DOPPLER ULTRASONIC FLOW METER

Series DFX Ultrasonic Doppler Flow Meters measure the flow of liquids that contain sound reflectors—suspended solids or gas bubbles—greater than 35 micron size. The DFX software automatically adjusts filtering parameters and gain settings so that reliable readings are ensured over a wide range of liquid and reflector conditions. DFX is housed in a NEMA 4X (IP-66) enclosure and is configured by the user via the front panel keypad. A two-line backlit LCD displays rate and accumulated flow values in user selected measuring units. Power supply options include AC or DC operation and output options include 4-20mA, rate pulse and dual relay.

Two transducer types are available with the DFX meter:
Series DT9 clamp-on, non-intrusive transducer is recommended for use on most pipes constructed from metal or plastic. The DT9 is rated to NEMA 6P (IP-68) and has the ability to work with temperatures up to +400 °F (+200 °C).
Series DP7 hot-tappable insertion probe transducer is available for installations on pipe systems that do not permit ultrasound penetration. The DP7 inserts into the pipe wall and directly contacts the flowing liquid.

Both transducer types can be located up to 990 feet (300 meters) from the DFX display enclosure utilizing RG59 coaxial cable.

FEATURES

- Non-intrusive, clamp-on transducers for most pipes from ¼” (6 mm) and above.
- Minimal installation time: the DFX may be installed and fully operational within minutes. For most homogeneous pipe materials, there is no need to break into pipelines.
- Minimal material costs: clamp-on sensor eliminates the need for in-line flanges, pipe fittings, strainers, or filters.
- Wide measuring range: 0.15 to 30 FPS (0.05 to 9 MFS).
- Inherent immunity to VFD and other electronic/ultrasonic noise.
- Microprocessor-based system; configuration and accumulation data stored in non-volatile flash ROM.

- Hot tappable Insertion probe transducer available for concrete, FRP/GRP, or woodstave pipes.
- Reduced down-time: installation may be performed on full pipes and active systems – there is no need to shut the process down for installation or maintenance.
- Lower maintenance costs: with no moving parts, there is nothing on the DFX to wear down.
- Provision for multiple meters on a single pipe manifold installation.
- Accuracy ±2% full scale over calibrated span.
- Flexibility: with automatic gain control and in-field linearization, the DFX will adapt to a wide variety of applications.

800.535.3569  www.dynasonics.com
**PRINCIPLE OF OPERATION / TRANSDUCER OPTIONS**

The DFX flow meter operates by transmitting ultrasonic sound from its transmitting transducer through the pipe wall or from the probe tip into the flowing liquid. Each transducer and probe tip contains piezoelectric crystals to transmit this signal. The sound will be reflected by useful sonic reflectors (See "Product Applications" page) suspended within the liquid and recorded by the receiving transducer (see Figure 1). If the reflectors are moving within the sound transmission path, sound waves will be reflected at a frequency shifted (Doppler shift) from the transmitted frequency. The difference between the reflected frequencies and transmitted frequencies is directly proportional to the speed of the sonic reflectors, resulting in a liquid flow rate that is converted to various user defined measuring units.

**Clamp-On Transducer Options**

- **Standard temperature**
  - Standard pipe system (DT94)
  - Standard temperature
  - Standard pipe system (DT96)

- **High temperature**
  - Standard pipe system (DT95)
  - High temperature
  - Small pipe system (DT97)

**DFX Hazardous Area Installation**

- DP7 Doppler Probe
- DT9 Clamp-on Transducer
- Class I Div 2 Groups C & D T3 Area
- General Purpose Area
- Armored Conduit
# Specifications

## General

<table>
<thead>
<tr>
<th>Description</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measuring Principle</td>
<td>Doppler Ultrasonic</td>
</tr>
<tr>
<td>Flow Velocity Range</td>
<td>0.15-30 FPS (0.05-9 MPS)</td>
</tr>
<tr>
<td>Accuracy</td>
<td>±2% full scale, over calibrated span</td>
</tr>
<tr>
<td>Liquid Types</td>
<td>Liquids containing a minimum of 100 ppm of useful sonic suspended reflectors greater than 35 micron size, and at least 25% of the overall particle volume is larger than 100 microns (See “Product Applications” page for details)</td>
</tr>
</tbody>
</table>

## Monitor

<table>
<thead>
<tr>
<th>Description</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enclosure</td>
<td>NEMA 4X (IP-66), polycarbonate, stainless steel, brass, plated-steel mounting brackets 7.90H x 5.75W x 3.88D inches (178H x 146W x 98D mm)</td>
</tr>
<tr>
<td>Power Supply</td>
<td>115/230 VAC 50/60 Hz ±15% @ 5 VA Max; 12-28 VDC @ 2.5 VA Max</td>
</tr>
<tr>
<td>Display</td>
<td>2 line x 8 character LCD; LED backlighting; Top row 7-segment 0.7 inch (18 mm); Bottom row 14-segment 0.35 inch (9 mm); 8-digit rate 8-digit total (resettable)</td>
</tr>
<tr>
<td>Units</td>
<td>User configured - feet, gallons, ft³, Mil-gal, meters, liters, Mil ft³, m³, Mil-liters, acre-feet, oil barrels (42 gallon), liquid barrels (32.5 gallons), lbs., Kg</td>
</tr>
<tr>
<td>Rate Interval</td>
<td>Second, minute, hour, day. Totalizer exponent: E-2 to E+6 (x 1/100 to x 1,000,000)</td>
</tr>
<tr>
<td>Response Time</td>
<td>User selectable: 6-60 seconds</td>
</tr>
<tr>
<td>Outputs</td>
<td>4-20mA: 800 ohms max; internal or external power supply; 12-bit resolution; optically isolated Dual Relay: independently configured; Form C, 200 VAC @ 0.5 A resistive; rate alarm, totalizer pulse, error</td>
</tr>
<tr>
<td>Multiple Meters</td>
<td>Synchronization provision included—utilized for multiple meter, single pipe/ manifold system. Up to four meters may be interconnected, up to 100 feet (30 meters) apart.</td>
</tr>
<tr>
<td>Keypad</td>
<td>Four keys, tactile</td>
</tr>
<tr>
<td>Ambient Conditions</td>
<td>-40 °F to +185 °F (-40 °C to +85 °C)</td>
</tr>
<tr>
<td>Approvals</td>
<td>(Std.) General Purpose, CE meets the requirements of IEC 61326-1 Ed.1.0 b:2005 (Opt.) General Purpose certified by QPS to CSA 22.2 No. 142-87; CEC (2006)</td>
</tr>
</tbody>
</table>

## Transducers

<table>
<thead>
<tr>
<th>Description</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>Compression-mode Ultrasonic; 625 kHz</td>
</tr>
<tr>
<td>Housing Material</td>
<td>Standard Clamp-On: NEMA 6P (IP67) -40 °F to +210 °F (-40 °C to +100 °C) CPVC, Ultem®, Nylon, PVC (Cable Jacket), Aluminum (small pipe) High Temp Clamp-On: NEMA 4 (IP65) -40 °F to +400 °F (-40 °C to +200 °C) Vespel®, Anodized Aluminum, Nickel-plated brass, Teflon® (Cable Jacket) Doppler Probe: NEMA 6 (IP67) -40 °F to +210 °F (-40 °C to +100 °C); 700 PSI (48 Bar) Max. 316 Stainless Steel, Ultem®, Viton®, Nylon, PVC (Cable Jacket) Optional Flexible Armored Conduit: Zinc-plated steel, PVC</td>
</tr>
<tr>
<td>Pipe Sizes</td>
<td>Standard Clamp-On Transducers: 1 inch (25 mm) and above Small Pipe Clamp-On Transducers: ¼ to 1 inch (6 to 25 mm) Probe Transducers: 4 to 120 inch (101 to 3050 mm)</td>
</tr>
<tr>
<td>Cable Length</td>
<td>Standard Lengths: 20, 50 and 100 Feet (6, 15, 30 m) Optional Lengths: to 990 Feet (300 m)</td>
</tr>
<tr>
<td>Installation</td>
<td>General Purpose; (Opt.) Class I Division 2, Groups C and D, T3 area certified to CSA C22.2 No. 213-87m (99), CAN/CSA C60079-15:02</td>
</tr>
</tbody>
</table>
PART NUMBER CONSTRUCTION

**DDFX Digital Doppler Ultrasonic Flow Transmitter**

- **DDFXD 2 - □ □ □ □ □ A - □ □ □ □**
  - **Transmitter Type:**
    - 2) Rate and Totalizer
  - **Power Supply:**
    - A) 115 VAC
    - B) 230 VAC
    - E) 12-28 VDC
  - **Input/Output 1:**
    - N) None
    - 1) 4-20mA
    - 2) Dual Relay
    - 3) Rate Pulse
  - **Input/Output 2:**
    - N) None
    - 1) 4-20mA
    - 2) Dual Relay
    - 3) Rate Pulse
  - **Totalizer:**
    - A) Eight digit resettable
  - **Approvals:**
    - N) General purpose, CE approved
    - C) Certified to CSA standards

**DT9 Clamp-On Doppler Ultrasonic Transducer Set**

- **DT9 □ □ □ □ □ □ □ □**
  - **Transducer Type**
    - 4) Std temp/Std pipe
    - 5) Std temp/small pipe
    - 6) High temp/Std pipe
    - 7) High temp/small pipe
  - **Cable Length**
    - 020) 20' (6 m)
    - 050) 50' (15 m)
    - 100) 100' (30 m)
    - Maximum length: 990' (300 m) in 10' (3 m) increments
  - **Conduit Type**
    - N) None
    - A) Flexible armored
  - **Conduit Length**
    - 000) 0' (0 m)
    - 020) 20' (6 m)
    - 050) 50' (15 m)
    - 100) 100' (30 m)
    - Maximum length: 990' (300 m) in 10' (3 m) increments

*Std Temp: Maximum (+210 °F) (+100 °C)
High Temp: Maximum (+400 °F) (+200 °C)
Small Pipe: ¼"-1" (6 mm - 25 mm)
Std. Pipe: 1" (25 mm) and above

**DP7 Insertion Doppler Probe**

- **DP7 □ □ □ □ □ □ □ □**
  - **Probe Length**
    - 1) 8' (200 mm)*
    - 2) 18' (457 mm)
    - 3) 26' (711 mm)
    - 4) 38' (965 mm)
    - 5) 48' (1220 mm)
    - Consult factory for longer lengths
  - **Cable Length**
    - 020) 20' (6 m)
    - 050) 50' (15 m)
    - 100) 100' (30 m)
    - Maximum length: 990' (300 m) in 10' (3 m) increments
  - **Conduit Type**
    - N) None
    - A) Flexible armored
  - **Conduit Length**
    - 000) 0' (0 m)
    - 020) 20' (6 m)
    - 050) 50' (15 m)
    - 100) 100' (30 m)
    - Maximum length: 990' (300 m) in 10' (3 m) increments

*Cannot be used with hot tap assembly.
Note: All DP7 probes include a seal fitting for mounting in 1-½" NPT. Isolation Valve Kits are available for hot-tapped applications. Insertion/Retraction crank tools are available, consult factory.
PRODUCT APPLICATIONS / APPLICATION QUALIFICATION

Applications
- Sewage - Wastewater
- Paper Stock
- Primary Sludge
- RAS and WAS
- Dredging
- Carbonated liquids
- Mining slurry
- Drilling mud
- Coal-seam water

Successful application of Doppler ultrasonic flow meters relies on three physical constraints:

1. The liquid flowing within the pipe must contain 100 ppm of useful sonic suspended reflectors – dissolved solids do not generate reflections and are not relevant.
   - The speed of sound of the reflector must vary by greater than 10% from that of the liquid carrier.
   - Particles must be large enough to cause longitudinal reflection. Particles greater than 35 micron size meet this criteria.
   - In typical applications, there is often a distribution of particle sizes. If the volume of particles greater than 100 microns is 25 percent of the overall particle volume, then the reflectors are adequate for a Doppler ultrasonic flow meter.
   - The reflecting material must travel at the same velocity as the fluid for good accuracy. Upward flowing pipes running at low velocities may not carry heavier reflectors at the same velocity as the carrying liquid – leading to inaccurate flow measurements.

2. A significant portion of the ultrasound energy generated by the transducer must reach the sonic reflectors. In the case of a clamp-on transducer, the ultrasonic transducer must be acoustically coupled to the outside of a pipe (using grease or RTV couplant) and the pipe must permit ultrasound to pass without significant attenuation. Most pipes constructed of solid, homogenous materials meet this qualification. Pipes that cause application difficulty include concrete pressure pipes, woodstave pipes, Teflon®-lined pipes and fiberglass reinforced pipes. Pipes that do not readily pass ultrasound are candidates for the DP7 insertion probe transducer.

3. The pipe must be completely filled with liquid when measurements are made. The DFX microprocessor assumes that the pipe is completely full when it calculates flow rate. Use on partially-filled pipes may result in inaccurate readings.
DIMENSIONAL SPECIFICATIONS

MECHANICAL DIMENSIONS: INCHES (mm)

Series DFX

(3) 1/2" (m20) Conduit Holes

Power Connection

Transducer Connection

Input Output

Wall Mount

5.75 (146.1)

3.31 (79.5)

1.55 (39.4)

2.8 (71.1) DIA

(.35 (8.9)

6.08 (154.4)

6.74 (171.2)

.28 (7.11) DIA

(4 Places)

DT94

COAXIAL CABLES

1.91 (48.5)

4.38 (111.3)

1.70 (43.2)

DT95

COAXIAL CABLES

1.91 (48.5)

4.38 (111.3)

3.24 (82.3)

1.38 (35)

MAX PIPE DIA

DT96

COAXIAL CABLES

1.45 (36.8)

4.05 (102.9)

1.38 (35)

DT97

COAXIAL CABLES

1.45 (36.8)

4.05 (102.9)

2.85 (72.4)

1.38 (35)

MAX PIPE DIA

DP7 Insertion Probe

1.5 NPT

Wrench Flats 2.5 (64)

L

3.13 (81)

C

DUAL COAXIAL CABLES

DP7 Insertion Probe

Model | L Inches (mm) | C Inches (mm)
------|---------------|---------------
DP71  | 9.50 (241)    | 11.31 (287)   
DP72  | 19.50 (495)   | 21.31 (541) 
DP73  | 29.50 (749)   | 31.31 (795) 
DP74  | 39.50 (1003)  | 41.31 (1049) 
DP75  | 49.50 (1257)  | 51.31 (1303)