DYNASONICS®

Series MFX

Insertion MagProbe™ Flow Meter

Operations & Maintenance
Manual

REV 2/08

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This manual contains detailed operating instructions for all aspects of the MFX instrument. The following condensed instructions are provided to assist the operator in getting the instrument started up and running as quickly as possible. This pertains to basic operation only. If specific instrument features are to be used or if the installer is unfamiliar with this type of instrument, refer to the appropriate section in the manual for complete details.

MagProbe Location

1. SELECT THE MAGPROBE LOCATION

A. In general, select a mounting location on the piping system with a minimum of 10 pipe diameters (10 X the pipe inside diameter) of straight pipe upstream and 5 straight diameters downstream. See Table 2.1 for additional configurations.

B. When the probe is installed on a horizontal pipe, the preferred orientation for the probe is between 1 and 5 o'clock as shown in **Figure 1.1**. Ensure that the probe is installed square and centered on the pipe.

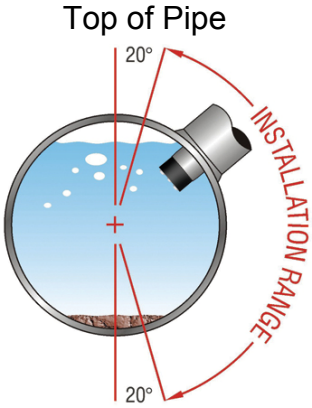


Figure 1.1

2. HOT TAP CONFIGURATION

A. Verify that all components being permanently installed or used during the installation procedure are rated for operation at the greatest system pressure anticipated.

B. Mount the pipe saddle or weld fitting at the location determined in step 1. Install the close nipple and ball valve. Drill a hole in the pipe that is at least 1/8" [3 mm] larger than the MagProbe tip. Close the ball valve.

C. Install the MagProbe insertion fitting.

Inserting MagProbe

3. INSERT THE MAGPROBE INTO THE PIPE

A. To obtain greatest accuracy, the measuring tip of the MagProbe must be inserted a proper distance into the pipe. For long, straight runs of pipe, this is 12.5% of the pipe internal diameter.

B. Before inserting the MagProbe into the insertion fitting, it is best to make all of the necessary measurements on the probe and installation fittings and place a insertion depth mark on the probe.

C. Measure the full length of the probe (E), calculate 12.5% of the pipe I.D. (A), obtain the pipe wall thickness (B) and measure the distance between the outer pipe wall and the

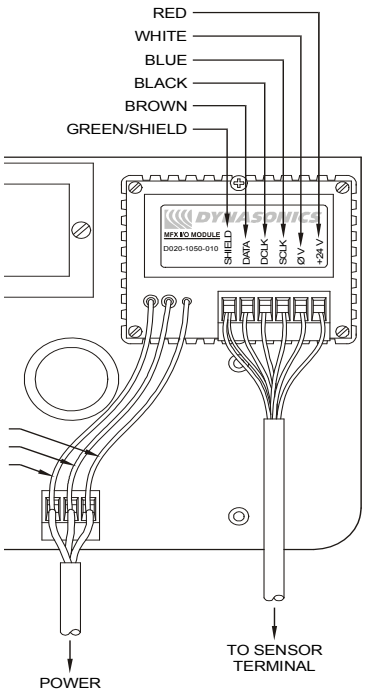


Figure 1.2

top of the insertion fitting (C).

D. Place a mark on the probe this is the proper distance from the top of the probe (D):

D = E - A - B - C

E. Insert the MagProbe into the insertion fitting and secure with the brass lock nuts—Series DMP2 - DMP6.

F. Open the ball valve and insert the probe to the distance marked in step D. Secure with the brass nuts.

G. Rotate the probe in the pipe so that the FLOW DIRECTION arrow points in the nominal forward flow direction (the MFX system will read flow in both directions) and to within ±2° of parallel to the pipe length.

4. ELECTRICAL CONNECTIONS

Connections

Run the MagProbe cables back to the MFX transmitter mounting location. Connect the MagProbe and power to the appropriate terminal connections within the MFX enclosure. **See Figure 1.2**.

A. Do not run the probe cable adjacent to electrically noisy wiring.

B. Verify that the MFX is configured for the power supply that will be utilized in the installation. Run power through the left hand conduit hole and secure to the proper terminals.

C. Connect a 12 AWG (minimum) ground wire between the ground lug on the MagProbe seal fitting and earth ground.

5. INITIAL SETTINGS AND POWER UP

Startup

A. Apply power to the instrument.

B. Verify that fluid velocity is indicated on the top line of the MFX display.

C. Input proper units of measure and I/O data.

General

The MagProbe is a point-velocity measuring device used primarily for measuring electrically conductive liquids, such as water and water-based liquids, in closed piping systems. The unit operates utilizing Faraday's principle of magnetic conduction, whereby a moving conductor (the liquid) has a voltage imposed on it that is directly proportional to two variables — the strength of a local magnetic field and the velocity of the moving conductor.

Imposed voltage α Magnetic field X Fluid velocity

If the strength of the magnetic field is held constant, then the magnitude of the voltage will be proportional to the velocity of the moving conductor. The equation then simplifies to **Imposed voltage α Fluid velocity.** Most modern magnetic meters, including the MFX, apply tri-stated, alternating polarity DC pulses to an integral electromagnet. See **Figure 1.3**. Voltage measurements are made with the magnet off, to measure ambient background noise, and then with the magnet on in both polarities. The magnitude difference in voltage measured is proportional to flow. Once fluid velocity is measured, then various volumetric flow measurements can be obtained if the pipe internal diameter (I.D.) is known.

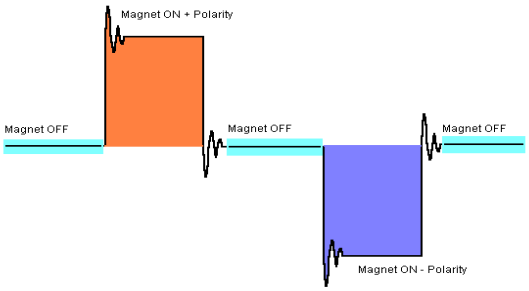


Figure 1.3 - Magnet Excitation

Point-velocity flow meters measure the fluid velocity at a specified depth into the fluid stream, typically 1/8 of the pipe I.D., which has been proven to be the nominal velocity point when symmetrical flow profiles are present. This assumption requires the probe to be certain numbers of pipe diameter downstream of any piping condition (elbows, valves, thermo-wells, tees, etc.) that can cause flow abnormalities. Typically, a minimum of 15 pipe diameters of straight pipe is required to develop a symmetrical flow profile. Systems where symmetrical flow profiles are not present can still be measured accurately, but flow profiling must be performed to determine proper probe insertion depth. A diagram of the MagProbe tip is illustrated in **Figure 1.4**.

The MFX MagProbe flow meter can be successfully applied on a wide range of metering applications. The simple to program transmitter allows the standard product to be used on pipe sizes ranging from 4 - 120 inch [100 - 3048 mm] pipe. A variety of liquid applications can be accommodated: potable water, chemicals, raw sewage, reclaimed water, cooling water, river water, plant effluent, etc. The MFX product will not operate on fluids with very high impedance such as DI water, distilled water, petroleum-based liquids or glycol-based liquids.

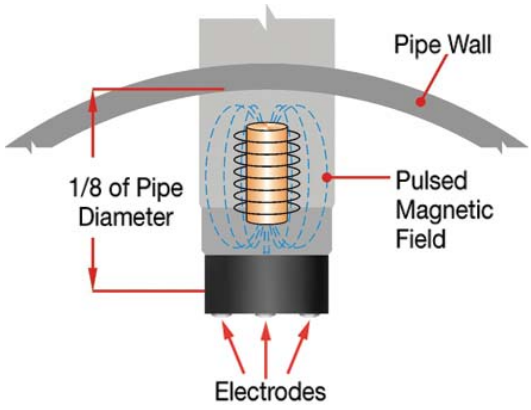


Figure 1.4 - MagProbe Design

User Safety

The MFX employs modular construction and provides electrical safety for the operator. The display face contains voltages no greater than 10 Vdc. The display face swings open to allow access to user connections. As a general precaution, always disconnect electrical power before opening the instrument enclosure.

Data Integrity

Non-volatile memory retains all user-entered configuration values in memory even if power is lost or turned off. Password protection is provided as part of the Security menu and prevents inadvertent configuration changes or totalizer resets.

Product Identification

The serial number and complete model number of your MFX and the DMP probe that was shipped with the MFX is located on the inside of the transmitter's front cover. Should technical assistance be required, please provide the Dynasonics Customer Service Department with this information.

Product Matrix

TRANSMITTER PART NUMBER MATRIX

Transmitter

D M F X 2 - □ □ N A - N N

Transmitter Type
2) Rate and Totalizer

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

Input/Output 1
N) None
1) 4-20 mA Output
2) Relay
3) Rate Pulse
4) RS232C
5) RS485
6) Data Logger

Input/Output 2
N) Reserved

Totalizer
A) Eight Digit Resettable

Approvals
N) Ordinary Area

Options
N) None

MagProbe Insertion Probe

MAGPROBE PART NUMBER MATRIX

D M P □-□□□-□ □□□-□

Probe Length
2) 18 inches (457 mm)
3) 28 inches (711 mm)
4) 38 inches (965 mm)
5) 48 inches (1220 mm)
*Consult Factory for Longer Lengths

Cable Length
020) 20 feet (6 m)
050) 50 feet (15 m)
100) 100 feet (30 m)
Maximum Length: 990 feet (297 m)
in 10 ft. (3 m) increments

Conduit Type**
N) None

Conduit Length**
000) 0 feet (0 m)

Options
N) None
B) 1.5 inch 150# RF flange connection 316SS

***Consult the Dynasonics factory for conduit availability and part numbers.*

PART 1 - SPECIFICATIONS

Transmitter

DESCRIPTION	SPECIFICATION
Power Requirements	115/230 VAC 50/60 Hz ± 15% @ 5 VA max.; 9-28 VDC @ 3 VA max.
Velocity Range	-30 to +30 FPS (-9 to +9 MPS); minimum flow 0.1 FPS (0.03 MPS)
Inputs/Outputs	All modules are optically isolated from earth and system grounds. Only one module may be installed.
Optional	**4-20 mA Output** 800 Ohms max.; 12-bit resolution; internal or external power; can be spanned anywhere in the velocity range **Relay** two separate Form C relays, 200 VAC @ 0.5 A resistive max. **Rate Pulse** 0-2,500 Hz; 0.21 Ohm resistance; 1 A max.; can be spanned anywhere in the velocity range **RS232C** data rate to 57.6K **RS485** supports up to 126 drops on three wires; 57.6K max. baud; Communications protocol **Data Logger** 200,000 point, 16-bit resolution; integral DB-9 connector for plugging into PC; can be removed and installed without disconnecting system power
Display	2-line x 8-character LCD, back lit. Top row: 7-segment digit height 0.7 inches (18 mm), Bottom row: 14-segment digit height 0.35 inches (9 mm); 8-digit rate, 8-digit totalizer (resettable)
Units:	User configured
Engineering units	Feet, gallons, cubic feet, mil-gal, barrels, acre-feet, lbs., meters, cubic meters, mil-liters, kg
Rate time intervals	Seconds, minutes, hours and days
Temperature Range	-40 ° to +185 °F (-40 ° to +85 °C), 0-95% relative humidity, non-condensing
Enclosure	NEMA 4X (IP-65), polycarbonate, SS, brass and plated steel. 7.00H × 5.75W × 3.88D inches (178H × 146W × 99D mm)
Accuracy Flow Rate	±2% of full scale
Sensitivity	±0.005 FPS (±0.0017 MPS)
Response Time	3-300 seconds, user configured, to 100% of value, step change in flow.
Security	Keypad lockout, access code enable
Approvals	(Std) Ordinary area

MagProbe

PROBE

DESCRIPTION	SPECIFICATION
Pipe Sizes	Internal diameters 4 to 120 inches (102 to 3048 mm); requires 1 1/2" NPT port
Liquid Requirements	Liquids with conductivity > 1 micro-Siemen/cm; liquids with solids that will not coat or wrap around the probe tip
Transmitter to Probe Distance	Up to 990 feet (297 meters)
Environment	-40 ° to +225 °F (-40 ° to +105 °C), NEMA 6 (IP67) submersible
Materials of Construction	316 Stainless Steel, PVDF, Viton®, PVC jacketed cable rated for outdoor and direct-burial use Electrodes: Titanium
Operating Pressure	Up to 700 PSIG (48 bar) max. @ +75 °F (+25 °C)

PART 1 - TRANSMITTER INSTALLATION

Transmitter Installation

After unpacking, it is recommended to save the shipping carton and packing materials in case the instrument is stored or re-shipped. Inspect the equipment and carton for damage. If there is evidence of shipping damage, notify the carrier immediately.

The enclosure should be mounted in an area that is convenient for servicing, calibration or for observation of the LCD readout.

1. Locate the transmitter within the length of MagProbe cable that was supplied with the MFX system. If this is not possible, replace the entire length of interconnect cable with Belden part number 9536, Dynasonics part number D005-1003-003 or equivalent. Do not splice the cable as shield integrity will be compromised and poor performance can result.

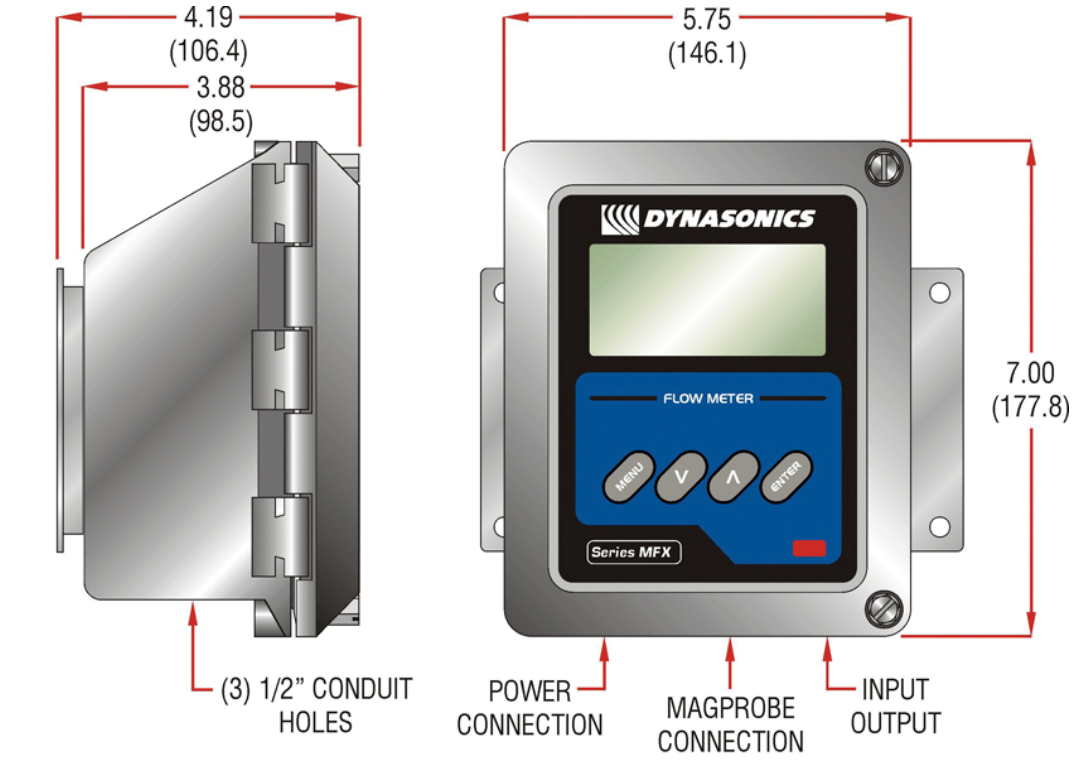
2. Mount the MFX transmitter in a location that is:

- ♦ Where little vibration exists.
- ♦ Protected from falling corrosive fluids.
- ♦ Within ambient temperature limits -40 to 185°F [-40 to 85°C]
- ♦ Out of direct sunlight. Direct sunlight may increase temperatures within the transmitter to above maximum limit.

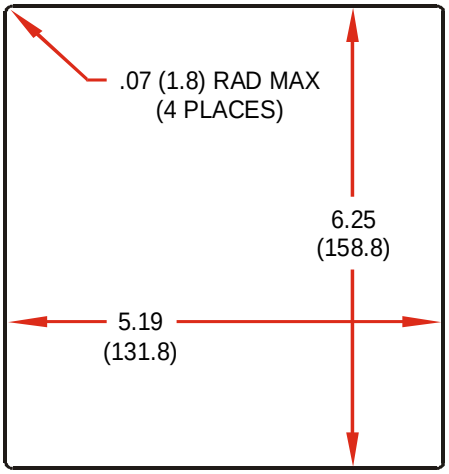
3. Mounting: Refer to **Figure 1.5** for enclosure and mounting dimension details. Ensure that enough room is available to allow for door swing, maintenance and conduit entrances. Secure the enclosure to a flat surface with four appropriate fasteners.

4. Conduit holes. Conduit hubs should be used where cables enter the enclosure. Holes not used for cable entry should be sealed with plugs.

NOTE: Use NEMA 4X [IP66] rated fittings/plugs to maintain the water tight integrity of the enclosure. Generally, the left conduit hole (viewed from front) is used for line power; the center conduit hole for transducer connections and the right hole is utilized for ISO-MOD I/O wiring.



PANEL MOUNT (optional)



PANEL CUTOUT

PANEL THICKNESS: 0.5"
(12 mm) MAX

WALL MOUNT

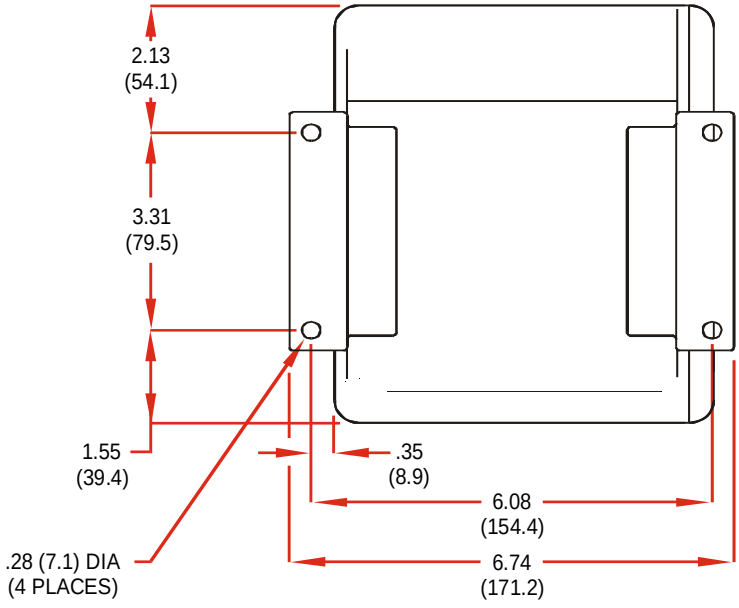


Figure 1.5 - MFX Transmitter Installation Dimensions

5. If additional holes are required, drill the appropriate size hole in the enclosure's bottom or side. Use extreme care not to run the drill bit into the wiring or circuits cards.

MagProbe Connections

To access terminal strips for electronic connectors, loosen the two screws in the enclosure door and open the door.

1. Guide the MagProbe terminations through the transmitter conduit hole located in the bottom-center of the enclosure. Secure the MagProbe conduit with the supplied conduit nut if flexible conduit was ordered with the transducer. If conduit was not purchased with the MagProbe sensor, an appropriate sealed strain relief bulkhead fitting should be utilized.

2. The terminals within MFX are a pluggable type - they can be removed wired and then plugged back in. Connect the appropriate MagProbe wires to P1 (Sensor) at the corresponding screw terminals on the MagProbe module. Observe proper wire colors and shield connections. See **Figure 1.6** or the Wiring Diagram located on the inner door of the transmitter.

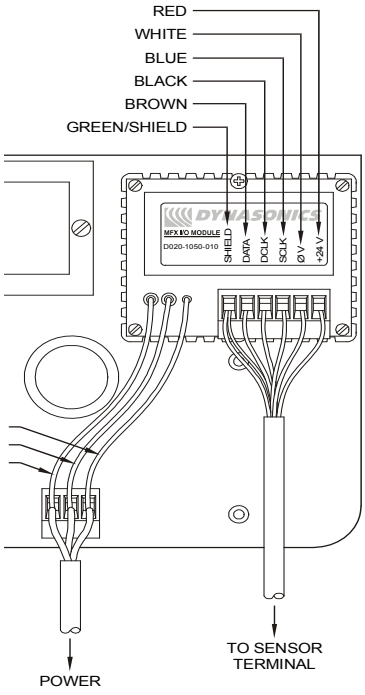


Figure 1.6

1. **NOTE:** The MagProbe cable carries low level signals. Locate the transmitter within the length of MagProbe cable that was supplied with the MFX system. If this is not possible, replace the entire length of interconnect cable with Belden part number 9536, Dynasonics part number D005-1003-003 or equivalent. Do not splice the cable as shield integrity will be compromised and poor performance can result.

Transmitter AC Power Connections

Connect line power to the screw terminals marked L1, L2 and Earth in the transmitter. See **Figure 1.7 and Figure 1.8**. Utilize the conduit hole on the left side of the enclosure for this purpose. Use wiring practices that conform to local codes (National Electric Code Hand book in the USA). The Earth ground terminal grounds the instrument, which is mandatory for safe operation and optimum flow meter performance.

CAUTION: Any other wiring method may be unsafe or cause improper operation of the instrument.

WIRING DIAGRAM

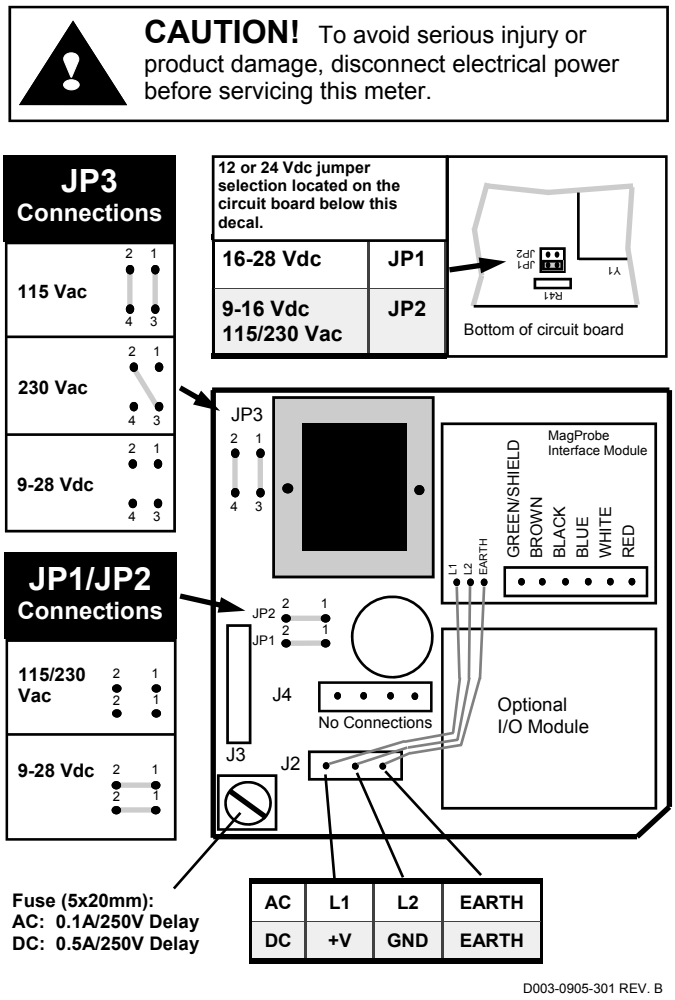


Figure 1.7
MFX Power Supply Configuration

Do not run line power with other signal wires within the same wiring tray or conduit.

NOTE: This instrument requires clean electrical line power. Do not operate this unit on circuits with noisy components (i.e. Fluorescent lights, relays, compressors, variable frequency drives, etc.).

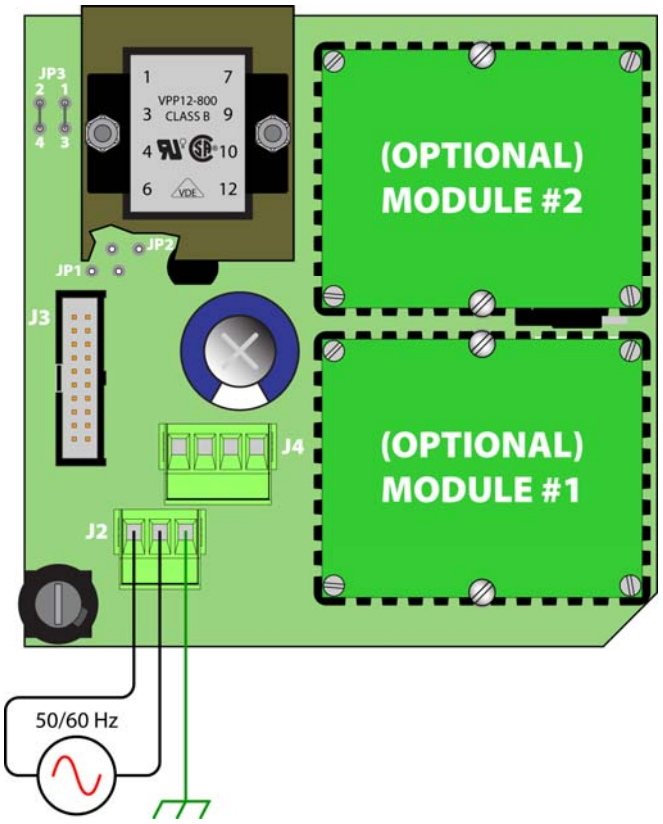


Figure 1.8
DC Power Connection

AC POWER CONNECTIONS

1. Verify that the jumpers at JP3 are properly oriented for the power supply. Verify that the jumpers at JP1 and JP2 are <u>not</u> present.
2. Connect L1, L2 and earth to the terminals referenced in **Figure 1.7** on page 1.12. Phase and neutral connections to L1 and L2 are not polarized. Do not operate without an earth ground connection.
3. See **Figure 1.8** for AC connection schematic. Wire gauges up to 14 AWG can be accommodated in the MFX terminal blocks.

DC Power Supply

DC POWER CONNECTIONS

The MFX may be operated from a 9-28 Vdc source, as long as the source is capable of supplying a minimum of 3 Watts.

1. Verify that the jumpers are properly placed. See the wiring diagram located on the inside door of the MFX enclosure or see **Figure 1.7** on page 1.12. The jumpers at JP3 should not be present and the jumpers at JP1 and JP2 will be in place. The jumper located beneath the microprocessor protection shield – the panel with the wiring diagram label mounted on it – should be positioned at JP2 for 9-16 Vdc input power and in JP1 position for 16-28 Vdc input power.
2. Connect the DC power source as illustrated in the schematic in **Figure 1.9**. Wire up to 14 AWG can be accommodated in the MFX terminal blocks.

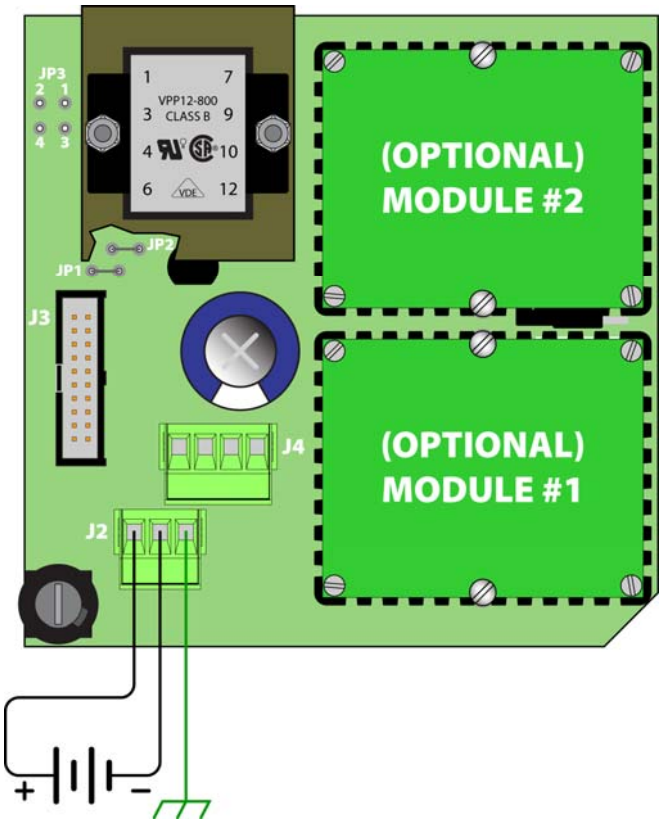


Figure 1.9
DC Power Connection

PART 1 - ISO-MOD

General

The TFXD utilizes ISO-MODs for input and output functions. ISO-MODs are epoxy encapsulated electronic input/output modules that are simple to install and replace in the field. See **Figure 1.10**. All modules are 2,500 V optically isolated from TFXD power and earth grounds. This eliminates the potential for ground loops and reduces the chance of severe damage in the event of an electrical surge.

Six ISO-MOD options are available, including: 4-20 mA, dual-relay, rate pulse, RS232C, RS485, and 200k point data logger. The MFX supports any of the six ISO-MOD input/output modules. All modules are field configurable by utilizing the keyboard or *UltraLink*™ interface. Field wiring connections to ISO-MODs are quick and easy using removable plug-in terminals. Configuration and connection of the various ISO-MODs are described on the following pages.

Figure 1.10
Two ISO-MOD I/O Modules Installed

To remove an ISO-MOD, remove the two machine screws that secure the module in place and pull the module straight out of the enclosure. A 10-pin connection is on the bottom of the module that mates with the circuit board underneath. Installation of a module is simply the reverse operation of removal. 4-20 mA modules will require calibration parameters to be entered if the module is replaced. See Part 3 of this manual for instructions on entry of calibration parameters.

4-20 mA Output

The 4-20 mA Output Module interfaces with most recording and logging systems by transmitting an analog current signal that is proportional to system flow rate. The 4-20 mA ISO-MOD may be configured via jumper selections for either an internally powered mode (current sourcing) **Figure 1.11A** or externally powered mode (current sinking) **Figure 1.11B**.

Internal Power Configuration: Ensure that jumpers are in place at JP1 and JP2 on the module. See **Figure 1.11A**. In this configuration the 4-20 mA output is driven from a +24 Vdc source located within the MFX flow meter. The 24 Vdc source is isolated from DC ground and earth ground connections within the MFX instrument. The module can accommodate loop loads up to 800 Ohms in this configuration.

External Power Configuration: Remove the two jumpers located at JP1 and JP2 on the module. See **Figure 1.7B**. In this configuration the 4-20 mA module requires power from an external DC power supply. The voltage of the external power source must be sufficient to power the module and drive the loop load. The loop loss attributed to the ISO-MOD is 7 Vdc, so the minimum voltage required to power a loop can be calculated using the following formula:

Loop voltage (min) = (loop load Ohms x 0.02) + 7

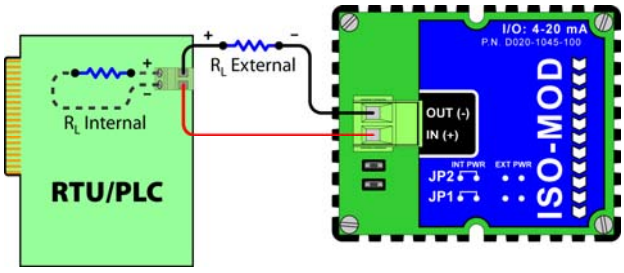


Figure 1.11A Internally Powered 4-20mA

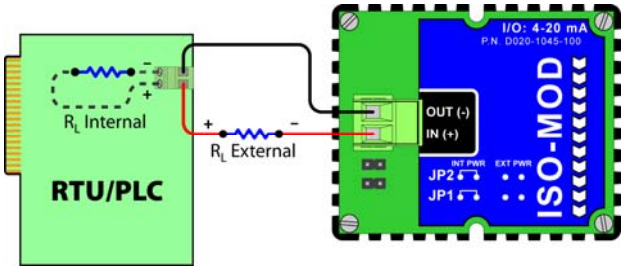


Figure 1.11B Externally Powered 4-20mA

Control Relay

Two independent SPDT (single-pole, double-throw) Form C relays are contained in this module. The relay operations are user configured via software to act in either a flow rate alarm, signal strength alarm or totalizer/batching mode. The relays are rated for 200 Vac maximum and have a current rating of 0.5 A resistive load [175 Vdc @ 0.25 A resistive]. It is highly recommended that a secondary relay be utilized whenever the Control Relay ISO-MOD is used to control inductive loads such as solenoids and motors.

Typical relay connections are illustrated in **Figure 1.12A**. The reed relays located within the relay module can interface directly with small pilot lights, PLCs, electronic counters and SCADA systems.

Figure 1.12B describes the connection of an external power relay to the Relay ISO-MOD. It is recommended that external power relays are utilized whenever the load to be switched exceeds the switch rating of the reed relays, or if the load is inductive in nature.

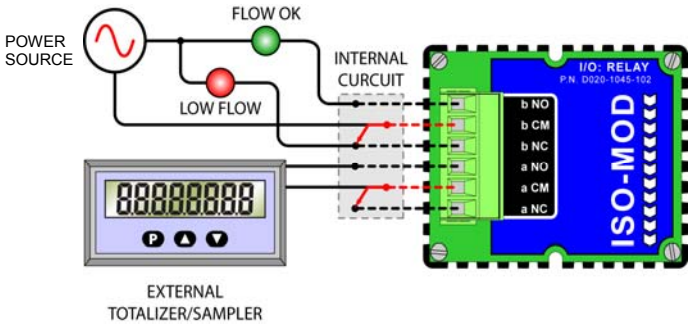


Figure 1.12A Typical Relay Connections

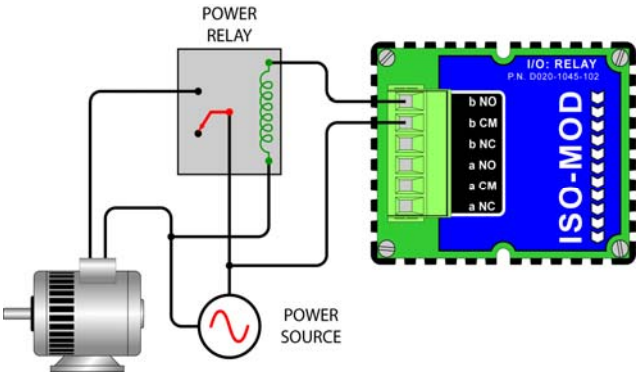


Figure 1.12B Slave Relay Connections

Rate Pulse

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. The frequency output range of the Rate Pulse Module is 0–2,500 Hz. This module has two types of outputs: one simulates the output of the coil of a turbine flow meter, and the other is an open-collector type that does not source voltage at its output. Both outputs may be connected simultaneously.

The turbine meter output creates a 500 mV peak-to-peak sawtooth waveform that is not referenced to ground. This output can be run to electronic monitors that are compatible with variable reluctance outputs from coils, such as those found in turbine and paddle-wheel flow meters. The input impedance of the receiving device should not be smaller than 2,000 Ohms.

The standard pulse output does not output a voltage, but acts as an “open-collector” output requiring an external power source and pull-up resistor. See **Figure 1.13**. The MOSFET in the Rate Pulse Module can support loads of 100 V @ 1A. Resistor selection is based on the input impedance of the receiving device. Select a resistor that is a maximum of 10% of the input impedance of the receiving device, but do not exceed 10k Ohms.

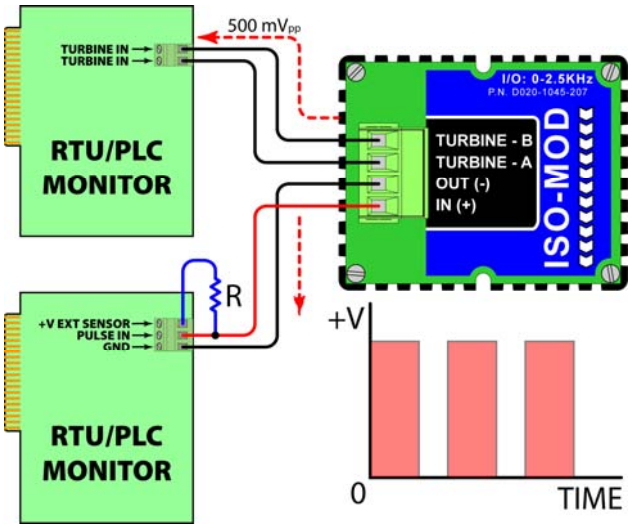


Figure 1.13
Rate Pulse Module

RS232C

The RS232C Module will interface with the serial communication ports of PCs, PLCs and SCADA systems that are used to monitor flow rate information in piping systems. A proprietary digital communications protocol is used for this communication. An explanation of the command structure is detailed in the Appendix of this manual. Flow rate, total, signal strength and temperature (if so equipped) can be monitored over the digital communications module. The RS232C Module may also be used to form a hardwire connection to a PC that is running the *UltraLink*™ software utility. Baud rates up to 19.2k are supported. **Figure 1.14** illustrates typical connections.

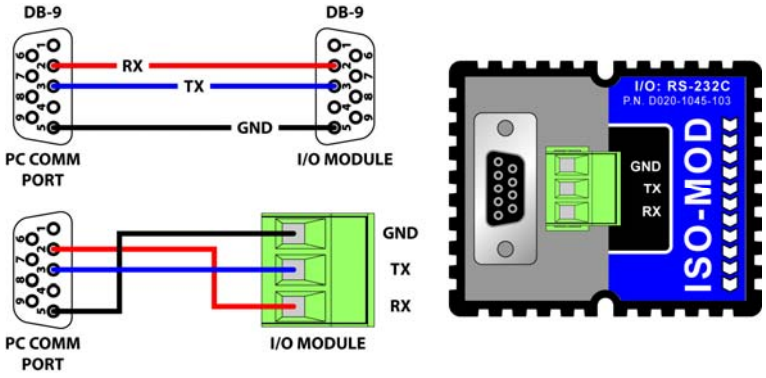


Figure 1.14
RS232 Connections

RS458

The RS485 Module allows up to 128 MFX systems to be placed on a single three-wire cable bus. All meters are assigned a unique one byte serial number that allows all meters on the cable network to be independently accessed. A proprietary digital communications protocol is used for this communication. An explanation of the command structure is detailed in the Appendix of this manual. Flow rate, total, signal strength and temperature (if so equipped) can be monitored over the digital communications bus. Baud rates up to 9600 and cable lengths to 5,000 feet [1,500 meters] are supported without repeaters or "end of line" resistors. *UltraLink*™ is also compatible with a multiple MFX network, allowing individual meters to be accessed, programmed, diagnosed and calibrated.

To interconnect meters, utilize three-wire shielded cable such as Belden 9939 or equal. In noisy environments the shield should be connected on one end to a good earth ground connection. An RS232 to RS485 scond, such as B&B electronics p/n 485SD9TB (illustrated in **Figure 1.15**) is required to interconnect the RS485 network to a communication port on a PC. If more than 128 meters must be monitored, an additional scond and communication port is required.

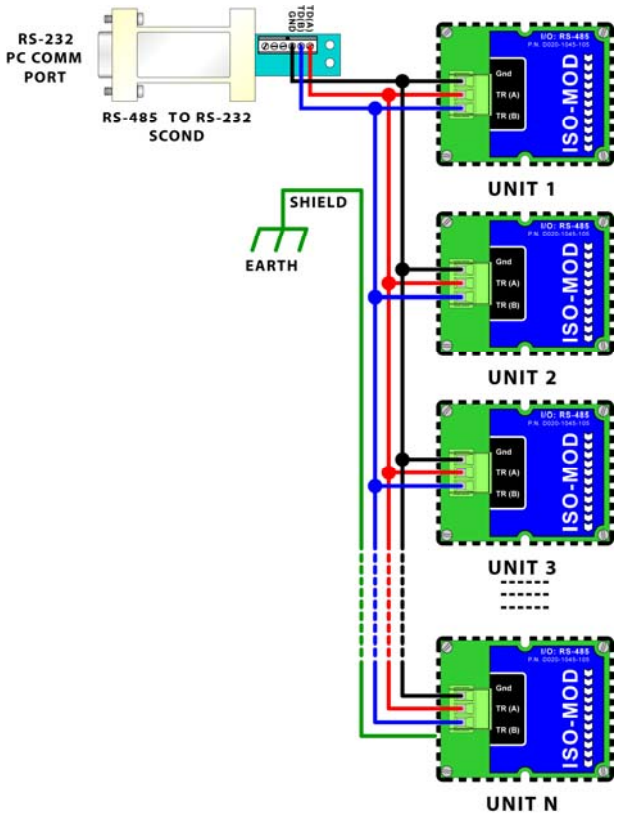


Figure 1.15
RS485 Network Connections

Data Logger

The 200,000 event data logger/electronic stripchart recorder can be configured to match most user applications. The logger stores time-stamped, high resolution (16-bit) data at user selected intervals ranging from 1 to 1,000 seconds. Configuration of and data retrieval from the logger are detailed in Sections 3 and 4 of this manual.

The module can be carried in a shirt pocket back to the office and plugged into a PC serial port via the module's integral DB-9 connector. See **Figure 1.16**. This eliminates the requirement to carry a computer to the flow meter site. The data in the logger can also be accessed without removing the module from the flow meter. Open the door of the flow meter and interconnect the 9-pin cable between the data logger and the PC serial communications port.
The logger is capable of storing up to 200,000 measurements. The measurements are broken into 16 blocks or pages with a maximum number of data points per block of 30,000.

If each block(page) is filled to the maximum, 6-2/3 blocks would be used:

If all 16 blocks are to be used, each block could hold 12,500 data points:

$$\frac{200{,}000 \text{ Points}}{30{,}000 \text{ Points}} = 6\text{-}2/3 \text{ Pages}$$

$$\frac{200{,}000 \text{ Points}}{16 \text{ Pages}} = 12{,}500 \text{ Points per page}$$

NOTE: The data logger is not accessible using the MFX's infrared adapter. Communications between the data logger and computer must be accomplished using a directly connected RS232C or RS485 connection.

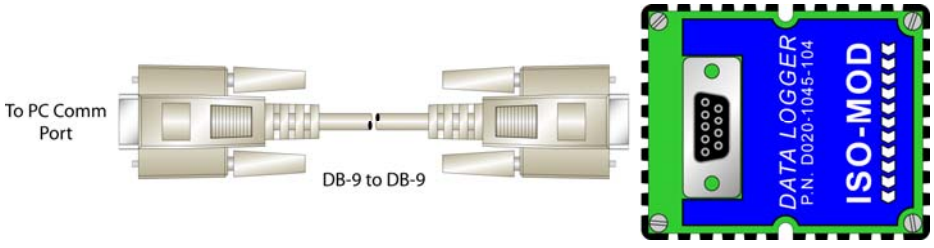


Figure 1.16
Data Logger Connection

Before Starting the Instrument

Note: <u>The MFX flow meter system requires a full pipe of liquid before a successful startup can be completed.</u> Do not attempt to make adjustments or change configurations until a full pipe is verified.

Instrument Startup

<u>Procedure:</u>

1. Verify that all wiring is properly connected and routed as described in Part 1 of this manual.
2. Verify that the MagProbe sensor is properly mounted as described in Part 2 of this manual.
3. Apply power. The display of a MFXD2 will display a software version number and then all of the segments will illuminate in succession. The meter will then enter run mode.
4. Verify that the following parameters have been entered into the MFX Flow Meter in the BASIC MENU (See Section 3 of this manual):
    - UNITS—either ENGLISH or METRIC
    - K-FACTOR (as it appears on the MagProbe sensor)
    - PIPE Outside Diameter
    - PIPE Wall Thickness
    - PIPE Liner Thickness
    - RATE unit selected
    - RATE interval selected
5. Once these parameters have been entered and saved, the flow meter will begin to measure and display flow rate. Section 3 of this manual describes in greater detail the configuration and programming of the MFX instrument.

PART 2 - MAGPROBE INSTALLATION

After unpacking, it is recommended to save the shipping carton and packing materials in case the instrument is stored or re-shipped. Inspect the equipment and carton for damage. If there is evidence of shipping damage, notify the carrier immediately.

MagProbe Mounting Considerations

The DMP insertion probe that is utilized by the MFX flow meter system contains an electromagnet, electrodes and amplification circuitry. Three electrodes, two measurement and one ground, are located in the black Ultem® plastic tip of the probe and are designed to be inserted to the average fluid velocity point within a pipe. Not all liquid within a pipe is flowing at a uniform fluid velocity, but a long straight run of pipe, full of flowing liquid, contains a predictable liquid velocity profile. By selecting proper upstream and downstream lengths of straight pipe from the probe installation point and by making precise insertion depths into the pipe, very accurate and reliable volumetric flow rates and totals can be obtained.

Top View of Pipe

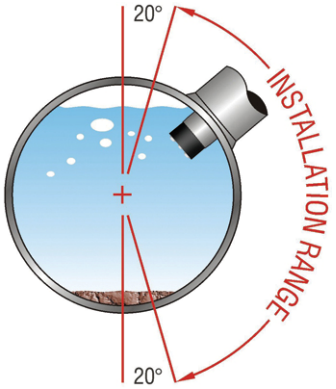


Figure 2.1

Step A - Mounting

Select a probe mounting location with adequate straight runs (without disturbances) of pipe, both upstream and downstream, to achieve stable and accurate readings. Examples of minimum upstream and downstream requirements are included in **Table 2.1**. Note that if adequate straight plumbing cannot be provided, the MFX system will operate repeatably, but will probably not achieve specified accuracy and will likely provide less stable readings.

When installing the DMP probe in a horizontal pipe, the preferred orientation is between 1 and 5 o'clock on the pipe — assuming 12 o'clock as the top. See **Figure 2.1**. Ensure that the mounting location allows for adequate clearance to install and retract the probe fully from the pipe.

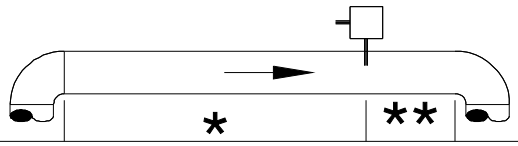
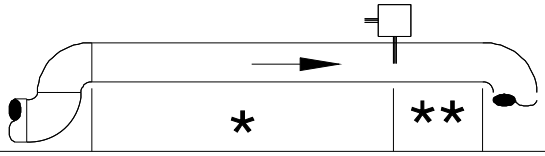
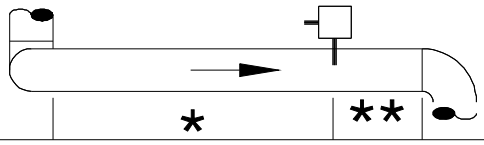
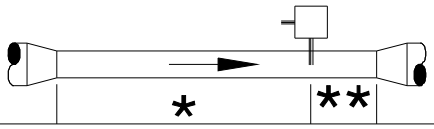
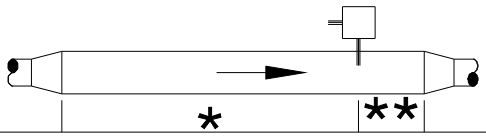
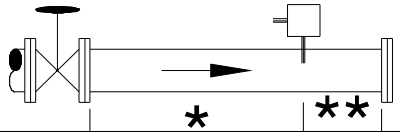
Piping Configuration and Probe Position	Upstream Dimension Pipe Diameters *	Downstream Dimension Pipe Diameters **
	9	3
	14	3
	24	4
	8	3
	8	3
	24	4

Table 2.1— Straight Pipe Recommendations[1]

[1] The MFX system will provide repeatable measurements on piping systems that do not meet these requirements, but the accuracy of these readings may be influenced to various degrees.

PART 2 - MAGPROBE INSTALLATION

Step B - Hot Tapped Installation

The installation instructions cover Hot-Tapped installations (installations where it is required to install or remove the Magprobe without shutting down the process pressure). If the product is being installed without an isolation valve, ignore the steps that pertain to its installation. **Figure 2.2** illustrates an exploded view of an isolation valve assembly and names the various components.

Hot-tapped installation will require the installation of either a welded pipe coupling or installation of a pipe saddle. The ball valve and close nipple can be purchased as a kit from Dynasonics or can be procured at most hydraulic or plumbing supply shops. The two critical factors that must be considered with the components are pressure rating and internal sizes. The DMP2 through DMP6 1-1/2" MagProbes are designed to operate with pipe pressures up to 700 psi [48 Bar]. Verify that the internal port of the opened valve is at least 1-1/2 inches [38 mm] to permit free passage of the probe without interference. Attempts to force a MagProbe through an opening smaller that stated will damage the probe tip and void the warranty.

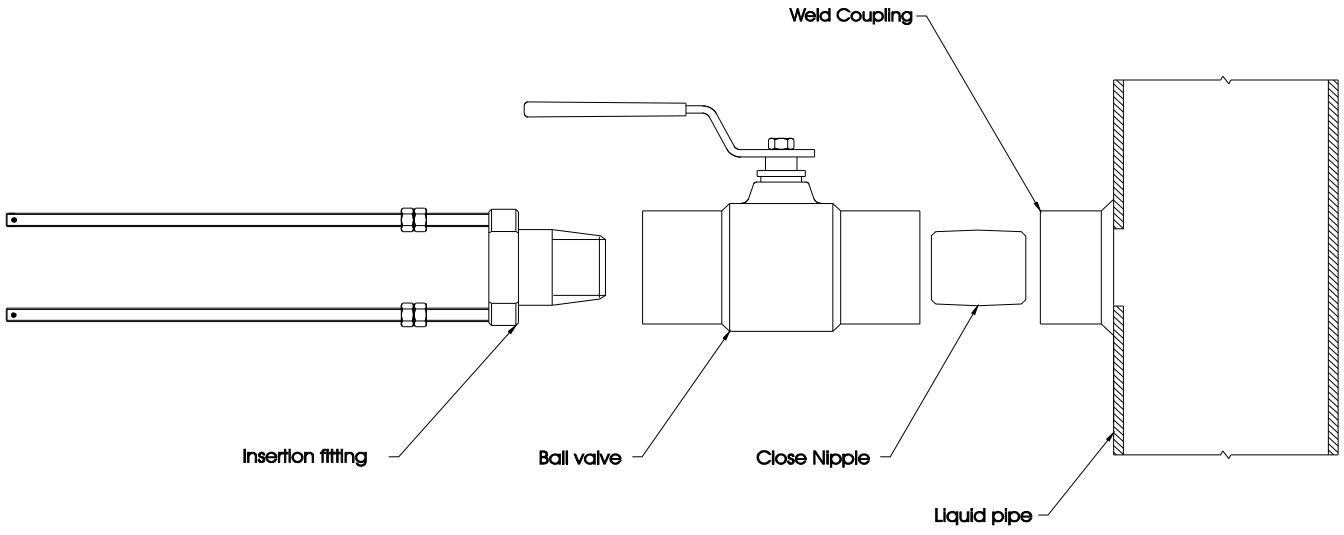


Figure 2.2

PART 2 - MAGPROBE INSTALLATION

Step C - Component Assembly

These instructions call for the use of a drilling machine designed for drilling holes in pipes that are under pressure (for example, Muller Co., Decatur, Illinois manufactures products for this purpose).

Procedures are as follows:

1. Verify that the line pressure within the pipe is within the rated limits of the pressure drilling machine, welded coupling or pipe saddle, valve and MagProbe to be used.
2. Grind off paint or other coatings from the pipe in the area where the DMP MagProbe Assembly is to be installed. Recommended minimum straight pipe lengths for best accuracy are 10 diameters upstream and 5 downstream. See **Table 2.1**.
3. Tack weld a 1½" NPT female weld-coupling to the pipe or install a pipe saddle according to the suppliers instructions. **The coupling or saddle must be aligned perpendicular to the pipe axis and square to its plane**.
4. Complete welding. A water tight, 0.25" minimum weld bead is recommended.
5. Install the close nipple into the weld coupling. Use appropriate pipe sealants.
6. Install the isolating ball valve on the close nipple. Verify that the valve is in fully open position.
7. Install drill bit and adapter into the pressure drilling machine. Then attach the machine to the isolation valve.
8. Drill through the pipe wall in accordance with the instructions supplied with the drilling machine.
9. Withdraw the drill bit through the isolating valve. Close the valve and remove the drilling machine. Check for leakage at valve and connections.

Step D - Probe Insertion Distances

PROBE INSERTION

Before inserting the MagProbe into the piping system, it is necessary to calculate the probe insertion depth that will place the measuring electrodes at the proper position in the pipe. In order to complete this calculation, some knowledge of the piping system must be known. Refer to the paragraphs that follow and **Figure 2.3** for information regarding this process. The variables required are

- The overall probe length
- Pipe internal diameter
- Pipe wall thickness (including liners)
- The length of the valve stack
- Amount of straight pipe diameters in the system

Using this information and referring to **Figure 2.3** proper insertion depth can be determined.

Measurement A — the typical depth that the MagProbe tip is inserted into the piping system is 1/8 (12.5%) of the pipe internal diameter. Assume 1/8 of the pipe internal diameter unless a system piping configuration does not have at least 15 pipe diameters of straight pipe in the installation area.

Measurement B — Pipe wall thickness. This information can be obtained from standard pipe wall charts (See the Appendix of this manual) or ideally can be measured using an ultrasonic wall thickness gauge. If the pipe is lined, include the liner thickness in this measurement.

Measurement C — Measure the distance that is going to be taken up by the pipe tap, nipple, full-flow ball valve and the insertion fitting.

Note: DMP1 through DMP6 probes utilize 1-1/2" NPT hardware. The insertion fitting for the DMP1 through DMP6 probes is approximately 2.5 inches long once completely torqued into position.

Measurement E — This is the overall length of the probe measured from the black measurement tip to the top flange on the probe.

Measurement D — This is the length of MagProbe that will be protruding from the insertion fitting after it is inserted to the proper depth in the fluid stream.

TO CALCULATE INSERTION DEPTH

Measure and record the following linear distances:

E = PROBE LENGTH = _____

C = INSERTION FITTING to PIPE WALL

= _____

B = PIPE WALL THICKNESS

= _____

A = 0.125 x PIPE ID = _____

D = INSERTION DEPTH = _____

D = E - C - B - A

Installation Measurements: DMP2 through DMP6 MagProbes

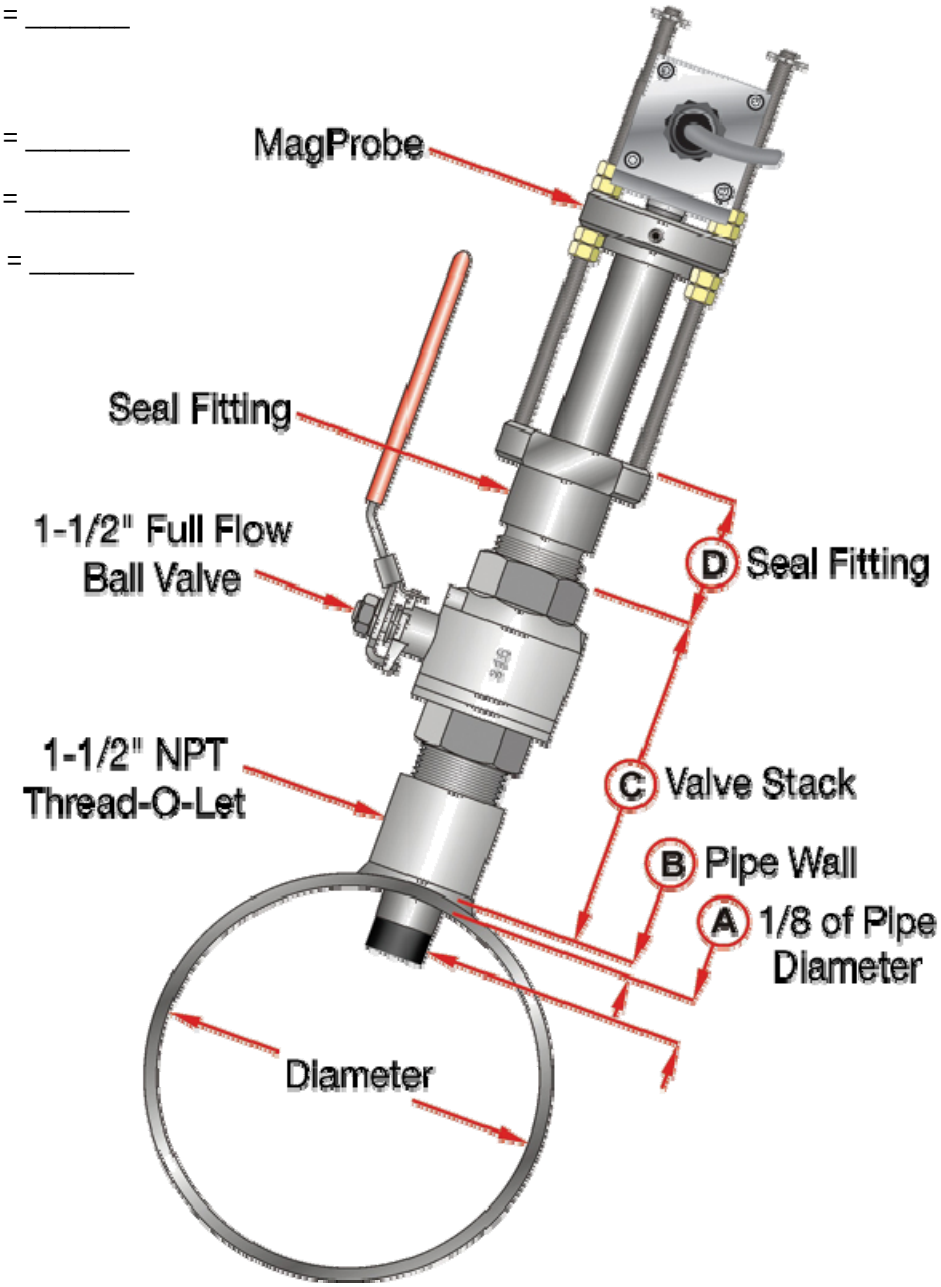


Figure 2.3

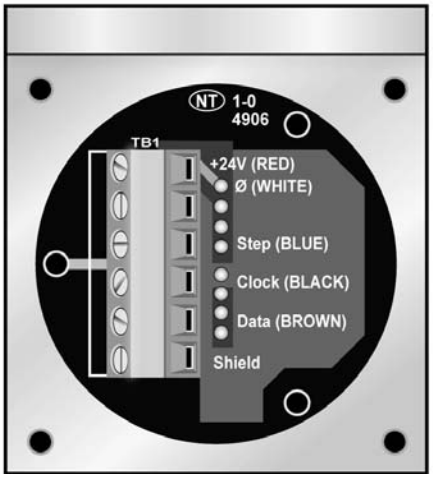
Step E - Cable Routing

PROBE CABLE

Before inserting the MagProbe into the pipe, the sensor cables should be routed to the transmitter location. Locate the transmitter within the length of MagProbe cable that was supplied with the MFX system. If this is not possible, replace the entire length of interconnect cable with Belden part number 9536, Dynasonics part number D005-1003-003 or equivalent. Do not splice the cable as shield integrity will be compromised and poor performance can result. Cable lengths up to 1000 feet [300 meters] can be utilized.

The wiring inside of the MagProbe conduit box is pictured in **Figures 2.5.**

Figure 2.5
MagProbe Interface Enclosure



IMPORTANT NOTE!

CAUTION: Both power and digital signals are carried through the MagProbe cable. These signals are robust, but care should be taken in routing the cables. Avoid running cables near sources of high voltage equipment or sources of extreme electrical noise—high EMI/RFI. Also avoid routing the cables in cable tray configurations, unless the trays are specifically used for other low voltage, low level, signal cables.

PROBE GROUND CONNECTION

Attach a wire of 12 AWG or larger between the #10-32 ground lug on the insertion fitting and earth ground.

Step F - MagProbe Insertion DMP2 through DMP6

MAGPROBE INSERTION DMP2 through DMP6

1. Apply sealant to the 1-1/2" NPT threads of the insertion fitting assembly. Screw the assembly into the isolation valve and tighten with a 2-1/2" pump wrench. Final orientation of the two threaded rods on the MagProbe insertion fitting should be approximately perpendicular to the pipe's axis.
2. Run the lower Jam nuts down to a point that approximates the final insertion position or at least far enough to allow insertion of the MagProbe into the insertion Fitting. Using the threaded rods as a guide and with the flow direction arrow pointing in the correct direction, position the MagProbe in the insertion fitting. Continue to insert the MagProbe as far into the isolation assembly as possible. The MagProbe tip will come in contact with the closed "ball" in the isolation valve.

CAUTION: Do Not Force the MagProbe Tip Against the "Ball", as damage to the MagProbe tip may result.

3. Replace the upper Jam Nuts (2 on each rod) and the cotter pins. The nuts should be run down to the top side of the retaining collar and the cotter pins replaced. Orient the MagProbe in the direction of flow as indicated on by the FLOW direction arrow located on the top of the MagProbe amplifier enclosure. See **Figure 2.6**.

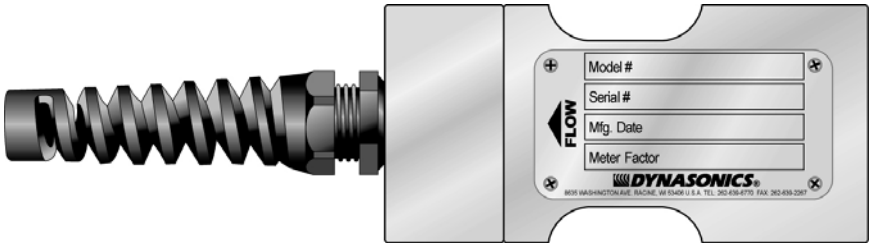


Figure 2.6

CAUTION: The nuts on both ends of the retaining rods must always be in place as a safety measure to prevent possible MagProbe blow out. Inserting cotter pins is a further safety measure.

4. Slowly open the isolation valve. When the valve is fully open, use a 9/16" wrench on the insertion nuts, alternately tightening

each nut about two complete turns to avoid uneven seal loading—two 9/16” ratcheting wrenches can expedite this process. Repeat until the length of probe remaining above the seal fitting equals the “D” length calculated in step D.

NOTE: For some low pressure\low temperature (less than 30 psi [2 Bar] and less than 100^{o} F [38^{o}C] the MagProbe may be pushed in by hand to decrease the insertion time. Dynasonics also offers insertion cranking tools for these probes.

Retracting DMP2 through DMP6 Probes

PROBE RETRACTION PROCEDURE

1. Retract the MagProbe by loosening the Upper Jam nuts counterclockwise — as viewed from the top of the MagProbe using a 9/16” wrench. If the pipe is under pressure, the nuts must be turned alternately about two turns at a time to prevent binding as a result of non-equal seal loading — two 9/16” ratcheting wrenches can expedite this process. In many cases, the line pressure will cause the MagProbe to retract. Should the MagProbe bind or if system pressure is very low, use the retraction nuts on the lower side of the MagProbe flange to assist in the MagProbe retraction. Continue this procedure until the MagProbe is fully retracted into the insertion fitting.

CAUTION: Do not run the drive nuts off the rods until the isolation valve is fully closed.

2. After the MagProbe is retracted past the "ball” in the isolation valve, the Isolation Valve may be closed to isolate the MagProbe from the line and the MagProbe can be removed entirely.

CAUTION: If the probe tip is not above the "ball" of the isolation valve, the valve cannot be closed. If the valve will not close smoothly, the body or tip of the MagProbe is most likely not above the "ball". Attempting to force the valve into the closed position may result in damage to the probe.

PART 3 - KEYPAD CONFIGURATION

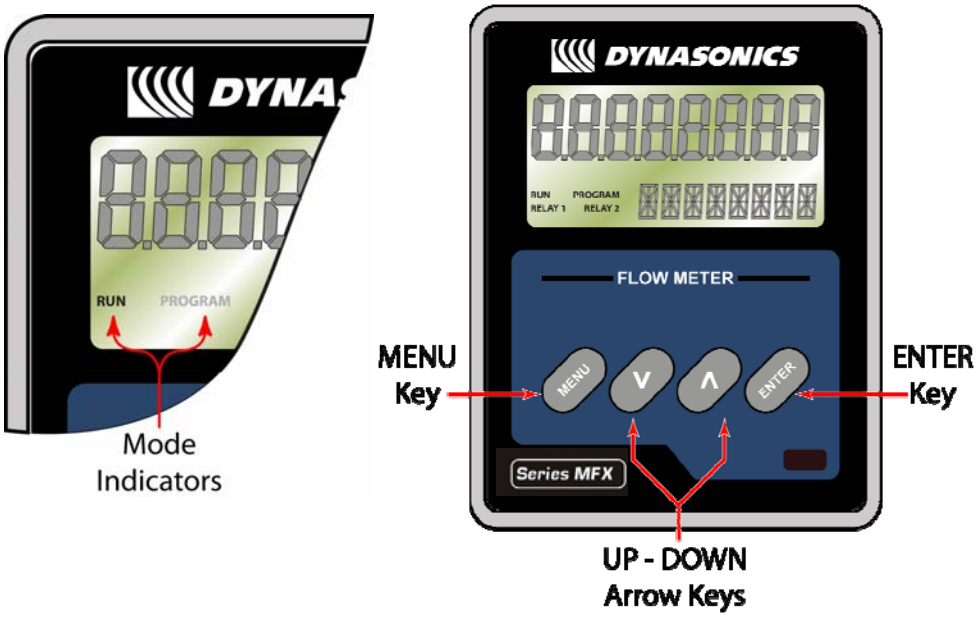
General

After installation of the MagProbe sensor and connection of appropriate power supplies to the MFX, keypad configuration of the instrument can be undertaken. All entries are saved in non-volatile FLASH memory and will be retained in the event of power loss.

The DMFXD2 is configured through the keypad interface and the DMFXD1 is configured through a software utility at the Dynasonics factory.

Keypad Operation

The MFX contains a four-key tactile feedback keypad interface that allows the user to view and change configuration parameters used by the MFX operating system.



1. The MENU key is pressed from RUN mode to enter PROGRAM mode. The MENU key is pressed in PROGRAM mode to exit configuration parameters and menus. If changes to any configuration parameters have been made, the user will be prompted with a SAVE?YES when returning to RUN mode.
2. The ARROW keys are used to scroll through menus and configuration parameters. The ARROW keys are also used to adjust parameter numerical values.
3. The ENTER key is pressed from the RUN mode to view the

current software version operating in the instrument.

- used to access the configuration parameters in the various menus.
- Used to initiate changes in configuration parameters.
- Used to accept configuration parameter changes.

Menu Structure

The MFX software is structured using menus. A Map of the user interface has been included in the Appendix of this manual. The Map provides a visual path to the configuration parameters that users need to access. This tool should be employed each time configuration parameters are accessed or revised.

The five menus used in the structure of the MFX are as follows:

1. **BSC MENU** -- BASIC operations menu. It contains all of the configuration parameters necessary to program the meter to measure flow.
2. **OUT1 MEN** -- Configures the type and operating parameters of the ISO-MOD located in Module #1 position.
3. **SEC MENU** -- SECURITY MENU utilized for resetting totalizers, resetting the operating system and revising security passwords.
4. **SER MENU** -- SERVICE MENU contains system measurements that are used by service personnel for troubleshooting instruments installed on piping systems.
5. **DSP MENU** -- DISPLAY MENU used to configure meter display functions.

PART 3 - KEYPAD CONFIGURATION

The following sections define the configuration parameters located in each of the menus.

1. BASIC MENU

The BASIC menu contains all of the configuration parameters necessary to make the MFX operational.

UNITS Selection

UNITS

ENGLSH
METRIC

Installs a global measurement standard into the operation of the instrument. The choices are either English or Metric measurements.

- Select ENGLSH if all configurations (pipe sizes, etc.) are to be made in inches. Select METRIC if the meter is to be configured in millimeters.

IMPORTANT!

NOTE: If the UNITS entry has been changed from ENGLSH to METRIC or from METRIC to ENGLSH, the entry must be saved and the instrument reset (power cycled or System Reset entered) in order for the MFX to initiate the change in operating units. Failure to save and reset the instrument may result in meter not measuring properly.

K-factor Entry

K FACTOR -- MagProbe K-Factor Entry

0.1—100.00

Each MagProbe has a unique K-Factor that is factory set and recorded on the information tag located on the MagProbe flow sensor. To enter the MagProbe K-Factor into the MFX, press the ENTER key, then use the up/down arrow keys to adjust displayed value to equal the unique K-Factor value. When the value is proper, press the ENTER key to record the value. This procedure must be followed if a replacement MagProbe is procured from the Dynasonics factory.

Pipe Diameter

PIPE OD -- Pipe Outside Diameter Entry

ENGLSH (Inches)
METRIC (Millimeters)

Enter the pipe outside diameter in inches if ENGLSH was selected as UNITS; in millimeters if METRIC was selected.

IMPORTANT NOTE: Charts listing popular pipe sizes have been included in the Appendix of this manual. Correct entries for pipe O.D. and pipe wall thickness are critical to obtaining accurate flow measurement readings.

Pipe Wall Thickness

PIPE WT -- Pipe Wall Thickness Entry

ENGLSH (Inches)
METRIC (Millimeters)

Enter the pipe wall thickness in inches if ENGLSH was selected as UNITS; in millimeters if METRIC was selected.

IMPORTANT NOTE: Charts listing popular pipe sizes have been included in the Appendix of this manual. Correct entries for pipe O.D. and pipe wall thickness are critical to obtaining accurate flow measurement readings.

Liner Thickness

LINER T -- Pipe Liner Thickness Entry

ENGLSH (Inches)
METRIC (Millimeters)

Enter the pipe liner thickness. Enter this value in inches if ENGLSH was selected as UNITS; in millimeters if METRIC was selected.

Insertion Depth

IINS DEPTH -- Insertion Depth Entry

ENGLSH (Inches)
METRIC (Millimeters)

Data defaulted to .125 x pipe I.D. No manual entry is necessary.

Engineering Units—RATE

RATE UNT - Engineering Units for Flow Rate

GALLONS - U.S. Gallons
LITERS - Metric Liter
MGAL - Millions of U.S. Gallons
CUBIC FT - Cubic Feet
CUBIC ME - Cubic Meters
ACRE FT - Acre Feet
OIL BARR - Oil Barrels (42 U.S. Gallons)
LIQ BARR - Liquor Barrels (31.5 U.S. Gallons)
FEET - Linear Feet
METERS - Linear Meters

Select a desired engineering unit for flow rate measurements.

Engineering Units—RATE INTERVAL

RATE INT - Time Interval for Flow Rate

MIN - Minutes
HOUR - Hours
DAY - Days
SEC - Seconds

Select a desired engineering unit for flow rate measurements.

Engineering Units—TOTAL

TOTL UNT - Engineering Units for Flow Totalizer

GALLONS - U.S. Gallons
LITERS - Metric Liter
MGAL - Millions of U.S. Gallons
CUBIC FT - Cubic Feet
CUBIC ME - Cubic Meters
ACRE FT - Acre Feet
OIL BARR - Oil Barrels (42 U.S. Gallons)
LIQ BARR - Liquor Barrels (31.5 U.S. Gallons)
FEET - Linear Feet
METERS - Linear Meters

Select a desired engineering unit for flow accumulator (totalizer) measurements.

Engineering Units—TOTAL Exponent

TOTL E - Flow Totalizer Exponent Value

E-1 to E6

Utilized for setting the flow totalizer exponent. This feature is useful for accommodating a very large accumulated flow. The exponent is a "X10^{n}" multiplier, where "n" can be from -1 (X 0.1) to +6 (X 1,000,000).**Table 3.5** should be referenced for valid entries and their influence on the DMFX display.

Exponent	Display Multiplier
E-1	x 0.1 (÷10)
E0	x 1 (no multiplier)
E1	x 10
E2	x 100
E3	x 1,000
E4	x 10,000
E5	x 100,000
E6	x 1,000,000

Minimum Flow Rate

MIN RATE -- Minimum Flow Rate Settings (Value)

Rate Unit/Rate Interval

A minimum volumetric flow rate setting is entered to establish filter software settings. Volumetric entries will be in the Engineering Rate Units and Interval selected on pages 3.9 and 3.10 of this manual. For unidirectional measurements, set MIN RATE to zero. For bi-directional measurements, set MIN RATE to the highest negative (reverse) flow rate expected in the piping system.

Maximum Flow Rate

MAX RATE -- Maximum Flow Rate Settings (Value)

Rate Unit/Rate Interval

A maximum volumetric flow rate setting is entered to establish filter software settings. Volumetric entries will be in the Engineering

Rate Units and Interval selected on pages 3.9 and 3.10 of this manual. Set MAX RATE to the highest (positive) flow rate expected in the piping system.

Low Flow Cut-off

FL C-OFF - Low Flow Cut-off
Percent of MAX RATE

A Low Flow Cut-off entry is provided to allow very low flow rates (that can be present when pumps are off and valves are closed) to be displayed as Zero flow. Typical values that should be entered are between 1.0% and 5.0% of full-scale.

System Damping

DAMP PER - System Damping
Relative Percent Entry

DAMP PER establishes a maximum adaptive filter value. Under stable flow conditions (flow that varies less than ±5%) this adaptive filter will increase the number of successive flow readings that are averaged together up to this maximum value. If flow changes outside of the ±5% window, the Flow Filter adapts by decreasing and allows the meter to react faster. A minimum filter setting is established with the MIN DAMP setting described below. **DAMP PER** is usually set to a value that is equal to or greater than **MIN DAMP**. Increasing this value tends to provide smoother steady-state flow readings and outputs.

Minimum System Damping

MIN DAMP - System Damping
Relative Percent Entry

In installations where very turbulent or erratic flow is encountered, increasing the **MIN DAMP** setting can increase display and output stability by forcing more averaging of flow readings. This filter is not adaptive, so increasing this setting will decrease the response time of the instrument to all changes in flow rate. **MIN DAMP** is usually set to a value that is equal to or less than **DAMP PER**.

2. OUTPUT #1 MENU

4-20mA

ISO-MOD 4-20mA

FL 4MA
FL 20MA
CAL 4MA
CAL 20MA
4-20 TST

Configured via jumper selections into either a passive or active transmission mode (See Section 2 for details), 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 using the Flow Measuring Range entries. These entries can be set anywhere in the –30 to +30 FPS [-9 to +9 MPS] measuring range of the instrument. Output resolution of the module is 12-bits (4096 discrete points) and the module can drive up to 800 ohms of load with its internal 24V isolated power source.

4-20mA Span

The FL 4MA and FL 20MA entries are used to set the span of the 4-20 mA analog output. These entries are volumetric rate units that are equal to the volumetric units configured as Engineering Rate Units and Engineering Units Time Interval entered on page 3.10. These entries may be entered anywhere in the flow measurement range of the instrument (velocity range of –30 to +30 FPS [-9 to +9 MPS]).

NOTE: The Minimum Rate may be set anywhere in the flow measurement range of –30 to +30 FPS [-9 to +9 MPS]). For example: If bi-directional flow needs to be logged, set the MIN RATE at a negative value.

For example, to span the 4-20mA output from –100 GPM to +100 GPM, with 12mA being 0 GPM, set the FL 4MA and FL 20MA inputs as follows:

FL 4MA = -100.0
FL 20MA = 100.0

For example, to span the 4-20mA output from 0 GPM to +100 GPM, with 12mA being 50 GPM, set the FL 4MA and FL 20MA inputs as follows:

FL 4MA = 0.0
FL 20MA = 100.0

4-20mA Calibration

The 4-20mA ISO-MOD is factory calibrated and should not require adjustment unless it is replaced.

The CAL4MA entry allows fine adjustments to be made to the "zero" of the 4-20mA output. To adjust the 4mA output, an ammeter or reliable reference connection to the 4-20mA output must be present.

NOTE: The CAL 4MA and CAL 20MA entries should not be used in a attempt to set the 4-20mA range. Utilize FL 4MA and FL 20MA, detailed above, for this purpose.

Procedure:

1. Disconnect one side of the current loop and connect the ammeter in series (disconnect either wire at the terminals labeled +/- on the **ISO-MOD** 4-20mA module).
2. Using the arrow keys, increase the numerical value to increase the current in the loop to 4mA. Decrease the value to decrease the current in the loop to 4mA. Typical values range between 40-80 counts.

Re connect the 4-20mA output circuitry as required.

Calibration of the 20mA setting is conducted much the same way as the 4mA adjustments.

Procedure:

1. Disconnect one side of the current loop and connect the ammeter in series (disconnect either wire at the terminals

labeled +/- on the **ISO-MOD** 4-20mA module).

2. Using the arrow keys, increase the numerical value to increase the current in the loop to 20mA. Decrease the value to decrease the current in the loop to 20mA. Typical values range between 3700-3900 counts.

Re connect the 4-20mA output circuitry as required.

4-20mA Test

4-20 TST - 4-20mA Output Test

4-20

Allows a simulated value to be output on from the 4-20mA output. By incrementing this value, the 4-20mA output will transmit the indicated current value. This feature can be utilized to confirm connectivity with chart recorders, data acquisition systems or other monitoring equipment.

Rate Pulse/ Freq

ISO-MOD: RATE PULSE (Value)

Flow at 0 Hz *(FL 0H)*
Flow at 2.5k Hz *(FL 2.5KH)*

NOTE: The Maximum Rate may be set anywhere in the flow measurement range of –30 to +30 FPS [-9 to +9 MPS]. For example: If bi-directional flow needs to be logged, set the MIN RATE at a negative value and MAX RATE at a positive value.

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 using the Flow Measuring Range entries. Output resolution of the module is 12-bits (4096 discrete points) and the maximum output frequency setting is 2,500 Hz. The module has two output modes, turbine meter simulation and “open collector”. The turbine meter simulation sources a non-ground referenced saw-tooth waveform with a maximum amplitude of approximately 500 mV p-p. The open collector output utilizes a 0.21 Ohm FET output that is rated to

operate at 100 V and 1 A maximum. If the open collector output is utilized, an external voltage source and limit resistor must be present. See Part 1 of this manual for connection information.

Rate Pulse Span

The FL 0H and FL 25KH entries are used to set the span of the 0 to 2.5k Hz frequency output. These entries are volumetric rate units that are equal to the volumetric units configured as Engineering Rate Units and Engineering Units Time Interval entered on pages 3.11 and 3.12 of this manual.

For example, in a bi-directional system, to span the 0 to 2.5k Hz output from –100 GPM to +100 GPM, with 1.25k Hz being 0 GPM, set the FL 100H and FL 10KH inputs as follows:

FL 0H = –100.0
FL 25KH = 100.0

For example, to span the 0 to 2.5k Hz output from 0 GPM to +100 GPM, with 1.25k Hz being 50 GPM, set the FL 0H and FL 25KH inputs as follows:

FL 0H = 0.0
FL 25KH = 100.0

Dual Relay

ISO-MOD Dual Relay

RELAY 1 AND RELAY 2

NONE
TOTALIZE
TOT MULT
FLOW
ON
OFF
SIG STR
ERRORS

Two independent SPDT (single-pole, double-throw, Form C) relays are contained in this module. The relay operations are user configured via software to act in either a flow rate alarm, signal

strength alarm, error alarm or totalizer/batching mode. The relays are rated for 200 VAC max. and a have current rating of 0.5A resistive load [175 VDC @ 0.25A resistive]. It is highly recommended that a slave relay be utilized whenever the Control Relay ISO-MOD is used to control inductive loads such as solenoids and motors.

Batch/ Totalizer Relay

TOTALIZE mode configures the relay to output a 50 mSec pulse (contact changeover) each time the display totalizer increments — divided by the TOT MULT. The TOT MULT value must be a whole, positive, numerical value.

For example, if the Totalizer Exponent is set to E0 (x1) and the Relay Multiplier is set to 1, then the relay will pulse each time the totalizer increments one count, or each single, whole measurement unit totalized.

If the Totalizer Exponent is set to E2 (x100) and the Relay Multiplier is set to 1, then the relay will pulse each time the display totalizer increments or once per 100 measurement units totalized.

If the Totalizer Exponent is set to E0 (x1) and the Relay Multiplier is set to 2, the relay will pulse once for every two counts that the totalizer increments.

Flow Rate Relay

Flow Rate Relay configuration permits relay changeover at two separate flow rates allowing operation with an adjustable switch deadband. **Figure 3.1** illustrates how the setting of the two set points influences rate alarm operation.

A single-point flow rate alarm would place the ON> setting slightly higher than the OFF< setting – allowing a switch deadband to be established. If a deadband is not established, switch chatter (rapid switching) may result if the flow rate is very close to the switch point.

Error Alarm Relay

When a relay is set to ERROR mode, the relay will activate when any error occurs in the flow meter that has caused the meter to stop measuring reliably. See the Appendix of this manual for a list of potential error codes.

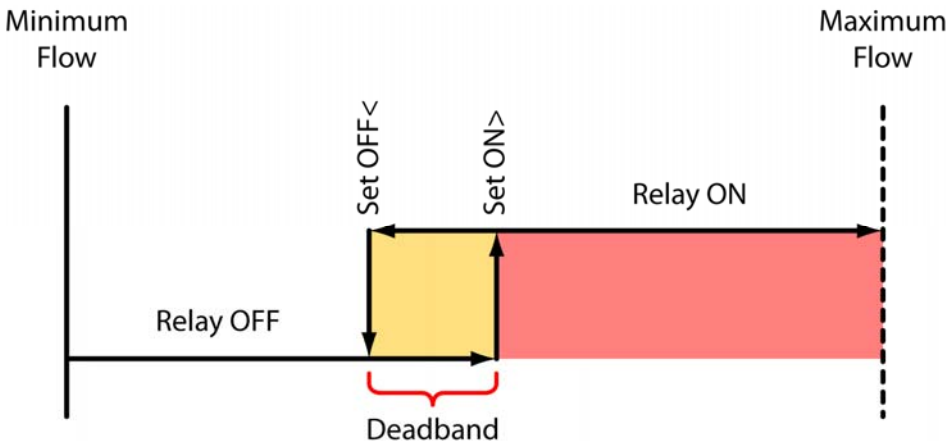


Figure 3.1
Single Point Alarm Operation

RS232C Module

ISO-MOD RS-232C

Baud Rate	*(RS232 BA)*
1200 Baud	*(1200)*
2400 Baud	*(2400)*
9600 Baud	*(9600)*
19,200 Baud	*(19200)*

The RS232C Module can be interfaced with serial communication ports of PCs, PLCs and SCADA systems. This module runs a proprietary digital protocol, detailed in the Appendix of this manual, that is used to monitor flow rate information in piping systems. The RS232C Module may also be used to form a hardwire connection to a PC that is running the *UltraLink*™ software utility. Baud rates up to 19.2k are supported.

RS-485 I/O

ISO-MOD RS485 (Choices and Values)

RS485 Mode	*(RS485 MO)*
Slave	*(SLAVE)*
Master	*(MASTER)*
Baud Rate	*(RS485 BA)*
1200 Baud	*(1200)*
2400 Baud	*(2400)*
9600 Baud	*(9600)*

19,200 Baud *(19200)*
Device Address *(1-127)*

The RS485 Module allows up to 126 MFX systems to be daisy-chained on a single three-wire cable network. Communications are through a proprietary digital protocol, detailed in the Appendix of this manual. All meters are assigned a unique one byte serial number that allows all of the meters on the cable network to be accessed independently. Baud rates up to 19.2k and cable lengths to 5,000 feet [1,500 meters] are supported without the need for repeaters.

RS485 MO

Select SLAVE for all of the MFX meters connected to the unit designated as MASTER.

RS485 BA

Select a Baud rate that is compatible with the operating system.

ADDRESS

Each MFX connected on the communications bus must have an unique address number assigned. Address 127 is a universal address that will result in all MFX instruments on the network responding simultaneously — regardless of address — resulting in CRC errors. Only select address location 127 if one meter is on the network.

Data Logger Option

ISO-MOD: DATALOGGER (Value)

LOGGING INTERVAL

From the OUTPUT 1 menu, select the time INTERVAL between readings. INTERVAL values between 1 and 30,000 seconds are acceptable.

For reference there are:

60 seconds in 1 minute
300 seconds in 5 minutes
1,800 seconds in 30 minutes
3,600 seconds in 1 hour
30,000 seconds in 8.33 hours

Table 3.6 describes some typical configurations of the INTERVAL and DURATION times with what the expected data samples collected count will be.

Table 3.6 — Interval and Duration Times

Example No.	INTERVAL Seconds	DURATION Hours Operated	Samples Collected
1	1	24 (1 day)	86,400
2	10	168 (7 days)	60,480
3	60 (1min)	720 (30 days)	43,200
4	300 (5 min)	8,760 (1 yr)	105,120
5	1,800 (30 min)	8,760 (1 yr)	17,520
6	3,600 (1 hr)	8,760 (1 yr)	8,760
7	18,000 (5 hr)	26,280 (3 yr)	17,520

3. SECURITY MENU

The SEC MENU allows the user to make password revisions, reset the flow totalizer and reset the transmitter microprocessor.

Totalizer RESET

TOT RES

NO
YES

Select YES to reset the Positive, Negative and Net flow totalizer/ accumulator to Zero.

System RESET

SYS RSET

NO
YES

Select YES to initiate a microprocessor reset. All system configurations and totalizer values will be maintained.

Change Password

CH PSWD? -- Change the Security Password

0-9999

By changing the Security Password from 0 to some other value (any value between 1-9999), configuration parameters will not be accessible without first entering that value when prompted. If the value is left at 0, no security is invoked and unauthorized changes could be made.

4. SERVICE MENU

Signal Strength

SIG STR - Signal Strength

This feature is not activated on the MFX flow meter product.

Signal Strength Cutoff

SIG C-OF - Signal Strength Cutoff

This feature is not activated on the MFX flow meter product.

Substitute Flow Entry

SUB FLOW - Substitute Flow

Substitute Flow or SUB FLOW is a value that the analog outputs and the flow rate display will be driven at when an error condition in the flowmeter occurs. The typical setting for this entry is a value that will make the instrument display zero flow during an error condition. TABLE 3.2 below lists some typical settings to achieve “Zero” with respect to MIN and MAX FLOW settings.

*UltraLink is required to set values outside of 0.0-100.0.

MIN RATE SETTING	MAX RATE SETTING	SUB FLOW SETTING	DISPLAY READING DURING ERRORS
0.0	1,000.0	0.0	0.000
-500.0	500.00	50.0	0.000
-100.0	200.0	33.3	0.000
0.0	1,000.0	-5.0*	-50.00

TABLE 3.2 Substitute Flow Entry

Setting/ Calibrating Zero Flow

SET ZERO—Calibrating Zero Flow

The MFX flow meter has been calibrated at the Dynasonics factory; this calibration procedure includes calibration of "zero" flow. Field calibration of "zero" is typically not required and other troubleshooting methods should typically be reviewed to ensure that the flow meter "zero" requires recalibration.

To zero the meter:

1. The pipe must be full of liquid.
2. Flow must be absolute zero—verify by closing a valve securely. Allow time for any settling to occur.
3. Press ENTER, use the arrow keys to make the display read YES.
4. Press ENTER.
5. The procedure is complete.

An alternative method for verifying and calibrating zero flow <u>when flow cannot be turned off</u> is covered in Section 4 of this manual.

Factory Default Zero Calibration

D-FLT 0 - Reverting to Factory Default Zero

If the flow in a piping system cannot be shutoff, allowing the SET ZERO procedure described above to be performed, the factory default zero should be utilized. To utilize the D-FLT 0 function, simply press ENTER, then press an ARROW key to display YES on the display and then press ENTER. This function can also be utilized to correct an inadvertently entered or erroneous SET ZERO entry.

Correction Factor

COR FTR - Universal Correction Factor

This function can be used to make the MFX system agree with a different or reference flow meter, by applying a correction factor/ multiplier to the readings and outputs. A factory calibrated system should be set to 1.000. The range of settings for this entry is 0.500 to 1.500. The following examples describe two uses for the COR FTR entry.

- The MFX meter is indicating a flow rate that is 4% higher than another flow meter located in the same pipe line. To make the MFX indicate the same flow rate as the other meter, enter a COR FTR of 0.960, to lower the readings by 4%.

5. DISPLAY MENU

Flow Display Mode

T/R SCAN - Totalizer and Rate Display Scan

FLOW
TOTAL
BOTH

The MFX will only display FLOW RATE with the T/R SCAN set to FLOW -- it will not display the TOTAL FLOW. MFX will only display FLOW TOTAL with the T/R SCAN set to TOTAL -- it will not display the FLOW RATE. By selecting BOTH, the display will scan between RATE and TOTAL at the interval selected in SCN DWL.

Totalizer Display Mode

TOTAL—Totalizer Mode

NET
POS
NEG
BATCH

Select NET to display the net difference between the positive direction and negative direction totalizers. Select POS to only view the positive direction totalizer. Select NEG to only view the negative direction totalizer. Select the BATCH totalizer to configure the totalizer to count up to a value that is entered as BTCH MUL (described on the following page). After reaching the BTCH MUL value, the display will return to zero and will repeat counting to the BTCH MUL value.

Rate/Total Scan Time

SCN DWL - Display Scan Dwell Time

1-10 Seconds

Adjustment of SCN DWL sets the time interval that the display will dwell at RATE and then alternately TOTAL values. This adjustment range is from 1 second to 10 seconds.

Displaying Batch Total

BTCH MUL - Totalizer Batch Quantity

If BATCH was chosen for the TOTALIZER DISPLAY MODE, a value for batch accumulation must be entered. This is the value that the totalizer will accumulate to before resetting to zero and repeating the accumulation. This value includes any exponents that were entered in the BASIC menu as TOTAL E. For example:

- If BTCH MUL is set to **1,000**, RATE UNT to **LITERS** and TOTL E to **E0** (liters X 1); the BATCH totalizer will accumulate to 1,000 liters, return to zero and repeat indefinitely. The totalizer will increment 1 count for every 1 liter that has passed.
- If BTCH MUL is set to **1,000**, RATE UNT to **LITERS** and TOTL E to **E2** (liters X 100); the BATCH totalizer will accumulate to 100,000 liters, return to zero and repeat indefinitely. The totalizer will only increment 1 count for every 100 liters that has passed.

PART 4 - SOFTWARE UTILITIES

The MFX flow meter is supported by a troubleshooting software utility called ***UltraLink***™. While *UltraLink*™ was developed to be utilized with Dynasonics Series TFX ultrasonic flow meters, the utility does have features that can assist MFX users in troubleshooting, configuration and calibration of the insertion magnetic flow meter system.

A PC running *UltraLink*™ can be hardwired to a MFX flow meter through an RS232 or RS485 module or, more commonly, the communications link is through an infrared communicator. The infrared communicator is available from Dynasonics as part number D005-2115-001. If the infrared communicator is to interface with a USB port on a PC, a USB-to-DB-9 interface adapter is required (Dynasonics part number D005-2116-004).

System Requirements

PC-type computer, running Windows® 95/98/2000/XP/Vista operating system, a communications port (USB ports require a USB-to-DB-9 adapter, Dynasonics p/n D005-2116-004).

Installation

1. ***UltraLink***™ can be found on the Dynasonics website (www.dynasonics.com) for no cost or a CD can be purchased by contacting Dynasonics sales.
2. Backup/Copy all files from the website link to a folder on the computer hard disk.
3. From the "Start" command, RUN **UlSetup.exe** from the hard disk folder.
4. During the installation of *UltraLink*™ *,* the installer will be queried as to which product the software is primarily going to be used with; select TFXD.
5. **UlSetup** will automatically extract and install on the hard disk and place a short-cut icon on the desktop.

Initialization

1. Connect communications cable, Dynasonics p/n D005-2115-001, to a PC communication port and point the communicator at the MFX infrared window, located in the lower right-hand corner of the meter front panel. Alternately, connect the PC communications port directly to an optionally installed RS232C or RS485 module located within the MFX flow meter.
2. Double-click on the *UltraLink*™ icon. The first screen is the "RUN-mode" screen (see **Figure 4.1**), which contains real-time information regarding flow rate, totalizer accumulation, system signal strength, diagnostic data and the flow meter's serial number. The indicator in the lower right-hand corner will indicate communications status. If a red **ERROR** is indicated, click on the Communications button on the top bar. Click on **Communications/Initialize**. Choose the appropriate COM port and interface type. Proper communications are established when a green **OK** is indicated in the lower right-hand corner of the PC display.

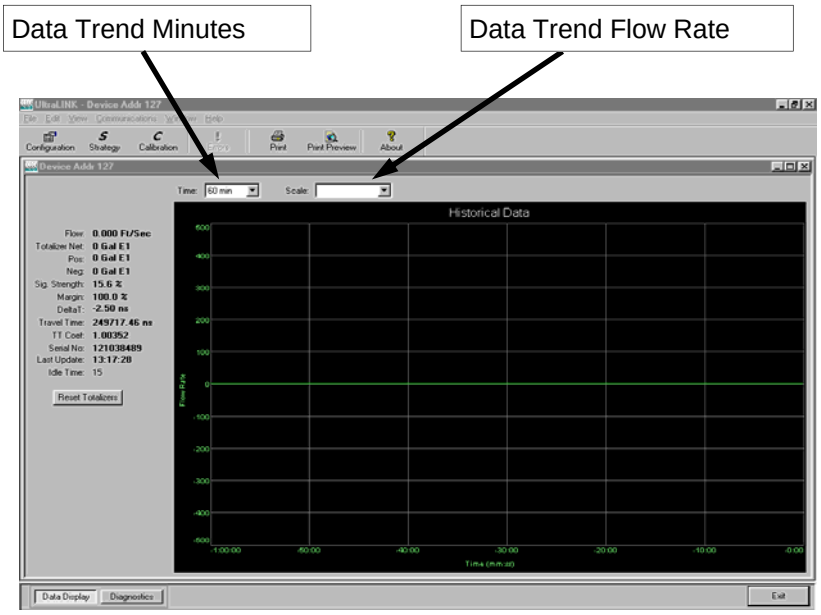


Figure 4.1
***UltraLink*™ Data Screen**

Pipe and Liquid Configuration

Click on the button labeled **Configuration** for updating flow range, liquid, pipe and I/O operating information. The first screen that appears after clicking the **Configuration** button is the **BASIC** tab. See **Figure 4.2**.

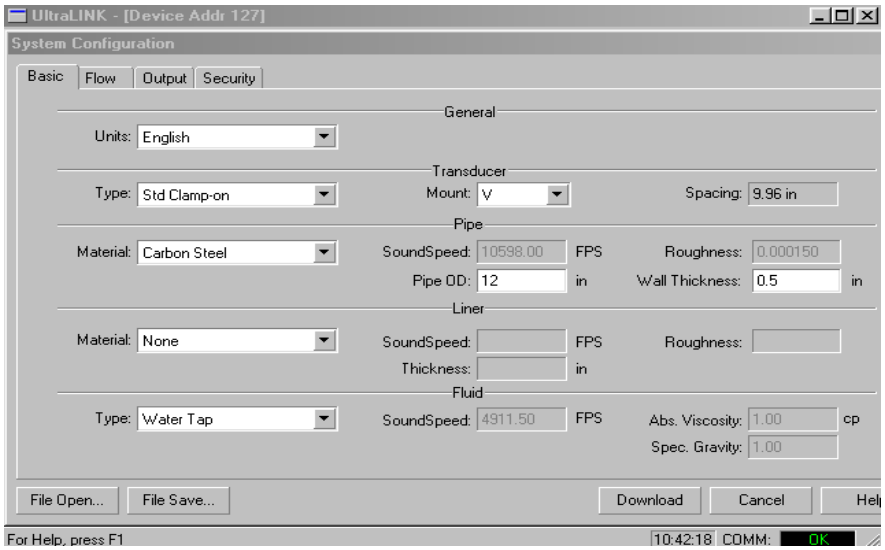


Figure 4.2
Basic Tab

1. **BASIC** TAB - see **Figure 4.2**

- **General Units** allows selection of either English (U.S.) or Metric units of measure. If measurements of the pipe are to be entered in inches, select English. If pipe measurements are to be entered in millimeters, select Metric. If the General Units are altered from those at instrument startup, then click on the Download button on the lower right-hand portion of the screen and recycle power to the MFX.
- **Transducer Type** does not pertain to the MFX product.
- **Transducer Mount** does not pertain to the MFX product.
- **Transducer Spacing** does not pertain to the MFX product.
- **Pipe Material** does not pertain to the MFX product.
- **Pipe O.D.** and **Wall Thickness** are based on the physical dimensions of the pipe on which the transducers will be mounted. Enter this value in inches for English units or millimeters for Metric units.

- **Liner Material** is selected from the pull-down list.
- **Liner Thickness** (entry becomes available when a Liner Material is selected) enter this value in inches for English units or millimeters for Metric units.
- **Fluid Type** does not pertain to the MFX product.

Flow Units Configuration

2. **FLOW** TAB - see **Figure 4.3**

- **Flow Rate Units** are selected from the pull-down lists. Select an appropriate rate unit and time from the two lists.
- **Totalizer Units** are selected from pull-down lists. Select an appropriate totalizer unit and totalizer exponent. The totalizer exponents are in Scientific Notation and permit the eight digit totalizer to accumulate very large values before the totalizer "rolls over" and starts again at zero. **Table 4.1** on page 4.6 illustrates the Scientific Notation values and their respective decimal equivalents.
- **MIN Flow** is used by the MFX to establish filter settings in its operating system. Enter a flow rate that is the minimum flow rate anticipated within the system. For unidirectional systems,

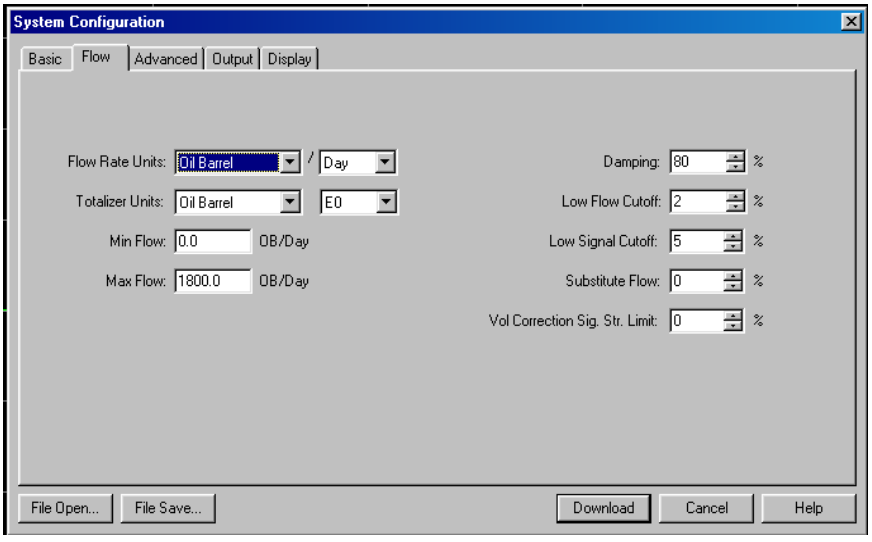


Figure 4.3
Flow Tab

TABLE 4.1 — Totalizer Exponent Values

Exponent	Display Multiplier
E-1	x 0.1 (decimal is moved on display)
E0	x 1 (no multiplier)
E1	x 10
E2	x 100
E3	x 1,000
E4	x 10,000
E5	x 100,000
E6	x 1,000,000

this value is typically zero. For bi-directional systems this value is set to a negative number that is equal to the maximum negative flow rate that is anticipated within the system.

- **MAX Flow** is used by the MFX to establish filter settings in its operating system. Enter a flow rate that is the maximum, positive flow rate anticipated within the system.
- The **Damping** value is increased to increase stability of the flow rate readings. Damping values are decreased to allow the flow meter to react faster to changing flow rates.
- **Low Flow Cutoff** is entered as a percentage between MAX Flow and MIN Flow and influences how the flow meter will act at flows very close to zero. Generally, an entry of 1% provides for a stable zero indication, while providing a 100:1 turndown ratio for measurements.
- **Low Signal Cutoff** does not pertain to the MFX product.
- **Substitute Flow** is used to provide an indication and output that signifies that an error exists with the flow meter or its setup. It is set as a percentage between MIN Flow and MAX Flow. In a unidirectional system this value is typically set to zero, to indicate zero flow while in an error condition. In a bi-directional system, the percentage can be set such that zero is displayed in

an error condition. To calculate where to set the Substitute Flow value in a bi-directional system, perform the following operation:

$$\text{Substitute Flow} = 100 - \left(\frac{100 \times \text{MAX Flow}}{\text{MAX Flow} - \text{MIN Flow}} \right)$$

3. **ADVANCED** TAB - does not pertain to MFX

Output Configuration

4. **OUTPUT** TAB - see **Figure 4.4**

The entries made in the Output tab establish input and output calibration and ranges for the ISO-MOD module installed in the MFX flow meter. If an optional module was ordered from and installed at the Dynasonics factory the Output tab will contain information and configuration for that module. If a module is to be installed in the field, place the module into the Module #1 position and secure with screws. Select the appropriate module from the pull-down menu and press the Download button. If a module has been changed from the factory setting, a Configuration error will result. This error will be cleared by resetting the MFX microprocessor from the Communications/Commands/Reset Target button or by cycling power on the MFX flow meter. Once the proper output modules are selected and the microprocessor is reset, calibration and configuration of the modules can be completed. If a module slot is empty in the MFX enclosure, select NONE as the module type.

4-20 mA Module Configuration

If the 4-20 mA output has been installed, the screen shown in **Figure 4.4** will appear in *UltraLink*™ at the OUTPUT tab:

- **Flow @4mA** and **Flow @20mA** set the span of the 4-20 mA output. The entry is made in the same flow measurement units that were entered in the Flow tab. The output can be set to span across zero (4 mA can be set to a negative flow value) so that the module will output bi-directional flow. For example, if a flow range spans from –100 to +100, the MFX will output 4 mA at –100 and 20 mA at +100 and output 12 mA (50% of the

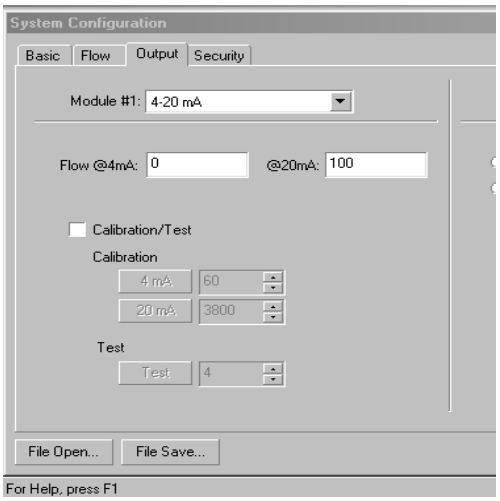


Figure 4.4
Output Tab

output) at 0.

- **Calibration/Test** is used to adjust the factory calibration span of the 4-20 mA output and to test (simulate) the output. The 4-20 mA output is factory calibrated and should not require adjustment in the field. Should the module be replaced or if recalibration is required, the following procedure is used to calibrate the span of the module:
  1. Connect a milliamp meter serially within the 4-20 mA module output.
  2. Check the Calibration/Test box.
  3. Select the 4 mA Calibration box.
  4. Adjust the count value to the right of the 4 mA button until the milliamp meter registers 4.00 mA.
  5. Select the 20 mA Calibration box.
  6. Adjust the count value to the right of the 20 mA button until the milliamp meter registers 20.00 mA.
  7. Press the Test button.
  8. Adjust the count value to 12.
  9. Verify that the milliamp meter registers 12.00 mA.
  10. Uncheck the Calibration/Test box.

Relay Module Configuration

If the Dual Relay output has been installed into the MFX flow meter, the screen shown in **Figure 4.5** on page 4.12 will appear in *UltraLink*™ at the OUTPUT tab. Each relay can be configured separately for one of four operations: Batch/Totalizer, Flow Rate, Signal Strength or Error.

- **Batch/Total** mode configures the relay to output a 50 mSec pulse (contact changeover) each time the display totalizer increments divided by the Multiplier. The Multiplier value must be a whole, positive, numerical value.

  For example, if the Totalizer Exponent is set to E0 (x1) and the Relay Multiplier is set to 1, then the relay will pulse each time the totalizer increments one count, or each single, whole measurement unit totalized.

  If the Totalizer Exponent is set to E2 (x100) and the Relay Multiplier is set to 1, the relay will pulse each time the display totalizer increments or once per 100 measurement units totalized.
  If the Totalizer Exponent is set to E0 (x1) and the Relay Multiplier is set to 2, the relay will pulse once for every two counts that the totalizer increments.

- **Flow Rate Relay** configuration permits relay changeover at two separate flow rates allowing operation with an adjustable switch

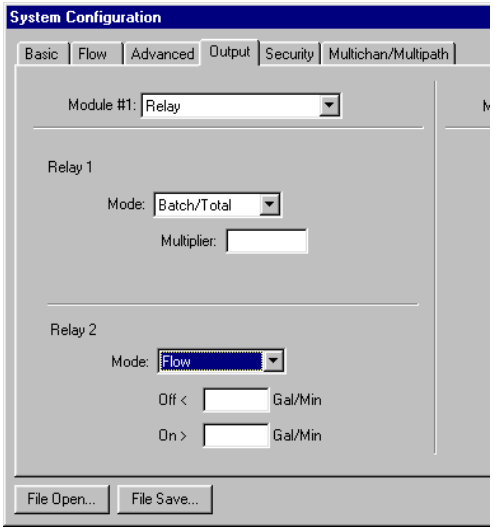


Figure 4.5
Dual Relay Configuration

deadband. **Figure 4.6** on page 4.13 illustrates how the setting of the two set points influences Rate Alarm operation.

A single-point flow rate alarm utilizes the ON> setting slightly higher than the OFF< setting – allowing a switch deadband to be established. If a deadband is not established, switch chatter (rapid switching) may result if the flow rate is very close to the switch point.

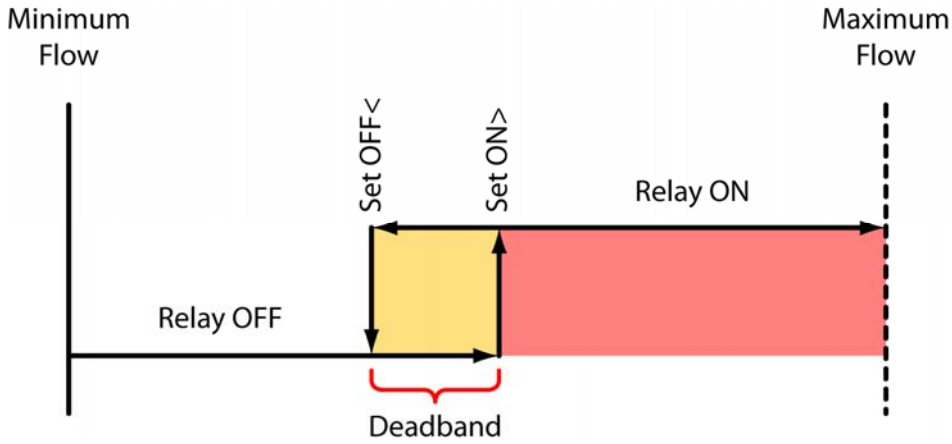


Figure 4.6
Single-point Alarm Operation

- The **Signal Strength alarm** does not pertain to the MFX.
- **Error Alarm** will cause contact changeover whenever an error is displayed on the MFX flow meter.

Rate Pulse Module Configuration

The Rate Module is utilized to transmit information to external counters and PID systems via a frequency output that is proportional to flow rate. The standard output of the module is 0-2,500 Hz, which corresponds to the flow rate span entered by the user. The Rate module configuration screen is shown in **Figure 4.7**.

- **Flow @0Hz** and **Flow @1/2.5KHz** set the span of the Rate pulse output. The entry is made in the same flow measurement units that were entered in the Flow Tab. The output can be set to span across zero (0 Hz can be set to a negative flow value) so that bi-directional flow can be output from the module. For example, if a flow rate range spans from –100 to +100, the MFX will output 0 Hz at –100 and 2,500 Hz at +100 and output 1,250 Hz (50% of the output) at 0.
- **Test** allows the user to output/simulate a particular output by entering a flow rate in the Test box. To have the MFX output a particular pulse frequency, select the Test box and enter a flow rate into the Test box. The MFX will output a pulse train at a frequency that is equal to the flow rate indicated in the test box. After testing is complete, unselect the Test box.

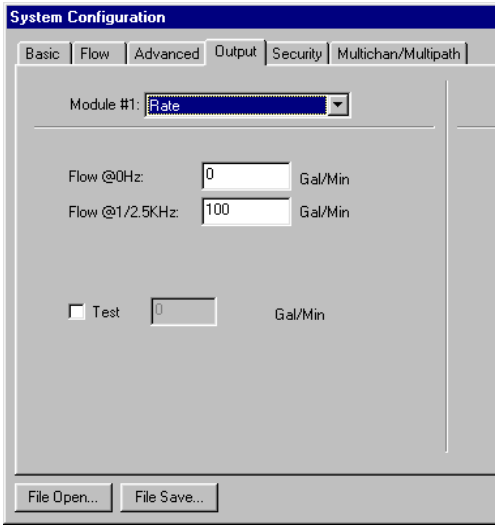


Figure 4.7
Rate Pulse Configuration

RS232 Configuration

The RS232 configuration window permits the selection of communications baud rate. Match this baud rate to that of the instrument with which the MFX will be required to communicate. **Figure 4.8** shows the RS232 configuration screen.

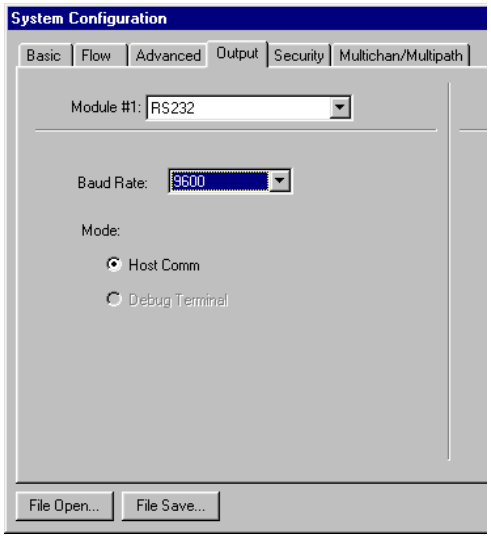


Figure 4.8
RS232 Configuration

RS485 Configuration

The RS485 configuration window permits the selection of communications baud rate and mode of the particular MFX instrument in the network. **Figure 4.9** shows the RS485 configuration screen.

- All MFX instruments on a single network must operate at the same Baud rate – 9600 baud is typical.
- Select the Mode of the MFX – either Master or Slave. Each network may have one Master and as many as 126 Slaves.

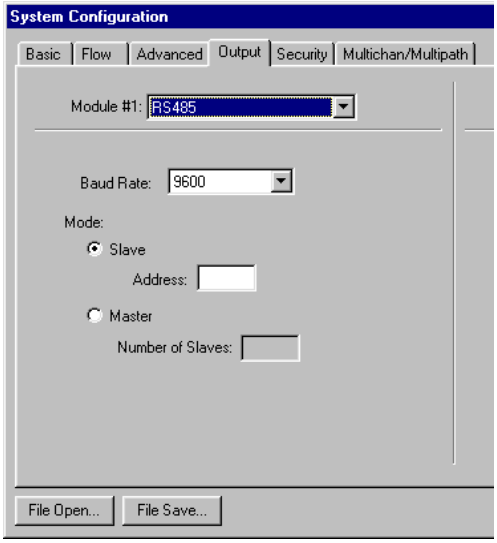


Figure 4.9
RS485 Configuration

Setting Zero on a Flowing Pipe

Calibrating Zero on a Flowing Pipe

UltraLink provides a means to calibrate “zero” flow on a pipe where the flow in the pipe cannot be shut off or blocked. To achieve optimum results, the flow in the pipe must be steady during the period when the calibration is performed. The procedure will take several minutes. If the flow is not steady and a zero calibration is required, it is best to remove the MagProbe sensor from the piping system, place it into a container of water and perform the zero as described in Section 3 of this manual.

To perform a zero calibration on a pipe with flowing liquid:

1. Press the **Calibration** button on UltraLink’s main **Data Display**. At Page 1 of 3, press the Next> button. See **Figure 4.10**.

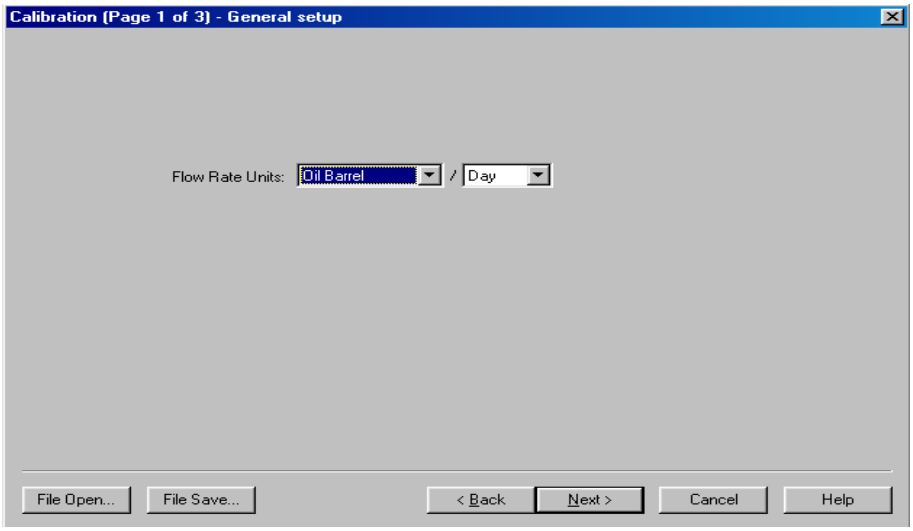


Figure 4.10
Calibration Units

2. On Page 2 of 3, Calibration—Zero Flow, note the **Current Delta T** that is displayed in the window. Note the value located in the **Set ->** box. If the box is empty, note the value as zero. See **Figure 4.11**.
3. Turn the MagProbe sensor 180-degrees in the piping system, keeping the same insertion depth.
4. Wait for the reading in the **Current Delta T** box to stabilize.

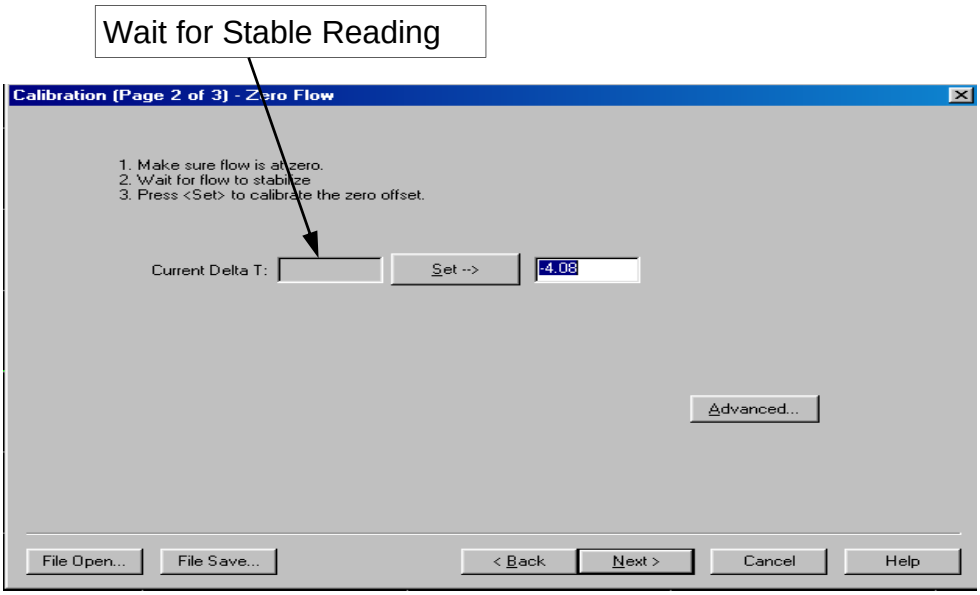


Figure 4.11
Setting Zero Flow

Note the **Current Delta T** reading.

5. Enter a value in the Set -> box that is equal to:

   New **Set ->** = (Forward reading - Reverse reading)/2 + **Set ->**

6. Enter the new calculated **Set ->** value into the box, ensuring to use a value of proper polarity—either positive or negative.
7. Press **Next** and then **Finish** on Page 3 of 3.

Saving Meter Configuration on a PC

The complete configuration of the flow meter can be saved from the **Configuration** screen. Select File **Save** button located in the lower left-hand corner of the screen and name the file. Files are saved as a *.dcf extension. This file may be transferred to other flow meters or may be recalled should the same pipe be surveyed again or multiple meters programmed with the same information.

Printing Out a Flow Meter Configuration and Calibration Report

Select **File** from the upper task bar and **Print** to print out a calibration/configuration information sheet for the flow meter installation.

Signal Quality

The **Diagnostics** screen provides valuable information regarding the signal-to-noise ratio (flow meter data quality). The two lines represent the voltage measurement across the electrodes with the magnet biased with forward polarity and the other line with the magnet biased with negative polarity. The separation between the lines increases with flow velocity and as a line reaches the top or bottom axis will roll over to the opposite axis.

In general, the more stable the signals appearing on the Diagnostics screen are, the more stable the flow measurement readings will be. Unstable signals, such as the signals shown in **Figure 4.12**, are indicative of

- poor earth ground connections to the MagProbe,
- the probe electrodes not touching the conductive fluid in the pipe (non-full pipe),
- electrodes that have become fouled with a non-conductive substance or
- noisy power supply source.

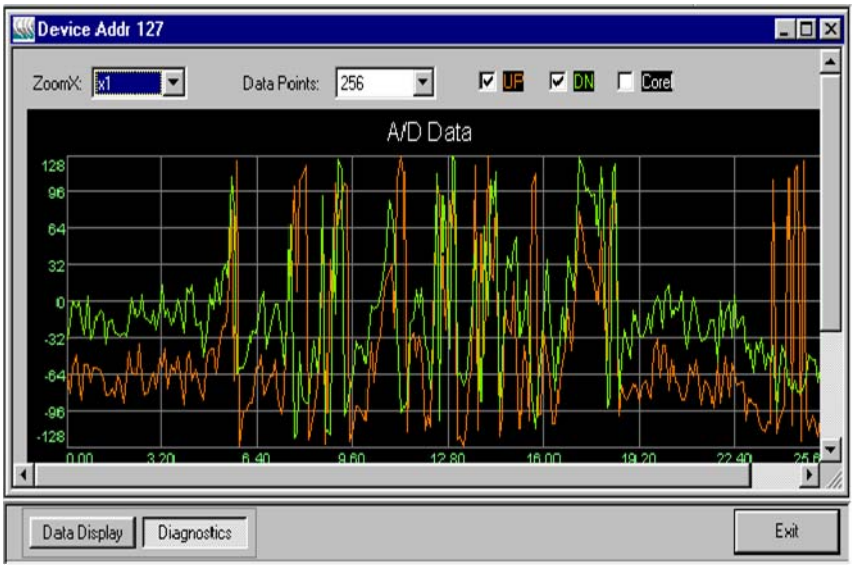


Figure 4.12—Noisy Diagnostic Signal

An example of signals that will provide good reading stability are shown in **Figure 4.13**.

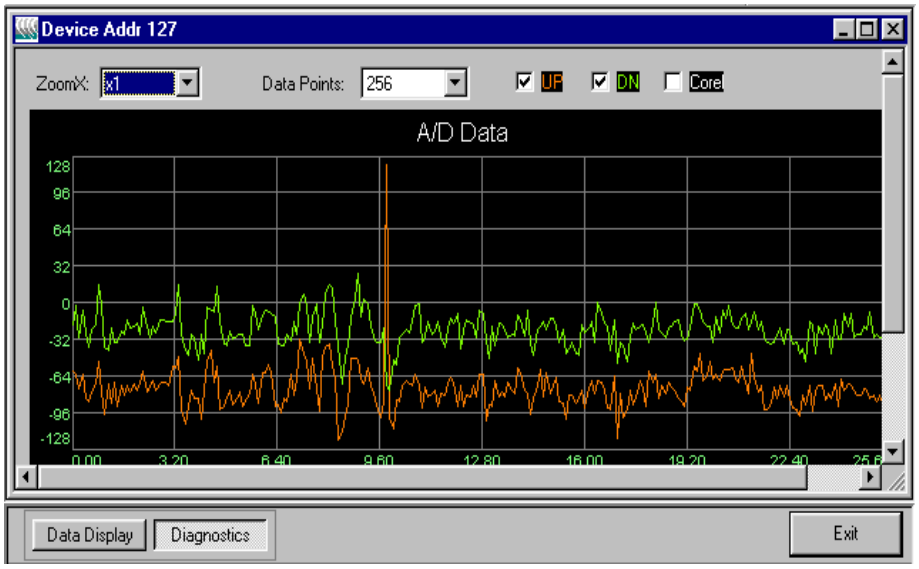


Figure 4.13—Good Diagnostic Signal

Using the Data Logger Software

During the installation of *UltraLink*™, a file called **Dynasonics DatLog** was installed and the utility will be located in the Dynasonics Program section of the computer. Run the DatLog program to start the utility. The screen shown in **Figure 4.14** will appear as the computer is attempting to establish communications with the logger module.

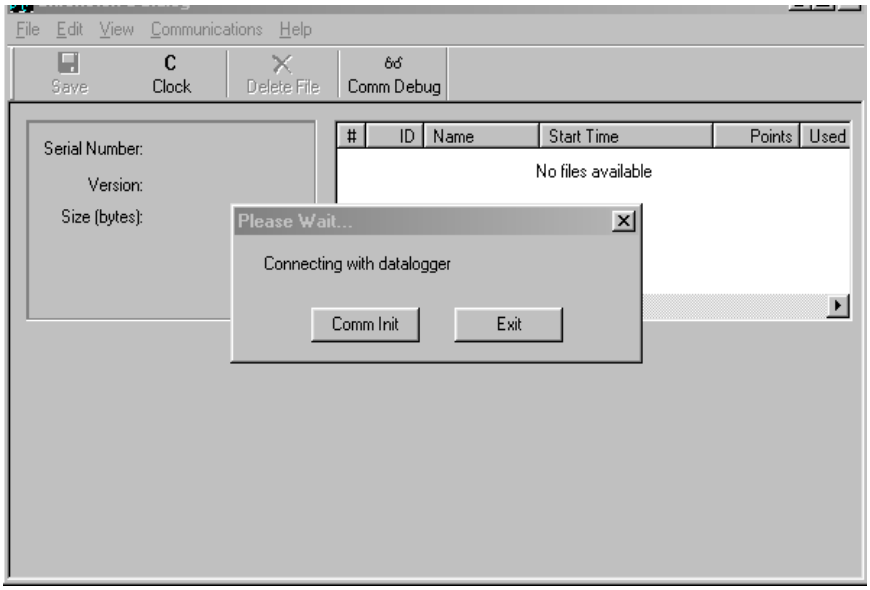


Figure 4.14
Logger Communication

Turn OFF the logger via the MFX keypad in the OUTPUT menu or via UltraLink in the Configuration/Output screen. Connect the logger to the computer's serial communications port with the enclosed DB-9 cable. After a few moments, the Please Wait window will disappear and a green OK will appear in the lower right-hand corner of the window. After communications are established (and the OK is displayed) the utility will scan the logger for all existing files. If the logger module is very full, uploading of the file data may take several minutes. A bar graph showing upload progress will provide status. The files will appear on the table—see **Figure 4.15**. Information regarding starting time, date and points collected will appear.

If a file is selected, the time-stamped data will appear on the strip chart located on the bottom of the window. The mouse can be used to select a small portion of the graph and expand the data to the

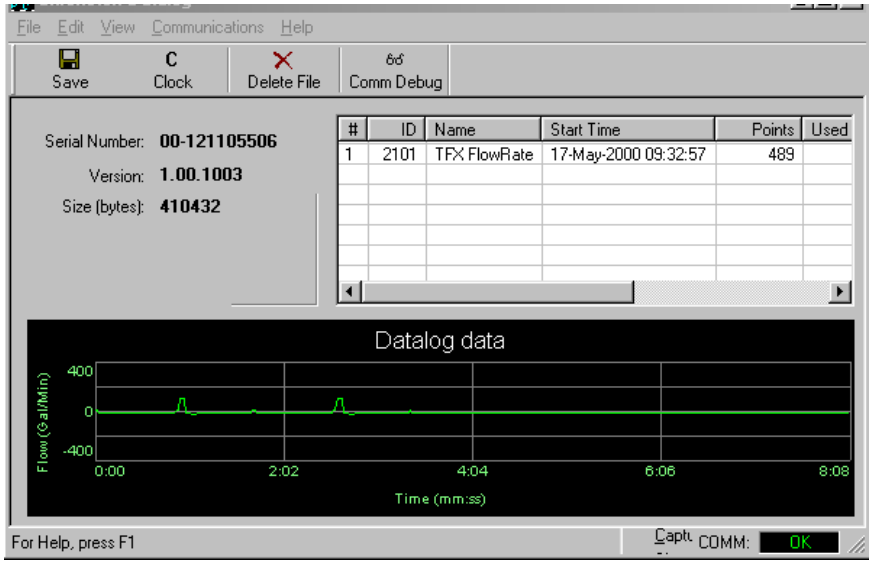


Figure 4.15
Logger Files

width of the screen. To revert to the entire data file, right-click the graph.

Saving Logger Files to a PC

To save the file to a computer, select the file from the file table and click the Save button located on the top task bar; see **Figure 4.16**. Datalog saves the files in .csv (comma separated value) format. These files can be opened in programs such as Microsoft Excel® or Corel® Quattro Pro® for manipulation or graphical purposes.

NOTE: The spreadsheet programs listed above are limited to the number of lines of data that can be imported. Very large files may need to opened in a program such as Microsoft WordPad and/or saved in two or more sections.

Setting the Logger Clock

The data logger module contains a real-time clock that can be set by clicking the Clock button on the top task bar; see **Figure 4.17**. Activating the window compares the data logger clock to the clock located in the PC. Adjustments can be made and uploaded to the logger.

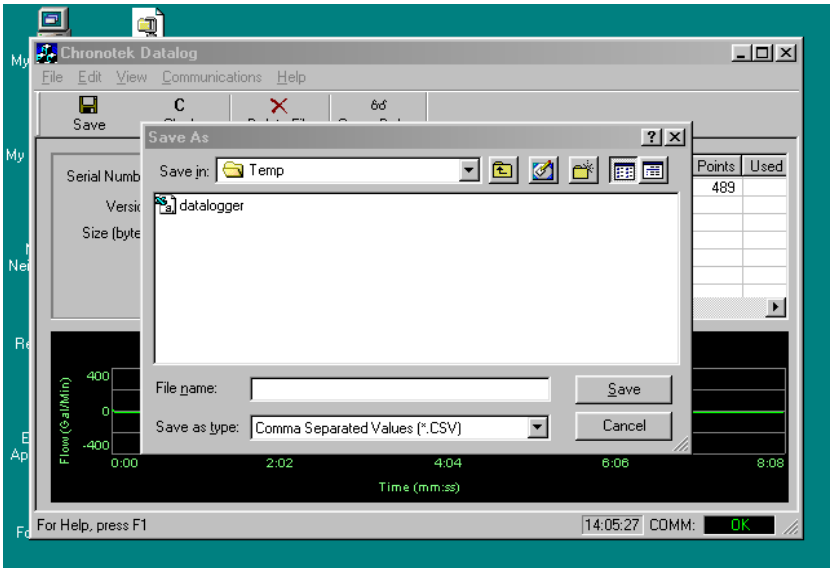


Figure 4.16
Saving Data Files

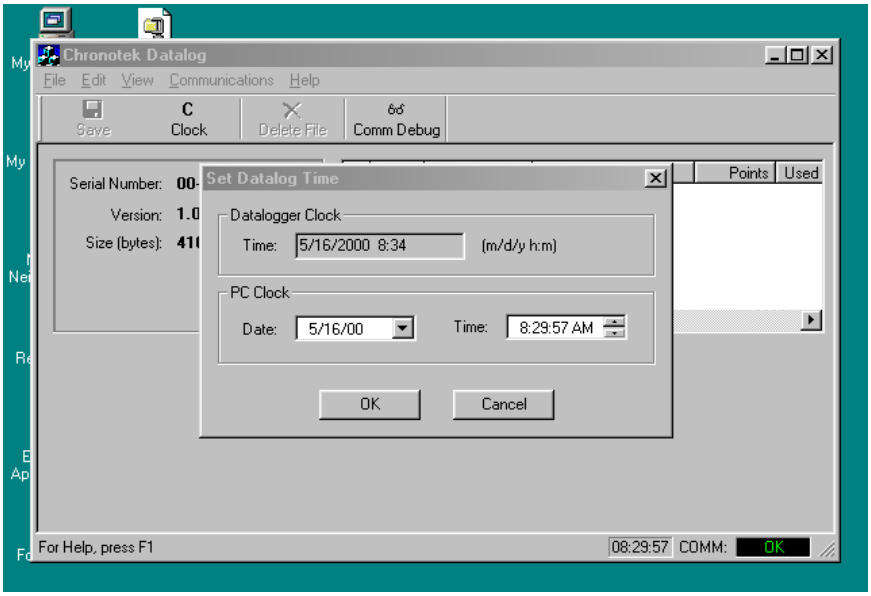
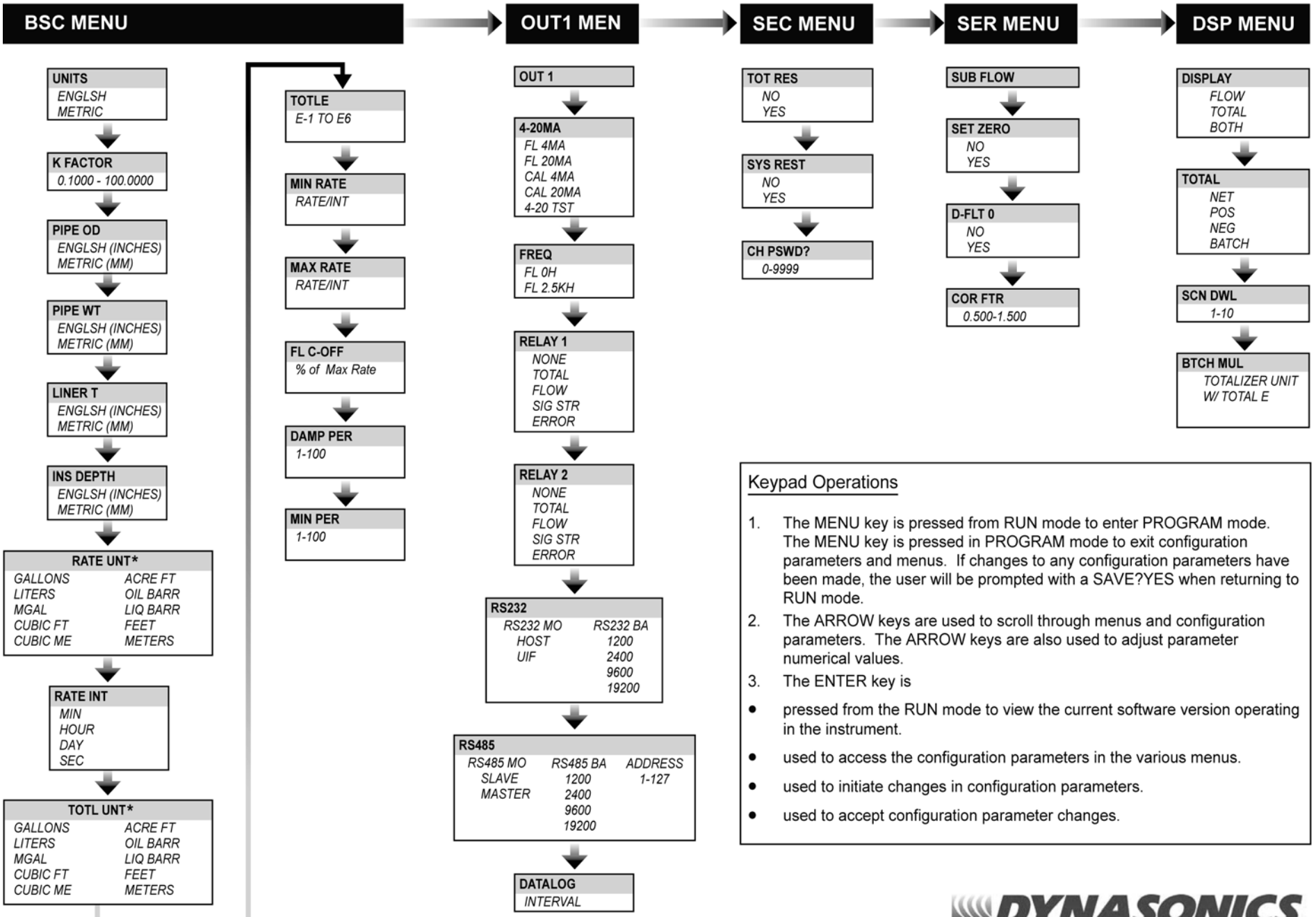


Figure 4.17
Setting the Clock

A P P E N D I X

MFX User Interface Map



*List provided for example only. Additional entries are available.

Keypad Operations

1. The MENU key is pressed from RUN mode to enter PROGRAM mode. The MENU key is pressed in PROGRAM mode to exit configuration parameters and menus. If changes to any configuration parameters have been made, the user will be prompted with a SAVE?YES when returning to RUN mode.
2. The ARROW keys are used to scroll through menus and configuration parameters. The ARROW keys are also used to adjust parameter numerical values.
3. The ENTER key is

- pressed from the RUN mode to view the current software version operating in the instrument.
- used to access the configuration parameters in the various menus.
- used to initiate changes in configuration parameters.
- used to accept configuration parameter changes.

DYNASONICS

Date: 9/2007 • Revision: 1.00.2213

RS232 COMMUNICATIONS PROTOCOL

RS232 PROTOCOL

The RS232 works on a simple command data structure. The basic structure is:

[:] [cmd] [data] [bcc] [\n]

:	Start of transmission, 1 byte
cmd	Command Code, 1 byte
data	Data or instruction
bcc	Block check character, 1 byte
\n	End of transmission, 1 byte

Command Codes:

The MFX has 4 basic command codes as follows:

01h	Set flow data
05h	Return flow data
11h	Preset Non-volatile data
15h	Return Non-volatile data

01h Set Flow Data: The data byte instructs the MFX processor to send flow data automatically or to stop automatic sending. Automatic flow data is sent once per second as a contiguous string followed by a \n. No bbc is returned

Data	Information to be returned	
10h	Return velocity at 1 second intervals	[:] [S] [+xx.xx]
11h	Return flow rate at 1 second intervals	[:] [F] [+xxxx.xx]
12h	Return totallizer at 1 second intervals	[:] [T] [+xxxxxx]
13h	Return conductivity after being calculated	[:] [Y] [xxxx]
1Fh	Clear automatic sending	

05h Return Flow Data upon request: The data byte instructs the MFX processor to return the flow data specified in the data byte. Flow data is sent once. No bbc is returned.

Data	Information to be returned	
10h	Return velocity	[:] [S] [+xx.xx] [\n]
11h	Return flow rate	[:] [F] [+xxxx.xx] [\n]
12h	Return totallizer	[:] [T] [+xxxxxx] [\n]
13h	Return last conductivity	[:] Y] [xxxx] [\n]

11h Preset Non-Volatile Data: This command, followed by 82 bytes of hex data will preset the MFX programming registers to match the incoming data. The data structure is listed later as NVD.

[;] [11h] [data] [data].....[bbc] [\n]

15h Return Non-Volatile Data: this command will be cause the MFX to respond with the data contained in the programming registers. The data structure is listed later as NVD.

[:] [15h] [bbc] [\n]

RS232 COMMUNICATIONS PROTOCOL

bbc generation: the bbc byte is generated by summing without overflow all characters in the transmission prior to the bbc byte excluding the [:] The bbc byte is then subtracted from ffh and added to 01h. The incoming bbc byte is compared to the calculated bbc.

NVD structure: The non-volatile data is contained in a data structure as listed below: Care must be taken when presetting the NVD registers as there is no error checking involved in presetting of these values. If improper data is supplied, the MFX may no longer function properly, or may cease to function completely.

```
union
{
        structure struct
        {
                char VELU[5];
                char FRUnit[5];
                char Cndx;
                char Scale;
                unsigned char rly2_code;
                unsigned char rl21_code;
                unsigned char time_code;
                unsigned char unit_code;
                unsigned int cal20;
                unsigned int cal4;
                unsigned int SP_Hi;
                unsigned int SP_Lo;
                unsigned int access_code;
                float PRB_FACT;
                float MIN_FLOW;
                float MAX_FLOW;
                float VEL_CODE;
                float RLY2_LL;
                float RLY1_LL;
                float RLY2_HL;
                float RLY1_HL;
                float MFE;
                float TIMECODE;
                float UNITCODE;
                float CUTOFF;
                float P_ID;
                float TOT;
        };
        unsigned char[82];
}NVD;
```

Non-volatile data is transferred one character at a time as the data is contained in memory. The entire block must be received as a whole without error or else the transmission will be ignored and an error code will be returned.

DYNASONICS

Cast Iron Pipe

Standard Classes

	CLASS A			CLASS B			CLASS C			CLASS D			CLASS E			CLASS F			CLASS G			CLASS H		
Size (Inches)	O.D. Inch	I.D. Inch	Wall	O.D. Inch	I.D. Inch	Wall	O.D. Inch	I.D. Inch	Wall	O.D. Inch	I.D. Inch	Wall	O.D. Inch	I.D. Inch	Wall	O.D. Inch	I.D. Inch	Wall	O.D. Inch	I.D. Inch	Wall	O.D. Inch	I.D. Inch	Wall
3	3.80	3.02	0.39	3.96	3.12	0.42	3.96	3.06	0.45	3.96	3.00	0.48												
4	4.80	3.96	0.42	5.00	4.10	0.45	5.00	4.04	0.48	5.00	3.96	0.52												
6	6.90	6.02	0.44	7.10	6.14	0.48	7.10	6.08	0.51	7.10	6.00	0.55	7.22	6.06	0.58	7.22	6.00	0.61	7.38	6.08	0.65	7.38	6.00	0.69
8	9.05	8.13	0.46	9.05	8.03	0.51	9.30	8.18	0.56	9.30	8.10	0.60	9.42	8.10	0.66	9.42	8.10	0.66	9.60	8.10	0.75	9.60	8.00	0.8
10	11.10	10.10	0.50	11.10	9.96	0.57	11.40	10.16	0.62	11.40	10.04	0.68	11.60	10.12	0.74	11.60	10.00	0.80	11.84	10.12	0.86	11.84	10.00	0.92
12	13.20	12.12	0.54	13.20	11.96	0.62	13.50	12.14	0.68	13.50	12.00	0.75	13.78	12.14	0.82	13.78	12.00	0.89	14.08	12.14	0.97	14.08	12.00	1.04
14	15.30	14.16	0.57	15.30	13.98	0.66	15.65	14.17	0.74	15.65	14.01	0.82	15.98	14.18	0.90	15.98	14.00	0.99	16.32	14.18	1.07	16.32	14.00	1.16
16	17.40	16.20	0.60	17.40	16.00	0.70	17.80	16.20	0.80	17.80	16.02	0.89	18.16	16.20	0.98	18.16	16.00	1.08	18.54	16.18	1.18	18.54	16.00	1.27
18	19.50	18.22	0.64	19.50	18.00	0.75	19.92	18.18	0.87	19.92	18.00	0.96	20.34	18.20	1.07	20.34	18.00	1.17	20.78	18.22	1.28	20.78	18.00	1.39
20	21.60	20.26	0.67	21.60	20.00	0.80	22.06	20.22	0.92	22.06	20.00	1.03	22.54	20.24	1.15	22.54	20.00	1.27	23.02	20.24	1.39	23.02	20.00	1.51
24	25.80	24.28	0.76	25.80	24.02	0.89	26.32	24.22	1.05	26.32	24.00	1.16	26.90	24.28	1.31	26.90	24.00	1.45	27.76	24.26	1.75	27.76	24.00	1.88
30	31.74	29.98	0.88	32.00	29.94	1.03	32.40	30.00	1.20	32.74	30.00	1.37	33.10	30.00	1.55	33.46	30.00	1.73						
36	37.96	35.98	0.99	38.30	36.00	1.15	38.70	35.98	1.36	39.16	36.00	1.58	39.60	36.00	1.80	40.04	36.00	2.02						
42	44.20	42.00	1.10	44.50	41.94	1.28	45.10	42.02	1.54	45.58	42.02	1.78												
48	50.50	47.98	1.26	50.80	47.96	1.42	51.40	47.98	1.71	51.98	48.00	1.99												
54	56.66	53.96	1.35	57.10	54.00	1.55	57.80	54.00	1.90	58.40	53.94	2.23												
60	62.80	60.02	1.39	63.40	60.06	1.67	64.20	60.20	2.00	64.82	60.06	2.38												
72	75.34	72.10	1.62	76.00	72.10	1.95	76.88	72.10	2.39															
84	87.54	84.10	1.72	88.54	84.10	2.22																		

March, 2000

DYNASONICS

Steel, Stainless Steel, P.V.C.

Standard Schedules

Nominal Pipe Size Inches	OUTSIDE DIAMETER	SCH. 5		SCH. 10 (LTWALL)		SCH. 20		SCH. 30		STD.		SCH. 40		SCH. 60		X STG.		SCH. 80		SCH. 100		SCH. 120		SCH. 140		SCH. 180	
		ID	Wall	ID	Wall	ID	Wall	ID	Wall	ID	Wall	ID	Wall	ID	Wall	ID	Wall	ID	Wall	ID	Wall	ID	Wall	ID	Wall	ID	Wall
1	1.315	1.185	0.065	1.097	0.109					1.049		1.049	0.133			0.957	0.179	0.957	0.179							0.815	0.250
1.25	1.660	1.530	0.065	1.442	0.109					1.380		1.380	0.140			1.278	0.191	1.278	0.191							1.160	0.250
1.5	1.900	1.770	0.065	1.682	0.109					1.610		1.610	0.145			1.500	0.200	1.500	0.200							1.338	0.281
2	2.375	2.245	0.065	2.157	0.109					2.067		2.067	0.154			1.939	0.218	1.939	0.218							1.687	0.344
2.5	2.875	2.709	0.083	2.635	0.120					2.469		2.469	0.203			2.323	0.276	2.323	0.276							2.125	0.375
3	3.500	3.334	0.083	3.260	0.120					3.068		3.068	0.216			2.900	0.300	2.900	0.300							2.624	0.438
3.5	4.000	3.834	0.083	3.760	0.120					3.548		3.548	0.226			3.364	0.318	3.364	0.318								
4	4.500	4.334	0.083	4.260	0.120					4.026	0.237	4.026	0.237			3.826	0.337	3.826	0.337			3.624	0.438	3.624	0.438	3.438	0.531
5	5.563	5.345	0.109	5.295	0.134					5.047	0.258	5.047	0.258			4.813	0.375	4.813	0.375			4.563	0.500	4.563	0.500	4.313	0.625
6	6.625	6.407	0.109	6.357	0.134					6.065	0.280	6.065	0.280			5.761	0.432	5.761	0.432			5.501	0.562	5.501	0.562	5.187	0.719
8	8.625	8.407	0.109	8.329	0.148	8.125	0.250	8.071	0.277	7.981	0.322	7.981	0.322	7.813	0.406	7.625	0.500	7.625	0.500	7.437	0.594	7.187	0.719	7.187	0.719	6.183	1.221
10	10.750	10.482	0.134	10.42	0.165	10.25	0.250	10.13	0.310	10.02	0.365	10.020	0.365	9.750	0.500	9.750	0.500	9.562	0.594	9.312	0.719	9.062	0.844	9.062	0.844	8.500	1.125
12	12.750	12.420	0.165	12.39	0.180	12.25	0.250	12.09	0.330	12.00	0.375	11.938	0.406	11.626	0.562	11.750	0.500	11.370	0.690	11.060	0.845	10.750	1.000	10.750	1.000	10.120	1.315
14	14.000			13.50	0.250	13.37	0.315	13.25	0.375	13.25	0.375	13.124	0.438	12.814	0.593	13.000	0.500	12.500	0.750	12.310	0.845	11.810	1.095	11.810	1.095	11.180	1.410
16	16.000			15.50	0.250	15.37	0.315	15.25	0.375	15.25	0.375	15.000	0.500	14.688	0.656	15.000	0.500	14.310	0.845	13.930	1.035	13.560	1.220	13.560	1.220	12.810	1.595
18	18.000			17.50	0.250	17.37	0.315	17.12	0.440	17.25	0.375	16.876	0.562	16.564	0.718	17.000	0.500	16.120	0.940	15.680	1.160	15.250	1.375	15.250	1.375	14.430	1.785
20	20.000			19.50	0.250	19.25	0.375	19.25	0.375	19.25	0.375	18.814	0.593	18.376	0.812	19.000	0.500	17.930	1.035	17.430	1.285	17.000	1.500	17.000	1.500	16.060	1.970
24	24.000			23.50	0.250	23.25	0.375	23.25	0.375	23.25	0.375	22.626	0.687	22.126	0.937	23.000	0.500	21.560	1.220	20.930	1.535	20.930	1.535	20.930	1.535	19.310	2.345
30	30.000			29.37	0.315	29.00	0.500	29.00	0.500	29.25	0.375	29.250	0.375			29.000	0.500										
36	36.000			35.37	0.315	35.00	0.500	35.00	0.500	35.25	0.375	35.250	0.375			35.000	0.500										
42	42.000									41.25	0.375	41.250	0.375			41.000	0.500										
48	48.000									47.25	0.375	47.250	0.375			47.000	0.500										

DYNASONICS

Ductile Iron Pipe

Standard Classes

Pipe Size (inches)	Outside Diameter (inches)	Class 50		Class 51		Class 52		Class 53		Class 54		Class 55		Class 56		Cement Lining Std./Double Thickness
		ID	Wall	ID	Wall	ID	Wall	ID	Wall	ID	Wall	ID	Wall	ID	Wall	
3	3.96			3.46	0.25	3.40	0.28	3.34	0.31	3.28	0.34	3.22	0.37	3.14	0.41	
4	4.80			4.28	0.26	4.22	0.29	4.16	0.32	4.10	0.35	4.04	0.38	3.93	0.44	
6	6.90	6.40	0.25	6.34	0.28	6.28	0.31	6.22	0.34	6.16	0.37	6.10	0.40	6.04	0.43	.123/.250
8	9.05	8.51	0.27	8.45	0.30	8.39	0.33	8.33	0.36	8.27	0.39	8.21	0.42	8.15	0.45	
10	11.10	10.32	0.39	10.46	0.32	10.40	0.35	10.34	0.38	10.28	0.41	10.22	0.44	10.16	0.47	
12	13.20	12.58	0.31	12.52	0.34	12.46	0.37	12.40	0.40	12.34	0.43	12.28	0.46	12.22	0.49	
14	15.30	14.64	0.33	14.58	0.36	14.52	0.39	14.46	0.42	14.40	0.45	14.34	0.48	14.28	0.51	
16	17.40	16.72	0.34	16.66	0.37	16.60	0.40	16.54	0.43	16.48	0.46	16.42	0.49	16.36	0.52	
18	19.50	18.80	0.35	18.74	0.38	18.68	0.41	18.62	0.44	18.56	0.47	18.50	0.50	18.44	0.53	.1875/.375
20	21.60	20.88	0.36	20.82	0.39	20.76	0.42	20.70	0.45	20.64	0.48	20.58	0.51	20.52	0.54	
24	25.80	25.04	0.38	24.98	0.41	24.92	0.44	24.86	0.47	24.80	0.50	24.74	0.53	24.68	0.56	
30	32.00	31.22	0.39	31.14	0.43	31.06	0.47	30.98	0.51	30.90	0.55	30.82	0.59	30.74	0.63	
36	38.30	37.44	0.43	37.34	0.48	37.06	0.62	37.14	0.58	37.40	0.45	36.94	0.68	36.84	0.73	
42	44.50	43.56	0.47	43.44	0.53	43.32	0.59	43.20	0.65	43.08	0.71	42.96	0.77	42.84	0.83	.250/.500
48	50.80	49.78	0.51	49.64	0.58	49.50	0.65	49.36	0.72	49.22	0.79	49.08	0.86	48.94	0.93	
54	57.10	55.96	0.57	55.80	0.65	55.64	0.73	55.48	0.81	55.32	0.89	55.16	0.97	55.00	1.05	

March, 2000

DYNASONICS

FPS TO GPM CROSS - REFERENCE (Schedule 40)

Nominal Pipe (Inches)	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	13.490	14.844	16.190	17.540	18.890	20.240	21.590	22.941	24.290
1.25	1.38	4.6620	6.9929	9.3239	11.655	13.99	16.317	18.648	20.979	23.310	25.641	27.970	30.300	32.630	34.960	37.300	39.627	41.958
1.5	1.61	6.3454	9.5182	12.691	15.864	19.04	22.209	25.382	28.555	31.730	34.900	38.070	41.250	44.420	47.590	50.760	53.936	57.109
2	2.07	10.489	15.734	20.979	26.224	31.47	36.713	41.958	47.202	52.450	57.692	62.940	68.180	73.430	78.670	83.920	89.160	94.405
2.5	2.47	14.935	22.402	29.870	37.337	44.80	52.272	59.740	67.207	74.670	82.142	89.610	97.080	104.50	112.00	119.50	126.95	134.41
3	3.07	23.072	34.608	46.144	57.680	69.22	80.752	92.288	103.82	115.40	126.90	138.40	150.00	161.50	173.00	184.60	196.11	207.65
3.5	3.55	30.851	46.276	61.702	77.127	92.55	107.98	123.40	138.83	154.30	169.68	185.10	200.50	216.00	231.40	246.80	262.23	277.66
4	4.03	39.758	59.636	79.515	99.394	119.3	139.15	159.03	178.91	198.80	218.67	238.50	258.40	278.30	298.20	318.10	337.94	357.82
5	5.05	62.430	93.645	124.86	156.07	187.3	218.50	249.72	280.93	312.10	343.36	374.60	405.80	437.00	468.20	499.40	530.65	561.87
6	6.06	89.899	134.85	179.80	224.75	269.7	314.65	359.60	404.55	449.50	494.45	539.40	584.30	629.30	674.20	719.20	764.14	809.09
8	7.98	155.89	233.83	311.78	389.72	467.7	545.61	623.56	701.50	779.40	857.39	935.30	1013.0	1091.0	1169.0	1247.0	1325.1	1403.0
10	10.02	245.78	368.67	491.56	614.45	737.3	860.23	983.12	1106.0	1229.0	1351.8	1475.0	1598.0	1720.0	1843.0	1966.0	2089.1	2212.0
12	11.94	348.99	523.49	697.99	872.49	1047.0	1221.5	1396.0	1570.5	1745.0	1919.5	2094.0	2268.0	2443.0	2617.0	2792.0	2966.5	3141.0
14	13.13	422.03	633.04	844.05	1055.1	1266.0	1477.1	1688.1	1899.1	2110.0	2321.1	2532.0	2743.0	2954.0	3165.0	3376.0	3587.2	3798.2
16	15.00	550.80	826.20	1101.6	1377.0	1652.0	1927.8	2203.2	2478.6	2754.0	3029.4	3305.0	3580.0	3856.0	4131.0	4406.0	4681.8	4957.2

FPS TO GPM: GPM = $(\text{PIPE ID})^2 \times \text{VELOCITY IN FPS} \times 2.45$

GPM TO FPS: $\text{FPS} = \dfrac{\text{GPM}}{(\text{ID})^2 \times 2.45}$

FPS X .3048 = MPS

GPM X .0007 = GPD

GPM X 3.7878 = LPM

DYNASONICS

FPS TO GPM CROSS - REFERENCE (Schedule 40)

Nominal Pipe (Inches)	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
18	16.88	697.52	1046.3	1395.0	1743.8	2093.0	2441.3	2790.1	3138.8	3488.0	3836.3	4185.0	4534.0	4883.0	5231.0	5580.0	5928.9	6277.7
20	18.81	866.14	1299.0	1732.0	2165.3	2598.4	3031.5	3464.6	3897.6	4330.7	4763.8	5196.8	5629.9	6063.0	6496.0	6929.1	7362.2	7795.3
24	22.63	1253.7	1880.0	2507.0	3134.1	3761.0	4387.8	5014.6	5641.5	6268.3	6895.1	7522.0	8148.8	8775.6	9402.4	10029	10656	11283
26	25.25	1560.7	2341.0	3121.0	3901.9	4682.2	5462.6	6243.0	7023.4	7803.7	8584.1	9364.5	10145	10925	11706	12486	13266	14047
28	27.25	1817.8	2727.0	3636.0	4544.5	5453.4	6362.3	7271.2	8180.0	9088.9	9997.8	10907	11816	12725	13633	14542	15451	16360
30	29.25	2094.4	3142.0	4189.0	5236.0	6283.2	7330.4	8377.6	9424.9	10472	11519	12566	13614	14661	15708	16755	17803	18850
32	31.25	2390.6	3586.0	4781.0	5976.5	7171.9	8367.2	9562.5	10758	11953	13148	14344	15539	16734	17930	19125	20320	21516
34	33.25	2706.4	4060.0	5413.0	6766.0	8119.2	9472.4	10826	12179	13532	14885	16238	17592	18945	20298	21651	23004	24358
36	35.25	3041.8	4563.0	6084.0	7604.5	9125.4	10646	12167	13688	15209	16730	18251	19772	21292	22813	24334	25855	27376
42	41.25	4165.4	6248.0	8331.0	10414	12496	14579	16662	18744	20827	22910	24992	27075	29158	31241	33323	35406	37489
48	47.99	5637.8	8457.0	11276	14095	16913	19732	22551	25370	28189	31008	33827	36646	39465	42284	45103	47922	50740
54	53.98	7133.1	10700	14266	17833	21399	24966	28532	32099	35665	39232	42798	46365	49931	53498	57065	60631	64198
60	60.09	8839.2	13259	17678	22098	26518	30937	35357	39777	44196	48616	53035	57455	61875	66294	70714	75134	79553
72	72.10	12726	19089	25451	31814	38177	44540	50903	57266	63628	69991	76354	82717	89080	95443	101805	108168	114531
84	84.10	17314	25971	34628	43285	51943	60600	69257	77914	86571	95228	103885	112542	121199	129856	138514	147171	155828

FPS TO GPM: GPM = $(\text{PIPE ID})^2 \times \text{VELOCITY IN FPS} \times 2.45$

GPM TO FPS: $\text{FPS} = \dfrac{\text{GPM}}{(\text{ID})^2 \times 2.45}$

FPS X .3048 = MPS

GPM X .0007 = GPD

GPM X 3.7878 = LPM

STATEMENT OF WARRANTY

Dynasonics Division, Racine Federated Inc. (hereinafter "the Company") warrants its products under normal use and service to be free of defects in material and workmanship for a period of twelve (12) months from date of shipment (the "Warranty Period").

This Warranty does not apply to defects caused by acts of God, abuse, misuse, vandalism or improper installation or operation. Further, this Warranty does not apply to products that have been altered or improperly repaired by a party other than the Company or its authorized agents.

To make claim under this Warranty, the Customer must notify the Company in writing within the Warranty Period. The Company may either repair or replace, at its option, any products found to be defective. Return to the Customer of repaired items will be shipped freight prepaid by the Company. Any repaired products shall be warranted for the remainder of the unexpired Warranty Period plus the amount of time the products were under repair, or for a period of 90 days, whichever is longer.

This Warranty is in lieu of all other warranties, express or implied, including, without limitation, any implied warranty of merchantability or fitness for a particular purpose. The sole and exclusive liability of the Company hereunder shall be to repair or replace a defective product or part, or if unable to do so, refund the purchase price of the product at the Company's option.

In all events, the Company shall not be liable for special, indirect, incidental or consequential losses or damages of any kind or nature whatsoever, even if the Company has been advised of the possibility of such loss or damage. No waiver, alteration or modification of this Warranty shall be binding against the Company unless in writing and signed by an authorized executive officer of the Company.

GENERAL TERMS AND CONDITIONS OF SALES

1. PAYMENT – Terms of payment are effective from the actual date of invoice. If, in the Seller's opinion, the financial condition of the Buyer at any time – or any other circumstances – do not justify the incurrence of production costs of shipment on the terms of payment specified, the Seller may require partial or full payment in advance. Payment terms are net 30 days unless otherwise stated on invoice.

2. F.O.B. – All shipments are from Racine, Wisconsin, USA, unless otherwise other stated, and title transfers to the buyer upon leaving factory.

3. QUOTATION AND PRICES – Quoted prices are firm for 30 days unless stated in the quotation and are subject to change without notice after expiration of this period.

4. TAXES – Any applicable sales, use, revenue, excise or other taxes not specifically stated in the quotation are to be remitted by the Buyer directly to the appropriate regulatory agency.

5. WARRANTY – Seller's standard published warranty in effect at the time of shipment shall apply. This warranty is exclusive and is in lieu of all other warranties, express, implied, or statutory, including the warranty of merchantability.

6. DELIVERY – The Seller shall not be liable for loss or damage of any kind resulting from delay or inability to deliver on account of flood, fire, labor trouble, riots, civil disturbances, accidents, acts or orders or regulations of civil or military authorities, shortages of material, or any other causes beyond Seller's control.

7. PRODUCT CHANGES – In keeping with our continuing policy of product improvement, we reserve the right to make changes in our products at any time, without incurring an obligation to change, replace or upgrade equipment previously shipped.

8. CANCELLATIONS – An order placed by Buyer and accepted by Seller may be cancelled only with the Seller's consent and upon terms that will indemnify the Seller against loss.

9. RESTOCKING CHARGE – On standard equipment, the charge is 25%, provided the equipment is returned within 30 days in acceptable condition with a RGA number. Restocking charges for special equipment may vary from standard equipment, and will be handled on a case-by-case basis.
   No returns will be taken after one year.

RETURN OF EQUIPMENT/SALES INFORMATION

CONTACTS AND PROCEDURES

Customer Service/Application Engineer:

If you have a question regarding order status, placing an order, reviewing applications for future purchases, or wish to purchase a new flowmeter, please contact our new National Sales and Marketing Headquarters:

DYNASONICS
Division of Racine Federated, Inc.
8635 Washington Avenue
Racine, WI 53406
PHONE: (800)535-3569 or
(262)639-6770
FAX: (262)639-2267

Service/Repair Department:

If you already purchased equipment and have an operation problem, require service, or need to schedule field service, please contact our Service Department:

DYNASONICS
Division of Racine Federated, Inc.
8635 Washington Avenue
Racine, WI 53406
PHONE: (800)535-3569 or
(262)639-6770
FAX: (262)639-2267

Return Goods Authorization:

When returning equipment, it is necessary for you to contact our Service Department at (800)535-3569 or (262)639-6770 to obtain an RGA number for the authority and proper tracking of your material and its prompt inspection and return. The RGA number should be noted on the outside of the box. All returns of equipment go to the following address:

DYNASONICS
Division of Racine Federated, Inc.
8635 Washington Avenue
Racine, WI 53406
Attn: RGA #

8635 WASHINGTON AVENUE
RACINE, WI 53406
TOLL-FREE IN NORTH AMERICA.:
TEL: (800) 535-3569 FAX: (800) 732-8354
TEL: (262) 639-6770 FAX: (262) 639-2267
URL: www.dynasonics.com