1 YEAR
WARRANTY

User's Guide

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Series FDT-30
Transit Time Ultrasonic Flow Meter

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Servicing North America:

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One Omega Drive, Box 4047
Stamford, CT 06907-0047
Tel: (203) 359-1660
FAX: (203) 359-7700
e-mail: info@omega.com

Canada:
976 Bergar
Laval (Quebec) H7L 5A1, Canada
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FAX: +420 (0)59 6311114
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e-mail: info@omegashop.cz

Germany/Austria:
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Tel: +49 (0)7056 9398-0
FAX: +49 (0)7056 9398-29
Toll Free in Germany: 0800 639 7678
e-mail: info@omega.de

United Kingdom:
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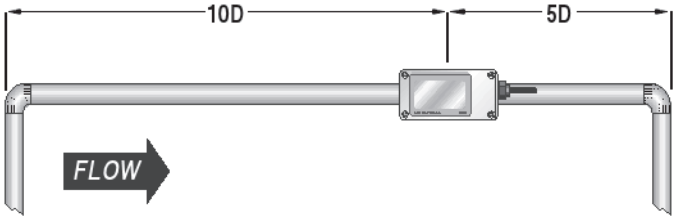
Northbank, Irlam, Manchester
M44 5BD United Kingdom
Tel: +44 (0)161 777 6611
FAX: +44 (0)161 777 6622
Toll Free in United Kingdom: 0800-488-488
e-mail: sales@omega.co.uk

TABLE OF CONTENTS

QUICK-START INSTRUCTIONS

This manual contains detailed operating instructions for the FDT-30 instrument. The following condensed instructions are provided to assist an experienced operator in basic operation of the instrument. If the operator is unfamiliar with this type of instrument, refer to the detailed explanations located on pages 10-32.

A. Select a flow meter mounting location with at least 10 pipe diameters upstream and 5 diameters downstream from the meter with no flow disturbances (i.e. elbows, tees, needle valves, etc.). See **Figure 1**.



FLOW METER MOUNTING

Figure 1

B. On horizontal pipe, choose a flow meter mounting location within approximately 45-degrees of the side of the pipe. See **Figure 2**. Locate the flow meter so that the pipe will be completely full of liquid when flow is occurring in the pipe. Avoid mounting on vertical pipes where the flow is moving in a downward direction.

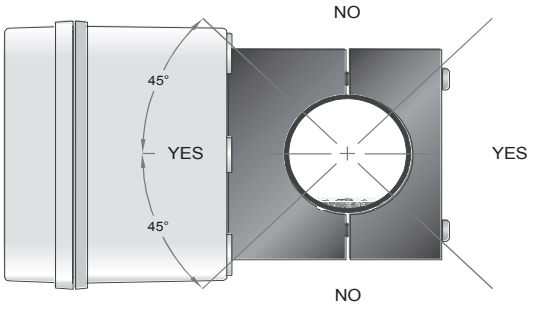


Figure 2

FLOW METER MOUNTING ORIENTATION

C. Remove rust, scale and paint from the flow meter mounting location. Clean to bare metal. Plastic pipes do not require preparation.

D. Apply a thin, even layer of silicone grease to the two transducer faces. Ensure that air bubbles are not present over the two brown plastic sound-guides. Place the electronic portion of the flow meter onto the prepared area of pipe, making sure that the flow direction arrow is pointing in the direction of flow. Place the clamp portion opposite the flow meter and secure with the enclosed screws. Only moderate torque is required on the screws—DO NOT OVER TIGHTEN and DO NOT ROTATE the flow meter on the pipe once the screws have been tightened.

E. Connect 11-30 Vdc to the power terminals within the FDT-30 transmitter. Ensure that the power supply is capable of sourcing a minimum of 0.25 Amps. Observe polarity.

F. Connect either the 4-20mA, pulse output or both outputs to the data acquisition or monitoring system as required.

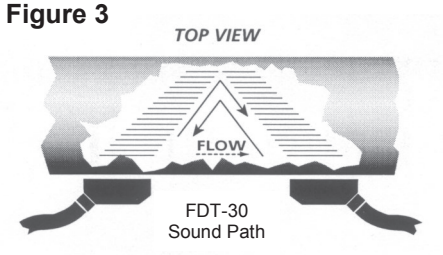
G. Apply power.

H. If the pipe is full of liquid, a flow rate reading will appear. If the pipe is empty or partially empty, a ERROR 0010 will be shown on the display. The error will clear when flow resumes and the pipe fills up with water.

INTRODUCTION AND OPERATING THEORY

FDT-30 transit time flow meters measure flow velocity by sending pulses of ultrasound energy back and forth between two piezoelectric devices. See **Figure 3**. The piezoelectric components are located behind the oval-shaped, dark plastic sound guides that are embedded in the flow sensor clamp. If the liquid inside of the pipe is moving, the sound will travel faster when it is sent in the direction of liquid flow than it will when it is sent against the liquid flow. The FDT-30 microprocessor generates the pulses and measures the elapsed time required for the sound to travel between the piezoelectric devices. Liquid velocity is proportional to the difference in time between upstream and downstream time measurements. The FDT-30 compensates for gas content in the liquid and will remove gaseous content from flow rate and totalizer readings. Outputs from the flow meter include 4-20 mA analog, turbine frequency output/pulse output.

Figure 3



SPECIFICATIONS/OPERATING CONDITIONS

For a complete table of specifications, contact Omega.

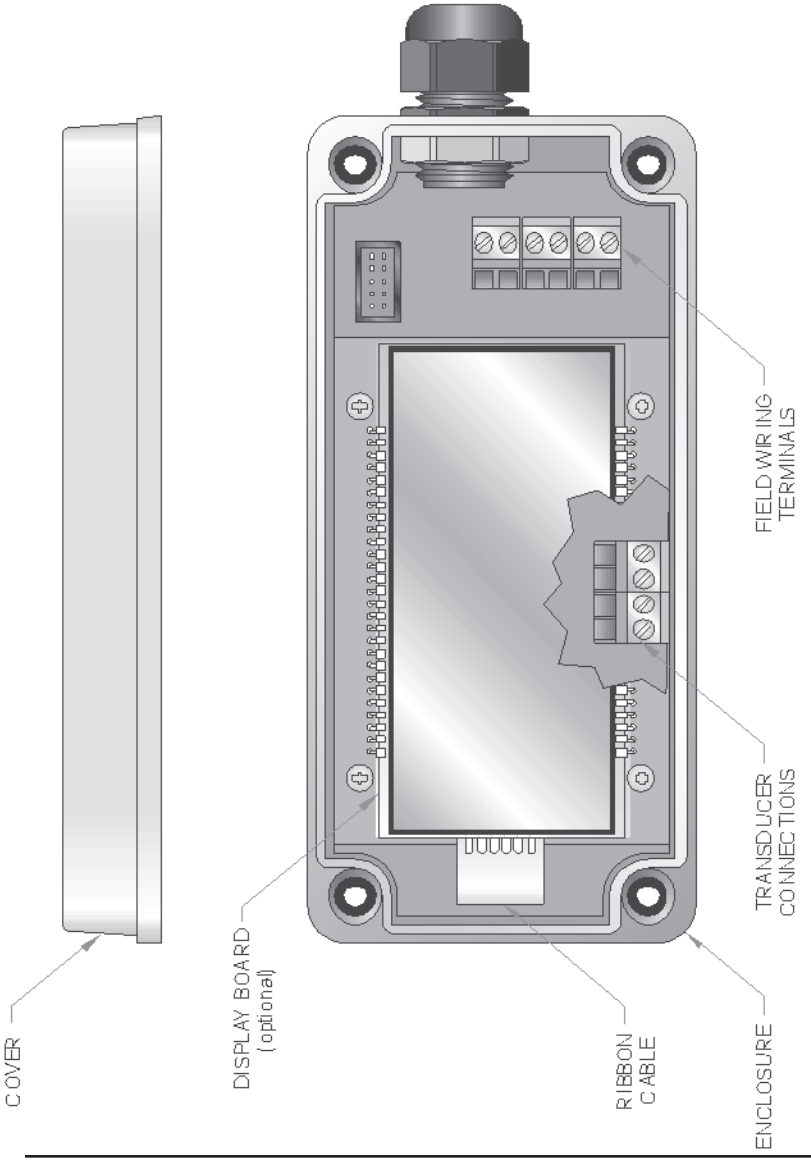
Description	Specification
Input Voltage	11-30 VDC @ 0.25A
Flow Range Reference	0.1 to 40 FPS [0.03 to 12.4 MPS]
Sch 40 ½" Pipe	0.5 to 25 GPM [20 to 850 BPD]
Sch 40 ¾" Pipe	1.0 to 55 GPM [40 to 1800 BPD]
Sch 40 1" Pipe	2.0 to 100 GPM [80 to 3400 BPD]
Sch 40 1¼" Pipe	4.0 to 150 GPM [170 to 5000 BPD]
Sch 40 1½" Pipe	5.0 to 220 GPM [170 to 7500 BPD]
Sch 40 2" Pipe	8.0 to 400 GPM [275 to 13500 BPD]
Accuracy	±1% of rate above 1 FPS [0.3 MPS]
Environment	Indoor use
Ambient Temperature	General Purpose: 0 to +185°F [-20 to +85°C] Hazardous Area: 0 to +105°F [-20 to +40°C
Altitude	Up to 2000 meters
Humidity	-20º to 31ºC; 80% max; decreasing linearly to 50% at 40ºC
Transient Overvoltages	According to installation category 1, in accordance with IEC 664
Pollution Degree	2 in accordance with IEC 664
Enclosure Material	ABS/Polycarbonate
4-20 mA Output	12-bit, sourcing, DC ground referenced
Pulse Output	Turbine Frequency Output/Pulse Output—Switch Selectable, non-ground referenced AC/Ground referenced square wave, 0-1,000 Hz, 100mVpp minimum/5VDC.

SYMBOL EXPLANATIONS

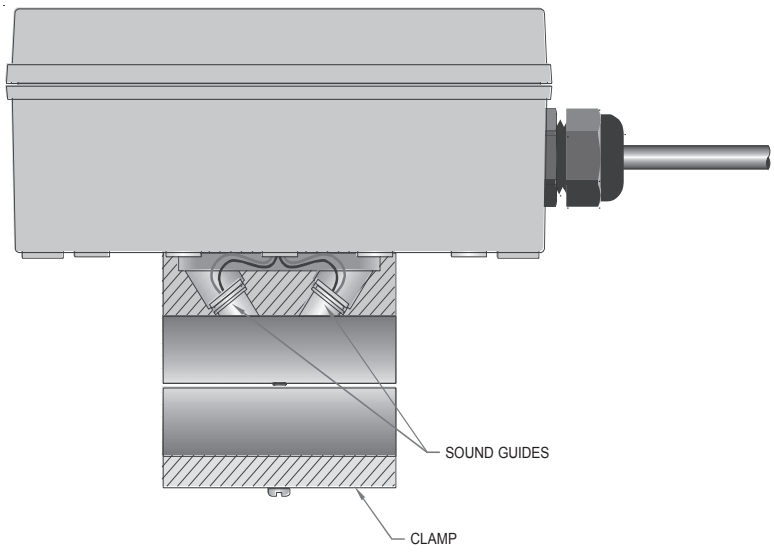

Caution—Refer to accompanying documents

FLOW METER COMPONENTS AND TERMINOLOGY

The pictures on the following two pages reference key components and their respective terminology of the FDT-30 flow meter. These terms are utilized throughout this manual.



TERMINOLOGY


SOUND GUIDES
CLAMP

FLOW METER INSTALLATION

IMPORTANT NOTE:
Not following instructions properly may impair safety of equipment and/or personnel.

IMPORTANT NOTE:
Must be operated by a power supply suitable for the location.

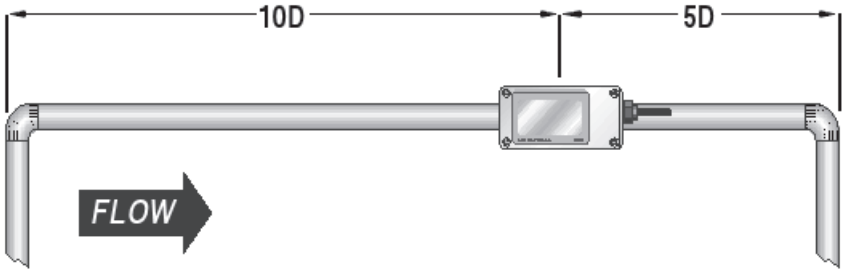
IMPORTANT NOTE:
Do not connect or disconnect either power or outputs unless the area is known to be non-hazardous.

A. FLOW METER LOCATION

The first step in the installation process is the selection of an optimum location for the flow measurement to be made. For this to be done effectively, a basic knowledge of the piping system and its plumbing is required.

An optimum location would be defined as a piping system that is completely full of liquid when measurements are being taken and has lengths of straight pipe such as those described in **Figure 4**. The optimum straight pipe diameter recommendations apply to pipes in both horizontal and vertical orientation.

Note: If adequate straight plumbing cannot be provided the FDT-30 will operate repeatably, but will most likely not achieve ideal accuracy.

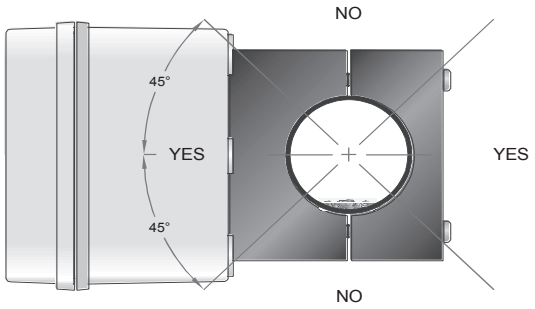


FLOW METER MOUNTING

Figure 4
Straight Pipe Recommendations

B. MOUNTING ORIENTATION ON THE PIPE

If the flow meter is applied to horizontal pipe, choose a mounting position within approximately 45-degrees of 3 o'clock or 9 o'clock on the pipe, assuming 12 o'clock to be to top of the pipe. These positions provide optimum acoustic penetration into the moving liquid. As illustrated in **Figure 5,** placement at the top or bottom of the pipe can result in poor sound penetration due to air pockets (on the top of the pipe) or sediment (at the bottom of the pipe).



FLOW METER MOUNTING ORIENTATION

Figure 5 Mounting Orientation on Horizontal Pipes

It is best to plumb and orient the piping system so that it will be completely full of liquid at all times—whether the liquid is flowing or not. Typically, by slightly sloping the pipe in the upward direction or orienting the check valve judiciously within the piping system this can be accomplished.

If the flow meter is applied to vertical pipe with flow moving in an upward direction, radial orientation does not matter.

C. PIPE PREPARATION

Before the transducer face can be coupled to a pipe surface, an area slightly larger than the flat surface of the transducer must be cleaned to bare metal on the pipe. Remove all scale rust and paint. Thoroughly dry and clean the mounting surface.

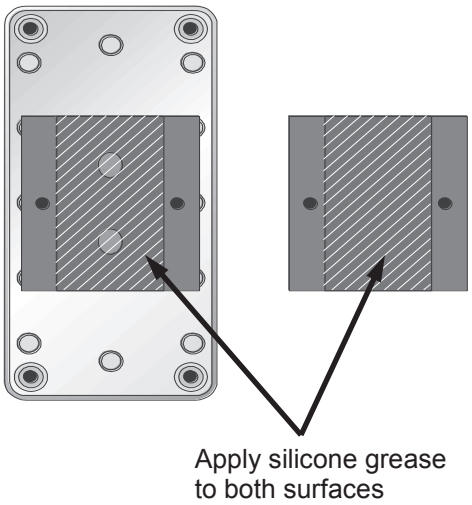
Note: For plastic pipes, such as PVC or PVDF, pipe preparation is typically not required.

D. APPLYING ACOUSTIC COUPLANT

To assure an acoustically conductive path between the transducer face and the prepared pipe surface, a coupling compound is employed. Enclosed with the FDT-30 flow meter is a tube of silicone based grease. This grease is adequate for the majority of installations. If an alternate grease is utilized, the grease must be specified not to flow at the temperature of the pipe surface or the ambient conditions.

Apply an even layer of grease, approximately 1/16" [1.5 mm] thick to the entire inside surface of the transducer. See **Figure 6**.

Figure 6
Applying
Acoustic Couplant



E. MOUNTING THE FLOW METER

Place the flow meter on the prepared area of the pipe, observing the flow direction arrow on the side of the flow meter enclosure. Place the flow meter clamp on the backside of the pipe and secure with the two enclosed screws. Tighten only enough to hold the flow meter in place and to squeeze some of the acoustic couplant from the mounting faces. Over tightening may strip the threads and is unnecessary for flow meter operation.

IMPORTANT NOTE: Do not rotate the FDT-30 flow meter on the pipe once the screws have been tightened, as the acoustic grease may be disturbed. If the grease layer between the sound guides and the pipe obtains an air pocket, the flow meter signal strength and, hence, operation may be compromised.

If upon power up the flow meter indicates ERROR 0010 and the pipe is full of liquid, reapplication of the acoustic grease will be necessary.

F. FIELD WIRING—GENERAL

The FDT-30 is equipped with a single conduit hole located in the flow meter enclosure that should be suitable for most installations. A sealed cord grip or conduit connection should be utilized to retain the NEMA 3 integrity of the flow meter enclosure. Failure to do so will void the manufacturer's warranty and can lead to product failure.

For hazardous area installation, see the drawing at back of this manual. For non-hazardous location installations, flow meter power and output signals can be carried by a single cable with multiple conductors. Select a 20-24 AWG shielded cable with an external jacket suitable for the installation environment and either 2, 4, or 6 conductors—dependent on the electronic output requirements.

Wiring methods and practices are to made in accordance with the NEC—National Electrical Code® and/or other local ordinances that may be in affect. Consult the local electrical inspector for information regarding wiring regulations.

When making connections to the field wiring terminals inside of the flow meter, strip back the wire insulation approximately 0.25

inches [6 mm]. Stripping back too little may cause the terminals to clamp on the insulation and not make good contact. Stripping back too much insulation may lead to a situation where the wires could short together between adjacent terminals. Wires should be secured in the Field Wiring Terminals using a screw torque of between 0.5 and 0.6 Nm.

G. FIELD WIRING—POWER

IMPORTANT NOTE:
Must be operated by a power supply suitable for the location.

IMPORTANT NOTE:
Do not connect or disconnect either power or outputs unless the area is known to be non-hazardous.

Power for the FDT-30 flow meter is obtained from a direct current DC power source. The power source should be capable of supplying between 11 and 30 Vdc at a minimum of 0.25 Amps or 250 milliamps. With the power from the DC power source disabled or disconnected, connect the positive supply wire and ground to the appropriate field wiring terminals in the flow meter. See **Figure 7**. A wiring diagram decal is located on the inner cover of the flow meter enclosure.

If the flow meter is only to be utilized as a flow rate indicator or totalizer, no further wiring will be required. Skip to step J.

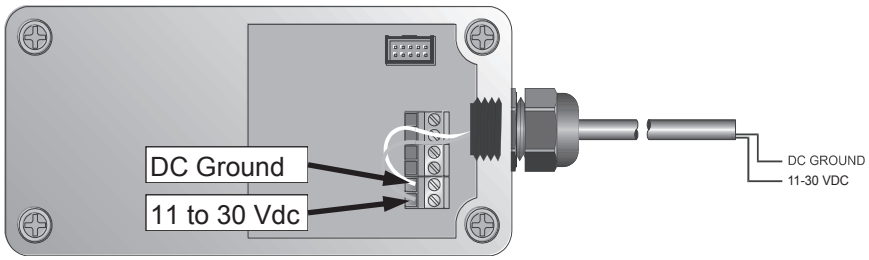


Figure 7
DC Power Connection

H. CONNECTING THE 4-20 mA OUTPUT

The FDT-30 is equipped with a ground-referenced 4-20 mA output—the output shares a common ground with the power supply. The output transmits a continuous current output that is proportional to liquid flow rate. The output was scaled at the factory and the scaling information is recorded on the label located on the side of the FDT-30 enclosure. To ensure that the instrument or data acquisition system that is receiving the 4-20 mA signal responds properly, it must be spanned identically to the FDT-30.

The 4-20 mA output is designed to source current across a loop resistance that is typically located within a data acquisition system or other receiving instrument. The maximum resistance that the FDT-30 can accommodate is directly related to the DC power source that is powering the flow meter and the 4-20 mA loop. **Chart 1** illustrates the range of load resistance that can be used with a given power supply voltage. Ensure that the loop load resistance is within the shaded region of the graph, or non-linearity and transmitting errors will occur.

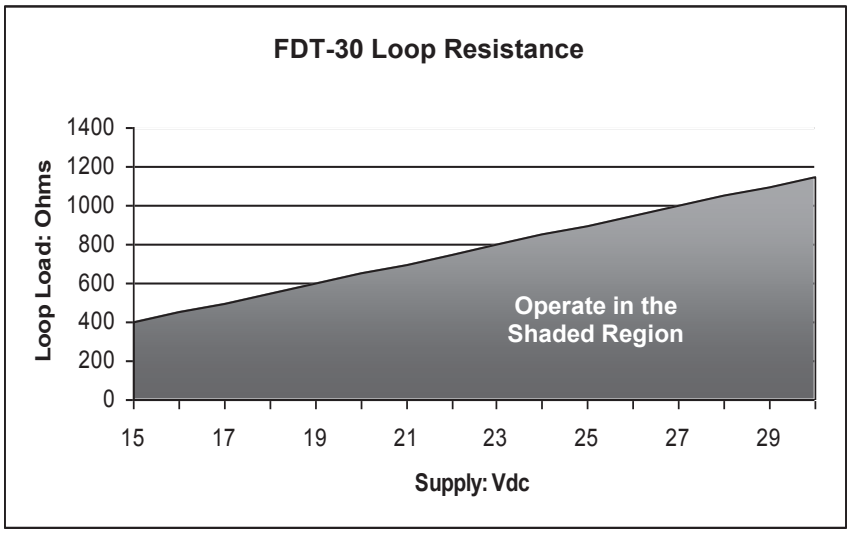


Chart 1
4-20 mA Loop Load

The 4-20 mA output is polarized and since the output shares the DC common with the power supply, reversing the connections can cause a short circuit in the DC power circuit. **Figure 8** shows a block diagram of how the 4-20 mA interfaces with the receiving device.

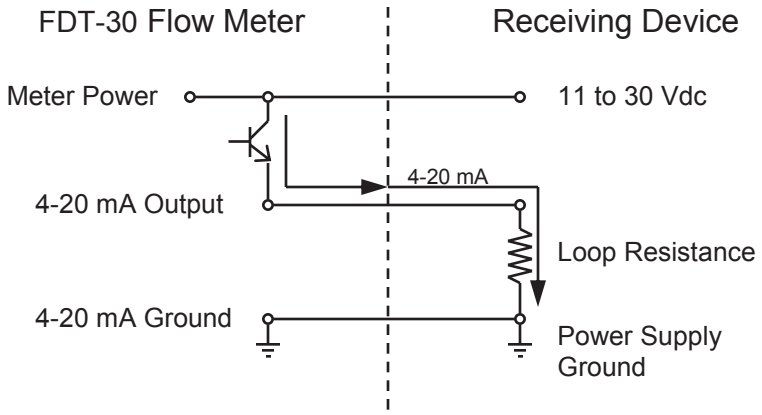


Figure 8
4-20 mA Block Diagram

Connect the wires to the appropriate Field Wiring Terminals within the FDT-30 enclosure. See **Figure 9**.

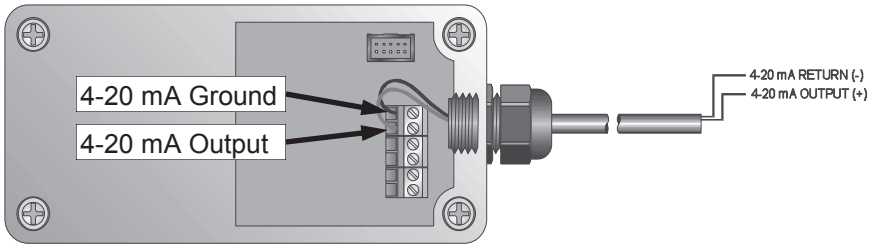


Figure 9
4-20 mA Connections

I. CONNECTING THE PULSE OUTPUT

The FDT-30 is equipped with a circuit that outputs a pulse waveform that varies proportionally with flow rate. The quantity of pulses per unit volume of liquid is described by the K-factor that is recorded on the side of the flow meter enclosure. To ensure that accurate readings are being recorded by the receiving instrument, the FDT-30 and the receiving instrument must have identical K-factor values programmed into them.

Two pulse output options are available with the FDT-30:

- Turbine meter simulation—This option is utilized when a receiving instrument is capable of interfacing directly with a turbine flow meter's magnetic pickup. The output is a relatively low voltage AC signal that is not ground referenced. The minimum AC amplitude is approximately 500 mV peak-to-peak. The FDT-30 is configured for turbine simulation if the third character after the first dash number in the model number is a "1". Dip switch SW1 must be in the off or open position. See **Figure 10**.
- TTL pulse frequency—This option is utilized when a receiving instrument requires that the pulse voltage level be either of a higher potential and/or referenced to DC ground. The output is a square-wave with a peak-to-peak voltage swing of 5 volts. The FDT-30 is configured for TTL pulse frequency if the third character after the first dash number in the model number is a "2". Dip switch SW1 must be in the on or closed position. This option is selected by placing SW1 in the OFF position. See **Figure 10**.

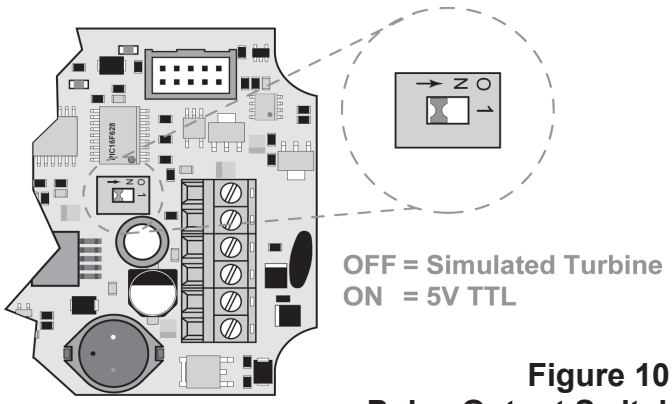


Figure 10
Pulse Output Switch Positions

Turbine Meter Simulation Output Connection

Connection of the turbine meter simulation output is simply a matter of connecting the two Field Wiring Terminals to the turbine meter input terminals on the receiving instrument and verifying that the K-factor listed on the side of the FDT-30 enclosure is programmed into the receiving instrument. This output is not referenced to DC ground and is not polarized, so wiring polarity is not important. See **Figure 11**.

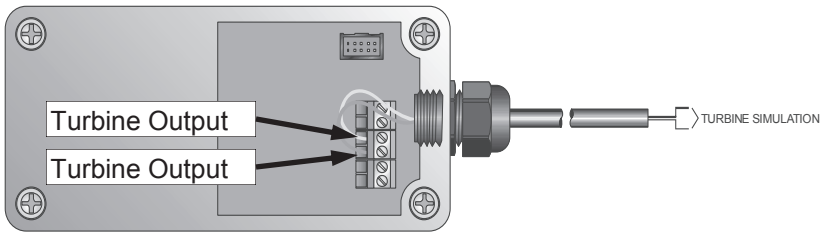


Figure 11
Turbine Meter Simulation Connections

TTL Pulse Frequency Connection

Connection of the TTL pulse frequency output is a matter of connecting the two Field Wiring Terminals to the frequency input terminals on the receiving instrument and verifying that the K-factor listed on the side of the FDT-30 enclosure is programmed into the receiving instrument. This output is referenced to DC ground and is polarized. Connect the TTL Pulse plus (+) field terminal in the flow meter to the frequency input on the receiving instrument. Connect the TTL Pulse negative (-) field terminal to the frequency input negative or DC common connection in the receiving instrument. See **Figure 12**.

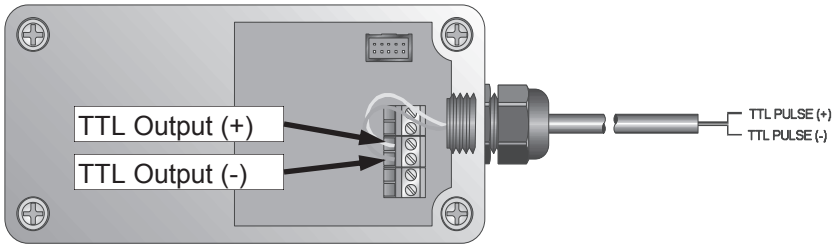


Figure 12
TTL Pulse Output Connections

J. APPLYING POWER TO THE FDT-30

The FDT-30 flow meter requires a full pipe of liquid before a successful startup can be completed. Do not attempt to make adjustments or change configurations until a full pipe is verified.

1. Verify that all wiring is properly connected and routed as described in Steps A though I of this manual.
2. Verify that the flow sensor is properly mounted and that the acoustic grease is intact between the transducer faces and the pipe.
3. Apply power. The display of the FDT-30 will display a display test where all segments will illuminate in succession and then the software version will be displayed. The meter will then enter RUN Mode.

4. Upon entering RUN Mode, the FDT-30 will provide one of the following responses:

   - The display may indicate ERROR 0010, which indicates low signal strength. Low signal strength is caused by one of the following:

     ⇒ an empty pipe (gas locked)

     ⇒ gas content in the liquid that exceeds 10%

     ⇒ inadequate acoustic grease between the flow meter transducer and the pipe

     ⇒ a broken connection between a transducer and the main circuit board—check wire terminations under the display.

   - The display may indicate a flow rate.

     ⇒ If 0.000 is indicated, it means that the meter is operating properly, but that the liquid is not moving.

     ⇒ A negative value would indicate that flow is moving backwards—against the flow direction arrow. A standard FDT-30 will not output flow signals under this condition.

     ⇒ The flow meter indicates flow rate. This verifies that signal strength is adequate and that the flow is moving in the direction that the flow arrow signifies.

TROUBLESHOOTING GUIDE

Unit does not turn "ON" when power is applied	• Verify that voltage in the range of 11-30 Vdc is present at the field terminals. • If the voltage is present and neither LED on the main printed circuit board is illuminated, return the flow meter to the factory for evaluation.
Unit reads zero flow when flow is actually running	• Verify that the Maximum Flow Rate value is not set to a very high value and causing the Flow Cutoff percent entry to drive the readings to zero. Decrease Max Flow setting or decrease Flow Cutoff percentage. • Verify that a zero was not entered on page 3 of the calibration screen.
ERROR 0010 is Displayed on the Screen	• The flow meter is not mounted onto the pipe using an acoustic couplant. • The acoustic couplant is not uniform between the flow meter transducer and the pipe. • The liquid contains more than 10% suspended gas bubbles. • The pipe is full of gas—gas locked.
Flow Meter Reads Negative Flow Readings	• Flow is running backwards when compared to the FLOW DIRECTION arrow located on the side of the flow meter enclosure.
Flow Meter is Reading Flow, But Output Is Not Transmitting	• Verify that one of the LEDs on the main printed circuit board is flashing—if not, contact Omega. • Verify connections and polarity of wiring. • Test output with a milliamp meter, oscilloscope or other test instrument. • Verify that the output is configured for RATE (Figure 16).

WARRANTY/DISCLAIMER

OMEGA ENGINEERING, INC. warrants this unit to be free of defects in materials and workmanship for a period of **13 months** from date of purchase. OMEGA's WARRANTY adds an additional one (1) month grace period to the normal **one (1) year product warranty** to cover handling and shipping time. This ensures that OMEGA's customers receive maximum coverage on each product.

If the unit malfunctions, it must be returned to the factory for evaluation. OMEGA's Customer Service Department will issue an Authorized Return (AR) number immediately upon phone or written request. Upon examination by OMEGA, if the unit is found to be defective, it will be repaired or replaced at no charge. OMEGA's WARRANTY does not apply to defects resulting from any action of the purchaser, including but not limited to mishandling, improper interfacing, operation outside of design limits, improper repair, or unauthorized modification. This WARRANTY is VOID if the unit shows evidence of having been tampered with or shows evidence of having been damaged as a result of excessive corrosion; or current, heat, moisture or vibration; improper specification; misapplication; misuse or other operating conditions outside of OMEGA's control. Components in which wear is not warranted, include but are not limited to contact points, fuses, and triacs.

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RETURN REQUESTS/INQUIRIES

Direct all warranty and repair requests/inquiries to the OMEGA Customer Service Department. BEFORE RETURNING ANY PRODUCT(S) TO OMEGA, PURCHASER MUST OBTAIN AN AUTHORIZED RETURN (AR) NUMBER FROM OMEGA'S CUSTOMER SERVICE DEPARTMENT (IN ORDER TO AVOID PROCESSING DELAYS). The assigned AR number should then be marked on the outside of the return package and on any correspondence.

The purchaser is responsible for shipping charges, freight, insurance and proper packaging to prevent breakage in transit.

FOR **WARRANTY** RETURNS, please have the following information available BEFORE contacting OMEGA:

1. Purchase Order number under which the product was PURCHASED,
2. Model and serial number of the product under warranty, and
3. Repair instructions and/or specific problems relative to the product.

FOR **NON-WARRANTY** REPAIRS, consult OMEGA for current repair charges. Have the following information available BEFORE contacting OMEGA:

1. Purchase Order number to cover the COST of the repair,
2. Model and serial number of the product, and
3. Repair instructions and/or specific problems relative to the product.

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pH/CONDUCTIVITY

- pH Electrodes, Testers & Accessories
- Benchtop/Laboratory Meters
- Controllers, Calibrators, Simulators & Pumps
- Industrial pH & Conductivity Equipment

DATA ACQUISITION

- Data Acquisition & Engineering Software
- Communications-Based Acquisition Systems
- Plug-in Cards for Apple, IBM & Compatibles
- Datalogging Systems
- Recorders, Printers & Plotters

HEATERS

- Heating Cable
- Cartridge & Strip Heaters
- Immersion & Band Heaters
- Flexible Heaters
- Laboratory Heaters

ENVIRONMENTAL MONITORING AND CONTROL

- Metering & Control Instrumentation
- Refractometers
- Pumps & Tubing
- Air, Soil & Water Monitors
- Industrial Water & Wastewater Treatment
- pH, Conductivity & Dissolved Oxygen Instruments

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