User's Guide

Series FD613
Ultrasonic Flow Meter

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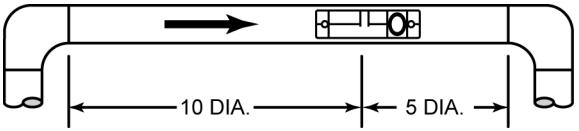
QUICK-START INSTRUCTIONS

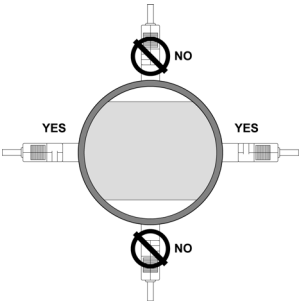
This manual contains detailed operating instructions for the FD613 instrument. The following condensed instructions are provided to assist an experienced operator in basic operation of the instrument. If the operator is unfamiliar with this type of instrument, refer to the detailed explanations located at the corresponding letter on pages 8-11.

A. Select a transducer mounting location at least 10 pipe diameters downstream and 5 diameters upstream of flow disturbances (i.e. elbows, tees, valves, etc.)



STEP A

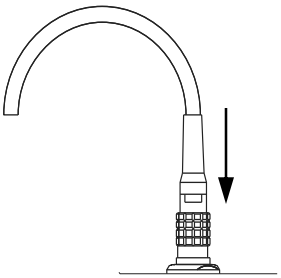
B. On horizontal pipe, choose a transducer mounting location approximately 90 degrees from the top of the pipe.



STEP B

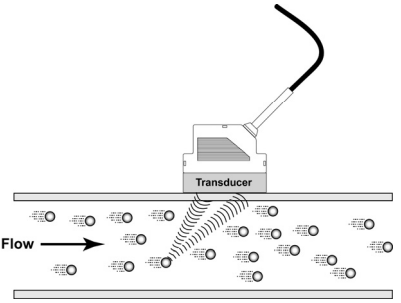
C. Remove rust, scale and paint from the transducer mounting location. Clean to bare metal. Plastic pipes do not require preparation.

D. Plug the transducer plug into the transducer jack.



STEP D

E. Apply approximately ⅛" (3mm) silicone grease to the transducer face. Place the transducer face on the prepared area of pipe. Hold the transducer parallel to the pipe with the cable pointing downstream of the flow direction.



STEP E

F. Press the ON/OFF key. Wait at least 30 seconds before recording a reading. The FD613 will automatically turn itself off after 3 minutes.

STEP F

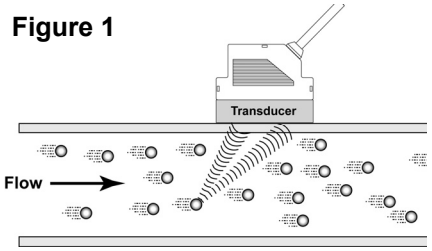
G. Change units of measure by pressing the FT/SEC - M/SEC key.

INTRODUCTION AND OPERATING THEORY

Series FD613 Phase Shift Flow Meters feature advanced *Trans-Phase* measuring technology, providing accurate and reliable flow velocity assessments in closed piping systems. The FD613 utilizes a non-invasive transducer which is hand-held or strapped to the outside of a pipe. Within seconds, the large 0.7 inch [18mm] LCD provides stable readings in either FPS (Feet per Second) or MPS (Meters per Second). This product is designed to operate on metal, plastic or rubber pipes containing liquids with greater than 100 ppm of suspended solids or entrained gases that act as reflectors.

Phase Shift flow meters utilize two piezoelectric crystals contained within one transducer to transmit ultrasonic sound energy into the fluid stream and receive reflected sound from reflectors (suspended solids or entrained gases) within the liquid. See **Figure 1.** In accordance with the theories of Christian Johann Doppler (circa 1842), if the liquid is moving (and therefore carrying the reflectors with it) and oscillating energy is imposed on the moving reflector, the reflected energy's frequency of oscillation will be altered with respect to the transmitted frequency. The magnitude of frequency change is directly proportional to the velocity of the reflector.

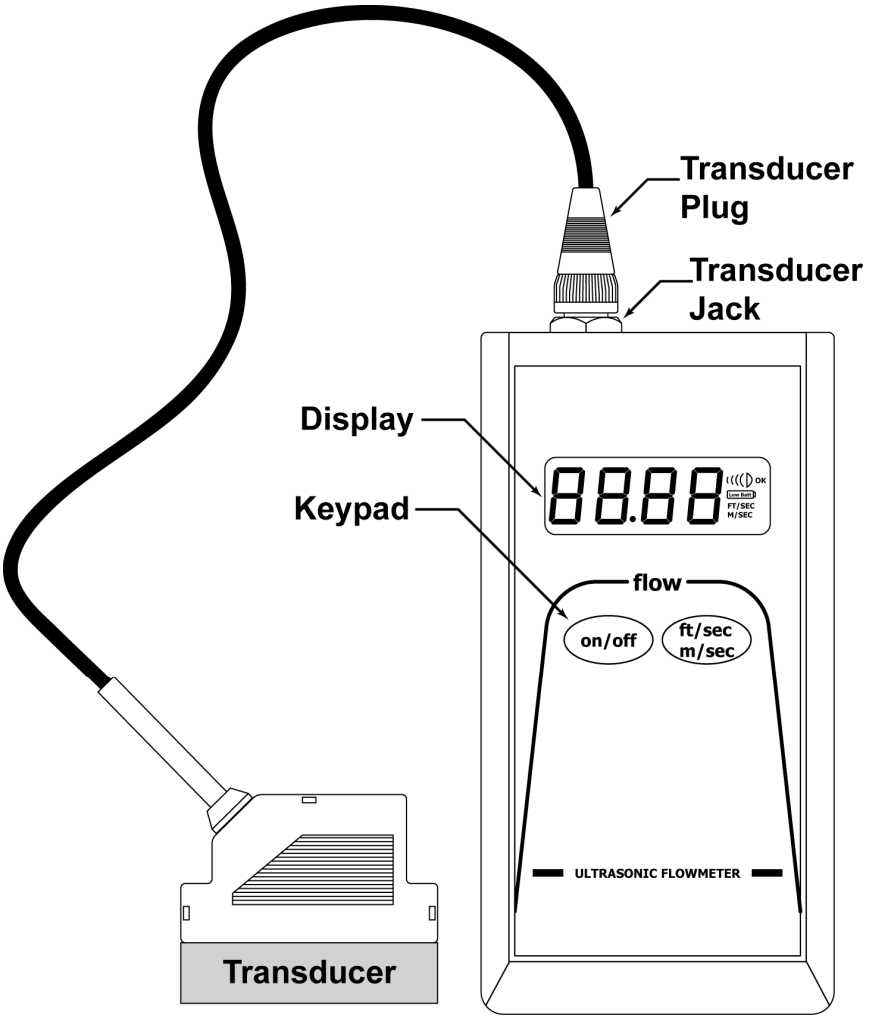
Figure 1



SPECIFICATIONS

Description	Specification
Power	Four AA alkaline cells provide over 30 hours of operation
Flow Range	0.30 to 30.00 FPS [0.10 to 9.00 MPS]
Temperature	Electronics: -28°F to +140°F [-20°C to +60°C] Transducer: -40°F to +180°F [-40°C to +82°C]
Enclosure Rating	NEMA 12X, splash resistant
Accuracy	±2% full scale
Transducer Mount	Hand-held (clamp on), utilize acoustic couplant such as DOW 111

CONTROLS AND TERMINOLOGY

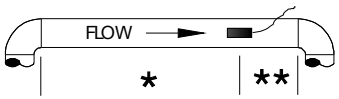
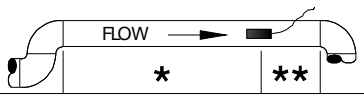
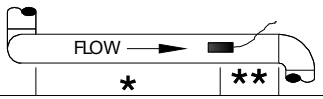
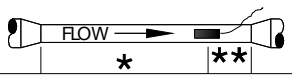
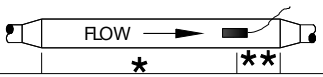
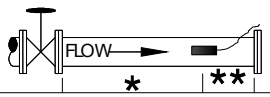


Note: The FD613 battery compartment is located on the back of the enclosure. Remove the two upper screws to gain access to the battery compartment.

A. TRANSDUCER LOCATION

Selecting the proper location for taking a flow measurement is the single most critical step in the operational procedure. The transducer utilized by the FD613 flow meter contains two piezoelectric crystals for transmitting and receiving ultrasonic signals through the wall of a pipe. Select a transducer location with adequate straight runs (without flow disturbances) of pipe, both upstream and downstream, to achieve stable and accurate readings. Examples of common piping configurations and the recommended minimum upstream and downstream pipe lengths are included in **Table 1**.

Table 1

Piping Configuration and Transducer Position	Upstream Dimension: Pipe Diameters *	Downstream Dimension: Pipe Diameters **
	9	3
	14	3
	24	4
	8	3
	8	3
	24	4

Note: If adequate straight plumbing cannot be provided the FD613 will operate repeatably, but will most likely not achieve ideal accuracy.

B. MOUNTING LOCATIONS ON THE PIPE

If the transducer is applied to horizontal pipe, choose a mounting position at approximately 3 o'clock or 9 o'clock, assuming 12 o'clock to be to top of the pipe. These positions typically provide optimum acoustic penetration into the moving liquid. As illustrated in **Figure 2,** 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).

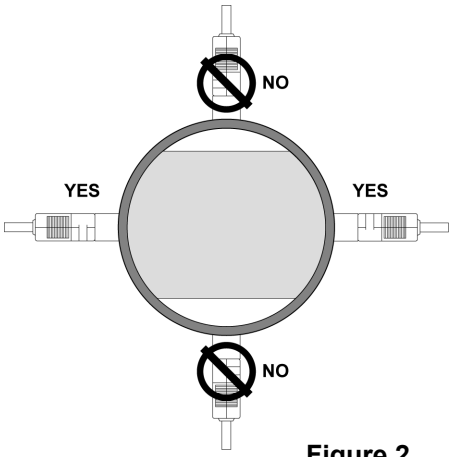


Figure 2

If the transducer is applied to vertical pipe, 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. CONNECTING THE TRANSDUCER

Connect the transducer plug into the transducer jack. The connection is polarized, so alignment of the keyway is necessary.

NOTE: The splash-resistant environmental seal is provided only when the transducer plug is secured into the transducer jack. It is advisable to make this connection before entering an area where the FD613 may be dropped into or splashed with liquid.

E. APPLYING THE TRANSDUCER

To ensure an acoustically conductive path between the transducer face and the prepared pipe surface, a coupling compound is employed. Enclosed with the FD613 flow meter is a tube of Dow Corning 111 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 ⅛" (3 mm) thick to the flat surface of the transducer. Place the transducer on the prepared area of the pipe, with the cable pointing downstream. See **Figure 3**. Align the transducer with the pipe, ensuring that it is parallel with the pipe wall. Apply only enough pressure to hold the transducer in place. If no reading is shown, perform a "rub test" by rubbing thumb across the dry transducer head. The zeros should display a low flow reading. See Troubleshooting Guide for further recommendations.

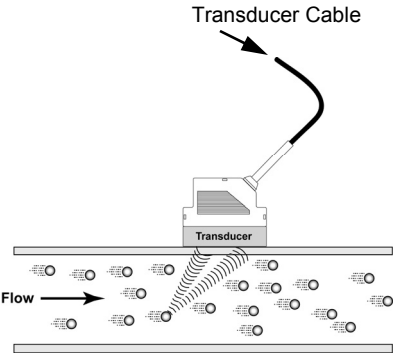


Figure 3

F. OBTAINING A READING

Press the ON/OFF key on the keypad. On power up, the FD613 performs internal diagnostics and starts the ultrasonic transmitter. The display will read **Hold** for approximately 5 seconds during this time. If the transducer is properly mounted to a pipe containing flowing liquid with at least 100 ppm of 100 micron or larger particles or entrained gases, the display will begin to indicate velocity. The default units of measure are FPS (feet per second). The response time of the FD613 is approximately 10 seconds to obtain a reading. Adequate signal strength is obtained when the OK icon appears in the upper right corner of the display. See **Figure 4.** Readings taken without this icon present may be erroneous. It is recommended that survey readings of at least 30 seconds be taken to ensure reading stability.

Figure 4

The FD613 can be turned off by pressing the ON/OFF key on the keypad, or the unit will automatically turn off after approximately 3 minutes of operation.

G. CHANGING UNITS OF MEASURE

Toggle between FPS (feet per second) and MPS (meters per second) by depressing the FT/SEC - M/SEC key on the keypad.

H. CONVERSION FROM VELOCITY TO VOLUME

The velocity readings taken from the FD613 can be readily converted to volumetric flow rate measurements such as GPM (gallons per minute) or LPM (liters per minute). A chart is located on page 13 of this manual that contains conversions for many popular schedule 40 pipe sizes. If the pipe size is not located in this chart, use the following equations:

- For conversion to GPM (pipe I.D. in inches):

$$\mathbf{GPM = FT/SEC \times 2.448 \times I.D.^2}$$

- For conversion to LPM (pipe I.D. in millimeters):

$$\mathbf{LPM = M/SEC \times 0.047 \times I.D.^2}$$

I. LOW BATTERY INDICATION

When the power supply batteries become drained to a level of 4 volts, the LOW BAT icon will illuminate on the right-hand side of the display. Typical alkaline batteries will provide about 2 hours of operation after the LOW BAT icon turns on. The flow meter will no longer operate when battery voltage is less than 3.5 volts. At 3.5 volts and lower, an **Err1** will be displayed and then unit will shut off.

Replace the batteries by removing the two screws located on the upper portion of the enclosure back. Install four fresh AA alkaline batteries following the polarity indicated within the battery compartment and replace the battery cover. A fresh set of alkaline batteries will provide approximately 30 hours of service. *Use of carbon-based batteries is not recommended.*

Do not allow discharged batteries to remain in the FD613 during storage. Discharged batteries can leak and may cause severe damage to the internal circuits of the FD613. **Damage caused by leaking batteries will not be covered under the manufacturer's warranty.**

J. DISPLAY TEST

The FD613 contains software to verify operation of the individual LCD segments. To run the display test, turn the FD613 off. Press and hold the FT/SEC - M/SEC key, then press the ON/OFF key. Release both keys and verify that all segments illustrated in **Figure 4** illuminate. The FD613 firmware version number (FX.XX) is displayed at the end of the test.

TROUBLESHOOTING GUIDE

Unit does not turn "ON" when ON/OFF key is pressed	• Verify that batteries are installed and contain a charge.
"Err1" is indicated	• The batteries must be replaced.
No display readings are obtained and no "OK" icon is observed	• Poor acoustic coupling to pipe. Apply silicone grease to transducer. • Ensure pipe is full of a flowing liquid. • If the pipe has a plastic liner, move the transducer to another location. The liner may contain an air void. • Non-working transducer. Rub transducer head with thumb for reading. • Liquid contains less than 3% total suspended solids. • Move transducer closer to a source of flow disturbance. (i.e. an elbow, pump outlet or control valve.)
Dashes appear on display	• Liquid velocity is greater than 30 FPS (9 MPS).
Readings are obtained, but the "OK" icon does not turn on.	• Signal strength is low. Flow readings may be erroneous. Move the transducer closer to a source of hydraulic disturbance.
Erroneous Readings	• Transducer mounted incorrectly. • Another local ultrasonic instrument is operating at approximately the same frequency as the FD613. • Excessive pipe vibration. • Very viscous (thick) liquids will cause the unit to read lower than actual flow. • The pipe is not completely full of liquid.

LIQUID VELOCITY TO VOLUME CONVERSION CHART

		FPS TO GPM CROSS - REFERENCE (Schedule 40)																
NOM. PIPE SIZE	I.D INCH	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6	6.5	7	7.5	8	8.5	9
1	1.05	2.6989	4.0484	5.3978	6.7473	8.097	9.4462	10.796	12.145	13.49	14.844	16.19	17.54	18.89	20.24	21.59	22.941	24.29
1.25	1.38	4.662	6.9929	9.3239	11.655	13.99	16.317	18.648	20.979	23.31	25.641	27.97	30.3	32.63	34.96	37.3	39.627	41.958
1.5	1.61	6.3454	9.5182	12.691	15.864	19.04	22.209	25.382	28.555	31.73	34.9	38.07	41.25	44.42	47.59	50.76	53.936	57.109
2	2.07	10.489	15.734	20.979	26.224	31.47	36.713	41.958	47.202	52.45	57.692	62.94	68.18	73.43	78.67	83.92	89.16	94.405
2.5	2.47	14.935	22.402	29.87	37.337	44.8	52.272	59.74	67.207	74.67	82.142	89.61	97.08	104.5	112	119.5	126.95	134.41
3	3.07	23.072	34.608	46.144	57.68	69.22	80.752	92.288	103.82	115.4	126.9	138.4	150	161.5	173	184.6	196.11	207.65
3.5	3.55	30.851	46.276	61.702	77.127	92.55	107.98	123.4	138.83	154.3	169.68	185.1	200.5	216	231.4	246.8	262.23	277.66
4	4.03	39.758	59.636	79.515	99.394	119.3	139.15	159.03	178.91	198.8	218.67	238.5	258.4	278.3	298.2	318.1	337.94	357.82
5	5.05	62.43	93.645	124.86	156.07	187.3	218.5	249.72	280.93	312.1	343.36	374.6	405.8	437	468.2	499.4	530.65	561.87
6	6.06	89.899	134.85	179.8	224.75	269.7	314.65	359.6	404.55	449.5	494.45	539.4	584.3	629.3	674.2	719.2	764.14	809.09
8	7.98	155.89	233.83	311.78	389.72	467.7	545.61	623.56	701.5	779.4	857.39	935.3	1013	1091	1169	1247	1325.1	1403
10	10.02	245.78	368.67	491.56	614.45	737.3	860.23	983.12	1106	1229	1351.8	1475	1598	1720	1843	1966	2089.1	2212
12	11.94	348.99	523.49	697.99	872.49	1047	1221.5	1396	1570.5	1745	1919.5	2094	2268	2443	2617	2792	2966.5	3141
14	13.13	422.03	633.04	844.05	1055.1	1266	1477.1	1688.1	1899.1	2110	2321.1	2532	2743	2954	3165	3376	3587.2	3798.2
16	15	550.8	826.2	1101.6	1377	1652	1927.8	2203.2	2478.6	2754	3029.4	3305	3580	3856	4131	4406	4681.8	4957.2
18	16.88	697.52	1046.3	1395	1743.8	2093	2441.3	2790.1	3138.8	3488	3836.3	4185	4534	4883	5231	5580	5928.9	6277.7

SPARE PARTS AND ACCESSORIES

PART NUMBER	DESCRIPTION
D002-2007-001	SS Mounting Strap, 36 inch (900 mm)
D002-2007-002	Nylon Mounting Strap, 30 inch (750 mm)
FDT-GREASE	Couplant, Silicone (for temporary mounting)
FD613-S1	Series FD613 Small Pipe Transducer
FD613-S2	Series FD613 Standard Pipe Transducer
M-3238	Series FD613 Operations Manual
D003-1009-005	FD613 Carrying Case

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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