate for this calibration point.				
Rate Calibr. point 14 K-Factor	554	1108	–	–
Range: 0.95 - 1.05 m3/h				
Rate Calibr. point 15 Flow rate	555	1110	m^3/h	bph
Range: -50000 - +50000 m3/h				
Identifies the flow rate for this calibration point.				
Rate Calibr. point 15 K-Factor	556	1112	–	–
Range: 0.95 - 1.05 m3/h				
Rate Calibr. point 16 Flow rate	557	1114	m^3/h	bph
Range: -50000 - +50000 m3/h				
Identifies the flow rate for this calibration point.				
Rate Calibr. point 16 K-Factor	558	1116	–	–
Range: 0.95 - 1.05 m3/h				

Limits

Description	Winscreen Object #	Modbus Register	Unit SI	Unit US
Low flow cutoff limit	430	860	m/s	ft/sec
Nominal Value: 0.3m/s, Range: 0-1m/s				
Below this velocity limit the flow will be set to 0.				
Max VOS	431	862	m/s	ft/sec
Typical Value: 2000m/s				
Above this velocity of sound limit the VOS error alarm will be set.				
Min VOS	432	864	m/s	ft/sec
Typical Value: 1000m/s				
Below this velocity of sound limit the VOS error alarm will be set.				
Max Flow	433	866	m/s	ft/sec
Typical Value: 20m/s				
Above this flow velocity the too high flow alarm will be set.				
Min Flow	434	868	m/s	ft/sec
Typical Value: -20m/s				
Below this flow velocity the too low flow alarm will be set.				
Min Signals used	435	870	%	%
Typical Value: 30%				
If the signal % drops below this limit, the signal % low alarm wil be set.				
Max Gain	436	872	–	–
Typical Value: 2600				
If the gain is above the limit, the gain high alarm will be set.				
Max Gain Difference	437	874	%	%
Typical Value: 50%				
If the gain on individual paths differs more than the specified limit compared to the median gain.				
Max VOS deviation	438	876	m/s	ft/sec
Typical Value: 2m/s				
If the VOS on individual paths differs more than the specified limit compared to the median VOS.				
Min S/N ratio (Processed signal)	439	878	dB	dB
Typical Value: 15dB				
If the signal level (compared) to the noise drops below this level the S/N ratio alarm will be set.				
Max turbulence level	440	880	%	%
Typical Value: 20%				
If the variation in flow velocity (pr. path) is larger than the specified limit, the turbulence alarm will be set.				
Max Deviation Profile Flatness	441	882	%	%
Typical Value: 20%				
If the profile flatness differs more than the specified limit the alarm will set.				
Max Deviation Profile Symmetry	442	884	%	%
Typical Value: 20%				
If the profile symmetry differs more than the specified limit the alarm will set.				
Max Deviation Swirl/crossflow	443	886	%	%
Typical Value: 20%				
If the transversal flow differs more than the specified limit the alarm will set.				

Profile

Description	Winscreen Object #	Modbus Register	Unit SI	Unit US
Lower Flow Limit, Profile Correction	446	892	m/s	ft/sec
Typical Value: 20m/s, Range: 0-30m/s, 0=Off				
Below this limit no flow profile checking and path substitution will be performed. Path substitution is still possible by VOS checking based on Max VOS deviation (438).				
Allowed VOS Profile Dev. Center Pair	447	894	m/s	ft/sec
Typical Value: 2m/s, Range: 0.5-5m/s				
Below this limit a both center paths (3 and 4) will be used for calculation reference VOS.				
Profile Learner, Minimum Velocity	448	896	m/s	ft/sec
Typical Value: 15m/s, Range: 0.5-30m/s				
Below minimum velocity the reference flow profile will not be updated.				
Profile Learner, Maximum Velocity	449	898	m/s	ft/sec
Typical Value: 15m/s, Range: 0.5-30m/s				
Above maximum velocity the reference flow profile will not be updated.				
Profile Learner, Path Quality Limit	451	902	–	–
Typical Value: 60, Range: 0-100				
Below the quality limit (signal %), the reference flow profile will not be updated.				
Profile Learner, Averaged Cycles	452	904	–	–
Typical Value: 30, Range: 0-100				
The average flow profile of the specified number of measurement cycles will be used for the reference flow profile.				
Profile Learner, Stability Req.	453	906	–	–
Typical Value: 1, Range: 0-1				
Factor used to verify stability of flow profile before recording.				
Reference/Initial Flow Profile Factors 1	454	908	–	–
Typical Value: 0.9, Range: 0.7-1.2				
Reference flow profile.				
Reference/Initial Flow Profile Factors 2	455	910	–	–
Typical Value: 0.9, Range: 0.7-1.2				
Reference flow profile.				
Reference/Initial Flow Profile Factors 3	456	912	–	–
Typical Value: 1.0, Range: 0.7-1.2				
Reference flow profile.				
Reference/Initial Flow Profile Factors 4	457	914	–	–
Typical Value: 1.0, Range: 0.7-1.2				
Reference flow profile.				
Reference/Initial Flow Profile Factors 5	458	916	–	–
Typical Value: 1.0, Range: 0.7-1.2				
Reference flow profile.				
Reference/Initial Flow Profile Factors 6	459	918	–	–
Typical Value: 0.9, Range: 0.7-1.2				
Reference flow profile.				
Allowed Vel.profile deviation	460	920	us	us
Typical Value: 5us, Range: 0.5-10us				
If the measured flow velocity for the path differs more than the specified limit calculated in us, the path is substituted.				

Profile – Continued

Description	Winscreen Object #	Modbus Register	Unit SI	Unit US
Allowed VOS.profile deviation	461	922	us	us
Typical Value: 5us, Range: 0.5-10us				
If the measured velocity of sound for the path differs more than the specified limit calculated in us, the path is substituted.				
Profile Indication Level	462	924	–	–
Typical Value: 1, Selection: 0 or 1				

IO

Description	Winscreen Object #	Modbus Register	Unit SI	Unit US
Pulse Handling	474	948	–	–
Nominal Value: Single Pulse, Selections: Single Pulse/Dual Pulse				
Selects how pulses will be handled in forward vs. reverse flow. Single Pulse=Pulses generated on both output pair regardless of direction. Flow direction can be extracted from pulse phase coding. Dual Pulse=Separate pulse pair for forward and reverse flow.				
Pulse output rating	475	950	pulses/m^3	pulses/BBL
Nominal value depends on meter size, Range 100-20000p/m3				
Specifies the scaling of the pulse frequency from the flow rate.				
Pulse/AO update rate	476	952	sec	sec
Nominal value: 0.05s, Range 0.02-1.0s				
Specifies how often the pulse output and analog output will be updated.				
Modbus averager update rate	477	954	sec	sec
Nominal value: 5s, Range 3-10s				
Specifies how often Modbus registers will be updated.				
Slot 1 IO Type	478	956	–	–
Nominal value: 10 (No Module), Range 0-10				
Selects the type of module in the slot. 0=4-20mA input for Temperature. 1=4-20mA input for Pressure. 4=4-20mA output for flow rate. 5=4-20mA output for flow rate at standard conditions. 10=No module installed.				
Slot 1 Max value	479	958	–	–
Nominal value and range depends on physical unit				
Maximum value of physical value being measured/output.				
Slot 1 Min value	480	960	–	–
Nominal value and range depends on physical unit				
Minimum value of physical value being measured/output.				
Slot 1 calibration factor A	481	962	–	–
Nominal value: 1.0				
Calibration factor applied to the normalized converter count value.				
Slot 1 calibration factor B	482	964	–	–
Nominal value: 0				
Calibration factor applied to the normalized converter count value.				

IO – Continued

Description	Winscreen Object #	Modbus Register	Unit SI	Unit US
Slot 1 calibration factor CAL1	483	966	–	–
Range 0-65536				
Calibration factor of the module (printed on the module).				
Slot 1 calibration factor CAL2	484	968	–	–
Range 0-65536				
Calibration factor of the module (printed on the module).				
Slot 2 IO Type	485	970	–	–
Nominal Value: 10 (No Module), Range 0-10				
Selects the type of module in the slot. 0=4-20mA input for Temperature. 1=4-20mA input for Pressure. 4=4-20mA output for flow rate. 5=4-20mA output for flow rate at standard conditions. 10=No module installed.				
Slot 2 Max value	486	972	–	–
Nominal value and range depends on physical unit				
Maximum value of physical value being measured/output.				
Slot 2 Min value	487	974	–	–
Nominal value and range depends on physical unit				
Minimum value of physical value being measured/output.				
Slot 2 calibration factor A	488	976	–	–
Nominal Value: 1.0				
Calibration factor applied to the normalized converter count value.				
Slot 2 calibration factor B	489	978	–	–
Nominal Value: 0.0				
Calibration factor applied to the normalized converter count value.				
Slot 2 calibration factor CAL1	490	980	–	–
Range 0-65536				
Calibration factor of the module (printed on the module).				
Slot 2 calibration factor CAL2	491	982	–	–
Range 0-65536				
Calibration factor of the module (printed on the module).				
Com1 Duplex mode	492	984	–	
Nominal Value: Full duplex, Selections: Full duplex/half duplex				
Selects full or half duplex. Half duplex is used on RS485, two wires (Tx and Rx are send on the same pair).				
Com2 Modbus node number	493	986	–	–
Nominal Value: 1, Range: 1200-19200				
Modbus node number for multidrop networks. Use node number 1 for 1-to-1 connections.				
Com2 Baudrate	494	988	–	–
Nominal Value: 9600, Range: 1200-19200				
Communication speed. Meter and client (PC) needs to use the same baudrate.				
Com2 Duplex mode	495	990	–	–
Nominal Value: Full duplex, Selections: Full duplex/half duplex				
Selects full or half duplex. Half duplex is used on RS485, two wires (Tx and Rx are send on the same pair).				

Misc.

Description	Winscreen Object #	Modbus Register	Unit SI	Unit US
Transducer X-ref	463	926	–	–
Nominal Value: 0, Other values only for diagnostics use				
Pulse bias	466	932	–	–
Nominal Value: 1.01, Range: 1.0-1.1				
Pulse frequency factor to ensure pulses are not lost				
Debug Mode	467	934	–	–
Nominal Value: None, Selections: None/Trace buffer/Meas. errors/Transit time log/Pulse Diagnostics				
Select the usage of the debug buffer.				

Fallback Values

Description	Winscreen Object #	Modbus Register	Unit SI	Unit US
Fallback Value – Line Pressure	660	1320	bara	psiA
Range 1-250BarA				
Fallback value for pressure. Used if fallback is selected in the Line Pressure Selector (406), or value is not updated on Modbus or Analog module.				
Fallback Value – Line Temperature	661	1322	°C	°F
Range: -40 - +120˚C				
Fallback value for pressure. Used if fallback is selected in the Line Temperature Selector (407), or value is not updated on Modbus or Analog module.				

Transducer Calibration node 1

Description	Winscreen Object #	Modbus Register	Unit SI	Unit US
Node 1 Signal Type	502	1004	–	–
Nominal Value 128, Range: 0-400				
Identifies the signal type for this node during transducer calibration.				
Node 1 Tr. Delay 1	503	1006	us	us
Range: 0-1us				
Identifies the transducer delay for each pair of transducers for this node during transducer calibration.				
Node 1 Tr. Delay 2	504	1008	us	us
Range: 0-1us				
Identifies the transducer delay for each pair of transducers for this node during transducer calibration.				
Node 1 Tr. Delay 3	505	1010	us	us
Range: 0-1us				
Identifies the transducer delay for each pair of transducers for this node during transducer calibration.				
Node 1 Tr. Delay 4	506	1012	us	us
Range: 0-1us				
Identifies the transducer delay for each pair of transducers for this node during transducer calibration.				
Node 1 Tr. Delay 5	507	1014	us	us
Range: 0-1us				
Identifies the transducer delay for each pair of transducers for this node during transducer calibration.				
Node 1 Tr. Delay 6	508	1016	us	us
Range: 0-1us				
Identifies the transducer delay for each pair of transducers for this node during transducer calibration.				

VPC Correction Table

Description	Winscreen Object #	Modbus Register	Unit SI	Unit US
Number of VPC points	509	1018	–	–
VPC point 1 VPC X	510	1020	–	–
Range: 1-3				
VPC point 1 Correction	511	1022	%	%
Range: -5 - +5				
VPC point 2 VPC X	512	1024	–	–
Range: 1-3				
VPC point 2 Correction	513	1026	%	%
Range: -5 - +5				
VPC point 3 VPC X	514	1028	–	–
Range: 1-3				
VPC point 3 Correction	515	1030	%	%
Range: -5 - +5				
VPC point 4 VPC X	516	1032	–	–
Range: 1-3				
VPC point 4 Correction	517	1034	%	%
Range: -5 - +5				
VPC point 5 VPC X	518	1036	–	–
Range: 1-3				
VPC point 5 Correction	519	1038	%	%
Range: -5 - +5				
VPC point 6 VPC X	520	1040	–	–
Range: 1-3				
VPC point 6 Correction	521	1042	%	%
Range: -5 - +5				
VPC point 7 VPC X	522	1044	–	–
Range: 1-3				
VPC point 7 Correction	523	1046	%	%
Range: -5 - +5				
VPC point 8 VPC X	524	1048	–	–
Range: 1-3				
VPC point 8 Correction	525	1050	%	%
Range: -5 - +5				

Measured Values

Description	Winscreen Object #	Modbus Register	Unit SI	Unit US
Log Count	0	0	–	–
This counter is incremented by one each time the meter has calculated a new flow rate. Rolls over at 65536.				
Alarm Status	1	2	–	–
The alarm status is a bit coded value. Each alarm has a value, and the values are added. 1=Too high flow 2=Electronics failure 4=Transducer failure 8=Calculation error 16=Signal % low 32=Gain error 64=VOS difference 128=Path substitution 256=Parameter error 512=S/N ratio low 1024=Turbulence level high 2048=Profile deviation high				
Flow Velocity	2	4	m/s	ft/sec
Measured flow velocity through meter (Integrated across all paths).				
Velocity of Sound	3	6	m/s	ft/sec
Measured velocity of sound. (Average for all paths).				
Actual Volume Flowrate	4	8	m^3/h	bph
Measured volume flowrate.				
Accumulated Volume Forward	5	10	m^3	bbl
Accumulated volume in forward flow direction. Rolls over at 1000000000 (1E9) m3. Always accumulating in forward flow.				
Accumulated Volume Reverse	6	12	m^3	bbl
Accumulated volume in reverse flow direction. Rolls over at 1000000000 (1E9) m3. Always accumulating in reverse flow.				
Profile flatness (Center/Outer Paths)	7	14	%	%
Amount of flow on the outer paths compared to the center paths.				
Profile symmetry (Upper/Lower Paths)	8	16	%	%
Amount of flow on the top paths compared to the bottom paths.				
Swirl Flow	9	18	%	%
Amount of flow rotation (clockwise)				
Cross Flow	10	20	%	%
Amount of dual vortex rotation				
Increment Time Duration	11	22	sec	sec
Time elapsed since last update of MODBUS registers. (See also object 10.)				
Used Line Pressure	12	24	bara	psiA
Line Pressure (at meter) used in calculation for correction of: 1. Dimensions (ID, angle, path lengths) 2. Selection of transducer calibration node 3. Correction of zero calibration data Source (Analog/Modbus/Fallback) is selected by object 706.				

Measured Values – Continued

Description	Winscreen Object #	Modbus Register	Unit SI	Unit US
Used Line Temperature	13	26	°C	°F
Line Temperature (at meter) used in calculation for correction of: 1. Dimensions (ID, angle, path lengths) 2. Selection of transducer calibration node 3. Correction of zero calibration data Source (Analog/Modbus/Fallback) is selected by object 707.				
Measured Flow Velocity 1	14	28	m/s	ft/sec
Flow velocity measured along each single path.				
Measured Flow Velocity 2	15	30	m/s	ft/sec
Flow velocity measured along each single path.				
Measured Flow Velocity 3	16	32	m/s	ft/sec
Flow velocity measured along each single path.				
Measured Flow Velocity 4	17	34	m/s	ft/sec
Flow velocity measured along each single path.				
Measured Flow Velocity 5	18	36	m/s	ft/sec
Flow velocity measured along each single path.				
Measured Flow Velocity 6	19	38	m/s	ft/sec
Flow velocity measured along each single path.				
Measured Velocity of Sound 1	20	40	m/s	ft/sec
Velocity of sound measured along each single path.				
Measured Velocity of Sound 2	21	42	m/s	ft/sec
Velocity of sound measured along each single path.				
Measured Velocity of Sound 3	22	44	m/s	ft/sec
Velocity of sound measured along each single path.				
Measured Velocity of Sound 4	23	46	m/s	ft/sec
Velocity of sound measured along each single path.				
Measured Velocity of Sound 5	24	48	m/s	ft/sec
Velocity of sound measured along each single path.				
Measured Velocity of Sound 6	25	50	m/s	ft/sec
Velocity of sound measured along each single path.				
Signals pr. path pr. calculation.	98	196	–	–
Number of signals on each path used to calculate the flow rate update for the pulse out.				

Signal Measurements

Description	Winscreen Object #	Modbus Register	Unit SI	Unit US
Signal Percentage 1A	26	52	%	%
How many of the received signals are used for calculation.				
Signal Percentage 1B	27	54	%	%
How many of the received signals are used for calculation.				
Signal Percentage 2A	28	56	%	%
How many of the received signals are used for calculation.				
Signal Percentage 2B	29	58	%	%
How many of the received signals are used for calculation.				
Signal Percentage 3A	30	60	%	%
How many of the received signals are used for calculation.				
Signal Percentage 3B	31	62	%	%
How many of the received signals are used for calculation.				
Signal Percentage 4A	32	64	%	%
How many of the received signals are used for calculation.				
Signal Percentage 4B	33	66	%	%
How many of the received signals are used for calculation.				
Signal Percentage 5A	34	68	%	%
How many of the received signals are used for calculation.				
Signal Percentage 5B	35	70	%	%
How many of the received signals are used for calculation.				
Signal Percentage 6A	36	72	%	%
How many of the received signals are used for calculation.				
Signal Percentage 6B	37	74	%	%
How many of the received signals are used for calculation.				
Gain 1A	38	76	–	–
The amplification of the received signal. Logarithmic scale, 200 = double/half. Range 100-2600				
Gain 1B	39	78	–	–
The amplification of the received signal. Logarithmic scale, 200 = double/half. Range 100-2600				
Gain 2A	40	80	–	–
The amplification of the received signal. Logarithmic scale, 200 = double/half. Range 100-2600				
Gain 2B	41	82	–	–
The amplification of the received signal. Logarithmic scale, 200 = double/half. Range 100-2600				
Gain 3A	42	84	–	–
The amplification of the received signal. Logarithmic scale, 200 = double/half. Range 100-2600				
Gain 3B	43	86	–	–
The amplification of the received signal. Logarithmic scale, 200 = double/half. Range 100-2600				
Gain 4A	44	88	–	–
The amplification of the received signal. Logarithmic scale, 200 = double/half. Range 100-2600				
Gain 4B	45	90	–	–
The amplification of the received signal. Logarithmic scale, 200 = double/half. Range 100-2600				

Signal Measurements – Continued

Description	Winscreen Object #	Modbus Register	Unit SI	Unit US
Gain 5A	46	92	–	–
The amplification of the received signal. Logarithmic scale, 200 = double/half. Range 100-2600				
Gain 5B	47	94	–	–
The amplification of the received signal. Logarithmic scale, 200 = double/half. Range 100-2600				
Gain 6A	48	96	–	–
The amplification of the received signal. Logarithmic scale, 200 = double/half. Range 100-2600				
Gain 6B	49	98	–	–
The amplification of the received signal. Logarithmic scale, 200 = double/half. Range 100-2600				

Travel Times

Description	Winscreen Object #	Modbus Register	Unit SI	Unit US
Raw transit time A 1	68	136	nS	nS
The measured transit time firing downstream (positive flow) on each path. Transit time is not corrected for transducer calibration.				
Raw transit time A 2	69	138	nS	nS
The measured transit time firing downstream (positive flow) on each path. Transit time is not corrected for transducer calibration.				
Raw transit time A 3	70	140	nS	nS
The measured transit time firing downstream (positive flow) on each path. Transit time is not corrected for transducer calibration.				
Raw transit time A 4	71	142	nS	nS
The measured transit time firing downstream (positive flow) on each path. Transit time is not corrected for transducer calibration.				
Raw transit time A 5	72	144	nS	nS
The measured transit time firing downstream (positive flow) on each path. Transit time is not corrected for transducer calibration.				
Raw transit time A 6	73	146	nS	nS
The measured transit time firing downstream (positive flow) on each path. Transit time is not corrected for transducer calibration.				
Raw transit time Diff B-A 1	74	148	nS	nS
Difference in transit time between upstream and downstream. Positive number means positive flow.				
Raw transit time Diff B-A 2	75	150	nS	nS
Difference in transit time between upstream and downstream. Positive number means positive flow.				
Raw transit time Diff B-A 3	76	152	nS	nS
Difference in transit time between upstream and downstream. Positive number means positive flow.				
Raw transit time Diff B-A 4	77	154	nS	nS
Difference in transit time between upstream and downstream. Positive number means positive flow.				
Raw transit time Diff B-A 5	78	156	nS	nS
Difference in transit time between upstream and downstream. Positive number means positive flow.				
Raw transit time Diff B-A 6	79	158	nS	nS
Difference in transit time between upstream and downstream. Positive number means positive flow.				

Profile

Description	Winscreen Object #	Modbus Register	Unit SI	Unit US
Uncorrected flow velocity 1	80	160	m/s	ft/sec
Same as object 14-19, but not corrected for path substitution.				
Uncorrected flow velocity 2	81	162	m/s	ft/sec
Same as object 14-19, but not corrected for path substitution.				
Uncorrected flow velocity 3	82	164	m/s	ft/sec
Same as object 14-19, but not corrected for path substitution.				
Uncorrected flow velocity 4	83	166	m/s	ft/sec
Same as object 14-19, but not corrected for path substitution.				
Uncorrected flow velocity 5	84	168	m/s	ft/sec
Same as object 14-19, but not corrected for path substitution.				
Uncorrected flow velocity 6	85	170	m/s	ft/sec
Same as object 14-19, but not corrected for path substitution.				
Uncorrected velocity of sound 1	86	172	m/s	ft/sec
Same as object 20-25, but not corrected for path substitution.				
Uncorrected velocity of sound 2	87	174	m/s	ft/sec
Same as object 20-25, but not corrected for path substitution.				
Uncorrected velocity of sound 3	88	176	m/s	ft/sec
Same as object 20-25, but not corrected for path substitution.				
Uncorrected velocity of sound 4	89	178	m/s	ft/sec
Same as object 20-25, but not corrected for path substitution.				
Uncorrected velocity of sound 5	90	180	m/s	ft/sec
Same as object 20-25, but not corrected for path substitution.				
Uncorrected velocity of sound 6	91	182	m/s	ft/sec
Same as object 20-25, but not corrected for path substitution.				
Velocity profile factor 1	92	184	–	–
Reference flow profile used for check and correction/substitution of path velocity and VOS.				
Velocity profile factor 2	93	186	–	–
Reference flow profile used for check and correction/substitution of path velocity and VOS.				
Velocity profile factor 3	94	188	–	–
Reference flow profile used for check and correction/substitution of path velocity and VOS.				
Velocity profile factor 4	95	190	–	–
Reference flow profile used for check and correction/substitution of path velocity and VOS.				
Velocity profile factor 5	96	192	–	–
Reference flow profile used for check and correction/substitution of path velocity and VOS.				
Velocity profile factor 6	97	194	–	–
Reference flow profile used for check and correction/substitution of path velocity and VOS.				
Travel time correction count 1	204	408	–	–
Indicates how many times the travel time on that specific path have been substituted.				
Travel time correction count 2	205	410	–	–
Indicates how many times the travel time on that specific path have been substituted.				
Travel time correction count 3	206	412	–	–
Indicates how many times the travel time on that specific path have been substituted.				

Profile – Continued

Description	Winscreen Object #	Modbus Register	Unit SI	Unit US
Travel time correction count 4	207	414	–	–
Indicates how many times the travel time on that specific path have been substituted.				
Travel time correction count 5	208	416	–	–
Indicates how many times the travel time on that specific path have been substituted.				
Travel time correction count 6	209	418	–	–
Indicates how many times the travel time on that specific path have been substituted.				

S/N Measurements

Description	Winscreen Object #	Modbus Register	Unit SI	Unit US
S/N ratio raw signal 1	50	100	dB	dB
Measured ratio between the raw noise and the used signal in dB. Each 6dB means half the amplitude.				
S/N ratio raw signal 2	51	102	dB	dB
Measured ratio between the raw noise and the used signal in dB. Each 6dB means half the amplitude.				
S/N ratio raw signal 3	52	104	dB	dB
Measured ratio between the raw noise and the used signal in dB. Each 6dB means half the amplitude.				
S/N ratio raw signal 4	53	106	dB	dB
Measured ratio between the raw noise and the used signal in dB. Each 6dB means half the amplitude.				
S/N ratio raw signal 5	54	108	dB	dB
Measured ratio between the raw noise and the used signal in dB. Each 6dB means half the amplitude.				
S/N ratio raw signal 6	55	110	dB	dB
Measured ratio between the raw noise and the used signal in dB. Each 6dB means half the amplitude.				
S/N ratio used signal 1	56	112	dB	dB
Measured ratio between the noise (after signal processing) and the used signal in dB. Each 6dB means half the amplitude.				
S/N ratio used signal 2	57	114	dB	dB
Measured ratio between the noise (after signal processing) and the used signal in dB. Each 6dB means half the amplitude.				
S/N ratio used signal 3	58	116	dB	dB
Measured ratio between the noise (after signal processing) and the used signal in dB. Each 6dB means half the amplitude.				
S/N ratio used signal 4	59	118	dB	dB
Measured ratio between the noise (after signal processing) and the used signal in dB. Each 6dB means half the amplitude.				
S/N ratio used signal 5	60	120	dB	dB
Measured ratio between the noise (after signal processing) and the used signal in dB. Each 6dB means half the amplitude.				
S/N ratio used signal 6	61	122	dB	dB
Measured ratio between the noise (after signal processing) and the used signal in dB. Each 6dB means half the amplitude.				
Turbulence level 1	62	124	%	%
Level of path velocity turbulence calculated as standard deviation of last 10 seconds.				
Turbulence level 2	63	126	%	%
Level of path velocity turbulence calculated as standard deviation of last 10 seconds.				
Turbulence level 3	64	128	%	%
Level of path velocity turbulence calculated as standard deviation of last 10 seconds.				

S/N Measurements – Continued

Description	Winscreen Object #	Modbus Register	Unit SI	Unit US
Turbulence level 4	65	130	%	%
Level of path velocity turbulence calculated as standard deviation of last 10 seconds.				
Turbulence level 5	66	132	%	%
Level of path velocity turbulence calculated as standard deviation of last 10 seconds.				
Turbulence level 6	67	134	%	%
Level of path velocity turbulence calculated as standard deviation of last 10 seconds.				

Standard Calculations

Description	Winscreen Object #	Modbus Register	Unit SI	Unit US
Prove Run No.	100	200	–	–
Average Flow Rate	101	202	m^3/h	bph
MM Factor	102	204	pulses/m^3	pulses/BBL
Prove Time	103	206	sec	sec
Accumulated Prove Volume	104	208	m^3	BBL
Accumulated Master Meter Pulses	105	210	–	–
VPC X	106	212	–	–
VPC Correction	107	214	%	%

IO Values

Description	Winscreen Object #	Modbus Register	Unit SI	Unit US
Pulse out requested frequency	110	220	Hz	Hz
Current frequency generated on the pulse output.				
Time Stamp	111	222	sec	sec
Time stamp of last frequency change.				
Pulse out total count forward	112	224	–	–
Internal pulse counter inside the AVR processor. If this is moving, the AVR is.				
Pulse In 1 Count	113	226	–	–
Received number of pulses on the digital input 1.				
Pulse In 2 Count	114	228	–	–
Received number of pulses on the digital input 2.				
Freq In 1	115	230	–	–
Current frequency on digital input 1.				
Freq In 2	116	232	–	–
Current frequency on digital input 2.				
Slot 1 Count Value	120	240	–	–
The digital value read/sent to the analog module.				
Slot 2 Count Value	121	242	–	–
The digital value read/sent to the analog module.				
Analog Temperature Input	122	244	°C	°F
Temperature value read from temperature transmitter. The selector object (707) needs to be set to analog to use this value.				
Analog Pressure Input	123	246	bara	psiA
Pressure value read from pressure transmitter. The selector object (706) needs to be set to analog to use this value.				
Line Pressure, Modbus	130	260	bara	psiA
Temperature value received from modbus link. The selector object (707) needs to be set to modbus to use this value.				
Line Temperature, Modbus	131	262	°C	°F
Pressure value received from modbus link. The selector object (706) needs to be set to modbus to use this value.				
Time Consumption Total	140	280	ms	ms
Time consumption objects are used to verify that different parts of the DSP algorithms does not consume too much processor time.				

Status / Errors

Description	Winscreen Object #	Modbus Register	Unit SI	Unit US
Log Count	200	400	–	–
This counter is incremented by one each time the meter has calculated a new flow rate. Rolls over at 65536.				
Alarm Status	201	402	–	–
The alarm status is a bit coded value. Each alarm has a value, and the values are added. 1=Too high flow 2=Electronics failure 4=Transducer failure 8=Calculation error 16=Signal % low 32=Gain error 64=VOS difference 128=Path substitution 256=Parameter error 512=S/N ratio low 1024=Turbulence level high 2048=Profile deviation high				
Currently used transducer calibration node	202	404	–	–
Transducer calibration node is selected based on used temperature and pressure.				
Profile Learner State	203	406	–	–
Indicates the current status for recording of the current profile. 0=Learning 1=Flow velocity outside learning range (No learning). 2=Unstable flow profile (No learning) 3=Low quality of measurements (No learning).				
Too Low Flow	216	432	–	–
This alarm is set when the flow velocity is higher than the alarm limit set in object 433. 0=OK 1=Alarm				
Too High Flow	217	434	–	–
This alarm is set when the flow velocity is higher than the alarm limit set in object 434. 0=OK 1=Alarm				
Electronics Failure	218	436	–	–
This alarm is set when the electronics have detectable internal problem i.e. inter-processor communication or checksum errors. Bit code: 1=Pulse module error 2=DSP Checksum Error 4=CP Checksum Error 8=Avr Checksum Error 16=Database Checksum Error 32=Hardware Lock Open				
Transducer Failure	219	438	–	–
When the signal % is low or gain is high, the transducer failure alarm is set. Bit code: 1=1A, 2=2B, 4=2A, 8=2B, 16=3A, 32=3B, 64=4A, 128=4B, 256=5A, 512=5B, 1024=6A, 2048=6B				
Calculation Error	220	440	–	–
This alarm is set when it is impossible to calculate a flow. Bit code: 1=Path 1, 2=Path 2, 4=Path 3, 8=Path 4, 16=Path 5, 32=Path 6				
Signal % Low	221	442	–	–
This alarm is set when the signal % is lower than the alarm limit set in object 435. Bit code: 1=Path 1, 2=Path 2, 4=Path 3, 8=Path 4, 16=Path 5, 32=Path 6				
Gain High	222	444	–	–
This alarm is set when the gain is higher than the alarm limit set in object 436. Bit code: 1=1A, 2=1B, 4=2A, 8=2B, 16=3A, 32=3B, 64=4A, 128=4B, 256=5A, 512=5B, 1024=6A, 2048=6B				
Gain Deviation	223	446	–	–
This alarm is set when the gain of the path differs more from the median than the alarm limit set in object 437. Bit code: 1=1A, 2=1B, 4=2A, 8=2B, 16=3A, 32=3B, 64=4A, 128=4B, 256=5A, 512=5B, 1024=6A, 2048=6B				

Status / Errors – Continued

Description	Winscreen Object #	Modbus Register	Unit SI	Unit US
VOS Difference	224	448	–	–
This alarm is set when the VOS of the path differs more from the median than the alarm limit set in object 438. Bit code: 1=Path 1, 2=Path 2, 4=Path 3, 8=Path 4, 16=Path 5, 32=Path 6				
Path Substitution Indication	225	450	–	–
This alarm is set if the path velocity and VOS is substituted because of wrong measurement. Bit code: 1=Path 1, 2=Path 2, 4=Path 3, 8=Path 4, 16=Path 5, 32=Path 6				
S/N Ratio Low	226	452	–	–
This alarm is set when the S/N level of the used (processed) signal is lower than the alarm limit set in object 439. Bit code: 1=Path 1, 2=Path 2, 4=Path 3, 8=Path 4, 16=Path 5, 32=Path 6				
Turbulence Level High	227	454	–	–
This alarm is set when the turbulence level of the path is higher than the alarm limit set in object 440. Bit code: 1=Path 1, 2=Path 2, 4=Path 3, 8=Path 4, 16=Path 5, 32=Path 6				
Flow Profile Deviation	228	456	–	–
This alarm is set when the flow profile differs more from the reference profile than the alarm limit set in object 441-443. Bit code: 1=Profile Flatness Alarm, 2=Profile Symmetry Alarm, 4=Swirl Flow Alarm, 8=Cross Flow Alarm				

Hi-Res Accumulators

Description	Winscreen Object #	Modbus Register	Unit SI	Unit US
Accumulated Volume Forward (m3)	230	460	–	–
Non-resettable Accumulator for forward flow. (Integer part)				
Accumulated Volume Forward (m3*1E-9)	231	462	–	–
Non-resettable Accumulator for forward flow. (Fraction part)				
Accumulated Volume Reverse (m3)	232	464	–	–
Non-resettable Accumulator for reverse flow. (Integer part)				
Accumulated Volume Reverse (m3*1E-9)	233	466	–	–
Non-resettable Accumulator for reverse flow. (Fraction part)				
Accumulated Error Volume Forward (m3)	234	468	–	–
Non-resettable Accumulators. Only accumulating when there is an active alarm.				
Accumulated Error Volume Forward (m3*1E-9)	235	470	–	–
Non-resettable Accumulators. Only accumulating when there is an active alarm.				
Accumulated Error Volume Reverse (m3)	236	472	–	–
Non-resettable Accumulators. Only accumulating when there is an active alarm.				
Accumulated Error Volume Reverse (m3*1E-9)	237	474	–	–
Non-resettable Accumulators. Only accumulating when there is an active alarm.				

External Input

Description	Winscreen Object #	Modbus Register	Unit SI	Unit US
External Update of Line Pressure	1000	2000	bara	psiA
Write only register from Modbus for continuous update of this value. Set the selector to Modbus to use this value. Note that register 10000-10028 is containing the same set of registers as 1000-1028 (for backward compatibility).				
External Update of Line Temperature	1001	2002	°C	°F
Write only register from Modbus for continuous update of this value. Set the selector to Modbus to use this value.				

Section VIII – Related Publications

The following literature can be obtained from FMC Technologies Measurement Solutions, Inc. Literature Fulfillment at measurement.fulfillment@fmcti.com or online at *www.fmctechnologies.com/measurementsolutions.*

When requesting literature from Literature Fulfillment, please reference the appropriate bulletin number and title.

Specifications – Ultra^6 .... Bulletin SSLS001
Specifications – Ultra^4 .... Bulletin SSLS002
Winscreen Manual .... Bulletin MN0A001
External Communication, MPU Series B and Ultra Series Procedure Manual .... Bulletin MN0A002

Revisions included in MNLS001 Issue/Rev. 0.5 (8/12):
Page 6: Updated Electrical Installation section - For ATEX and IEC Ex Installations.

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