MULTIPLE-PIPE, MULTIPLE-PATH FLOWMETER

Series TFXM Multiple-Pipe, Multiple-Path Transit Time Flowmeters feature advanced non-invasive flow measurement technology – providing a measuring system with unsurpassed accuracy, versatility, low-cost of installation and low-cost of ownership. The TFXM system installs quickly onto liquid piping systems with its non-invasive, non-fouling transducers and can be configured and operational within minutes. Mathematical formulas can be applied to discrete flow measurements – up to eight discrete channels/pipes – to display and output average flow, flow difference, proportions or sums.

TFXM is designed for indoor and outdoor fixed installations and is designed to operate on both AC and DC power sources. The backlit graphics display provides four lines of user-selected flow information including rate, totalizer, liquid sound speed and signal strength – for any meter connected to the TFXM network. An integral optical interface is used with the optional Windows® ***ULTRA****LINK*™ software utility and allows simple in-field programming, calibration and software upgrades. All TFX systems utilize Dynasonics' proprietary dual time-base time expansion software algorithm, digital cross-correlation, optically isolated input-output and field replaceable communication modules.

TFX flow measurement systems are a cost effective versatile investment that can be readily configured for piping from 1 inch [25mm] to 100 inches [2540mm].

FEATURES

- **Use of the TFXM as a multiple-pipe flowmeter results in significantly lower cost per pipe versus the use of discrete meters on each pipe.**
- **Automatic Reynolds Number compensation assures accurate measurements through the laminar, transition and turbulent system flow regions.**
- **Non-invasive clamp-on transducers are simple and cost efficient to install. Since the transducers do not contact the liquid, fouling, pressure drop, leaks and maintenance are eliminated.**
- **The measurement range of the TFX system includes zero flow. Reading accuracy and reliability, especially at low flow rates, are improved versus mechanical, DP and vortex shedding flowmeter performance.**
- **Multiple-path, single-pipe installations assure accurate flow measurements without the need for long runs of straight pipe.**
- **User configurable rate and totalizer units include: feet, gallons, cubic feet, million gallons, barrels, acre feet, pounds, meters, liters, cubic meters, million liters and kilograms.**
- **Each measurement channel contains integral 4-20 mA, dual-relay and RS485 communications. Field replaceable output and communication module options include: 200,000-event data logger, rate pulse, RTD (see TFX BTU-Pro data sheet), and RS232C.**
- **An integral optical interface and optional Windows® software utility provide complete control of system configuration, calibration and diagnostics – without opening the NEMA 4X enclosure.**

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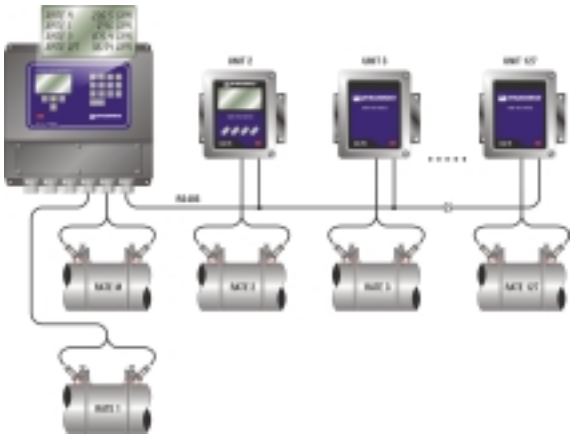
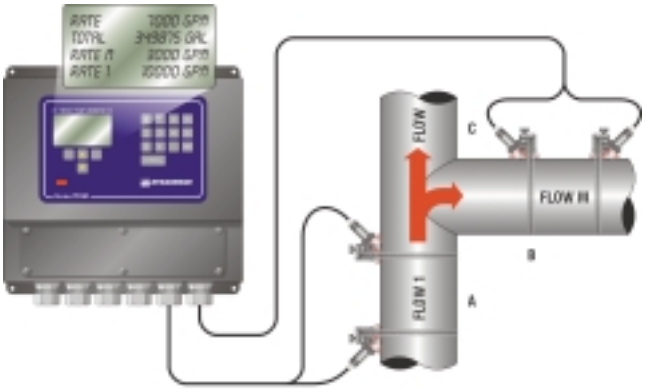
Product Configurations



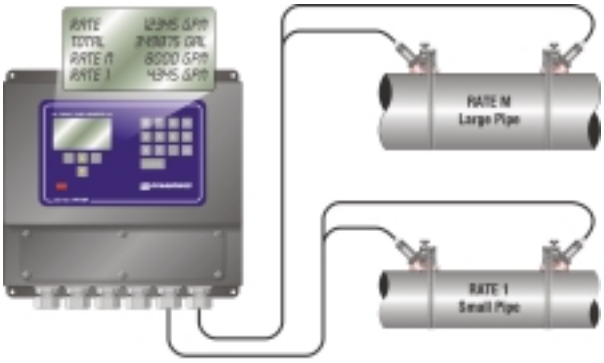
Multiple-Pipe Master Flowmeter

Multiple pipes can be configured and displayed on the TFXM console.



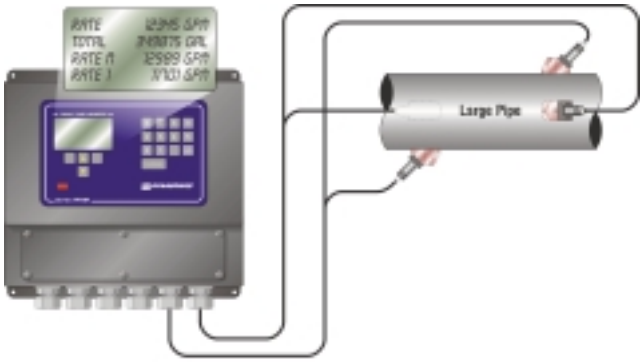
Multiple-Pipe Difference Flowmeter

Displays the actual flow of pipes and the difference flow of a non-measured pipe.



Multiple-Pipe Summation Flowmeter

Displays the actual flow of multiple pipes as well as the sum of the pipes.



Multiple-Path Single-Pipe Flowmeter

By averaging multiple paths on a single pipe, stability and accuracy of measurements can be improved.

ULTRALINK™ Software Utility

Real-Time Infrared Communications. *Configuration and calibration are quick and simple using* ***ULTRA****LINK*™ *and your PC. Dynasonics Infrared Serial Adapter (P.N. D005-2115-001) allows full programming access without the need to open the TFX enclosure or connect wires.*

Designed with the user/operator in mind, configuration and calibration of transit time ultrasonic flowmeters have never been as simple and straight forward as with Series TFX. Integration of your PC, the TFX flowmeter and ***ULTRA****LINK*™ provides the ultimate in operator control. ***ULTRA****LINK*™ is a software utility that operates on a Windows® PC operating system and communicates with TFX flowmeters through a serial communications port and infrared serial adapter. Since the communication link is infrared light, the user need only be within 10 feet [3 meters] of the TFX meter – interconnection wires and opening of the meter enclosure are not necessary.

Order Dynasonics P.N. D005-2115-100. Kit includes ***ULTRA****LINK*™ on a 3.5 inch diskette and one infrared serial adapter.

Note: TFXM does not require ***ULTRA****LINK*™ or the use of a computer for configuration. The software and computer are requirements for in-field calibration and some advanced functions of TFX systems.

MULTIPLE-PIPE, MULTIPLE-PATH FLOWMETER

Principles of Operation

TFX transit time flowmeters utilize two transducers, shown as elements A and B in Figure 1, which function as both ultrasonic transmitters and receivers. The transducers are clamped on the outside of a closed pipe at a specific distance from each other. (The transducers can be mounted in V-mode as shown in Figure 1, W-mode where the sound transverses the pipe four times, or in Z-mode where the transducers are mounted on opposite sides of the pipe. This selection is based on pipe and liquid characteristics.) The flowmeter operates by alternately transmitting and receiving a frequency modulated burst of sound energy between the two transducers. The burst is first transmitted in the direction of fluid flow and then against fluid flow. Since sound energy in a moving liquid is carried faster when it travels in the direction of fluid flow (downstream) than it does when it travels against fluid flow (upstream), a differential in the times of flight will occur. If the fluid is not moving, the time of flight difference will be zero and the flowmeter will indicate zero flow. The sound's time of flight is accurately measured in both directions and the difference in time of flight is calculated. The liquid velocity (V) inside the pipe can be related to the difference in time of flight (dt) through the following equation: V = K*D*dt, where K is a constant and D is the distance between the transducers.

Top View

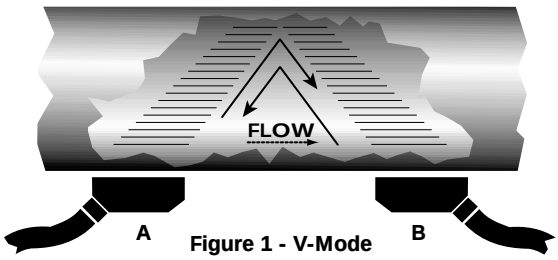


Figure 1 - V-Mode Configuration

Part Number Construction

Instrument

DTFXM ☐ - ☐ ☐ ☐ ☐ ☐ - ☐ ☐

Channels
1) One Internal Channel
2) Two Internal Channels

Power Supply
A) 115 VAC
B) 230 VAC
C) 100 VAC
E) 9-28 VDC

Channel 1 Input/Output
(RS485 is Standard on all Models)
1) 4-20 mA and Dual-Relay
2) Dual-Relay and One Option
3) 4-20 mA and One Option

Channel 1 Option Input/Output
N) None (If "1" is selected previously)
1) 4-20 mA (secondary)
2) Dual-Relay (secondary)
3) Rate Pulse
4) RS232
6) Data Logger
7) Heat Flow

Channel 2 Input/Output [TFXM2]
N) None—[TFXM1]
1) 4-20 mA and Dual-Relay
2) Dual-Relay and One Option
3) 4-20 mA and One Option

Approvals
N) Class 1 DIV2 (Pending)
X) Class 1 DIV1 (Pending)

Options
N) None

Channel 2 Input/Output [TFXM2]
N) None – [TFXM1 or if "1" is selected previously]
1) 4-20 mA (Secondary)
2) Dual-Relay (Secondary)
3) Rate Pulse
4) RS232
6) Data Logger
7) Heat Flow

Transducer

DTT ☐ - ☐ ☐ ☐ - ☐ ☐ ☐ ☐ - ☐

Construction
N) Standard [CPVC, Ultem®]
H) High Temp [Stainless, Vespel®]

Cable Length
020) 20 feet [6.1 m]
050) 50 feet [15 m]
100) 100 feet [30 m]
Maximum length: 990 feet [306 m] in 10 ft. [3 m] increments

Conduit Type
A) Flexible Armored
N) None

Conduit Length
(Standard Construction: Conduit Length = Cable Length)
000) None
020) 20 feet [6.1 m]
050) 50 feet [15 m]
100) 100 feet [30 m]
Maximum length: 990 feet [306 m] in 10 ft. [3 m] increments

Options
N) Standard
X) Intrinsically Safe

One tube of silicone couplant is included with a transducer order. Mounting straps are not included.

Stainless Steel Mounting Straps
P.N. D002-2007-001: 36 inches [0.92 m] long, and require some overlap.

Number of straps required (round up to the next even number) =

$$\frac{\text{Pipe Outside Diameter [inches]} \times 6.28}{32 \text{ inches}}$$

SPECIFICATIONS

TRANSMITTER

DESCRIPTION	SPECIFICATION
Power Requirements	10-28 VDC @ 8 VA max.; 115/230 VAC 50/60 Hz ±15% @ 14 VA max.
Velocity	-40 to +40 FPS [-12 to +12 MPS]
Outputs	All output modules are optically isolated from earth and system grounds
Standard (integrated)	**RS485** standard; choice of either **4-20 mA** and/or **Dual-Relay**
Optional (plug-in)	**4-20 mA** (secondary) 800 Ohms max.; 12-bit resolution; passive or active **Dual-Relay** (secondary) Two separate Form C relays, 200 VAC max. @ 0.5 A resistive **Pulse Output** FET output (open collector action), 0-2,500 Hz max., 1 A max. **RS232** data rate to 57.6K **Data Logger** 200,000-event, 16-bit, DB-9 connection, removable, can be removed and installed without disconnecting system power **Heat Flow** (see TFX BTU-Pro Data Sheet); Supports two 1000 Ω RTDs, multiplexed, 12-bit resolution
Display	128 x 64 pixel graphics LCD, LED back lit. Two user selectable font sizes 0.35" [8.9 mm] or 0.2" [5.0 mm]; configure for either two or four data lines
Data	The following data can be displayed for up to 8 pipes or paths: 8 digit rate, 8 digit totalizer, liquid sound speed, signal strength
Units: **Rate** **Totalizer**	User configured - feet, gallons, ft^3 , mil-gal, oil barrels, liquor barrels, acre-feet, lbs., meters, liters, m^3 , mil-liters, Kg Rate time: sec, min, hr, day Forward, reverse, batch and net total
Ambient Conditions	-40 to 185°F [-40 to 85°C], 0-95% relative humidity, non-condensing
Enclosure	NEMA 4, [IP-66] epoxy-coated steel, polycarbonate keypad and SS hardware. 11.0H x 11.4W x 4.1D inches [280H x 290W x 104D mm]; 11.5 lbs. [5.2 Kg]
Accuracy Flow Rate	±0.5% of reading at rates > 1 FPS [0.3 MPS] for field calibrated systems; ±1% of reading at rates > 1 FPS [0.3 MPS] uncalibrated ±|0.01 FPS [0.003 MPS]| at rates < 1 FPS [0.3 MPS]
Sensitivity	Flow: 0.001 FPS [0.0003 MPS]
Repeatability	±0.01% of reading
Response Time	Flow: 1-10 seconds, user configured, to 90% of value, step change in flow
Security	Keypad lockout, four-digit user selected access code

TRANSDUCER

DESCRIPTION	SPECIFICATION
Liquid Types Supported	Virtually all non-aerated homogeneous liquids
Transducer to Transmitter Distance	(Std) 20 to 100 feet [6 to 30 meters], (Opt) lengths to 990 feet [300 meters]
Pipe Sizes	(Std) 1 to 100 inches [25 to 2540 mm] pipe I.D.
Temperature	(Std) -40° to 300°F [-40° to 150°C]; (Opt) -40° to 450°F [-40° to 230°C]
Environment	(Std) NEMA 6 [IP 67]; (Opt) Class I, II, III; Div 1, Groups C-G (pending)
Housing Material	(Std) CPVC, nylon, Ultem®; (Opt) Stainless, nickel-plated brass and Vespel®
Mounting	(Std) Stainless steel hose clamps (P.N. D002-2007-001), not included; (Opt) aluminum track assembly for pipes smaller than 10 inches [250 mm]

ISO-MOD Input/Output Modules

Field-Replaceable Electronic Modules for System Integration

General

The standard TFXM provides integral RS485 communications in addition to two relays per measurement channel and one 4-20 mA output per measurement channel. TFXM permits the selection of one other input/output device, selected from the list below, per measurement channel. If an optional input/output device is required, either the 4-20 mA or the dual-relay device will need to be disabled for that particular measurement channel. All output electronics and modules are 2,500 V optically isolated from TFXM power and Earth grounds – eliminating the potential for ground loops and reducing the chance of severe damage in the event of an electrical surge.

Six ISO-MOD options are available for TFXM including: 4-20 mA (secondary), dual-relay (secondary), rate pulse, RS232C, 200,000-event data logger and RTD heat-delivered option. All modules are field configurable by utilizing the keyboard or ***ULTRA****LINK*™ interface. Features of the various ISO-MODs are described below. See the TFX BTU-Pro data sheet for details regarding the RTD Heat flow Module option.

4-20 mA Output

Easily configured via switch selections into either an internally powered or externally powered mode, the 4-20 mA Output Module interfaces with virtually all recording and logging systems by transmitting an analog current signal that is proportional to system flow rate. Independent 4 mA and 20 mA span settings are established in software. These settings can span negative and positive flow directions to output bi-directional flow data. Output resolution of the module is 12-bits (4,096 discrete points) and because of its low insertion loss characteristics (less than 5 V typical) the module can drive more than 800 Ohms of load with a 24 V power source.

Dual-Relay

Operation of two independent SPDT (single-pole, double-throw, Form C) relays is controlled through software entries. Independent configurations include: Flow Rate Alarm with adjustable deadband, a Totalizer/Batch Counter outputs a 50 millisecond contact closure every time the totalizer increases by a set flow accumulation, a Signal Strength Alarm warns operators if a pipe has emptied or if excessive aeration is present, or a System Error Alarm warns operators that an error has occurred and the flowmeter is no longer operational. The relays are rated for 200 VAC maximum and have a current rating of 0.5 Amps resistive load [175 VDC @ 0.25 Amps resistive load]. If current or voltage levels greater than those specified are to be controlled or if a highly inductive load such as a solenoid or motor is to be controlled, a secondary relay should be utilized.

RS232C Input/Output Module

The RS232 Module can be interfaced with the serial communication ports of PCs, PLCs and SCADA systems that are used to monitor flow rate information in piping systems. The RS232 Module may also be used to form a hardwire connection to a PC that is running the ***ULTRA****LINK*™ software utility. Baud rates up to 57.6K are supported.

Rate Pulse Output Module

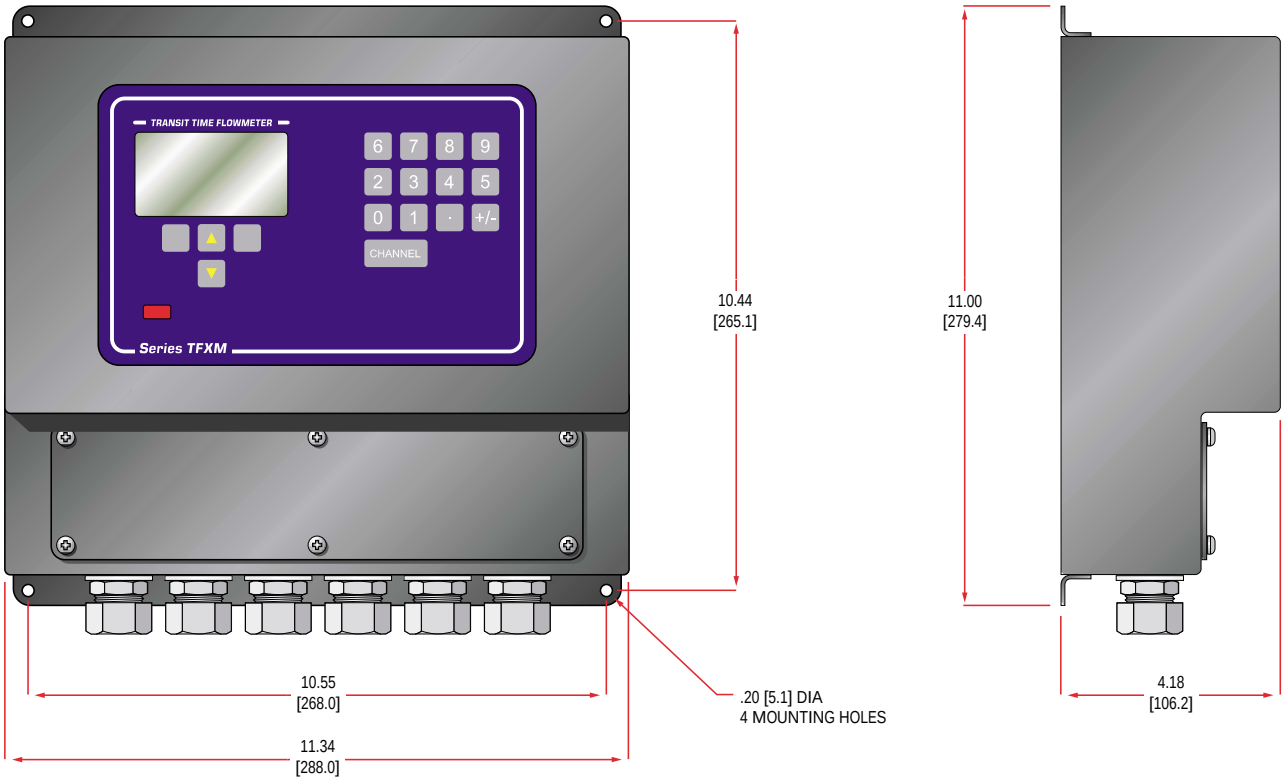
The Rate Pulse Output Module is utilized to transmit information to external counters and PID systems via a frequency output that is proportional to system flow rate. Independent Zero and Span settings are established in software. These settings can span negative and positive flow directions to output bi-directional flow data. Output resolution of the module is 12-bits (4,096 discrete points) and the maximum output frequency setting is 2,500 Hz – other frequency ranges may be available, please consult the Dynasonics factory. The module has a MOSFET output with an "On" resistance of 0.21 Ohms and is rated at 100 V, 1 A continuous operation.

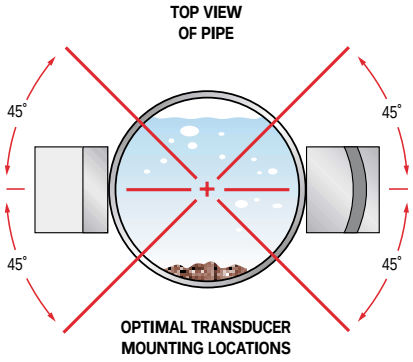
Data Logger Module

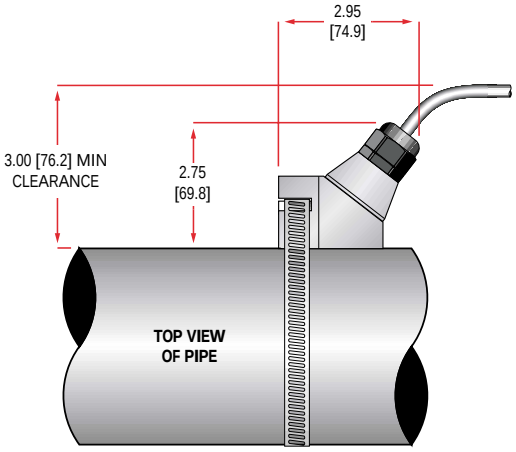
This powerful 200,000-event data logger/electronic stripchart recorder can be configured to match user applications. The logger stores time-stamped, high resolution (16-bit) data at user selected intervals ranging from 1 to 1,000 seconds. Configuration and data retrieval from the logger is via a hardwire connection between the flowmeter and a PC running the included Windows® software utility.

Dimensional Specifications

Mechanical Dimensions: Inches [mm]







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