

# Doppler Flow Meter

UFX Handheld Battery-Powered Meter



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## SCOPE OF THIS MANUAL

This manual is divided into two main sections:

- “Quick-Start Operating Overview” on page 3 is intended to help you get the UFX flow meter up and running quickly. Refer to the detailed instructions if you require additional information.
- The remaining chapters provide a detailed description of all software settings and hardware installation guidance.

### IMPORTANT

Read this manual carefully before attempting any installation or operation. Keep the manual accessible for future reference.

## UNPACKING AND INSPECTION

Upon opening the shipping container, visually inspect the product and applicable accessories for any physical damage such as scratches, loose or broken parts, or any other sign of damage that may have occurred during shipment.

**NOTE:** If damage is found, request an inspection by the carrier’s agent within 48 hours of delivery and file a claim with the carrier. A claim for equipment damage in transit is the sole responsibility of the purchaser.

## SAFETY

### Terminology and Symbols



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



Indicates a hazardous situation, which, if not avoided, is estimated to be capable of causing minor or moderate personal injury or damage to property.

## QUICK-START OPERATING OVERVIEW

This manual contains detailed operating instructions for the UFX flow meter. 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 in this document.

1. Select a transducer mounting location at least 10 pipe diameters downstream and 5 diameters upstream of flow disturbances (such as elbows, tees and valves).

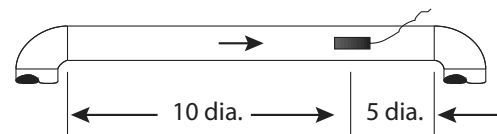


Figure 1: Pipe diameters

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

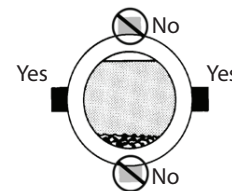


Figure 2: Transducer location on the pipe

3. Remove rust, scale and paint from the transducer mounting location. Clean to bare metal. Plastic pipes do not require preparation.
4. Plug the transducer plug into the transducer jack.

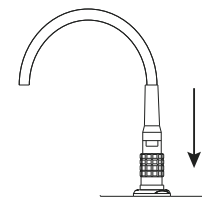


Figure 3: Transducer plug

- Apply approximately 1/8 inch (3 mm) of silicone grease to the transducer face. Place the transducer face on the prepared area of the pipe. Hold the transducer parallel to the pipe with the cable pointing downstream of the flow direction.

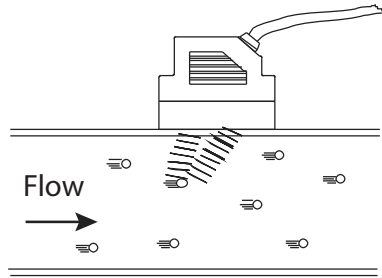


Figure 4: Operation

- Press the **ON/OFF** key. Wait at least 30 seconds before recording a reading. The UFX flow meter automatically turns off after 3 minutes.
- To change units of measure, press the **FT/SEC M/SEC** key.

## INTRODUCTION AND OPERATING THEORY

The UFX Doppler Flow Meter features provides flow velocity readings in closed piping systems with suspended solids or entrained gases in liquids. The UFX flow meter uses a non-invasive transducer, which is handheld or strapped to the outside of a pipe. The meter 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.

Doppler flow meters use 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 4*. When the liquid is moving and carrying the reflectors with it, and ultrasonic waves are transmitted on the moving reflector, the reflected wave's frequency will be altered with respect to the transmitted frequency. The magnitude of frequency change is directly proportional to the velocity of the reflector.

## CONTROLS AND TERMINOLOGY

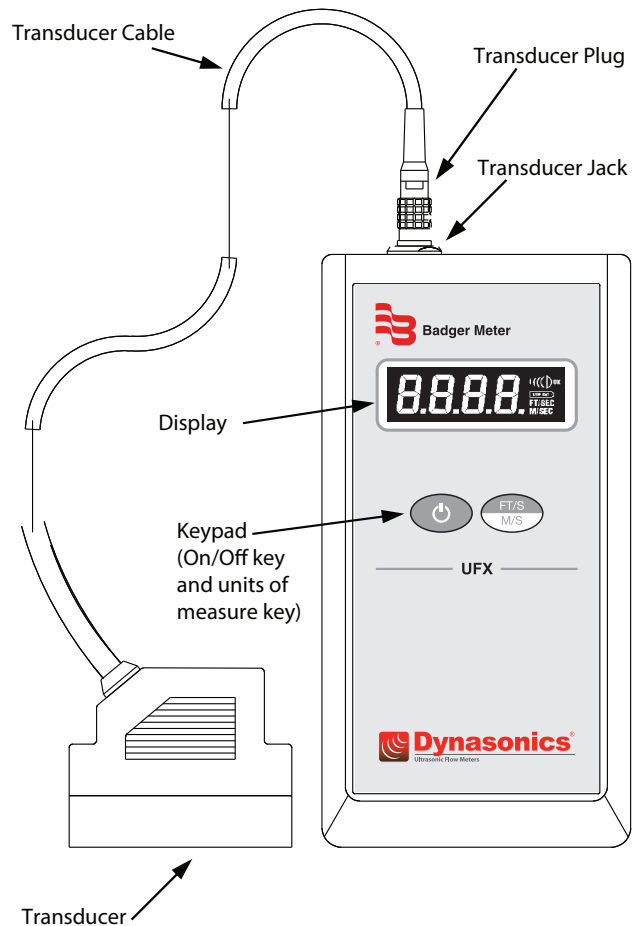


Figure 5: Controls

**NOTE:** The UFX flow meter's battery compartment is on the back of the enclosure. Remove the two upper screws to gain access to the battery compartment.

## TRANSDUCER LOCATION

Selecting the proper location for taking a flow measurement is the single most critical step in the operational procedure. The transducer used by the UFX 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*.

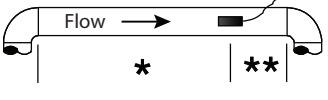
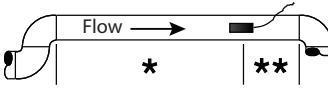
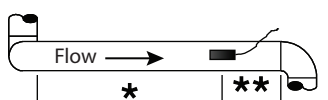
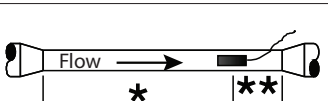
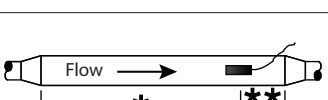
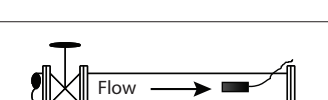
Piping Configuration and Transducer Position	Upstream Dimension	Downstream Dimension
	Pipe Diameters	Pipe Diameters
	*	**
	9	3
	14	3
	24	4
	8	3
	8	3
	24	4

Table 1: Transducer location

## MOUNTING LOCATIONS ON THE PIPE

If the transducer is applied to horizontal pipe, choose a mounting position at approximately 90 degrees from the top of the pipe. These positions typically provide optimum acoustic penetration into the moving liquid. As shown in *Figure 6*, 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).

If the transducer is applied to vertical pipe, orientation does not matter.

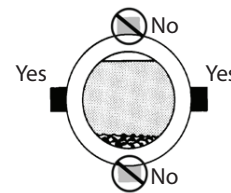


Figure 6: Transducer location on the pipe

## 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.

## 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 UFX flow meter may be dropped into or splashed with liquid.

## APPLYING THE TRANSDUCER

To provide an acoustically conductive path between the transducer face and the prepared pipe surface, use the coupling compound (Dow Corning 111 silicone-based grease) supplied with the UFX flow meter. This grease is adequate for the majority of installations. If an alternate grease is used, 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 1/8 inch (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. Align the transducer with the pipe so 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 your thumb across the dry transducer head. The screen should display a low flow reading. See the “*Troubleshooting Guide*” on page 7 for further recommendations.

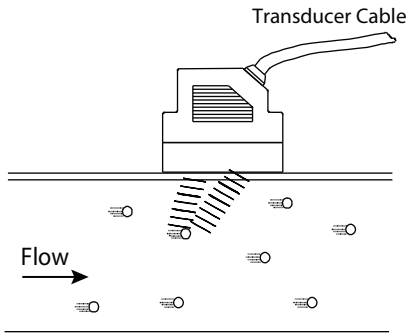


Figure 7: Operation

## OBTAINING A READING

Press the ON/OFF key on the keypad. On power up, the UFX flow meter 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 FT/S (feet per second). The response time of the UFX flow meter 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 8. Readings taken without this icon present may be erroneous. It is recommended that survey readings of at least 30 seconds be taken to provide reading stability. The UFX flow meter 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.



Figure 8: Reading

## CHANGING UNITS OF MEASURE

Toggle between FT/S (feet per second) and M/S (meters per second) by pressing the **FT/SEC M/SEC** key.

## CONVERSION FROM VELOCITY TO VOLUME

The velocity readings taken from the UFX flow meter can be readily converted to volumetric flow rate measurements such as GPM (gallons per minute) or LPM (liters per minute). See the “*Liquid Velocity to Volume Conversion Chart*” on page 8 for conversions of 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):  
 $GPM = FT/SEC \times 2.448 \times I.D.^2$
- For conversion to LPM (pipe I.D. in millimeters):  
 $LPM = M/SEC \times 0.047 \times I.D.^2$

## 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 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.

### ⚠ CAUTION

**DO NOT ALLOW DISCHARGED BATTERIES TO REMAIN IN THE UFX FLOW METER DURING STORAGE. DISCHARGED BATTERIES CAN LEAK AND MAY CAUSE SEVERE DAMAGE TO THE INTERNAL CIRCUITS OF THE UFX FLOW METER. DAMAGE CAUSED BY LEAKING BATTERIES WILL NOT BE COVERED UNDER THE MANUFACTURER’S WARRANTY.**

## DISPLAY TEST

The UFX flow meter contains software to verify operation of the individual LCD segments. To run the display test:

1. Turn off the UFX flow meter.
2. Press and hold the **FT/SEC M/SEC** key, then press the **ON/OFF** key.
3. Release both keys and verify that all segments illustrated in *Figure 8* illuminate.

The UFX 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	<ul style="list-style-type: none"> <li>• Poor acoustic coupling to pipe. Apply silicone grease to transducer.</li> <li>• Ensure pipe is full of a flowing liquid.</li> <li>• If the pipe has a plastic liner, move the transducer to another location. The liner may contain an air void.</li> <li>• Non-working transducer. Rub transducer head with thumb for reading.</li> <li>• Liquid contains less than 3% total suspended solids.</li> <li>• Move transducer closer to a source of flow disturbance (i.e. an elbow, pump outlet or control valve).</li> </ul>
Dashes appear on display	Liquid velocity is greater than 30 FT/S (9 M/S).
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	<ul style="list-style-type: none"> <li>• Transducer mounted incorrectly.</li> <li>• Another local ultrasonic instrument is operating at approximately the same frequency as the UFX flow meter.</li> <li>• Excessive pipe vibration.</li> <li>• Very viscous (thick) liquids will cause the unit to read lower than actual flow.</li> <li>• The pipe is not completely full of liquid.</li> </ul>



# LIQUID VELOCITY TO VOLUME CONVERSION CHART

Nom. Pipe Size	I.D. (inch)	Dynasonics			FPS to GPM Cross-Reference (Schedule 40)													
		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	17.97	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	20.6446	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	16.144	57.68	69.00	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	4.5.8	437	468.2	499.4	530.65	561.87
6	6.06	89.899	164.85	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	167.7	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

## SPECIFICATIONS

Liquid Requirements	100 ppm of 100 micron size suspended solids or entrained gases
Pipe Sizes	Std. 1" (25 mm) and greater Small pipe 1/4"...1" (6...25 mm)
Flow Range	0.3...30 fps (0.1...9 mps)
Accuracy	±2% of full scale
Display	Single line, four digit LCD readout of velocity, signal strength, measuring units, and low battery indication
Enclosure Rating Dimensions	NEMA 4 (IP65) ABS plastic; 1.5 lb (0.7 kg) 4" W x 7.7" H x 1.7" D (101.6 mm x 195.6 mm x 43.2 mm)
Transducer Material	Plated body; Ultem® 1000 sensor material
Ambient Temperature	-28...140° F (-20...60° C)
Liquid Temperature	-40...180° F (-40...82° C)
Humidity	0...95% non-condensing
Supply Voltage	Battery powered; non-rechargeable alkaline, four AA cells; providing greater than 30 hours of operation
Cable	6.6 feet (2 m) cable and connector
Mounting Method	Handheld with acoustic couplant compound

## PARTS AND ACCESSORIES

Nylon Mounting Strap 30" (750 mm)	D002-2007-002
Couplant, Silicone (for temporary mounting)	D002-2011-001
SS Identification Tag	D001117
UFX Standard Pipe Transducer	DTUFX-D1
UFX Small Pipe Transducer	DTUFX-B1
UFX Carrying Case	D003-1009-005
Velocity Conversion Slide Chart	D003-0913-002

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