Ultrasonic flowmeters

SITRANS FUS1020 IP65 NEMA 4

Operating Instructions - September 2008

SITRANS F

SIEMENS

SIEMENS

FIELD MANUAL

IMPORTANT NOTICE

Controlotron is now part of:

Siemens Industry, Inc.
Industry Automation Division
CoC Ultrasonic Flow
Hauppauge, NY 11788 USA

SITRANS FUS 1020
NEMA-4/IP 65 CLAMP-ON
TRANSIT-TIME FLOWMETER

ATTENTION

This equipment contains components that are susceptible to electrostatic discharge (ESD). Please observe ESD control measures during the handling and connection process.

Field Manual CQO:1020NFM-1 Rev D
September 2008

For use with Operating System
Software Version 3.01.04F or later

Manual Changes

NOTE: For the latest updates and revisions to this field manual go to
www.support.automation.siemens.com/ and check the Product Manual listing.

MANUAL ADDENDUM

Digital Damping Procedure Update For Gas & Liquid Flowmeters

Manual Addendum
September 2008

Digital Damping Procedure Update for Gas & Liquid Flowmeters

INTRODUCTION

The following Digital Damping procedure updates are for SITRANS F gas and liquid clamp-on flowmeters.Replace the Digital Damping Control: (Hot Key 1 and 2) procedure in the "Detection Modes" section (sub-paragraph: Command Modes) in the appropriate gas and liquid STIRANS F flowmeter manuals.

FUG1010 Gas Clamp-on Flowmeter Manuals

Digital Damping Control: (Hot Key 1 and 2)

The FUG1010 permits user modification of the digital averaging used by the signal processing routines. In general, the default damping values selected by the FUG1010 will provide optimal performance over a wide range of transit time applications. However, in extreme cases of unstable flow, pulsating flow, low signal levels or high electronic noise it may be necessary to override these default settings to permit uninterrupted and reliable flow measurement.

Test Facilities Graph Screen

The FUG1010 Graph Screen includes the capability to access a set of command codes, which enable a user to override a number of default meter settings. The most important parameter is the *digital damping control*, which can be accessed by pressing number <1> or <2> on the keypad while in the Signal Graph Screen mode.
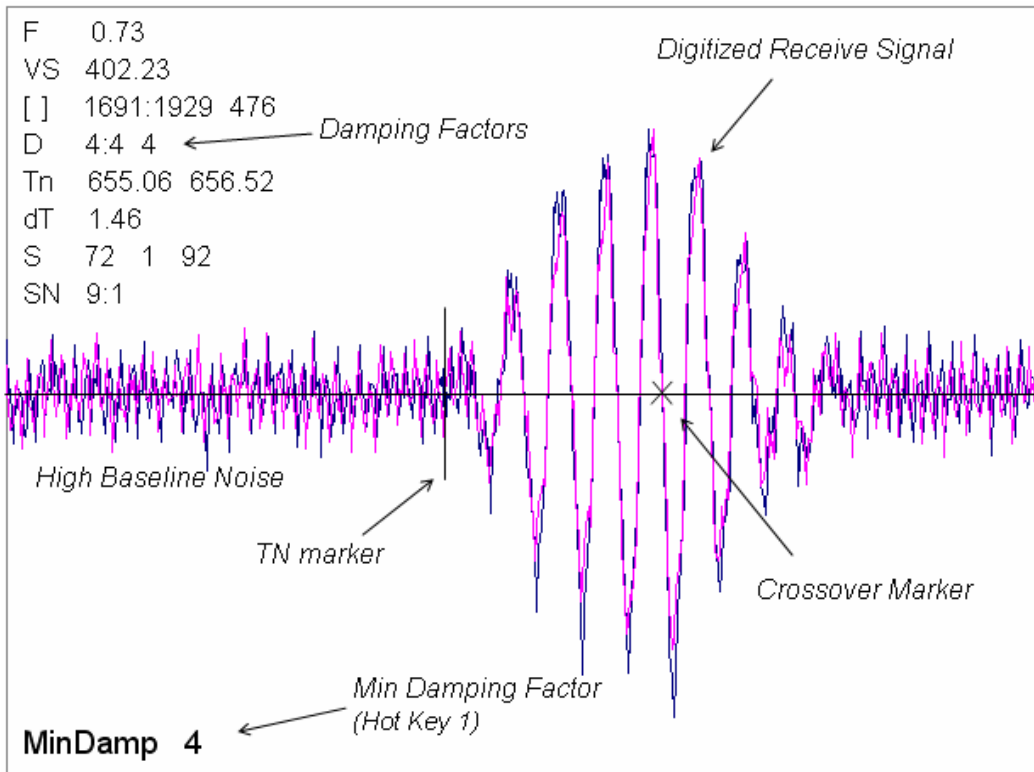
[MinDamp] Command

Pressing the <1> key will cause [MinDamp #] to appear on the command line at the lower left-hand corner of the screen. The number listed to the right of the command code represents the exponent in the FUG1010 exponential averaging routine, where the larger the number the greater the digital averaging. Pressing the <+> key will increase the damping value. Likewise, pressing the <-> key will decrease the damping value. To exit this mode, press the <0> key on the keypad.

[MaxDamp] Command

Pressing the <2> key will bring up the [MaxDamp] command. The function of this parameter is similar to the [MinDamp] command described above; however, the two parameters interact in the following manner. The MinDamp value must not exceed the MaxDamp value, therefore increasing the MinDamp value above the previous MaxDamp value will set both parameters to the same value. In most cases, it is preferred that both damping parameters be set to the same value, however, in cases where rapid response to changes in gas sound velocity for flow rate is required, the two values may be set differently. In this situation the meter will use the MaxDamp value when conditions are stable, but then switch to a faster damping value (limited by MinDamp) when a significant change in sound velocity or flow rate is perceived. To exit this mode, press the <0> key on the keypad.

To access the Digital Damping Control using the Test Facilities Graph Screen, proceed as follows:

1. **To use the Test Facilities Graph Screen you must have a working site.**
2. To activate the Test Facilities Graph Screen:

   ● In the main menu, scroll to the [Diagnostic Data] menu and select [Test Facilities].
   ● Scroll down to [Graph], press the <Right Arrow> and highlight [Yes]. Press <ENT> to select.
   ● The Test Facilities Graphic Screen will appear on the meter display as shown below.

Setting the Digital Damping Factor to a value HIGHER than the default value of 4 may be necessary in cases where the signal to noise ratio (SN) is found to be unacceptably low (<15:1), but only if the noise is determined to be asynchronous (i.e., not associated with the transmit or flowmeter timing circuitry) as shown in the signal example above, where the baseline noise has a higher frequency than the true gas signal.

The following application conditions may require a higher Digital Damping Factor:

● Close proximity to pressure control valves which may generate in-band acoustic noise
● Very low acoustic signal levels (ALC < 40%)
● High electronic noise from variable frequency drives or other external equipment.
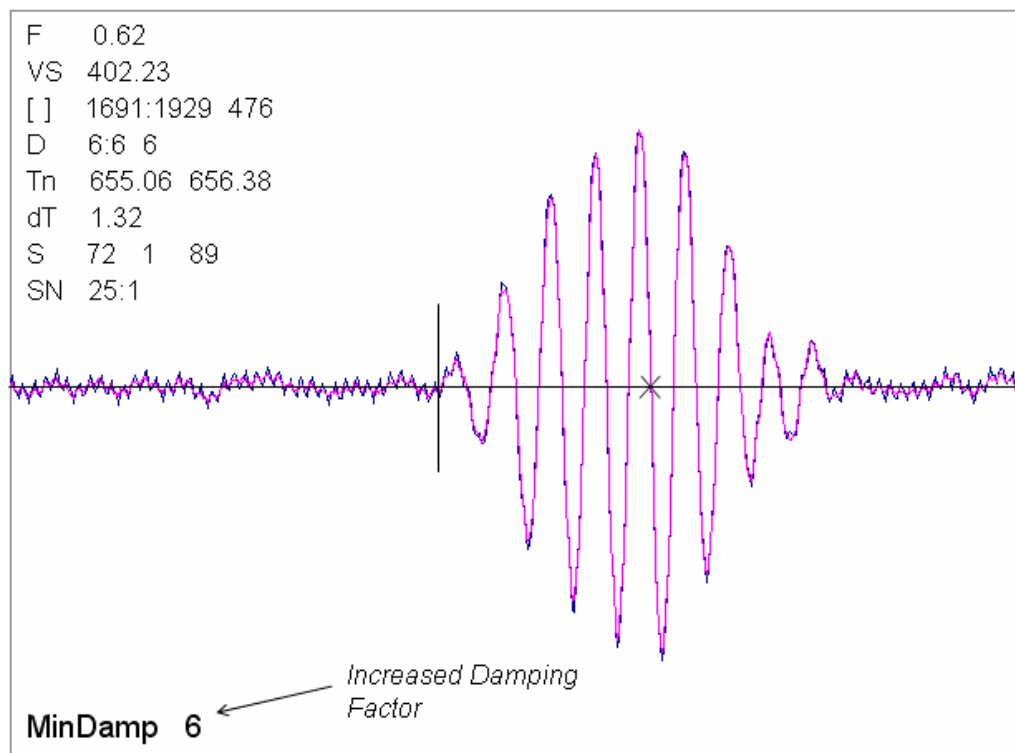
To INCREASE the Digital Damping:

1. Press the <1> key while viewing the Test Facilities Graph Screen as shown above. The damping control [MinDamp #] should appear on the command line at the lower left-hand corner of the screen.

Note: The number listed to the right of the command code on the screen represents the exponent in the exponential averaging routine, where the larger the number represents the greater the digital averaging. Setting this exponent higher than 7 is generally not recommended.

2, Pressing the <+> key will increase the MinDamp Factor by one unit for each key press. To exit this mode, press the <0> key on the keypad.


```
F     0.62
VS   402.23
[ ]   1691:1929  476
D     6:6  6
Tn    655.06  656.38
dT    1.32
S     72  1    89
SN    25:1
```

MinDamp 6 ← Increased Damping Factor

The above example shows that increasing the Digital Damping reduces asynchronous noise.

Setting the Digital Damping factor to a value LOWER than the default value of 4 may be justified in cases where pulsating flow is present (such as from a reciprocating compressor) or for the purpose of diagnosing transient signal behavior. A pulsating flow condition that generates more than +/- 45 degrees of phase jitter will generally cause signal correlation problems when any digital averaging is used. In this case it may be necessary to completely eliminate the digital averaging by reducing the Digital Damping Factor to 0. In such a case it may also be necessary to install a narrow band tuned amplifier (Input Module) if too much asynchronous noise exists.

To DECREASE the Digital Damping:

1. Press the <2> key while viewing the Test Facilities Graph Screen. The damping control [MaxDamp #] should appear on the command line at the lower left-hand corner of the screen.

2. Pressing the <-> key will decrease the MaxDamp Factor by one unit for each key press. To exit this mode, press the <0> key on the keypad.

Liquid Clamp-on Flowmeter Manuals

Replace the Digital Damping Control: (Hot Key 1 and 2) procedure in the "Detection Modes" section (sub-paragraph: Command Modes) in the following flowmeter manuals:

FUS1010 IP 65 (NEMA 4X) Clamp-On Flowmeter manual (CQO:1010NFM-3)
FUE1010 IP 65 (NEMA 4X) Clamp-On Flowmeter manual (CQO:1010ENFM-3)
FUH1010 IP 65 (NEMA 4X) Clamp-On Flowmeter manual (CQO:1010DVNFM-3)
FUH1010 IP 65 (NEMA 4X) Clamp-On Flowmeter manual (CQO:1010PVNFM-3)
FUP1010 IP 40 (NEMA 1) Clamp-On Portable Flowmeter manual (CQO:1010PFM-3)
FUE1010 IP 40 (NEMA 1) Clamp-On Portable Flowmeter manual (CQO:1010EPFM-3)

Digital Damping Control: (Hot Key 1 and 2)

The meter permits user modification of the digital averaging used by the signal processing routines. In general, the default damping values selected by the METER will provide optimal performance over a wide range of transit time applications. However, in extreme cases of unstable flow, pulsating flow, low signal levels or high electronic noise it may be necessary to override these default settings to permit uninterrupted and reliable flow measurement.

Test Facilities Graph Screen

The Graph Screen includes the capability to access a set of command codes, which enable a user to override a number of default meter settings. The most important parameter is the *digital damping control*, which can be accessed by pressing number <1> or <2> on the keypad while in the Signal Graph Screen mode.

[MinDamp] Command

Pressing the <1> key will cause [MinDamp #] to appear on the command line at the lower left-hand corner of the screen. The number listed to the right of the command code represents the exponent in the meter exponential averaging routine, where the larger the number the greater the digital averaging. Pressing the <+> key will increase the damping value. Likewise, pressing the <-> key will decrease the damping value. To exit this mode, press the <0> key on the keypad.
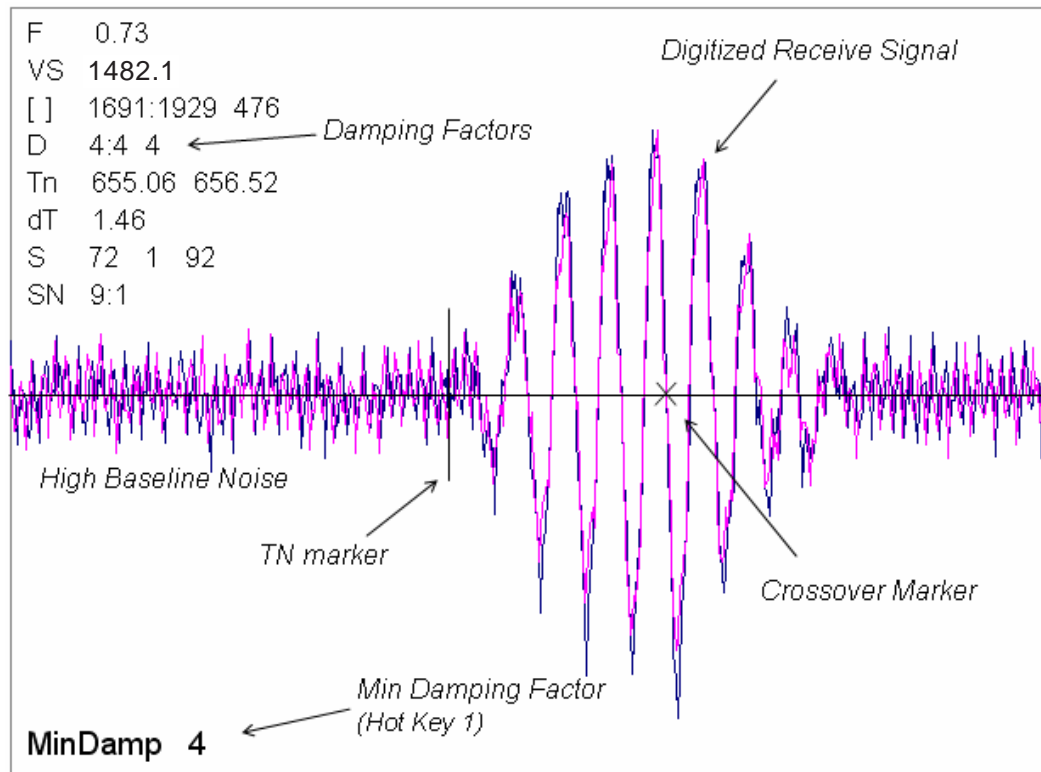
[MaxDamp] Command

Pressing the <2> key will bring up the [MaxDamp] command. The function of this parameter is similar to the [MinDamp] command described above; however, the two parameters interact in the following manner. The MinDamp value must not exceed the MaxDamp value, therefore increasing the MinDamp value above the previous MaxDamp value will set both parameters to the same value. In most cases, it is preferred that both damping parameters be set to the same value, however, in cases where rapid response to changes in liquid sound velocity for flow rate is required, the two values may be set differently. In this situation the meter will use the MaxDamp value when conditions are stable, but then switch to a faster damping value (limited by MinDamp) when a significant change in sound velocity or flow rate is perceived. To exit this mode, press the <0> key on the keypad.

To access the Digital Damping Control using the Test Facilities Graph Screen, proceed as follows:

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  ● In the main menu, scroll to the [Diagnostic Data] menu and select [Test Facilities].
  ● Scroll down to [Graph], press the <Right Arrow> and highlight [Yes]. Press <ENT> to select.
  ● The Test Facilities Graphic Screen will appear on the meter display as shown below.


```
F     0.73                                    Digitized Receive Signal
VS   1482.1
[ ]   1691:1929  476
D     4:4  4     ←————— Damping Factors
Tn   655.06  656.52
dT   1.46
S     72  1  92
SN   9:1
```

High Baseline Noise

TN marker

Crossover Marker

Min Damping Factor
(Hot Key 1)

MinDamp 4

Setting the Digital Damping Factor to a value HIGHER than the default value of 4 may be necessary in cases where the signal to noise ratio (SN) is found to be unacceptably low (<15:1), but only if the noise is determined to be asynchronous (i.e., not associated with the transmit or flowmeter timing circuitry) as shown in the signal example above, where the baseline noise has a higher frequency than the true liquid signal.

The following application conditions may require a higher Digital Damping Factor:
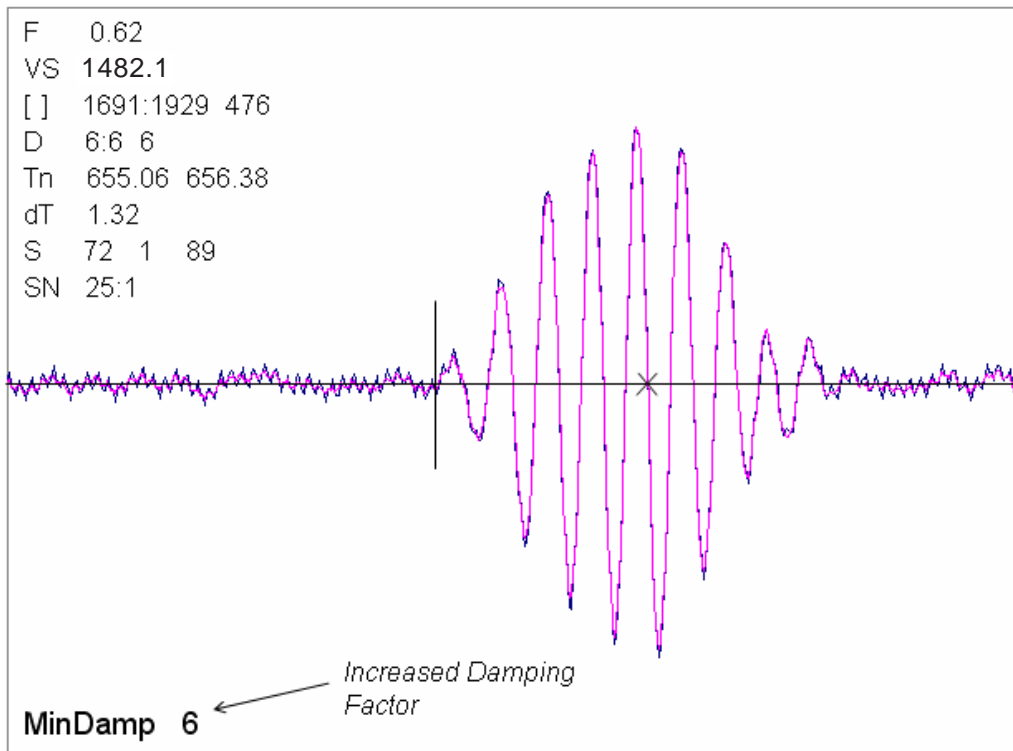
● Close proximity to pressure control valves which may generate in-band acoustic noise
● High un-dissolved gas solids content in liquid.
● High electronic noise from variable frequency drives or other external equipment.

To INCREASE the Digital Damping:

1. Press the <1> key while viewing the Test Facilities Graph Screen as shown above. The damping control [MinDamp #] should appear on the command line at the lower left-hand corner of the screen.

Note: The number listed to the right of the command code on the screen represents the exponent in the exponential averaging routine, where the larger the number represents the greater the digital averaging. Setting this exponent higher than 7 is generally not recommended.

2. Pressing the <+> key will increase the MinDamp Factor by one unit for each key press. To exit this mode, press the <0> key on the keypad.


```
F    0.62
VS   1482.1
[ ]  1691:1929  476
D    6:6  6
Tn   655.06  656.38
dT   1.32
S    72  1   89
SN   25:1
```

Increased Damping Factor

MinDamp 6

The above example shows that increasing the Digital Damping reduces asynchronous noise.

Setting the Digital Damping factor to a value LOWER than the default value of 4 may be justified in cases where pulsating flow is present (such as from a reciprocating pump) or for the purpose of diagnosing transient signal behavior. A pulsating flow condition that generates more than +/- 45 degrees of phase jitter will generally cause signal correlation problems when any digital averaging is used. In this case it may be necessary to completely eliminate the digital averaging by reducing the Digital Damping Factor to 0.

To DECREASE the Digital Damping:

1. Press the <2> key while viewing the Test Facilities Graph Screen. The damping control [MaxDamp #] should appear on the command line at the lower left-hand corner of the screen.

2. Pressing the <-> key will decrease the MaxDamp Factor by one unit for each key press. To exit this mode, press the <0> key on the keypad.

TABLE OF CONTENTS

1.   INTRODUCTION TO THE FUS1020 NEMA TYPE 4 FLOWMETER

Congratulations on purchasing the Sitrans FUS1020 NEMA Type 4 flowmeter. The FUS1020 flowmeter utilizes a compact integrated design technology yet is easy to install and operate. It will not take long for you to appreciate its unmatched performance and its many features such as our unique enhanced transit-time MultiPulse technology and full Wide-Beam transducer operation mode.

FUS1020 is a compact NEMA Type 4/IP 65 transit-time flow computer. Functionally, it operates as a stand-alone flowmeter using conventional clamp-on transducers or in-line flow tubes. This product is intended for use in ordinary, non-hazardous locations.

IMPORTANT NOTE: To maintain NEMA Type 4/IP65 rating for wet location the specified glands must be used. See Appendix A engineering drawing 1022CGA-8.

The FUS1020 is available in the following configurations:

- FUS1020DN Dual Channel Remote Wall-Mounted Flow Display Computer/Transmitter
- FUS1020N Single Channel Remote Wall-Mounted Flow Display Computer/Transmitter
- FUS1020N Integral Single Channel Flow Display Computer/Transmitter

1.1   SYSTEM HARDWARE DESCRIPTION

FUS1020 is housed inside a NEMA Type 4 steel, epoxy painted case that contains the main electronics and the Touch Keypad User Interface. The Keypad enclosure cover includes a 2 x 16 character LCD Alphanumeric Display viewable through a plastic window. Removing this cover provides access to I/O terminal blocks (TB1 and TB2), RS-232 Serial Connector J1, and System Lockout Switch S1. Removing the Power enclosure cover provides access to fused power input connector P1 (100-240 VAC or 9-36 Vdc), fuse F1 and jumper JP1. The primary instrumentation output is a loop powered isolated 4-20 mA current.

NOTE: For continued safety protection of the Model FUS1020, in accordance with UL/Listing, the supply mains branch circuit must be limited to a maximum of 20A by circuit breaker.

The FUS1020 flowmeter provides for an RS-232 remote access I/O port via a DB-9 connector, an assignable optically isolated status (relay) output, a second 4-20 mA Analog Output and two "F" connectors for track or remote mount transducer cabling. The FUS1020 single channel version also provides an optically isolated high resolution/high stability digital synthesized pulse generator output.

Transducer mounting assembly options include (refer to Appendix A for details):

- Trackless spacer bar-stainless steel strap mount

- Mounting Track for Integrated FUS1020N Flow Display Computer/Transmitter and transducer mounting track

- Mounting Track for Remote FUS1020N/DN computer

1.2   INTRODUCTION TO THE FUS1020 OPERATING SYSTEM

The FUS1020 software resides on Flash ROM chips. Software upgrades are available from our Technical Services Group (www.siemens.com). All FUS1020 models provide a ready reference to the software version and modification code. Additionally, a check-sum assures that the software code has retained its original integrity. The operating system consists of real-time data collection and meter control algorithms and an Installation Menu interface for easy data entry.

1.2.1 INSTALLATION MENU OVERVIEW

For all FUS1020 models, site set up is accomplished under the control of an Installation Menu. The Installation Menu presents all the site setup options consistent with the meter type installed. In other words, the Installation Menu changes to be compatible with the particular meter type selected at the "top" menu level.

The Installation Menu sequentially presents choices in related groups of information (such as Pipe Data, Datalogger Setup, etc.). This menu structure makes it easy to locate any category that is relevant to the application. Most Installation Menu items are pre-set to default values based on a factory template. Because of these defaults, few steps are required to complete the usual site setup:

● Create a site setup
● Enter the pipe outer diameter
● Enter the pipe wall thickness
● Select a transducer type and size
● After mounting the transducers on the pipe, complete the Xdcr Install procedure
● Save the site setup, if so desired, by providing a unique file name

In addition, the operating system allows the factory template to be customized so as to suit user preferences. This feature is particularly advantageous for users who may need to routinely re-install the system at different locations within a facility. The system includes a comprehensive Diagnostic Menu that provides real-time flow and related data, information on current operating conditions, plus system test and recovery routines.

Please note that you can review site parameters at any time with little danger of altering the data, since you would have to perform specific keystrokes to affect a change. The meter allows a site data dump, either to a printer to obtain hard copy, or to a PC for storage as a data file. Retaining a copy of the site setup is particularly important for flow calibrated systems.

1.2.2 OVERVIEW OF REAL-TIME DATA COLLECTION

Real-time operation commences after the completion of the site setup procedure. The real-time operating software's function is to collect the primary measurement data from the transducer system and FUS1020 is a multitasking, multifunction system, all necessary operations are interleaved to guarantee the fastest operation and greatest real-time data density.

Installation Menu choices govern the functionality of the real-time operating system. For example, data will be reported either in data units selected by the installer during the site setup or default units, if the installer chose not to edit that menu choice. You can access the Installation Menu at any time to change the selected flow rate units. Note that changing primary site setup data like the pipe outer diameter (OD) or the transducer model will invalidate the site setup, thus requiring a reinstallation.

1.2.3 STANDARD FEATURES

● Similar features as in the 1010X family of flowmeters yet compact, integral design eliminates running sensor cabling.

● Bidirectional flow measurement up to 50 ft/sec (15 m/s) with active zero.

● Accurate operation on any pipe material from 1/2" to 360" (12 to 9150mm) diameter.

- Flexible setup options using either the touch panel keypad sensors or a PC/laptop connected to the RS-232 port.

- Integral 2x16 Character LCD panel display shows real-time data and Installation Menu for keypad input or RS-232 remote programming.

- Flexible mounting: Integral and/or Remote - either on pipe or located up to 300 feet (100m) from the transducers. For distances greater then 300 feet (up to 1000 ft), please contact Siemens Customer Service.

- Menu Lockout Switch prevents unauthorized access to site setup data.

- Wide-Band pipe matching provides high performance and stability for Steel pipes.

- ZeroMatic Path sets Zero flow compensation without stopping flow; eliminates zero drift.

Integral Datalogger

FUS1020 provides an integral Datalogger that records user-assigned data at a programmable log interval for later retrieval. Data reports can be transmitted via the RS-232 port to either a serial printer for hard copy, or to a PC/laptop computer where the report format is comma-delimited ASCII text to facilitate its import to spreadsheet or database software.

Analog Outputs

- Loop powered isolated current varies from 4-20 mA in proportion to any user-selected data function.

- Digital PGEN output pulse function allows user assigned PGEN digital signal pulses per unit of volume.

- Buffered open collector relay trigger output provides logic levels for response to user-assigned alarm functions.

Performance Specifications (Example for typical 6-inch pipe)

Accuracy	+/- 2.0% of rate, or better
Batch Repeatability	+/- 0.1%
Flow Range	+/- 40 ft/sec, (+/- 12 m/s) including zero flow, bi-directional
Flow Sensitivity	0.001 ft/sec, (0.0003 m/s) flow rate independent
Zero Drift	0.01% ft/sec or better with ZeroMatic Path active
Data Refresh Rate	3 Hz
Time Averaged Response Rate	1 to 60 seconds

Mechanical, Electrical, Environment and Safety Specifications

Weight	4.0 lbs / 1.82 kg
Dimensions	inches: 7.77 W x 4.06 H x 4.30 D
	millimeters: 197 W x 103 H x109 D
Cover Screw Torque	min,. 12 oz-in, max. 15 oz-in
	min. 864 g-cm, max. 1080 g-cm
Power	AC Units: 100-240 VAC @ 12 VA 50-60 Hz
	DC Units: 9-36 Vdc @ 12 Watts
Fuse F1	2A, quick-acting, 5mm x 20mm, UL/CSA Listed
Operating Temperature Range	14^oF to 122^oF
	-10^oC to 50^oC
Storage Temperature Range	-4^oF to 140^oF
	-20^oC to 60^oC
Operating Altitude Range	up to 6,563 ft
	up to 2,000 m
Transport Altitude	-2,000 ft to 40,000 ft
	-609 m to 12,192 m
Humidity	80% up to 87.8^oF decreasing linearly to 50% at 104^oF
	80% up to 31^oC decreasing linearly to 50% at 40^oC
Service Rating	Indoor/Outdoor use; NEMA Type 4, IP65
Safety	UL Listed and UL_c Listed to Canadian Safety Standards, UL61010-1, File E304857
	Pollution Degree 2
	Cat II

1.3 DESCRIPTION OF CHANNEL FUNCTIONS (FUS1010DN Systems only)

Dual Path FUS1020DN systems provide two flow measurement channels that allow its operation as two completely independent single-channel flow meters. In addition, you can combine the two measurement channels in the various meter types described below to enhance the functionality of the system. On single channel systems, you do not get a choice of meter types since this requires two independent measurement channels.

Dual Channel Flow

Dual Channel Flow provides two independent measurement channels that operate simultaneously.
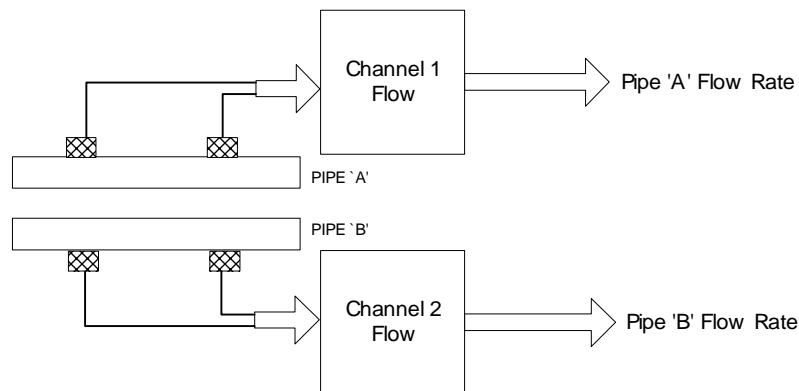
Dual Path Flow

Dual Path Flow uses two measurement channels to achieve a single output via a "virtual" third channel. The resultant data is the average of the two channels. This meter type only supports clamp-on or in-line transit-time operation. Benefits include highest available precision and enhanced immunity from distorted flow profile conditions.
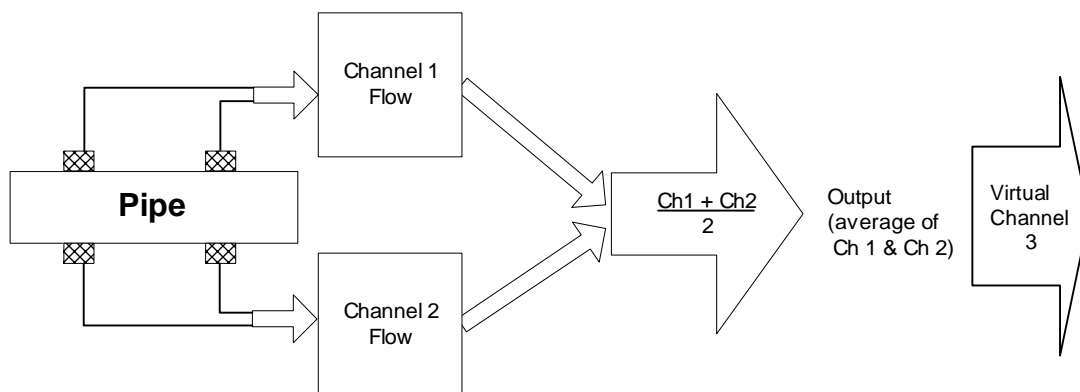
Channel 1+2 Flow

Channel 1+2 produces a data output via a virtual Channel 3, proportional to the sum of the flow of two independent pipes. This requires setting the two flow channels to operate independently.
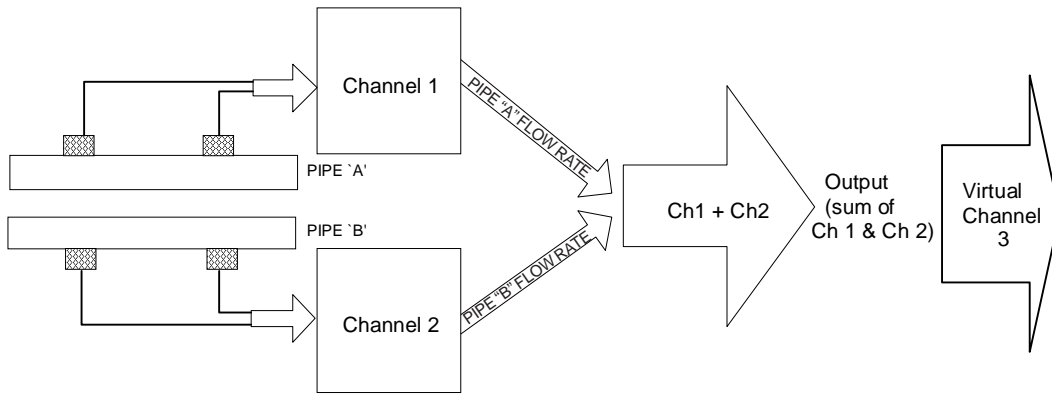
Channel 1-2 Flow

Channel 1-2 produces a data output via a virtual channel 3, proportional to the difference of the flow of two independent pipes. This requires setting the two flow channels to operate independently. Note that you can still select the individual channel outputs with this configuration.
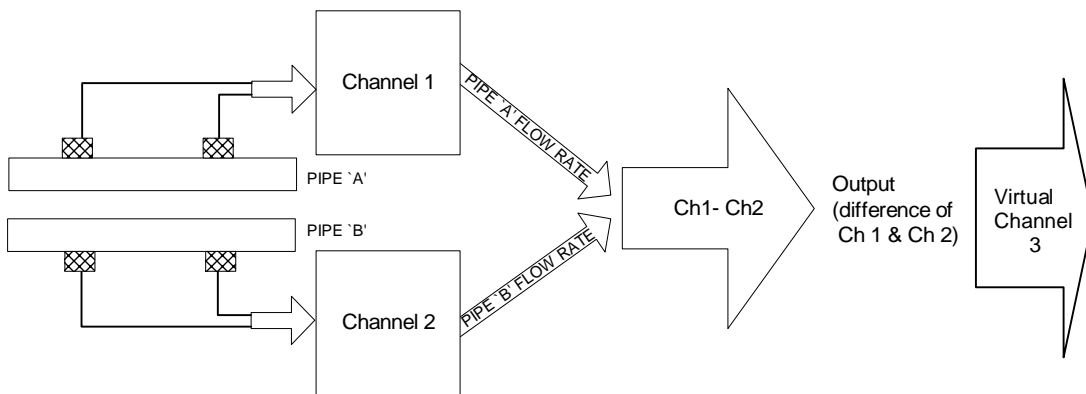
1.4   CLAMP-ON TRANSIT-TIME THEORY OF OPERATION

Note that in the figure below, two transducers are mounted to the outside of a pipe. If we identify the direction of flow through the pipe, you can see that one transducer location is "upstream" and the other transducer location is "downstream" with respect to the direction of flow.
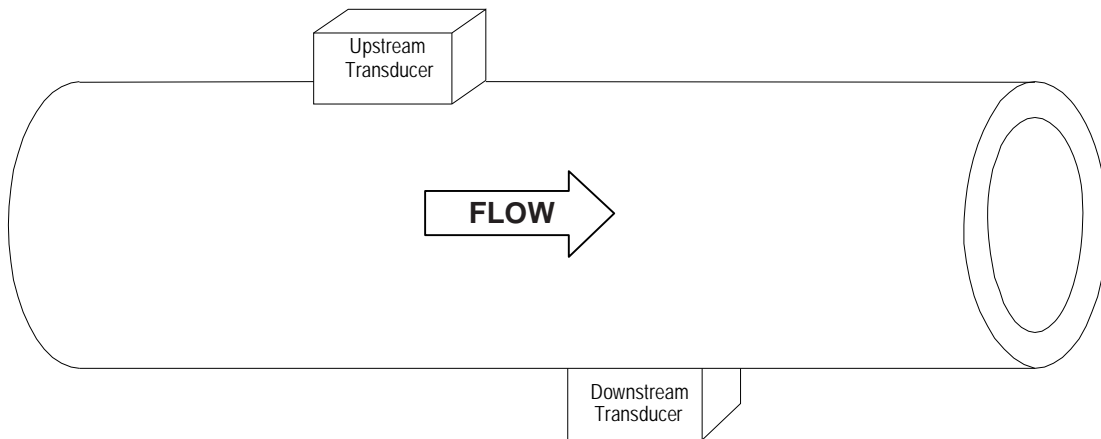
For transit-time operation, the flow computer converts a series of electronic pulses to high frequency sonic signals. Transducers inject these sonic signals through the pipe wall into the flowing liquid. Each transducer alternates as either a transmitter or a receiver of the high frequency signals. This causes the direction of the sonic signal to alternate between the downstream direction (traveling with the flow) and the upstream direction (traveling against the flow). The transit-time technique relies on the effect of the flowing liquid on the amount of time it takes to travel "downstream" versus "upstream."
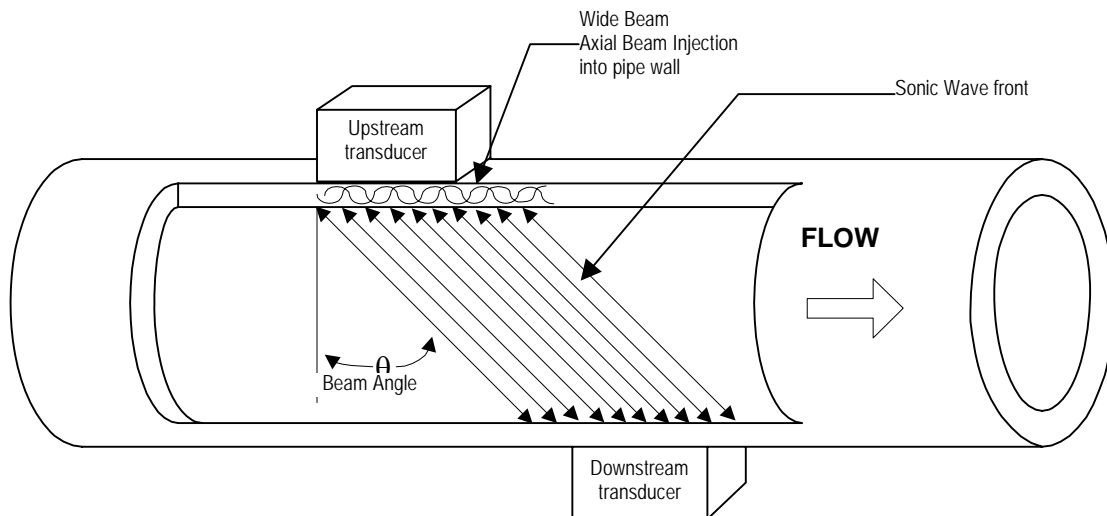
Wide Beam Transmission

As shown in the figure above, an ultrasonic transducer induces an axial sonic beam within the wall of the pipe. These vibrations spread along the pipe wall and then enter the liquid in the form of a Wide Beam wave front traveling at an angle to the main pipe axis. The wide beam "rains" over the receiving transducer. The wide coverage of the receiver is necessary because the angle of the sonic beam is related to the liquid's sonic propagation velocity by Snell's Law.

$$\text{Beam Angle} = \text{Arc Sine} \left(\frac{\text{Liquid Sonic Propagation Velocity}}{\text{Transducer Phase Velocity}} \right)$$

According to this formula, we can state that, *as the liquid sonic propagation velocity changes so will the angle between the sonic beam and the flow stream*.

Therefore, a significant liquid sonic velocity shift could deflect a "narrow" beam transmission away from the receiving transducer entirely. The upstream vs. downstream transit-time difference will also be affected by the changing (or refracting) beam angle. This makes it necessary for clamp-on systems to continuously compute this angle, since it is subject to varying degrees of refraction. The flow computer derives the angle by knowing the fixed position of the transducers, the dimensions of the pipe and the measured transit-time. Therefore, the flow computer computes the beam angle relative to the axis of the pipe.

Flow Calibration Factor

Normally, the flow stream is in line with the axis of the pipe. On this basis, the calibration factor of a clamp-on ultrasonic flowmeter is proportional to the cosine of the beam angle relative to the pipe axis. However, this reveals that if the angle of flow stream is *not* in line with the pipe axis, the flow calibration factor could be compromised. This most often occurs when the transducer mounting location is within close proximity of a bend or other pipe obstruction. This is why we recommend that whenever possible you mount clamp-on transducers on the longest available straight run of pipe and also use Reflect Mode mounting (as shown below).
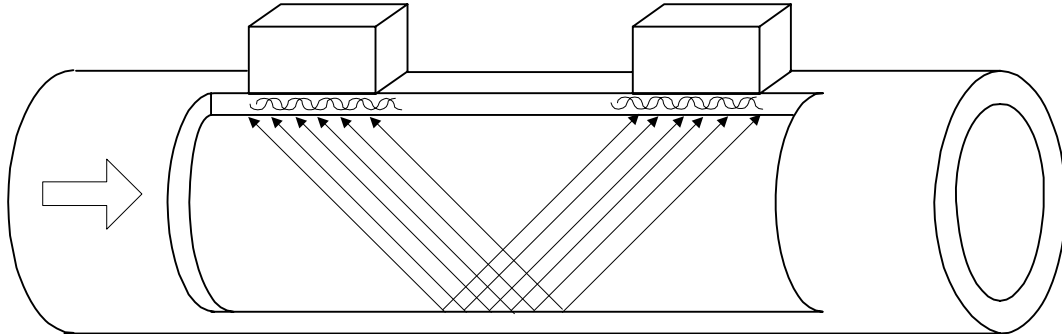
Reflect mounting automatically corrects for non-axial flow or cross flow conditions. When the exchange of sonic signals occur by reflection off the far pipe wall as shown above, the average beam versus stream angle will be equivalent to that of an axial flow stream.

Another important consideration is that the ultrasonic flowmeter has to compensate for the flow profile to maintain calibration accuracy. Shown below is a graphic of a "fully-developed" flow profile. Note that the fluid velocity increases toward the center (axis) of the flow stream.

Fluid velocity near the axis of the flow stream tends to be greater
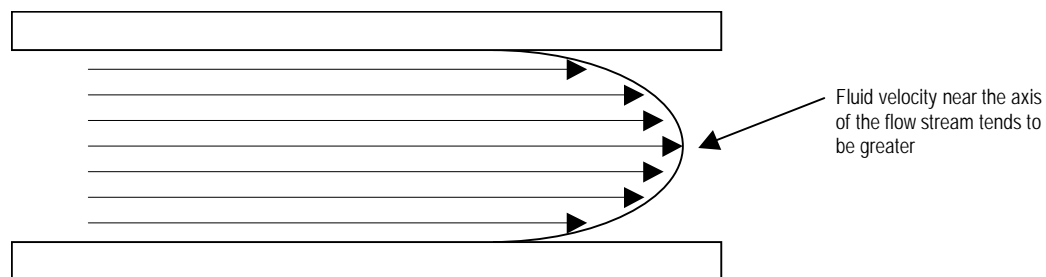
The degree of the flow profile curvature is directly proportional to the Reynolds number of the flowing liquid. FUS1020 software applies a compensation factor, which is selected based on knowledge of the Reynolds number of the liquid. The algorithm continuously calculates this number from the measured flow velocity, the pipe diameter and the viscosity of the liquid. The user enters this information during the site setup procedure. The FUS1020 infers the current liquid viscosity and accommodate installations whose piping configuration does not permit fully developed flow, such as conditions where a limited upstream straight pipe run is available for transducer installation.

2. GETTING STARTED

This section explains the two programming interfaces available for the FUS1020 flowmeter. Instructions include how to navigate through the Installation Menu using either the FUS1020 Keypad or a personal computer. It describes the actions required to enter numeric and alphabetic data, as well as how to select an item from lists of available options.

2.1 IMPORTANT SAFETY CONSIDERATIONS

The FUS1020 Permanent flowmeter is electrical equipment that operates from either an external AC or optional DC power source. All electric safety codes that apply to your application must be observed. We recommend that only experienced personnel with knowledge of local electrical codes and operating safety procedures perform the installation and wiring. Since regulations vary by geographic location, industry, etc., it is solely the user's responsibility to operate this equipment safely.

Siemens cannot accept responsibility for any damage that may occur due to failure to observe any local safety rules. This equipment is not intended for use in Hazardous (Classified) Locations. It is the user's responsibility to ensure that only properly trained personnel install and operate it.

If the equipment is used in a manner not specified by Siemens, the safety protection provided by the equipment may be impaired.

Always check the unit for continued safety by visually inspecting the enclosure cover gasket for good bonding, signs of wear and any bridging of wiring. Check the glands for proper sealing. Check the cover for proper seating. If the gasket appears worn or has other defects, or you have concerns about any of the other safety aspects of the FUS1020, contact the Technical Service group for servicing.

2.2 POWER CONNECTIONS

2.2.1 INPUT POWER CONNECTOR (P1) AND FUSE (F1) LOCATIONS

The standard FUS1020 flowmeter requires either 100/120/240 VAC or 9-36 VDC depending on the model for its power input. The AC or DC power wires are connected directly to P1 terminal screws. The power input is protected by a GMA 2A UL/CSA Listed fuse (F1), which is located under the Power Enclosure Cover. Replace this fuse with only the exact type if it becomes necessary to do so.

Model FUS1020 With Keypad Enclosure Cover And Power Enclosure Cover Removed

SYMBOLS	
⏚	Protective Conductor Terminal
⚡	Caution, risk of electric shock
⚠	Caution, risk of danger
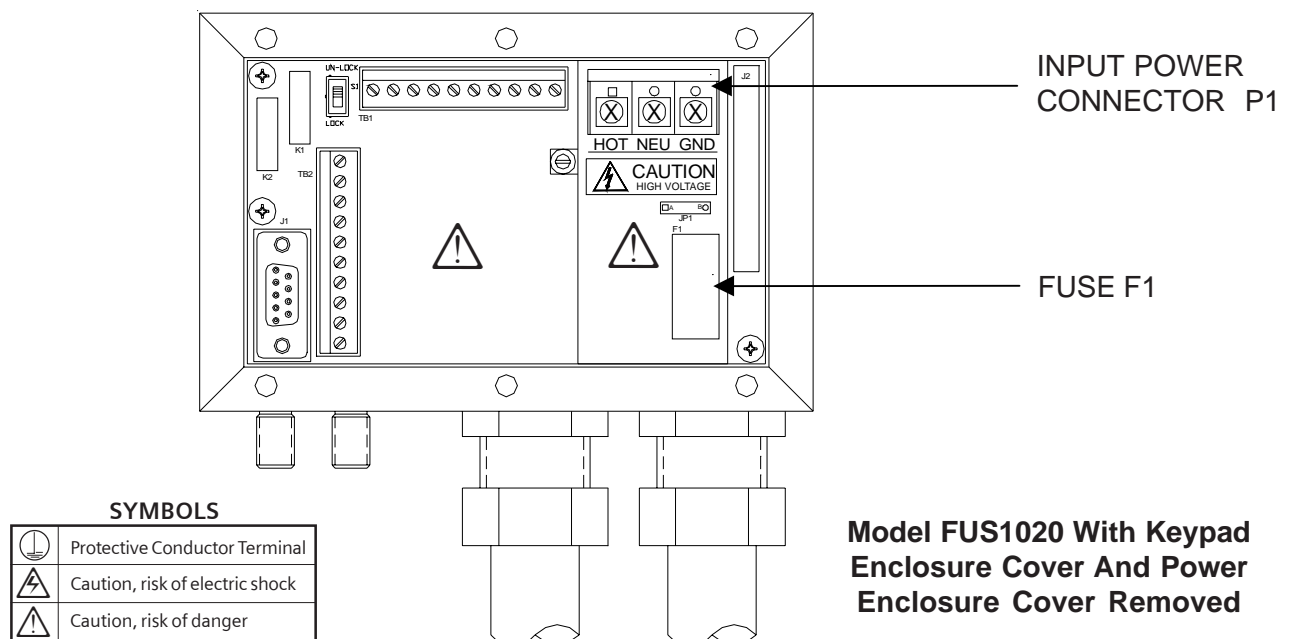
2.2.2 POWER SUPPLY WIRING

NOTE: Refer to installation drawing 1020-7.

WARNING: Turn off main power before installing AC connections to the FUS1020 NEMA Type 4 flowmeter. Contact with exposed wiring may lead to fire, electric shock, or serious personal injury.

● Using a cross-head screwdriver, remove the six #8 securing screws from the Keypad Enclosure Cover and remove cover.

● Loosen the captive setscrew securing the Power Enclosure Cover and remove cover.

● To determine type of power connection refer to the following part numbers:
1020N*-S = AC Power or 1020N*-Z = DC Power

● Pull either the AC or DC wires through flowmeter case cable hole.

● Locate power plug P1. Loosen P1 connector screws.

● Wire input AC or DC power wires to the appropriate screws and tighten screws securely.

NOTE: Power Supply connector wires should be stripped stranded or solid conductors AWG 12 -18.
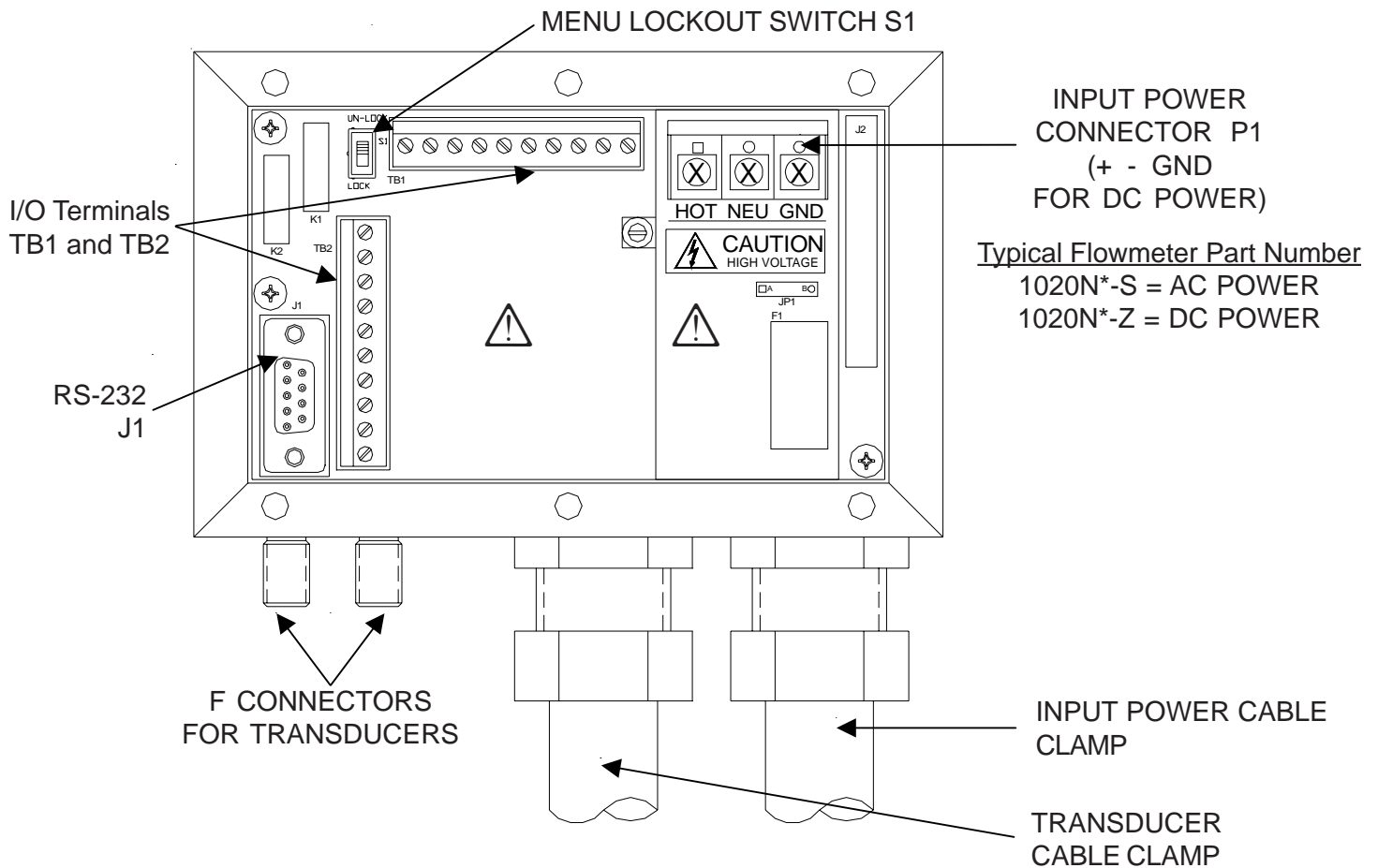
● Replace Power Enclosure Cover and tighten setscrew.

● Connect the power cables to the appropriate power source (100-240 VAC @ 50/60 Hz or 9-36 VDC) and power up unit.

Note: The branch circuit must be limited to 20A. It is recommended that the circuit breaker be located near the Model FUS1020.

● If unit is operational, turn power off, replace Keypad Enclosure cover using six #8 securing screws (torque to 7 oz-in). Reinstall transducer cables.

● Do not position the FUS1020 in such a way that it is difficult to operate the circuit breaker or the disconnection device.

2.3   THE MENU LOCKOUT SWITCH

FUS1020 includes a menu lockout switch to prevent unauthorized access to the Installation Menu. In addition, a password entry option is available (see Channel Setup in Section 6). The menu lockout switch (S1) resides on the I/O module on the left side of I/O wiring terminal block TB1 (see below). Please switch to the unlocked position before attempting to program the flow computer. We recommend that the installation menu remains locked during normal operation.
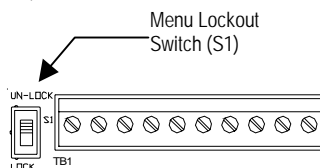
2.4   FLOWMETER INSTALLATION SUMMARY

As you will see in the following sections, FUS1020 contains a hierarchical menu structure consisting of sub-menus that contain individual menu locations we call menu cells. The Installation Menu Structure chart in paragraph 2.6.2 appears comprehensive, however, do not let the size of the Installation Menu intimidate you. FUS1020 is a universal instrument that serves many industries. Therefore, it provides a large number of functions and features. Most menu locations already have default values installed that never need to be edited unless you are interested in that specific function or feature. Listed below are the minimum steps required to achieve operation with a local flow display. The figure on the next page shows a simplified FUS1020 hardware configuration using clamp-on spool transducers.

● Collect the site data (pipe and liquid data, part numbers, etc.).

● Choose a mounting location for the flow computer and transducers.

● Mount the flowmeter at the selected location. Note: Mounting hardware not supplied. (Refer to Outline Drawing 1020-8 in Appendix A.)

● Connect power to the flow computer. (Refer to Installation Drawing 1020-7 in Appendix A.)

● Prepare pipe for transducer mounting.

● Access the Installation Menu and create a site.

● Enter pipe parameters and select a liquid, if required.

● Invoke transducer install procedure.

● Mount transducers on pipe and connect to flow computer.

● Complete transducer install menu operation.

● Set zero levels (generally Direct Mount applications only).

● Visually inspect top cover sealing gasket, cover screws, tightness of fitting glands, and wire routing for proper installation; otherwise, contact the Technical Service Group.

Flowmeter Installation Flowchart

```
                        ┌─────────────────────────┐
                        │  Flowmeter Installation  │
                        └─────────────────────────┘
                                    │
            ┌───────────────────────┴───────────────────────┐
            ▼                                                 ▼
   ┌─────────────────┐                           ┌─────────────────┐
   │  Collect Site   │                           │   Enter Pipe    │
   │     Data        │                           │   Parameters    │
   └─────────────────┘                           └─────────────────┘
            │                                              │
            ▼                                              ▼
   ┌─────────────────┐                           ┌─────────────────┐
   │ Choose Mounting │                           │     Invoke      │
   │  Location For   │                           │   Transducer    │
   │ Flowmeter and   │                           │    Install      │
   │  Transducers    │                           │   Procedure     │
   └─────────────────┘                           └─────────────────┘
            │                                              │
            ▼                                              ▼
   ┌─────────────────┐                           ┌─────────────────┐
   │  Prepare Pipe   │                           │Mount Transducers│
   │    Surface      │                           │  on Pipe and    │
   └─────────────────┘                           │connect Flowmeter│
            │                                     └─────────────────┘
            ▼                                              │
   ┌─────────────────┐                                     ▼
   │    Access       │                           ┌─────────────────┐
   │  Installation   │                           │    Complete     │
   │     Menu        │                           │   Transducer    │
   └─────────────────┘                           │Installation Menu│
            │                                     │   Operations    │
            ▼                                     └─────────────────┘
   ┌─────────────────┐
   │  Create a Site  │
   └─────────────────┘
            │
            └─────────────────────────────────────────────┘
```

Siemens 1020
Copyright 2006

Wide Beam
Clamp-On
Ultrasonic
Flowmeter

SIEMENS

DATA/CONTROL
CABLES

POWER CABLE
(refer to drawing 1020-7 in
Appendix A for details)

TRANSDUCER CABLES

TRANSDUCER 2

TRANSDUCER 1

POS FLOW

WALL MOUNTED DUAL CHANNEL FUS1020 FLOWMETER

2.5   CHOOSING A PROGRAMMING INTERFACE

As mentioned previously, site setup is accomplished under the control of an Installation Menu that allows you to enter information that is specific to each site. System 1020 provides two ways of accessing the Installation Menu. You can view the Installation Menu locally on the 16 x 2 character LCD panel display and use the 5-key Touch KeyPad for navigation and data entry. Alternately, you can access the Installation Menu using a personal computer connected to the instrument via its RS-232 compatible serial port.

2.5.1   OVERVIEW OF THE 5-KEY TOUCH KEYPAD

The KeyPad interface provides a simple data entry method that is viewed via the 2x16 integral LCD display. It is not necessary to open the housing to effect data entry, thus avoiding the need for hot-work permits and the like for user menu access.

Individual functions and parameters are selected from a hierarchical menu structure. Menu control and navigation is accomplished by simply pressing the keys on the KeyPad. The Touch KeyPad provides five keys. Four of the keys are used for directional navigation within the Installation Menu. A symbol on each key shows the effective direction. The fifth key provides the ENTER function (bullseye).

SYSTEM 1020 LCD DISPLAY PANEL AND KEYPAD
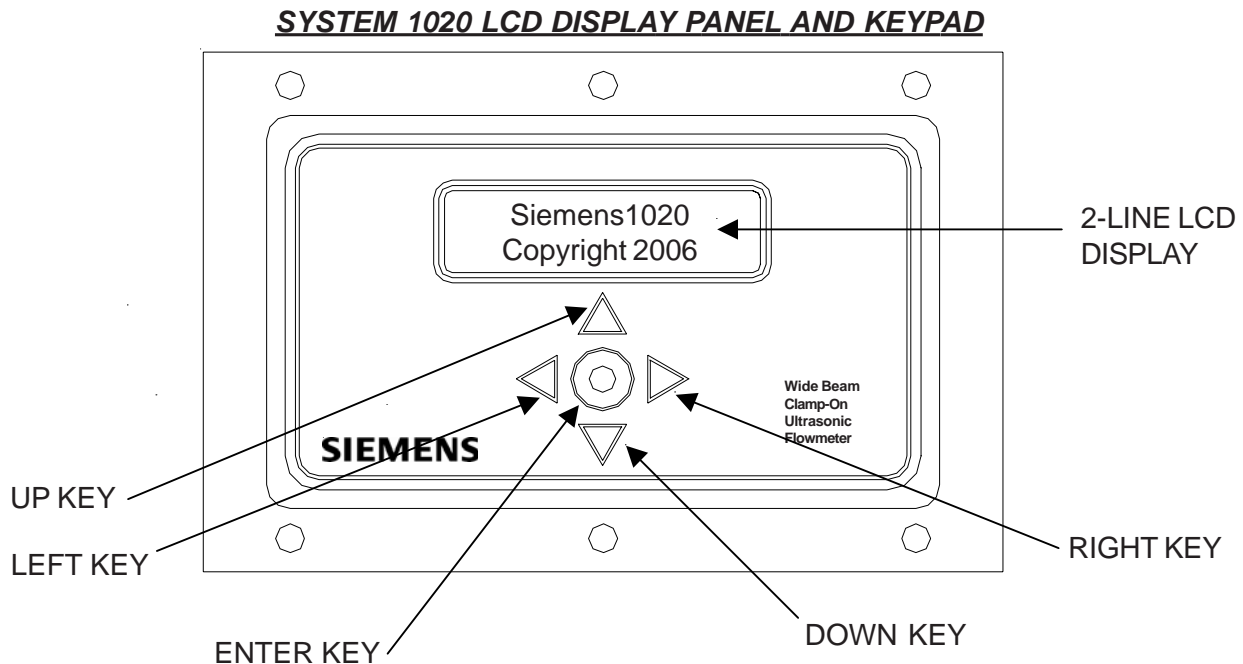
2.5.2   OVERVIEW OF THE RS-232 INTERFACE

System 1020 site parameters can also be programmed using a PC connected to the RS-232 serial port. This requires a standard DB-9 serial cable connector and a communication software package. The serial interface jack (J1) is a 9-pin connector that accommodates IBM-compatible serial ports. A PC communication program such as Terminal (Windows 3.x) or HyperTerminal (Windows 95/98/NT/ 2000/XP) serves as the interface. These programs reproduce the menu screens that appear on 1010/ 1020 systems equipped with graphic display screens. Setup procedures for the 1020 and portable units, or dedicated graphic screen displays, are identical. We recommend this method because it allows you to view the Installation Menu using a 40 character by 12-line interface. The following example screen is an actual HyperTerminal screen capture.

```
Siemens      2 Channel [1]   XYZ
Scroll saved Site Setup list and Enter

Recall Site Setup    XYZ
Channel Enable       No
Create/Name Site     XYZ
Site Security        Off
Delete Site Setup    XYZ
Save Site            XYZ




Channel Setup
```

**TYPICAL MENU SCREEN AS IT APPEARS IN A COMMUNICATION PROGRAM**

2.6   INSTALLATION MENU OPERATION WITH THE KEYPAD

This section describes how to use the KeyPad to access the Installation Menu. It will show you how to navigate through its hierarchical structure and how to enter/edit site parameters. (Note that many of these menu selections may be made prior to permanently installing the meter in the field.) Refer to paragraph 2.2 Power Connections and Installation Drawing 1020-7 (or 1020DR-7) for wiring instructions before turning on unit.

2.6.1 ACCESSING AND LEAVING THE INSTALLATION MENU

When you first apply power to the meter, there will be a 20 to 30 second delay and then you will see a scrolling banner and a copyright notice appear on the LCD panel display. This means that the meter requires a new (or stored) site setup to be loaded into its *active memory* (active memory will be explained later). The first time you access the Installation Menu, you can leave it only by saving a site or by turning the meter off. After installing and activating a site, use the ENTER key to toggle between the local flow display screen and the last accessed menu location.

Siemens 1020
Copyright 2006

LCD Panel display showing initial screen with copyright notice.

Wide Beam
Clamp-On
Ultrasonic
Flowmeter

SIEMENS
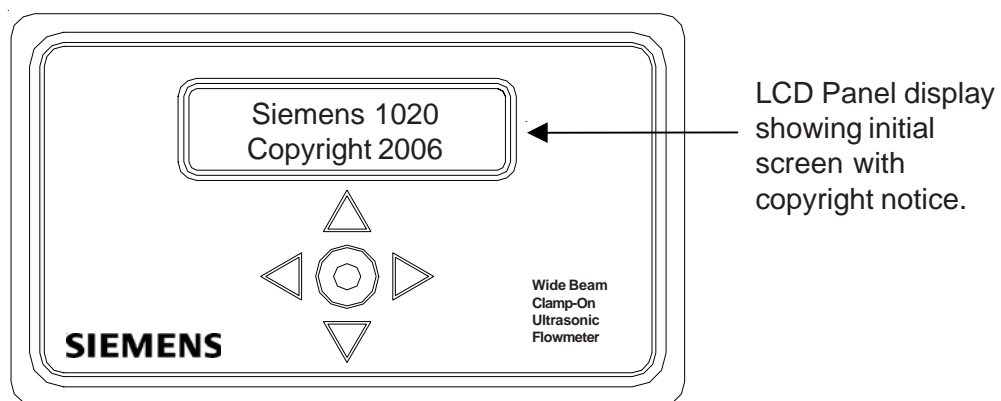
To access the Installation Menu:

● Make sure the Menu Lockout Switch is in the unlocked position (see paragraph 2.3).

● Press the ENTER Key. This accesses the top level of the Installation Menu, as shown in the following figure. Note that the top line of the LCD display shows the currently selected menu [Meter Type] and that the second line shows [Single Channel] preceded by the "greater than" symbol (>).

Top Level of
Installation
Menu

ENTER Key

Meter Type
>Single Channel

Current
Selection

Wide Beam
Clamp-On
Ultrasonic
Flowmeter

SIEMENS
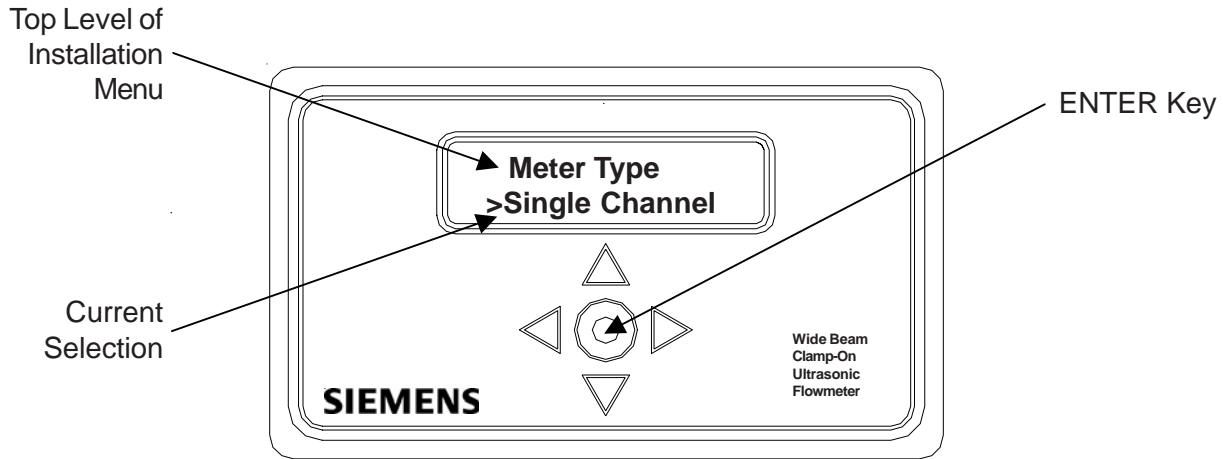
Pressing the ENTER key now would switch the "greater than" symbol to a colon (:). The colon indicates that the data listed on the second line can be edited. This convention applies to all menu cells that provide option lists throughout the Installation Menu. If the menu cell requires a numeric value, the ENTER key switches the "greater than" (>) character to an equal sign (=) instead. The equal sign indicates that you can edit the numeric value.

2.6.2 SYSTEM 1020 INSTALLATION MENU STRUCTURE

The Single Channel 1020 Installation Menu is shown in its entirety below and on the next page. The <Left, Right, Up and Down Arrows> move you through the menu structure. For example, pressing the <Right Arrow> from [Meter Type] changes the display to [Single Channel]. Similarly, pressing the <Left Arrow> from [Single Channel] moves you back to [Meter Type].

INSTALLATION MENU STRUCTURE

Meter Type ⇨	Single Channel ⇨	Channel Setup ⇨	⇕	Recall Site
				Channel Enable
				Create/Name Site
		⇕		Site Security
				Delete Site
				Save/Rename Site
		Pipe Data ⇨	⇕	Pick Pipe Class
				Select Pipe Size
				Pipe OD
		⇕		Pipe Material
				Wall Thickness
				Liner Material
				Liner thickness
	⇕	Application Data ⇨	⇕	Liquid Class
				Pipe Config
		⇕		Anomaly Diams
		Pick/Install Xdcr ⇨	⇕	Transducer Model
				Transducer Size
				Xdcr Mount Mode
				Spacing Offset
		⇕		Number Index
				Spacing Method
				Ltn Value <in>

(continued)

INSTALLATION MENU STRUCTURE *(continued)*

Meter Type ⇨	Single Channel ⇨	Pick/Install Xdcr ⇨ ⇕	⇕ Install Complete? Empty Pipe Set Zero Flow Adjust	
		Operation Adjust ⇨ ⇕	⇕ Damping Control	⇕ Smart Slew Time Average
			Deadband Control	
			Memory/Fault Set	Fault/Memory
			Memory Delay <s>	
		Flow/Total Units ⇨ ⇕	⇕ Flow Vol. Units Flow Time Units Flow Disp. Range Flow Disp. Scale Total Vol. Units Totalizer Scale Total Resolution Totalizer Mode Batch/Sample Total Reset Totalizer	
	⇕	Data Span/Set/Cal ⇨ ⇕	Span Data ⇨ ⇕	⇕ PGEN Max Flow Min Flow Max Vs m/s Min Vs m/s
			Set Alarm Levels ⇨ ⇕	⇕ Hi Flow Low Flow Interface Vs m/s Aeration % Makeup Latch
			Calib. Flowrate	Intrinsic/Kc/MultiPoint
		Datalogger Setup ⇨ ⇕	⇕ Datalogger Mode Datalogger Data Log Time Interval Datalogger Events	
		I/O Data Control ⇨ ⇕	⇕ Analog Out Setup ⇨ Relay Setup ⇨	Io1/Io2 (para. 6.9) Relay 1 (para. 6.9)
		Diagnostic Data ⇨ ⇕	Flow Data ⇨ ⇕	⇕ Flow Total Vs m/s Signal mV Valc % Vaer % Alarm Status AnCal HiFlow LoFlow
			Application Info ⇨ ⇕	⇕ TN uSec TL uSec DeltaT nSec Burst/Sec % Accepted Last Makeup Makeup Status
			Liquid Data ⇨	Reynolds #

(continued)

INSTALLATION MENU STRUCTURE *(continued)*

Meter Type ⇨	Single Channel ⇨	Diagnostic Data ⇨	Site Setup Data ⇨	⇕ fx (drive)
				N (burst length)
				Ltn in
				Vfmax
				Vs max m/s
			⇕	Vs min m/s
				Empty %
				Samples/Cycle
	⇕	⇕		Max Damping
				MIn Damping
				HF
			Test Facilities ⇨	⇕ Makeup
				Tx Up
				Tx Dn
			⇕	Fixed ALC
				Tx Up Fixed ALC
				Tx Dn Fixed ALC
			Print Site Setup	No/Yes
			Date Site Create	xx.xx.xx xx.xx.xx

THE METER FACILITIES MENU

Meter Facilities ⇨	Preferred Units ⇨	⇕ English ⇩ Metric		
	Table Setups ⇨	Pipe Table ⇨	Create/Edit Pipe ⇨	⇕ Choose Pipe Class
				Choose Pipe Name
				Outer Diameter
			⇕	Wall Thickness
		⇕		Liner Material
	⇕			Liner Thickness
			Delete Pipe ⇨	⇕ Choose Pipe Class
				Pick Pipe Name
		Transducer Type ⇨	⇕ 1021 Xdcr	
		⇕	1011 Universal	
			991 Universal	
	Datalogger Control ⇨	⇕ Output Datalogger		
		Circular Memory		
	⇕	Est Log Time Left		
		Clear Datalogger		
	Memory Control ⇨	⇕ Data memory left ⇩ Defragment		
	⇕			
	Analog Output Trim ⇨	⇕ Trim Io 1/ Io2 ⇩ Trim Pgen 1		
	⇕			
	Clock Set ⇕ ⇨	⇕ Date ⇩ Time		
	RS-232 Setup ⇨	⇕ Baud Rate		
		Parity		
		Data Bits		
	⇕	Line Feed		
		Network ID		
		RTS Key Time		
	System Info ⇨	⇕ Version		
		Reset Date/Time		
		Op System P/N		
	⇕	Checksum		
		Code		
		System Time		

2.6.3 HOW TO USE THE KEYPAD TO ENTER DATA

As shown previously, you use the four direction arrows to navigate through the Installation Menu structure. The Installation Menu chart can be used as a "menu map" to show you exactly where you are within the menu structure. When you arrive at a menu cell that requires data, you will have to perform one of three data entry actions:

● Select an item (or items) from a scrollable list of options (e.g., a class of liquids).
● Provide a numeric value (e.g., a pipe outer diameter).
● Provide an alphanumeric string (e.g., a file name for a site setup).

This section explains how to use the KeyPad to enter each type of data. The conventions used with these instructions are:

● Menus, Sub-menus and menu cell names will be enclosed in square brackets: e.g., [Pipe Data], [Channel Enable].

● The following symbols will be used to represent the *direction arrows* and the ENTER button:

Right Arrow	▷
Left Arrow	◁
Down Arrow	▽
Up Arrow	△
Enter	◎

How to Select Items from an Option List

This section shows how to select an item from an option list. The following example explains how to change the current liquid type to [Diesel Fuel]. The left-hand figure below shows the [Select Liquid] menu cell. Notice that the second line shows the current selection: [Water 20C/68F]. (The "greater than"symbol placed before the parameter indicates that it is the current selection.)

NOTE: Use the menu chart to see how to get to the [Select Liquid] menu cell.

● Press the ▷ symbol. Note that the (>) symbol changes to a colon (:) as shown in the figure below. You have now entered the [Select Liquid] option list. You can use either the <Up or Down> Arrow to scroll through the available choices. All option lists operate in a "wrap-around" fashion. This means that when you arrive at the last item on the list, the next scroll places you back at the top.

"Greater Than" sign symbol indicates current parameter is [Water 20C/68F]

The "colon" indicates that you have entered the [Select Liquid] option list.
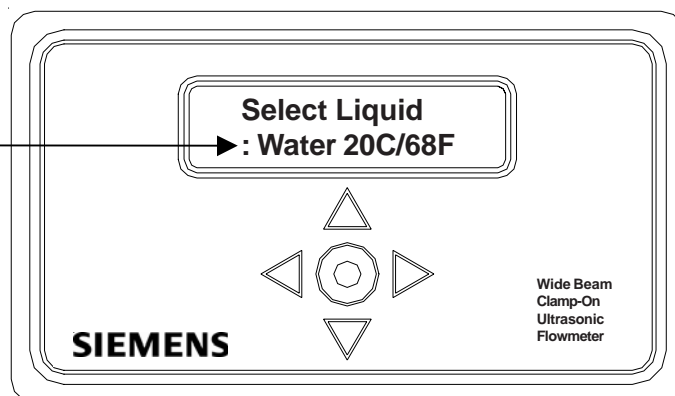
● Press the ▽ symbol. Note that the selection changes to [Water 50C/86F]. This is the next item on the [Select Liquid] option list. Keeping the key pressed activates an auto-repeat function to scroll the list automatically. Note that every key pressed item changes to another liquid on list (see paragraph 6.3 for the [Select Liquid] option list). Note that holding down on either the <Up or Down Arrow> will cause the menu to scroll up or down (Auto Repeat Feature).

● Stop pressing when the screen shows [Diesel Fuel]. Press the Enter ◎ switch. This replaces the parameter [Water 20C/68F] with [Diesel Fuel]. Note that the screen changes to the menu cell [Estimated Vs] and that the second line shows the value: [1377]. This is the estimated sonic velocity (Vs) of the liquid, Diesel Fuel. If you want to you can use △ to return to the [Select Liquid] to verify that the menu cell shows the new liquid selection.

```
┌─────────────────────────────────┐      ┌─────────────────────────────────┐
│   ┌───────────────────────┐      │      │   ┌───────────────────────┐      │
│   │  Select Liquid         │      │      │   │  Estimated Vs m/s      │      │
│   │  :Diesel Fuel          │      │      │   │  > 1377                │      │
│   └───────────────────────┘      │      │   └───────────────────────┘      │
│            △                     │      │            △                     │
│         ◁ ◎ ▷    Wide Beam       │      │         ◁ ⬡ ▷    Wide Beam       │
│            ▽     Clamp-On        │      │            ▽     Clamp-On        │
│  SIEMENS         Ultrasonic      │      │  SIEMENS         Ultrasonic      │
│                  Flowmeter       │      │                  Flowmeter       │
└─────────────────────────────────┘      └─────────────────────────────────┘
```
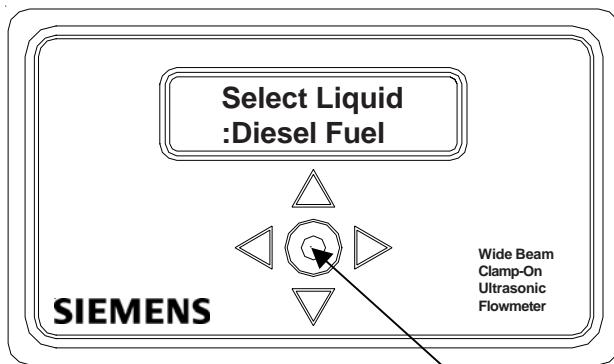
Press ENTER Key to select Diesel Fuel.
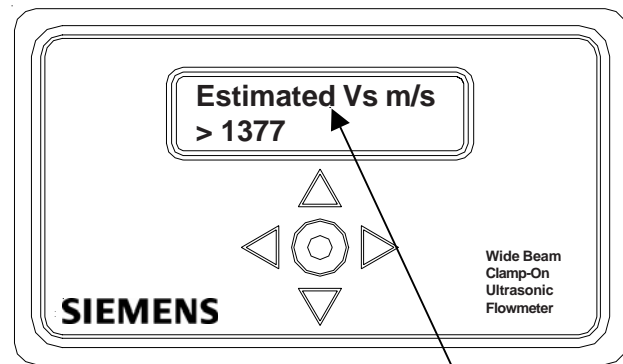
After selecting [Diesel Fuel] the menu moves to the next cell.

A Note on Multiple Select Option Lists

Certain option lists allow you to make more than one selection. For example, the [Datalogger Data] option list allows you to select any or all of the available data items for your reports. As previously described, you can use △ and ▽ to move the cursor through the list. However, when you use ◎ to select an item, the cursor moves to the next item in the option list. If you use ◎ to return to the item that you selected, you will see that an asterisk (*) appears next to that item to show that it is selected. Unlike option lists that offer a single selection, the cursor remains within the option list so that you can make other selections. To deselect a previously selected item, scroll to that item (marked by an asterisk) and then use ◎.

After selecting all the desired items, use ◁ to leave a multiple select option list.

How To Enter Numeric Data

This section shows how to edit a numeric menu cell. The following example uses the [Pipe OD] menu cell. The left-hand figure on the next page shows the [Pipe OD] menu cell. Notice that the second line shows the current outer diameter value: [0.500]. (The "greater than" symbol placed before the parameter indicates that it is the current selection.) This example explains how to change the pipe outer diameter to 4.500.

Pipe OD (in)
> 0.500

SIEMENS

Wide Beam
Clamp-On
Ultrasonic
Flowmeter

Pipe OD (in)
> _ 0.500

SIEMENS

Wide Beam
Clamp-On
Ultrasonic
Flowmeter
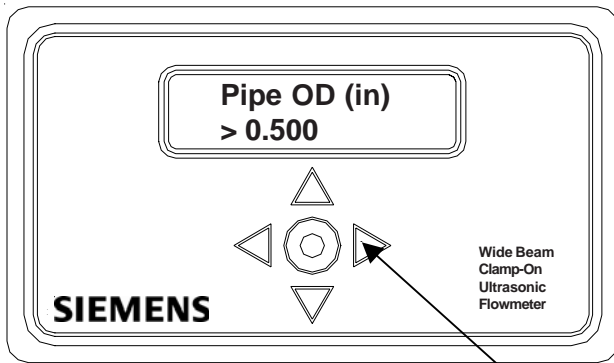
Press Right Key to
activate numeric entry.
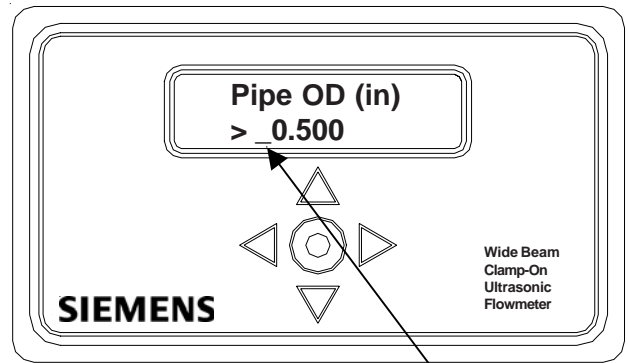
The first position allows you to
change the mathematical sign.

● Use ▷ to activate numeric entry. Notice that an equal sign (=) appears before the current entry and
that an underscore (_) appears in front of the number (as shown on the right-hand figure above).
The underscore at the first position allows you to change the mathematical sign of the number. For
example, if you use △ or ▽ at the first position the value switches to a negative number.

● Use ▷ to leave the sign intact and move the cursor to the first number position. This clears the
current number as shown on the left-hand figure below. We will enter the number 4.500.

Pipe OD (in)
> 0

SIEMENS

Wide Beam
Clamp-On
Ultrasonic
Flowmeter

Pipe OD (in)
> 4.

SIEMENS

Wide Beam
Clamp-On
Ultrasonic
Flowmeter
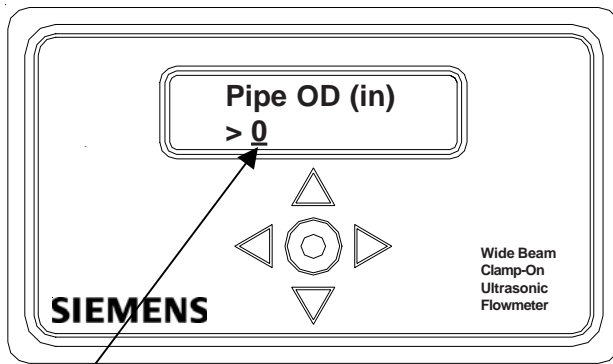
Cursor shown at first
number position.
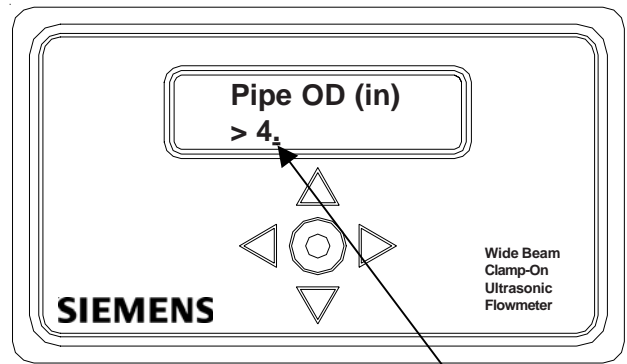
The decimal point
shown selected.

● Use △ to scroll through the number list. Stop scrolling at numeral [4]. Use ▷ to move to the second
number position. Use ▽ to scroll list to decimal point as shown in the right-hand figure above.

Pipe OD (in)
> 4.5

SIEMENS

Wide Beam
Clamp-On
Ultrasonic
Flowmeter

Pipe Material
> Steel

SIEMENS

Wide Beam
Clamp-On
Ultrasonic
Flowmeter
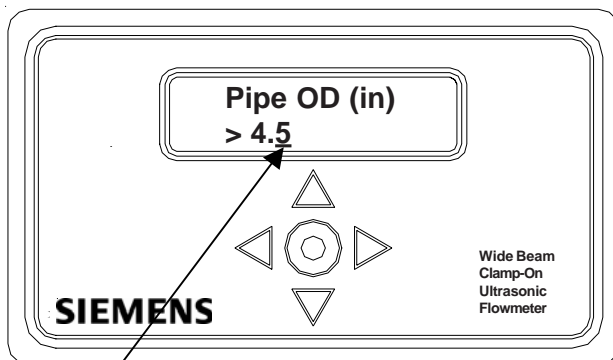
Cursor shown at third
number position.
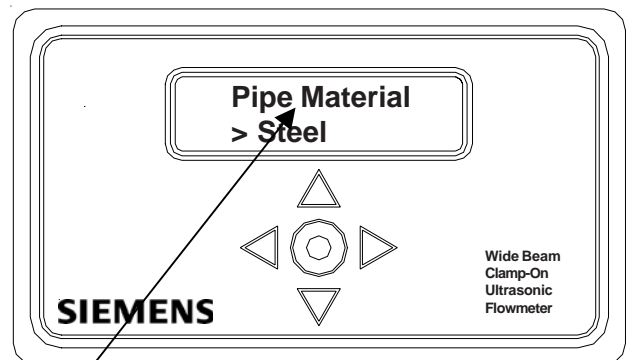
After entering the new value, the screen
switches to the next menu cell.

● Use ▷ to move cursor to move to the third number position. Use △ to scroll the number list to [5]. Use ◎ to register the new pipe outer diameter. This moves the screen to the next menu cell [Pipe Material] as shown in the right-hand figure above. You can use △ to move back to [Pipe OD] to check that the flow computer accepted the new value.

How to Enter Alphanumeric Strings

This section shows how to edit an alphanumeric menu cell. An alphanumeric string is a series of numbers and letters including the Quotation Mark, the Pound Sign symbols and/or a space. The meter uses these symbols to identify a specific site setup or user-modified table. Menu cells that accept alphanumeric strings provide an eight-character entry field. The following example uses the [Create/ Name Site] menu cell. We will create a new site setup named [SITE1].

NOTE: This procedure is the first action required to start a new site setup.

The first time you access [Create/Name Site] you will see a "greater than" symbol and blank second line (as shown in the left-hand figure below). Use ▷ to access the alphanumeric entry field at the first character position. Note that the prompt changes to a question mark (?) as shown in the right-hand figure below.
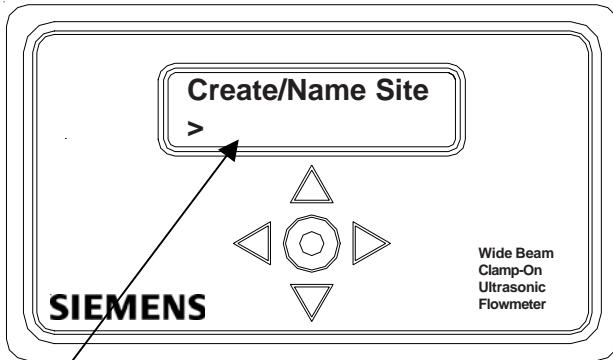
Note site name field is
initially blank.
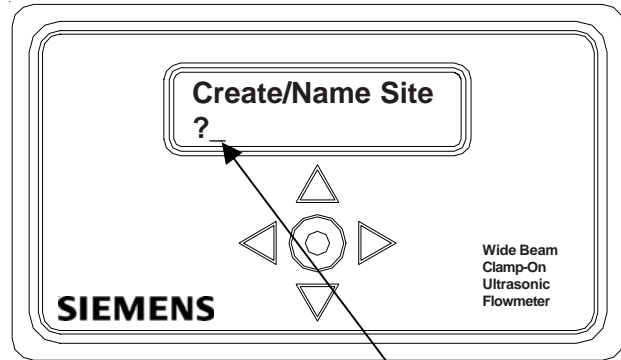
[?] indicates cell is ready to accept data.
Cursor shown at first character position.

● With the cursor at the first character position, use △ to scroll through the character list until you see [S]. Use ▷ to move the cursor to the second position. Use ▽ to scroll the list back down to [I]. Use ▷ to move the cursor to the third position. Use △ to scroll list to [T]. Use ENTER to move to the fourth position. Use ▽ to scroll list to [E]. Use ▷ to the fifth position. Use ENTER to scroll list to [1] (numbers appear after you scroll down past letter A as shown in the left-hand figure below). Use ◎ to create the new site setup: SITE1. This selects the next menu cell: [Site Security] as shown in the right-hand figure below.
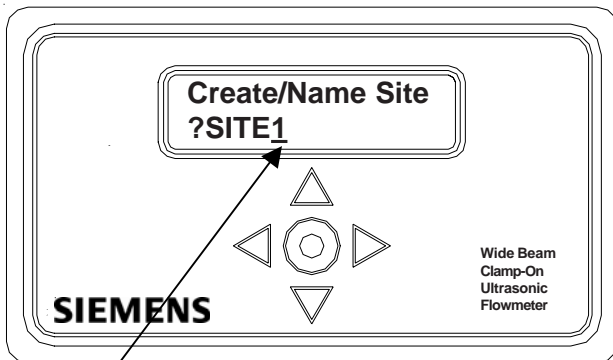
Cursor shown at fifth
character position.
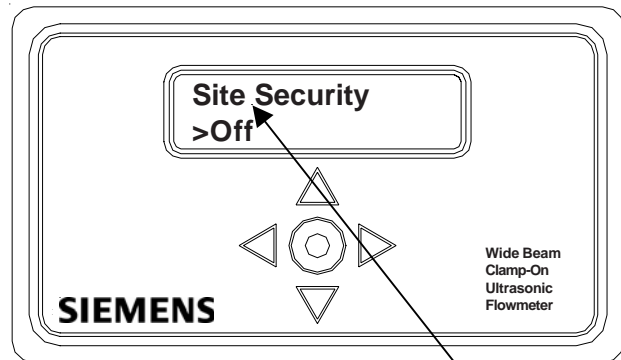
Screen switches to next menu cell
after entering site setup name.

2.7   HOW TO USE THE RS-232 INTERFACE

This section describes the hardware, software and procedural requirements for programming System 1020 using a PC connected to its RS-232 serial I/O port. Although you can construct your own interface cable, it is probably more convenient to purchase a standard DB-9 (Belden Pro Series Direct Cable #F3B207-10) serial interface cable. This 9-pin serial interface cable can connect two computers that are equipped with DB-9 male serial ports. You will also need a PC communication program such as Terminal (Windows 3.x) or HyperTerminal (Windows 95/98/NT/2000/XP) to serve as the data entry interface. We recommend these programs simply because they are free and universally owned. However, you can use your own favorite DOS or Windows-based software as long as it supports VT-100 emulation. These programs reproduce the menu screens that appear on our 1010/1020 systems with graphic display screens (screens shown in this section are actual HyperTerminal screen captures). The site setup procedure for System 1020 and our graphic display systems (e.g., FUS1010N) are virtually identical.

NOTE: If you use a DOS-based communications program, make sure that your PC is loading the ANSI.SYS driver via your Config.Sys start-up file. Set the RS-232 parameters to match those of the flowmeter (see example of HyperTerminal screen on the next page).

NOTE: Many newer Laptop PC's are not equipped with serial ports, having USB ports only. These PC's will require a USB RS-232 adaptor that can be purchased commercially. Not all of these adaptors are suitable. *Siemens has found the best performance is achieved with the adaptor from Radio Shack, (Part# 26-183).*

2.7.1   THE RS-232 INTERFACE CABLE

The figure below shows the location of serial interface cable connector J1 used to make the physical connection between the 1020 flow computer and your PC. (The recommended serial cable is Belden part number: F3B207-10.) Refer to Appendix B for serial interface cable wiring details.
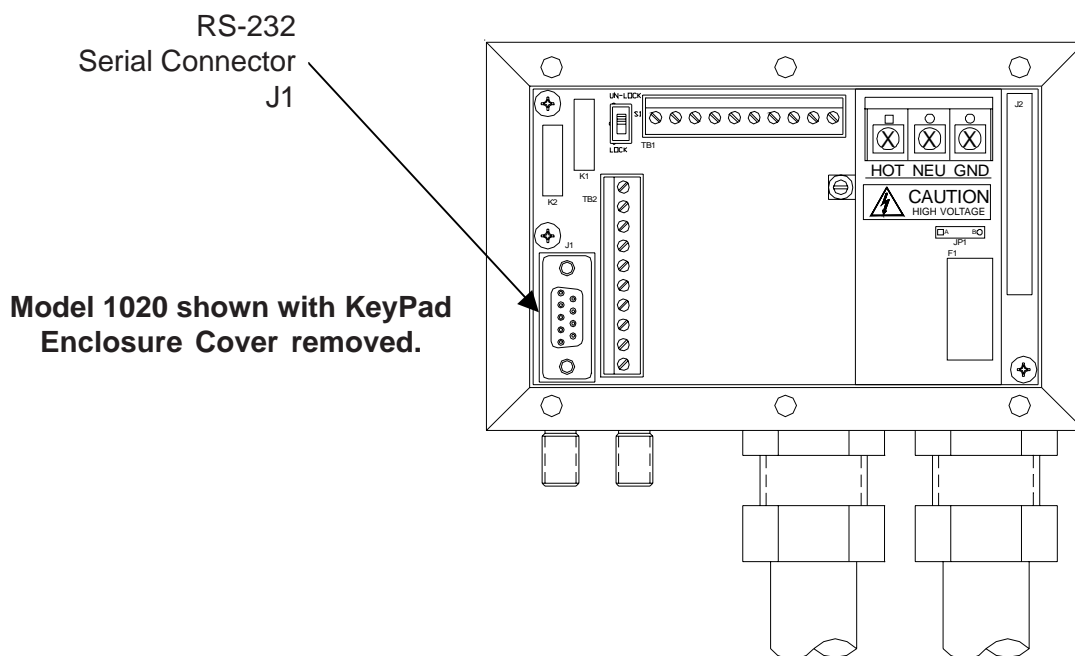
SERIAL CONNECTOR J1 FOR DB-9 SERIAL INTERFACE CABLE

2.7.2   ESTABLISHING COMMUNICATIONS USING HyperTerminal

This section shows how to communicate with 1020 using the Windows based communication program HyperTerminal. It assumes that you're familiar with Windows 95/98/NT/2000/XP and have a basic understanding of serial communications.

All IBM compatible computers provide at least one serial port using a 9-pin connector. The port designation can be either COM 1 or COM 2. Usually, when a computer has two serial ports, COM 1 will be the 9-pin connector and COM 2 will be the 25-pin connector. However, port designations can vary from manufacturer to manufacturer, so you will have to positively identify the COM port you wish to use for the flow computer interface. Connect cable between the flow computer and your PC using the 9-pin connector.

NOTE: Be aware that on some laptop computers, the available COM ports may be assigned to peripheral devices, such as a modem, mouse or an infrared port, etc. Therefore, you may not have a COM port available for this interface. In such a case, refer to your PC manual for instructions on how to reassign your COM ports for standard operation.

The following example explains how to set up HyperTerminal:

● From the Windows 95/98/NT/2000/XP desktop, Left-Click on the [START] button.

● Holding down the left mouse button, move the highlight up to [Programs], then across to [Accessories]. Slide the highlight down to [HyperTerminal], then release the left mouse button.

● Within the HyperTerminal window, move the mouse pointer down to [Hyperterm.exe] and then double-click the left mouse button.

● This selects the [Connection Description] dialog box. Enter a name for your connection (e.g., 1020N). You can optionally select an icon for this connection by clicking on one of the icons displayed in the scrolling frame at the bottom of the window. Click [OK].

● This selects the [Phone Number] dialog box. Move cursor to the arrow at right of [Connect Using] field. Left click on arrow to expand field and move the highlight down to [Direct to Com 1 (or 2)] depending on the port connected to the interface cable. Click [OK] to select [Com 1 (or 2) Properties] Dialog box. Set up your RS-232 parameters as shown (below left). Left-click on the [OK] button.

● You will now see a blank terminal screen. Next click [File] on the top menu bar. Drag the highlight down to [Properties] and then left-click.

● Left-click [Settings] tab. Expand the [Emulation] box by clicking the <Down Arrow> on the right-hand side. Drag the highlight down to [VT-100] and then left-click to select it as shown (below right).
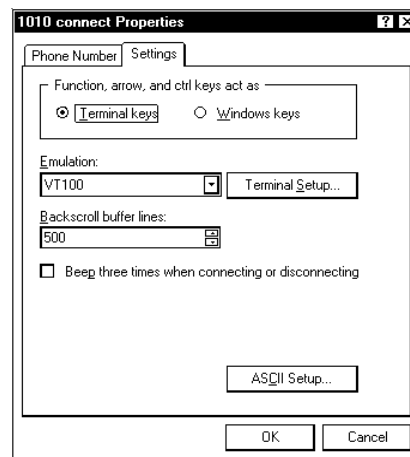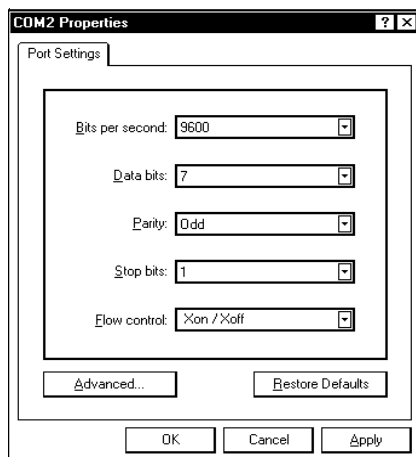
Next, left-click on the [ASCII Setup] button. In the [ASCII Sending] dialog box, ensure that the [Send line ends with line feeds] and the [Echo Typed characters locally] are <u>UNCHECKED</u>. In the [ASCII Receiving] dialog box, left-click to place a check mark before [Append line feeds to in-coming line ends] dialog. When your screen looks like the example below, left-click the [OK] button.
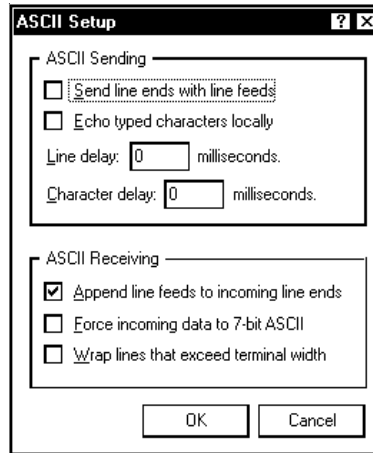
- You are now ready to communicate with the 1020. But first, save your settings by moving the mouse curser to [File], sliding the cursor to [Save], then clicking [OK] on the Save dialog box.

- The next time you want to use HyperTerminal; Click on *Start*. Drag to *Programs*. Drag to *Accessories*. Drag to *HyperTerminal,* and click. Double-click icon you selected for the connection.

NOTE: For easier access, create a shortcut to the connect icon from your desktop. Right-click on the icon to open its dialog box. Left-click on [Copy], move mouse cursor to a blank area on your desktop. Right-click to open dialog box and left-click on [Paste] to place a shortcut to the connect icon on your desktop.

2.7.3 ACCESSING THE INSTALLATION MENU

Once parameters are set, HyperTerminal automatically connects with the flow computer when you double-click the icon created previously. The interface provides three discrete terminal modes: *Command* mode, *Installation Menu* mode and *Data Display* mode, which only becomes active after a successful installation.

- Establishing a connection with the flowmeter automatically initiates *Command* mode. You will see a blank screen. Press <ENT> a few times until **[? For Help]** appears on the terminal screen.

- Type: **?** (question mark) and then press <ENT> to see a list of the available commands. Type: [**menu**] and then press <ENT> to access the top level of the Installation Menu.

NOTE: To facilitate modem use, the [menu] ceases after 3 minutes of inactivity. For a longer connection time, type: menu 1000 and press ENTER. The optional number is the time in minutes that the connection will be maintained. Typing [Menu 1000] keeps the interface alive until you cancel it.

Data Display Mode

After you complete the installation, and the meter is operating normally, you can use <CTRL + L> on your PC keyboard to toggle between *Installation Menu* mode and *Data Display* mode (strike <L> while holding down <CTRL> key). Note that the 1020 RS-232 interface does not support graphics. Therefore, if you use HyperTerminal to view the data display screens, you will see the data in alphanumeric form only. You can use the PC's <Up Arrow> and <Down Arrow> to switch between available display screens.

2.7.4   DATA ENTRY USING THE RS-232 INTERFACE

The following is a step-by-step example of how to enter data for a Single-Channel 1020N Integral flow computer using the RS-232 interface and a communications program. Again, don't let the size of the Installation Menu intimidate you. Most menu cells contain default parameters. You need only access the menu cells that control a needed parameter, such as the pipe outer diameter.

Accessing and Leaving the Installation Menu

● Make sure the Menu Lockout Switch is in the correct position. Connect the serial interface cable between the flow computer and your laptop computer.

● Run HyperTerminal (or your choice of communication program) using settings explained previously.

● In Command Mode, type [menu 1000]; press <ENTER> to select the top level of the Installation Menu.

NOTE: NOTE: Type <Menu> to enter Installation Menu. After programming is complete, repeated <Left Arrow> key will access the Flow Display. Key <Enter> from Flow Display to re-enter menu. Key <Ctrl L> to exit menu.

Siemens	**Site [1]**	**Channel 1**
Select Meter Type		
Meter Type		**Single Channel**
Meter Facilities		
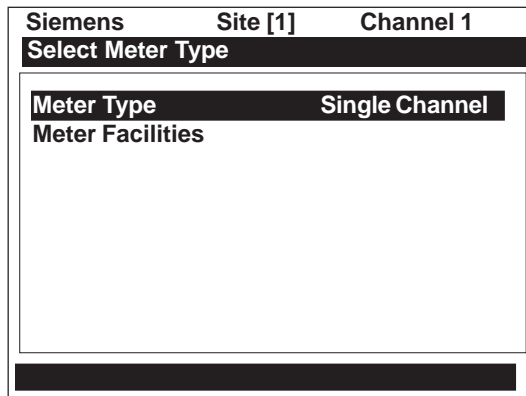
Note on the screen above that there are two columns, a left-hand and a right-hand side. The first left-hand item, [Meter Type], is highlighted (reversed). [Meter Type] allows you to choose a configuration from the right-hand column list (on Single Channel models, there is only a single channel). The next left-hand selection is Meter Facilities. Use this menu to set global options and controls.

2.7.5 NAVIGATING THROUGH THE INSTALLATION MENU

After successfully accessing the Installation Menu, you can begin to set up the 1020. The following table shows the PC keyboard Installation Menu navigation keys.

PC KEYBOARD	DESCRIPTION
MENU	Enter Installation Menu.
<UP Arrow>	Move up one menu cell (or change Flow Display screen).
<DOWN Arrow>	Move up one menu cell (or change Flow Display screen).
<RIGHT Arrow>	Move right one menu cell.
<RIGHT Arrow> (during Install)	Allows manual frequency selection.
<LEFT Arrow>	Move left one menu cell. Repeated <LEFT Arrow> exits Menu and Display screen.
^L (Ctrl L)	Exits Menu.
<ENTER>	Enter data and re-enter menu from Flow Display screen.
<ENTER> (during Install)	Forced Transmit test mode (Version 3 software)
<Backspace> or <DEL>	Deselect list selection or zero numeric entry.
| (bar) Shift + \ (back slash)	Change number sign or type (-) minus key.
Digits	Numerals zero through 9.
•	Decimal Point.
@	System Reset (refer to paragraph 7.8.2).

2.7.6   INTRODUCTION TO THE 1020 MENU SCREENS

This section introduces the System 1020 Installation Menu as it appears on a communication program. The Installation Menu consists of sub-menus, each providing individual menu locations (*menu cells*) that store site data. For convenience, this manual refers to sub-menus simply as menus (e.g., the Pipe Data Menu shown below). Note that the screen contains a left-hand column and a right-hand column. The left-hand column shows the menu cells and the right-hand column shows the current data stored in the adjacent menu cell.

Site indicates that this screen is form a single channel meter. A dual channel mode shows either channel 1 or channel 2

Currently active measurement channel

Site Name of currently active site setup

Menu Prompt Line (Reverse Video)

Currently Selected Menu cell

Menu cell Left-hand column)

Highlighted Data

Menu cell data (Right-hand column)

Current Selected Menu

| Siemens | Site | [1] | SITE1 |

Enter pipe Outer Diameter manually

Select Pipe Class	Manual Entry
Select Pipe Size	N/A
Pipe OD (in)	= 0.500
Pipe Material	Steel
Wall Thickness	0.100
Liner Material	None
Liner Thickness	0.000

Pipe Data

TYPICAL 1020 INSTALLATION MENU SCREEN

EXPLANATIONS OF INSTALLATION MENU CALLOUTS

Current Selected Meter Type	[Site] indicates Single Channel Flowmeter operating mode selected.
Menu Prompt Line	When you select a menu cell, a reverse text prompt appears on the top of the screen to explain the function of the cell.
Selected Channel	The [1] shows that measurement Channel 1 is currently selected.
Currently Selected Menu Cell	Selecting a menu cell causes it to highlight in the right-hand column.
Highlighted Data	The right-hand column shows the current value highlighted. Pressing the <Right Arrow> provides access to an option list or numeric field, where you can change the current value.
Menu Cell	A menu cell is an individual location within a menu (in this case Pipe data) that stores data (either a numeric entry or a list selection).
Menu Cell Data	The right-hand column shows the current value stored by the left-hand column menu cell. The Pipe Data menu includes option list items and numeric entries.
Current Selected Menu	The highlighted bar at the bottom of the screen shows the name of the menu that you accessed (e.g., Pipe Data).

2.8   DATA ENTRY PROCEDURES USING THE RS-232 INTERFACE

The left-hand column shows the menu cells (described previously). Another way to look at left-hand column items is to consider them menu questions. Then you can see that the right-hand column answers these questions. Right-hand column answers can be:

- Another series of menu cells (that become left-hand column items when selected).

- An alphanumeric string (e.g., a site name).

- An item from a scrollable option list (e.g., a class of liquids).

- A numeric entry (e.g., a pipe outer diameter).

2.8.1   ENTERING ALPHANUMERIC STRINGS

An alphanumeric string is a series of numbers and letters including the Quotation Mark and the Pound Sign symbols. You can also use a space. The meter uses these to identify a site setup or user-modified table. Menu cells that use these strings provide an 8-character (max.) field for data entry. Entering alphanumeric strings are easy since the 1020 responds to keys typed on your keyboard. The following example uses the [Create/Name Site] menu cell. This is the first action required to begin a new site setup. We will use the site name [SITE1]. See the screen below. Note that the right-hand highlight is blank.

[Create/Name Site] menu cell. This is the first data required by the flowmeter.

```
Siemens           Site   [1]
Right arrow & Enter Creates a new Site

Recall Site Setup        No Sites
Channel Enable           No
Create/Name Site
Site Security            Off
Delete Site Setup        No Sites
Save/Rename Site



Channel Setup
```

Blank Site Name Field
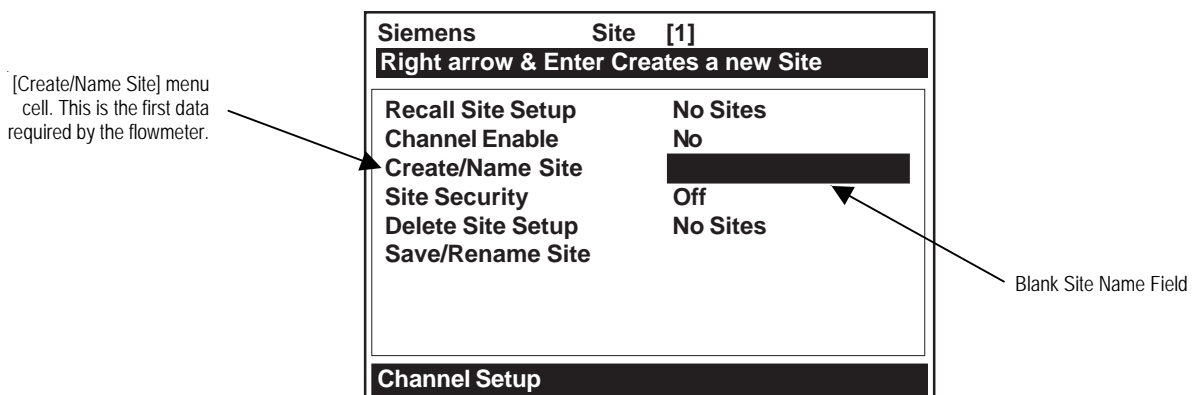
Press the <Right Arrow> to access the alphanumeric entry field. Note that the prompt changes to a question mark (?). Use the PC keyboard to type: SITE1. Note that the letters are upper case without you having to use the <Shift> or <Caps Lock> keys. (See menu screen on next page.)

```
Siemens          Site   [1]
Right arrow & Enter Creates a new Site

Recall Site Setup        No Sites
Channel Enable           No
Create/Name Site         ?SITE1■
Site Security            Off
Delete Site Setup        No Sites
Save/Rename Site


Channel Setup
```
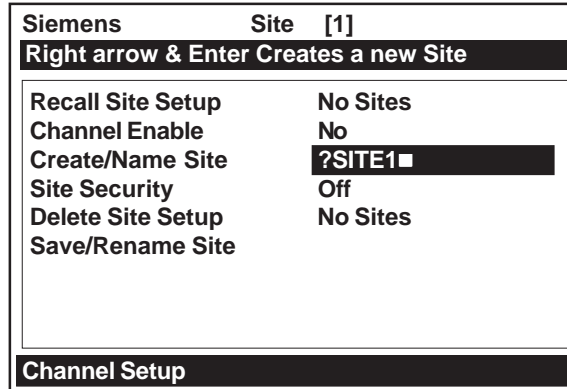
After you finish typing the string, press <ENTER> to register it. This creates a new site setup called [SITE1]. This action prepares the 1020 for installation by loading default parameters in all the appropriate menu cells. Note that the [Recall Site] menu cell shows: [No Sites] and that the [Save/ Rename Site] menu cell now lists the site name. Although, you just created site setup SITE1, it will not be permanently stored until you invoke the [Save/Rename Site] command.

```
Siemens          Site   [1]      SITE1
Use with Care -- Turn Security On or Off

Recall Site Setup        No Sites
Channel Enable           No
Create/Name Site         SITE1
Site Security            Off
Delete Site Setup        No Sites
Save/Rename Site         SITE1


Channel Setup
```
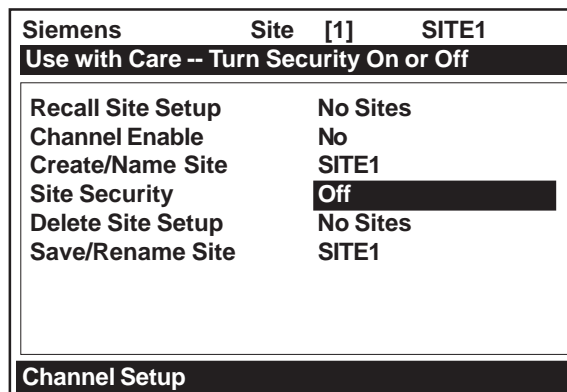
2.8.2 SELECTING ITEMS FROM AN OPTION LIST

Examine the screen below. It shows how to use an option list to select a *Relay Setup* for your application. How to access this menu will be explained later. Note that the menu name [I/O Data Control] appears highlighted on the lower left of the screen. Note also that the menu cell [Relay Setup] is highlighted. *Note that the right-hand column has no data at this time.*

```
Siemens          Site   [1]      SITE1
Assign Alarm Data function to each relay

 Analog Setup
 Relay Setup






I/O Data Control
```
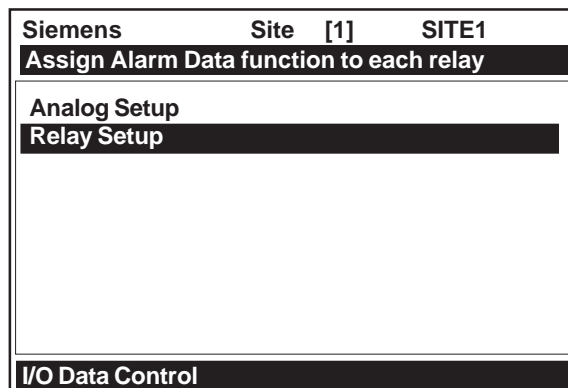
Pressing the <Right Arrow> changes the left-hand column to [Relay 1]. Pressing the <Right Arrow> again accesses the option list. This expands the highlighted area to show the contents of the list. Note that a "greater than" symbol (>) points to the top item on the list.

```
 Siemens        Channel      [1]      SITE1
 Select a function for Relay 1

    Relay 1                  >Off
                             Power On
                             High Flow
                             Low Flow
                             Flow Alarm
                             Fault Alarm
                             Spacing
                             Empty
                             Aeration
                             Interface
                             Reverse Flow
                             Batch Tot

 Relay Setup
```
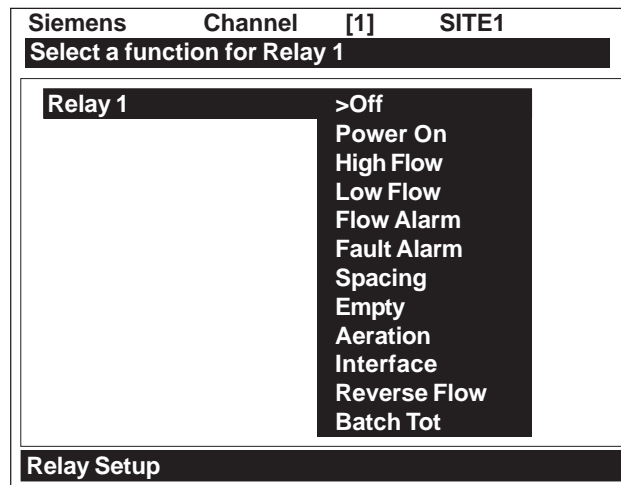
The <Up and Down Arrows> allow you to scroll the option lists. Every key press sequentially moves the cursor to the next item. Due to the size of the display screen, some option lists include more items than the display can show. For example, on the screen above the last option shown is [Batch Tot]. However, this option list has more listings. Continue to press the <Down Arrow> to see more Relay selections. When you arrive at the last item on a list, the next <Down Arrow> press brings you back to the top of the list. This is because the option lists are of the "wrap-around" type.

To select an option list item, move the cursor to the item and then press the <ENTER> key.This places your selection at the top of the list and moves you out of the option list to the next menu cell. Examine the screen below. The option list item: [Fault Alarm] has been selected and appears in the right-hand column.

**NOTE: The selected option list menu cell appears in the right-hand column and the high-
        lighted area moves to the next menu cell in the menu sequence: [Relay 2], <u>if available</u>.**
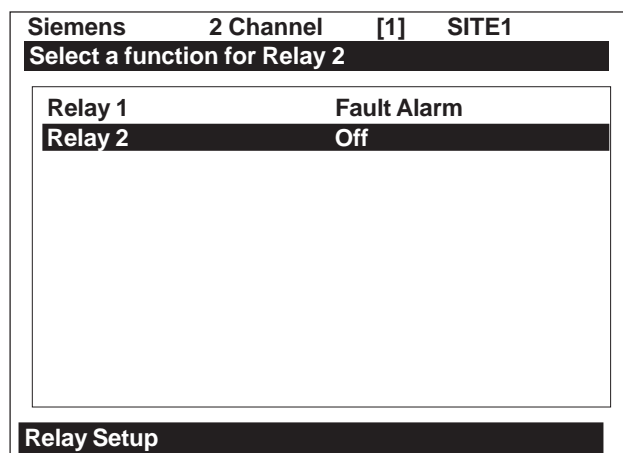
```
 Siemens        2 Channel     [1]      SITE1
 Select a function for Relay 2

    Relay 1                  Fault Alarm
    Relay 2                  Off




 Relay Setup
```

Multiple Select Option Lists

Certain option lists allow you to make more than one selection. For instance, the Datalogger Data option list allows you to select any or all of the available data items for your reports. You can use the <Up and Down Arrows> to move the cursor through the list. If you press <ENTER> to select an item, a plus sign (+) appears next to that item. The cursor remains so that you can make other selections. To deselect a previously selected item, move cursor next to that item and press <CLR>. Use the <Left Arrow> to leave any multiple select option list.

```
┌──────────────────────────────────────────────────────────┐
│ Siemens          Channel  [1]          SITE1             │
│ ██Select Datalogger Data██████████████████████████████   │
│  ┌───────────────────────┬──────────────────────────┐    │
│  │ Datalogger Mode        │ +Site Id                 │    │
│  │ ██Datalogger Data██    │ +Date                    │    │
│  │ Log Time Interval      │ +Time                    │    │
│  │ Datalogger Events      │ Flow                     │    │
│  │ Display Datalogger     │ Average Flow             │    │
│  │                        │ Raw Flow                 │    │
│  │                        │ Total                    │    │
│  │                        │ Vs                       │    │
│  │                        │ Valc                     │    │
│  │                        │ Aeration                 │    │
│  │                        │ Alarms                   │    │
│  │                        │ DeltaT (usecs)           │    │
│  └───────────────────────┴──────────────────────────┘    │
│ ██Datalogger Setup███████████████████████████████████   │
└──────────────────────────────────────────────────────────┘
```
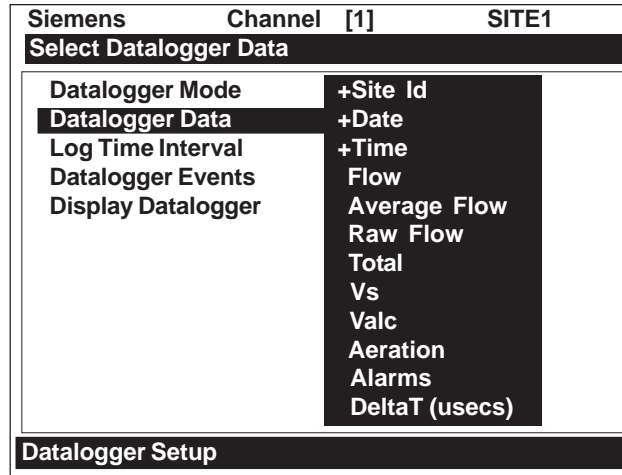
2.8.3 ENTERING NUMERIC DATA

When a menu cell requires a numeric answer, press the <Right Arrow> to access a number entry field. *Note that an equal sign (=) appears before the current entry.* You can now use the number keys and the decimal point key to type a new value. If applicable, you can use <+/-> keys to change the mathematical sign of the number. Press <ENTER> to store the numeric data.

For example, to set the Span Data use the <Down Arrow> to scroll down the Clamp-On menu and highlight [Data Span/Set/Cal].

```
┌──────────────────────────────────────────────────────────┐
│ Siemens          Channel   [1]          SITE1            │
│ ██Data Span, Set and Calibrate control████████████████   │
│  ┌───────────────────────────────────────────────────┐   │
│  │ Channel Setup                                     │   │
│  │ Pipe Data                                         │   │
│  │ Application Data                                  │   │
│  │ Pick/Install Xdcr                                 │   │
│  │ Operation Adjust                                  │   │
│  │ Flow/Total Units                                  │   │
│  │ ██Data Span/Set/Cal██                             │   │
│  │ Datalogger Setup                                  │   │
│  │                                                   │   │
│  └───────────────────────────────────────────────────┘   │
│ ██Clamp-on███████████████████████████████████████████   │
└──────────────────────────────────────────────────────────┘
```
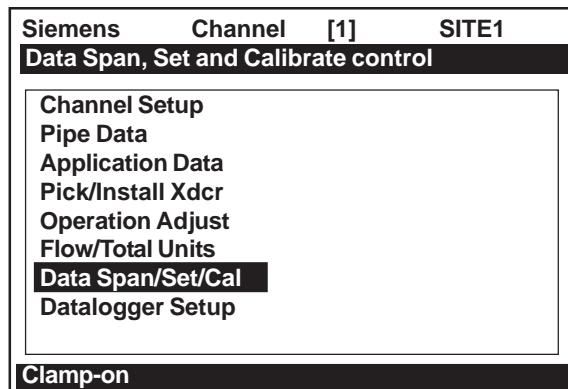
● Press the <Right Arrow> and [Span Data] is highlighted.

```
Siemens          Channel    [1]    SITE1
Span 0% and 100% Values for Analog Data

   Span Data
   Set Alarm Levels
   Calibrate Flow Rate      Chan Not Setup
   Reynold's Table          Standard




Data Span/Set/Cal
```

● Press the <Right Arrow> again and [Max Flow GAL/MIN] will appear. To change the [Max Flow GAL/MIN] data, press the <Right Arrow> and an equal sign appears. Using the number keys, enter the new data (e.g., 1846). Press the <ENTER> key to store the numeric data.

```
Siemens          Channel    [1]    SITE1
Set 100% <20 mA> flow rate

   Max Flow GAL/MIN        =0.00
   Min Flow GAL/MIN         0.00
   Max Vs m/s               0.00
   Min Vs m/s               0.00






Span Data
```

```
Siemens          Channel    [1]    SITE1
Set 100% <20 mA> flow rate

   Max Flow GAL/MIN         1846
   Min Flow GAL/MIN         0.00
   Max Vs m/s               0.00
   Min Vs m/s               0.00






Span Data
```

2.9   HOW TO SET UP A CHANNEL FOR TRANSIT-TIME OPERATION

This section shows how to set up a single-channel for a transit-time, clamp-on operation and how to create a new site setup, enter pipe data and then select a liquid class (which tailors the meter response to the liquid's density and viscosity). It explains how to select a clamp-on transducer model, pick a mounting mode and, after physically mounting the transducers on the pipe, invoke the [Install Transducer] procedure. This setup is the fastest way to get the meter operational. It accepts most defaults and only provides a data output on the local LCD display panel. The first step is to create a new site setup.

NOTE: <u>Always</u> begin a new installation by issuing the [Create/Name Site] command. This action prepares the flow computer for site programming by loading system defaults into the appropriate menu cells.

2.9.1 HOW TO ACCESS THE CHANNEL SETUP MENU AND CREATE A SITE

As shown is previously, when you access the Installation Menu, you will arrive at the top menu location [Meter Type]. With single-channel meters, all you have to do is press the <Right Arrow> twice to access the main section of the Clamp-On Menu (see next page).

```
Siemens            Site    [1]
Create-Name-Recall-Enable & Delete Site

  Channel Setup
  Pipe Data
  Application Data
  Pick/Install Xdcr
  Operation Adjust
  Flow/Total Units
  DataSpan/Set/Cal
  Datalogger Setup
  I/O Data Control
  Diagnostic Data


```

- Press the <Right Arrow> to move into the [Channel Setup] menu as shown below. Note that the highlight is on the first menu cell: [Recall Site].

```
Siemens            Site    [1]
Scroll  saved Site Setup list and Enter

  Recall Site        No Sites
  Channel Enable          No
  Create/Name Site
  Site Security           Off
  Delete Site         No Sites
  Save/Rename Site




Channel Setup
```

- Use the <Down Arrow> to move the highlight to [Create/Name Site]. Create a site named: SITE1 (as detailed in paragraph 2.8.1).

2.9.2 HOW TO ENTER PIPE DATA

After creating the site, the next step is to enter the Pipe Data. The Pipe Data menu allows you to either enter the pipe data manually or select a preset pipe configuration from an option list. This section explains how to enter the data manually. The two mandatory entries to be entered in this menu are the pipe's Outer Diameter (OD) and its Wall Thickness. Here we will insert a pipe outer diameter of 9.00" and a pipe wall thickness of 0.29" as an example.

- Press the <Left Arrow> to leave [Channel Setup]. Press the <Down Arrow> and then the <Right Arrow> to enter the [Pipe Data] menu.

- Move the highlight to [Pipe OD <in>] and then press the <Right Arrow> and then the <Right Arrow>. Note that an equal sign appears before the current parameter.

```
Siemens          Site    [1]      SITE1
Enter pipe Outer Diameter manually

  Pick Pipe Class          Manual Entry
  Select Pipe Size         N/A
  Pipe OD <in>             =0.500
  Pipe Material            Steel
  Wall Thickness           0.100
  Liner Material           None
  Liner Thickness          0.000



Pipe Data
```

● Type digit 9 and then press <ENTER>. Next, move the highlight to [Wall Thickness]. Press the <Right Arrow>, type 0.29, and then press <ENTER>. The [Pipe Data] screen will show these changes as seen below.

```
Siemens          Site    [1]      SITE1
Identify Liner material for Lined Pipes

  Pick Pipe Class          Manual Entry
  Select Pipe Size         N/A
  Pipe OD <in>             9.000
  Pipe Material            Steel
  Wall Thickness           0.290
  Liner Material           None
  Liner Thickness          0.000



Pipe Data
```

2.9.3 HOW TO SELECT A LIQUID TYPE

Next, we will select a liquid type. Liquid selection is optional. However, selecting a liquid makes it more likely that the meter's initial transducer spacing recommendation will be valid. In addition, it allows the meter to adjust its flow profile compensation curve to the viscosity of the liquid. You do not have to find the exact liquid on the option list. Picking a liquid with similar characteristics is sufficient. The default selection is Water @ 20°C/68°F. For this example we will select [Diesel Fuel]. Press the <Left Arrow> back to [Full Site Setup], then press <Down Arrow> to [Application Data]. Press the <Right Arrow> to access the [Application Data] menu. Note that the menu cell [Liquid Class] is highlighted and the default selection [Water 20C/68F] appears in the right-hand column.

```
Siemens       2 Channel  [1]      SITE1
Select Liquid Class from Liquid Table

  Liquid Class             Water 20C/68F
  Pipe Config              Fully Developed






Application Data
```

● Press the <Right Arrow> to access the [Select Option List]. Press the <Down Arrow> until the cursor selects [Diesel Fuel].

```
Siemens          2 Channel   [1]     SITE1
Access Liquid Option List
┌─────────────────────────────────────────┐
│ Select Liquid        Water 150C/302F     │
│ Estimated Vs m/s     Water 175C/347F     │
│ Viscosity cS         Water 200C/392F     │
│ Density SG           Water 225C/437F     │
│                      Water 250C/482F     │
│                      Acetic Acid         │
│                      Bromine             │
│                      Carbon Tet          │
│                      Chlorine            │
│                      >Diesel Fuel        │
└─────────────────────────────────────────┘
Liquid Class
```

● Press the [ENTER] key to select [Diesel Fuel]. Note that the screen now lists an estimate of the liquid's Sonic Velocity (Vs), its Viscosity (in centistokes) and its Specific Gravity (Density SG). All these parameters can be edited. This allows you to "fine-tune" the liquid so that it is as close as possible to the actual liquid to be measured.

```
Siemens         2 Channel   [1]     SITE1
Initial sonic velocity
┌─────────────────────────────────────────┐
│ Select  Liquid       Diesel Fuel         │
│ Estimated Vs m/s     1377                │
│ Viscosity cS         2.30                │
│ Density SG           0.000               │
│                                          │
│                                          │
│                                          │
│                                          │
└─────────────────────────────────────────┘
Liquid Class
```

2.9.4 HOW TO MANUALLY SELECT TRANSDUCERS AND A MOUNTING MODE

In this section, we'll explore how to override the meter recommendations. Please note that the modifications shown in the following example are only intended to provide examples of the meter's flexibility. For this example, we will discuss the procedures required to mount a set of 1021 transducers of size [C] in Reflect Mode (see next page).

```
┌─────────────────────────────────────────┐
│ Siemens       2 Channel    [1]    SITE1  │
│ ▓Scroll List and select desired Model▓▓▓ │
│                                          │
│ ▓Transducer Model▓▓▓▓▓  1011 Universal   │
│  Transducer Size        Select Xdcr      │
│  Xdcr Mount Mode        Invalid          │
│  Spacing Offset         Invalid          │
│  Number Index           Invalid          │
│  Spacing Method         Invalid          │
│  Ltn Value              Invalid          │
│  Install Complete?      No               │
│  Empty Pipe Set         Chan Not Setup   │
│  Zero Flow Adjust       Chan Not Setup   │
│                                          │
│ ▓Pick/Install Xdcr▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓ │
└─────────────────────────────────────────┘
```

● To change the Transducer Model, press the <Right Arrow> to access the [Transducer Model] option list and move the cursor down to [1021 Xdcr]. Press the [ENTER] key to select menu cell [1021 Xdcr].

```
┌─────────────────────────────────────────┐
│ Siemens       2 Channel    [1]    SITE1  │
│ ▓Scroll List and select desired Model▓▓▓ │
│                                          │
│ ▓Transducer Model▓▓▓▓▓  1011 Universal   │
│  Transducer Size        >1021 Xdcr       │
│  Xdcr Mount Mode        1022A            │
│  Spacing Offset         Invalid          │
│  Number Index           Invalid          │
│  Spacing Method         Invalid          │
│  Ltn Value              Invalid          │
│  Install Complete?      No               │
│  Empty Pipe Set         Chan Not Setup   │
│  Zero Flow Adjust       Chan Not Setup   │
│                                          │
│ ▓Pick/Install Xdcr▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓ │
└─────────────────────────────────────────┘
```

● Note that the meter now presents you with a recommended transducer(s) in the top-line prompt. You can now select the transducer you intend to use for this application.

```
┌─────────────────────────────────────────┐
│ Siemens       2 Channel    [1]    SITE1  │
│ ▓Recommended Xdcr Mount Mode [Reflect]▓▓ │
│                                          │
│  Transducer Model       1021 Xdcr        │
│  Transducer Size        C1               │
│ ▓Xdcr Mount Mode▓▓▓▓▓▓▓  Reflect         │
│  Spacing Offset         Invalid          │
│  Number Index           4                │
│  Spacing Method         Invalid          │
│  Ltn Value              6.359            │
│  Install Complete?      No               │
│  Empty Pipe Set         Chan Not Setup   │
│  Zero Flow Adjust       Chan Not Setup   │
│                                          │
│ ▓Pick/Install Xdcr▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓ │
└─────────────────────────────────────────┘
```

● To select the recommended transducer, press the <Right Arrow> to access the 1021 transducer option list. Move the cursor down to [C1]. Press the [ENTER] key to select the transducer size. This prompts the meter to calculate the install parameters. As shown below, the meter accepts the size [C1] entry, and adjusts the transducer data accordingly.

```
Siemens        2 Channel     [1]    SITE1
Recommended Xdcr Mount Mode [Reflect]

  Transducer Model       1021  Xdcr
  Transducer Size        C1
  Xdcr Mount Mode        Reflect
  Spacing Offset         Invalid
  Number Index           4
  Spacing Method         Invalid
  Ltn Value              6.359
  Install Complete?      No
  Empty Pipe Set         Chan Not Setup
  Zero Flow Adjust       Chan Not Setup

Pick/Install Xdcr
```

● To exercise the flexibility of the meter, we can now override the [Xdcr Mount Mode] recommendation by selecting the Direct Mount Mode instead. Press the <Right Arrow> and scroll the cursor to [Direct], then press the [ENTER] key to make the selection. The transducer Number Index and Ltn values are automatically recomputed in response to any changes you make to the previous selection. *NOTE: Reflect mount is recommended.*

Installing The Transducers

You now have to mount the transducers in accordance with the indexes recommended on the screen (refer to Section 3). Be sure you do not install your transducers backwards, or reverse the Upstream and Downstream cables.

```
Siemens        2 Channel     [1]    SITE1
Key [Install] after mounting transducers

  Transducer Model       1021  Xdcr
  Transducer Size        C1
  Xdcr Mount Mode        Reflect
  Spacing Offset         Invalid
  Number Index           4
  Spacing Method         Invalid
  Ltn Value              2.330
  Install Complete?      No
  Empty Pipe Set         >Install
  Zero Flow Adjust       Chan Not Setup

Pick/Install Xdcr
```

● Use the [Install Complete?] menu cell to inform the meter that the transducers are mounted. Use the <Right Arrow> then the <Down Arrow> to move the cursor to [Install]. Press the [ENTER] key. As mentioned previously, the meter adjusts its operation to accommodate the transducers, mounting mode, pipe and liquid data. It reports the measured sonic velocity for your approval (in this case, 1395 m/s).

```
Siemens          2 Channel    [1]    SITE1
Drive  53    0    36    [6:          :0]

  Transducer Model         1021  Xdcr
  Transducer Size          C1
  Xdcr Moun
  Spacing Of    Measured Vs m/s
  Number Inc         1395
  Spacing Method           Invalid
  Ltn Value (in)           2.330
  Install Completed?       Install
  Empty Pipe Set           Chan Not Setup
  Zero Flow Adjust         Chan Not Setup

Pick/Install Xdcr
```

● However, as an example, assume that the liquid's sonic velocity is very well known and is actually 1377 m/s. Press the <Right Arrow>. Note that an "equal sign" appears before the displayed sonic velocity. Type [1377] and then press the [ENTER] key.

NOTE: As your 1020 metering experience with various liquids evolves, your knowledge and confidence regarding their sonic velocities will grow. If the Estimated Vs and Measured Vs at site are different, as in the example on the previous page, consider it a warning that something about the installation may be incorrect. Recheck transducer mounting geometry (e.g., Are they axial, diametrical and spaced correctly?) and your pipe data and re-install. On the other hand, when the Measured Vs conforms to the Actual Vs, your degree of confidence in the correctness of the installation and the meter's intrinsic calibration performance should be high.

```
Siemens          2 Channel    [1]    SITE1
Drive  53    0    36    [6:          :0]

  Transducer Model         1021  Xdcr
  Transducer Size          C1
  Xdcr Moun
  Spacing Of    Measured Vs m/s
  Number Inc         1377
  Spacing Method           Invalid
  Ltn Value (in)           2.330
  Install Completed?       Install
  Empty Pipe Set           Chan Not Setup
  Zero Flow Adjust         Chan Not Setup

Pick/Install Xdcr
```

● This commands the meter to re-calculate its timing parameters to accommodate the new sonic velocity setting.

```
┌─────────────────────────────────────────┐
│ Siemens      2 Channel    [1]    SITE1    │
│ ▊Drive  53   0    36    [6:         :0]▊  │
│                                           │
│ Transducer Model      1021  Xdcr          │
│ Transducer Size       C1                  │
│ Xdcr Mount Mode       Reflect             │
│ Spacing Offset        Invalid             │
│ Number Index          4                   │
│ Spacing Method        Invalid             │
│ Ltn Value (in)        2.330               │
│ Install Completed?    Install             │
│ ▊Empty Pipe Set       Chan Not Setup▊     │
│ Zero Flow Adjust      Chan Not Setup      │
│ ▊Pick/Install Xdcr                        │
└─────────────────────────────────────────┘
```

● Press the <Left Arrow> to accept the Vs setting. The highlight moves to [Empty Pipe Set]. This action indicates that the meter has accepted the new Vs setting and is now measuring flow.

Setting The Zero Flow Level

The [Zero Flow Adjust] menu cell becomes active after the meter completes the transducer install procedure. When you invoke the Transducer Install, the meter performs an automatic routine (Auto Zero) to establish a standard zero flow setting. However, AutoZero only supports the Reflect Mode transducer mounting. It will be suppressed for a Direct Mode installation (like the example described in this section). In addition, some conditions disallow the proper functioning of AutoZero even in Reflect Mode. In such a case, the meter provides two alternate means of achieving a zero setting:

● <u>Actual Zero</u>*: requires zero flow in pipe.*

● <u>ReversaMatic</u>: *obtain a zero by Xdcr reversal.*

Zero Flow Adjust helps the meter to remove a possible zero offset due to pipe or transducer asymmetry. Setting the zero flow level allows the meter to sense absolute flow direction and magnitude under low flow conditions. Zero Flow Adjust also provides a ZeroClr routine to remove a zero offset setting (done automatically or manually). In most cases, AutoZero works well and is desirable since it requires no user input. When AutoZero is not possible, we recommend using the Actual Zero command. Actual Zero requires you to stop flow to allow the meter to sense any zero offset. If not possible due to application conditions, then the second alternative, ReversaMatic, allows zero level sensing when liquid flow is at any velocity. However, you should use Actual Zero at the first opportunity. The ZeroClr command instantly resets the zero flow registers to [0.000].

Performing The Actual Zero Routine

NOTE: Please reduce flow through the pipe to zero.

This example continues the sample application. We have successfully installed our C1H transducers (in Direct Mode) and can stop flow for the purpose of performing an Actual Zero (see next page).

● Press the <Right Arrow> to access the [Zero Flow Adjust] option list.

```
┌─────────────────────────────────────────────────┐
│ Siemens        2 Channel     [1]    SITE1         │
│ ▐Conforms Indicated flow to Actual zero          ▌│
│                                                   │
│   Transducer Model         1021  Xdcr            │
│   Transducer Size          C1                    │
│   Xdcr Mount Mode          Reflect               │
│   Spacing Offset           Invalid               │
│   Number Index             4                     │
│   Spacing Method           Invalid               │
│   Ltn Value            ┌─────────────────┐       │
│   Install Complete?    │ Auto Zero       │       │
│   Empty Pipe Set       │ ZeroMatic       │       │
│  ▐Zero Flow Adjust    ▌│ ZeroClr         │       │
│                        │ >Actual Zero    │       │
│                        │ ReverseMatic    │       │
│                        └─────────────────┘       │
│ ▐Pick/Install Xdcr                               ▌│
└─────────────────────────────────────────────────┘
```

● Press [ENTER]. A pop-up window requests that you set current flow rate (in selected rate units) to equal zero (0.000). If you know current instantaneous flow rate and need to enter a numeric offset now, you can use the numeric keys to type that value (e.g., 0.012 GPM).

```
┌─────────────────────────────────────────────────┐
│ Siemens        2 Channel     [1]    SITE1         │
│ ▐Conforms Indicated flow to Actual zero          ▌│
│                                                   │
│   Transducer Model         1021  Xdcr            │
│   Transducer Size          C1                    │
│   Xdcr Moun┌──────────────────────┐ lid          │
│   Spacing Of│ Zero flow KGAL/MIN   │              │
│   Number In│ = 0.000              │              │
│   Spacing Method           Invalid               │
│   Ltn Value                2.330                 │
│   Install Complete?        Yes                   │
│   Empty Pipe Set           MTYmatic              │
│   Zero Flow Adjust         Actual Zero           │
│ ▐Pick/Install Xdcr                               ▌│
└─────────────────────────────────────────────────┘
```

Assuming no numeric offset, press [ENTER]. When you send this command, the flow computer measures the zero flow rate for up to sixty seconds, integrating (averaging) the data for the best zero correlation. During this time, the menu prompt at the top of the LCD screen shows a timer that counts from zero to sixty. You can allow zero averaging for the entire period or cancel the process at any time by pressing the [ENTER] key. This controls the amount of data the meter averages to obtain a zero level. In addition, you can bypass zero integration entirely by pressing the [ENTER] key twice in rapid succession.

```
┌─────────────────────────────────────────────┐
│ Siemens         2 Channel    [1]    SITE1    │
│ Integrating 11      Press [ENT]              │
│ ┌───────────────────────────────────────┐   │
│ │ Transducer Model      1021  Xdcr      │   │
│ │ Transducer Size       C1              │   │
│ │ Xdcr Mount Mode       Reflect         │   │
│ │ Spacing Offset        Invalid         │   │
│ │ Number Index          4               │   │
│ │ Spacing Method        Invalid         │   │
│ │ Ltn Value             2.330           │   │
│ │ Install Complete?     Yes             │   │
│ │ Empty Pipe Set        MTYmatic        │   │
│ │ Zero Flow Adjust      Actual Zero     │   │
│ └───────────────────────────────────────┘   │
│ Pick/Install Xdcr                            │
└─────────────────────────────────────────────┘
```

This counter increments to sixty during Zero Flow sensing.

● Upon completion, the meter moves the cursor to [Operation Adjust] on the Installation Menu.

Using The ReversaMatic Routine

As an example, we have successfully installed 1021Transducers, Size C1, in Reflect Mode. However, conditions at the site will not allow us to change the flow rate at the mounting location. In this case, we will use the ReversaMatic routine to establish a zero flow level.

NOTE: It is recommended that the Actual Zero routine be performed at the first opportunity. In addition, You should perform the ReversaMatic procedure as quickly as possible to ensure that the flow rate remains constant throughout the procedure.

● Press the <Right Arrow> to access the [Zero Flow Adjust] option list. Move the cursor to [Reversa-Matic]. Press [ENTER] to invoke the routine.

```
┌─────────────────────────────────────────────┐
│ Siemens         2 Channel    [1]    SITE1    │
│ Conforms Indicated flow to Actual zero       │
│ ┌───────────────────────────────────────┐   │
│ │ Transducer Model      1021  Xdcr      │   │
│ │ Transducer Size       C1              │   │
│ │ Xdcr Mount Mode       Reflect         │   │
│ │ Spacing Offset        Nominal         │   │
│ │ Number Index          4               │   │
│ │ Spacing Method        Invalid         │   │
│ │ Ltn Value (in)          ┌───────────┐ │   │
│ │ Install Completed?      │ Auto Zero │ │   │
│ │ Empty Pipe Set          │ ZeroMatic │ │   │
│ │ Zero Flow Adjust        │ ZeroClr   │ │   │
│ │                         │ Actual Zero│ │   │
│ │                         │>ReverseMatic│ │  │
│ │                         └───────────┘ │   │
│ └───────────────────────────────────────┘   │
│ Pick/Install Xdcr                            │
└─────────────────────────────────────────────┘
```

● The meter begins to measure the positive flow rate. *"Positive'" flow refers to flow moving from the upstream transducer location to the downstream transducer location.* Note the top prompt line shows: *ReversaMatic Active* (see next page).

```
┌─────────────────────────────────────────┐
│ Siemens        2 Channel    [1]    SITE1 │
│ ReversaMatic Active    [6:          :0]  │
│                                          │
│  Transducer Model      1021  Xdcr        │
│  Transducer Size       C1                │
│  Xdcr Mount Mode       Reflect           │
│  Spacing Offset        Invalid           │
│  Number Index          4                 │
│  Spacing Method        Invalid           │
│  Ltn Value             Auto Zero         │
│  Install Complete?     ZeroMatic         │
│  Empty Pipe Set        ZeroClr           │
│  Zero Flow Adjust      Actual Zero       │
│                        >ReverseMatic     │
│ Pick/Install Xdcr                        │
└─────────────────────────────────────────┘
```

● Upon completion, the meter beeps and the LCD screen shows the prompt:

Reverse XDCRs   Press [ENT].

● You must now remove and then remount the upstream and downstream transducers in their reversed positions (i.e., Mount the Up Transducer with its cable in the Down Transducer/cable location. Mount Down Transducer with its cable in the Up Transducer/cable location). If possible, this procedure should be done without removing the transducer cables from the transducers. When remounting the transducers, couple them to the pipe properly.

● After re-installing the transducers, press [ENTER]. The computer measures the negative flow rate briefly, then beeps and repeats the prompt: **Reverse Xdcrs   Press [ENT].** You must now remount the transducers for normal operation (in their original orientation). When remounting transducers, couple them to the pipe properly.

```
┌─────────────────────────────────────────┐
│ Siemens        2 Channel    [1]    SITE1 │
│ Reverse XDCRs          Press [ENT]       │
│                                          │
│  Transducer Model      1021  Xdcr        │
│  Transducer Size       C1                │
│  Xdcr Mount Mode       Reflect           │
│  Spacing Offset        Invalid           │
│  Number Index          4                 │
│  Spacing Method        Invalid           │
│  Ltn Value             Auto Zero         │
│  Install Complete?     ZeroMatic         │
│  Empty Pipe Set        ZeroClr           │
│  Zero Flow Adjust      Actual Zero       │
│                        >ReverseMatic     │
│ Pick/Install Xdcr                        │
└─────────────────────────────────────────┘
```

This completes the ReversaMatic procedure. The system's zero accuracy will be close to that obtainable using the Actual Zero method. Press the [ENTER] key and a window prompts you to save the Site Setup. (You do not have to do this right now.) Press the <Left Arrow> and you should now see a flow screen.

```
Siemens          2 Channel  [1]      SITE1
Conforms operation to user performance

  Channel Setup
  Pipe Data
  Applicati
  Pick/Inst    Save/Rename Site?
  Operatio     SITE1
  Flow/Tota
  DataSpan/Set/Cal
  Datalogger Setup
  I/O Data Control
  Diagnostic Data

  Full Site Setup
```
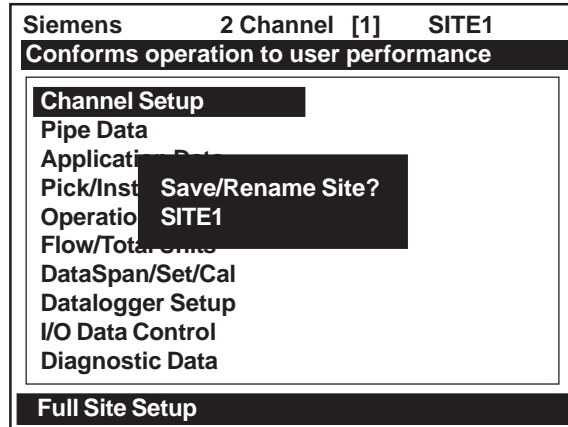
3. HARDWARE INSTALLATION GUIDE

This section explains how to mount the flow computer assembly and how to complete the Input/Output wiring. In addition, it provides details on how to select a location and then install clamp-on transducers. Please refer to the installation/outline drawings located in Appendix A that provide important installation information that does not appear in this section.

3.1 MOUNTING THE FUS1020 FLOWMETER

The Model FUS1020 Flowmeter can either be integrally mounted to the transducer track or as a remote mounted unit. It is shown below in the remote wall mounted position. Please refer to Outline Drawing 1020-8 in Appendix A of this field manual for outline dimensions, etc. The Model FUS1020 can operate with 1021 Series transducers, 1011 Universal Series tranducers and 990 Series transducers. For Flow Tube setup and operation refer to Section 4.
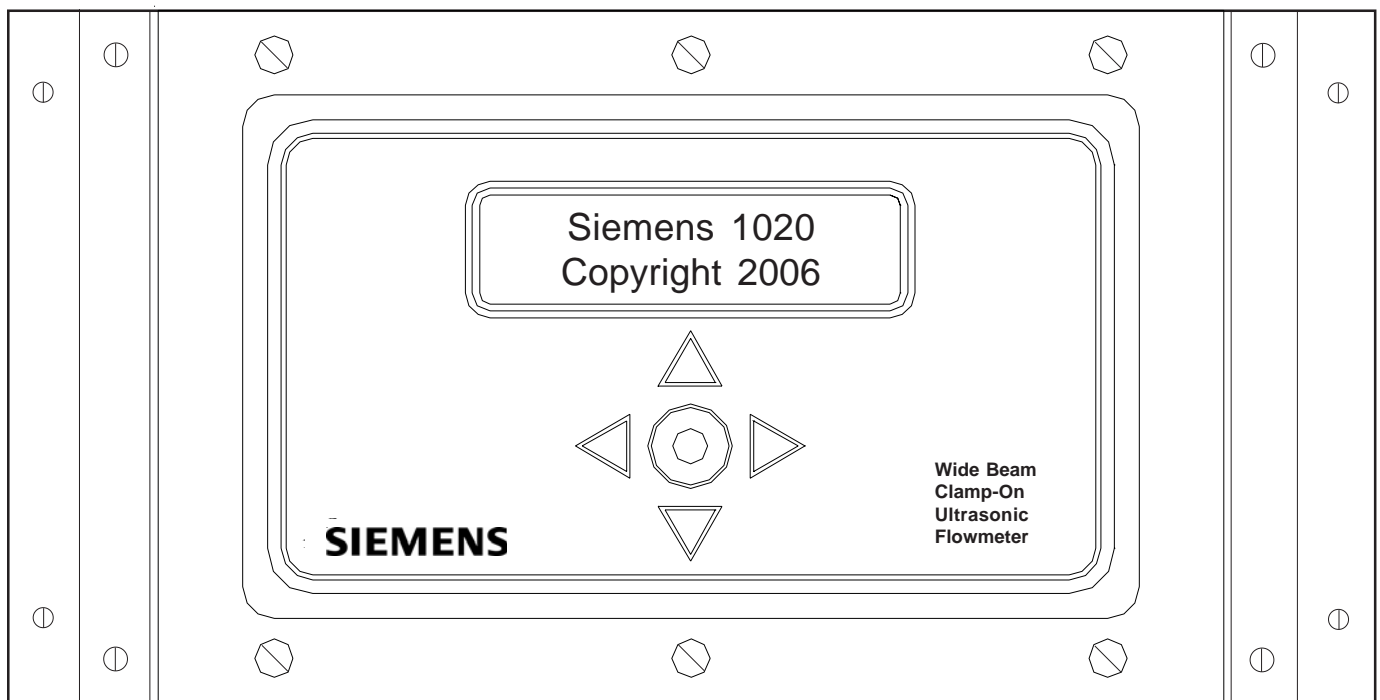
WALL MOUNTED MODEL FUS1020 FLOWMETER

3.2   INPUT/OUTPUT WIRING

The following tables and illustrations describe both the 1020N and 1020DN input/output signals. Consult the Installation Drawings in Appendix A for details regarding I/O and transducer connections for your specific model.

3.2.1   1020N INPUT/OUTPUT WIRING (TB1 and TB2)

MENU LOCKOUT SWITCH S1

J1 (DB9)

PIN#	SIGNAL
1	NU
2	Rs232 Rx
3	Rs232 Tx
4	Rs232 DTR
5	Ground
6	NU
7	Rs232 RTS
8	Rs232 CTS
9	NU

TB1

J1

I/O Terminals TB1 and TB2

TB2
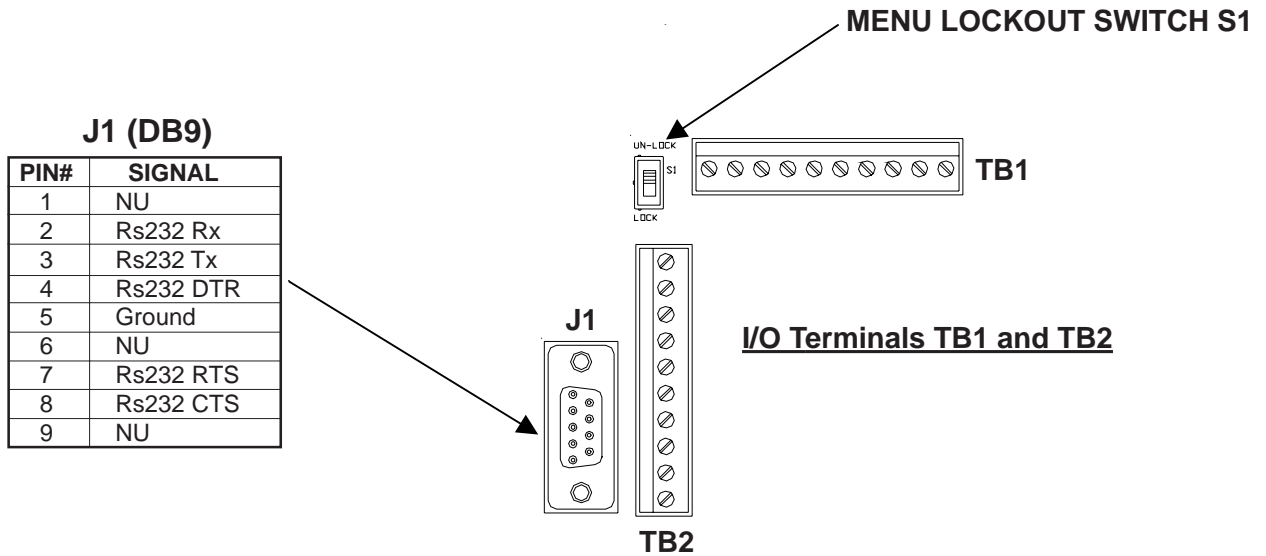
1020N INPUT/OUTPUT WIRING (TB1)

PIN#	SIGNAL	FUNCTION	DESCRIPTION
1	N/C	NOT DEFINED	Reserved for future implementation.
2	N/C	NOT DEFINED	
3	IsoIo1 Ret	ISOLATED LOOP RETURN	Spannable 4-20 mA output proportional to any available data
4	IsoIo1	ISOLATED LOOP SUPPLY	variable assigned under menu control. See drawing 1020-7 Schematic A (Loop Powered).
5	+5 VDC	For CC Supplied Access. Only	Up to 250 mA +5 Volts Source
6	Ground	Ground	Ground
7	DigOut1 Ret	STATUS BIT RETURN	Status output responds to any available alarm function
8	DigOut1	STATUS OUTPUT	assigned under menu control (see 1020N-7 Schematic C).
9	IsoPgen Ret	STATUS BIT RETURN	Pgen Source. Synthesized digital pulse proportional to flow
10	IsoPgen	STATUS OUTPUT	(see 1020-7 Schematic C).

1020N INPUT/OUTPUT WIRING (TB2)

PIN#	SIGNAL	FUNCTION	DESCRIPTION
1	GROUND	GROUND	GROUND
2	DigIn1	Digital Input CH 1	NoTotCh1 Input (see 1020-7 Schematic D).
3	DigIn1 Ret	Digital Input Return Ch 1	NoTotCh1 Return (see 1020-7 Schematic D).
4	DigIn2	Digital Input Ch 2	ClrTot Input (see 1020-7 Schematic D).
5	DigIn2 Ret	Digital Input Return Ch 2	ClrTot Return (see 1020-7 Schematic D).
6	RS232 Rx	RS-232 Receive	Std RS-232 Signals & Port Receive Data from outside source
7	RS232 Tx	RS-232 Transmit	Std RS-232 Signals & Port Transmit Data to outside destination
8	Ground	Ground	Standard RS-232 Signals and Port
9	RS232 RTS	RS-232 Request to Send	Standard RS-232 Signals and Port
10	RS232 CTS	RS-232 Clear to Send	Standard RS-232 Signals and Port

3.2.2 1020DN INPUT/OUTPUT WIRING (TB1 and TB2)

The following tables and illustrations describe the 1020DN (i.e., the dual-channel version of the 1020) input/output signals. Consult the Installation Drawings in Appendix A for details regarding both I/O and transducer connections for your specific model.

MENU LOCKOUT SWITCH S1

J1 (DB9)

PIN#	SIGNAL
1	NU
2	Rs232 Rx
3	Rs232 Tx
4	Rs232 DTR
5	Ground
6	NU
7	Rs232 RTS
8	Rs232 CTS
9	NU

TB1

J1

I/O Terminals TB1 and TB2

TB2
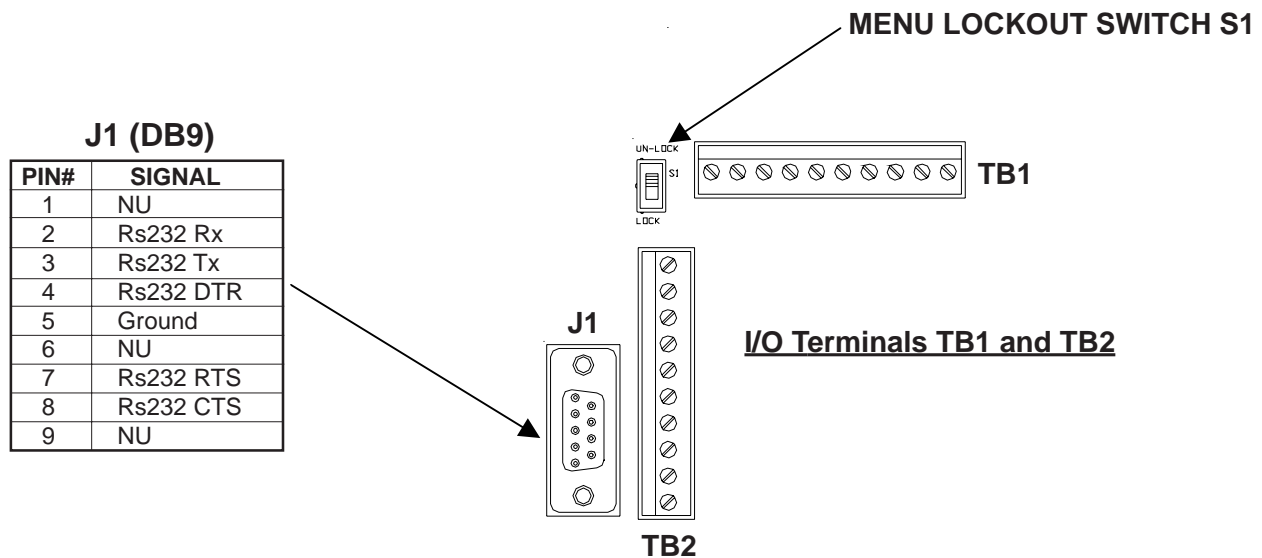
1020DN INPUT/OUTPUT WIRING (TB1)

PIN#	SIGNAL	FUNCTION	DESCRIPTION
1	Isolo2 Ret	ISOLATED LOOP RETURN (CH2)	Spannable 4-20 mA output proportional to any available
2	Isolo2	ISOLATED LOOP RETURN (CH2)	data variable assigned under menu control.
3	Isolo1 Ret	ISOLATED LOOP RETURN CH 1)	See drawing 1020-7 Schematic A (Loop Powered).
4	IsoIo1	ISOLATED LOOP SUPPLY (CH1)	
5	+5 VDC	For CC Supplied Accessories Only	Up to 250 mA +5 Volts Source
6	Ground	Ground	Ground
7	DigOut2 Ret	STATUS BIT RETURN	Status output responds to any available alarm function
8	DigOut2	STATUS OUTPUT	assigned under menu control.
9	DigOut1 Ret	STATUS BIT RETURN	(See 1020N-7 Schematic C)
10	DigOut1	STATUS OUTPUT	

1020DN INPUT/OUTPUT WIRING (TB2)

PIN#	SIGNAL	FUNCTION	DESCRIPTION
1	GROUND	GROUND	GROUND
2	DigIn1	Digital Input CH 1	NoTotCh1 Input (see 1020-7 Schematic D).
3	DigIn1 Ret	Digital Input Return Ch 1	NoTotCh1 Return (see 1020-7 Schematic D).
4	DigIn2	Digital Input Ch 2	NoTotCh2 Input (see 1020-7 Schematic D).
5	DigIn2 Ret	Digital Input Return Ch 2	NoTotCh2 Return (see 1020-7 Schematic D).
6	RS232 Rx	RS-232 Receive	Std RS-232 Signals & Port Receive Data from outside source
7	RS232 Tx	RS-232 Transmit	Std RS-232 Signals & Port Transmit Data to outside destination
8	Ground	Ground	Standard RS-232 Signals and Port
9	RS232 RTS	RS-232 Request to Send	Standard RS-232 Signals and Port
10	RS232 CTS	RS-232 Clear to Send	Standard RS-232 Signals and Port

3.3 PREPARING TO MOUNT THE TRANSDUCERS

Installing the transducers is fairly straightforward. However, careful planning will avoid any snags that may delay the installation. Previously, based on the input you fed into the meter's computer, it recommended the transducers' size, mounting option and spacing. With the transducers at hand, we are now ready to mount them. But first, some very important preliminary work must be done which consists of:

● Selecting a mounting option for your application

● Selecting a location on the pipe

● Preparing the pipe to accept the transducers

NOTE: When installing transducers, do not key in the V/M (Version/Modification) label number as the Transducer Size.

3.3.1 HOW TO IDENTIFY 1021 TRANSDUCERS AND MOUNTING HARDWARE

The 1021 series transducers and mounting frames have the following codes for easy identification:

Transducer Size	**Transducer Frequencies**
A .... SIZE 'A'	Transducer frequencies are repre-
B .... SIZE 'B'	sented by the numbers 1,2, and 3.
C .... SIZE 'C'	
D .... SIZE 'D'	

The transducer part number located on the front face provides a more detailed identification.

For example, the transducer part number 1021A1 means:
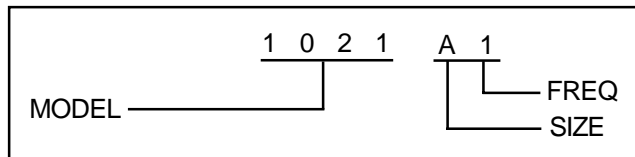
For example, the mounting track part number 1022C1R-D means:
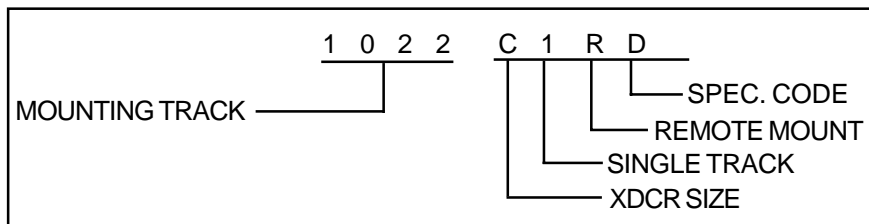
3.3.2 SELECTING A LOCATION FOR CLAMP- ON TRANSDUCERS

● Locate the transducers downstream from the center of the longest available straight run. A location ten pipe diameters or greater downstream from the nearest bend will provide the best flow profile conditions.

- Do not, if possible, install the transducers downstream from a throttling valve, a mixing tank, the discharge of a positive displacement pump or any other equipment that could possibly aerate the liquid. The best location will be as free as possible from flow disturbances, vibration, sources of heat, noise, or radiated energy.

- Avoid mounting the transducers on a section of pipe with any external scale. Remove all scale, rust, loose paint, etc., from the location.

- Do not mount the transducers on a surface aberration (pipe seam, etc.).

- Do not mount transducers from different ultrasonic flowmeters on the same pipe. Also, do not run the transducer cables in common bundles with cables from communication equipment, other Controlotron systems, or any type of ultrasonic equipment. You can run these cables through a common conduit <u>ONLY</u> if they originate at the same flowmeter.

- Never mount transducers under water, unless you order submersible units and you install them in accordance with factory instructions.

- Never mount transducers on the top or bottom of a horizontal pipe. The best placement on a horizontal pipe is either the nine o'clock or three o'clock position for Reflect Mode, or one transducer at nine o'clock and one transducer at three o'clock for Direct Mode. Mounting on a vertical pipe is recommended only if flow is in the upward direction. *When mounting on a vertical pipe flowing in a downward direction make sure there is sufficient back pressure in the system to maintain a full pipe.*

Transducer located at 9 o'clock

Transducer located at 3 o'clock

END VIEW OF PIPE
(Horizontal Plane)
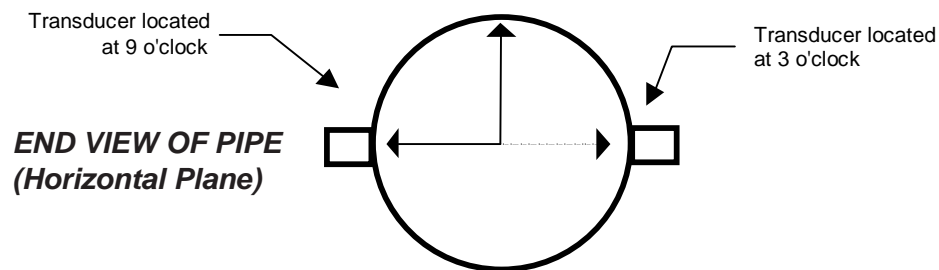
3.3.3 CLAMP-ON TRANSDUCER MOUNTING MODES

Siemens clamp-on transducers support Direct or Reflect mounting modes. The flow computer recommends a mounting mode after analyzing your pipe and liquid data entries. However, you can install clamp-on transducers in the way that best suits your application and the transducer type you purchased.

Upstream Transducer

Pipe

Downstream Transducer

FLOW

Sonic Path
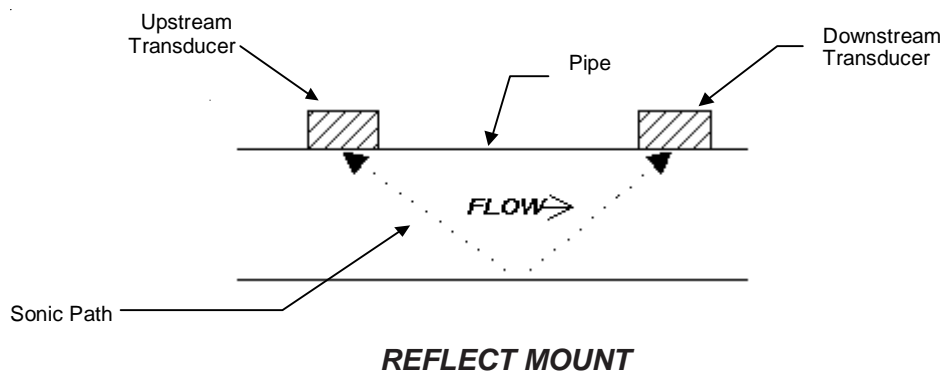
REFLECT MOUNT

(Pipe shown in Top View for ease in visualizing sonic path)

We recommend Reflect mounting whenever possible. This is the simplest way to mount the transducers. Also, Reflect mount resists abnormal flow profile conditions such as cross-flow within the flow stream. Reflect Mode supports the AutoZero function, which zeroes the meter automatically without stopping flow. In addition, Reflect mounting may be the only possibility if conditions do not allow access to the opposite side of the pipe.

Direct mount provides a shorter sonic beam path. This can improve performance with sonically attenuative liquids or pipe materials. Compared to Direct mounting, Reflect mount requires almost double the amount of mounting length. Therefore, Direct mount may be the only option if the availability of mounting space is limited.
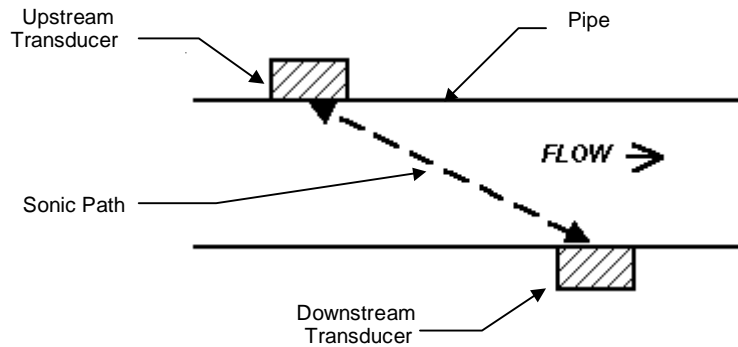
DIRECT MOUNT

(Pipe shown in Top View for ease in visualizing sonic path)

3.3.4 PREPARING THE PIPE

● Pick a mounting location with the longest straight run. You must have easy access to at least one side of your pipe. The mounting location must remain full, even at zero flow.

● Always use Reflect Mode whenever possible.

● After receiving the spacing dimensions from the Installation Menu, prepare the pipe sur-face. De-grease the surface, if necessary, and remove any grit, corrosion, rust, loose paint, etc. Use abrasive material to provide a clean contact surface for the transducers.

● Refer to the following paragraphs for illustrated instructions on how to locate each area to be cleaned and how to use each mounting option.

NOTE: Only install transducers on a pipe at the 3 o'clock or 9 o'clock positions. Do not install transducers on the top of a pipe.
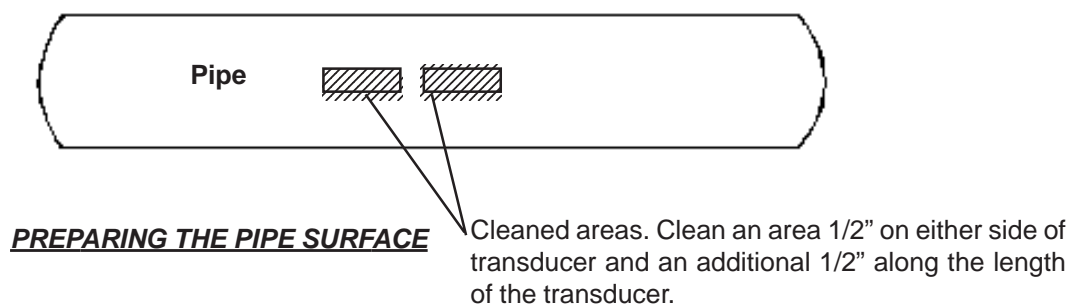
PREPARING THE PIPE SURFACE   Cleaned areas. Clean an area 1/2" on either side of transducer and an additional 1/2" along the length of the transducer.

3.3.5 SONIC COUPLING COMPOUND RECOMMENDATIONS

Clamp-on transducers must be in close contact with a smooth surface free of paint, etc. You must use a sonic couplant to properly couple the transducer to the pipe. The sonic couplant material fills voids between the transducer and pipe and allows a uniform transfer of sonic energy into the pipe wall. The following table lists the sonic couplants recommended by Controlotron.

NOTE: CC128 is recommended for 1021 series transducer installation.

<p align="center">RECOMMENDED SONIC COUPLING COMPOUNDS</p>

ITEM	CC#	USE	CHARACTERISTICS
1	101	Temporary and portable use on Clamp-on flow transducers. Temp. range: -40°F to 100°F.	Low in halogens and sulfur content.
2	102	Temporary and portable use for all Clamp-on flow transducers. Well suited for survey use. Temp. range: -30°F to 100°F.	Low in halogens and sulfur content. Water soluble.
3	109	Temporary and portable use for all Clamp-on flow transducers. Temp. range: -40°F to 300°F.	Low viscosity Petroleum product.
4	112	Permanent ambient temperature couplant for plastic flow transducers. Temp. range: -40°F to 250°F.	Room temperature vulcanizing silicone rubber.
5	113	Protective spray for providing corrosion resistance to exposed transducer and track parts.	Spray on liquid. Excellent resistance to salt water atmosphere.
6	114	Temporary and long term couplant for all flow transducer types. Temp. range: -40°F to 255°F.	Teflon filled grease. Water resistant.
7	122	Long term and permanent couplant for Clamp-on transducers. Temp. range: -40°F to 450°F.	Long chain polymer grease. Resists breakdown and thinning at high temperatures.
8	124	Long term and permanent couplant for Clamp-on transducers. Temp. range: -40°F to 250°F.	Two part room temperature cure adhesive.
9	128	Temporary and long term couplant for all flow transducer types. Temp. range: -40°F to 375°F.	High viscosity silicone grease. Water resistant.
10	129 129A	Adhesive backed Dry/Damping couplant for all flow transducer types.	Viscoelastic polymer sheet. Water resistant.

Notice: *Siemens holds US Patent Number 4,929,368 on the CC#122 Coupling Compound and all compounds of this type. Its use is restricted to Siemens products only, unless a special license has been obtained. Licenses for use with other products are available through the Siemens Sales Department.*

3.4   REFLECT MODE TRANSDUCER INSTALLATION

Single and Dual Mounting Track Assembly frames are the easiest way to mount transducers in the Reflect Mode. The result is a rigid structure that eliminates spacing measurements, and maintains the transducer-to-transducer geometry. In addition, Reflect mounting allows you to move the entire assembly while maintaining the original transducer spacing**.**

3.4.1 DUAL MOUNTING TRACK ASSEMBLY/TRANSDUCER INSTALLATION

NOTE: The following transducer and mounting track installation procedure applies to the 1020 Single Channel and 1020 Dual Channel Remote wall mounted flowmeters.

●   Locate wall position to mount 1020 Flowmeter.

●   Mount flowmeter and connect power cables as required (see drawing 1020-7).

●   Apply power to flowmeter.

●   Perform all required Installation Menu steps until the flowmeter issues the Number Index. Record the number index value displayed in the [Pick/Install] menu. *This number index value will be used to position the transducers.*
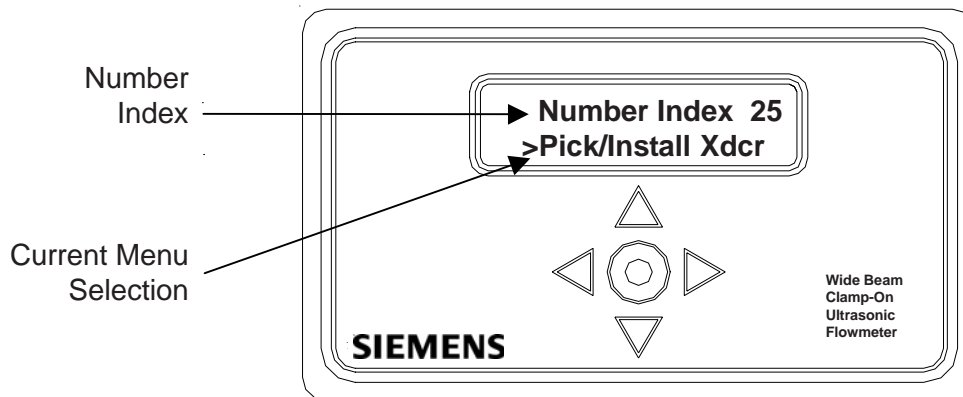
●   Select transducer mounting location (3 or 9 o'clock position) and prepare surface of pipe (Figure 1). Smooth irregular surfaces and clean pipe of dirt, grease and rust (see paragraphs 3.3.2 and 3.3.4).

NOTE: Mounting to painted surfaces is acceptable only if the paint is uniform and bonded well to the pipe. If any pits or air bubbles are observed, paint must be removed or another location should be considered.
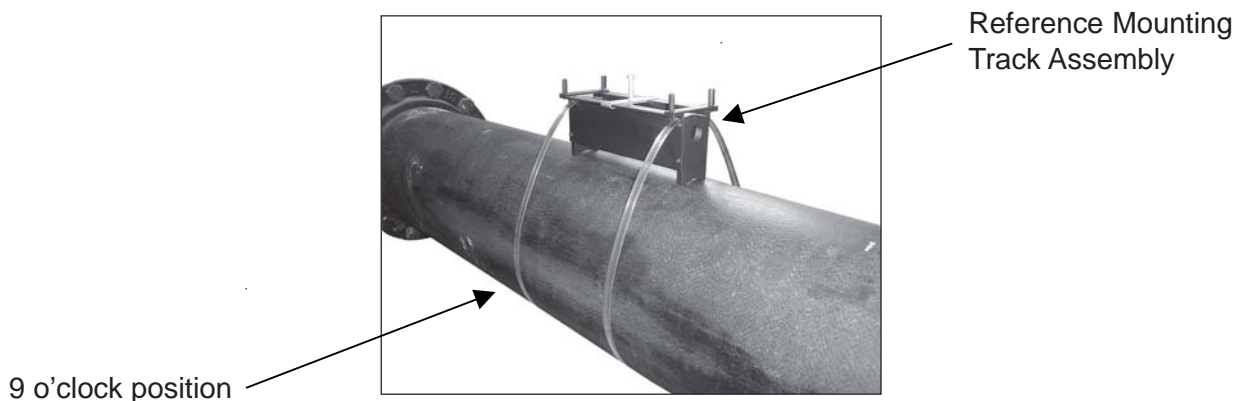
Figure 1

● Using a flat blade screwdriver or 5/16" nutdriver, mount the Reference Mounting Track on pipe. Install straps but do not tighten at this time (Figure 2). *IMPORTANT: Make sure Reference Index Screws on mounting tracks are facing toward each other.*

● Rotate the mounting track to the previously selected location on the pipe and fully tighten the securing straps.

Mounting Straps

Strap Screw

Reference Index Screw (located under mounting strap)

Reference Mounting Track Assembly in 9 o'clock position
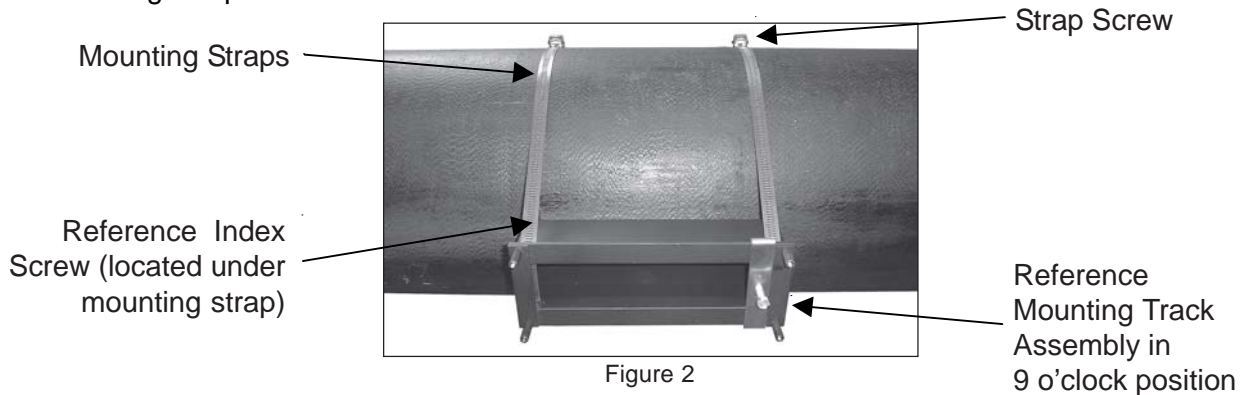
Figure 2

● Place a straight edge firmly on mounting track assembly (Figure 3). Draw a line out from the end of the track. This line will be used to align the second mounting track assembly to the Reference Mounting Track.

Figure 3

● Install second mounting track assembly keeping securing straps loose (Figure 4). Rotate the second assembly until its nearest corner aligns with the Reference Mounting Track and the line drawn in the previous step.

Line

Second Mounting Track

Corner

Reference Mounting Track
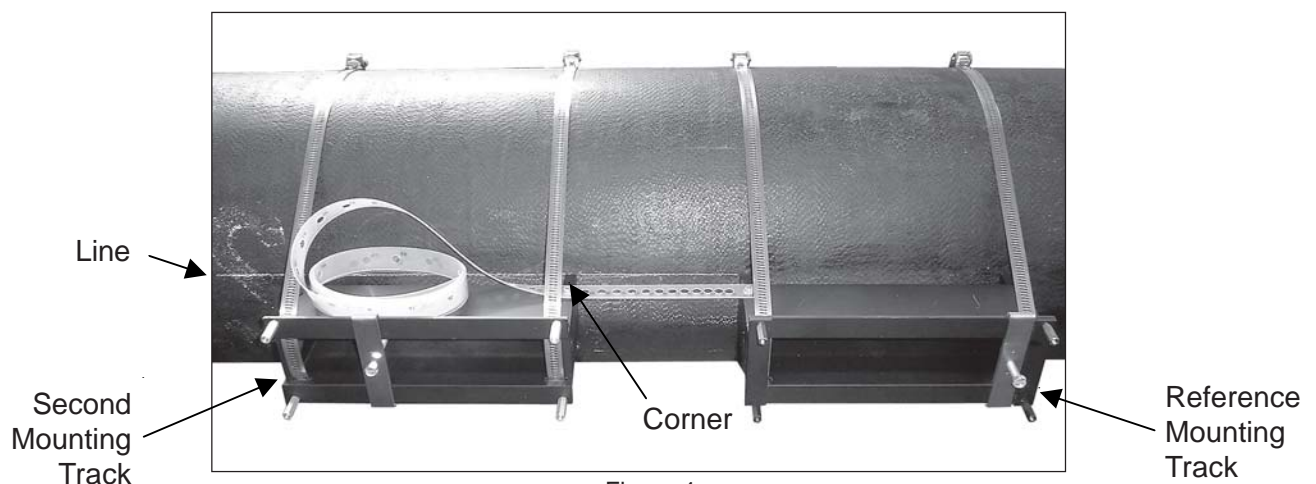
Figure 4

● Install spacing strip on Reference Mounting Track index screw (Figure 5).

● Locate the Number Index selected by flowmeter and move the second mounting track assembly to that location using the spacing strip index numbers. Fit the spacing strip hole on the second mounting track index screw. Remove slack in spacing strip by moving second mounting track away from Reference Mounting Track.

● Fully tighten securing straps on second mounting track assembly.

Spacing Strip
Number Index
Hole

Spacing Strip

Reference
Index Screw

Figure 5

● Feed cable through cable bushing access hole, connect to transducer and press cable bushing into hole (Figure 6).

● Place the supplied O-Ring gasket around the recess in the transducer's footprint (Figure 6). Apply a 1/4" bead of couplant to emitting surface of transducer.

O-Ring

Coupling
Compound

Transducer
Cable

Figure 6

Transducer

Cable
Bushing
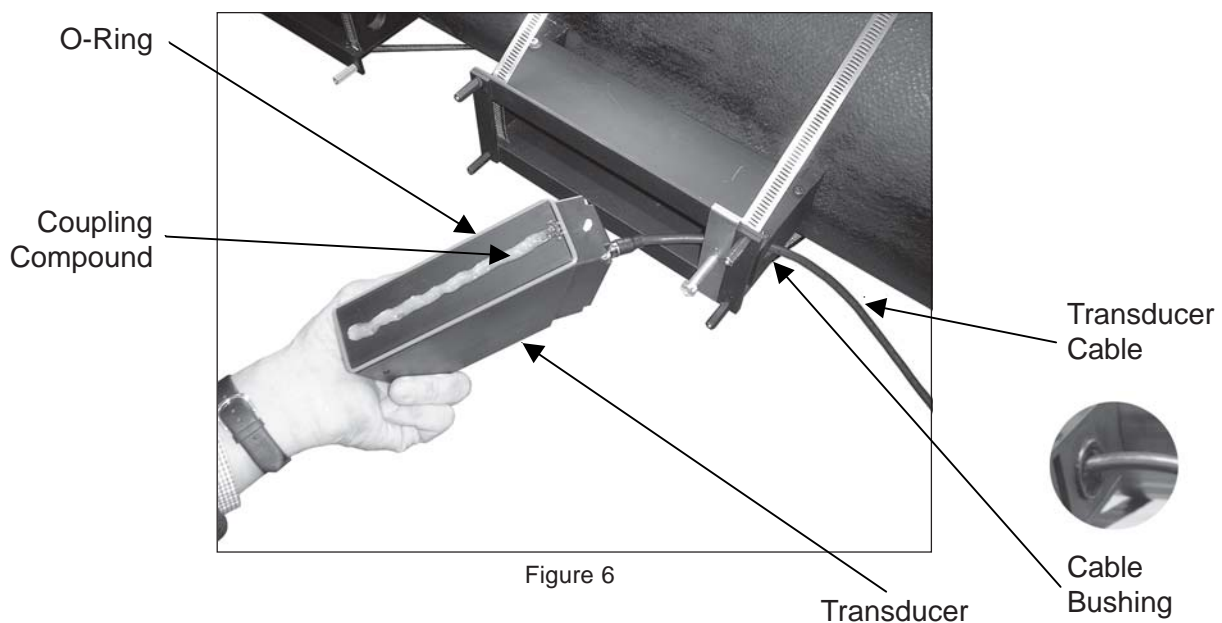
● Install transducer back end first and mate with pipe (Figure 7). Butt front of transducer against track assembly and secure by tightening the transducer clamp.

NOTE: Transducer must be in contact with the mounting track reference stop (head of screw) for accurate transducer positioning.

Front End of Transducer

Transducer Clamp
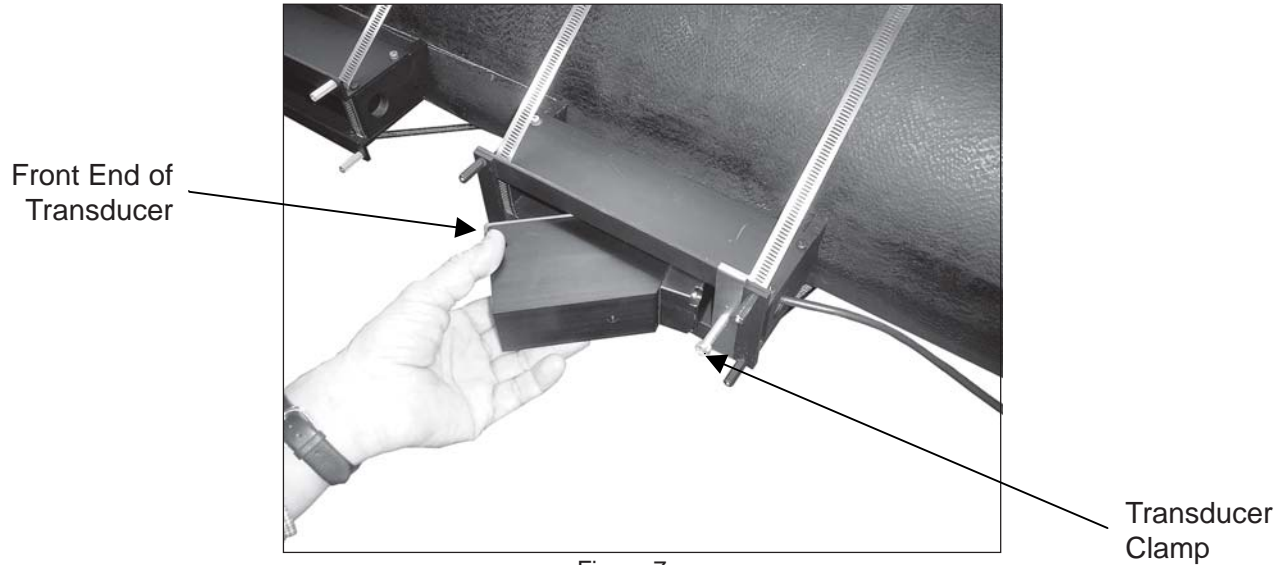
Figure 7

● Seat O-Ring gasket to the pipe by pushing it off the corners of the transducer (Figure 8).

O-Ring

Reference Mounting Track Assembly

Xdcr Cable

Xdcr Cable
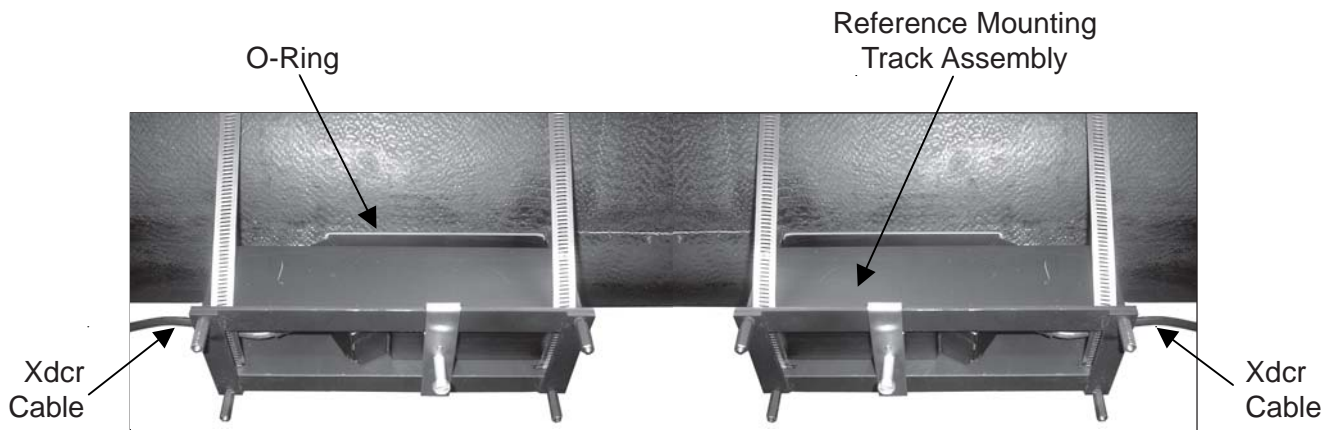
Figure 8

● Install second transducer as described above but with front of transducer facing the Reference Mounting Track Assembly.

● Confirm installation is functional by completing flowmeter menu.

● Install mounting track assembly covers and secure with eight screws.

Securing Screws

Mounting Track Covers

Figure 9

3-11
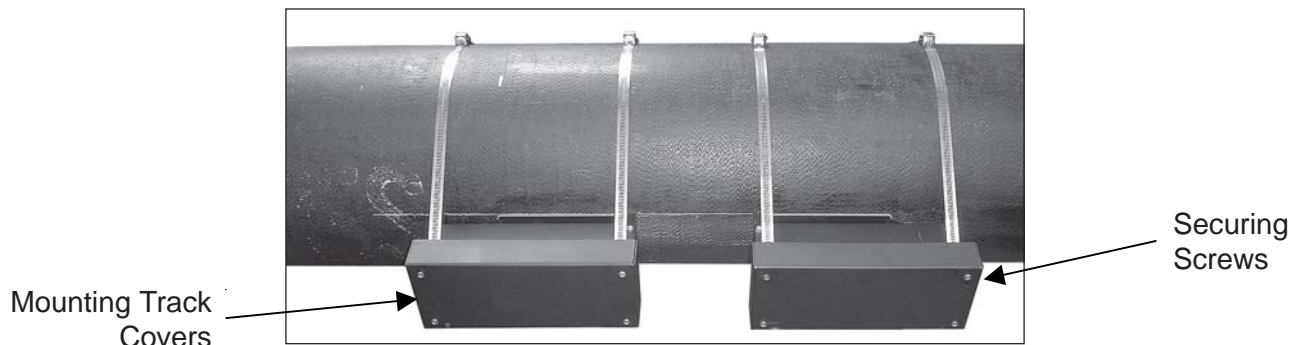
3.4.2 DUAL MOUNTING TRACK ASSEMBLY/TRANSDUCER INSTALLATION FOR DUAL CHANNEL INTEGRATED 1020 FLOWMETER

● Complete all installation steps in paragraph 3.4.1 Dual Mounting Track Assembly/Transducer Installation but do not install mounting track covers.

● Secure 1020 Integrated Flowmeter to one Mounting Track Cover with four bolts, washers, lock washers and nuts (Figure 1). Secure other mounting track cover to second mounting track/ transducer assembly.

NOTE: The Integrated Flowmeter can be attached to either Mounting Track Cover.

● Secure Integrated Flowmeter/Mounting Track Cover Assembly to Mounting Track Assembly and secure with four screws (Figure 2).

Figure 1
Integrated Flowmeter secured
to Mounting Track Cover Assembly

Figure 2

Dual Integrated Flowmeter/Mounting Track
Cover Assembly secured to Mounting Track

● Connect transducer cables ensuring upstream/downstream orientation is correct (Figure 3). Confirm installation is functional by completing flowmeter menu.

Figure 3

Connect Transducer Cables

3.4.3 SINGLE MOUNTING TRACK ASSEMBLY/TRANSDUCER INSTALLATION

NOTE: The following transducer and mounting track installation procedure applies to the 1020 Single Channel Remote wall mounted flowmeter.

● Locate wall position to mount 1020 Single Channel Flowmeter.

● Mount flowmeter and connect power cables as required (see drawing 1020-7).

● Apply power to flowmeter.

● Perform all required Installation Menu steps until the flowmeter issues the Number Index. Record the number index value displayed in the [Pick/Install Xdcr] menu. *This number index value will be used to position the transducer.*

● Locate positions on pipe for transducer Single Mounting Track Assembly (see paragraph 3.3.2).

● Place mounting straps around the pipe and the Mounting Track Assembly (Figure 1).

Figure 1

Mounting Strap   Strap Screw

Figure 2

● Tighten the mounting strap screws enough to take up all of the slack, but not enough to prevent rotation of the assembly. Rotate the assembly on the pipe to the 9 o'clock position ensuring that it is a smooth area without any raised spots or seams. Mark a generous area around the mounting frame (1/2" on either side and half again the length front and back) with a pencil or chalk (Figure 2). Move or revolve the assembly away from the area marked (loosen straps if necessary to do this).

● Prepare the area you marked by de-greasing the surface, if needed, and removing any grit, corrosion, rust, loose paint or surface irregularities with the abrasive pipe conditioning material provided. Clean the pipe of all debris and abrasive particles.

● Return Mounting Track Assembly to the marked location.

● Using a flat blade screwdriver or 5/16" nutdriver, secure transducer Mounting Track Assembly straps to seat the assembly firmly to the pipe.

● Make sure transducers are a matched pair. They both should have the same serial number but marked either "A" or "B" (e.g., 100A and 100B).

● For each transducer, place the supplied O-Ring gasket around the recess in the transducer's footprint (Figure 3).

Figure 3

● Locate the Reference Index Marker on the Mounting Track Assembly (Figure 4). Determine the upstream direction and feed the appropriate transducer cable from the flowmeter through the end plate of the Mounting Track Assembly. Press cable bushing into hole (Figure 5).

NOTE: Ensure that the upstream/downstream orientation in respect to the transducer cables and the 1020 connectors is correct.

Figure 4

Front Edge
of Transducer   Reference
                                 Index Marker

Figure 5

Cable Bushing
(Strain Relief)

● Attach the cable to the transducer. Fill the protective boot with couplant compound and push in place to cover connection (Figure 3).

● Apply a 1/4" bead of couplant down the center of the emitting surface of the transducer (Figure 3).

● Install transducer into Mounting Track Assembly and align its front edge with the Reference Index Marker. Mate to pipe and clamp in place (Figures 4 and 6).

Number Index

Reference
Index Marker

Figure 6
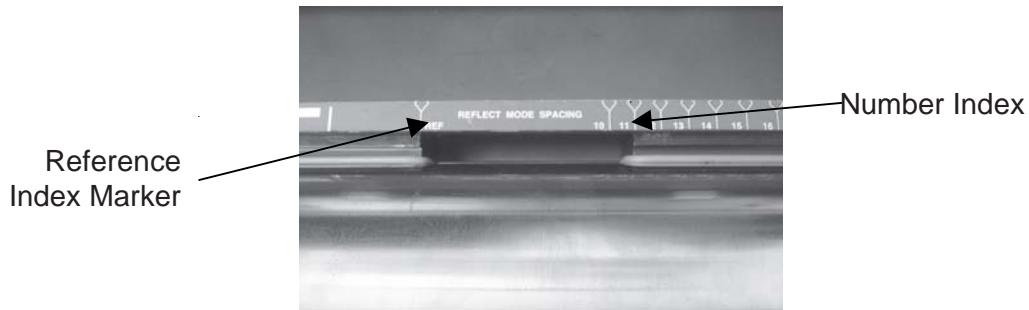
● Repeat installation steps for second transducer and align to the Number Index previously selected by the flowmeter. Mate to pipe and clamp in place.

● Release O-Ring gaskets from their seats and allow them to contact the pipe by pushing the corners down with a screwdriver. Wipe away any excess couplant (Figure 7).

O-Ring
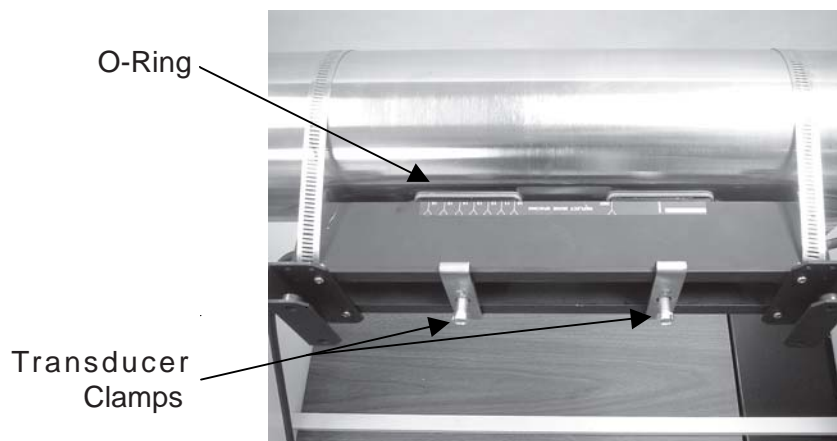
Transducer
Clamps

Figure 7

● Confirm installation is functional by completing flowmeter menu.

● Place Mounting Track Cover on Mounting Track Assembly and secure with four screws (Figure 8).

Mounting Track Cover
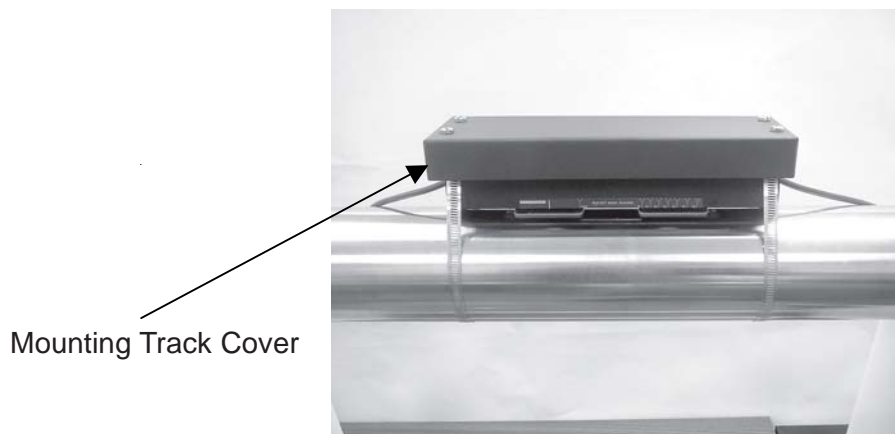
Figure 8

3.4.4 SINGLE MOUNTING TRACK ASSEMBLY/TRANSDUCER INSTALLATION FOR SINGLE CHANNEL INTEGRATED 1020 FLOWMETER

● Connect power cables to flowmeter as required (see drawing 1020-7).

● Apply power to flowmeter.

● Perform all required Installation Menu steps until the flowmeter issues the Number Index. Record the number index value displayed in the [Pick/Install Xdcr] menu. *This number index value will be used to position the transducer.*

● Locate positions on pipe for transducer Single Mounting Track Assembly (see paragraph 3.3.2).

● Place mounting straps around the pipe and the Mounting Track Assembly (Figure 1).

Figure 1

Mounting Strap   Strap Screw

Figure 2

● Tighten the mounting strap screws enough to take up all of the slack, but not enough to prevent rotation of the assembly. Rotate the assembly on the pipe to the 9 o'clock position ensuring that it is a smooth area without any raised spots or seams. Mark a generous area around the mounting frame (1/2" on either side and half again the length front and back) with a pencil or chalk (Figure 2). Move or revolve the assembly away from the area marked (loosen straps if necessary to do this).

- Prepare the area you marked by de-greasing the surface, if needed, and removing any grit, corrosion, rust, loose paint or surface irregularities with the abrasive pipe conditioning material provided. Clean the pipe of all debris and abrasive particles.

- Return Mounting Track Assembly to the marked location.

- Using a flat blade screwdriver or 5/16" nutdriver, secure transducer Mounting Track Assembly straps to seat the assembly firmly to the pipe.

- Make sure transducers are a matched pair. They both should have the same serial number but marked either "A" or "B" (e.g., 100A and 100B).

- For each transducer, place the supplied O-Ring gasket around the recess in the transducer's footprint (Figure 3).

Figure 3

- Locate the Reference Index Marker on the Mounting Track Assembly (Figure 4). Determine the upstream direction and feed the appropriate transducer cable from the flowmeter through the end plate of the Mounting Track Assembly. Press cable bushing into hole (Figure 5).

NOTE: Ensure that the upstream/downstream orientation with respect to the transducer cables and the 1020 connectors is correct.
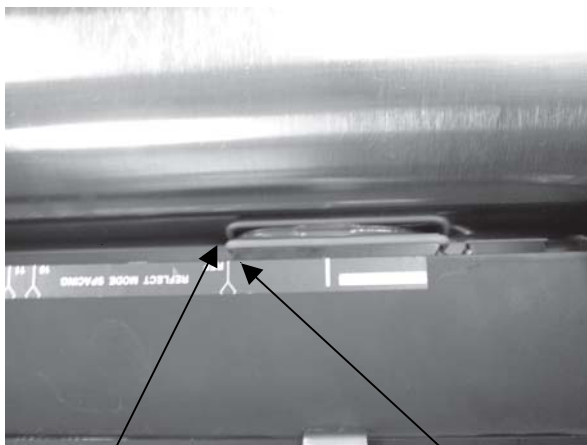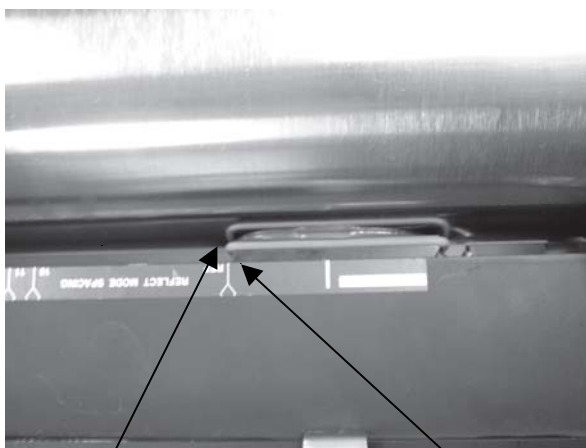

Figure 4

Front Edge
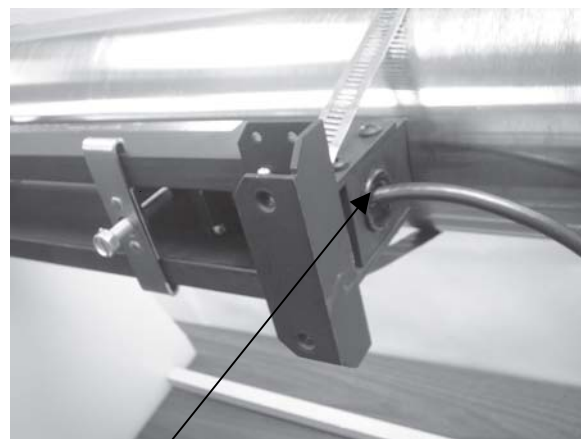of Transducer

Reference
Index Marker
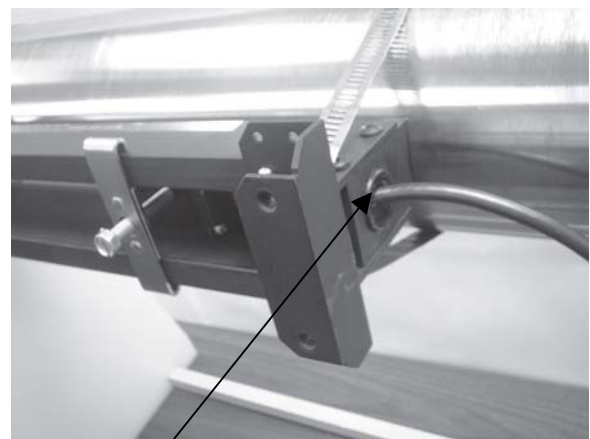
Figure 5

Cable Bushing
(Strain Relief)

- Attach the cable to the transducer. Fill the protective boot with coupling compound and push in place to cover connection (Figure 3).

● Apply a 1/4" bead of couplant down the center of the emitting surface of the transducer (Figure 3).

● Install transducer into Mounting Track Assembly and align its front edge with the Reference Index Marker. Mate to pipe and clamp in place (Figures 4 and 6).

Number Index

Reference
Index Marker
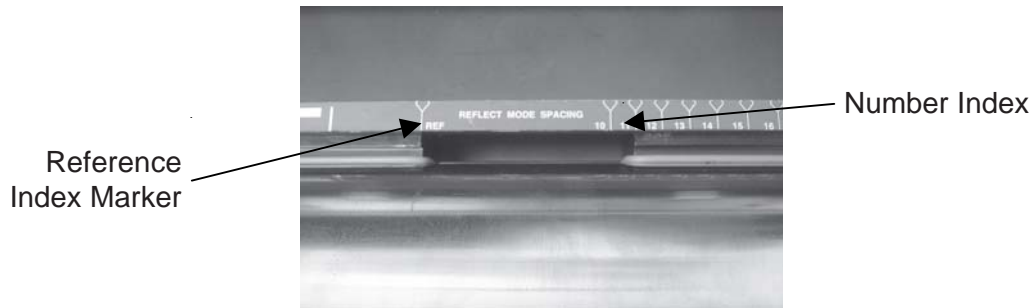
Figure 6

● Repeat installation steps for second transducer and align to the Number Index previously selected by the flowmeter. Mate to pipe and clamp in place.

● Release O-Ring gaskets from their seats and allow them to contact the pipe by pushing the corners down with a screwdriver. Wipe away any excess couplant (Figure 7).

O-Ring
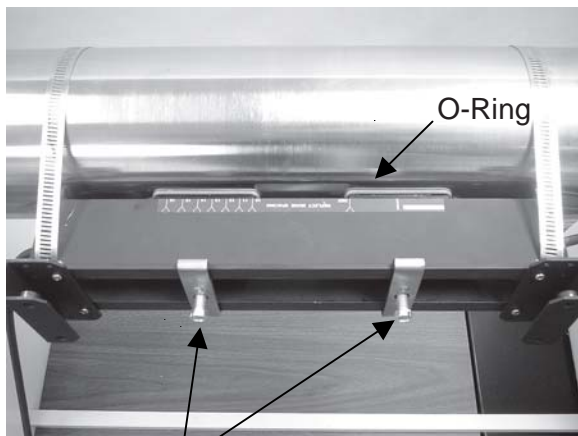
Transducer
Clamps

Figure 7

Figure 8
Integrated Flowmeter secured
to Mounting Track Cover Assembly

● Secure 1020 Integrated Flowmeter to Mounting Track Cover with four bolts, washers, lock washers and nuts (Figure 8).

● Secure Integrated Flowmeter/Mounting Track Cover Assembly to Mounting Track Assembly and secure with four screws (Figure 9).

● Connect transducer cables ensuring upstream/downstream orientation is correct (Figure 10). Confirm installation is functional by completing flowmeter menu.

Figure 9

Integrated Flowmeter/Mounting Track Cover
Assembly secured to Mounting Track

Figure 10

Connect Transducer Cables

3.5   DIRECT MODE TRANSDUCER INSTALLATION

Dual Mounting Track Assembly frames allow the mounting of transducers in the Direct Mode. The combination of mounting frames and spacing guides is the recommended way to mount Direct Mode transducers. The mounting frame establishes the axial alignment of the transducers, and allows you to remove and replace either transducer while preserving their exact mounting location.

3.5.1   DUAL MOUNTING TRACK ASSEMBLY/TRANSDUCER INSTALLATION

NOTE: The following transducer and mounting track installation procedure applies to the 1020 Single Channel and 1020 Dual Channel Remote wall mounted flowmeters.

● Locate wall position to mount 1020 Flowmeter.

● Mount flowmeter and connect power cables as required (see drawing 1020-7).

● Apply power to flowmeter.

● Perform all required Installation Menu steps until the flowmeter issues the Number Index. Record the Number Index value displayed in the [Pick/Install] menu. *This value will be used to position the transducers.*

Number Index

Current Menu
Selection

Number Index 25
>Pick/Install Xdcr

Wide Beam
Clamp-On
Ultrasonic
Flowmeter

SIEMENS
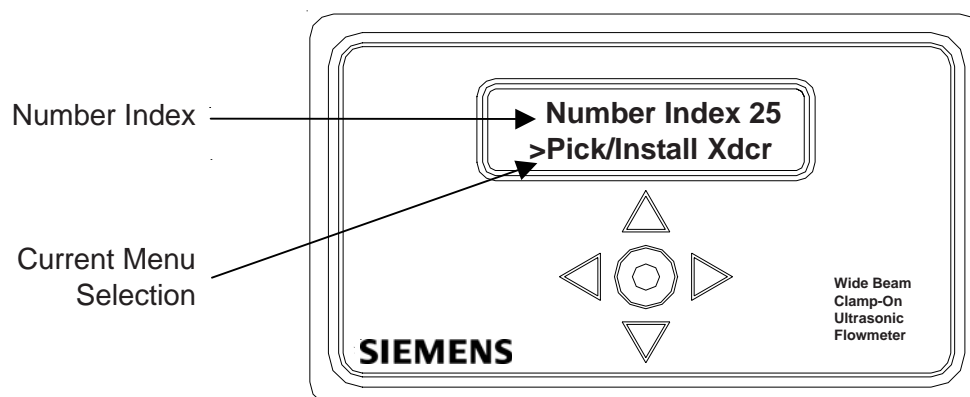
Mounting Reference Track Assembly

For Direct Mode mounting, you will use the Number Index value to establish the distance between transducers and Mounting Guide. This method will locate the transducers at the nine o'clock and three o'clock positions. The Mylar Mounting Guide comes in various lengths and widths to accommodate most pipe sizes (see list below).

Mounting Guide P/N	Size
1012-145-1A	2" x 26" (50.8 x 660.4 mm)
1012-145-1	2" x 45" (50.8 x 1143.0 mm)
1012-145-2	4" x 81" (101.6 x 2057.4 mm)
1012-145-3	4" x 155" (101.6 x 3937.0 mm)

● Select transducer mounting location (3 and 9 o'clock position) and prepare surface of pipe (Figure 1). Smooth irregular surfaces and clean pipe of dirt, grease and rust (see paragraphs 3.3.2 and 3.3.4).

NOTE: Mounting to painted surfaces is acceptable only if the paint is uniform and bonded well to the pipe. If any pits or air bubbles are observed, paint must be removed or another location should be considered.

Reference Mounting
Track Assembly

9 o'clock position
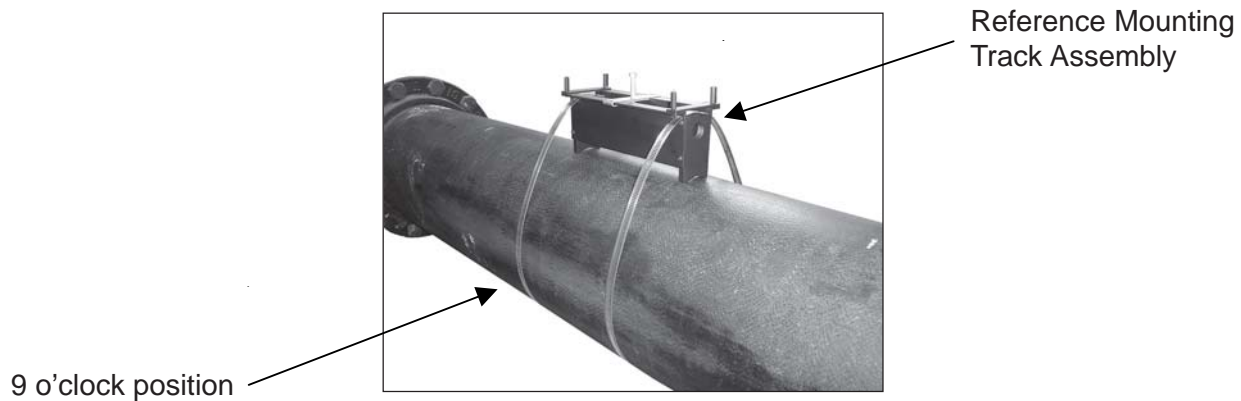
Figure 1

● Using a flat blade screwdriver or 5/16" nutdriver, mount the Reference Mounting Track Assembly on pipe. Install straps but do not tighten at this time (Figure 2).

● Rotate the mounting track to the previously selected location on the pipe and fully tighten the securing straps.

NOTE: The track assembly is self-aligning to the pipe axis. You can check this by visually checking if the edge of the track is parallel with horizontal axis of the pipe.

Strap Screw

Mounting Straps

Reference
Mounting Track
Assembly in
9 o'clock position
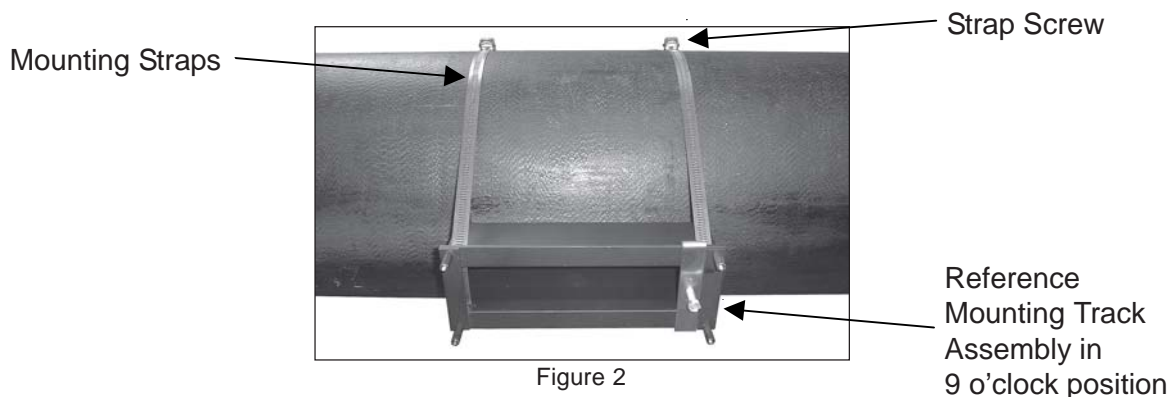
Figure 2

- Feed cable through cable bushing access hole, connect to transducer and press cable bushing into hole (Figure 3).

- Place supplied O-Ring gasket around the recess in the transducer's footprint (Figure 3). Apply a 1/4" bead of couplant to emitting surface of transducer.

O-Ring

Coupling
Compound

Transducer
Cable

Cable
Bushing

Transducer
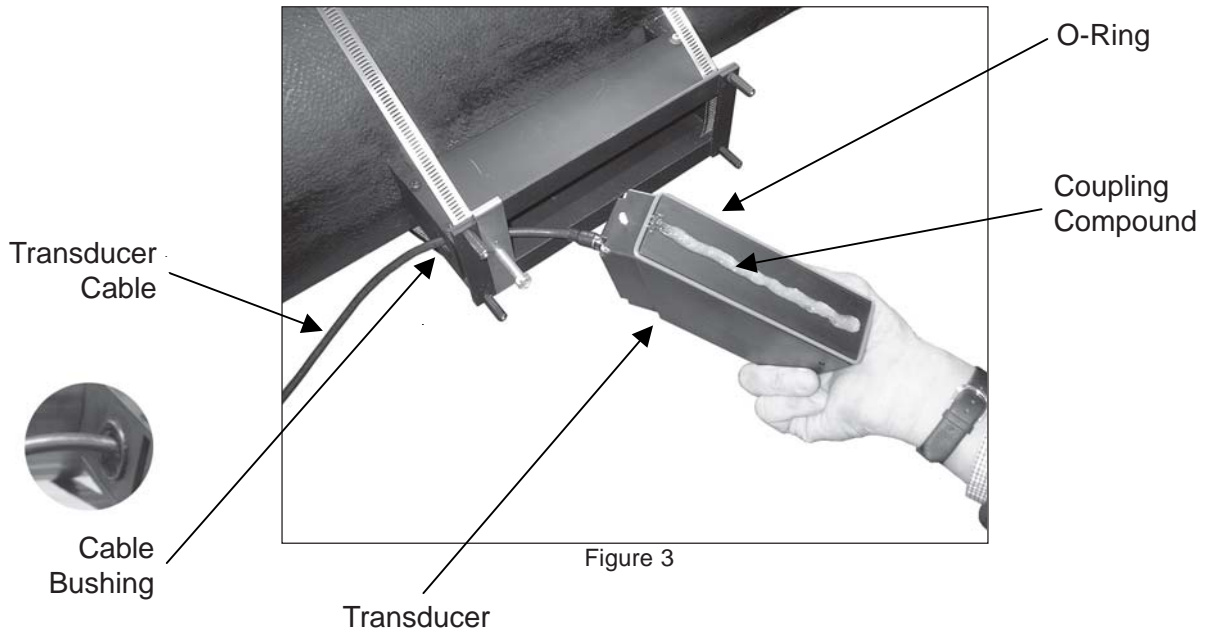
Figure 3

- Install transducer back end first and mate with pipe (Figure 4). Butt front of transducer against track assembly and secure by tightening the transducer clamp.

NOTE: Transducer must be in contact with the mounting track reference stop (head of screw) for accurate transducer positioning.

Front End of
Transducer

Transducer
Clamp
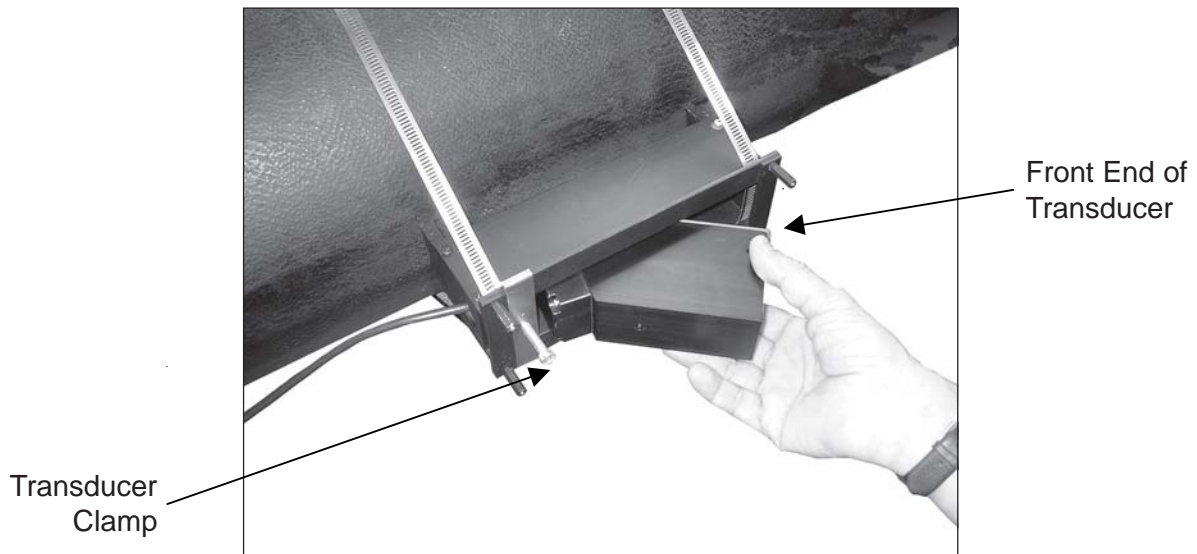
Figure 4

- Seat O-Ring gasket to the pipe by pushing it off the corners of the transducer (Figure 5).

- Install Mounting Track Assembly cover and secure with four screws.

O-Ring

Securing
Screws

Mounting Track
Cover
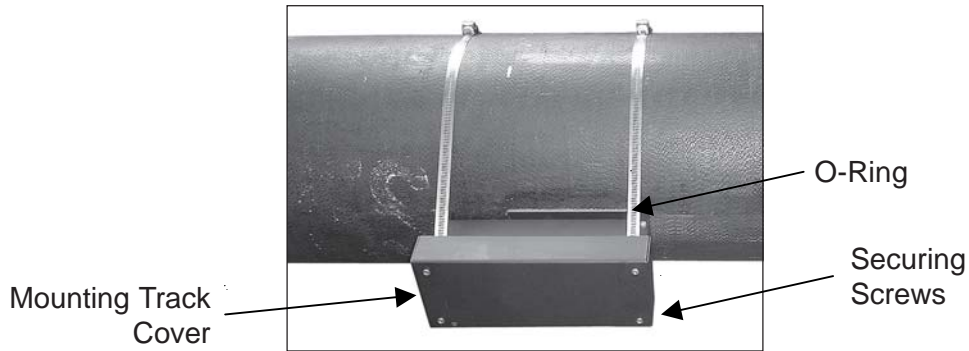
Figure 5

Preparing Mylar Mounting Guide

●   Wrap the Mylar Mounting Guide around the pipe (Figure 6). Line up both vertical edges of the
    guide and, ensuring that it is snug around the pipe, mark along the overlapping edge. Arrange so
    that one end overlaps the other by at least three inches. Trim to fit if necessary, ***but be sure not
    to trim at the overlapping end in order to keep it square***.

Figure 6

●   Remove Mylar Mounting Guide and lay it out on a flat surface (Figure 7). Either measure the exact
    distance halfway between the overlap edge and the mark at the overlap, or fold the guide from the
    overlap edge to overlap mark and draw a line at the fold or halfway point (see below).

Mounting Guide

Mark (or fold) exactly
at half-way point

Overlap Edge

Circumference

FINDING THE HALFWAY DISTANCE
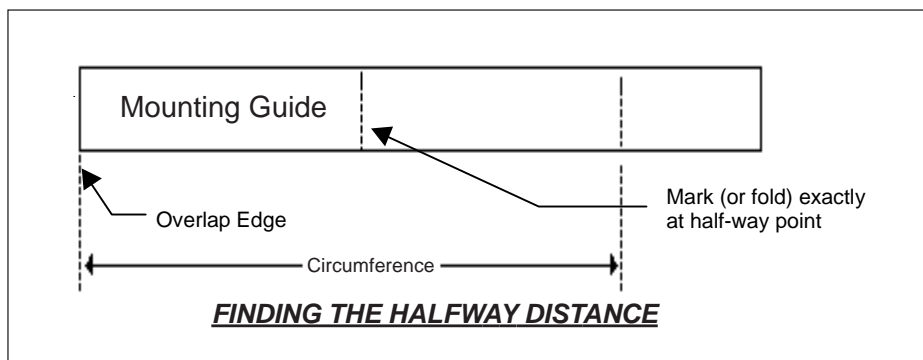
Figure 7

Finding Second Mounting Track Assembly Location

The following steps establish the position of the second Mounting Track Assembly on the exact opposite side of the pipe.

● Place a straight edge on top of the Reference Mounting Track Assembly (Figure 8). Draw a horizontal line out from the end of the assembly. (This line establishes a reference relative to the pipe axis.) The line will be used to align the Mylar Mounting Guide and the second Mounting Track Assembly to the Reference Mounting Track.

● Install the second Mounting Track Assembly locating it on the same side as the Reference Mounting Track Assembly (Figure 9). Do not fully tighten the securing straps at this time.

Figure 8

Figure 9

● Acquire the "Number Index" from the flowmeter For Direct Mode mounting. Install the Spacing Strip on the Reference Mounting Track index screw (Figure 10). Use the Spacing Strip and Number Index value to space the transducers at the correct distance from each other. Remove Spacing Strip.

NOTE: For small Number Indices, the Mounting Guide must be placed on the outside edge of the second Mounting Track Assembly to allow for correct transducer positioning (see diagram below).

Figure 10

3-23
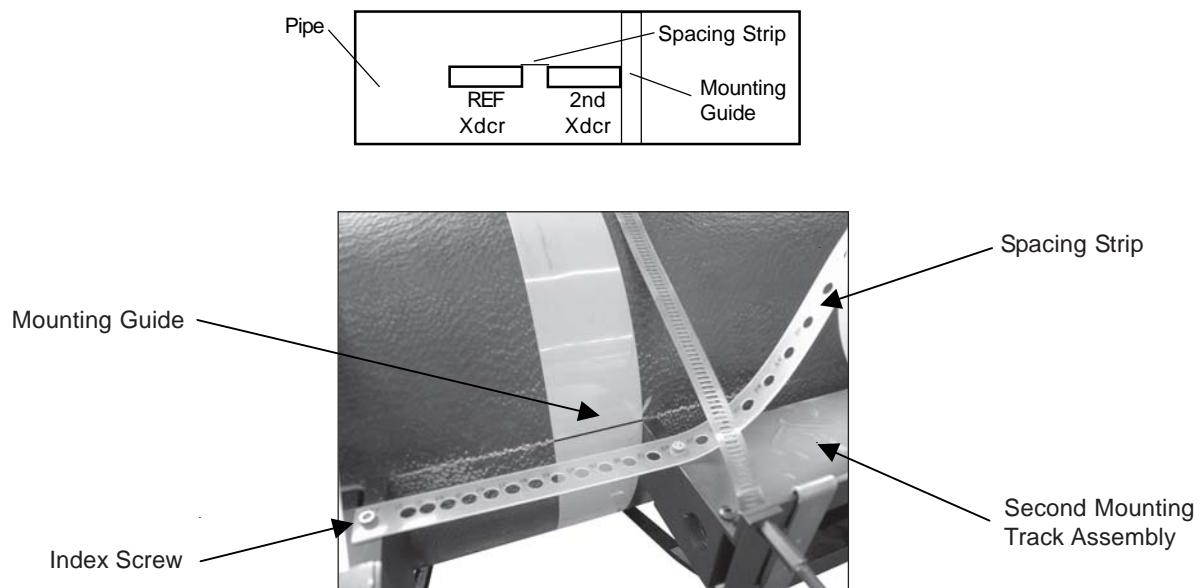
● Wrap Mounting Guide around the pipe (Figure 10) and position it against the outside edge of the second Mounting Track Assembly. Position Mounting Guide so its mark is aligned with the **top edge** of the second Mounting Track Assembly. Tape it in this position on the pipe.

● Note the opposite side of the pipe and the position of the halfway mark with respect to the Reference Mounting Track Assembly. This mark will be used to align the second Mounting Track Assembly.

● Mark a generous area on the pipe where the second Mounting Track Assembly will be located.

● Prepare surface of pipe. Smooth irregular surfaces and clean pipe of dirt, grease and rust (see paragraphs 3.3.2 and 3.3.4).

● Rotate the second Mounting Track Assembly to the opposite side of the pipe and align the bottom corner with the halfway mark drawn on the Mounting Guide (Figures 11 and 12).

SIDE VIEW
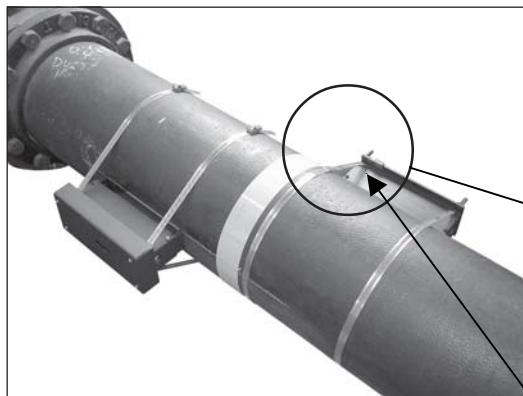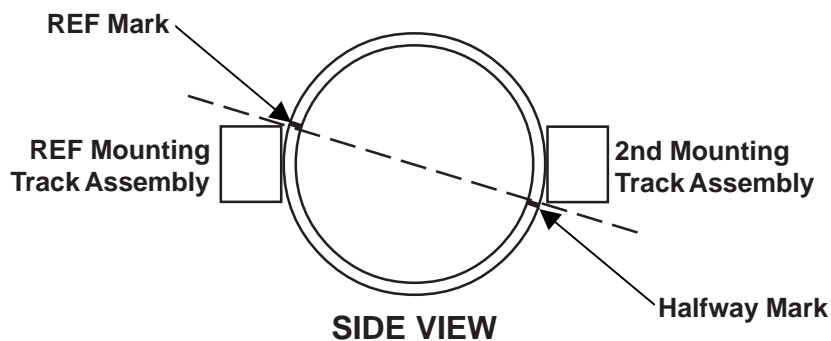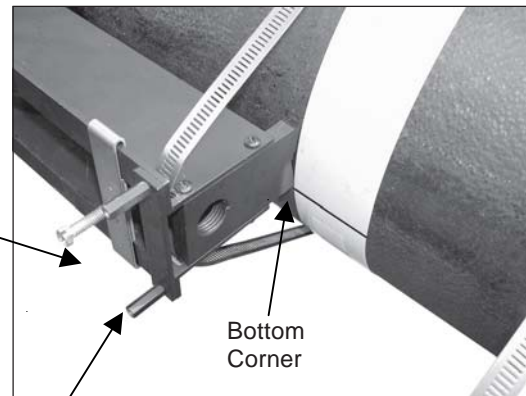
Figure 11

Figure 12

Second Mounting
Track Assembly

Mounting Second Track Assembly

●   Using a flat blade screwdriver or 5/16" nutdriver, tighten the second Mounting Track Assembly securing straps (Figure 13).

Figure 13

●   Install the transducer in the same manner as the Reference Track Assembly and install cover.

●   Connect transducer cables ensuring upstream/downstream orientation is correct.

●   Confirm installation is functional by completing flowmeter menu.

3.5.2 DUAL MOUNTING TRACK ASSEMBLY/TRANSDUCER INSTALLATION FOR DUAL CHANNEL INTEGRATED 1020 FLOWMETER

● Complete all installation steps for Direct Mode transducer installation in paragraph 3.5.1 Dual Mounting Track Assembly/Transducer Installation *but do not install mounting track covers.*

● Secure 1020 Integrated Flowmeter to one Mounting Track Cover with four bolts, washers, lock washers and nuts (Figure 1). Secure other mounting track cover to second mounting track/ transducer assembly.

NOTE: The Integrated Flowmeter can be attached to either Mounting Track Cover.

● Secure Integrated Flowmeter/Mounting Track Cover Assembly to Mounting Track Assembly and secure with four screws (Figure 2).

Figure 1

Integrated Flowmeter secured
to Mounting Track Cover Assembly

Figure 2

Dual Integrated Flowmeter/Mounting Track
Cover Assembly secured to Mounting Track

● Connect transducer cables ensuring upstream/downstream orientation is correct (Figure 3). Confirm installation is functional by completing flowmeter menu.

Figure 3

Connect Transducer Cables

3.6   1011 UNIVERSAL TRANSDUCER INSTALLATION

3.6.1   HOW TO IDENTIFY 1011 TRANSDUCERS AND MOUNTING HARDWARE

NOTE: When installing transducers, do not key in the V/M (Version/Modification) label number as the Transducer Size.

1011 series of universal transducers and mounting frames have the following color-codes for easy identification:

GOLD .... SIZE 'A'   GREEN................. SIZE 'D'
BLUE .... SIZE 'B   BLACK.................. SIZE 'E'
RED .... SIZE 'C'

The transducer part number located on the front face provides a more detailed identification. *For example, the Part Number: 1011PPS-C2 means:*
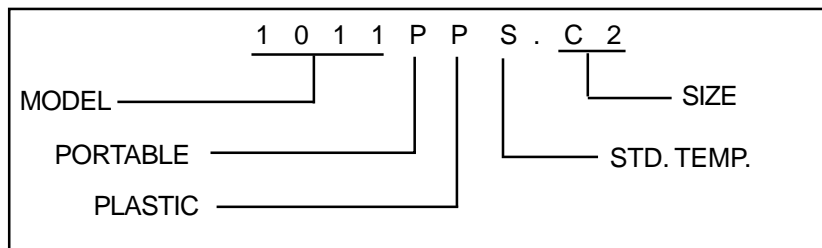
NOTE: Refer to paragraph *3.3 Preparing To Mount The Transducers* before proceeding with the following installation procedures.

3.6.2   REFLECT MODE - MOUNTING FRAMES AND SPACER BAR

The combination of a spacer bar with mounting frames is the easiest way to mount in Reflect Mode. The result is a rigid structure that eliminates spacing measurements, and maintains the transducer-to-transducer geometry. In addition, reflect mounting allows you to move the entire assembly while maintaining the original transducer spacing**.**
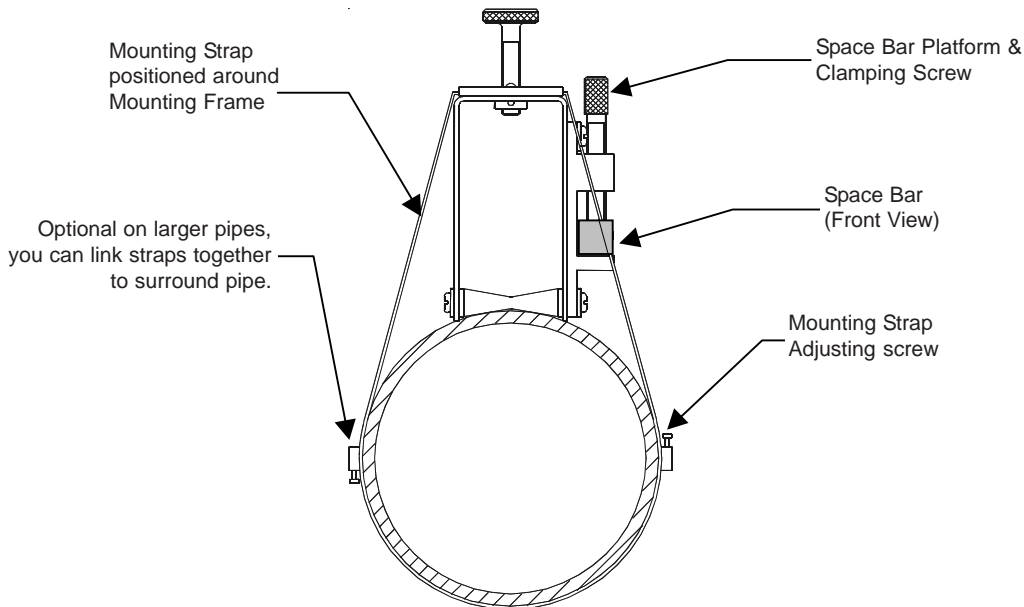
INSTALLATION - REFLECT MOUNT WITH FRAMES AND SPACER BAR
NOTE: Minimum Ltn 0.75 in. (18 mm)
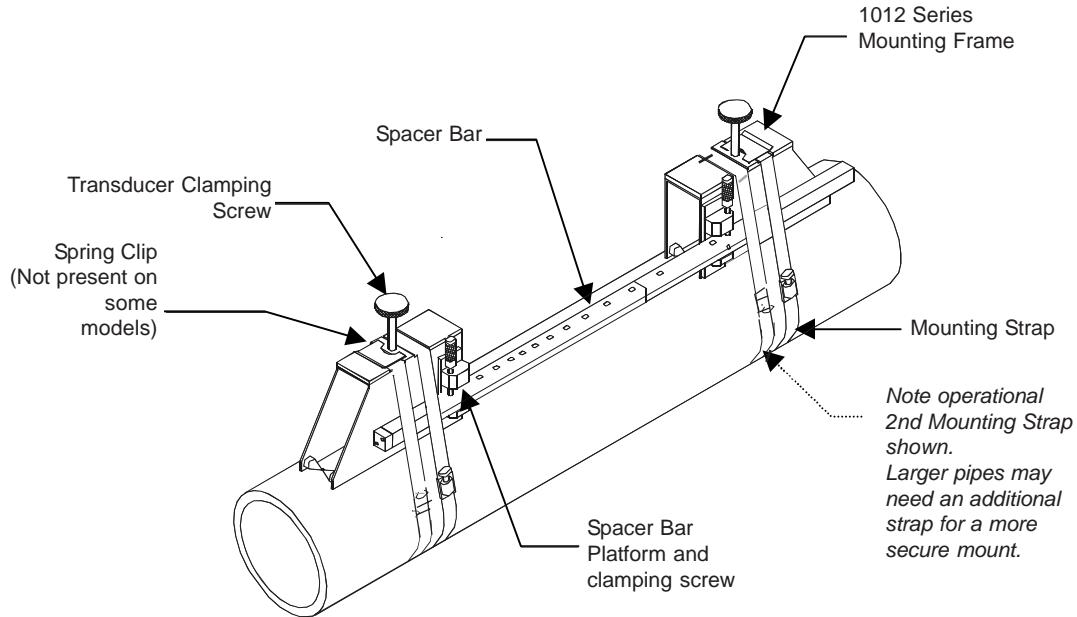
1. Perform all required menu steps until the flow computer issues the number index and prompts you to press <ENTER> to finish the transducer install routine. Stop at this point.

   Note the number index value displayed in the Pick/Install menu. You will use this number to properly space the transducers. Check to ensure that you have a matched set of transducers. They both should have the same S/N number but marked with either an "A" or "B" (e.g., 100A and 100B).

2. On a flat surface, attach the spacer bar to a mounting frame so that the reference hole on the spacer bar fits over the post on the platform of the frame; tighten the securing screw. Slide the second mounting frame onto the other end of the spacer bar, align the number index hole with the post on the platform; then tighten the securing screw. Ensure that the angled sides of both frames face away from each other. At the mounting location, place the mounting frame/spacer bar assembly on the pipe so that it rests on the top of the pipe. Wrap a mounting strap around the pipe. Engage the end of the mounting strap with the mounting strap adjusting screw. Slide it under the spring clip (if so equipped) of one of the mounting frames. Make sure to position it for easy access to the mounting strap adjusting screw. Do the same to the other mounting frame.

3. Tighten the mounting strap screw enough to take up all of the slack, but not enough to prevent rotation of the assembly. Rotate the assembly on the pipe to the 9 o'clock position ensuring that it is a smooth area without any raised spots or seams. Mark a generous area around the mounting frames (1/2" on either side and half again the length front and back) with a pencil or chalk. Move or revolve the assembly away from the area marked (loosen straps if necessary to do this).

4. Prepare the two areas you marked by de-greasing the surface, if needed, and removing any grit, corrosion, rust, loose paint or surface irregularities with the abrasive pipe conditioning material provided. Clean the pipe of all debris and abrasive particles.

5. Reposition the assembly over the center of the prepared surfaces. Tighten the mounting straps to seat the assembly firmly on the pipe. Do not overtighten.

Apply a continuous 1/8-inch bead of coupling compound to the center of the face of a transducer, then slide it into the mounting frame but holding it away from making contact with the pipe until it butts up against the stop (to keep from smearing couplant where it's not needed); then push down onto the pipe. Tighten the transducer clamping screw to hold the transducer firmly in place. Repeat for the other transducer.

6. Observing the upstream to downstream orientation, attach the UP and DN cables to the transducers. Attach the other ends to the flowmeter's UP and DN terminals. See Engineering Drawing 1020-7.

7. You can now press <ENTER> to finish the transducer install routine. The available Mounting Strap kits are listed below. Each kit comes with up to two band sizes to cover its designated pipe diameter range and a spacing guide for Direct Mount.

Strap Mounting Kit P/N	Pipe Diameter	Band Sizes (Qty.)
1012MS-1A	2" (50.8mm) to 7" (177.8mm)	#88 (2) #128 (2)
1012MS-1	2" (50.8mm) to 13" (330.2mm)	#88 (2) #152 (2)
1012MS-2	13" (330.2mm) to 24" (609.6mm)	#188 (2) #280 (2)
1012MS-3	24" (609.6mm) to 48" (1219.2mm)	#152 (2)

3.6.3 REFLECT MODE WITH SPACER BAR ONLY

The spacer bar eliminates manual spacing measurements and provides rigidity for mounting the transducers while maintaining axial alignment.
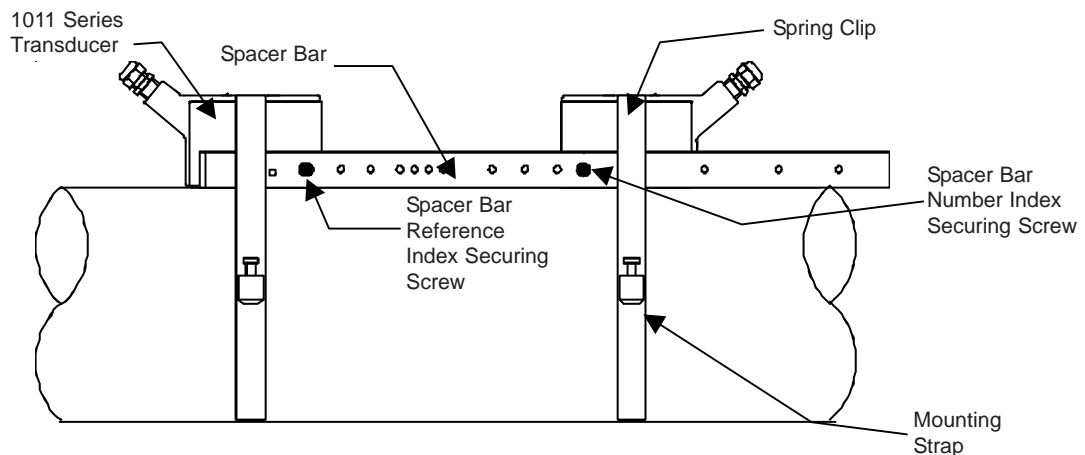
INSTALLATION - REFLECT MOUNT WITH TRANSDUCERS AND SPACING BAR

1. Perform all required menu steps until the flow computer issues the number index and prompts you to press <ENTER> to finish the transducer install routine. Stop at this point.

Note the number index value displayed in the Pick/Install menu. You will use this index to properly space the transducers. Check to ensure that you have a matched set of transducers. They both should have the same S/N number but marked with either an "A" or "B" (e.g., 100A and 100B).

2. Assemble the transducers to the spacer bar, with the cable connectors facing away from each other as shown above. The spacer bar is attached to a transducer using a transducer index screw. One transducer is attached using the "REF" hole on the spacer bar. The second transducer is attached to the spacer at the index hole specified in Step 1.

3. Temporarily position the assembly (in the 9 o'clock position) at the location where you have deter-mined it would be mounted. Ensure that it is a smooth area without any raised spots or seams. Mark a generous area around the transducers (1/2" on either side and half again the length front and back) with a pencil or chalk. Remove the assembly.

4. Prepare the two areas you marked by de-greasing the surface, if needed, and removing any grit, corrosion, rust, loose paint or surface irregularities with the abrasive pipe conditioning material provided. Clean the pipe of all debris and abrasive particles.

5. Remove transducer from the spacer bar that was attached through the REF hole. Put a mounting strap around the pipe and engage an end into the adjusting screw (adjusting screw should be pointing up). Apply a 1/8-inch continuous bead of couplant compound down the center (the long way) of the contact surface of one of the transducers (see paragraph 3.3.5 Recommended Sonic Coupling Compounds). Place the transducer on the pipe center in the middle of one of the areas you have cleaned with its cable connector pointing away from the other cleaned area. Holding the transducer in place, slide the mounting strap over it (and under the clip if there is one) and tighten with a screwdriver. While tightening, check to ensure that the white dot under the front label is centered on the pipe and that there is equal space on both edges. Also, make sure to position strap for easy access to the mounting strap adjusting screw.
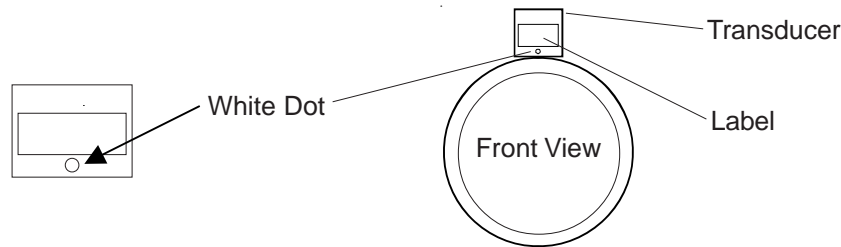
6. Repeat Step 5 with the second transducer leaving it still attached to the spacer bar. Apply a 1/8-inch bead of couplant to the transducer. At the same time you place it in the middle of the second area prepared, secure the spacing bar to the already mounted transducer by inserting the transducer index screw through the REF hole on the Bar. Put mounting strap around transducer and tighten as in Step 5. Sight along spacer bar to ensure axial alignment to the pipe. Adjust if necessary and do not overtighten. Ensure that the transducers do not move while tightening.

7. Connect the transducer cable, ensuring that you have observed the upstream/downstream orien-tation in respect to the cable and the input jack on the flow computer. If this is a dual-channel unit, make sure you are connecting the cables to the correct channel's input jacks. Repeat this proce-dure for the number index transducer.

8. Return to the menu, and press <ENTER> to finish the transducer install routine.

3.6.4   DIRECT MODE - MOUNTING FRAMES, SPACER BAR AND MOUNTING GUIDES

The combination of mounting frames, spacer bar and mounting guides is the recommended way to mount Direct Mode transducers. The mounting frame establishes the axial alignment of the transduc-ers, and allows you to remove and replace either transducer while preserving their exact mounting location.
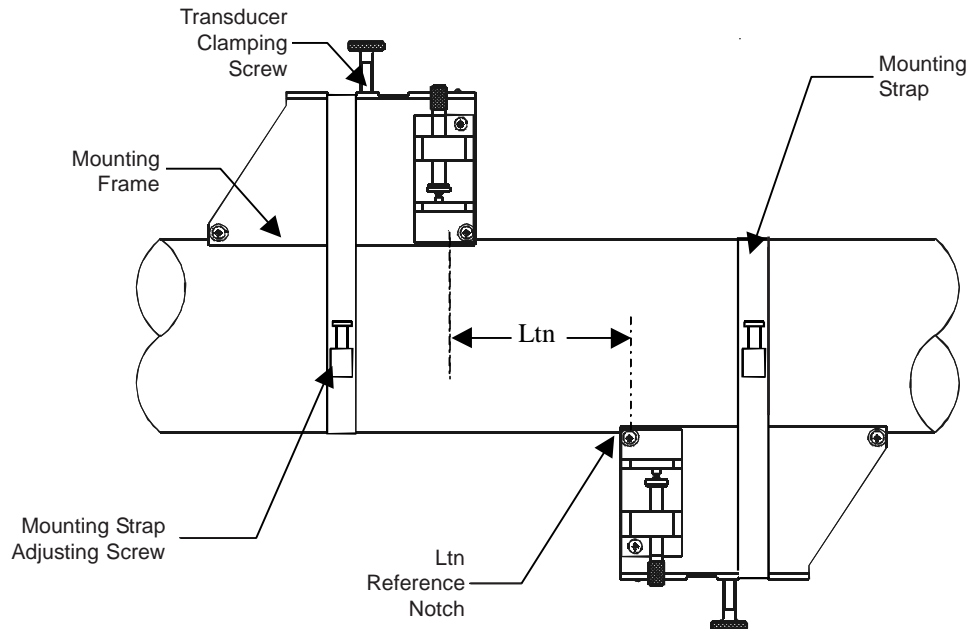
INSTALLATION - DIRECT MODE WITH TRANSDUCERS, MOUNTING FRAMES SPACER BAR (Not Shown) AND SPACING GUIDE

For Direct Mode mounting, you will use a spacer bar to establish the distance between transducers and a Mounting Guide to easily locate the transducers at the nine o'clock and three o'clock positions. Should the distance between transducers be beyond the span of a spacer bar, a measuring tape can be used. The Mylar Mounting Guide comes in various lengths and widths to accommodate most pipe sizes (see list below).

Mounting Guide P/N	Size
1012-145-1A	2" x 26" (50.8 x 660.4 mm)
1012-145-1	2" x 45" (50.8 x 1143.0 mm)
1012-145-2	4" x 81" (101.6 x 2057.4 mm)
1012-145-3	4" x 155" (101.6 x 3937.0 mm)
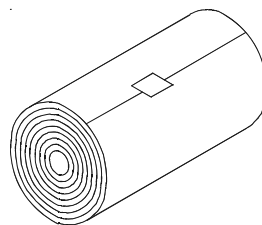
MYLAR MOUNTING GUIDE

1. Perform all the required menu steps up until the point where the flow computer issues the number index and prompts you to press <ENTER> to finish the transducer install routine.

   Make a note of the number index displayed in the Pick/Install menu. Check to ensure that you have a matched set of transducers. They both should have the same S/N number but marked with either an "A" or "B" (e.g., 100A and 100B).

2. Temporarily position one of the frames on the pipe where you will be mounting it. Ensure that this is a smooth area without any raised areas (seams, etc.) With a pencil or chalk, mark a generous area around the frame (1/2" on either side and half again the length front and back). Remove the assembly.

3. Prepare the area you marked by de-greasing surface, if needed, and removing any grit, corrosion, rust, loose paint or surface irregularities with the abrasive material provided.

4. Put a mounting strap around the pipe and engage an end into adjusting screw (screw should be pointing up). Position frame in the middle of area you have cleaned and centered on the pipe with its angled end facing away from where the other frame will sit.

Transducer Clamping Screw

Spring Clip

Mounting Strap

Mounting Strap Adjusting Screw
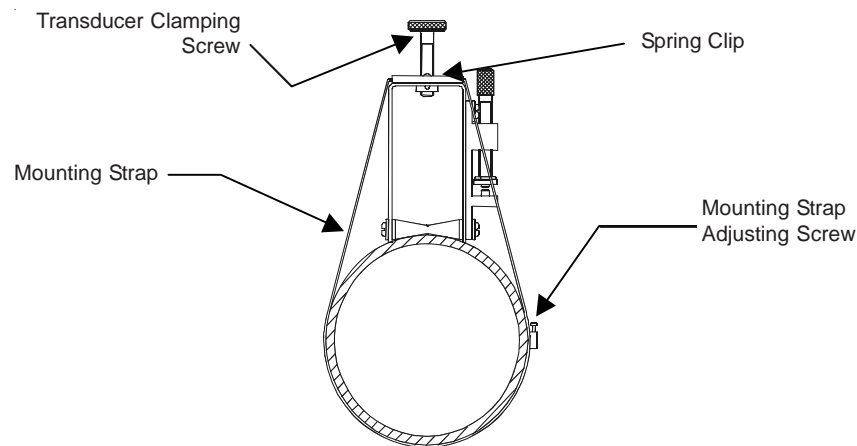
WRAPPING STRAP UNDER PIPE AND ATTACHING TO ADJUSTING SCREW

5. Slide the mounting strap over it (and under the clip if there is one) and tighten with a screwdriver. While tightening, check to ensure that the center of the tapered roller is centered on the pipe.

6. Attach the second frame to the spacer bar with an index spacer screw into the index hole specified in Step 1. The angle on the frame should be facing away from the direction the length of the bar is going. Now attach the free end of the spacer bar by inserting an index spacer screw through the REF hole on the spacer bar and then into the hole on the mounted frame. Tighten. Sight to ensure that this frame is lined up in center of pipe and while holding alignment, place a dot (with pencil or chalk) in the center of the tapered roller at the bottom of the frame (see A on next page). While holding, also mark along the front edge of the frame with pencil or fine chalk line (see B on next page).

7. Disassemble the spacer bar and the unmounted frame. Use the bar as a straight edge and, with one edge against the mounted frames tapered roller center and the other crossing the dot you drew, draw a line crossing the dot (see "B" on next page). Set the bar aside.

8. Wrap the Mylar Mounting Guide around the pipe so that the left edge is against the transducer edge mark (see "C" next page). Arrange so that one end overlaps the other by at least three inches. Trim to fit if necessary, ***but be sure not to trim at the overlapping end in order to keep it square***.

A

Pipe — Dot — Transducer

Transducer

Transducer Edge Line

Spacer Bar

B

Dot

Transducer

Spacer Bar — Line

C

Mylar Spacing Guide

Trim material from inner edge if necessary

Mylar Spacing Guide

End View

3" Overlapping Edge

WRAPPING THE MYLAR SPACING GUIDE AROUND THE PIPE

9. Realign left edge of the guide with the transducer edge mark. Line up both vertical edges of the guide and ensuring that it is snug around the pipe, mark along the overlapping edge.

10. Remove Mylar Mounting Guide and lay it out on a flat surface. Either measure the exact distance halfway between the overlap edge and the mark at the overlap, or fold the guide from the overlap edge to overlap mark and draw a line at the fold or halfway point (see below).

SPACING GUIDE

Overlap Edge

Mark (or fold) exactly at half-way point

CIRCUMFERENCE

FINDING THE HALFWAY DISTANCE
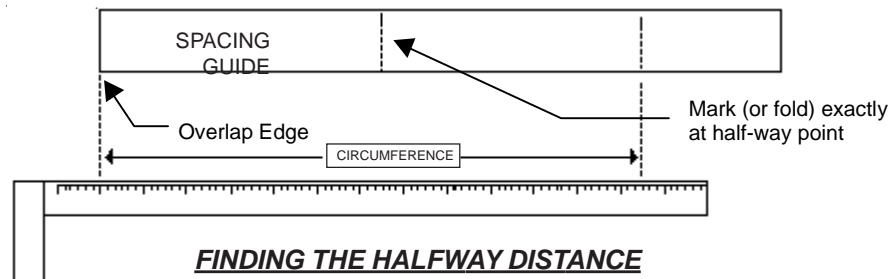
11. Reinstall the Mounting Guide; its left edge abutting the transducers edge mark on the pipe and the overlapping edge in line with the dot (now a line) on the pipe (see "C" on previous page). Tape it in this position on the pipe. Take the second frame and place it against the edge of the guide with its tapered roller centered on the center mark on the guide. Temporarily position the frame (in the 3 o'clock position opposite the mounted frame - see below) where it will be mounted. Ensure that this is a smooth area without any raised spots (seams, etc.). Mark a generous area around the mounting frames (1/2-inch on either side and half again the length front and back) with a pencil or chalk. Remove the frame and the mylar guide.

9 o'clock
Transducer

3 o'clock
Transducer
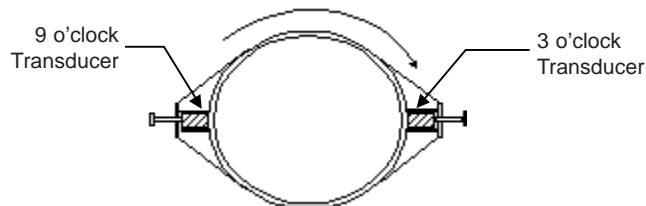
ALIGNING THE TRANSDUCERS FOR DIRECT MODE OPERATION

12. Prepare the area you marked by de-greasing the surface, if needed, and removing any grit, corrosion, rust, loose paint or surface irregularities with the abrasive pipe conditioning material provided. Clean the pipe of any debris and abrasive particles.

13. Replace the mylar guide back in the same position it was in and retape it to the pipe.

14. Put a mounting strap around the pipe and engage an end into adjusting screw (screw should be pointing up). Position frame in the middle of area you have cleaned and centered on the pipe with its angled end facing away from where the other frame will sit; and aligned with the edge and center marks on the guide. Slide the mounting strap over it (and under the clip if there is one) and tighten with a screwdriver. While tightening, check to ensure that the center of the tapered roller is centered on the pipe.

15. Apply a 1/8-inch continuous bead of couplant compound down the center (the long way) of the contact surface of one of the transducers. Place the transducer into one of the frames so that the couplant compound does not smear until it contacts the pipe. Slide it in until it butts against the stop and, while holding in-place, tighten the transducer clamping screw tight enough to hold firmly in-place. Do the same with the other transducer.

16. Connect the transducer cable, ensuring that you have observed the upstream/downstream orientation in respect to the cable and the input jack on the flow computer. If this is a dual-channel unit, make sure you are connecting the cables to the correct channel's input jacks. Repeat this procedure for the number index transducer.

17. Return to the menu, and press <ENTER> to finish the transducer install routine.

3.6.5 USING 1012T MOUNTING TRACKS

The 1012TP Mounting Tracks provide a rigid mounting platform for Series 1011 Universal transducers. The mounting tracks service pipe sizes up to a maximum of 5.00" (140 mm) outer diameter. The assembly consists of lightweight aluminum track rails with integral transducer clamping screws. Attached index pins enable positive locating of the transducers at fixed spacing locations. Roller-chains and tension screws secure the assembly to the pipe. The following instructions refer to 1011 Universal transducers.

The 1012T mounting tracks support both Direct and Reflect mounting modes. The flow computer recommends the appropriate transducers, mounting track and mounting mode, based on the pipe data entries. Refer to the instructions in paragraph 3.5 for details on the Transducer Installation procedure. If necessary, review paragraphs 3.2.2 through 3.3.5 for details on how to select and prepare a mounting location on your pipe.

Installing a 1012T Mounting Track in Reflect Mode

Paragraph 3.6 describes the Transducer Installation procedures that lead up to the automatic selection of transducers, mounting mode and spacing method. Examine the figure below, which shows a typical Pick/Install Xdcr menu screen. Note the automatic assignment of model numbers for the transducer and mounting track (see below), plus the designation of the number index.

Display shows
Transducer Model

Display shows
mounting track
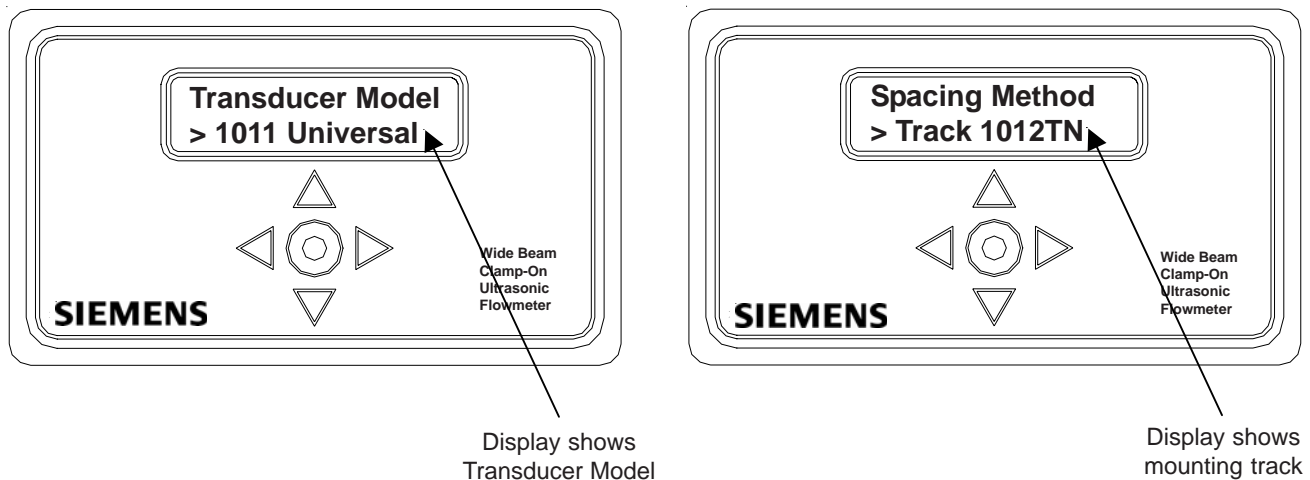
This example requires a Model 1012T Mounting Track to accommodate size B3 Universal transducers. Note the reported number index. You will be inserting an index pin into this hole on the track rail to position one of the transducers (see diagram on next page).

1. Perform all required menu steps up until the point where you respond to the [Install Complete?] prompt. Note the reported number index. You will be inserting index pins into this hole and the reference hole on the track rail (see diagram on next page). Check to ensure that you have a matched set of transducers. They both should have the same S/N number but marked with either an "A" or "B" (e.g., 100A and 100B).
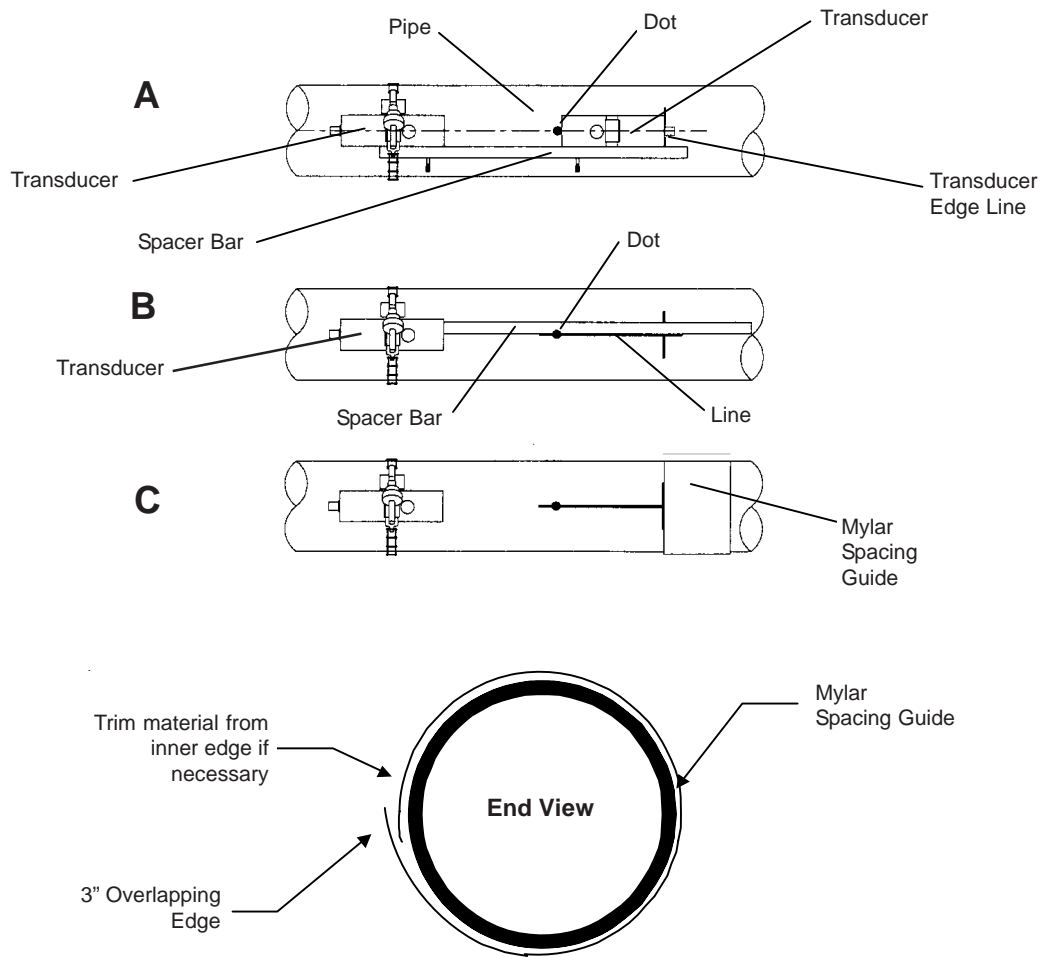
FRONT VIEW ↑
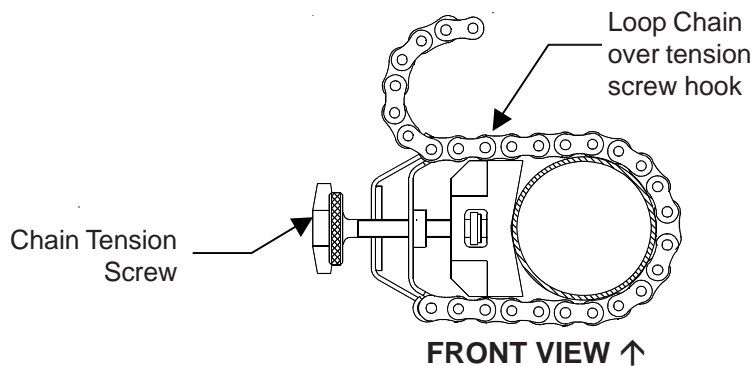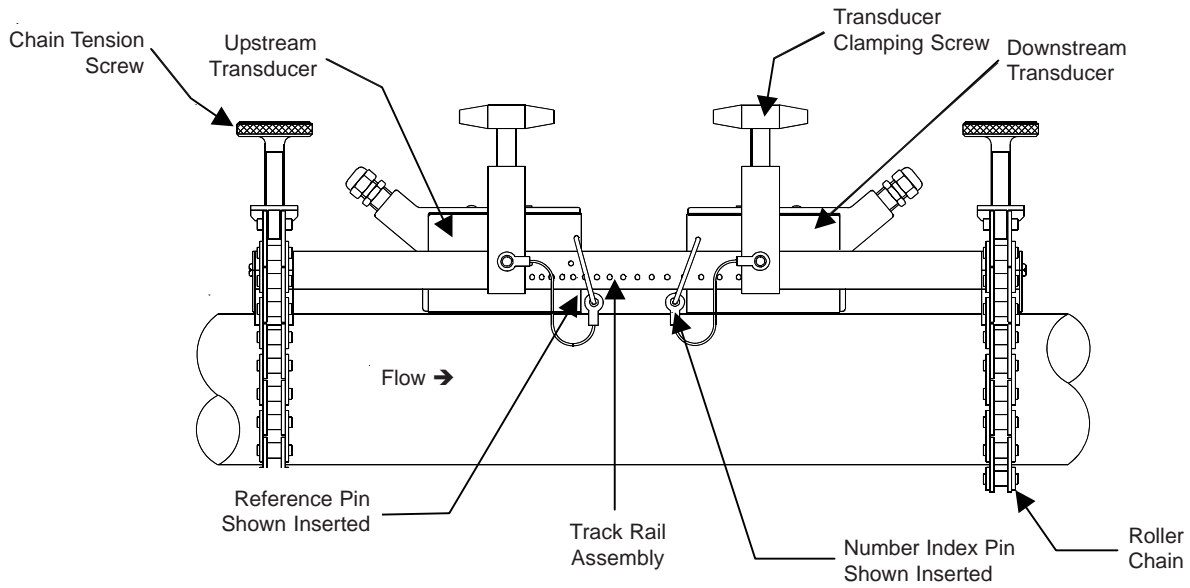
INSTALLATION - REFLECT MOUNT WITH MOUNTING TRACK

2. Place the track rail assembly on the top surface of the pipe at the location where you have determined it would be mounted. Ensure that it is a smooth area without any raised spots or seams. Holding the assembly in place, loop one of the roller chains under the pipe, pull it around and maintain tension while slipping a link over the tension screw hook. Tighten the tension screw enough to hold the assembly on the pipe, but still allow rotation. Repeat for the other roller chain. Rotate the track rail assembly to the intended nine o'clock mounting position on the pipe, then tighten both tension screws just enough to prevent rotation. Do not overtighten.

3. Mark a generous area around the transducers (1/2-inch on either side and half again the length front and back) with a pencil or chalk. Loosen and move the assembly away from marked area. Prepare the two areas you marked by de-greasing the surface, if needed, and removing any grit, corrosion, rust, loose paint or surface irregularities with the abrasive pipe conditioning material provided. Clean the pipe of all debris and abrasive particles.

4. Insert the index pin into the reference hole. Select a transducer, apply a thin band of couplant compound to the transducer's contact surface. Place the transducer between the track rails, slightly behind the pin and under the clamping screw assembly. Slide it forward until it butts up firmly against the reference pin.

5. Once transducer is in place, secure with the transducer clamping screw. Do not overtighten. Observe the upstream/downstream orientation and connect the transducer cable to the computer's input jack. If a dual-channel unit, make sure you connect the cable to the input jacks of the correct channel. Repeat this procedure for the number index transducer.

Installing a 1012T Mounting Track in Direct Mode

Paragraph 3.6 describes the Transducer Installation procedures that lead up to the automatic selection of transducers, mounting mode and spacing method. Shown is a Model 1012T mounting track to accommodate size B3 Universal transducers. Examine the figure below which shows a typical Pick/Install Xdcr menu screen. Note the automatic assignment of model numbers for the transducer and mounting track (see below), plus the designation of number index.

Display shows
Transducer Model

Display shows
mounting track
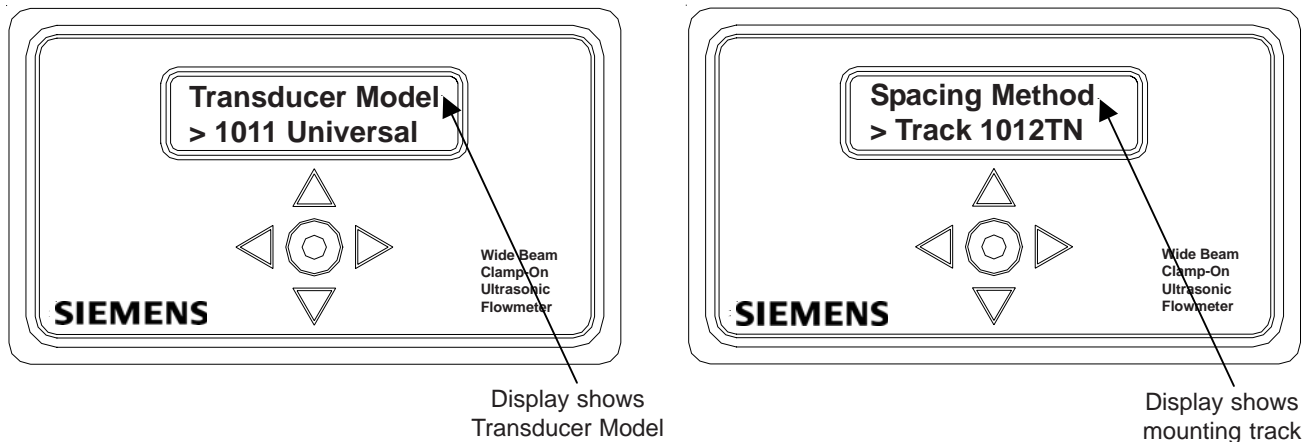
1. Perform all required menu steps up until the point where the flow computer prompts you to press <ENTER> to finish the transducer install routine. Note the reported number index.

    You will be inserting an index pin into this hole and the reference hole. Check to ensure that you have a matched set of transducers. They both should have the same S/N number but marked with either an "A" or "B" (e.g., 100A and 100B).

2. The direct mount configuration uses two track rails, one for each transducer, installed 180⁰ apart on the pipe. One track rail includes the tension screw while the other has a locating stud to support the chain (see below and on next page).
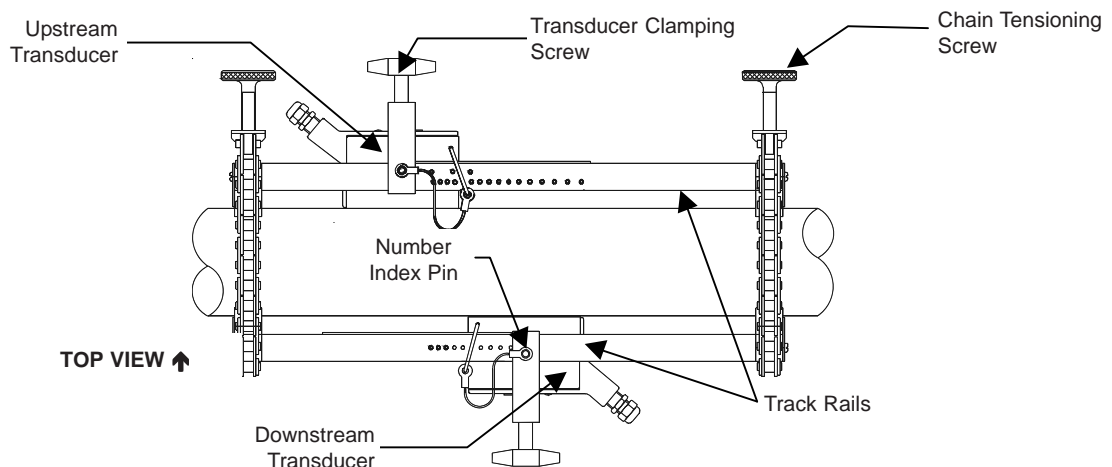
__INSTALLATION – DIRECT MOUNT 180º OPPOSED WITH MOUNTING TRACK__

Tension Screw Hook

Center of this link is over the locating stud. An equal number of links on either side of this stud ensures 180° opposed installation.

Chain Tension Screw

Xdcr Clamping Screw
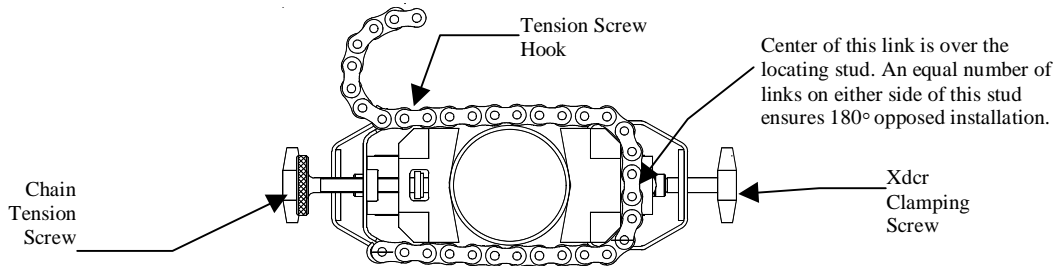
3. If this is a horizontal pipe, place the track with the chain tension screws on top of the pipe (screws up, the chains hanging down and the numbered scale facing you) where you have determined it would be best to mount it.

4. Place the other track (with the centering stud on the bottom and the lettering on the scale toward the same side as the top track) directly underneath it (180^0). Hold in place while you wrap the chain around the pipe; first onto the centering stud on the bottom track and then onto the hook under the Tensioning Screw. With the chain in-place, count the number of links between the beginning of the chain and the centering stud; and then between the centering stud and the hook. They both should have the same number of links. Arrange so they do and then loosely tighten. Do the same with the other chain. For a vertical pipe installation, it will probably be much easier to tie, tape or bungee cord the two tracks in place while chaining.

5. Wrap a length of the Mylar Mounting Guide around the pipe and against the end of the track assembly. Ensure that the edges on both sides align and tape to the pipe. Loosen the chains enough to allow you to rotate the track assembly 90^0 until one track is in a 9 o'clock position and the other in a 3 o'clock position on the pipe (horizontal pipe). Tighten both chains but not too tight.

6. Insert an index pin into the REF hole of the track with the tensioning screws. Take one of the transducers and insert it between the track rails and to the left of the index pin with the cable connector pointing away from the pin. Move the transducer right until the pin stops it. Hold it in this position and move the transducer clamping screw over the transducer and tighten. Insert the other index pin into the index hole (see Step 1) on the other track marked "Direct Mode Spacing." Insert the second transducer (with its cable connector pointing away from the pin) between the track rails on the right side of the pin and move the transducer left until it's stopped by the pin and then follow the same procedure as with the first transducer.

7. Mark a generous area around the transducers where they contact the pipe with a pencil or chalk. Make a mark showing the center between the tracks on the mylar guide. Release the tension on the transducers and remove them. Loosen the chains and rotate the track assembly on the pipe so you can gain access to the areas marked.

8. Prepare the area you marked by degreasing the surface, if needed, and removing any grit, corrosion, rust, loose paint or surface irregularities with the abrasive pipe conditioning material provided.

9. Revolve the tracks on the pipe into the position they were originally in by using the edge of the mylar guide as a stop for both the upper and lower tracks and the mark on the guide to center that track. This time, before installing each transducer, apply a 1/8-inch continuous bead of couplant compound along the center (the long way) of the contact surface of the transducer. Also, keep the transducers lifted slightly from the pipe when installing until the transducer is against the pin; then push down against the pipe. Remember to install the transducers with the cable connectors facing away from each other.

Once the transducer is in place, Secure it with its clamping screw. Do not overtighten.

**NOTE: Some transducers require a right-angle adapter. This adapter should be installed be-
fore placing the transducer in the tracks.**

10. Connect the transducer cable, ensuring that you have observed the Upstream/Downstream orien-
tation in respect to the cable and the input jack on the flow computer. If this is a dual-channel unit,
make sure you are connecting the cables to the correct channel input jacks.

4.   OPERATING SYSTEM 1020 WITH FLOW TUBES

The 1020 flow computer supports the software (optional) for Siemens 992DFT and 1011FT Flow Tubes. This versatile in-line transit-time flowmeter system has proven to be a valuable tool for servicing many small line and extremely low flow applications.

Typical Applications include:

- Controls and Refrigerants
- Fuel Flow Measurement
- Water and Wastewater treatment chemical feed
- Chemical and Pharmaceutical Batching
- Food Processing - Juice, Wine, Beer
- Hydraulic Oil Leak Detection
- Measurement of Additives
- Automobile Assembly and Testing

Typical Industries Serviced include:

- HVAC (Hotels, Airports, Government)
- Power Generation (Nuclear, Fossil, and Hydro)
- Chemical Processing
- Food and Pharmaceutical
- Aircraft Avionics and Ground Support
- Water and Wastewater
- Aerospace
- Automobile Manufacturing

4.1   GENERAL INSTALLATION GUIDELINES

Installing Flow Tubes is a simple operation, but to assure proper installation, refer to both the instructions in this section and the Installation/Outline drawings that came with your specific Flow Tube. They both contain important information that you will need for a successful installation.

4.1.1   LIQUID APPLICABILITY AND COMPATIBILITY

Successful flow measurement using a transit-time Flow Tube depends on the sonic transmit signal traveling through the liquid and arriving at the receive transducer without excessive attenuation. Most liquids are excellent sonic conductors, regardless of their electric or optical properties. Although highly viscous liquids exhibit a greater degree of sonic attenuation, the 992 and 1011 series Flow Tubes operate successfully with most of these liquids.

The usual cause of low liquid sonic conductivity is sonic beam scattering due to liquid non-homogeneity. Thus, liquids that contain gas bubbles or suspended solids are considered unsuitable applications. However, dissolved gasses and organic solids of a moderate viscosity usually do not cause any problems.

The accuracy of the liquid viscosity entry is important. It governs the degree of Reynolds Number compensation that the flow computer applies to the final rate output. Therefore, flow data errors could result if you enter an inaccurate viscosity value. Please note that Controlotron may be able to provide the correct liquid viscosity and data for your application. Controlotron flow tubes are constructed from CPVC, Teflon, (PFA), Kynar (PVDF) or stainless steel. Ensure that the liquid to be measured is compatible with the flow tube material.

4.1.2 SELECTING THE RIGHT FLOW TUBE

Select the appropriate body material: *Consider liquid compatibility, operating temperature, and pressure. These must never exceed the rating of the flow tube. Consult installation drawings to determine appropriate fittings for coupling the flow tube into your piping.*

Select the appropriate size: *Try to match as closely as possible the diameters of the pipe and the flow tube. This will reduce or eliminate the potential for a noticeable pressure drop. In addition, the operating flow range must fall within the indicated specifications.*

Flow Tube Pressure and Temperature Ratings

Material	Temperature Range	Max. Pressure
CPVC	0°F to 200°F (-15°C to 90°C)	150 psig (10.3 bar)*
Kynar PVDF	0°F to 275°F (-15°C to 135°C)	150 psig (10.3 bar)*
Teflon PFA	0°F to 250°F (-15°C to 120°C)	100 psig (7.0 bar)*
316 SS (size 1)	-40°F to 400°F (-40°C to 204°C)	5200 psig (350 bar)*
316 SS (size 2)	-40°F to 400°F (-40°C to 204°C)	4200 psig (240 bar)*

*Maximum specifications may be reduced depending on the liquid and operating temperature.

Flow Tube Material, Size & Flow Range Ratings

Material	Size	Flow Range
CPVC	1	0 to 5 GPM (0 to 20 LPM)
CPVC	2	0 to 25 GPM (0 to 95 LPM)
PVDF	1	0 to 5 GPM (0 to 20 LPM)
PVDF	2	0 to 25 GPM (0 to 95 LPM)
PFA	1	0 to 5 GPM (0 to 20 LPM)
PFA	2	0 to 16 GPM (0 to 60 LPM)
316 SS	1	0 to 10 GPM (0 to 40 LPM)
316 SS	2	0 to 30 GPM (0 to 115 LPM)

4.1.3 FLOW TUBE MOUNTING LOCATION

Consider the following guidelines when choosing a Flow Tube mounting location.

a. The flow tube must be mounted horizontally, with its inlet and outlet facing upward. This minimizes the possibility of trapped air bubbles that could interfere with transducer signals.

b. For the best flow profile, locate the flow tube downstream from the center of the longest available straight run. Make sure to locate the inlet upstream relative to the outlet.

c. DO NOT select a location *immediately* downstream from:

- A throttling valve or other source of cavitation.

- A mixing tank or other device that could aerate the liquid.

- The discharge of a positive displacement pump.

d. DO NOT mount the flow tube on a section of pipe that may be empty during zero flow. If this cannot be avoided, then be aware that the system will not be able to measure flow until the pipe refills and flow persists for long enough to drive all the air from the flow tube.

e. DO NOT run the transmit/receive cables in common bundles with cables from any other equipment.

f. DO NOT mount the flow tube under water, unless you order a submersible cable kit and install it according to factory instructions.

4.1.4 FLOW DATA SCATTER AND DAMPING

Use the slew rate and damping controls to smooth data response time to suit your application. The default SmartSlew control provides excellent output regulation without sacrificing an instant response to sudden flow changes. Therefore, we recommend SmartSlew for most applications. The Damping control is particularly effective when one cannot avoid mounting the flow tube very close downstream from a potential cavitation source such as a positive displacement pump.

4.2 CONSIDERATIONS FOR CRITICAL APPLICATIONS

All flowmeters depend on proper site flow conditions and installation to achieve precise, critical flow measurements. Unfavorable factors such as liquid non-homogeneity or stratification and aeration/cavitation increase the possibility of reduced accuracy. This applies to all flowmeters, regardless of their design, sophistication, expense and published intrinsic accuracy. These factors become critical when applications involve custody transfer, tenant billing, and nuclear or other safety-related flows.

Our System 1020 Universal NEMA Flowmeters include provisions to minimize adverse flow conditions to achieve extremely high accuracy. This requires closely following the instructions for proper equipment selection, use of the correct clamp-on transducer or flow tube configuration and paying close attention to installation instructions.

If your application requires critical measurement accuracy it is not realistic to simply install the flowmeter and expect optimum performance. Carefully review your piping configuration. Select the best mounting location and install the transducers or flow tube in strict accordance with the published instructions. This holds true even when the system is calibrated for enhanced precision at a flow laboratory. Its precision can be impaired by not closely following the programming and installation instructions. We recommend that all potential installers (especially critical installations) participate in our training programs. Another possible alternative is to commission our trained professionals to start-up the system for you.

To Obtain Technical Assistance

The operating program provides comprehensive diagnostics data. Using this data, our engineers can analyze your system in relation to the application usage. A detailed analysis will provide solutions to virtually any adverse application problem. If you need technical assistance, contact your local Siemens representative for expert help (www.siemens.com).

4.3   HOW TO SET UP SYSTEM 1020 FOR FLOW TUBE OPERATION

The example in this section shows how to set up channel 1 of a 1020 dual channel system for use with a 1011FT stainless steel Flow Tube. Note that Series 1020 dual-channel models allow flow tube operation with either measurement channel. In addition, all 1020 flow computers operate with both 1011FT and 992DFT series of flow tubes. This example begins at the Channel Setup Menu. If necessary, review paragraph 1.3 for instructions on how to select a Meter Type and a measurement channel.

4.3.1 OVERVIEW

Setting up the measurement channel for Flow Tube operation consists of the following tasks:

- Select a Meter Type (in this case Dual Channel Flow).
- Select a channel to install the flow tube (e.g., Channel 1).
- Set Kc calibration (slope correction) indicated on Flow Tube tag. (Note: Programmed Kc must match offset error on plastic Kc tag to get accurate flow tube readings. See paragraph 6.7.3 Calibrate Flow Rate.)
- Create a site setup to store the flow tube installation parameters.
- Enter liquid Parameters (optional, default = water@68°F).
- Complete the Flow Tube install procedure.

4.3.2 SETUP PROCEDURE

1. From the Channel Select screen, press <Right Arrow> to access the option list, then press the <Down Arrow> to move the cursor to [FlowTube] (if required).

```
┌─────────────────────────────────────────┐
│ Siemens     2 Channel [1]    Channel 1   │
│ ███████████████████████████████████████  │
│ Choose Channel 1 Flowmeter Type          │
│                                          │
│ █████████████████        █████████████   │
│ Channel 1                Clamp-on        │
│ Channel 2                >FlowTube        │
│                                          │
│                                          │
│                                          │
│                                          │
│                                          │
│                                          │
│ ███████████████████████████████████████  │
│ Dual Channel Flow                        │
└─────────────────────────────────────────┘
```
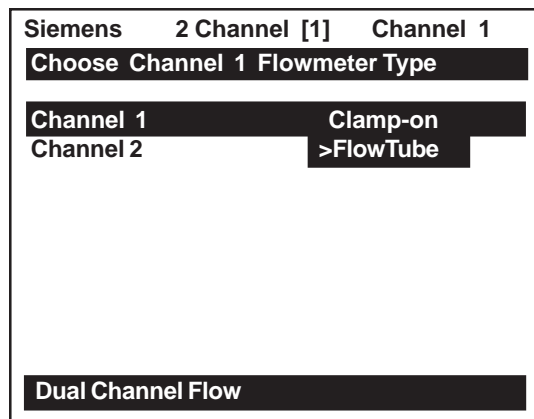
2. To select Flow Tube press <Enter>. This enables the Flow Tube menu. Press the <Right Arrow> to access Channel Setup menu.

```
┌─────────────────────────────────────────┐
│ Siemens        2 Channel     [1]         │
│ Scroll saved Site Setup list and Enter   │
│ ┌───────────────────────────────────────┐│
│ │ Recall Site Setup        No Sites     ││
│ │ Channel Enable           No           ││
│ │ Create/Name Site                      ││
│ │ Site Security            Off          ││
│ │ Delete Site Setup        No Sites     ││
│ │ Save/Rename Site                      ││
│ │                                       ││
│ │                                       ││
│ │                                       ││
│ └───────────────────────────────────────┘│
│ Channel Setup                            │
└─────────────────────────────────────────┘
```

3. Move the highlight by pressing the <Up/Down Arrow> to [Create/Name Site]. To access the site name field press the <Right Arrow>. In this example, we will simultaneously create and name the site: FLOW1.

   Use the character lists to select a site name as shown below.

```
┌─────────────────────────────────────────┐
│ Siemens        2 Channel     [1]         │
│ Right Arrow & Enter Create a new Site    │
│ ┌───────────────────────────────────────┐│
│ │ Recall Site Setup        No Sites     ││
│ │ Channel Enable           No           ││
│ │ Create/Name Site         ?FLOW1       ││
│ │ Site Security            Off          ││
│ │ Delete Site Setup        No Sites     ││
│ │ Save/Rename Site                      ││
│ │                                       ││
│ │                                       ││
│ │                                       ││
│ └───────────────────────────────────────┘│
│ Channel Setup                            │
└─────────────────────────────────────────┘
```

4. Press <Enter> to create a new site and register the site name: FLOW1. Note that the name now appears in the site name field on the upper right of the display and in the [Save/Rename Site[menu cell.

```
┌─────────────────────────────────────────┐
│ Siemens      2 Channel    [1]    FLOW1   │
│ Use with Care -- Turn Security ON or Off │
│ ┌───────────────────────────────────────┐│
│ │ Recall Site Setup        No Sites     ││
│ │ Channel Enable           No           ││
│ │ Create/Name Site         FLOW1        ││
│ │ Site Security            Off          ││
│ │ Delete Site Setup        No Sites     ││
│ │ Save/Rename Site         FLOW1        ││
│ │                                       ││
│ │                                       ││
│ │                                       ││
│ └───────────────────────────────────────┘│
│ Channel Setup                            │
└─────────────────────────────────────────┘
```

5. Press the <Left Arrow> to leave the Channel Setup menu.

Note that the next menu down is Liquid Data. This menu allows you to enter Viscosity (in centistokes) and the Density (specific gravity) data for the liquid to be measured. Data entry in this menu is optional. The default values are those of Water at 68°F (20°C). If you choose to edit these parameters, you should be aware that the viscosity of the liquid is an important factor. It governs the degree of Reynolds Number compensation that the flow computer applies to the final rate output. Therefore, flow data errors could result if you enter inaccurate data. Note that the Siemens Technical Service Group may be able to provide the viscosity data for the liquid to be measured.

6. To move the highlight to [Install Flow Tube] press the <Down Arrow>.

```
Siemens      2 Channel    [1]        FLOW1
Pick Flow Tube size and Type

Install FlowTube         1S
Install Complete?        No
Empty Set <FT>           Chan Not Setup
Zero Flow Adjust         Chan Not Setup




Install FlowTube
```

7. To access the [Install Flow Tube] option list press the <Right Arrow>. Note that this list shows the currently available flow tube sizes. The number is the size (e.g., 1). The letter represents the material (e.g., S = Steel, P = PVC, T = Teflon, K = Kynar). In this example, we will install a size 1S Flow Tube. This 1011FTP-1S (Stainless Steel) unit uses a 5/8" Swagelok Tube Fitting.

```
Siemens      2 Channel    [1]        FLOW1
Pick Flow Tube size and Type

Install FlowTube         >1S
Install Complete?         1P
Empty Set <FT>            1K
Zero Flow Adjust          1T
                          2S
                          2P
                          2K
                          2T

Install FlowTube
```

8. To select size *1S* press <Enter>. This moves the highlight to [Install Complete?].

> *You can complete the Installation procedure without actually mounting the flow tube at its intended location. Fill the flow tube completely with liquid and connect the Up and DN cables according to the Installation/Outline Drawing. Complete the instructions in this section. If you choose to mount the Flow Tube first, please conform to the guidelines presented in this section and the Installation Drawing. In any case, do not proceed with these instructions until the flow tube is filled completely with liquid.*

9. After filling the flow tube with liquid, press the <Right Arrow> to access the [Install Complete?] option list and then move the cursor to [Install] by pressing the<Up/Down Arrow>.

```
Siemens        2 Channel     [1]      FLOW1
Key Install to start operation

  Install FlowTube          1S
  Install Complete?        >Yes
  EmptySet <FT>             New Makeup
  Zero Flow Adjust          Chan Not Setup




Install FlowTube
```

10. To invoke install routine press <Enter>. This triggers Initial Makeup (an internal process that interrogates the flow tube and analyzes setup data to optimize operation). During procedure, the meter shows its progress by highlighting the prompt line.

```
Siemens        2 Channel     [1]      FLOW1
Drive  27               m  10 [6:              :0]

  Install FlowTube          1S
  Install Complete?        Install
  Empty Set <FT>            Chan Not Setup
  Zero Flow Adjust          Chan Not Setup




Install FlowTube
```

11. Upon completion, the computer reports the measured sonic velocity. You can accept this reading or press the <Right Arrow> to adjust it (see field manual for instructions).

12. Pressing the <Down Arrow> accepts the displayed sonic velocity. This moves the highlight to [Empty Set <FT>].

> *Note that the default Empty Set <FT> is [MTYmatic]. The flow computer determines the empty flow tube setting automatically during the Initial Makeup, so use of this menu cell is optional.*

13. Press <Down Arrow> to move the highlight to [Zero Flow Adjust]. Press the <Right Arrow>. This triggers the Zero Flow pop-up window (see below). You can accept the default zero setting: [0.000] or enter a zero offset by typing it with the numeric keys.

    In either case, the flow through the Flow Tube ***MUST BE EQUAL TO ZERO FLOW OR YOUR DESIRED OFFSET.***

```
Siemens        2 Channel    [1]     FLOW1
Conforms Indicated flow to Actual zero

Install FlowTube            1S
Install Complete?           Yes
Empty Set     Zero Flow GAL/MIN
Zero Flow     = 0.000




Install FlowTube
```

14. To start the zero acquisition routine press <Enter>. The highlighted prompt at top of the screen shows: [Integrating "n" (n=counter)]. The integration period continues up a count of 60. You can stop the integration count at any time by simply pressing <Enter>.

    However, it is best to let the computer integrate the readings for the entire count.

```
Siemens        2 Channel    [1]     FLOW1
Integrating 9       Press  [ENT]

Install FlowTube            1S
Install Complete?           Yes
Empty Set <FT>              MTYmatic
Zero Flow Adjust            Actual Zero




Install FlowTube
```

15. When this routine is finished, the cursor moves to [Operation Adjust]. The flowmeter will be measuring flow. Press <Enter> to leave the menu.

    A pop-up window prompts you to save the site. Do so by pressing the <Right Arrow>, then <Enter>. Provide a site name, if desired (see paragraph 6.1.3). This moves you to the flow rate display screen. The flowmeter is now operational.

4.4   SPECIFICATIONS – CPVC FLOW TUBE

Typical values, subject to change without notice.

	Size 1	Size 2
Liquid	Must be compatible with CPVC under operating conditions and free of suspended gasses or solids.	Must be compatible with CPVC under operating conditions and free of suspended gasses or solids.
Pressure Drop	0.28 psi @ 1.5 GPM (5.7 LPM) flowing water at 68°F	0.24 psi @ 4.5 GPM (17.0 LPM) flowing water at 68°F
Sensitivity	0.0005 GPM (0.002 LPM)	0.0015 GPM (0.0057 LPM)
Linearity	1% of flow for rates above 0.09 GPM (0.34 LPM)	1% of flow for rates above 0.27 GPM (1.0 LPM)
Repeatability	±0.2% of flow for rates above 0.6 GPM (2.3 LPM)	±0.2% of flow for rates above 1.5 GPM (5.7 LPM)
Zero Stability	±0.0013 GPM (0.005 LPM)	±0.003 GPM (0.011 LPM)
Accuracy, Intrinsic	±1% of flow over 0.15 GPM (0.57 LPM) to 5 GPM (20 LPM)	±1% of flow over 0.5 GPM (1.9 LPM) to 25 GPM (95 LPM)
Accuracy, Flow Calibrated	±0.5% of flow over 0.15 GPM (0.5 LPM) to 5 GPM (20 LPM)	±0.5% of flow over 0.5 GPM (1.9 LPM) to 25 GPM (95 LPM)
Connection	$^3/_8$" FPT	¾" FPT

4.5   SPECIFICATIONS – KYNAR PVDF FLOW TUBE

Typical values, subject to change without notice.

	Size 1	Size 2
Liquid	Must be compatible with PVDF under operating conditions and free of suspended gasses or solids.	Must be compatible with PVDF under operating conditions and free of suspended gasses or solids.
Pressure Drop	0.28 psi @ 1.5 GPM (5.7 LPM) flowing water at 68°F	0.24 psi @ 4.5 GPM (17.0 LPM) flowing water at 68°F
Sensitivity	0.0005 GPM (0.002 LPM)	0.0015 GPM (0.006 LPM)
Linearity	1% of flow for rates above 0.09 GPM (0.34 LPM)	1% of flow for rates above 0.27 GPM (1.0 LPM)
Repeatability	±0.2% of flow for rates above 0.6 GPM (2.3 LPM)	±0.2% of flow for rates above 1.5 GPM (5.7 LPM)
Zero Stability	±0.0013 GPM (0.005 LPM)	±0.003 GPM (0.011 LPM)
Accuracy, Intrinsic	±1% of flow over 0.15 GPM (0.57 LPM) to 5 GPM (20 LPM)	±1% of flow over 0.5 GPM (1.9 LPM) to 5 GPM (95 LPM)
Accuracy, Flow Calibrated	±0.5% of flow over 0.15 GPM (0.57 LPM) to 5 GPM (20 LPM)	±0.5% of flow over 0.5 GPM (1.9 LPM) to 25 GPM (95 LPM)
Connection	$^3/_8$" FPT	$^3/_4$" FPT

4.6   SPECIFICATIONS – TEFLON PFA FLOW TUBE

Typical values, subject to change without notice

	Size 1	Size 2
Liquid	Must be compatible with PFA under operating conditions and free of suspended gasses or solids.	Must be compatible with PFA under operating conditions and free of suspended gasses or solids.
Pressure Drop	0.23 psi @ 1.0 GPM (3.8 LPM) flowing water at 68°F	0.23 psi @ 3.0 GPM (11.4 LPM) flowing water at 68°F
Sensitivity	0.0004 GPM (0.0015 LPM)	0.001 GPM (0.004 LPM)
Linearity	1% of flow for rates above 0.07 GPM (0.26 LPM)	1% of flow for rates above 0.27 GPM (1.00 LPM)
Repeatability	±0.2% of flow for rates above 0.6 GPM (2.3 LPM)	±0.2% of flow for rates above 1.5 GPM (5.7 LPM)
Zero Stability	±0.001 GPM (0.0038 LPM)	±0.003 GPM (0.012 LPM)
Accuracy, Intrinsic	±1% of flow over 0.15 GPM (0.57 LPM) to 5 GPM (20 LPM)	±1% of flow over 0.5 GPM (1.9 LPM) to 16 GPM (60 LPM)
Accuracy, Flow Calibrated	±0.5% of flow over 0.15 GPM (0.57 LPM) to 5 GPM (20 LPM)	±0.5% of flow over 0.5 GPM (1.9 LPM) to 16 GPM (60 LPM)
Connection	$^1/_2$" Flaretek Ultrapure PFA Tube Fitting	$^3/_4$" Flaretek Ultrapure PFA Tube Fitting

4.7   SPECIFICATIONS – 316 STAINLESS STEEL FLOW TUBE

Typical values, subject to change without notice

	Size 1	Size 2
Liquid	Must be compatible with 316SS under operating conditions and free of suspended gasses or solids.	Must be compatible with 316SS under operating conditions and free of suspended gasses or solids.
Pressure Drop	0.21 psi @ 1.6 GPM (6.0 LPM) flowing water at 68°F	0.20 psi @ 4.5 GPM (17.0 LPM) flowing water at 68°F
Sensitivity	0.0005 GPM (0.002 LPM)	0.0015 GPM (0.0057 LPM)
Linearity	1% of flow for rates above 0.1 GPM (0.38 LPM)	1% of flow for rates above 0.3 GPM (1.1 LPM)
Repeatability	±0.2% of flow for rates above 0.5 GPM (1.9 LPM)	±0.2% of flow for rates above 1.5 GPM (5.7 LPM)
Zero Stability	±0.001 GPM (0.0038 LPM)	±0.004 GPM (0.015 LPM)
Accuracy, Intrinsic	±1% of flow over 0.13 GPM (0.57 LPM) to 10 GPM (40 LPM)	±1% of flow over 0.4 GPM (1.5 LPM) to 30 GPM (114 LPM)
Accuracy, Flow Calibrated	±0.5% of flow over 0.13 GPM (0.5 LPM) to 10 GPM (38 LPM)	±0.5% of flow over 0.4 GPM (1.5 LPM) to 30(114 LPM)
Connection	$^5/_8$" Swagelok Tube Fitting	1" Swagelok Tube Fitting

ADDITIONAL INSTALLATION NOTES

● All Siemens Flow Tubes are supplied with integral line connections. The end-user must supply any adapters, etc. required for line connection.

● When connecting a screwed fitting to a Kynar, Teflon (PFA) or CPVC Flow Tube, please start the thread carefully to avoid cross threading. Hand-tighten only. If necessary, use Teflon tape manufactured for plastic piping to effect a leak-proof seal (see Appendix A - Engineering Drawings for details).

● Whenever possible, use the mounting brackets to support the weight of the flow tube.

● Consult the supplied engineering drawing for important dimensional data.

1011FT Series 316 Stainless Steel Flow Tube
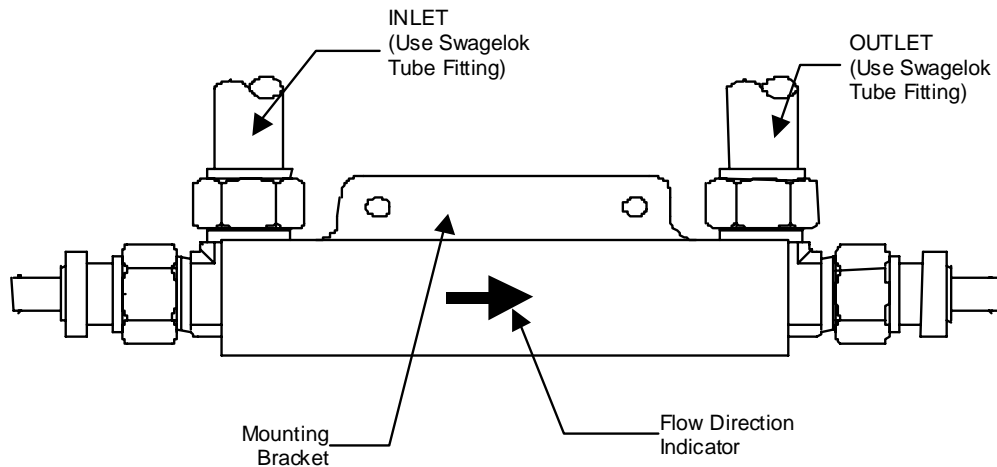
992DFT Series CPVC or Kynar PDFA Flow Tube

Inlet
(FPT)

Mounting
Bracket

Flow
Direction
Indicator

Outlet
(FPT)

SIEMENS
FLOW
V/M   S/N

Model
Identification

Calibration factor (valid for
indicated flow direction
only)
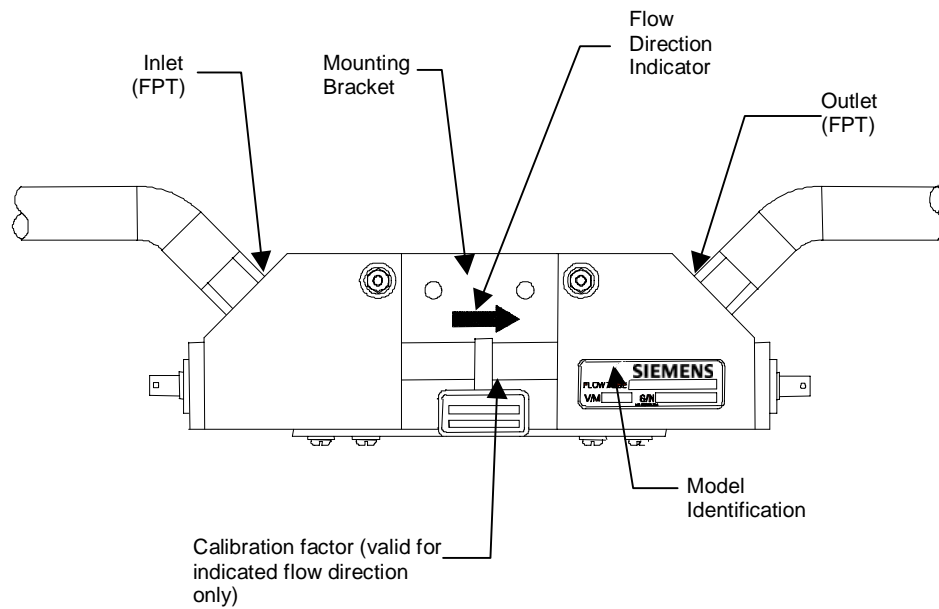
992DFT Series Teflon PFA Flow Tube

Flow
Direction
Indicator

INLET
(Use
Flaretek
Tube Fitting)

OUTLET
(Use
Flaretek
Tube Fitting)

SIEMENS
FLOW TUBE
V/M   S/N

Mounting Bracket

Calibration factor (valid
for indicated flow
direction only)

Model Identification
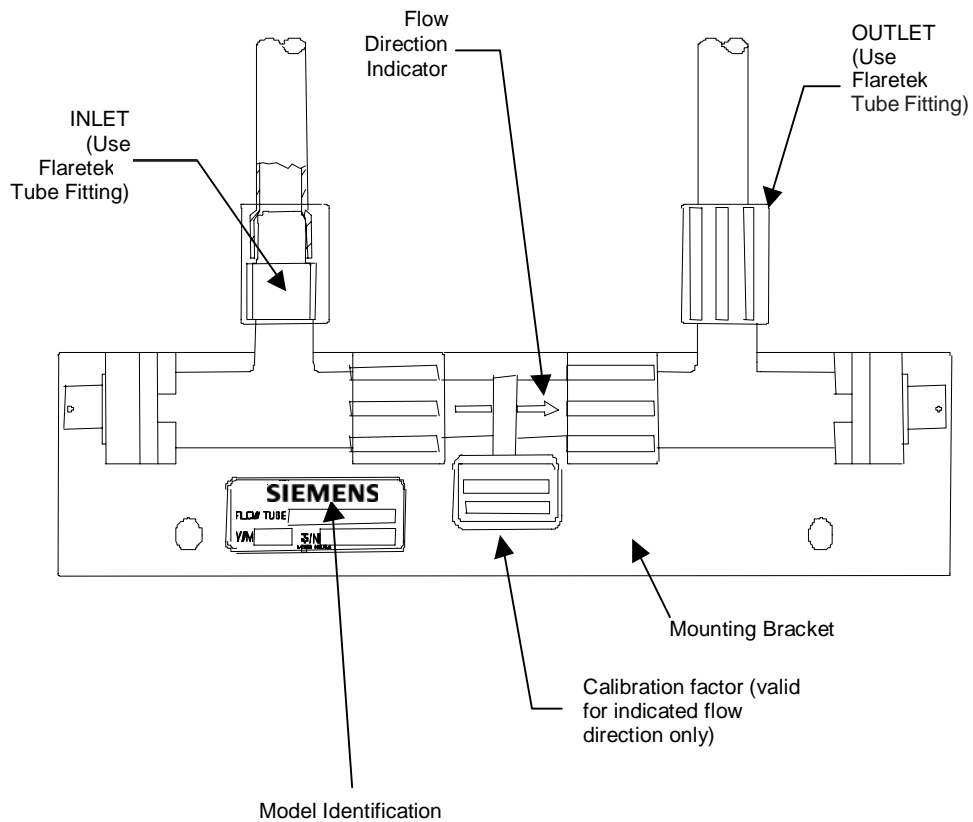
5.   SYSTEM 1020 APPLICATION NOTES

System 1020 is an extremely versatile transit-time flowmeter that operates with either non-intrusive clamp-on or in-line (non-wetted) flow transducers. Please review the following application guidelines to obtain the best service from this equipment.

System 1020 provides a simple menu-driven interface for site programming. During the installation procedure, you tell the system what you need it to do. It will then verify the pipe and liquid conditions, and based on your selections, optimize its operation automatically. However, the system cannot protect itself from critical data entry errors that you input. Its performance depends on the accuracy of the information that you provide it.

For normal operation, the flow computer only needs a receive signal of sufficient amplitude to activate its automatic gain controlled detection circuits. Severely adverse application conditions may reduce system performance, or cause apparent operational failures. Finding the culprit that caused this can usually also reveal an appropriate remedy. Should this still present a problem, call us for technical assistance.

5.1   TO OBTAIN TECHNICAL ASSISTANCE

The meter's computer provides comprehensive diagnostics data. Using this data, our engineers can analyze the system in relation to the application. Proper analysis will provide solutions to virtually any application problem. For technical assistance, please contact your local Siemens representative for expert help (www.siemens.com).

5.2   CONSIDERATIONS FOR CRITICAL APPLICATIONS

All flowmeters depend on site flow conditions and proper installation to achieve precise, critical flow measurements. Unfavorable factors such as liquid non-homogeneity or stratification and aeration/cavitation increase the possibility of reduced accuracy. This applies to all flowmeters, regardless of their design, sophistication, expense and published intrinsic accuracy. These factors become critical when applications involve custody transfer, tenant billing, and nuclear or other safety-related flows.

System 1020 flowmeters automatically compensates for adverse flow conditions to achieve extremely high accuracy. This requires following the instructions for proper equipment selection, use of the correct clamp-on transducer or flow tube configuration, and paying close attention to installation instructions. Such judicious use implies expert equipment knowledge and experience, plus a thorough understanding of flow conditions.

If your application requires critical measurement accuracy, it is not realistic to simply install the flowmeter and expect optimum performance. Carefully review your piping configuration, select the best mounting location and install the transducers or flow tube in strict accordance with the published instructions. Even when the system is calibrated for enhanced precision at a flow laboratory, this does not relieve you of the responsibility of adhering to the programming instructions and installation requirements. We recommend that all potential installers for critical applications participate in our training programs. Another alternative is to commission our trained professionals to start-up the system for you.

5.3   PIPE CONSIDERATIONS FOR CLAMP-ON TRANSDUCER

Clamp-on flow transducers operate on any round pipe that conducts sound. Suitable pipe materials include most metals, plastics, glass and mandrel wound FRP. Pipes with a fine grain structure (e.g., carbon and stainless steel) conduct sound more freely than cast iron, ductile iron or copper pipes. Nevertheless, all are usually acceptable. Unsuitable pipes include concrete or other non-homogeneous materials. Pipe liners are acceptable if they are sonically conductive and bonded solidly to the inner wall of the pipe. The system operates successfully on pipes with cement liners that are "spun" onto the pipe interior to exclude any air bubbles. Pipes with smoothly applied bituminous and epoxy coatings are also acceptable. Plastic liners are universally acceptable, if they are in intimate contact with the inner wall and not merely slipped within the pipe.

5.3.1   PIPE DIMENSIONS

Siemens manufactures transducer assemblies to service pipes from 0.25" to 360" in outer diameter. During the transducer install procedure, the flow computer will recommend transducer sizes based on the site data that you enter. Pipes with OD-to-Wall thickness (OD/W) ratios greater than 10 to 1 are ideal applications. Operation on pipes with OD/W ratios of 7 to 1 (or less) are acceptable, but may exhibit reduced stability and linearity. Generally, higher OD/W ratios provide better stability. If a pipe has a low OD/W ratio, you should use the smaller of the recommended transducer sizes (if the flow computer recommends two transducer sizes).

5.3.2   PICKING THE APPROPRIATE TRANSDUCER

To ensure that you select the appropriate transducers for your application, consider the pipe outer diameter, temperature range and degree of precision required. Decide whether you need two independent flow channels or if you have to operate the system in dual-path configuration for greater accuracy and flow profile aberration immunity.

Initial transducer size recommendations are based on your pipe outer diameter, wall thickness and pipe material entries. However, you can override the meter recommendations to accommodate specific situations. For example, you may own a set of transducers whose size does not appear on the meter list. You may be able to use transducers on a pipe size outside of their nominal pipe OD range. During transducer install, the flow computer recommends Spacing Indices (for spacer bars and mounting tracks) or **Ltn,** (actual distance required between transducers). Once you mount transducers and invoke the install routine, you can determine the suitability of your transducers by checking the signal strength and comparing the reported sonic velocity with the actual sonic velocity of the liquid to be measured.

NOTE: Transducer pairs must have matching serial numbers.

5.3.3   FLOW VELOCITY RANGE

System 1020's flow velocity range with clamp-on transducers is at least ±40 ft/sec regardless of the diameter of the pipe. Depending on application conditions, this range can extend to over 100 ft/sec. This measurement range is greater than needed for virtually any application. For optimum accuracy at very low flow rates and for small line sizes, consider using our 992DFT or 1011FT flow tubes.

5.3.4   OVERVIEW OF SYSTEM PERFORMANCE

Our system performance specifications are based on acceptable liquid sonic conductivity and other pertinent application conditions. The diversity that characterizes liquid flow, makes it impossible for us to cover all possible application conditions that have the potential to reduce performance. Performance

within specifications depends primarily on the receive signal's signal-to-noise ratio and amplitude. The information in the following paragraphs may point to application conditions that could reduce system performance below its normally high level.

5.3.5 ACCURACY

Although system accuracy is exceptional over a wide turndown ratio, at extremely low flow rates, a small zero offset becomes a high percentage of actual flow. Obviously, the ultimate accuracy will be obtained by performing an on-site flow calibration. A flow calibration can increase system accuracy to between 0.3% to 0.5%, depending on application conditions.

Two common data-entry mistakes may reduce performance. If you enter an incorrect liquid viscosity value, you could compromise the intrinsic flow profile compensation curve. Incorrectly identifying the transducers will reduce accuracy. Measured sonic velocity (Vs) errors will usually reveal this problem and, simply returning to the appropriate menu cells, entering the correct values, then repeating the transducer installation, will resolve it.

5.3.6 REPEATABILITY

Some applications require repeatability rather than absolute accuracy. System 1020 features excellent repeatability specifications since its digital "no moving parts" design avoids the adverse effects of hysteresis and other wear mechanisms typical of mechanical devices.

5.3.7 DATA STABILITY

Two main factors influence the system's data stability: *Data Scatter and Drift.*

Data Scatter

Data scatter is a rapid variation in flow readings (within a span of about 0.1 to 5 seconds). Minimal data scatter (approximately 0.01 to 0.03 ft/sec) is a natural by-product of digital computation that extracts the extremely small difference in the up vs. down sonic transit time. Minimal data scatter will not influence the integrated flow total over periods as short as several minutes. Naturally, it will be a greater percentage of the reading when the meter measures extremely low flow rates. Poor liquid sonic conductivity may attenuate sonic signal to a level that increases data scatter. You should check the signal level (Valc %) item on the Diagnostic Menu. Usually, this is indicated by a low Valc % value (less than 30).

System 1020 does not exhibit inertia since it has no moving parts. In addition, it takes readings ten times per second. Therefore, it can detect and track very brief flow fluctuations that are beyond the response capability of some conventional meters. This performance level is required for detecting very fast and short flow transients or for a fast-response servo control loop application. However, you can use the damping and slewing controls to smooth the output response if you want the system to ignore rapid flow fluctuations or data scatter.

Data Drift

Drift is a defined as a long-term cyclical flow deviation resulting from the variation of liquid temperature or liquid sonic velocity. Drift may be more noticeable when combined with a poor signal-to-noise ratio. System 1020 is carefully designed to minimize the effects of drift. There are no drift-prone analog phase-locked loop devices in the primary detection circuits. In addition, we use only the most stable plastics or steel to construct our transducers.

5.4   FLOW CONDITIONS

Very rarely are real-world flow conditions uniform and predictable. Therefore, the 1020 operating system provides a considerable degree of control over the stability/agility of the flow rate output. System 1020 is significantly more agile in tracking pressure wave induced Vs transients, and will recover from mistracking more quickly and smoothly than any other competing transit-time flowmeter.

5.4.1 LOW FLOW RATES

Our 1020 Systems provide a flow resolution and measurement range that surpasses any other type of flowmeter. Therefore, it operates superbly for low or high flow rate applications. However, with our clamp-on systems, using the highest resolution when measuring a low flow rate may cause natural data scatter to become a high percentage of the reading. Since it is data scatter, it will not contribute any error to a totalizer reading accumulating for at least several minutes. However, if the flow rate is extremely low (e.g., under 0.25 ft/sec) the minute zero drift retained by the system may cause an observable performance decline. Therefore, if your application involves extremely low flow velocities, and your line size is 2" or under, our 992DFT or 1011FT Flow Tubes might serve you best.

5.4.2 FLOW DATA SCATTER AND DAMPING

The transit-time flowmeter's ability to respond to the extremely fast flow fluctuations that characterize "real" flow may surprise you. Most conventional flowmeters cannot detect these rapid flow fluctuations since they are subject to unavoidable mechanical inertia. System 1020's response speed is ideal for tracking fast flow transients. However, if this performance is unnecessary, you can smooth the System 1020's response time to suit any application.

System 1020 Damping and Slewing Controls

The 1020 can detect and display minute flow fluctuations that are always present, though not usually detectable by typical flowmeters. This rapid response accommodates applications that require the tracking of fast flow transients.

Time Average is a filter that controls the output damping (the number of samples averaged together to produce the instrument's primary rate output). It allows you to enter a value in seconds that the flow computer uses to integrate its response to flow changes. Do not confuse this with the update speed of analog outputs. This occurs every 0.2 seconds, regardless of the time average that you select. One practical application is to set the time average damping so that the meter maintains a smooth output, when it is installed downstream from devices (e.g., a positive displacement pump) that may cause regular surges in the liquid flow.

SmartSlew is a digital signal processing method that generates a variable time constant based on the real-time assessment of collected data. When the flow data exhibits a steady trend, SmartSlew extends the time constant - resulting in very smooth data output. SmartSlew instantaneously reduces the time constant whenever the trend of flow changes, even for a short duration. The flow output quickly follows the slewing of actual flow. SmartSlew thus provides excellent data without sacrificing the fast response required for precise flow control. Feel free to experiment with time average damping and slewing factors to discover which settings optimize the collected data. With SmartSlew enabled, you can create very smooth output graphs without losing the ability to respond to fast flow transients that may be undetectable with the fixed time average filter enabled.

5.4.3 NOTES ON LIQUID CONDITIONS

Successful transit-time flow measurement depends on sonic transmit signals traveling through liquid and arriving at the receive transducer without excessive attenuation. Receive signals can be scattered by liquids carrying dispersed particulate matter, either of a solid, non-homogeneous or gaseous nature. This is especially true if the dispersed material is of different sonic impedance than the base liquid. Liquids that contain an excess of gas bubbles or mineral solids may prove to be unsatisfactory transit-time applications. However, these liquids are perfectly suitable for Reflexor flowmetering. Liquids containing dissolved gasses or dissolved organic solids will not cause any problems for transit-time operation.

Most liquids are excellent sonic conductors, regardless of their electrical or optical properties. Although highly viscous liquids exhibit a greater degree of sonic attenuation, System 1020 operates perfectly with the vast majority of these liquids. The **Valc %** (signal strength) item on the Diagnostic Menu is a good indicator of this condition. A low value (under 30) indicates a possible low liquid sonic conductivity, or improper transducer installation.

5.4.4 ERRONEOUS LIQUID PARAMETER SPECIFICATION

The viscosity of the liquid is an important factor. It governs the degree of Reynolds Number compensation that the flow computer applies to the final rate output. Therefore, flow data errors could result if you enter an inaccurate viscosity value. Controlotron's Technical Service Department can provide reliable viscosity data for most liquids.

5.4.5 LIQUID COMPATIBILITY

Since our clamp-on transducer systems never contact liquid, the issue of liquid compatibility only applies to entrained gases or mineral solid content that might impair sonic signals Since System 1020 is designed to measure flow using both transit-time and Reflexor™ techniques, we can safely say that it will operate most successfully on virtually all liquids. Although highly viscous liquids exhibit a greater degree of sonic attenuation, the 992 and 1011 Series Flow Tubes operate successfully with most of these liquids as well (see paragraph 4.1.1).

5.4.6 AERATION

Undissolved gases, having very low sonic impedance, may cause sonic beam scattering. In large quantities, they can reduce the sonic signal strength. Small bubbles, caused by cavitation, usually provoke more signal loss than an equal quantity of large gas bubbles. Usually, the problem can be alleviated by eliminating the cause. Aeration may be caused by a mixing tank, throttling valve cavitation, or air suction upstream of the transducer location.

System 1020 can operate successfully with a larger amount of aeration than any other transit-time flowmeter. It measures and reports the aeration level as the analog output, Vaer %. This represents the relative degree of aeration detected within the flow stream. Its computer reports the Vaer level until it impedes operation and forces a Fault Alarm. The Vaer output accommodates applications requiring an aeration indicator. The Vaer also appears on the display screen. The aeration percentage can be used as an alarm relay set-point. You can set the aeration alarm setpoint such that it trips before aeration reaches a level that impairs flow measurement.

NOTE: Before performing the installation routine, allow enough time for the liquid to flush out all air trapped in the pipe.

5.4.7 SLURRIES

High-density undissolved solids (e.g., sand slurry) may cause application problems if present in sufficient quantity to scatter the sonic beam significantly. Low-density solids, such as organic materials, coal slurries and unaerated sewage sludge, are usually adequate sonic conductors and their sonic impedance is very close to most liquids. Excessive mineral solids though could trigger the aeration alarm.

5.4.8 TWO-PHASE LIQUIDS

Two-phase liquids (e.g., oil and water) cause some sonic beam scattering. However, these usually conduct sonic beams sufficiently for proper operation (unless heavy aeration is present also). Two-phase liquids with large quantities of different components, such as sand or free gas, could prove to be too attenuative for transit-time operation. However, switching to Reflexor mode will keep the meter operational under these circumstances.

5.4.9 VISCOUS LIQUIDS

Highly viscous liquids tend to "absorb" some of the energy of the sonic beam. This causes a reduction of signal amplitude when compared to low viscosity liquids. However, most high viscosity liquids are sufficiently conductive for acceptable operation. A low Valc % value usually indicates low sonic conductivity.

5.4.10 TEMPERATURE AND PRESSURE RATINGS

We rate our 1021 and 1011 Universal transducers for operation up to 250°F. For higher temperature applications the System 1010 series of flowmeters should be used. Please refer to Section 4 for flow tube pressure and temperature ratings.

5.5   OVERVIEW OF SYSTEM 1020 MEMORY RESOURCES

System 1020 memory resources include both Read-Only-Memory (ROM) and battery-backed Random Access Memory (RAM). The ROM memory contains the system operating instructions, on-line help text, default data, and the pipe, transducer and liquid tables.

The flowmeter uses 1 Megabyte of RAM (standard) to provide three discrete storage functions:
Active Memory - Site Storage Memory - Datalogger Memory.

Upon creating a site, the meter copies all ROM-based defaults into the meter's operational database, the *Active Memory*. This provides two advantages. First, RAM-based operation increases performance. Second, this creates an immediate Site Setup, based on the meter's defaults. To make the meter operational, you just have to enter *required* data (e.g., pipe and transducer data) and edit other default settings to suit your application. When you program the meter, all your entries are retained in the Active Memory. This enables you to use the meter immediately after finishing a Site Setup. You're not limited to one set of site parameters. You can copy site data from *Active Memory* to *Site Storage Memory*.

Site Storage Memory provides permanent storage area for several inactive Site Setups. The multi-site storage feature allows rapid reinstallation at many locations. All you have to do to reactivate an inactive Site Setup is to recall it back into to *Active Memory*. However, be aware that this action over-writes ALL the data residing in the *Active Memory* area.

The Datalogger logs data collected at preset intervals during operation. It uses the system RAM resources independently of *Active Memory* and *Site Storage Memory*. Therefore, data movement between Active Memory and Site Storage memory will not affect it directly. However, all stored data

shares a common RAM pool. The meter allocates the actual amount of bytes available for each storage function dependent on the demands of each facility. Therefore, an unusually large Datalogger file may reduce the amount of site storage memory available. Storing several inactive site setups may reduce the available logging capacity.

If you receive a [Memory Full!] message when you try to save a Site Setup, then you will have to delete an obsolete Site Setup or clear the Datalogger Memory to make room. Another Datalogger memory consideration applies to dual-channel systems, when both measurement channels are actively logging data. Dual-channel meters store logged data from BOTH channels in a common file so you must include Site ID for each line to identify the applicable measurement channel.

The 1020 also offers a Memory Map and Defragmenting command in the Meter Facilities area of the menu as an aid in visualizing and maximizing the efficient utilization of your meter's memory resources.

5.6   REFERENCE TABLES

The following tables provide reference data that may be required during the Site Setup.

SONIC VELOCITY (in meters/sec) FOR COMMON LIQUIDS @ 68°F

Liquids/Oils	Vs(m/s)	Liquids/Oils	Vs(m/s)
Acetate, Butyl (n)	1270	Ethanol	1180
Acetate, Ethyl	1180	Ethylene Glycol	1620
Acetate, Methyl	1150	Gasoline	1250
Acetate. Propyl	1180	Glycerine	1920
Alcohol	1440	Linalool	1400
Alcohol, Butyl (n)	1270	Linseed Oil	1770
Alcohol, Ethyl	1180	Methylethyl Ketone	1210
Alcohol, Methyl	1120	Motor Oil (SAE 20/30)	1487
Alcohol, Propyl (i)	1170	Paraffin Oil	1420
Alcohol, Propyl (n)	1220	Pentane	1010
Benzene	1330	Petroleum	1290
Benzol, Ethyl	1340	Trichlorethylene	1050
Butyrate, Ethyl	1170	Transformer Oil	1390
Carbon Tetrachloride	938	Turpentine	1280
Diethyl Ketone	1310		

SONIC VELOCITY FOR PURE WATER @ VARIOUS TEMP. (meters/sec)

Liquid	Deg. C	Deg. F	Vs (m/s)	Liquid	Deg. C	Deg. F	Vs (m/s)
Water	0	32	1402	Water	120	248	1519
	10	50	1447		130	266	1503
	20	68	1482		140	284	1485
	30	86	1509		150	302	1466
	40	104	1529		160	320	1440
	50	122	1543		170	338	1412
	60	140	1551		180	356	1390
	70	158	1555		190	374	1360
	80	176	1554		200	392	1333
	90	194	1550		220	428	1268
	100	212	1543		240	464	1192
	110	230	1532		260	500	1110

Vps VALUES (in inches/second) FOR SOME COMMON METALS

Metal	Vps (in/sec)	Metal	Vps (in/sec)
Aluminum	120,000	Magnesium O-1	120,000
AL 1100 (2S)	121,000	Magnesium ZK-60A-TS	120,000
AL 1100-0 (2S0)	122,000	Monel	107,000
AL 2014 (14S)	121,000	Molybdenum	132,000
AL 2024-T4 (24ST)	124,000	Nickel	118,000
AL 2117-T4 (17ST)	123,000	Steel, 302 Cres.	123,000
Brass	89,400	Steel, 347 Cres.	122,000
Brass, Alpha	79,500	Steel, 1020	128,000
Brass, Half Hard	80,700	Steel, 1095	126,000
Brass, Naval	83,500	Steel, 4150, Rc14	110,000
Bronze, Phosphor	87,800	Steel, 4150, Rc18	125,000
Cadmium	59,100	Steel, 4150, Rc43	126,000
Carpenter 20 Steel	117,900	Steel, 4340	126,000
Columbium	82,700	Tantalum	114,000
Columbium (10W, 10TN)	74,800	Tin	65,700
Constantan	104,000	Titanium	122,000
Copper	89,400	Titanium, T1 150A	124,000
Iconel	119,000	Titanium Carbide	203,000
Iron	127,000	Tungsten	113,000
Iron, Cast	110,000	Vanadium	109,000
Magnesium AM-35	122,000	Zinc	94,900
Magnesium PS-1	119,000	Zirconium	88,600
Magnesium J-1	118,000		

SONIC VELOCITY OF PURE WATER RELATIVE TO TEMPERATURE

Temp °F	Velocity M/S	Temp °F	Velocity M/S	Temp °F	Velocity M/S
0.0	1292.45	106.0	1530.67	212.0	1543.11
2.0	1300.64	108.0	1532.40	214.0	1542.10
4.0	1308.63	110.0	1534.06	216.0	1541.05
6.0	1316.44	112.0	1535.64	218.0	1539.97
8.0	1324.06	114.0	1537.16	220.0	1538.85
10.0	1331.50	116.0	1538.61	222.0	1537.70
12.0	1338.77	118.0	1539.99	224.0	1536.51
14.0	1345.86	120.0	1541.30	226.0	1535.29
16.0	1352.78	122.0	1542.55	228.0	1534.03
18.0	1359.53	124.0	1543.74	230.0	1532.74
20.0	1366.12	126.0	1544.86	232.0	1531.42
22.0	1372.55	128.0	1545.91	234.0	1530.06
24.0	1378.82	130.0	1546.91	236.0	1528.67
26.0	1384.94	132.0	1547.84	238.0	1527.26
28.0	1390.90	134.0	1548.72	240.0	1525.81
30.0	1396.72	136.0	1549.53	242.0	1524.33
32.0	1402.39	138.0	1550.29	244.0	1522.83
34.0	1407.91	140.0	1550.99	246.0	1521.29
36.0	1413.30	142.0	1551.63	248.0	1519.73
38.0	1418.55	144.0	1552.21	250.0	1518.14
40.0	1423.66	146.0	1552.74	260.0	1507.00
42.0	1428.64	148.0	1553.22	270.0	1497.00
44.0	1433.48	150.0	1553.64	280.0	1487.00
46.0	1438.20	152.0	1554.01	290.0	1476.00
48.0	1442.80	154.0	1554.32	300.0	1465.00
50.0	1447.27	156.0	1554.59	310.0	1453.00
52.0	1451.62	158.0	1554.80	320.0	1440.00
54.0	1455.85	160.0	1554.98	330.0	1426.00
56.0	1459.97	162.0	1555.07	340.0	1412.00
58.0	1463.97	164.0	1555.13	360.0	1383.00
60.0	1467.86	166.0	1555.15	370.0	1368.00
62.0	1471.64	168.0	1555.11	380.0	1353.00
64.0	1475.31	170.0	1555.03	390.0	1337.00
66.0	1478.88	172.0	1554.90	400.0	1320.00
68.0	1482.34	174.0	1554.72	410.0	1302.00
70.0	1485.70	176.0	1554.49	420.0	1283.00
72.0	1488.96	178.0	1554.22	430.0	1264.00
74.0	1492.13	180.0	1553.91	440.0	1244.00
76.0	1495.19	182.0	1553.55	450.0	1220.00
78.0	1498.16	184.0	1553.14	460.0	1200.00
80.0	1501.04	186.0	1552.70	470.0	1180.00
82.0	1503.82	188.0	1552.21	480.0	1160.00
84.0	1506.52	190.0	1551.67	490.0	1140.00
86.0	1509.13	192.0	1551.10	500.0	1110.00
88.0	1511.65	194.0	1550.48		
90.0	1514.08	196.0	1549.82		
92.0	1516.44	198.0	1549.12		
94.0	1518.70	200.0	1548.38		
96.0	1520.89	202.0	1547.60		
98.0	1523.00	204.0	1546.78		
100.0	1525.03	206.0	1547.60		
102.0	1526.99	208.0	1545.02		
104.0	1528.86	210.0	1544.08		

SYSTEM 1020 REYNOLDS COMPENSATION FACTOR

Reynolds #	Positive Comp	Negative Comp
0	0.7808	0.7808
1277	0.7869	0.7869
1566	0.7930	0.7930
1694	0.7991	0.7991
1830	0.8052	0.8052
1930	0.8113	0.8113
1986	0.8174	0.8174
2044	0.8234	0.8234
2104	0.8295	0.8295
2166	0.8356	0.8356
2227	0.8417	0.8417
2287	0.8478	0.8478
2348	0.8539	0.8539
2410	0.8600	0.8600
2476	0.8661	0.8661
2558	0.8722	0.8722
2656	0.8783	0.8783
2759	0.8844	0.8844
2853	0.8905	0.8905
3077	0.8965	0.8965
3477	0.9026	0.9026
4006	0.9087	0.9087
4651	0.9148	0.9148
5678	0.9209	0.9209
7582	0.9270	0.9270
10000	0.9296	0.9296
13326	0.9331	0.9331
33832	0.9375	0.9375
97443	0.9420	0.9420
278428	0.9464	0.9464
779166	0.9508	0.9508
2184262	0.9553	0.9553

TERMINOLOGY CHART

This chart provides explanations for uncommon terms used in this manual.

TERM	EXPLANATION
Active Memory	Section of RAM allocated for active site parameters (all current values). The flow computer receives site-specific operating instructions from Active Memory.
Alphanumeric Field	An 8-character data entry field that allows you to specify a Site Name or a Security code.
Arrow Keys	Use the <Up, Down, Left and Right> Arrows to navigate through the Installation Menu in their respective directions. The <Up or Down> Arrows allow you also to scroll through option list items.
Asterisk	Refers to the marker used in the Installation Menu to indicate a current option list selection. When you access an option list, you can move the asterisk with the <Up or Down> Arrows to a new selection, then press <Enter> to select the item.
Cursor	This refers to the highlighted text and the arrow cursor that you move via the arrow direction when navigating through menus or menu cells.
Data Entry	Refers to data entered into a menu cell (either numeric or option list selection).
Datalogger Memory	Memory segment that stores data items logged during operation. You can view the Datalogger contents either on-screen or transmit it to an external device via the RS-232 serial port. The amount of Datalogger memory depends on how many sites reside in Site Storage memory.
ENTER Key	Use the <ENTER> key to store a current numeric value or option list item.
Flow Computer	Refers to the meter itself (system refers to the meter and transducers combined).
Flow Tube	Refers to our in-line (non-wetted) transducer assemblies suite for small (under 2" lines) and extremely low-flow applications.
Graphic Screen	Refers to the integral display screen.
Initial Makeup	An internal process performed during installation, where the flow computer acquires its receive signal and enhances other parameters for optimal operation at a site.
In-process Makeup	An internal process where the flow computer recovers its Initial Makeup parameters, after a fault condition interrupts operation.
Installation Menu	The meter's overall menu structure. Allows you to define all aspects of the meter's operation.
Interface m/s	Refers to an alarm function that declares the passage of a liquid interface by a comparison of the relative sonic velocities of the two liquids.
LAPTOT	Refers to a system function that freezes the Totalizer display, while the Totalizer continues to update its registers.
Spacing Offset	Fixed transducer offset assigned by the flow computer. This can be over-ridden by the installer.
Local Display Menu	Refers to the 1020's integral display screen. Sub-sections of the Installation Menu that you to define specific operational functions (e.g., RS-232 Setup).

(continued)

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TERM	EXPLANATION
Menu Cell	A location within a Menu where you define either a single numeric value or option list selection that supports the Sub-Menu's function. Certain view-only menu cells show reference data appropriate to the current application.
NEGFLOW	Totalizer mode for negative flow total only.
NETFLOW	Totalizer mode that combines positive and negative flow totals.
NOTOT	System function that disables the internal Totalizer.
Number Index	Computed transducer spacing index based on the estimated sonic velocity measurement. This Index **cannot** be overridden by installer.
Numeric Data	Refers to a value entered into a menu cell. An example would be the pipe outer diameter.
Numeric Entry	Refers to a number you type into menu cell that stores numeric data.
Numeric Keys	Use PC numeric keys to type a numeric value where appropriate.
OpSys ROM	The read only memory that stores its basic operating instructions and permanent defaults.
Option List	Lists of options presented at menu cells that allow you to select either a single item or multiple items (depending on the function that the menu cell controls).
Parameter	Refers to value (either numeric or list selection) stored in a menu cell.
POSFLOW	Totalizer mode for positive flow total only.
Register	Refers to a memory location used by the flow computer to store data such as the flow total, etc.
Site Name	A user-entered name that meter associates with a stored Site Setup. You retreive a particular Site by selecting its name from a site name list.
Site Setup	A collection of parameters used by the meter to service a specific site (or location).1020 allows you to store several independent Site Setups.
Site Storage Memory	Section of RAM allocated for permanent data storage. This memory segment stores inactive site setups (including a backup of active site). The meter's Site Setup storage capacity depends on the dynamic memory allocation as dictated by each application. In addition, the meter uses Site Storage Memory to store configurable operating parameters such as pipe and liquid tables.
Spacing Index	Refers to the Number Index, used by the flow computer to determine the space between the upstream and down stream transducers on clamp-on systems.
TOTCNT	A totalizer pulse count function used for Batching or Sampling.
Transducer	Clamp-on flow sensors that the meter uses to measure the flow rate.
Vaer	The meter's aeration percent output.
Vps	The sonic propagation velocity of a pipe.
Vs	The sonic velocity of a liquid.

5.7 THE NEMA DUAL-PATH MENU CHART

This section shows the 1020 Permanent Dual Path Menu Chart. The Dual Path Flow, Dual Channel Flow, Ch 1+2 Flow and Ch 1-2 Flow Channel Setup menus are virtually identical. The Flow Tube menu repeats the Clamp-On menu, except for the exclusion of menu cells only appropriate for clamp-on transducers.

NOTE: The Installation menu for single channel systems does not provide the Meter Type choices shown below.

THE METER TYPE MENU

⇨ Meter Type	⇨ Dual Channel Flow	⇨ Channel 1	⇨ Clamp-On	⇨ Channel Setup
	⇕	⇕	⇨ Flow Tube	⇨ Channel Setup
		⇨ Channel 2	⇨ *same as Ch. 1*	
	⇨ Dual Path Flow	Channel/Path Setup		
⇕	⇨ Ch 1+2 Flow	⇨ Channel 1	⇨ Clamp-on	⇨ Channel Setup
		⇕	⇨ Flow Tube	⇨ Channel Setup
	⇕	⇨ Channel 2	⇨ *same as Ch. 1*	
		⇨ Channel 3	⇨ Channel 3 Setup	⇨ Channel Setup
	⇨ Ch 1-2 Flow	⇨ *Same as Ch 1+2 Flow*		

THE METER FACILITIES MENU

Meter Facilities ⇨	Preferred Units ⇨ ⇕	⇕ English Metric	
	Table Setups ⇨ ⇕	Pipe Table ⇨ ⇕	Create/Edit Pipe ⇨ ⇕	⇕ Choose Pipe Class Choose Pipe Name Outer Diameter Wall Thickness Liner Material Liner Thickness
			⇨ Delete Pipe ⇨	⇕ Choose Pipe Class Pick Pipe Name
		⇨ Transducer Type ⇨ ⇕	⇕ 1011 Universal / 991 Universal 1021 Xdcr	
	Datalogger Cntrl ⇨ ⇕	⇕ Output Datalogger Circular Memory Est LogTime Left Clear Datalogger	
	Memory Control ⇨ ⇕	⇕ Data Memory Left Defragment	
⇕	Analog Output Trim ⇨ ⇕	Trim Io 1 ⇨	⇕ Operate Trim @ 4mA
	⇨	Trim Io 2 ⇨	⇕ Operate (2 Channel) Trim @ 4mA
	Clock Set ⇨ ⇕	⇕ Date Time	xx.xx.xx xx.xx.xx xx.xx
	RS-232 Setup ⇨ ⇕	⇕ Baud Rate Parity Data Bits Line Feed Network ID RTS Key Time	
	System Info ⇨ ⇕	⇕ Version Reset Date/Time Op System P/N Checksum Code System Time	xx.xx.xx. xx.xx.xx

THE CLAMP-ON MENU

Clamp-On ⇨	Channel Setup ⇨	⇕ Recall Site Setup Channel Enable Create/Name Site Site Security Delete Site Save/Rename Site	
	Pipe Data ⇨	⇕ Pick Pipe Class Select Pipe Size Pipe OD (in / mm) Pipe Material Wall Thickness Liner Material Liner Thickness	
	Application Data ⇨	Liquid Class ⇨	⇕ Select Liquid Estimated Vs m/s Viscosity cS Density S.G.
	⇨	Pipe Configuration ⇨	⇕ Fully Developed (default) 1 Elbow Dbl Elbow + Dbl Elbow - Valve Expander Reducer Norm Entry Header Inlet Intrusions
⇕	Pick/Install Xdcr ⇨	⇕ Install Path Transducer Model Transducer Size Xdcr Mount Mode Spacing Offset Number Index Spacing Method Ltn Value Install Complete? Empty Pipe Set Zero Flow Adjust	(Dual Path only)
	Operation Adjust ⇨	Damping Control ⇨	⇕ SmartSlew Time Average
	⇨	Deadband Control ⇨	x.xx (numeric entry)
	⇨	Memory/Fault Set ⇨	⇕ Fault Memory
	⇨	Memory Delay <s> ⇨	x.xx (numeric entry)
	Flow/Total Units ⇨	⇕ Flow Volume Units Flow Time Units Flow Display Range Flow Display Scale Total Volume Units Totalizer Scale Total Resolution Totalizer Mode Batch/Sample Tot Reset Totalizer	
	Data Span/Set/Cal ⇨	Span Data ⇨	⇕ PGEN Max Flow (Units) Min Flow (Units) Max Vs m/s

(continued)

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THE CLAMP-ON MENU *(continued)*

Clamp-On ⇨	Data Span/Set/Cal ⇨	Span Data ⇨	Min Vs m/s
	⇨	Set Alarm Levels ⇨	⇕ Hi Flow (Units)
			Low Flow (Units)
	⇕	⇕	Interface Vs m/s
			Aeration %
			Makeup Latch
	⇨	Calibrate Flow Rate ⇨	⇕ Intrinsic
		⇕	Kc
			MultiPoint
	Datalogger Setup ⇨	⇕ Datalogger Mode	
		Datalogger Data	
	⇕	LogTime Interval	
		Datalogger Events	

I/O Data Control ⇨	Analog Out Setup ⇨	Io1/Io2 ⇨	⇕ Vfo
			Vfab
⇕	⇕		Vs
			Valc
			Vaer
⇨	Relay Setup ⇨	Relay 1	(See para. 6.9)

Diagnostic Data ⇨	*Path Select ⇨	⇕ 1 and 2
	⇕	1
		2
⇨	*Path Enable	No/Yes
⇨	Flow Data	⇕ Flow
		Flow Vel F/S
		Total
		Vs m/s
		Signal mV
	⇕	Valc %
		Vaer %
		Alarm Status
		AnCal
		HiFlow
		LoFlow
⇨	Application Info ⇨	⇕ TN uSec
		TL uSec
		DeltaT nSec
⇕	⇕	Burst/Sec
		% Accepted
		Last Makeup
		Makeup Status
⇨	Liquid Data ⇨	Reynolds #
⇨	Site Setup Data ⇨	⇕ fx (drive)
		N (burst length)
		Ltn in
		Vfmax
		Vs max m/s
	⇕	Vs min m/s
		Empty %
		Samples/Cycle
		Max Damping
		Min Damping
		HF
⇨	Test Facilities ⇨	⇕ Makeup
		Tx Up
		Tx Dn
	⇕	Fixed ALC
		Tx Up Fixed ALC

*Dual Path only

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(continued)

THE CLAMP-ON MENU *(continued)*

Clamp-On ⇨	Diagnostic Data ⇨	Test Facilities	Tx Dn Fixed ALC
⇕	⇨ ⇕	Print Site Setup ⇨	⇕ No / Yes
	⇨	Date Site Created: ⇨	xx.xx.xx. xx.xx

6.   THE 1020 INSTALLATION MENU

Programming System 1020 requires no special experience or training. This field manual contains all the necessary information. If you intend to connect this instrument to an external device, then please have the instruction manual for the device available for reference. The following paragraphs present a generic menu reference that applies to all configurations of 1020 NEMA 4 flowmeters.

This section contains a general description of how to enter site setup data via the 1020 Installation Menu. It assumes that you have already selected a meter type as described in the Getting Started section. For convenience, it presents the Installation Menu in the same sequence as it appears on the menu screen. Please note, however, that it is not necessary to program the meter sequentially. Refer to Section 2 to see how the Installation Menu appears on the 2x16 Character LCD Panel Display. In addition, refer to Section 2 for a general description of how to enter data and how to complete a basic Site Setup.

The conventions used with these instructions are:

● When the text refers to a KeyPad key or PC keyboard key, it will be enclosed in "less than" (<) and "greater than" (>) symbols (e.g., <ENTER>, <UP Arrow>, etc.).

● Where a visual of the key is shown; this means press this key.

● When the text refers to a menu or menu cell name, it will be enclosed with square brackets: e.g., [Pipe Data], [Channel Enable], etc.

● Each menu includes an image of its main screen and a diagram of its structure. The rightmost column of the structure diagram lists the option list choices of the menu cell, if applicable.

General Installation Menu Notes

● If a power failure occurs while you are entering or editing data, the entered data may not be retained in Active Memory.

● Although you can operate the meter immediately after completion of the site setup, we recommend that you preserve your settings by saving them under a site name. Site data can be saved at any time *before* invoking either the [Recall Site Setup] or the [Create/Rename Site] commands. When issued, these commands overwrite all data present in Active Memory. The meter will prompt you to save your site each time you leave the menu.

● The meter allows you to create your own personal site setup defaults. After creating a site setup and editing default parameters as desired, save the site using the name [FASTSTRT]. The next time you issue the [Create/Name Site] command, your custom parameters will become the system's defaults.

● We do not recommend that you attempt to operate the flowmeter at a new site by recalling and then editing an existing site setup. Each site must have its own set of transducer installation parameters, even if the data from the recalled site setup is identical.

● Always issue the [Create/Name Site] command to begin a new site setup. This will fill all the menu cells with defaults to eliminate the possibility of retaining unwanted parameters.

6.1   THE CHANNEL SETUP MENU

This menu is available after picking a meter type and a measurement technology. Use this menu to manage site setups. You can create, recall, delete and save entire site setups. You can apply Site Security, which permits read-only access to the Installation Menu unless you enter a password. The Channel Enable switch allows you to disable and enable a measurement channel. *Be aware that site name option lists only show sites that are consistent with the currently selected meter type.*

CHANNEL SETUP MENU STRUCTURE

Channel Setup	⇨	Recall Site Setup	⇨	*Site Name
		Channel Enable	⇨	⇕ Yes / No
⇕		Create/Name Site	⇨	*Site Name Entry/Edit
		Site Security	⇨	⇕ Off / On
		Delete Site Setup	⇨	Site Name List
		Save/Rename Site	⇨	Site Name Entry/Edit

This shows that the Meter Type is Dual Channel, operating with Channel 1 active.

This shows that the site setup [XYZ] is the active site.

Siemens   2 Channel [1]   XYZ
Scroll saved Site Setup list and Enter

Recall Site Setup	**XYZ**
Channel Enable	**Yes**
Create/Name Site	**1**
Site Security	**Off**
Delete Site Setup	**1**
Save/Rename Site	**1**

Channel Setup

This cell shows that site setup [XYZ] is stored in memory, and can be recalled. This option list expands as you save more sites.

Use this menu cell to enable or disable Site Security. Provide a password to enable. Re-enter the password to disable.

Use this menu cell to create and name a site setup. Note that the cell retains the name of the most recently created site setup [XYZ].

Use this menu cell at any time to manually save the site data. Note that attempting to leave the menu after entering/editing any site data triggers a Save Site pop-up window automatically.

Use this menu cell to free up site storage memory by deleting obsolete site setups. Note that the cell retains the name of the most recently created site setup [XYZ]. This option list expands as you save more sites.

6.1.1 HOW TO RECALL A SITE SETUP

The [Recall Site Setup] command allows you to reinstall the system at a former site. For an original installation, see [Create/Name Site] for instructions on how to create a new Site Setup. This menu cell provides a list of saved site names. Scrolling to a site name and pressing <ENTER> moves all the parameters associated with that name into Active Memory.

If there are no site setups present in site storage memory, the menu cell reports [No Sites] in the right-hand column. Saving a site setup with a site name adds the name to this option list.

The first selection on the list is the currently active Site Setup. The system will be ready for operation after you install the transducers and make the required hardware connections. Note that the installed transducers must comply with the recalled site parameters.

To recall a Saved Site Setup:

(*Where a visual of a key is shown, this means press that key on a PC or use the KeyPad.)*

> To access the list of saved site names press the <Right Arrow>.

> To move the cursor to the Site Name press the <Down Arrow>.

> Press <ENTER>. This triggers a pop-up window that asks if you intend to use the original transducer position (recommended). This means that you have to remount the transducers exactly as they were in the previous installation.

If you cannot recreate the original transducer installation, then press <Down Arrow> to change the pop-up list from [Original] to [New].

Press <ENTER>. This disables the measurement channel until you repeat the Pick/Install Transducer routine.

6.1.2 HOW TO ENABLE AND DISABLE A MEASUREMENT CHANNEL

The flow computer disables a measurement channel until the completion of the required Site Setup entries and the transducer installation procedure. The meter enables the measurement channel automatically after it receives all required site data and completes the transducer install routine. (The [Site Enable] menu cell allows you to disable or enable a measurement channel after there has been a successful transducer install).

The system does not require your presence for routine operation. If a fault condition (e.g., an empty pipe) disrupts operation, the system will recover automatically after the fault clears. Use *Channel Enable* [No] to turn off a channel that is currently unused but active; for example, if the transducers have been removed for servicing.

To disable a channel that is operating:

> To access the [Channel Enable] option list press the <Right Arrow>.

> Move the cursor to [No] by pressing the <Up/Down Arrows>.

> To disable the measurement channel press <ENTER>.

To enable a channel:

> To access the [Channel Enable] option list press the <Right Arrow>.

> Move the cursor to [Yes] by pressing the <Up/Down Arrows>.

> To enable the measurement channel press <ENTER>.

6.1.3 HOW TO CREATE/NAME A SITE SETUP

Use this command to create a new Site Setup. This is the first action required for an original installa-
tion. [Create/Name Site] inserts system defaults in all the appropriate menu cells. You can edit these
defaults as necessary to suit your needs.

You do not have to provide a site name in order to create a new Site Setup. You can create a site simply
by pressing the <Right Arrow> to access the menu cell entry field and then pressing <ENTER>. This
creates a "nameless" Site Setup. However, if you intend to use the meter's multi-site storage facility,
you must enter a unique site name for each site setup you want to retain in site storage memory.

To create and name a new Site Setup:

   To access the first character position press the <Right Arrow>.

   On a PC keyboard, type the name of the new Site Setup (8 characters max.) and then press
   <ENTER> to create and name the new site.

   Press the <Up/Down Arrows>.to select a character, then press the <Right Arrow> to highlight to
   next character position.

   To select the second character press the <Up/Down Arrows>.

   Repeat this process to select all the characters (8 max.) you want to use to identify the new Site
   Setup.

   To create the new Site Setup press <ENTER>.

**NOTE: If you decide to use numbers in the site name, you can type these characters directly
        from the PC keyboard.**

6.1.4 HOW TO ENABLE/DISABLE SITE SECURITY

With Site Security enabled, the meter will require a password before it allows any activity that could
interrupt or affect system operation. You can still access the Installation Menu. However, Site Security
limits access to the viewing of parameters only. In other words, you will still be able to review site data,
but you will not be able to make any changes.

Activate Site Security with care. Once activated, the only way to deactivate it is via the Site Security
[Off] command. However, the cursor will not move to the [Site Security] option list until you enter the
correct password. Therefore, it is essential that you never forget or misplace the password. The only
way to deactivate Site Security without knowing the password is to return the unit to Controlotron.
However, the process the factory uses to remove Site Security will eliminate any existing site data as
well. Remember, your meter contains a Menu Enable switch which also provides this function.

> **CAUTION: MAKE CERTAIN THAT YOU RETAIN A COPY OF THE PASSWORD IN A SE-
>   CURE LOCATION.**

To activate Site Security:

   To access [Site Security] option list press the <Right Arrow>.

To scroll the option list to [On] press the <Up/Down Arrows> then <ENTER>. [Enter Code?] appears at the top of the display screen.

Type your password on the PC keyboard, use numeric keys, or press the <Up/Down Arrows> with the Magnetic Wand to select the first character.

To move the cursor to the second character position press the <Right Arrow>.

Repeat the selection process for the second character. Continue this process until all the required characters (8 max.) appear in the field.

To store code press <ENTER>. [Confirm Code ?] appears at top of the display screen. Retype code exactly as described above.

Press <ENTER>. This moves the cursor to the [Site Security] option list.

To scroll the option list to [Site Security: On] press the <Up/Down Arrows>. Once you turn on Site Security, you must enter the correct code to turn it off.

To activate Site Security press <ENTER>.

6.1.5 HOW TO DELETE A SITE SETUP

If you attempt to save a Site Setup when memory is full, the screen will show [Memory Full]. If you get this message after issuing a Save/Rename Site command, you'll have to delete an unneeded Site Setup to clear memory space. The Datalogger and Site Storage share a common memory pool, so a large amount of logged data could also trigger the [Memory Full] message. For how to clear Datalogger memory, see [Meter Facilities/Datalogger Control]. The Defragment Command may also secure more memory (see Meter Facilities/Memory Control Menu).

To delete a stored Site Setup:

To highlight [Delete Site] press <Down Arrow>.

To access the Delete Site option list press <Right Arrow>.

Move the cursor to the site name of the site setup you want to delete.

To delete the obsolete site setup press <ENTER>.

6.1.6 HOW TO SAVE/RENAME A SITE SETUP

The Save/Rename Site command copies data from Active Memory to the Site Storage Memory. Saved Site Setups can be recalled for future use. This menu cell allows you to save a Site Setup at any time during the programming process. However, you must recall and complete the Site Setup in order to achieve operation.

When you access the Save/Rename Site menu cell, the name of the most recently created Site Setup (refer to 6.1.3 How to Create/Name a Site Setup) appears automatically. If this name is acceptable, you can press <ENTER> to save the Site Setup. You can change the listed site name by following the procedure on the next page.

You may select up to eight characters. If you decide to use numbers or a decimal point in the site name, you can also type these characters directly from your PC keyboard.

To Save or Rename a Site Setup:

Type the site name with the PC keyboard or use the KeyPad and pressthe <Right Arrow> to access the first character position.

To select a character press the <Up/Down Arrows> then <ENTER> to highlight to next character position.

To select the second character press the <Up/Down Arrows>. Repeat this process to select all the characters (8 max.).

To save the site data present in Active Memory press <ENTER>.

6.2   THE PIPE DATA MENU

This menu becomes available after picking a Meter Type, Measurement Channel and Measurement Technology. We recommend that you edit the Pipe Data immediately after creating a new Site Setup.

The Pipe Data menu allows you to define the application's pipe parameters. Select a pipe from one of the meter's stored pipe tables (see menu structure below); or input the pipe size and description manually. Manual entries include Pipe Material, Outer Diameter (OD) and pipe Wall Thickness. Liner Material and Liner Thickness entries are included to support pipes with liners. The meter requires the pipe outer diameter (OD) and wall thickness to operate. You must define these parameters to complete the installation.

The pipe table includes descriptions for over sixty standard pipes plus any user-entered pipes (see Meter Facilities). To use these presets, first pick a Pipe Class (e.g., ASA Stainless Steel), then pick a pipe size within that class (e.g., 4SS10). When you select a particular pipe class/size, the relevant pipe parameters appear in the [Pipe Data] menu cells. If a given pipe class/size does not match your application exactly you can still edit each individual parameter to fine-tune your selection. In addition, the Meter Facilities section of the Installation Menu provides a pipe table editor that allows you to customize any or all of the stored pipe tables.

NOTE: If you edit the pipe parameters after the system is operating, you will have to repeat the transducer install procedure.

Use this menu cell to edit the pipe outer diameter.

Use this menu cell to edit the pipe material.

Use this menu cell to edit the wall thickness.

Use this menu cell to select a Pipe Class from one of the meter's presets. The [Manual Entry] selection (default) means that you enter pipe data manually.

After picking a pipe class, use this menu cell to select a pipe from within that class.

Use this menu cell to select a pipe liner material.

Use this menu cell to edit the pipe liner thickness.

Siemens	2 Channel	[1]	ABC

Select Pipe Class from Pipe Table

Select Pipe Class	Manual Entry
Select Pipe Size	No Pipes
Pipe OD <in>	0.500
Pipe Material	Steel
Wall Thickness	0.100
Liner Material	None
Liner Thickness	0.000

Pipe Data

PIPE TABLE MENU STRUCTURE

Pipe Data ⇨	Pick Pipe Class ⇨ ⇕	⇕ **ASA Stainless Steel** ASA Carbon Steel ASA Plastic Metric DN Steel Metric SGP Steel Cast Iron Table Ductile Iron Table Copper Tube Table		
	Select Pipe Size ⇨	⇨ ⇕ **ASA Stainless Steel** **1SS10** **2SS10** **3SS10** **4SS10** **6SS10** **8SS10**	ASA Carbon Steel ⇨ ⇕ 1CS40 1CS80 2CS40 2CS80 3CS40 3CS80 4CS40 4CS80 6CS40 6CS80 8CS40 8CS80 10CS40 10CS_XS 12CS_STD 12CS_XS 16CS_STD 16CS_XS 18CS_STD 18CS_XS 20CS_STD 20CS_XS 24CS_STD 24CS_XS 30CS_STD 30CS_XS 36CS_STD 36CS_XS 1/12S40 1/12S80	ASA Plastic ⇨ ⇕ 1P40 1P80 2P40 2P80 3P40 3P80 4P40 4P80 6P40 6P80 8P40 8P80 10P40 10P_XS 12P_STD 12P_XS 16P_STD 16P_XS 18P_STD 18P_XS 20P_STD 20P_XS 24P_STD 24P_XS 30P_STD 30P_XS 36P_STD 36P_XS
		⇨ Metric DN Steel ⇕ 15_DN 20_DN 25_DN 40_DN 50 DN 80_DN 100 DN 150_DN 200 DN 250_DN 300_DN 350_DN 400_DN 500_DN 600_DN		
		⇨ Metric SGP Steel ⇕ 20A-SGP 25A-SGP 32A-SGP 40A-SGP 50A-SGP 65A-SGP 80A-SGP 90A-SGP 100A-SGP 125A-SGP 150A-SGP 175A-SGP 200A-SGP 225A-SGP 250A-SGP 300A-SGP 350A-SGP 400A-SGP 450A-SGP 500A-SGP	Cast Iron Table ⇨ ⇕ 6"cls C 10"cls C 12"cls C 16"cls C 20"cls C Ductile Iron Table ⇨ ⇕ 6"cls 52 8" cls 52 10"cls 52 12"cls 52 16"cls 52 24"cls 52	Copper Tubing Table ⇨ ⇕ 1" type K 1" type L 1" type M 2" type K 2" type L 2" type M 4" type K 4" type L 4" type M 6" type K 6" type L 6" type M
	Pipe OD (in/mm)	xx.xx (numeric entry	Auto if specific pipe is selected	
	Pipe Material ⇨	⇕ Steel ABS Aluminum Black Iron Brass Cast Iron CuNi (70/30)		

(continued)

*NOTE: The highlighted selection in the above table illustrates how to choose the ***ASA Stainless Steel*** **Pipe Class** and all its available Pipe Name selections. All other Pipe Classes (e.g., ASA Carbon Steel) listed can be selected in the same manner.

THE PIPE DATA MENU STRUCTURE (*cont.*)

Pipe Data ⇨	Pipe Material ⇨	⇕ CuNi (90/10)
		Copper
		Ductile Iron
		FRP
		Glass
		Hastelloy
		Inconel
	⇕	Kynar <PVDF>
		Monel
		Nickel
		Polyethylene
		PVC (Plastic)
		Teflon
		Titanium
⇨	Wall Thickness ⇨	x.xxx *(numeric entry)*
⇨	Liner Material ⇨	⇕ None
		Cement
		Coal Tar
		Enamel
	⇕	Glass
		Plastic
		HDPE
		Teflon
		Rubber
⇨	Liner Thickness	x.xxx *(numeric entry)*

(Note: ⇕ appears at left beside Pipe Data)

6.2.1 HOW TO SELECT A PIPE CLASS

The 1020 pipe tables are arranged by classes of common type and material. The default selection is [Manual Entry]. As its name infers, you would use this selection to manually enter individual pipe parameters.

To select a Pipe Class:

To access the [Pipe Class] option list press the <Right Arrow>.

To scroll through the available classes press the <Up/Down Arrows>.

To select the class that fits your application press <ENTER>.

When you pick a Pipe Class, the [Select Pipe Size] menu cell (see below) presents the pipe size option list associated with the selected class. By using the pipe class and pipe size option lists, you automatically load all the required pipe information. You can also select a pipe class/size, then edit any of the associated defaults to fine-tune the pipe data.

NOTE: Create custom pipe data via the Pipe Table editor in the Meter Facilities menu.

6.2.2 HOW TO SELECT A PIPE SIZE

Selecting a Pipe Size installs the selected pipe parameters into the balance of the Pipe Data menu cells and prepares the 1020 for Transducer selection and installation. This option is not applicable if the Pipe Class is [Manual Entry].

After selecting a pipe class:

> To access the pipe size option list press the <RightArrow>.

> To scroll to the required pipe press the <Up/Down Arrows>.

> To register selection press <ENTER>.

6.2.3 HOW TO ENTER THE PIPE OD (in. or mm.)

Use this menu cell to edit the pipe outer diameter. Be aware that you will not be able to complete the transducer installation successfully unless this information is accurate. In addition, if you change this parameter on a previously installed site, you will have to repeat the transducer installation. *Note: Use actual pipe dimensions, not ASA code or any other standard.* The English/Metric selection in the Meter Facilities menu determines whether these dimensions are in inches or millimeters.

To enter the Pipe OD:

> To enable numeric entry press the <Right Arrow>.

> Use the PC numeric keys or KeyPad to enter the exact outer diameter of the pipe in inches or millimeters.

> To register the Pipe OD press <ENTER>.

6.2.4 HOW TO SELECT A PIPE MATERIAL

The pipe material selection affects flow calibration to a small degree. It also influences the meter-generated transducer size and spacing recommendations. Select a substitute material if you do not find the material of your pipe in the pipe table. You can edit each pipe parameter to achieve a closer match. If you change any pipe parameters, after running the Transducer Install procedure, you may have to re-space the transducers. The [Pipe Material] option list provides a selection of common pipe materials. The default pipe material is Steel. Press the <Down Arrow> to accept the default setting for this menu cell.

To select a Pipe Material:

> To access the [Pipe Material] option list press the <Right Arrow>.

> To scroll to the required pipe material press the <Up/Down Arrows>.

> To register selection press <ENTER>.

6.2.5 HOW TO ENTER THE WALL THICKNESS

The wall thickness of the pipe is one of the required parameters. The flow computer needs this data to generate accurate transducer size and spacing data recommendations.

Selecting a pipe class/size inserts a wall thickness value. If this data is inaccurate, then use this menu cell to set the pipe's wall thickness (in English or Metric data units).

To enter the Pipe Wall Thickness:

To enable numeric entry press the<Right Arrow>.

Use the PC numeric keys or KeyPad to enter exact wall thickness (use in/mm).

To register the pipe wall thickness press <ENTER>.

6.2.6 LINER MATERIAL

For lined pipes, select a pipe liner from the material option list. If the pipe liner material does not appear on the list then select the closest type available. If necessary, call Customer Service for additional help. The system default Liner Material is [None]. If the pipe does not have a liner, press the <Down Arrow> twice to bypass to the next two menu cells. The [Liner Material] option list offers a selection of common liner materials.

To select a Liner Material:

To access the [Liner Material] option list press <Right Arrow>.

To scroll to the required Liner material press the <Up/Down Arrow>.

To register selection press <ENTER>.

6.2.7 LINER THICKNESS

If you specified a pipe liner in the [Liner Material] menu cell, then use this menu cell to set its exact thickness in appropriate units (English or Metric).

To enter a Liner Thickness:

To enable numeric entry press the <Right Arrow>.

Use PC numeric keys or KeyPad to enter the exact line thickness value.

To register the data press <ENTER>.

6.3   THE APPLICATION DATA MENU

This menu becomes available after picking a Meter Type, Measurement Channel and Measurement Technology. Use of this menu is optional.

CAUTION: An erroneous Viscosity entry could affect the meter's intrinsic calibration. Do not alter the default viscosity value of your liquid unless you are sure of your data.

Use the [Application Data] menu to edit default settings to match your application. When you specify a Liquid Class, the meter will adjust its operation to accommodate the liquid's estimated sonic velocity, viscosity and specific gravity. If necessary, you can edit each liquid class parameter individually to obtain a closer match with the liquid. The default liquid is Water at 68°F (20°C).

Use this menu to select a class of liquids and optionally edit the following liquid parameters:
- Estimated Vs
- Viscosity
- Density (Specific Gravity)

Use this menu cell to enter the number of pipe diameters between the upstream configuration ad the transducer installation.

```
┌─────────────────────────────────────────┐
│ Siemens      2 Channel   [1]      FLOW 1 │
│ Select Liquid Class from Liquid Table    │
│                                          │
│ Liquid Class            Water 20C/68F    │
│ Pipe Configuration    Fully Developed    │
│ Anomaly Diams                  10        │
│                                          │
│                                          │
│                                          │
│ Application Data                         │
└─────────────────────────────────────────┘
```

Use this menu cell to select the pipe configuration that most accurately represents the upstream pipe conditions.

Use this menu cell to enter the number of pipe diameters between the upstream configuration and the transducer installation.

APPLICATION DATA MENU STRUCTURE

Application Data	⇨ Liquid Class	⇨	Select Liquid	⇨	⇕ Water 13C/55F
					Water 20C/68F
					Water 50C/122F
					Water 75C/167F
					Water 100C/212F
					Water 125C/257F
					Water 150C/302F
					Water 175C/347F
					Water 200C/392F
					Water 225C/437F
					Water 250C/482F
			⇕		Acetic Acid
					Alcohol
					Bromine
					Carbon Tet
					Chlorine
					Diesel Fuel
					Gasoline
					Glycerine
					Kerosene
					MEK
					Oil (SAE 20)
					Sea Water
					Toluene
					Trichloroethyl
					Other

(continued)

APPLICATION DATA MENU STRUCTURE *(continued)*

Application Data ⇨	Liquid Class ⇨ ⇕	⇨ ⇨ ⇨	Estimated Vs m/s	xxxx *(numeric entry)*
			Viscosity, cS	x.xx *(numeric entry)*
			Density SG	x.xxx *(numeric entry)*
	Pipe Configuration (Change to Upstream Piping) ⇨	⇕	Fully Developed *	
			1Elbow	
			Dbl Elbow +	
			Dbl Elbow -	
⇕			Valve	
	⇕		Expander	
			Reducer	
			Norm Entry	
			Header Inlet	
			Intrusions	
	Anomaly Diams ⇨		xxxx (numeric entry)	

*Default

6.3.1   HOW TO SELECT A LIQUID CLASS

The liquids listed in the Liquid Class option list are representative samples of the class of liquids to which they belong. Selecting a named liquid fills in the [Estimated Vs m/s], [Viscosity cS], and [Density SG] parameters automatically. However, you have the option of editing these parameters individually to fine tune the liquid settings. If you do not find a liquid that matches your application, then you can select [Other]. This selection will not provide a liquid name or automatic parameter entry.

Use this menu cell to select a liquid. Selecting a liquid automatically enters data into Liquid Class menu cells.

Use this menu cell to edit the specific gravity of the liquid.

Siemens	2 Channel	[1]	FLOW1

Access Liquid Option List

Select Liquid	**Water 20C/68F**
Estimated Vs m/s	**1482**
Viscosity cS	**1.00**
Density SG	**1.000**

Liquid Class
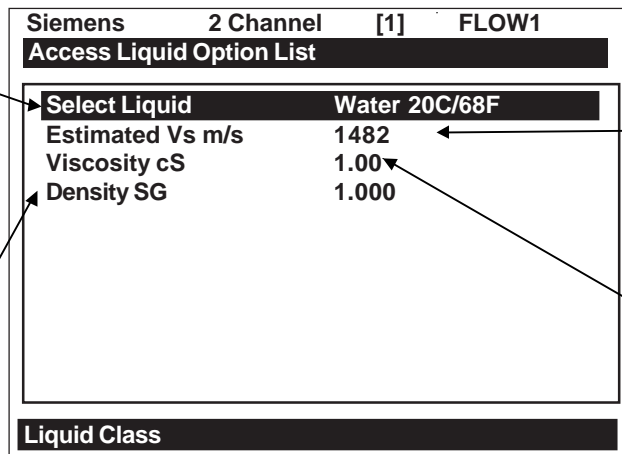
Use this menu cell to edit the Estimated Vs ONLY if you are sure of a more accurate value. This will reduce the chances of a re-spacing request for clamp-on flow transducers during the install procedure.

Use this menu cell to edit the liquid viscosity ONLY if you are certain that the data you enter is accurate. An erroneous entry could affect meter calibration.

To select a Liquid Class:

        To access the option list press the <Right Arrow>.

        Scroll through the list to find the closest match to the application's liquid.

        To register selection press <ENTER>.

How to Edit the Estimated Vs (liquid sonic velocity)

During transducer installation, the flow computer bases its initial transducer spacing recommendation on the value stored in this menu cell. Estimated Vs m/s allows you to review and modify (if necessary) the Vs value for the liquid class you selected.

After you install the transducers, the computer will measure Vs directly. If the displayed (or edited) Vs stored in this menu cell is accurate, the transducers will be spaced correctly. This will eliminate the need to re-space the transducers after their initial installation. However, if the estimated Vs is substantially different from the measured value, the computer will request you to re-space the transducers during the transducer install procedure.

NOTE: During the Xdcr install procedure (see paragraph 6.4), you can ignore a respacing request by pressing the <Down Arrow> instead of <ENT>. If this triggers a Spacing Alarm, check [Diagnostic Data/Site Setup Data] to make sure the measured Vs value does not exceed the Vs max or Vs min items.

To edit the Estimated Vs m/s:

      To activate numeric entry press the <Right Arrow>.

      Use PC numeric keys or the KeyPad to enter the sonic velocity value as meters-per-second.

      To register the data press <ENTER>.

How to Edit the Viscosity (cS) Setting

The [Viscosity cS] menu cell shows the kinematic viscosity of the selected liquid (in centistokes). The viscosity value is particularly important for high viscosity liquids. The meter requires an accurate liquid viscosity to compute the flow profile compensation. If the displayed viscosity is correct, bypass this menu cell by pressing the <Down Arrow>. Please be aware that the viscosity of the liquid affects the Reynolds Number compensation applied to the final rate output. Therefore, inaccurate data could cause flow data errors. *Edit this entry only if you know the true viscosity of your liquid.* (Note: This menu cell can be edited without requiring site reinstallation.) If necessary, our Technical Service Group can provide reliable viscosity data for most liquids.

To edit the Viscosity setting:

      To activate numeric entry press the <Right Arrow>.

      Use PC numeric keys or KeyPad to enter the Viscosity value, which must be in centistokes.

      To register the data press <ENTER>

How to Edit the Density (SG) Setting

Use the [Density SG] menu cell to edit the nominal specific gravity of the selected liquid. (Note: This menu cell can be edited without requiring site reinstallation.) This allows the flow computer to provide a flow rate output in mass units, if required. This mode suits applications where the density is not only known, but also fixed, due to well-controlled liquid temperature and chemistry.

The default specific gravity setting is 1.000. The flow computer uses the liquid's specific gravity to form a multiplier for the conversion of volumetric flow to mass flow. Mass flow appears (in selected units) on the display screen. Density SG, as it applies to this system, is defined as the ratio of the mass of this liquid to the mass of an equal volume of water at 20°C or 68°F.

To edit the Density SG setting:

>   To activate numeric entry press the <Right Arrow>.

>   Use PC numeric keys or KeyPad to enter the Density SG value.

>   To register the data press <ENTER>

6.3.2 PIPE TEMPERATURE RANGE

Controlotron rates the 1021 and 1011 Universal transducers for operation up to 250°F. System 1010 series flowmeters should be used for higher temperature applications that exceed 250°F at transducer mounting locations. Please refer to Section 4 for flow tube pressure and temperature ratings.

6.3.3 PIPE CONFIGURATION

The [Pipe Configuration] menu cell in the Application Data menu presents a list of descriptions of piping configurations that could affect the flow profile characteristics (such as "Single Elbow"). Examine the option list. Selecting a piping configuration that closely approximates conditions at or near your mounting location allows the flow computer to compensate for the effect of upstream piping on flow profile. The number of diameters between the upstream configurations and the transducer installation can be numerically entered via the [Anomaly Diams] menu cell.

To select a Piping Configuration:

>   To access the option list press the <Right Arrow>.

>   To highlight the desired piping configuration press the <Up/Down Arrows>.

>   To register selection press <ENTER>.

The default pipe configuration (Fully Developed) will cause the flowmeter to use the conventional Reynolds Compensation Table when compensating for liquid flow profile behavior.

```
 Siemens      Dual Path   [1]        Path 1
 Disignate Pipe Shape Near Transducers

    Liquid Class            Water  20C/68F
    UniMass Table           Create/Edit Table
    Temperature Range       -40F  to  250F
    Pipe Configuration      Fully Developed
    Anomaly Diams           1 Elbow
                            Dbl Elbow +
                            Dbl Elbow -
                            Valve
                            Expander
                            Reducer
                            Norm Entry
                            Header Inlet
                            Intrusions
 Application Data
```

Use this menu cell to enter the number of pipe diameters between the upstream configuration and the transducer installation.

Use this menu cell to select the pipe configuration that most accurately represents the upstream pipe condition.

Pipe Configuration Menu Structure

Application Data ⇨	Pipe Configuration ⇨ (Change to Upstream Piping)	⇕ Fully Developed* 1 Elbow Dbl Elbow + Dbl Elbow - Valve Expander Reducer Norm Entry Header Inlet Intrusions
⇕	⇕	
⇨	Anomaly Diams	xxxx (numeric entry)

* Default

PIPE CONFIGURATION OPTION LIST DEFINITIONS

Fully Developed Fully Developed flow, as would be expected for very long straight pipe runs or installation downstream of a flow condition.

1 Elbow   Single 90 degree Elbow upstream of transducer installation.

Dbl Elbow +   Double out-of-plane Elbows upstream of transducer installation.

Dble Elbow -   Double in-plane Elbows upstream of transducer installation.

Valve   To Be Determined.

Expander   Pipe expansion upstream of transducer installation.

Reducer   Pipe reduction upstream of transducer installation.

Norm Entry   To Be Determined.

Header Inlet   Header or pipe manifold upstream of transducer installation.

Intrusions   To Be Determined.

6.4   THE PICK/INSTALL XDCR MENU

Use this menu after creating a new site setup in the Channel Setup menu, and defining the pipe parameters in the Pipe Data menu.

Based on pipe data (and optionally application data) entries, the Pick/Install Xdcr menu automatically identifies the most suitable transducers for the application. It recommends the appropriate mounting mode (direct or reflect) and lists the Spacer Bar or Mounting Track part number and spacing index. Ideally, you will be able to use the primary recommendations. However, you can edit the menu entries as required to accommodate different transducers or mounting configurations.

The flow computer will adjust its parameters to optimize performance based on your selections. The [Ltn Value (in)] menu cell shows the required spacing distance (in inches or millimeters) between the upstream and downstream transducers. Use the [Install Complete?] menu cell to inform the flow computer that you completed the physical mounting of the transducers. You can define the empty pipe and zero flow values once the transducers are operational.

Once you select the
type, use this menu
cell to specify the
transducer size.

This menu cell
allows you to select
a mounting mode.
*Use Reflect Mode
whenever possible.*

Use this menu cell to
select the type of
transducer to be
installed.

These menu cells
identify the spacing
indices on the spacer
bar. You must use
these settings to mount
the transducer properly.

This menu cell indicates the
model number of the
appropriate spacer bar for
your transducers and
spacing requirements.

This menu cell
shows the actual
spacing distance
required between
the transducers.

Siemens	2 Channel	[1]	FLOW1
Scroll List and select desired Model			
Transducer Model	**1011 Universal**		
Transducer Size	**B3**		
Xdcr Mount Mode	**Reflect**		
Spacing Offset	**Spacer Bar PB-1**		
Number Index	**0**		
Spacing Method	**Track 1012TAH**		
Ltn Value	**0.565**		
Install Complete?	**No**		
Empty Pipe Set	**MTYmatic**		
Zero Flow Adjust	**Actual Zero**		
Pick/Install Xdcr			

Use this menu cell to
inform the meter that you
have completed the
transducer mounting.

After the transducers are
operating, you can use
this menu cell to set the
empty pipe threshold.

After the transducers are
operating, you can use
this menu cell to
manually set the zero
flow correction.

PICK/INSTALL XDCR MENU STRUCTURE

Pick/Install Xdcr ⇨	Transducer Model⇨	991 Universal 1021 Xdcr 1011 Universal			
	Transducer Size ⇨	1011 Universal	1021 Xdcr	991 Universal	Flow Tube
		⇕ A1 A2 B1 B2 B3 C1 ⇕ C2 C3 D1 D2 D3 E1 E2 E3	⇕ A1 A2 B1 B2 C1 C2 D1 D2	⇕ 0A 0 1 2A 2 3A 3 4A 5A 5	⇕ 1F 1P 1K 1T 2F 2P 2K 2T
	Xdcr Mount Mode ⇨ ⇕	⇕ Direct Reflect			
	Spacing Offset ⇨ ⇕	⇕ Minimum Nominal Maximum			
	Number Index ⇨	4 *(generated)*			
	Spacing Method ⇨	Track	⇨ *auto P/N generation		
	Ltn ⇨	2.00 (generated)			
	Install Complete? ⇨ ⇕	⇕ No [Yes] Install	*[Yes] indicates successful install*		
	Empty Pipe Set ⇨ ⇕	⇕ MTYmatic Set Empty Actual MTY			
	Zero Flow Adjust ⇨ ⇕	⇕ AutoZero ZeroClr ReversaMatic Actual Zero ZeroMatic	*Reflect mount only*		

6.4.1 HOW TO SELECT A TRANSDUCER MODEL

Use the [Transducer Model] menu cell to define the type of transducer for use with your application. This allows the flow computer to adjust its transmit/receive functions accordingly. You can choose from the [991 Universal] transducer, the [1011 Universal] transducer, [1021 Xdcr] transducer or Flow Tube option lists. The system default is [1021 Xdcr]. If this suits the application, bypass this menu cell by pressing the <Down Arrow>.

To select a Transducer Model:

    To access the [Transducer Model] option list press the <Right Arrow>.

    To move the cursor to the required transducer model press the <Up/Down Arrows>.

    To store your selection press <ENTER>.

6.4.2   HOW TO SELECT A TRANSDUCER SIZE

When you move the cursor to [Transducer Size], the highlighted prompt at the top of the display screen shows a list of recommended transducer sizes. For example **[Recommended Xdcrs: B1, B2, C1, C2]**. The flow computer generates this list automatically based on your pipe and your application data entries. The left-most transducer size (e.g., B1) is the primary (most appropriate) choice. The right-most transducer (e.g., C2) is still acceptable (but the least desirable) choice. Since these are simply recommendations not requirements, you can override the flow computer and use any size, as long as the mounting method accommodates the pipe's diameter. The flow computer shows that your selection is acceptable if it is able to calculate transducer spacing (Ltn).

To select a Transducer Size:

    To access the [Transducer Size] option list press the <Right Arrow>.

    To move the cursor to the desired transducer size press the <Up/Down Arrows>.

    To select the transducer size press <ENTER>.

6.4.3   HOW TO SELECT A XDCR MOUNT MODE

The flow computer recommends the transducer mounting mode [Direct or Reflect]. In almost all cases it will be Reflect, since this is the most desirable configuration. Reflect Mode allows you to mount the transducers on pipes that do not permit back or side access. Reflect Mode provides inherent compensation for flow profile distortion (crossflow) that could be the result of unfavorable application conditions such as an insufficient upstream straight run. In addition, Reflect Mode supports the AutoZero function, which sets the zero flow velocity automatically.

Direct mounting may produce a stronger transducer signal and requires less mounting length than Reflect mounting. This can be important if the liquid or pipe material exhibits high sonic attenuation, thereby preventing operation in the Reflect configuration.

NOTE: We recommend using Direct Mount with Plastic pipes.

To select a Xdcr Mounting Mode:

    To access the [Xdcr Mount Mode] option list press the <Right Arrow>.

    To move the cursor to the required mounting type press the <Up/Down Arrows>.

    To store selection press <ENTER>.

6.4.4   REVIEWING THE SPACING METHOD

The flow computer analyzes your transducer selection, mounting mode and pipe size to determine the best way to install your transducers. It will recommend the use of either a mounting track, a spacer bar, or independent mounting. The flow computer will list the part number of a mounting track or spacer bar. If it decides upon independent mounting, it will report the distance required between the two transducers. In this case, you have to make sure that when you mount the transducers, the space between them equals the length specified in the Ltn menu cell.

6.4.5   HOW TO USE THE SPACING OFFSET

After you select the mounting method, the flow computer checks your entries for pipe size, transducer type etc. and then recommends a spacing offset. This is the first step in establishing the correct distance between the transducers. Spacer bars and mounting tracks utilize number indices (labels) to simplify transducer placement. One transducer is located at the Reference position, while the other one is located at the Number Index position. The Number Index cannot be directly edited. However, the Spacing Offset can be changed via its option list. Changing the Spacing Offset will alter the reported Number Index. Maximum spacing offset provides moderately greater signal levels but, in some cases, slightly decreased zero flow stability.

If the flow computer reports "Use Ltn," you have to measure the distance between the upstream and downstream transducers. The flow computer issues the actual distance between the transducers in inches or millimeters (See paragraph 6.4.7 Ltn Menu Cell). Note that, even though using Ltn does not call for the physical use of the Number Index, you can still change the Spacing Offset to influence the strength of the transmit signal.

System 1020 uses a pair of precisely matched transducers. Therefore, you can select either one for the Reference position. You must connect the Up transducer cable to the transducer mounted on the upstream side of the mounting track. This lets the meter display the flow direction correctly.

It is important that you note each transducer's serial number and its Index position during the original installation because to reinstall the flowmeter successfully, you must remount each transducer in its original position. Transducer pairs have matching serial numbers except for the appended letters "A" and "B." This helps you to identify each transducer.

To select a different Spacing Offset

> To access to [Spacing Offset] option list press the <Right Arrow>.
>
> To move the cursor to the desired offset press the <Up/Down Arrows>.
>
> To store selection press <ENTER>.

6.4.6   THE NUMBER INDEX MENU CELL

Selecting the [Spacing Offset] menu cell allows the flow computer to calculate the Number Index. The Number Index establishes the spacing between a pair of transducers. You cannot override this recommendation. To complete the transducer installation, you must accept the Number Index by mounting the transducer at that point on your spacer bar or mounting track. Initially, the flow computer bases its Number Index selection on the pipe diameter and estimated liquid sonic velocity (Vs) you entered in the Pipe Data menu. When you invoke the [Install Complete?] routine, the flow computer actually measures the liquid sonic velocity (Vs). In some cases, it may prompt you to re-space the transducers to another number index.

6.4.7 THE Ltn MENU CELL

This view only menu cell shows the distance in inches or millimeters between the front faces of the transducers along the axis of the pipe. If you are mounting the transducers without a track or spacer bar, you have to space them according to this value. Note that Ltn may be a negative number for direct mount on very small pipes where the transducer spacing overlaps.

6.4.8 HOW TO USE [INSTALL COMPLETE?]

Use the [Install Complete?] menu cell to inform the flow computer that you have mounted the transducers according to the selected mode and spacing requirements and are ready to start operation.

To start the [Install Complete?] routine for an original installation:

Select any transit-time mode (e.g., Clamp-On or Flow Tube) and press the <Right Arrow>.

Press <Down Arrow> and scroll to the [Pick/Install Xdcr] menu cell. Press <Right Arrow>.

Install transducers as required (refer to Section 3 for procedures).

NOTES

- *Mount the transducers using the selected mode (direct or reflect). Please refer to the transducer mounting procedures detailed in Section 3.*

- *When using a mounting track or a spacer bar in reflect mode, locate the first transducer at the Reference Index and the second transducer at the recommended Number Index.*

- *If transducers are mounted independently, you must use the recommended distance; Ltn to space the transducers.*

- *You must use the proper sonic coupling compound. See "Recommended Sonic Coupling Compounds" in Section 3 for appropriate type and part number.*

- *The pipe must be completely filled with a liquid, which can be either flowing or at zero flow.*

After transducers are properly mounted, the flow computer completes its Initial Makeup command and the [Install Complete?] menu cell appears.

To access the [Install Complete?] option list, press the <Right Arrow>.

Press <Down Arrow> and scroll to the [Install Complete?] menu cell and then press <ENTER>.

Press <ENTER>. The [Install Complete?] menu cell will indicate [Yes] after the 1020 is successfully installed.

```
┌─────────────────────────────────────────────┐
│ Siemens        2 Channel    [1]    SITE1      │
│ Key [Install] after mounting transducers      │
│                                               │
│   Transducer Model         1021  Xdcr         │
│   Transducer Size          B                  │
│   Xdcr Mount Mode          Reflect            │
│   Spacing Offset           Invalid            │
│   Number Index             10                 │
│   Spacing Method           Invalid            │
│   Ltn Value <in>           0.217              │
│   Install Complete?        Yes                │
│   Empty Pipe Set           Channel Not Setup  │
│   Zero Flow Adjust         Channel Not Setup  │
│                                               │
│  Pick/Install Xdcr                            │
└─────────────────────────────────────────────┘
```

***To complete the Install process** disregard the following paragraphs explaining the Force Transmit and Force Frequency diagnostic software routines. Proceed to the Install process completion steps immediately following the Force Transmit procedures.*

NOTE: If the transducers have been installed successfully but the Estimated Vs (sonic velocity) has been changed, the Pick/Install Xdcr menu cell [Install Complete?] option list will also display the [Transfer Install] function selection. The Transfer Install function allows the transducers to be optimally positioned for a different fluid, without the need for a new Initial Makeup procedure (see the Water Calibration addendum in this manual for details).

Force Transmit Procedure

This diagnostic software routine allows the user to "force" a transmitting condition that can be use to search for an amplitude level (ALC) when Detection Fault or Low Signal alarms are present. The routine forces the flowmeter to generate constant transmit bursts while reporting current receive signal strength for the user. To initiate the *Force Transmit* function, refer to the example that follows.

1. On a PC, after the detection mode is selected, press <ENT>. If using the Magnetic Wand, the detection mode is selected, touch <ENTER> sensor. While the flowmeter is going through the drives (see menu screen below), press the <ALT> and <ENTER> keys simultaneously.

```
┌──────────────────────────────────────┐   ┌──────────────────────────────────────┐
│ Siemens      2 Channel   [1]   SITE1  │   │ Siemens      2 Channel   [1]   SITE1  │
│ Key [Install] after mounting transducers│  │ Drive  0                              │
│                                        │   │                                        │
│  Transducer Model      1011 Universal │   │  Transducer Model      1011 Universal │
│  Transducer Size       B3             │   │  Transducer Size       B3             │
│  Xdcr Mount Mode       Direct         │   │  Xdcr Mount Mode       Direct         │
│  Spacing Offset        Minimum        │   │  Spacing Offset        Minimum        │
│  Number Index          4              │   │  Number Index          4              │
│  Spacing Method        Track 1012TP   │   │  Spacing Method        Track 1012TP   │
│  Ltn Value (in)        0.217          │   │  Ltn Value (in)        0.217          │
│  Install Complete?     No             │   │  Install Complete?     Install        │
│  Empty Pipe Set        Channel Not Setup│  │  Empty Pipe Set        Channel Not Setup│
│  Zero Flow Adjust      Channel Not Setup│  │  Zero Flow Adjust      Channel Not Setup│
│                                        │   │                                        │
│ Pick/Install Xdcr                      │   │ Pick/Install Xdcr                      │
└──────────────────────────────────────┘   └──────────────────────────────────────┘
```

NOTE: The <ALT> and <ENTER> keys must be pressed before the meter scans through all the drives, or the selection of the detection mode and the Force Transmit function must be initiated again.

2. As the meter begins going through the drives, press <ENTER> again. A typical menu screen appears as shown below (i.e., only when using a PC via the RS-232 port) and indicates the current ALC (e.g., 50). Steps 1 and 2 above must be completed before the meter scans through all the drives, or selection of the detection mode and the Force Transmit function must be initiated again.

NOTE: The 1020 flowmeter does not display the Force Transmit data display line.

This ALC number indicates the current receive signal strength and can be used for further diagnostic purposes.

```
Siemens          2 Channel     [1]     SITE1
ForceN        fx=8          m=7       ALC=50

   Transducer Model          1011 Universal
   Transducer Size           B3
   Xdcr Mount Mode           Direct
   Spacing Offset            Minimum
   Number Index              4
   Spacing Method            Track 1012TP
   Ltn Value (in)            0.217
   Install Complete?         Install
   Empty Pipe Set            Channel Not Setup
   Zero Flow Adjust          Channel Not Setup

 Pick/Install Xdcr
```

```
Siemens          2 Channel     [1]     SITE1


   Transducer Model          1011 Universal
   Transducer Size           B3
   Xdcr Mount M      ┌───────────────────┐
   Spacing Offs      │  Detection Fault   │
   Number Inde       │    Press [ENT]     │
   Spacing Meth      └───────────────────┘2TP
   Ltn Value (in)            0.217
   Install Complete?         Install
   Empty Pipe Set            Channel Not Setup
   Zero Flow Adjust          Channel Not Setup

 Pick/Install Xdcr
```

3. To exit Force Transmit, press the <Left Arrow> and a Detection Fault prompt will appear. Press the <Left Arrow> again and the meter will return to the Pick/Install Xdcr menu and highlight the [Empty Pipe Set] menu cell.

4. *To force a frequency*, repeat steps 1 and 2 above, but press <Right Arrow>. The following typical display line will appear:

**Drive
=0**

Using numeric keys or Magnetic Wand enter the frequency and press <ENTER>.
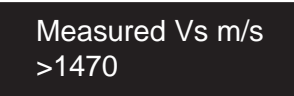
5. *If the Force Transmit diagnostic procedure is not used*, the normal [Install Complete?] function occurs as follows:

Immediately after you press <ENTER>, the computer starts an internal process called an Initial Makeup. The current Initial Makeup activity appears at the top of the display screen. For example:

Drive 14
6 - - - - - - - - - - - - -: 0

NOTE: In the example above, 0 indicates there were no setup rejections and Initial Makeup was successful. If the number 6 fluctuates and/or setup rejection numbers begin counting up to 9, a Detection Fault error message will appear.

During the Initial Makeup, the flow computer verifies your site data, records the sonic characteristics of the pipe and then adjusts internal parameters to optimize flow measurement. *Please remain patient.* This process can take several seconds or several minutes to complete. There is no relationship between the length of an Initial Makeup and the meter's subsequent performance. An Initial Makeup for larger pipes (and more demanding application conditions) simply takes a little longer. Upon sucessful completion of the initial makeup, the 1020 will show the measured Vs on the prompt line.

Measured Vs m/s
>1470

This means that the flow computer was able to complete the Initial Makeup and is now actively measuring flow. This prompt allows you to "fine-tune" the Measured Vs by pressing the <Right Arrow> to activate numeric entry. You can then use the numeric keys to type a different value. However, only edit the Measured Vs when you are certain of your liquid's actual sonic velocity. If, however, there is a large discrepancy between the "measured" Vs and the "actual" Vs, then consider that an accurate Vs measurement depends on certain parameters that the flow computer cannot sense directly (e.g., pipe dimensions or transducer placement). In other words, entering incorrect pipe parameters or not using the recommended spacing could result in an erroneous Vs measurement.

The meter is now ready to report flow. Press the <ENTER> key to display flow.

In cases where the actual Vs differs noticeably from the estimated Vs, the flow computer may issue a re-space command. This requires that you re-space the Number Index transducer at the new Number Index, then press <ENTER> again. Repeat the initial makeup process. You can override a re-space command by simply keying the [Down Arrow]. However, after the flowmeter begins operating, you must confirm that the sonic velocity (Vs) of the liquid falls between the [Vs max] and [Vs min] items in [Diagnostic Data / Site Setup Data].

Therefore, only consider editing the measured Vs after you remove all the primary causes for an in-accuracy. Check your pipe dimensions and pipe material entries. Re-check the transducer spacing and part numbers. Large Vs discrepancies are almost always due to erroneous pipe data or incorrect transducer placement.

To accept the Measured Vs:

Press the <Left Arrow> or <Down Arrow> moves the cursor to the [Empty Pipe Set] menu cell.

If you decide to edit the Measured Vs:

To activate numeric entry press the <Right Arrow>.

Use PC numeric keys or KeyPad to type the new Vs value (in meters-per-second).

To store the corrected Vs press <ENTER>.

The flow computer may recommend a new Number Index and prompt you to press <ENTER>. Remount the transducer at the new Number Index.

To repeat the Initial Makeup process press <ENTER>.

After the flow computer completes its Initial Makeup command, the [Install Complete?] option list changes to:

Install Complete?	Yes
	New Makeup

If you want to redo the Initial Makeup, move cursor to New Makeup, then press <ENTER>. This resets the option list. You can now repeat the install routine described previously.

6.4.9 THE EMPTY PIPE SET MENU

CAUTION: Only access the [Empty Pipe Set] menu when using the Actual MTY command.

The flow computer performs the MTYmatic routine automatically during its Initial Makeup to establish a standard setting for the Empty Pipe alarm. The [Empty Pipe Set] option list allows you to re-invoke MTYmatic, use an Actual MTY routine (if application conditions allow you to empty and refill the pipe) or use the Set Empty routine to set the empty pipe threshold by direct numeric entry.

How to Use the Actual MTY Command

If application conditions allow you to empty and refill the pipe, then you should perform the Actual Empty procedure. This is the recommended way to define the empty pipe threshold.

NOTE: <u>NEVER</u> perform this procedure when the pipe is full.

To perform the Actual MTY Procedure:

To access the [Empty Pipe Set] option list press the <Right Arrow>.

To move the cursor to [Actual MTY] press the <Down Arrow> then press <ENTER>.
 [Empty Pipe   Press Enter] appears on the menu prompt line.

Empty the pipe completely, then press <ENTER>. [Fill Pipe   Press Enter] appears on the menu prompt line.

Refill the pipe completely, then press <ENTER>.

How to Use the MTYmatic Command

You can repeat MTYmatic (performed during the Initial Makeup) to correct an inaccurate Actual MTY setting if conditions do not allow you to repeat the Actual Empty procedure.

NOTE: Only use the MTYmatic procedure when the pipe is full.

To start MTYmatic:

To access the [Empty Pipe Set] option list press the <Right Arrow>.

Move the cursor next to [MTYmatic] by pressing the <Right Arrow>.

To invoke MTYmatic press <ENTER>.

How to Use the Set Empty Command

Use [Set Empty] to enter a number that represents the signal strength level consistent with an empty pipe. [Set Empty] uses non-linear scaling. There is no direct correlation between the number you enter and any standard amplitude unit. If you set the number too low, the meter may not detect a true empty pipe. If you set it too high, it could trigger the empty pipe alarm, suspending flow measurement, even though the liquid is flowing.

To enter an Empty Pipe Alarm Threshold:

To access the [Empty Pipe Set] option list press the <Right Arrow>.

To move the cursor to [Set Empty] press the <Up Arrow>.

Press <ENTER>. The current empty threshold number appears in the prompt.

Use PC numeric keys or KeyPad to enter a new [Set Empty] number.

To store the [Set Empty] number press <ENTER>.

6.4.10   ZERO FLOW ADJUST MENU

Unlike turbine meters ultrasonic transit-time meters provide active flow measurement right down to zero flow, however, the measurement of the transit-time delta is dependent on the similarity or "match" of the electronics, cables and ultrasonic transducers. Consequently some flow offset (or zero offset) may be present in any installation. To eliminate this residual zero offset Controlotron has developed several different methods to insure proper zero flow compensation. The following paragraphs describe each method and when they should be used.

AutoZero

When the 1011 transducers are mounted in the Reflect Mode configuration (see paragraph 3.1.5) the AutoZero routine is automatically invoked at the end of the Initial Makeup. Flow does not have to be stopped to perform AutoZero since only the pipe wall signal is used in determining the zero offset and not the liquid component. The AutoZero routine performs a <u>one-time</u> analysis of the pipe wall component of the ultrasound signal to quantify any residual mismatch in the hardware. Once the AutoZero routine is complete, the system memorizes this measured zero offset and subtracts this value from the flow reading.

Actual Zero

The "Actual Zero" function simply averages the indicated "zero flow" readings (over a user defined time period) then stores this average value in memory. Under normal operation the indicated flow reading is zero compensated by simply subtracting this memorized value from the uncompensated flow reading. Actual Zero is the most positive method for zeroing the system, however, *flow must be stopped with the line blocked (if possible) before invoking this function.* If stopping flow is not possible then an alternate zeroing method should be selected.

ReversaMatic

This routine involves swapping the UP and Down transducers on the pipe (while keeping the cables attached) such that the difference in the transit-time change represents the zero offset. The fixed zero offset value is stored in memory in the same manner as described in Actual Zero. This routine would generally be used whenever flow cannot be stopped and the transducers <u>cannot</u> be mounted in the Reflect Mode configuration. Flow must be stable during the entire process.

ZeroMatic

When ZeroMatic is invoked the flowmeter first performs the same analysis as described above in the AutoZero routine. However, after this analysis is complete the flowmeter continues to interrogate the pipe wall signal and update the zero offset value under normal operation, such that the flowmeter dynamically compensates for changing conditions which would normally result in zero drift. ZeroMatic will only operate with the transducers mounted in the Reflect Mode configuration and is recommended for applications which experience large temperature extremes.

NOTE: Invoking ZeroMatic will clear any existing "fixed" or memorized zero offset. If any zero offset remains after flow is stopped, an Actual Zero can be performed without interrupting ZeroMatic operation. To disable ZeroMatic, invoke it again, but then press <Left Arrow> to abort the installation.

NOTE: The ZeroClr command only resets the memorized zero offset registers not those set when the AutoZero routine is invoked.

Using Actual Zero

NOTE: Flow must be stopped with the line blocked (if possible) before invoking this function.

To invoke Actual Zero:

Access the [Zero Flow Adjust] option list by pressing the <Right Arrow>.

Press <ENTER>. A pop-up window prompts you to set the current flow rate (in selected rate units) to equal zero (0.000).

NOTE: If a flow offset is desired (i.e., to test analog outputs) then press <Right Arrow> to enable numeric entry.

Press <ENTER> to start the Actual Zero process.

When you send the command, the flow computer analyzes the current flow rate for up to sixty seconds, integrating (averaging) the data for the best zero correlation. During this time, the menu prompt at the top of the display screen shows a timer that counts from zero to sixty. You can allow zero averaging for the entire period, or cancel the process at any time by pressing the <ENTER> key. This controls the amount of data the meter averages to obtain a zero level.

Using ReversaMatic

If site conditions do not permit stopping the flow rate at the mounting location, and you do not know the current flow rate, then you can use the ReversaMatic routine to establish the zero flow level. You should perform the ReversaMatic procedure as quickly as possible to ensure that the flow rate remains constant throughout the procedure.

To invoke ReversaMatic:

● To access the [Zero Flow Adjust] option list press the <Right Arrow>.

● Move the cursor to [ReversaMatic]. Press <ENTER> to invoke the routine.

● The meter begins to measure the positive flow rate. "Positive" flow refers to flow moving from upstream transducer location to the downstream transducer location. Note top prompt line shows: `Reversamatic Action`

● Upon completion, the meter beeps and the display screen shows:`Reverse Xdcrs / Press ENT`

● Now remove then remount the upstream and downstream transducers in their reversed positions. Mount the Up transducer (without removing its cable) in the Down transducer/cable location. Mount Down transducer with its cable in the Up transducer/cable location. When remounting the transducers, couple them to the pipe properly. Press <ENTER> (after re-installing the transducers).

● The flow computer measures the negative flow rate briefly, then beeps and repeats the prompt: `Reverse Xdcrs / Press ENT`

● Now remount the transducers for normal operation (in their original orientation). When remounting transducers, couple them to the pipe properly. Press <ENTER> (after re-installing the transducers).

This completes the ReversaMatic procedure. The system's zero accuracy will be very close to that obtainable using the Actual Zero method, providing flow remained constant during this procedure.

Important Note: *A caution on the use of upper and lower flow limits (used to prevent flow mis-registration) prior to using the Reversal Zero technique (ReversaMatic): If the negative flow rate that the meter reads in the step during which the transducers are reversed is more negative than the lower flow limit, the meter will re-register positive and the Reversal Zero cycle will thus be corrupted.*

Therefore, postpone the installation of upper and lower flow limits until the reversal zero procedure is executed successfully. For pipes that combine large diameters with very high flow velocities, it may be necessary to move the upper and lower flow limits out of the way until the reversal zero is completed. Moreover, pipes of this size frequently have excellent intrinsic zero performance and may not even need zeroing.

ZeroMatic (optional function)

NOTE: ZeroMatic is used in the Reflect Mode only. Invoking ZeroMatic clears any existing fixed zero offset.

Use this menu cell to select the ZeroMatic option. If conditions permit the use of the Auto Zero function then the ZeroMatic option can be used as well.

To select and enable the ZeroMatic option:

      In the Pick/Install Xdcr menu, press the <Down Arrow> to scroll to the [Zero Flow Adjust] menu cell.

      To access the [Zero Flow Adjust] option list press <ENTER>.

NOTE: If ZeroMatic is not running, the [Actual Zero] menu item will be displayed next to the [Zero Flow Adjust] menu cell.

```
Siemens          Dual Path          SITE1
Conformans Indicated flow to Actual Zero

Transducer Model      1011 Universal
Transducer Size       B3
Xdcr Mount Mode       Reflect
Spacing Offset        Minimum
Number Index          7
Spacing Method        Track 1012TP
Ltn Value (in)             ReversaMatic
Install Complete?          ZeroMatic
Empty Pipe Set             Auto Zero
Zero Flow Adjust           Actual Zero
                           ZeroClr

Pick/Install Xdcr
```

      Select the [ZeroMatic] menu cell by pressing the <Up/Down Arrows> then press <ENTER>.

```
Siemens            Dual Path            SITE1
ZeroMatic Active          [6:.................:0]

 Transducer Model        1011 Universal
 Transducer Size         B3
 Xdcr Mount Mode         Reflect
 Spacing Offset          Minimum
 Number Index            7
 Spacing Method          Track 1012TP
 Ltn Value (in)          0.778
 Install Complete?
 Empty Pipe Set
 Zero Flow Adjust        ZeroMatic


Pick/Install Xdcr
```

When the initial makeup of ZeroMatic is complete the screen will return to the Pick/Install Xdcr menu and automatically highlight [Operation Adjust], which is the next menu cell.

```
Siemens            Dual Path            SITE 1
Conforms operation to user Preferences

 Channel/Path Setup
 Pipe Data
 Application Data
 Pick/Install Xdcr
 Operation Adjust
 Flow/Total Units
 Data Span/Set/Cal
 Stripchart Setup
 Datalogger Setup
 I/O Data Control
 Diagnostic Data

 Dual Path Flow
```

<u>To disable the ZeroMatic function</u>:

      Select the [Pick/Install Xdcr] menu cell from the Dual Path Flow menu.

      Scroll down to the [Zero Flow Adjust] menu cell by pressing the <Up/Down Arrows>.

NOTE: The highlighted [ZeroMatic] menu item is the only indication that ZeroMatic is function-ing.

      Invoke the ZeroMatic initial makeup procedure as previously described above.

      While ZeroMatic initial makeup is running, press the <Left Arrow> to abort the process thereby disabling the function.

      The screen will return to the Dual Path Flow menu and highlight the [Operation Adjust] menu cell.

6.5   THE OPERATION ADJUST MENU

This menu becomes available after picking a meter type and measurement channel. We recommend that you use it after the transducers are installed and operating to "fine-tune" the meter's output characteristics.

Each application presents different data display and output requirements due to unique pipe and liquid conditions. Use the [Operation Adjust] menu to match meter operation to the site. You can set damping controls for the primary flow rate output. You can define a Deadband (i.e., usually a very low flow rate) below which the flow output will be forced to zero. You can also select the meter response to a continuous Fault condition.

Use this menu cell to select either SmartSlew™ or Time Average output damping.

Use this menu cell to enter a flow rate deadband threshold. Flow rates below this level will be reported as zero flow.
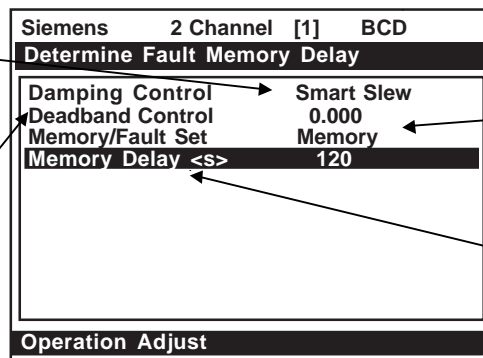
Use this menu cell to select meter response to a fault condition. Fault drops outputs to zero. Memory retains last valid reading for duration of Memory Delay.

Use this menu cell to enter the duration (in sec.) that you want the meter to maintain its last reading for during a fault condition. The hidden cell only appears if you select Memory Mode.

```
Siemens       2 Channel   [1]      BCD
Determine Fault Memory Delay

Damping Control          Smart Slew
Deadband Control            0.000
Memory/Fault Set          Memory
Memory Delay <s>            120




Operation Adjust
```

OPERATION ADJUST MENU STRUCTURE

Operation Adjust ⇨	Damping Control ⇨	⇕ Smart Slew x *(numeric selection)*
		Time Average xx.x *(numeric entry)*
	Deadband Control ⇨	x.xx *(numeric entry)*
⇕	Memory/Fault Set ⇨	⇕ Memory
		Fault
	Memory Delay (s) ⇨	xxx *(numeric entry) (hidden in Fault Mode)*

6.5.1 DAMPING CONTROL

System 1020 provides two different data output filter types, SmartSlew and Time Average (recommended). SmartSlew provides the best combination of data smoothing and quick response to sudden rate changes. It performs data scatter damping during steady flow periods while maintaining the ability to respond instantaneously to changing flow rates. SmartSlew values range from [1 to 9]. The default is [6]. Pick a higher number to slow meter response to a rate change.

Time Average integrates the instantaneous flow rate over a selectable time period. You enter a value (in seconds) that sets the time it takes the meter to respond to a rate change. The default is 10 seconds. Enter any amount of time up to 60 seconds maximum.

To edit the default SmartSlew setting:

> To access the SmartSlew option list press the <Right Arrow> three times.
>
> Scroll the numeric list to the desired choice by pressing the <Up/Down Arrows>.
>
> To register the new value press <ENTER>.

To select Time Average:

> To access the Damping Control option list press the <Right Arrow>.
>
> To move the cursor down to [Time Average] press <ENTER>.
>
> To enable Time Average entry press the <Right Arrow>.
>
> Use PC numeric keys or Keypad to enter the new Time Average setting.
>
> To register the new value press <ENTER>.

6.5.2 DEADBAND CONTROL

Use Deadband Control to instruct the meter to report zero flow if the flow rate falls below a specified level (usually a very low rate). It will prevent the possibility of data scatter (a natural result of digital computation) from causing false totalizer accumulation during long non-flowing periods. Inspect the actual data scatter during zero flow conditions to find the proper deadband setting for your application.

To edit the default setting (0.000):

> To enable numeric entry press the <Right Arrow>.
>
> Use PC numeric keys or KeyPad to enter the desired rate (using selected flow rate units).
>
> To register the new value press <ENTER>.

6.5.3 MEMORY/FAULT SET

Certain situations (e.g., an empty pipe or excessive aeration) will interrupt data production. Use Memory/ Fault Set to select the meter response to such an interruption. The Fault setting (default) will zero the flow rate output and declare an alarm on a flow display screen, Datalogger report and an assigned relay output.

For some applications, occasional temporary Fault conditions may be a normal part of the process and would not require an alarm response. The system offers a Memory operating mode to support such an application. Memory Mode suspends the system's Fault response by preventing the flow outputs from dropping to zero for the interval specified in the [Memory Delay] menu cell. During the Memory duration, the meter will maintain the last valid flow reading measured before the onset of the fault condition. The default Memory Delay is 60 seconds. You may select any duration from 3 to 604,800 seconds (one week).

To select Memory Mode:

> To access the [Memory/Fault Set] option list press the <Right Arrow>.
>
> Move the cursor down to [Memory] by pressing the <Down Arrow>.
>
> To make selection press <ENTER>.
>
> This moves the highlight to [Memory Delay <sec>].

Memory Delay <s>

Selecting [Memory] activates the suppressed [Memory Delay] menu cell. It allows you to specify the number of seconds that the meter maintains its last valid flow reading. When the memory delay expires, it triggers the fault alarm response described previously.

To specify the Memory Delay:

> To enable numeric entry press the <Right Arrow>.
>
> Use PC numeric keys or KeyPad to enter the delay in seconds.
>
> To register the new value press <ENTER>.

6.6   THE FLOW/TOTAL UNITS MENU

The Flow/Total Units menu is available after selecting a meter type and measurement channel. Use the Flow/Total Units menu to select energy and volumetric flow units and an associated time base for the energy and flow rate and total outputs. After making your selections, a view-only menu cell shows the resultant scaling. Another menu cell lets you adjust the output resolution by selecting a display range.

This system provides three totalizer display modes:

> **POSFLOW** .... *Positive (forward) energy/flow total only*
> **NEGFLOW** .... *Negative (reverse) energy/flow total only*
> **NETFLOW** .... *The net of the Positive and Negative energy/flow (default)*

NOTE: The Model 1020 Totalizer Controls can only be accessed as follows:

1. <u>**From the 1020 KeyPad:**</u>

    a. Only the CLEAR function is accessible from the KeyPad. In the Flow/Total Units menu, highlight the [Reset Totalizer] menu cell and select [Yes].

    b. The CLEAR (Reset Totalizer) and NOTOT (Freeze Totalizer) commands are enabled when TB2 Pins 17 & 18 (Freeze Totalizer) and TB2 pins 19 & 20 (Reset Totalizer) are accessed via the RS-232 serial port (see drawing 1020-7).

2. <u>**From the RS-232 Serial Port:**</u> **All the Totalizer commands listed below can be executed using the normal PC keyboard function keys via VT100 terminal key emulation. To execute: Open Windows HyperTerminal and click [File] then [Properties]. In [Settings] menu, select [Terminal Keys].**

<div align="center">

TOTALIZER CONTROLS *(the "n" in <Fn> = channel number)**

</div>

Key	Command	Description
F1 F2 — 1	CLEAR (also clears overflow)	Resetting the Totalizer registers clears all total data accumulated during operation. **NOTE: The Clear Totalizer function (CLRTOT) can only be invoked from the keypad or an external PC keyboard via the RS-232 port.**
F1 F2 — 2	NOTOT (Totalizer Freeze)	Invoking the NOTOT command disables the Totalizer. Totalization will not resume until you repeat the Fn and Numeric 2 key sequence. When you activate NOTOT, an N precedes the TOTAL symbol (i.e., [NTOTAL]) on the LCD Screen.
F1 F2 — 3	LAPTOT (Totalizer snapshot)	The LAPTOT command freezes the Totalizer screen display. However, the flow computer will continue to update its internal registers. The flow computer will show the current total when you repeat the F1 - Numeric 3 key sequence. When you activate LAPTOT, an L precedes the TOTAL symbol (i.e.,[LTOTAL]) on the LCD Screen.
F1 F2 — 4	CLEAR (BatchTot Register)	Clears the Batch Sample totalizer register. See Batch/Sample Total.
F1 F2 — 6	CLEAR (Makeup Latch)	Clears the Makeup Latch. See paragraph 6.7 The Data Span/Set/Cal Menu and subparagraph 6.7.1 Span Data.

The flow computer stores positive and negative accumulations in separate independent registers. You use the KeyPad or, if using a PC, the keyboard function and numeric keys to control the flow totalizer registers.

THE FLOW/TOTAL UNITS MENU STRUCTURE

Flow/Total Units ⇨	Flow Volume Units ⇨ ⇕	⇕ Gallons (US) Liters Cubic Feet Cubic Meters Cubic Inches Cubic Cm Ounces (U.S.) Imperial Gal 31.0 GAL BBL 31.5 GAL BBL 42.0 GAL BBL 55 GAL Drum Acre-feet Pounds Kilograms Tons Metric Tons Ft/Sec (Vel) M/Sec (Vel)	
	Flow Time Units ⇨ ⇕	⇕ MIN HR DAY SEC	
	Flow Disp. Range ⇨ ⇕	⇕ Autorange High	
	Flow Disp. Scale ⇨ ⇕	⇕ mGAL/MIN GAL/MIN KGAL/MIN	
	Total Vol. Units ⇨ ⇕	⇕ *Same list as Flow Volume Units*	
	Totalizer Scale ⇨ ⇕	⇕ GAL KGAL mGAL	
	Total Resolution ⇨ ⇕	⇕ 000000x0 0000000x 00000x00	
	Totalizer Mode ⇨ ⇕	⇕ NEGFLOW NETFLOW POSFLOW	
	Batch/Sample Total ⇨	x.xxx *(numeric entry)*	
	Reset Totalizer ⇨ ⇕	⇕ Yes No	

Use this menu cell to select
either volumetric or mass flow
rate units.

Use this menu cell to select a
time base for the flow rate
units.

Use this menu cell to select a
range for the flow rate display
screen.

Use this menu cell to select
either volumetric or mass flow
total units.

Use this menu cell to set the
resolution of the totalizer.

```
Siemens    2 Channel  [1]     FLOW1
Choose desired Flow rate volume units

Flow Volume Units      Gallons <US>
Flow Time Units        MIN
Flow Display Range     Autorange
Flow Display Scale     GAL/MIN
Total Volume Units     Gallons <US>
Totalizer Scale        KGAL
Total Resolution       00000x00
Totalizer Mode         NETFLOW
Batch/Sample Total     0.000
Reset Totalizer        Yes/No

Flow/Total Units
```

Use these menu cells
to set the scaling for the
flow rate and flow total
outputs.

Use this menu cell to
select how the totalizer
accumulates flow.

Use this menu cell to enter a
volume accumulation for the
batching or sampling totalizer
relay trigger.

6.6.1 FLOW VOLUME UNITS

The [Flow Volume Units] option list allows you to select the rate units the meter uses to report volumetric or mass flow. If you select mass units, the meter uses the specific gravity parameter (see Application Class section) to convert volumetric flow to mass flow. The default [English Units] is [Gallons <US>].

To select a Volumetric or Mass Unit:

To access the [Flow Volume Units] option list press the <Right Arrow>.

To move the cursor to the required units press the <Up/Down Arrows>.

To store selection press <ENTER>.

6.6.2 FLOW TIME UNITS

The [Flow Time Units] option list allows you to select a flow display time base. The system default is [Minutes]. If this suits the application, press the <Down Arrow> to bypass this menu cell.

To select Flow Time Units:

To select the desired time unit press the <Right Arrow> to access the [Flow Time Units] option list.

To move the cursor to the required time units press the <Up/Down Arrows>.

To store the time units press <ENTER>.

6.6.3   FLOW DISPLAY RANGE

The [FlowDisplay Range] option list offers a choice of [Autorange] (default) or [High Range]. The [Autorange] selection increases resolution automatically at low flow rates and reduces resolution at high flow rates as required to prevent data overflow. If you select [High Range], the meter controls its screen resolution to prevent data overflow at the highest possible flow.

To edit the Flow Display Range:

To access the [Flow Display Range] option list press the <Right Arrow>.

To move the cursor to the required display range press the <Up/Down Arrows>.

To store selection press <ENTER>.

6.6.4   FLOW DISPLAY SCALE

After you select rate units, the meter automatically computes a prefix to provide the best combination of capacity and resolution (e.g., KGAL/MIN). The [Flow Display Scale] menu cell shows the results. If the displayed scaling is not suitable, you can edit it by accessing the option list. Note that this scaling applies to all flow rate data displayed on the flow display screen, even if the units do not appear next to the data (because there may not be room on the screen). Therefore, always keep this prefix in mind when you enter flow related data.

To select a different Flow Display Scale:

To access the [Flow Display Scale] option list press the <Right Arrow>.

Move the cursor to the desired display scale press the <Up/Down Arrows>.

To register selection press <ENTER>.

6.6.5   TOTAL VOLUME UNITS

This menu cell allows you to select which units the meter uses for the flow total output. If you select mass units, the meter uses the specific gravity parameter (see paragraph 6.3.1) to convert volumetric flow to mass flow. The default [English Flow Total Units] is [Gallons <US>]. If this suits the application, press the <Down Arrow> to bypass this menu cell.

To change the default setting:

To access the [Total Volume Units] option list press the <Right Arrow>.

To move the cursor to the desired Total Volume Units press the <Up/Down Arrows>.

To store selection press <ENTER>.

6.6.6 TOTALIZER SCALE

After you select totalizer units, the meter automatically computes a prefix to provide the best combination of capacity and resolution (e.g., MGAL/MIN). The [Totalizer Scale] menu cell shows the results. If the displayed scaling is not suitable, you can edit it by accessing the option list. Note that this scaling applies to all flow total data displayed on the flow display screen, even if the units do not appear next to the data (because there may not be room on the screen). Always keep this prefix in mind when you enter totalizer-related data.

To select a different Totalizer Scale:

> To access the [Totalizer Scale] option list press the <Right Arrow>.

> Move the cursor to the desired display scale press the <Up/Down Arrows>.

> To register selection press <ENTER>.

6.6.7 TOTAL RESOLUTION

The meter assigns multiplier prefixes for the flow total units you selected (e.g., MGPM). It provides three resolution (or capacity) levels. Therefore, actual Totalizer display units depend on the selected multiplier. Check the total units by accessing the [Totalizer Scale] menu cell.

If you use the totalizer (TOTCNT) relay output, take into account:

a) The TOTCNT relay output pulses at a maximum rate of .5 pulse per second (.5 Hz).

b) The meter sends a totalizer output pulse for every advance of the rightmost visible totalizer digit.

It is possible for a high flow rate to persist long enough to exceed the relay output's .5 Hz rate. If this occurs, the meter will store excess pulses in an overflow buffer, and route them back to the relay when the flow rate drops enough to allow the TOTCNT output to catch-up. Exceeding the .5 Hz rate for long periods could cause an excessive accumulation of buffered pulses and continue to trip the relay after the flow rate lessens, or even stops. If this occurs, the meter will be unable to indicate the current flow total. Therefore, *select a resolution to ensure that, even at the maximum expected flow rate, the TOTCNT pulse will not be activated more than .5 times per second for any appreciable length of time*. Note that resetting the Totalizer also clears the overflow buffer.

To change the default resolution:

> To access the [Total Resolution] option list press the <Right Arrow>.

> Move the cursor to the required resolution by pressing the <Up/Down Arrows>.

> To store selection press <ENTER>.

6.6.8   TOTALIZER MODE

The Totalizer function operates in any of the modes listed below:

MODE	FLOW DIRECTION	NOTES
POSFLOW	positive flow	Accumulates flow in positive direction only.
NEGFLOW	negative flow	Accumulates flow in reverse direction only.
NETFLOW	positive or negative	Adds to positive total; subtracts from reverse total.

NOTE: NETFLOW (default) is best for applications where there may be zero flow for long periods. It minimizes false Totalizer register increments due to data scatter. Press the <Down Arrow> to accept the default setting.

To select a Totalizer Mode:

To access the [Totalizer Mode] option list press the <Right Arrow>.

Move the cursor to the required Totalizer mode by pressing the <Up/Down Arrow>.

To store selection press <ENTER>.

6.6.9   BATCH/SAMPLE TOTAL

The meter maintains a separate totalizer register for Batching or Sampling applications. Unlike the Flow Total registers, you cannot access this register directly. It is used for relay control only. If you assign the system relay to this function, a momentary (200 mS) relay pulse occurs whenever the BATCHTOT register accumulates a specified liquid quantity. You enter the total flow volume required to activate the relay, in the [Batch/Sample Total] menu cell. The numeric entry must reflect the selected flow total units. The [Totalizer Display Scaling] menu cell shows the applicable flow total units. The sign of the Batch/Sample Total determines positive or negative accumulations.

NOTE: The Batch/Sample total relay requires the same consideration for exceeding the maximum pulse rate as the TOTCNT relay (see paragraph 6.6.7 Total Resolution).

To enter a Batch/Sample Volume:

To activate numeric entry press the <Right Arrow>.

Use PC numeric keys or KeyPad to enter the desired Batch/Sample TOT accumulation.

To store data press <ENTER>.

6.6.10   RESET TOTALIZER

Use this function to set all 1020 totalizer registers, including the overflow register, to zero. For details, see your model's installation drawings. Full totalizer control over these registers is also obtainable with a PC using the menu access facility (see Totalizer Controls).

6.7   THE DATA SPAN/SET/CAL MENU

This menu becomes available after picking a Meter Type and Measurement Channel. However, some functions will only be active after the transducers are installed and operating properly. Use the [Data Span/Set/Cal] menu to set the range for analog outputs and setpoints for Alarm relay outputs. Additionally, the [Calibrate Flow Rate] menu allows you to apply external adjustments to the meter's intrinsic primary outputs.

THE DATA SPAN/SET/CAL MENU STRUCTURE

Data Span/Set/Cal ⇨	Span Data ⇨	PGEN ⇨	x.xxx (numeric entry)	
		Max Flow (Units) ⇨	x.xxx (numeric entry)	
	⇕	Min Flow (Units) ⇨	x.xxx (numeric entry)	
		Max Vs m/s ⇨	x.xxx (numeric entry)	
		Min Vs m/s ⇨	x.xxx (numeric entry)	
	Set Alarm Levels ⇨	Hi Flow ⇨	x.xxx (numeric entry)	
		Low Flow ⇨	x.xxx (numeric entry)	
⇕	⇕	Interface Vs m/s ⇨	x.xxx (numeric entry)	
		Aeration % ⇨	x.xxx (numeric entry)	
		Makeup Latch ⇨	Off	
			On	
	Calib. Flowrate ⇨	Intrinsic		
		Kc ⇨	x.xxx (numeric entry)	
	⇕	MultiPoint ⇨	Point #	xx (numeric entry)
			Indicated Rate	x.xxx (numeric entry)
			% Correction	x.xxx (numeric entry)

Use this menu to set the low and high range for analog outputs.

Use this menu cell to enter a calibration slope factor for volumetric flow (Vfo).

Siemens	2 Channel	(1)	Channel 1
Define data Alarm thresholds			

Span Data
Set Alarm Levels
Calib. Flowrate   **Intrinsic**

Data Span/Set/Cal

Use this menu to define setpoints for the alarm relay outputs.

6.7.1 SPAN DATA

The Span Data menu allows you to set 0% and 100% output limits for volumetric flow (Vfo), absolute flow (Vfab) and sonic velocity (Vs). Each menu cell shows appropriate rate units and time base. If you change flow rate units after spanning the system, the computer automatically updates the output data setup to reflect the change. Span limits apply to both the analog outputs and the on-screen stripchart. The flow outputs operate as follows:

Vfo *Spanned Volumetric*	The minimum and maximum flow rate entries establish the Vfo span. The [Max Flow] menu cell sets 100% of span. The [Min Flow] menu cell sets 0% of span. Use signed numbers for bi-directional spanning. Note that negative (reverse) flow is always lower than positive flow, whatever its absolute magnitude. For example, for a flow measurement range of -30 GPM to +10 GPM, the 4 mA span will be -30 GPM, and the 20 mA span will be +10 GPM.
Vfab *Spanned Absolute Volumetric Flow Rate:*	Vfab is the absolute magnitude of the volumetric flow rate (Vfo). There are no menu cells provided to span this output. Vfab shares the Vfo span entries. The Vfab minimum span is always zero. The maximum span for Vfab is the largest absolute value of either the min. or the max. flow rate (Vfo) entries. For example, a span between +10 GPM and -30 GPM, spans the Vfab output from 0 GPM to 30 GPM.
Vs *Spanned Liquid Sonic Velocity:*	Vs is the sonic velocity in meters-per-second (m/s) of the flowing liquid. The min. and max. Vs entries establish the Vs span. Max Vs (m/s) defines 100% of span. The Min Vs (m/s) defines 0% of span.

<u>**Maximum span values represent**</u>:   <u>**Minimum span values represent**</u>:

100% of span   0% of span
Current output of 20 mA   Current output of 4 mA
Voltage output of 10 Vdc   Voltage output of 0 Vdc

PGEN

The [PGEN P/*Unit Volume*] menu cell entry controls a digital output pulse function. It allows the assigning of PGEN digital signal pulses per unit of volume. For example, 1000 output pulses per unit volume of liquid. *Note: This output is not available on Dual Channel systems.*

NOTE: The unit of volume is determined by the Volume Units initially selected from the [Total Volume Units] menu cell option list (refer to paragraph 4.6.5).

<u>To assign PGEN output pulses:</u>

From the [Span Data] menu press the <Right Arrow>.

From the [PGEN P/Unit Volume] menu cell, press the <Right Arrow> to activate the numeric entry.

Use the numeric keys to enter the desired number of PGEN pulses per unit volume.

To store the data press <ENTER>.

Max Flow

The [Max Flow] menu cell stores the maximum range for the flow rate output (Vfo). It can be a positive or negative value. Enter the data using the flow rate units you selected. This entry also spans the unsigned flow variable (Vfab).

To enter the Max. Flow Range setting:

> To activate numeric entry press the <Right Arrow>.

> Use PC numeric keys or KeyPad to enter the maximum flow rate (100% of range).

> To store the data press <ENTER>.

Min Flow

The [Min Flow] menu cell stores the minimum range for the flow rate output (Vfo). It can be a positive or negative value (to reflect bi-directional flow). However, the minimum span for the unsigned flow (Vfab) is always zero. Enter the data using the flow rate units you selected.

To enter the Min. Flow Range setting:

> Activate numeric entry by pressing the <Right Arrow>.

> Use PC numeric keys or KeyPad to enter the minimum flow rate (0% of range).

> To store data press <ENTER>.

Max Vs m/s

The [Max Vs m/s] menu cell stores the maximum range for the sonic velocity output. The sonic velocity (Vs) appears on the Stripchart display and can drive any analog output or the alarm relay. The [Max Vs m/s] menu cell restricts this parameter to a maximum range of 2100 m/sec.

To set the maximum Vs output range:

> To activate numeric entry press the <Right Arrow>.

> Use PC numeric keys or KeyPad to enter the 100% range for the Vs output.

> To store data press <ENTER>.

Min Vs m/s

The [Min Vs m/s] menu cell stores the minimum range value for the sonic velocity output. The sonic velocity (Vs) can be displayed on the Stripchart and drive any analog output or the alarm relay. The [Min Vs m/s] menu cell restricts this parameter to a minimum range of 400 m/sec.

To set the minimum Vs output range:

> To activate numeric entry press the <Right Arrow>.

> Use PC numeric keys or KeyPad to enter the 0% range for the Vs output.

> To store data press <ENTER>.

6.7.2 SET ALARM LEVELS

The [Set Alarm Levels] menu allows you to select setpoints for system alarm functions. Alarms appear locally on the LCD digital display. In addition, you can use the [Relay Setup] menu to assign those functions to the system's relays. You may select from flow rate, liquid interface (Vs) and liquid aeration alarm functions. Entry of all alarm setpoints is accomplished using the selected rate units. You can enable or disable a Makeup Alarm Latch to keep the makeup alarm active until you reset it manually by an <Fn>6 simultaneous key press on a PC keyboard or via the KeyPad.

To access the [Set Alarm Levels] menu press the <Right Arrow>.

Hi Flow

The [Hi Flow] alarm menu cell allows you to set the HI alarm relay trip-point.

To set the Hi Flow alarm:

To activate numeric entry press the <Right Arrow>.

Use PC numeric keys or KeyPad to enter the Hi Flow alarm setpoint in the selected flow rate units.

To store data press <ENTER>.

Low Flow

The [Low Flow] alarm menu cell allows you to set the LO alarm relay trip-point.

To set the Low Flow alarm:

To activate numeric entry press the <Right Arrow>.

Use PC numeric keys or KeyPad to enter the Low Flow alarm setpoint in selected flow rate units.

To store data press <ENTER>.

Interface Vs m/s (meters-per-second)

The meter continuously measures liquid sonic velocity (Vs) and tracks changes in this parameter dynamically. It can compare sonic velocity differences in real-time. Its sonic velocity detection is so sensitive, it can quickly distinguish between two different liquids flowing through the same pipe. To set the interface alarm, you select a detection setpoint that falls in the middle of the Vs values of the two liquids.

For example, if Liquid "A" has a sonic velocity of 1249 m/s, and Liquid "B" has a sonic velocity of 767 m/s, then you should enter 1008 m/s for the interface setpoint. The Interface Alarm becomes active when the measured Vs meets or exceeds the reference value you enter in this menu cell.

NOTE: The valid Interface Vs range is: 400 to 2100 m/s.

To enter an Interface Vs alarm setpoint:

> To activate numeric entry press the <Right Arrow>.

> Use PC numeric keys or KeyPad to enter the Interface Vs value in meters-per second.

> To store the data press <ENTER>.

Aeration %

The System 1020 surpasses all other transit-time systems in its ability to operate with substantial aeration (caused by entrained gases, mixing condition or cavitation). Some applications may require an alarm indication if aeration exceeds a particular level. The meter detects this aeration level and provides this data as an output. The aeration percentage triggers the alarm relay whenever it meets or exceeds the threshold you set in this menu cell. The aeration percentage (Vaer %) appears in the Liquid Data section of the Diagnostic Menu. The digital display screen also shows the current aeration percentage.

NOTE: Severely aerated conditions may induce flowmeter fault. The 50% default setting usually allows enough leeway for continued operation. For intermittent faults, see memory interval in the Output Control menu.

To set the Aeration % alarm:

> To move the cursor to activate numeric entry press the <Right Arrow>.

> Use PC numeric keys or KeyPad to enter the Aeration percentage setpoint.

> To store data press <ENTER>.

Makeup Latch

A fault condition (e.g., caused by an empty pipe or a transient loss of power, etc.) could temporarily interrupt operation. After recovery from the fault, the meter executes an In-Process Makeup to restore operating parameters. During the makeup the meter sets a Makeup Alarm flag, which clears upon completion. Therefore, unless you were monitoring the unit continuously, you could miss the fact that an In-process Makeup occurred.

The [Makeup Latch] alerts you that the system implemented a Makeup by holding the Makeup Alarm active until you reset it manually by the simultaneous keystrokes: <Fn>6 (where "n" represents the measurement channel). In addition, if the Datalogger is active with Status Alarms selected, generating a Datalogger report will reset the Makeup Alarm Latch. This ensures that the alarm does not appear on succeeding Datalogger reports. A Makeup Alarm appearing on a subsequent report indicates that an In-Process Makeup must have occurred since the last Datalogger report.

To Enable (or Disable) the Makeup Latch:

> To access the [Makeup Latch] option list press the <Right Arrow>.

> Move the cursor to select either [On or Off] by pressing the <Up/Down Arrows>.

> To turn Makeup Latch [On] or [Off] press <ENTER>.

6.7.3 CALIBRATE FLOWRATE

The 1020 intrinsic calibration is excellent as confirmed by numerous laboratory and field trials under diverse application conditions. We thus can confidently say that in any given application, the majority of conventional flowmeters can not match the system's measurement range or its linearity. Some applications may require an output adjustment to match an official external reference. The [Calibrate Flowrate] menu allows you to select a calibration mode. The right-hand column shows the active calibration mode. You can select Intrinsic (factory), Kc (Slope Correction) or Multipoint (Non-linear) Calibration. Selecting either of the external calibration modes will not eliminate the Intrinsic (factory) calibration. You can use this menu cell to switch between Intrinsic, Kc or Multipoint at any time.

Kc Calibration

For most applications, the measured flow range produces a linear meter response. Therefore, the Kc (slope correction) calibration is the preferred method since it only requires a single correction factor for all the flow rates encountered. Changing the calibration can cause profound changes in a flowmeter's operating characteristics. Use only the most respected flow standard to obtain a correction factor. The percentage you enter must provide an accurate and consistent shift across the entire flow range anticipated for the application.

To obtain the Kc factor, compare flow total data taken simultaneously from the 1020 and a reference meter whose accuracy meets the required standard. Allow both meters to accumulate flow total data long enough to average out any differences due to flow fluctuation between the two meter locations. Compare outputs of the two totalizers to determine percent-age increase (+) or decrease (-) that is necessary to produce the best average correlation between 1020 and the reference standard. For example, entering [-0.29] will produce a reduction of 0.29% in the calibration at all flow rates. *Note: always enter the + or - sign first.*

To calculate Kc: $Kc = \left[\dfrac{\text{Actual Rate}}{\text{Indicated Rate}} -1 \right] \times 100$

To enter the Kc Factor:

        To enable numeric entry press the <Right Arrow>.

        Use PC numeric keys or Keypad to enter the required Kc (as calculated above). Note that the Kc value can be negative or positive. Enter the - or + sign first, then type in the calculated value.

        To store the data press <ENTER> Note that Kc now appears in the right-hand column of the Calibrate Flow Rate menu cell with its new value. Also note that this Kc value can be viewed on the site printout.

MultiPoint Calibration

MultiPoint calibration serves applications that require a non-linear meter calibration. You can enter correction factors for up to ten significant points over the entire measurement range. This is accomplished by:

    (a) Selecting up to 10 separate calibration points by entering a raw (un-calibrated) flow rate.

    (b) Entering a negative or positive correction for each calibration point that you select.

Like the Kc slope correction described previously, you locate critical flow rate points by comparing flow total data taken simultaneously from the 1020 and a reference meter whose accuracy meets the required standard. Again, it is important to note that you must allow both meters to accumulate flow total data for long enough to average out any differences due to flow fluctuation between the meter locations.

Compare the two flow total readings to identify up to ten separate points (termed raw flow rates) where there are significant deviations between 1020 and the reference meter. Calculate correction factors (either negative or positive percentages) for up to ten points along the flow range. For example, entering [-0.1] for point 1 produces a negative 0.1% change in the meter output whenever the system measures the raw flow rate specified for point 1, etc. The valid range for each percent correction is from -50% to +50%. If you enter a value outside of this range, the flow computer will set the calibration factor to the nearest limit.

Use these to match 1020's output with the reference meter's response curve. Selected calibration points must increase in magnitude from point 1 to point 10 (or the last point that you wish to calibrate).

NOTE: You must enter the raw flow rates in ascending order.

To perform a MultiPoint Calibration:

       To access the [Calibrate Flowrate] option list press the <Right Arrow>.

       Move the cursor up to [MultiPoint], then press <ENTER>.

       This selects the MultiPoint calibration screen, which shows:

Point #	(point 1 selected)
Indicated Rate	(shows current rate for point # 1)
% Correction	(amount of correction applied either (-) or (+) percentage)

       Press <Down Arrow> to move to the [Indicated Rate] field, then press the <Right Arrow>to enable numeric entry.

       Use PC numeric keys or KeyPad to enter a flow rate for point #1, then press <ENTER>. The highlight moves to the [% Correction] field for point #1.

       Press the <Right Arrow> to enable numeric entry.

       Use PC numeric keys or KeyPad to enter the required % correction for point #1.

       Press the <ENTER>. The highlight returns to the [Point #] field.

       To enable numeric entry press <Right Arrow> and then enter [2] (for the second calibration point).The cursor moves to the point #2, which is the [Indicated Rate] field.

       Use PC numeric keys or KeyPad to enter a flow rate for point #2. The value entered here must be of a greater magnitude than the value entered for point #1.

       Press <ENTER>. The cursor moves to the [% Correction] field.

To enable numeric entry press <ENTER>.

Use PC numeric keys or KeyPad to enter the required % correction for point #2.

Press <ENTER>.

Repeat this procedure for all required calibration points. After entering the last Flow Calibration Point press the <Right Arrow> to exit [MultiPoint Calibration].

6.8   THE DATALOGGER SETUP MENU

This menu becomes available after picking a Meter Type and Measurement Channel. The integral Datalogger records data via a RS-232 compatible external device (printer, computer, network, etc.). Use Datalogger Setup to select data items and real-time events for datalogger reports. You can also set the logging interval, operating mode and screen format. The Datalogger Setup menu allows you to choose time interval-based data categories or event-based status alarms, and to specify the interval between data reports.

View Datalogger reports by transmitting them via the RS-232 Serial Port to external printers and computers. Note that a single-channel meter uses a compression algorithm to maximize data storage. This disables back scrolling of datalogger reports.

Use this menu cell to pick a destination for Datalogger reports.

Use this menu cell to select items for Datalogger reports.

Use this menu cell to select a logging interval.

```
Siemens     2 Channel   [2]   Channel 2
Select datalogger destination

Datalogger Mode          Off
Datalogger Data          None
Log Time Interval        1 Min.
Data Logger Events       None




Datalogger Setup
```

THE DATALOGGER SETUP MENU STRUCTURE

Datalogger Setup ⇨	Datalogger Mode ⇨ ⇕	⇕ Off Memory RS-232 Output
⇨	Datalogger Data ⇨	⇕ None Site Id Date Time Flow Path Flow Average Flow Raw Flow Total Vs Path Vs Valc Path Valc Aeration Alarms Path Alarms Delta T (usecs) Path Delta T (usecs)
⇨	LogTime Interval ⇨	⇕ 5 Sec. 10 Sec. 15 Sec. 30 Sec. 1 Min. 5 Min. 15 Min. 30 Min. 1 Hr. 2 Hr. 4 Hr. 6 Hr. 12 Hr. 24 Hr. Demand
⇨	Datalogger Events ⇨	⇕ None Relay 1 Spacing Empty Aeration Interface Flow Alarm Fault Alarm Memory Makeup

6.8.1 DATALOGGER MODE

The [Datalogger Mode] option list allows you to disable the Datalogger, transmit reports to an external target via RS-232 port, or store selected data for later display. The default setting is [Off]. After enabling the Datalogger, select a data format before generating a report.

To select a Datalogger Mode:

To access the [Datalogger Mode] option list press the <Right Arrow>.

Move the cursor to the desired mode by pressing the <Up/Down Arrows>.

To store the selection press <ENTER>

6.8.2 DATALOGGER DATA

Set the Datalogger to record any or all of the data offered on the [Datalogger Data] option list shown below. However, recording unneeded data wastes valuable system RAM. We recommend that you always select [Site ID] (name) and [Time] to identify each line of data.

None	Default – Datalogging is disabled.
Site ID	You entered this site name when you created the site.
Date	The report date according to the meter's real time clock. (Format: MM.DD.YYYY)
Time	The report time according to the meter's real time clock. (Format: HH.MM)*
Flow	The instantaneous flow measured at the time of the report.
Average Flow	The average flow rate measured since the last report.
Raw Flow	The uncompensated flow rate in in/sec2 (only zeroed - no Reynolds number curve applied).
Total	The total flow accumulation measured at the time of the report.
Vs	The average liquid sonic velocity since the last report.
Valc	The signal strength measured at the time of the report.
Aeration	The aeration percentage recorded at the time of the report.
Alarms	The letter codes of any alarms active at the time of the report (see below).
Delta T (uSecs)	The Up to Down transit-time difference measured at the time of the report.

The Time field expands to HH.MM.SS when you select a logging interval of more than once per minute.

If you select Alarms, the Datalogger logs the state of each alarm function upon generating a report. A dash [-] represents an inactive alarm.

A letter code represents an active alarm (see below).

Alarm Letter Codes and Descriptions

S .... Spacing .... Transducer spacing may need re-adjustment
E .... Empty .... Pipe is empty
R .... Rate .... Flow above High setting or below Low setting
F .... Fault .... Three continuous seconds without new data update
A .... Aeration .... Current aeration percentage exceeds the alarm setpoint
M .... Memory .... Last valid reading for a selected interval during Fault condition
K .... Makeup .... In-Process Makeup occurred
I .... Interface .... Liquid Vs exceeds interface alarm setpoint
P .... Pig .... Pig passage detected (optional)
Z .... ZeroMatic .... ZeroMatic signal fault (optional)

NOTE: The time interval-based Datalogger records the state of all the alarms at the selected report time only. Therefore, if an alarm condition resets before the report time, it would not appear on the report. Use Datalogger Events to log transient alarms. This mode generates a report upon the detection of an alarm event.

To select Datalogger Data items:

      To access the Datalogger Data option list press the <Right Arrow>. Move the cursor to the desired data item by pressing the <Up/Down Arrows> then press <ENTER> to select it.

      Note that a plus sign (+) appears before the item.

To de-select Datalogger Data:

      Move the cursor to the data item then press <ENTER>. Note that this removes the plus sign (+) from the item.

      After selecting/deselecting all desired items press the <Left Arrow> to leave the Datalogger Data option list.

6.8.3　LOG TIME INTERVAL

The Datalogger records a "snapshot" of conditions at each log time interval. Datalogging uses a considerable amount of RAM, so only select short log intervals if it is fully justified.

NOTE: The meter maps the first Datalogger report time to an even division of its clock. Subsequent reports will conform to the selected interval.

To set the Log Time Interval:

      To access the [Log Interval] option list press the <Right Arrow>.

      Move the cursor to desired interval by pressing the <Up/Down Arrow>.

      To store your selection press <ENTER>.

6.8.4　DATALOGGER EVENTS

The 1020 offers "event-based" data logging that operates concurrently with "time interval" based data logging. The event-based function generates a Datalogger report upon the triggering of any of the alarms. This is useful for recording transient alarms (e.g., a liquid interface or a short aeration alert).

NOTE: An Alarm Event report will be generated immediately after the transition from a non-alarm to an alarm event. The reverse situation (alarm state to non-alarm state) does not trigger the event-based Datalogger.

Event-based Datalogger messages conserve memory. However, if you use this feature to monitor a level such as Flow Alarm, set the alarm threshold high enough to avoid repetitive triggering. You must select Site ID (Name) and Time to "time-stamp" the alarm events. Note that on the Datalogger report, a [-] represents a reserved letter code space (inactive alarm) and a letter code represents an active alarm.

To select Datalogger Event items:

To access the [Datalogger Events] option list press the <Right Arrow>.

Move cursor to desired item press the <Up/Down Arrow> then <ENTER> to select it.

Note that a plus sign (+) appears before the item.

To de-select Datalogger Events:

Move the cursor to the item by pressing the <Up/Down Arrow> then <ENTER>.

Note that this removes the plus sign (+) from the item.

After selecting all desired items press the <Left Arrow> to leave the [Datalogger Events] option list.

Important point about Datalogger resources and dual-channel systems.

When logging data on both measurement channels simultaneously, the Datalogger stores reports in a single common file. It is important that you select Site ID to appear on each line of data so that you can always identify which channel generated each report.

6.9 THE I/O DATA CONTROL MENU

This menu becomes available after picking a Meter Type and Channel. Use this menu to assign functions for the meter's analog outputs and optional inputs. The Analog Out Setup assigns functions to the meter's current, voltage and pulse rate outputs. Each menu cell presents an option list of the available data items. In addition, you can set up the alarm relays, enable and span the analog input ports.

Use this menu to assign data functions to analog outputs.

Use this menu to assign alarm functions to relay outputs.

```
Siemens        2 Channel   [1]      Channel 1
Assign Data to Analog Outputs

Analog Out Setup
Relay Setup




I/O Data Control
```
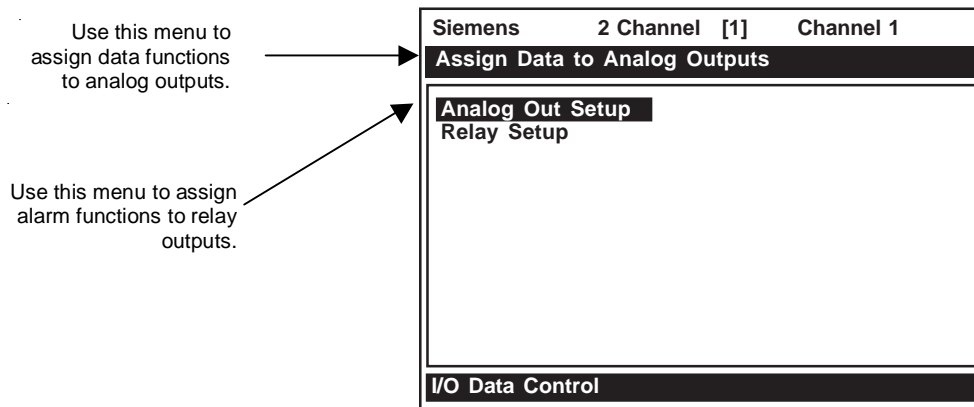
THE I/O DATA CONTROL MENU STRUCTURE

I/O Data Control ⇨	Analog Output Setup ⇨	Io1 ⇨	⇕ Vfo
			Vfo2
			Vfab
	⇕	⇕	Vs
			Valc
			Vaer
⇨	Relay Setup ⇨	Relay 1 ⇨	⇕ Off
			Power On
			High Flow
			Low Flow
			Flow Alarm
⇕			Fault Alarm
			Soft Fault
	⇕	⇕	Spacing
			Empty
			Aeration
			Interface
			Reverse Flow
			BatchTot
			Pos Total
			Neg Total
			Fltwarn

6.9.1   ANALOG OUTPUT SETUP

The 1020 provides current, voltage and pulse-rate analog outputs. Analog Output Setup allows you to assign data functions for these signals. The flow computer's terminal strip contains the analog output terminals.

System 1020 Analog Outputs

Io (Isolated current)	4 to 20 mA varies in proportion to an assigned data function.

Analog Out Setup Data Categories

Vfo	Spanned volumetric/mass flow rate
Vfo2	Additional panned volumetric/mass flow rate
Vfab	Spanned unsigned flow magnitude
Vs	Spanned liquid sonic velocity
Valc	Receive signal amplitude
Vaer	Relative degree of liquid aeration/cavitation

Assigning Io Output Functions (see paragraph 6.10.6)

The Io analog output is a loop-powered (or externally powered), isolated 4-20mA DC signal that varies linearly in relation to a selected data function.

To assign a function for the current output:

From [Analog Out Setup] menu cell, press the <Right Arrow> twice to access the [Io] option list.

Move the cursor to the desired data function by pressing the <Up/Down Arrow>.

To store selection press <ENTER>.

6.9.2   RELAY SETUP

Use this menu to assign a function to channel relays. System 1020 supports 2 types of relay outputs, Alarm Relay and Pulse Relay. Alarm Relay outputs operate in "fail-safe" mode. The relay(s) are energized under normal conditions - an alarm condition causes the relay(s) to de-energize until alarm clears. The Pulse Relay output supports totalizer and batch relay functions. The output pulse width is approximately 200 ms; maximum activation rate is .5 pulse per second. If totalizer pulses exceed this rate, excess pulses are stored in overflow register. This allows the relay to "catch up" when flow decreases enough.

NOTE: The Reset Totalizer [Yes/No] menu command clears all channel totalizers plus the overflow register described in the last paragraph.

Assigning Relay 1 Functions

The 1020 provides one alarm relay. Please refer to the appropriate Installation Drawing in Appendix B for wiring details. Relays respond to any of the alarm conditions/data functions included on the [Relay 1] option list.

Relay 1 Option List

Not Used	Not Active
Power Off	Power Off alarm occurs when power fails
High Flow	Flow rate exceeds high flow setpoint
Low Flow	Flow rate falls below low flow setpoint
Flow Alarm	Flow rate exceeds or falls below flow setpoints
Fault Alarm	System loses receive signal
Soft Fault	Fault condition - memory mode active
Spacing	Transducer spacing needs adjusting
Empty	Empty pipe alarm
Aeration	Aeration percentage exceeds alarm setpoint
Reverse Flow	Flow is in negative direction
BatchTot	Batch/Sample total advances
Interface	Liquid interface setpoint exceeded
Pos Total	Positive total volume advances by 1 digit
Neg Total	Negative total volume advances by 1 digit
Fltwarn	System fault warning

To assign functions to Relay 1:

      To access the [Relay 1] option list press the <Right Arrow>.

      Move the cursor to the desired relay assignment by pressing the <Up/Down Arrow>.

      To store selection press <ENTER>.

6.10 THE METER FACILITIES MENU

Meter Facilities functions are available immediately after unit startup by pressing the <ENTER> key. The Meter Facilities menu provides global control that enables you to identify and activate the following functions and features of the hardware supported by this model. See Section 5 for menu structure.

- Select data entry and meter output in either English (default) or metric units.

- Customize the default pipe and transducer tables to suit your requirements.

- Output, display, erase and select a memory management method for the Datalogger.

- Determine the amount of memory available.

- Verify/Adjust the analog output voltage and current using a multimeter.

- Verify/Adjust the analog pulse output using a frequency counter.

- Set the system clock/calendar.

- Obtain detailed software/hardware identification.

This menu allows you to specify default measurement units.

This menu allows you to create or edit pipe and transducer tables.

This menu allows you to work with and select a Datalogger storage method.

This menu allows you to set the system clock/calendar.

```
Siemens          Dual Path          SITE 1
Select Default Units for all Menus

Preferred Units          English
Table Setups
Datalogger Cntrl
Memory Control
Analog Output Trim
Clock Set               09.02.99  09.30.06
RS-232 Setup            38400  Odd 7
System Info

Meter Facilities
```

This menu allows you to view the number of data memory bytes.

This menu allows you to fine-tune the analog outputs.

This menu allows you to select RS-232 port parameters.

This menu shows detailed information about this model's hardware and software.

6.10.1 PREFERRED UNITS

The selection you make in this menu cell becomes the default units for all menu items and data outputs. You can choose either English or metric units. The factory setting is English.

To specify metric default units for all meter functions:

> To access the [Preferred Units] option list press the <Right Arrow>.

> Move the cursor to [Metric] by pressing the <Up/Down Arrow>.

> To register your selection press <ENTER>.

6.10.2 THE TABLE SETUPS MENU

The [Table Setups] menu cell allows you to pre-condition your pipe table and transducer types. The edits made in [Table Setups] become the default settings for creating a new site. Transducers "marked" in the [Transducer Types] menu will be preferentially selected when the meter recommends transducers during the automatic Pick/Install Transducer routine.

To access the [Table Setups] menu press the <Right Arrow>.

Table Setups	⇨ ⇕	Pipe Table
		Transducer Type

Pipe Table

The factory-programmed pipe table describes over sixty standard English and metric pipes. The table can save you programming steps by loading all required data at once from option list selection. The Pipe Table configuration is [PIPE CLASS ➜ PIPE NAME].

Pipe Class presents a list of standard metric and English Pipe classifications. Selecting a class (e.g., ASA Carbon Steel) conditions the [Pipe Name] option list to all the stored pipes within that class (see Pipe Data Menu Structure on next page). Selecting a pipe by its name (e.g., 2SS10) loads a description of that pipe in the remaining menu cells. Note that liner data is not provided. If your pipe is lined, then you will be required to enter the liner material and its thickness manually.

> To access the [Pipe Table] menu press the <Right Arrow>.

> To access the [Ceate/Edit Pipe] menu press the <Right Arrow>.

Siemens	2 Channel	SITE 1
Pick the Pipe Spec & Material Category		
Choose Pipe Class	**ASA Stainless Steel**	
Choose Pipe Name	**1SS10**	
Outer Diameter (in)	**1.315**	
Wall Thickness	**0.109**	
Liner Material	**None**	
Liner Thickness	**0.000**	
Create/Edit Pipe		

PIPE TABLE MENU STRUCTURE

Create/Edit Pipe ⇨	Choose Pipe Class ⇨	⇕ **ASA Stainless Steel** ASA Carbon Steel ASA Plastic Metric DN Steel Metric SGP Steel Cast Iron Table Ductile Iron Table Copper Tube Table		
	Choose Pipe Name ⇨	**ASA Stainless Steel** ⇨ ⇕ **1SS10** **2SS10** **3SS10** **4SS10** **6SS10** **8SS10**	ASA Carbon Steel ⇨ ⇕ 1CS40 1CS80 2CS40 2CS80 3CS40 3CS80 4CS40 4CS80 6CS40 6CS80 8CS40 8CS80 10CS40 10CS_XS 12CS_STD 12CS_XS 16CS_STD 16CS_XS 18CS_STD 18CS_XS 20CS_STD 20CS_XS 24CS_STD 24CS_XS 30CS_STD 30CS_XS 36CS_STD 36CS_XS 1/12S40 1/12S80	ASA Plastic ⇕ 1P40 1P80 2P40 2P80 3P40 3P80 4P40 4P80 6P40 6P80 8P40 8P80 10P40 10P_XS 12P_STD 12P_XS 16P_STD 16P_XS 18P_STD 18P_XS 20P_STD 20P_XS 24P_STD 24P_XS 30P_STD 30P_XS 36P_STD 36P_XS
		⇨ Metric DN Steel ⇕ 15_DN 20_DN 25_DN 40_DN 50 DN 80_DN 100 DN 150_DN 200 DN 250_DN 300_DN 350_DN 400_DN 500_DN 600_DN		
⇕	⇕	⇨ Metric SGP Steel ⇕ 20A-SGP 25A-SGP 32A-SGP 40A-SGP 50A-SGP 65A-SGP 80A-SGP 90A-SGP 100A-SGP 125A-SGP 150A-SGP 175A-SGP 200A-SGP 225A-SGP 250A-SGP 300A-SGP 350A-SGP 400A-SGP 450A-SGP 500A-SGP	⇨ Cast Iron Table ⇨ ⇕ 6"cls C 10"cls C 12"cls C 16"cls C 20"cls C	Copper Tubing Table ⇕ 1" type K 1" type L 1" type M 2" type K 2" type L 2" type M 4" type K 4" type L 4" type M 6" type K 6" type L 6" type M
			⇨ Ductile Iron Table ⇕ 6"cls 52 8" cls 52 10"cls 52 12"cls 52 16"cls 52 24"cls 52	

(continued)

*NOTE: The highlighted selection in the above table illustrates how to choose the ***ASA Stainless Steel*** **Pipe Class** and all its available Pipe Name selections. All other Pipe Classes (e.g., ASA Carbon Steel) listed can be selected in the same manner.

PIPE TABLE MENU STRUCTURE (continued)

Create/Edit Pipe ⇨	Outer Diameter (in) ⇨	x.xxx *(numeric entry)*	
	Wall Thickness ⇨	x.xxx *(numeric entry)*	
	Liner Material ⇨	⇕ None	
		Cement	
		Coal Tar	
		Enamel	
	⇕	Glass	
		Plastic	
		HDPE	
		Teflon	
		Rubber	
	Liner Thickness ⇨	x.xxx *(numeric entry)*	
Delete Pipe ⇨	Choose Pipe Class ⇨	*See Create/Edit Pipe*	
	Pick Pipe Name ⇨	*See Create/Edit Pipe*	

Create/Edit Pipe

The Pipe Table menu provides the primary data that the system uses to operate with different classes of pipes. This menu allows you to edit the Pipe Table by modifying any existing pipe or add an entirely new pipe.

The following is an example of how to use the [Create/Edit Pipe] menu cell function:

To access the [Create/Edit Pipe] menu press the <Right Arrow>.

To access the [Pipe Class] option list press the <Right Arrow>.

Press the <Up/Down Arrow> to scroll the option list to a class that provides the closest match to your pipe.

To select the [Pipe Class] press <ENTER>. This moves the highlight to the [Choose Pipe Name] menu cell.

To access the [Pipe Name] option list press the <Right Arrow>.

Scroll the option list to a pipe name and press <ENTER> to select it.

This loads [Outer Diameter (in)] and [Wall Thickness] menu cells for the selected pipe.

The highlight moves to [Outer Diameter (in)]. Press the <Right Arrow> to enable numeric entry. Enter the actual pipe OD using the appropriate English or metric units.

Press <ENTER> to store the OD. The highlight moves to [Wall Thickness].

Press the <Right Arrow> to enable numeric entry. Enter the actual wall thickness using the appropriate English or metric units.

Press <ENTER> to store the wall thickness.

Select a liner material from the [Liner Material] option list and enter its thickness (if required).

Press the <Left Arrow> to leave the Create/Edit Pipe menu. This triggers the [Save Pipe] prompt. Note that the second line lists the name of the selected pipe.

Press the <Right Arrow> and then press <ENTER> to use this name.

To use a new name, press the <Right Arrow> and then use the appropriate PC keys or KeyPad to rename the pipe (8 chars. Max.).

Press <ENTER>. This adds the new pipe to the pipe class.

Delete Pipe

This menu allows you to remove any of the pre-loaded pipes within a class from a pipe table. *We recommend that you use this function only to delete pipes that you have added so as to preserve the factory presets.*

To delete a pipe from the Pipe Table

To access the [Delete Pipe] menu press the <Right Arrow>. To access the [Choose Pipe Class] option list press the <Right Arrow>.

Press the <Up/Down Arrow> scroll the option list to the class that contains the pipe to be deleted.

To select the pipe class press <ENTER>. This moves the highlight to [Choose Pipe Name].

To access the [Choose Pipe Name] option list press the <Right Arrow>.

Press the <Up/Down Arrow> to scroll the option list to the pipe to be deleted.

To remove it from the pipe table press <ENTER>.

6.10.3 TRANSDUCER TYPE MENU

During the Transducer Install procedure, System 1020 analyzes the entered pipe and liquid data, then automatically generates a list of the transducer sizes most suited for the application. The Transducer Type menu allows you to place "marks" (asterisks) next to any transducers that you may want the meter to consider preferentially during its recommendation routine. These transducers will be included on the recommended list, that appears on the reverse-video prompt line at the top of the display screen. The left-most transducer on the list is the most applicable while the right-most transducer on the list is the least applicable. See the Transducer Type menu structure on the next page.

To mark Transducers:

To access the [Transducer Type] menu cell press the <Right Arrow>.

Press the <Up/Down Arrow> to scroll the highlight to a transducer type (e.g., 1011H High Precision) the press the <Right Arrow>to access the size option list.

Scroll through the option list by pressing the <Up/Down Arrow> and press <ENTER> to "mark" desired transducers. Note that a plus sign (+) appears before each "marked" transducer.

If you want to clear a "marked" transducer, move the highlight to the transducer then press the <ENTER> key. Note that this removes the plus sign.

To leave an option list press the <Left Arrow>.

TRANSDUCER TYPE MENU STRUCTURE

Transducer Type ⇨	1011 Universal ⇨	⇕ A1
		A2
		B1
		B2
		B3
		C1
	⇕	C2
		C3
		D1
		D2
		D3
		E1
		E2
⇕		E3
	1021 Xdcr ⇨	⇕ A1
		A2
		A3
		B1
		B2
	⇕	B3
		C1
		C2
		D1
		D2
		D3

6.10.4 THE DATALOGGER CONTROL MENU

The [Datalogger Control] menu in the Meter Facilities menu provides the Datalogger controls for the meter's measurement channels. It allows you to enable usage, select data items/alarm events, a logging interval and a destination for your Datalogger reports. While the [Datalogger Control] menu is measurement channel specific, this menu provides global control functions. This means that the settings made here apply to all measurement channels, meter types, operating modes, etc. This is possible because the meter stores logged data in a *single file*. This is significant for dual-channel systems, since the logged data from both channels are combined. Therefore, select the Site ID item for each channel to be logged.

The [Datalogger Control] menu allows you to select a [Circular Memory] mode that will over-write the oldest Datalogger data automatically when the Datalogger memory becomes full due to the data compression scheme employed. *Note that this is only available for dual-channel systems.*

The [Est Log Time Left] view-only menu cell shows an estimate of the hours and minutes of logging time remaining. This only applies to non-circular datalogging. Selecting [Circular Memory] blanks this field.

The [Output Datalogger] command sends data to an external device via the RS-232 serial port. Data transmitted from this menu will be from both channels of a dual-channel system.

The [Clear Datalogger] command erases the entire Datalogger file. For dual-channel systems, you are cautioned not to use this command if your intention is to clear the logged data of only one channel.

To access the [Datalogger Control] menu press the <Right Arrow>.

DATALOGGER CONTROL MENU STRUCTURE

Datalogger Control ⇨	Output Datalogger ⇨	⇕	No
			Yes
	Circular Memory ⇨	⇕	No
			Yes
	Est. Log Time Left ⇨		—:—
	Clear Datalogger ⇨	⇕	No
			Yes

Output Datalogger

This menu cell allows you to send the Datalogger contents to an external device (usually a computer or printer) via the meter's RS-232 Serial I/O port. This command is effective only after a successful install. In addition, you have to enable datalogging and select data items in the [Datalogger Control] menu. *Note: This command sends the data collected by both channels of a dual-channel system.* Therefore, you should include [Site ID] (current site setup name), [Date] and [Time] in your report so that you can identify the source of each report.

The 1020 meter interfaces with most serial printers or personal computers. Siemens offers the Model 996P portable serial printer. You must use the proper cabling between the flow computer and the external device. In addition, you must configure the [RS-232 Setup] menu cell correctly (see paragraph 6.10.8 RS-232 Setup).

You should turn off the Datalogger function before you transmit an extensive printout. This will avoid contaminating the printout with new Datalogger data. Datalogger reports are sequential ASCII text files.

NOTE: The meter suspends flow measurement while it transmits serial data.

To send Datalogger contents to the RS-232 Serial Port:

> Check the flow computer-to-external device connections and your RS-232 Setup parameters (see paragraph 6.10.8 RS-232 Setup).

> To access the [Output Datalogger] option list press the <Right Arrow>.

> Scroll the cursor to [Yes] by pressing the <Up/Down Arrow>.

> To transmit Datalogger contents to external device via the serial port press <ENTER>.

> To stop printout press the <Left Arrow>.

Circular Memory

In its default mode, the Datalogger collects data until its memory becomes full. At that time the flowmeter suspends data logging and cannot resume until the datalogger memory is cleared (see Clear Datalogger command). Multi-Channel systems include Circular Memory and Single Channel systems do not. Circular Memory allows the Datalogger to '"write over" its oldest records when memory reaches full capacity. If you enable Circular Memory, you are assured of always collecting the most recent data. But, also remember that you will lose the oldest Datalogger reports. Note further that invoking Circular Memory deletes the current contents of the Datalogger.

NOTE: To avoid potential data loss, the flowmeter prevents you from altering the Circular Memory setting when a channel is active.

<u>To setup and enable Circular Memory:</u>

The Datalogger Mode menu must have the [Memory] menu cell selected.

Datalogger items must be selected (e.g., Site ID, Date, Time, etc.).

All active channels in the Channel Setup menu must be disabled. To disable active channels, select the [Channel Enable] menu cell and then [No].

In the Datalogger Control menu, select [Circular Memory].

Press the <Right Arrow> to access the [Circular Memory] option list.

Move the cursor to [Yes] by pressing the <Up/Down Arrow>.

To store selection press <ENTER>.

Lastly, re-enable the channels that you disabled earlier to begin logging.

Est Log Time Left

Est Log Time Left is a "view-only" menu cell that shows an estimate of the amount of Datalogger time remaining in hours and minutes. This menu cell becomes active after you enable datalogging. Selecting Circular Memory and/or event-based datalogging (see Datalogger Setup), blanks the field [Est Log Time Left] and is based on the log interval and data selections made in the Datalogger Setup. For Single-Channel flowmeters, this time is an estimated minimum since data compression is employed for improved storage efficiency.

Clear Datalogger

If you use the Datalogger in its default mode, eventually you will use all the memory available for Datalogger storage. When this occurs, you will not be able to log more data until you free up the memory. The Clear Datalogger command erases ALL stored Datalogger data. Therefore, you should evaluate the currently stored data, and print any valuable information before using this command. *Note: Saved Sites also consume datalogger RAM.*

<u>To clear Datalogger Data Memory:</u>

To access the [Clear Datalogger] option list press the <Right Arrow>

Move the cursor to [Yes] by pressing the <Up/Down Arrow>.

To clear the memory press <ENTER>.

6.10.5 THE MEMORY CONTROL MENU

Memory Control is a reference menu that shows the amount of bytes of data memory left. The data memory capacity depends on the number and complexity of the site setups stored in memory and the size of the current datalogger file.

MEMORY CONTROL MENU

Data Memory Left	⇨	**XXXXX**
Defragment	⇨	⇕ **No** **Yes**

<u>Data Memory Left:</u> This view only menu cell shows the minimum remaining number of characters available for Datalogger and site storage. When the Datalogger is enabled for circular mode, the meter allocates all of memory except for two conventional empty sites worth for datalogger use.

<u>Defragment:</u> Selecting YES for this item consolidates memory data blocks into contiguous storage; collapsing the filler regions. You may be able to use an additional block for site or datalogger storage as a result. Use this command if you seem to be out of memory even though the Data Memory Left item indicates free capacity.

To view the amount of data memory bytes available press the <Right Arrow>.

6.10.6 THE ANALOG OUTPUT TRIM MENU

Analog Output Trim allows you to fine-tune the meter's current outputs using a multimeter connected to the output under test. In addition, you can use a frequency counter to fine-tune the meter's pulse rate output. These trim functions adjust the zero offset of the analog output. The span adjustment is not user adjustable. Connect it in series with the 4-20mA current loop of the 1020.

NOTE: The current, voltage, and Pgen trimming will be limited by the 12-bit resolution of the meter's D/A Convertor (DAC).

To access the Analog Output Trim menu press <Right Arrow>.

ANALOG OUTPUT TRIM MENU STRUCTURE

Analog Output Trim ⇨	Trim Io1⇨	⇕	Operate
			Trim @ 4mA ⇨ *Indicated mA = x.xx*
⇕	⇨ Trim Io2⇨	⇕	Operate
			Trim @ 4mA ⇨ *Indicated mA = x.xx*
	⇨ Pgen ⇨	⇕	Operate (Single Channel only)
			Trim @ 1kHz ⇨ *Indicated Hz = xxxx*

Current Output Trim (Io1 & Io2)

(Note: Can be trimmed to within .005 mA of nominal.)

<u>To calibrate a current output (Io1 or Io2):</u>

Set up the multimeter to read Amps, then connect it to the supply and return terminals of the current output under test. Note that the loop must also be supplied with an external voltage.

Move the highlight to the port to be tested, press the <Right Arrow>, then press the <Down Arrow> to move the cursor to Trim @ 4mA.

Press <ENTER>. This triggers a 4.00 mA pop-up window. The multimeter should now be reading 4.00 mA.

If the multimeter reading does not match, use PC numeric keys or KeyPad to enter the multimeter reading.

Press <ENTER> to register setting. This adjusts the meter's DAC (digital-to-analog converter) so that a 4mA output corresponds with 4mA on the multimeter.

Re-check the multimeter to make sure that it is now reading 4mA.

PGEN Output Trim (Single Channel models only)

(Note: Can be trimmed to within 1.25 Hz of nominal.)

<u>To calibrate a pulse rate output (PGEN):</u>

Connect a frequency counter to the supply and return terminals of the pulse rate output under test.

To move the highlight to the port to be tested press the <Up/Down Arrow>, press the <Right Arrow>, then press the <Down Arrow> to move the cursor to Trim @ 1kHz.

Press <ENTER>. This triggers a 1 kHz pop-up window. The frequency counter should now be reading 1 kHz.

If the frequency counter reading does not match, use PC numeric keys or KeyPad to enter the frequency counter reading.

Press <ENTER> to register setting. This adjusts the meter's DAC (digital-to-analog converter) so that a 1 kHz output corresponds with 1 kHz on the frequency counter.

Re-check the frequency counter to make sure that it is now reading 1 kHz.

6.10.7 THE CLOCK SET MENU

The [Clock Set] menu cell allows you to set the time and date. The meter uses its internal clock/calendar to record the real-time when certain data and diagnostic events occur. In addition, the clock/calendar provides the Datalogger and Stripchart date and time stamps.

CLOCK SET MENU STRUCTURE

Clock Set	Date xx.xx.xx *(date entry)*
	Time xx.xx *(time entry)*

Notice:
All Controlotron flowmeters include a real-time clock to provide a convenient date/time stamp for display screens and datalogger reports. The operating system does not rely on the date and time-of-day for any flowmeter operation. Therefore, the "Turn Of The Century" had no effect on the proper functioning of any of our systems. Although we limit the year to 2 digits in all our displays, the 1020 datalogger reports are Y2K complaint using an industry standard algorithm to form a 4 digit year field.

Date

The [Date] command sets the month, day and year for the meter's internal clock/calendar. Enter the date using the [MM.DD.YY] format. Replace MM with two digits to indicate the month. Replace DD with two digits to indicate the day. Replace YY with two digits to indicate the year. Type the period (.) separator between each set of digits. For example, you would enter December 7, 1997 by typing 12.07.97. You can use the <Right Arrow> to move the cursor back to a number if you need to re-type it. Press the <Up/Down Arrow> to remove the current setting.

To set the Date:

To enable numeric entry press the <Right Arrow>.

Use PC numeric keys or KeyPad to enter the date (MM.DD.YY).

To store the date press <ENTER>. This moves the cursor to [Time].

Time

The [Time] command sets the hours and minutes for the meter's internal clock/calendar. Enter the time using the [HH.MM.SS] format. Replace HH with 2 digits to indicate the hour (use 24-hr. clock format). Replace MM with 2 digits to indicate the minutes. Replace SS to indicate the seconds. You

also have to type the period (.) separator between each set of digits. For example, you would enter ten minutes after two o'clock in the afternoon by typing: 14.10.00 You can use the <Right Arrow> to move the cursor back to a number if you need to re-type it. Press the <Up/Down Arrow> key to remove the current setting.

<u>To set the clock:</u>

> To enable numeric entry press the <Right Arrow>.
>
> Use PC numeric keys or KeyPad to enter the time (HH.MM).
>
> To store the time press <ENTER>. This moves the cursor to [RS-232 Setup] menu cell.

6.10.8 RS-232 SETUP

Use the [RS-232 Setup] menu cell to set the operating parameters of the serial I/O port. Settings include baud rate, parity, data bits, line feed, network ID number and waiting period before a RTS time-out. Only activate the RS-232 output if you intend to transmit serial data. This will avoid burdening the system with unnecessary data transferals while it is performing flow computations.

NOTE: The RS-232 stop bit implementation is fixed. If you are using a communication program such as Windows 3.xx Terminal or Windows (95/98/NT/2000/XP) HyperTerminal, that includes a field for stop bits, select 1 stop bit.

RS-232 SETUP MENU STRUCTURE

RS-232 Setup ⇨	Baud Rate ⇨	⇕ 300
		1200
	⇕	2400
		4800
		9600
		38400
	Parity ⇨	⇕ Mark
		Odd
	⇕	Space
		Even
		None
	Data Bits ⇨	⇕ 7
	⇕	8
	Line Feed ⇨	⇕ No
⇕	⇕	Yes
	Network ID ⇨	xx *(numeric entry)*
	RTS Key Time ⇨	⇕ 0.0
		0.2 Sec.
		0.4 Sec.
		0.6 Sec.
	⇕	0.8 Sec.
		1.0 Sec.
		2.0 Sec.
		3.0 Sec
		4.0 Sec.

Baud Rate

The [Baud Rate] menu cell sets the asynchronous serial transmission data transfer rate of the RS-232 port. It provides a selection of standard baud rates up to 38,400 baud. The selected baud rate must match the baud rate setting of the receiving external device. The factory-set baud rate is 9600.

<u>To change the Baud Rate:</u>

> To access the [Baud Rate] option list press the <Right Arrow>.

> Move the cursor to the required baud rate by pressing the <Up/Down Arrow>.

> To store selection press ENTER>. This moves the cursor to [Parity].

Parity

Parity is a simple method to check the accuracy of an asynchronous serial data transfer. The parity setting tells the meter how to format the data words it sends to an external device. Parity is usually an additional bit added to each data word. For example, if you select [EVEN], the total sum of all the bits in a single data word (including the parity bit) will always be an even number.

The [Parity] option list includes all the standard parity settings for asynchronous serial transmission. The selected parity must match the parity setting of the receiving external device. Some devices ignore parity entirely; therefore, the option list includes [None]. The factory setting is [None].

<u>To edit the Parity setting:</u>

> To access the [Parity] option list press the <Right Arrow>.

> Move the cursor to the required parity setting by pressing the <Up/Down Arrow>.

> To store the data press <ENTER>. This moves the cursor to [Data Bits].

Data Bits

You can specify how many data bits the meter uses to format data words for serial transmissions. The default setting is [7]. (Note that the 996P portable printer requires a word length of [8].)

<u>To set the Data word length:</u>

> To access the [Data Bits] option list press the <Right Arrow>.

> To move the asterisk to the required bit setting press the <Up/Down Arrow>.

> Press <ENTER> to store data. This moves the cursor to [Line Feed].

Line Feed

Some serial devices (printers, terminals, etc.) insert a line feed automatically after they receive a carriage return character. When communicating with these device types, you should set the [Line Feed] menu cell to [OFF]. This instructs the flow computer to send a carriage return character without adding a line feed to avoid creating an additional blank line after each carriage return.

Setting the [Line Feed] to [ON] tells the flow computer to insert a line feed character after each carriage return that it transmits. This may be necessary to avoid the constant "wrapping" of transmitted data onto a single line. The factory setting is [NO] (line feed disabled). Note that the 996P portable printer requires [NO].

To enable (or disable) Line Feed:

To access the [Line Feed] option list press the <Right Arrow>.

Press the <Up/Down Arrow> to move the asterisk to [Yes] Line Feed enabled, or [No] Line Feed disable.

To store the data press <ENTER>. This moves the cursor to [Network ID].

Network ID

The [Network ID] menu cell stores an identification number to facilitate host computer polling when you use this system in a network environment. The Network ID number can be any value other than 0 (zero). The default setting, zero, disables the network function. Note that entering a non-zero Network ID number suspends all routine Datalogger activity regardless of any selected options.

NOTE: If you are using the flowmeter for a "stand-alone" application, you must keep the zero Network ID number.

To assign a Network ID number

To enable numeric entry press the <Right Arrow>.

Use PC numeric keys or KeyPad to enter the [Network ID] number.

To store Network ID press <ENTER>. This moves the cursor to [RTS Key Time].

RTS Key Time

During a serial transmission session, you can select how long the flow computer holds its *request-to-send* line high until it receives a *clear-to-send* signal. If the RTS key time expires, the 1020 will return its RTS line low and abort the transmission attempt. Data entry units are *seconds.* The default [RTS Key Time] is 0.2 seconds.

NOTE: The [RTS Key Time] function is only provided when the meter's Network ID number is non-zero.

To set the RTS Key Time:

To access the [RTS Key Time] option list press the <Right Arrow>.

To move the asterisk to the required RTS time press the <Up/Down Arrow>.

To store the data press <ENTER>.

6.10.9 SYSTEM INFO

This menu provides general information about the flowmeter.

System Info Menu Structure

Version	This is the meter's operating system version number. The Technical Services Group may request this number during consultations.
Reset Date/Time	Shows the date and time of this meter's last active or dynamic memory reset.
Op System P/N	Operating system part number of the flowmeter.
Checksum	Operating System verifying code. The Technical Services Group may request this number during consultations.
Code	Software Compile Date/Time. Operating System identifier. The Technical Services Group may request this number during consultations.

6.10.10 DATA DISPLAY SCREEN

The alphanumeric display of the 1020 provides visual access to all system variables and conditions. During installation the 2 x 16 character alphanumeric display is only used to access the numerous menus offered by the 1020 system. Once a measurement channel is activated and begins operation it can display a wide variety of meter data.

Activating The Display

To activate the Display Screen, simply connect power to the 1020 system. On power-up the 1020 will display one of the following:

● The scrolling Siemens Welcome Screen (i.e., if no channel had been previously activated), or

● The active channel's last data screen displayed prior to turning off the instrument.

After successful channel installation, use the KeyPad and repeatedly press the <Left Arrow> commands to leave the top level of the Installation Menu.

The display indicates data as follows (see figure below):

NOTE: The default display shows *two lines* of flowrate data.

● First Character Field - Displays the channel number (e.g., 1 or 2).

● Middle Character Field - Displays the numeric value of the data item selected.

● Last Character Field - Provides a mnemonic of the data type currently displayed.
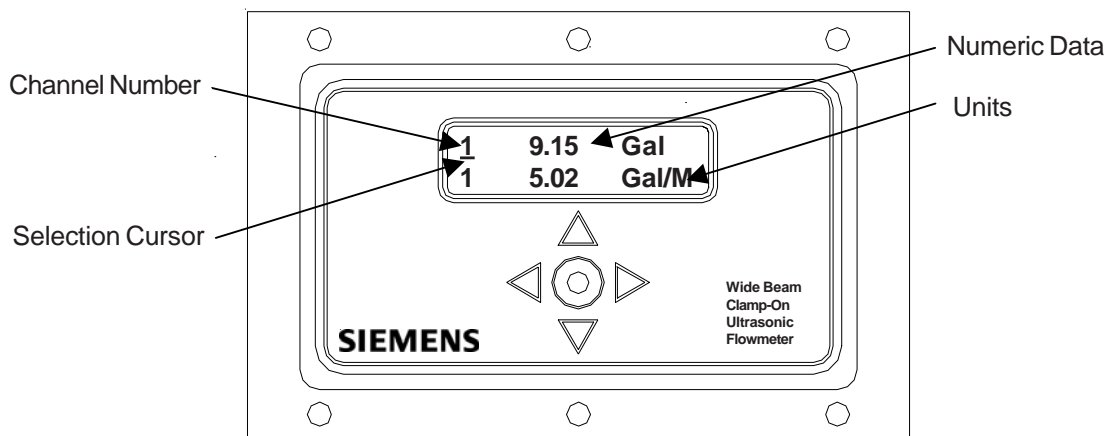
Although the list of available data items varies depending upon the model, the available data usually includes those items seen in the [Flow Data] submenu of the [Diagnostics Data] menu.

Selecting Display Data Items

The arrow keys are used to select the item that is displayed on each line as follows:

Right Arrow – Upon pressing the <Right Arrow> key, a selection cursor will appear under one of the channel indicator numerals (i.e., 1, 2, or 3). Pressing the <Right Arrow> key once again will cause the selection cursor to move to the other display line and so forth. (Note: The selection cursor will extinguish by itself after a period of inactivity.)

Up/Down Arrows – Once a display line is selected as described above, use the <Up or Down Arrows> to scroll the selected display line through the available data items. (Note: On two channel units the *channel selection indicator* will change when the data items come from the other channel.)

When satisfied with the item currently displayed, stop scrolling and use the <Right Arrow> to move to the other display line. Once the display is set up in the desired configuration, execute no further commands and the selection cursor will eventually extinguish.

Note that the System Menu can be invoked at any time by pressing the <ENTER> ◎ key.

The Data displays provided via the meter's serial interface mimic the other 1010 Family's more elaborate graphic displays. Display selection is provided via the <Up/Down Arrows> only. The 2 x 16 alphanumeric display is not available via the serial port.

7.   THE DIAGNOSTICS DATA MENU

The Diagnostics Data menu provides real-time application and setup data, plus test routines for the selected channel. To receive the best technical support, please be prepared to report any diagnostic data item upon request. Note also that these menus contain information that may only be meaningful to our technical support staff. Some Diagnostic Data items require a successful transducer installation and meter initialization to become available. These will report [Chan Not Setup] until you complete the installation procedure. The available diagnostic data depends on the meter type and channel configuration. All diagnostics are available when you select Channel 1 or 2 in [2 Channel Flow] mode.

DIAGNOSTIC DATA MENU STRUCTURE

⇨ Diagnostic Data	⇨ Path Select ⇕	⇨ ⇕ 1 and 2 / 1 / 2
	⇨ Path Enable	No/Yes
	⇨ Flow Data	⇨ ⇕ Flow / Flow Vel F/S / Total / Vs m/s / Signal mV / Valc % / Vaer % / Alarm Status / Ancal / HiFlow / LoFlow
	⇨ Application Info	⇨ ⇕ TN uSec / TL uSec / DeltaT nSec / Burst/Sec / % Accepted / Last Makeup / Makeup Status
	⇨ Liquid Data	⇨ Reynolds #
	⇨ Site Setup Data	⇨ ⇕ fx (drive) / N (burst length) / Ltn in / Vfmax / Vs max m/s / Vs min m/s / Empty % / Samples/Cycle / Max Damping / Min Damping / HF
	⇨ Test Facilities ⇕	⇨ ⇕ Makeup / Tx Up

(continued)

7-1

DIAGNOSTIC DATA MENU STRUCTURE *(continued)*

⇨ Diagnostic Data	⇨ Test Facilities	⇨ ⇕ Tx Dn
		Fixed ALC
⇕	⇕	Tx Up Fixed ALC
		Tx Dn Fixed ALC
	⇨ Print Site Setup	No/Yes
	⇨ Date Site Created	xx.xx.xx xx.xx.xx

7.1 MAIN DIAGNOSTICS SCREEN

This is the main Diagnostics Data screen. It provides menus that show Flow, Application, Liquid, Site Setup information. The Test Facilities menu provides test/control functions to optimize operation, analyze application conditions and to recover system operation.

```
Siemens      2 Channel   [1]    Channel 1
Real-time flow-related data

Flow Data
Application Data
Liquid Data
Site Setup Data
Test Facilities
Print Site Setup        No
Data Site Created       09.02.98  13.24.01



Diagnostic Data
```

DIAGNOSTIC MAIN MENU DESCRIPTION

Flow Data	This menu shows flow rate, total & alarm data; adjustable flow limits.
Application Info	This menu shows current meter operating status.
Liquid Data	This menu shows current Reynolds #.
Site Setup Data	This menu shows current transducer setup data and signal status.
Test Facilities	This menu provides system test and recovery routines.
Print Site Setup	This Menu cell allows you to send an ASCII dump of the current Site Data to a RS-232 port device (e.g. a printer or laptop computer).
Date Site Created	This menu cell shows date and time when the current site was created.

7.2 FLOW DATA MENU

This menu provides a "live" display of all flow-related output data.

```
Siemens      2 Channel   [1]    Channel 1
Current Flow Rate and Units

Flow GAL/MIN              -2.26
Flow Vel F/S
Total KGAL               0.0000
Vs m/s                   1273.21
Signal mV                44
Valc %                   57
Vaer %                   0
Alarm Status             ---R-----
AnCal GAL/MIN            0.0000
HiFlow GAL/MIN           1576.8
LoFlow GAL/MIN           -1576.8

Flow Data
```

FLOW DATA MENU ITEMS

Flow	This is a real-time (updated) flow rate display in current rate units (e.g., GAL/MIN).
Flow Vel F/S	Linear flow velocity in f/s and m/s depending on preferred units.
Total	This is a real-time (updated) flow total display in current total units (e.g., KGAL).
Vs m/s	Current liquid sonic velocity (Vs) in m/s. The Vs value depends on the liquid and its temperature. This menu cell allows "fine-tuning" when highlighted. Press the [+] or [1] key to increase, or the [-] or [2] key to decrease the reading. ***CAUTION: Incorrect usage will result in reduced accuracy.***
Signal (mV)	Xdcr signal strength (in mV). This is the amplitude of the transit-time re-ceive signals. Improper coupling, attenuative liquid or pipe could cause a low value.
Valc %	Input Amplifier gain indication. Larger % indicates a stronger liquid signal.
Vaer %	This shows the current percent of aeration detected by the meter.

Alarm Status	This letter code field shows the status of the meter's built-in alarms.
	A dash indicates an inactive alarm. Letter codes reflect the following alarm conditions:
	      S = Transducer Spacing Warning
	      E = Empty Alarm
	      R = Flow Rate Alarm (High or Low rate threshold exceeded)
	      F = Fault Alarm
	      A = Aeration Alarm
	      M = Memory Activated (Fault Suppressed)
	      K = Makeup Flag (May be Latched)
	      I = Interface Alarm
	      P = Pig Alarm (option)

AnCal	Flow Rate Simulator for calibrating external devices, etc. Highlight this item then press <Right Arrow> to enable numeric entry. Type desired simulated flow rate. Be aware of the units prefix (K, M, etc.). **NOTE: AnCal remains active only while you remain in this menu cell.**
HiFlow GAL/MIN	Most positive expected flow rate for application (adjustable).
LoFlow GAL/MIN	Most negative expected flow rate for application (adjustable).

Vs m/s

This menu cell shows the current sonic velocity in meters per second (m/s). If you move the cursor to this menu cell you will note that it switches from the usual arrow (➜) to a question mark (?). This indicates that you can increase the reading by pressing the [+] key for coarse adjustment or the [1] key for fine adjustment; or reduce the reading by pressing the [-] for coarse adjustment or the [2] key for fine adjustment. (When using the magnetic wand, touch the Enter sensor to increase the reading; touch the <Right Arrow> sensor to decrease the reading.) The pipe diameter and transmission frequency determines the effective increase or decrease per key press. Sonic velocity (Vs) adjustment is a diagnostic tool intended for our technicians or experienced users only. Improper use will affect the meter accuracy.

HiFlow and LoFlow

The [HiFlow] and [LoFlow] menu cells allow you to enter maximum and minimum expected flow rates based on current operating conditions. Under normal circumstances, you should never need to change these settings. It is possible however, that a Controlotron customer service engineer may ask you to edit these settings during a support session. In such a case, a <Right Arrow> at the menu cell enables numeric entry.

Important Note: *A caution on the use of upper and lower flow limits (used to prevent flow mis-registration) prior to using the Reversal Zero technique (Reversamatic): If the negative flow rate that the meter reads in the step during which the transducers are reversed is more negative than the lower flow limit, the meter will re-register positive and the Reversal Zero cycle will thus be corrupted.*

Therefore, postpone the installation of upper and lower flow limits until the reversal zero procedure is executed successfully. For pipes that combine large diameters with very high flow velocities, it may be necessary to move the upper and lower flow limits out of the way until the reversal zero is completed. Moreover, pipes of this size frequently have excellent intrinsic zero performance and may not even need zeroing.

AnCal

This menu cell allows you to enter an artificial flow rate in current rate units that will drive the meter's analog outputs, totalizer output and the screen shown below. You can use [AnCal] to check the analog outputs or as a reference source for calibrating external devices such as remote display screens or chart recorders and RTU's. To test the Totalizer function, leave [AnCal] active for enough time for an accumulation to appear on the screen below. Moving the cursor from the menu cell cancels the [AnCal] function.

The M status is asserted due to the method used to simulate flow data.

```
Siemens      2 Channel   [1]     Channel 1
Flow Rate Simulation Control

Flow GAL/MIN             120.00
Total GAL               5645.820
Vs m/s                  1274.33
Signal mV                     44
Valc %                        57
Vaer %                        13
Alarm Status            ------M--
AnCal GAL/MIN           > 120.000
HiFlow GAL/MIN          1577.9
LoFlow GAL/MIN          -1577.9

Flow Data
```

Note that the [Flow] menu cell immediately reflects the AnCal entry. Over time, the Total display will also increase.

To activate AnCal:

Move the cursor to the [AnCal] menu cell by pressing the <Up/Down Arrow>.

Press the <Right Arrow> to enable numeric entry. Note that an equal sign (=) appears before the number.

Enter the desired flow rate using current rate units (e.g., 120.00 GPM). Note that the [Flow] menu cell now reflects the artificial rate.

Move the cursor away from the menu cell by pressing the <Up/Down Arrow> to turn [AnCal] off.

7.3   THE APPLICATION INFO MENU

This menu provides a live display of the basic timing data used by the meter during operation.

```
Siemens     2 Channel   [1]     Channel 1
Time between transit and receive

TN uSec                    75.193
TL uSec                    44.009
DeltaT                        126
Burst/Sec                     256
% Accepted
Last Makeup               (Re)Start
Makeup Status        Measurement




Application Info
```

APPLICATION INFO MENU ITEMS

TN uSec	The total elapsed time between the transmission and reception of a sonic pulse.
TL uSec	The total time a sonic pulse takes to travel through the liquid.
DeltaT nSec	This is the instantaneous result of subtracting the down from the up transit times. **NOTE: This will appear to be more active than dampened flow readings**.
Burst/Sec	Number of transmissions per second under current operating conditions. The following factors influence this parameter: aeration, pressure transients, signal strength variation.
% Accepted	Running tally of accepted and rejected up/down burst sets.
Last Makeup	Reason for last Makeup (signal reacquisition).
Makeup Status	Current stage of Makeup routine. [Measurement = normal operation]

7.4   THE LIQUID DATA MENU

This menu shows the current Reynolds number used by the meter to implement flow profile compensation.

```
Siemens      2 Channel   [1]    Channel 1
Current Reynolds number

  Reynolds #                    318017




 Liquid Data
```

LIQUID DATA MENU ITEMS

Reynolds #	1020 corrects the current flow rate in accordance with this Reynolds number. This number is determined from pipe ID, current flow rate and liquid kinematic viscosity.

7.5   THE SITE SETUP DATA MENU

This menu provides data pertaining to transducer characteristics and operation. Some menu items are for technical support interpretation only.

```
Siemens      2 Channel   [1]    Channel 1
Current transit drive code

 fx (drive)                30
 N (burst length)          42
 Ltn in                    -1.154
 Vfmax GAL/MIN             1577.42
 Vs max m/s                2165.41
 Vs min m/s                936.62
 Empty %                   30
 Samples/Cycle             16
 Max Damping
 Min Damping
 HF                        <-0.120
 Site Setup Data
```

SITE SETUP MENU ITEMS

fx (drive)	Current Transmit drive code selected during Initial Makeup. The drive code controls the sonic transmit signal.
N (burst length)	Transmit burst duration selected during Initial Makeup. To change N count press <Right Arrow>. At equal sign enter numeric value (1 to 9 only).
Ltn (in/mm)	Spacing distance between the transducers. It will be in inches or millimeters, depending on default units.
Vfmax	The flow velocity (in selected units) corresponding to one whole cycle offset between upstream and downstream receive signals.
Vs max m/s	Maximum correctly calibrated Vs for current transducer spacing.
Vs min m/s	Minimum correctly calibrated Vs for current transducer spacing.
Empty %	Value of Empty Alarm Setting. The meter will declare an empty status if signal strength drops below this value.
Samples/Cycle	Digital sampling rate.
Max Damping	Maximum signal damping. Use to average digital data when an unstable condition occurs.
Min Damping	Minimal signal damping. Use to average digital data when an unstable condition occurs.
HF	Flow registration correction parameter.

Introduction to [HF] Menu Item

All 1010 flowmeters with version 3.01.02 and later operating systems include a new Diagnostics Menu item that permits the entry of a flow registration correction parameter labeled [HF]. This "HF" parameter is the input for a proprietary algorithm which automatically compensates for signal beam blowing in pipes utilizing either 1011 clamp-on or insert transducers, thereby extending the upper flow limit of all 1010 flowmeters. This algorithm provides the most benefit for clamp-on meters where high flow velocities and low sound velocities create the most challenging conditions for digital signal processing routines.

Using the [HF] Menu Item

Two methods for adjusting this parameter are provided via the [HF] menu cell, located within the "Diagnostics / Site Setup" submenu. The "Manual" method provides direct entry of this parameter and is primarily intended for the advanced user, whereas the "Automatic" method allows the 1010 flowmeter to automatically measure the required correction and install the parameter.

Guidelines for using the [HF] menu item are described below:

- This menu is only accessible for the transducer channels, not the virtual (average flow) channel of the flowmeter. (i.e., Diagnostics Path 1 or Path 2, but not Path 1 & 2).

- The 1010 flowmeter will inhibit the "Automatic" installation of the [HF] parameter if the flow rate is insufficient (too low) to accurately measure the required correction. If the maximum flow rate for the application is relatively low then this correction should not be required.

- If the flow rate is very high and the flowmeter is reporting erroneous or unstable flow, then the flowmeter may already be having trouble resolving the upstream and downstream signals. In this event, it may be necessary to first lower the flow rate to a moderate level before performing the "Automatic" HF adjustment. Once this is done the flowmeter should be able to properly measure the highest flow rates without problems.

- The limits of the "HF" parameter are +/- 0.7 and <u>any attempt to manually install a larger value will cause the flowmeter to abort the installation of the parameter.</u>

NOTE: Pressing the <Left Arrow> at any stage prior to accepting the measured value will abort the installation and return to the previous setting.

To access this [HF] menu item proceed as follows:

- At the [Meter Type] Menu, press the <Right Arrow> and then <ENTER> to select the desired Path (e.g., Dual Path Flow).

- In the [Dual Path Flow] Menu, press the <Down Arrow> and scroll to the [Diagnostic Data] menu cell. Press the <Right Arrow> to select it.

```
Siemens          Dual Path        4SS10G       Siemens          Dual Path        4SS10G
Access Path/Channel Diagnostic Data            Transducer Setup Data

  Channel /Path Setup                            Path Select          1
  Pipe Data                                      Path Enable          Yes
  Application Data                               Flow Rate
  Pick/Install Xdcr                              Application Info
  Operation Adjust                               Liquid Data
  Flow/Total Units                               Site Seup Data
  Data Span/Set/Cal                              Test Facilities
  Stripchart Setup                               Print Site Setup     No
  Datalogger Setup                               Date Site Created:   04.09.0314.52.23
  I/O Data Control
  Diagnostic Data

Dual Path Flow                                 Diagnostic Data
```

- In the [Diagnostic Data] Menu, highlight [Path Select] and select the desired transducer path. Press <ENTER> to select path.

- Press the <Down Arrow> and scroll to the [Site Setup Data] menu cell. Press the <Right Arrow> to select it.

"Manual" Adjustment Procedure

- In the [Site Setup Data] Menu, press the <Down Arrow> and scroll to the [HF] menu cell. Press the <Right Arrow> and a pop-up [Manual] prompt will appear as shown below. *Note: Press the <Up/Down Arrow> to select [Automatic], if desired.*

- Use the numerical keys to input the desired correction value. Press <ENTER> to input value.

```
Siemens          Dual Path        4SS10G       Siemens          Dual Path        4SS10G


fx (drive)           29                        fx (drive)           29
N (burst length)      5                        N (burst length)      5
Ltn in               5.316                      Ltn in               5.316
Vf max CU            Adjustment                 Vf max CU            >Manual
Vs max m/s           >Manual                    Vs max m/s           = -0.120
Vs min m/s           1555.00                    Vs min m/s           1555.00
Samples/Cycle        29                         Samples/Cycle        29
Max Damping                                     Max Damping
Min Damping                                     Min Daming
HF                   >-0.000                    HF                   >-0.000

Site Setup Data                                Site Setup Data
```

- The new correction value will appear next to the [HF] menu cell as shown below.

```
Siemens            Dual Path            4SS10G
███████████████████████████████████████

fx (drive)                29
N (burst length)           5
Ltn in                    5.316
Vf max CU
Vs max m/s
Vs min m/s                1355.00
Samples/Cycle             29
Max Damping
Min Damping
HF                        >-0.120


Site Setup Data
```

"Automatic" Adjustment Procedure

- In the [Site Setup Data] Menu, press the <Down Arrow> and scroll to the [HF] menu cell. Press the <Right Arrow> and a pop-up [Manual] prompt will appear.

- Press the <Up or Down Arrow> to select [Automatic] then press <ENTER>.

- The current <u>measured</u> correction value is displayed (see below).

- Press <ENTER> again to install this correction value which will now appear next to the [HF] menu cell.

NOTE: The value shown in the [Automatic] pop-up prompt can not be changed and is for user information only.

```
Siemens         Dual Path        4SS10G
███████████████████████████████████

fx (drive)            29
N (burst length)       5
Ltn in                5.316
Vf max CU        Adjustment
Vs max m/s       >Automatic
Vs min m/s        1355.00
Samples/Cycle         29
Max Damping
Min Damping
HF                   >-0.000


Site Setup Data
```

```
Siemens         Dual Path        4SS10G
███████████████████████████████████

fx (drive)            29
N (burst length)       5
Ltn in                5.316
Vf max CU        >Automatic
Vs max m/s       = 0.026
Vs min m/s        1355.00
Samples/Cycle         29
Max Damping
Min Damping
HF                   >-0.026


Site Setup Data
```

- If you decide not to use the [Automatic] selection, press any key other than <ENTER> to abort the operation.

7.6   THE TEST FACILITIES MENU

The Test Facilities menu provides commands for system analysis and recovery. The most useful for the end-user is [Makeup] command. Using these routines under the supervision of our technical support staff will help us to provide technical analysis and solutions.

```
┌─────────────────────────────────────────┐
│ Siemens        2 Channel  [1]    Channel 1 │
│ Right arrow invokes an InProcess Makeup  │
│ ┌─────────────────────────────────────┐ │
│ │ Makeup                     No       │ │
│ │ Tx Up                      No       │ │
│ │ Tx Dn                      No       │ │
│ │ Fixed ALC                  No       │ │
│ │ Tx Up Fixed ALC            No       │ │
│ │ Tx Dn Fixed ALC            No       │ │
│ │                                     │ │
│ │                                     │ │
│ └─────────────────────────────────────┘ │
│ Test Facilities                          │
└─────────────────────────────────────────┘
```

<u>To start a Test Routine:</u>

To scroll the cursor to the test routine press the <Up/Down Arrow>.

To access the test option list press the <Right Arrow>. Press <Up/Down Arrow> to move the asterisk to [Yes].

To start the routine press <ENTER>.

To end the routine press the <Left Arrow>.

TEST FACILITIES COMMANDS

Makeup	Commands the meter to re-acquire the receive signal.
Tx Up	Forces upstream transmission only.*
Tx Dn	Forces downstream transmission only.*
Fixed ALC	Select "Yes" to command amplifier to hold a constant gain.*
TX Up Fixed ALC	Fixed ALC while transmitting up only.*
TX Dn Fixed ALC	Fixed ALC while transmitting down only.*

* For technical service diagnostics.

Makeup

The Test Facility Makeup routine allows you to command the meter to re-acquire the operating parameters established during the Initial Makeup routine invoked by the [Install Completed?] command (see paragraph 6.4 Pick/Install Xdcr).

<u>To invoke the Makeup routine:</u>

Press <Up/Down Arrow> to scroll the cursor to [Makeup].

Press the <Right Arrow> to access the test option list. Press <Up/Down Arrow> to move the cursor to [Yes].

Press <ENTER> to start the makeup routine.

7.7 TROUBLESHOOTING TIPS

The System 1020 has highly reliable circuitry and will provide trouble-free operation within specified environments. Even a well-crafted precision instrument can fail if exposed to extreme temperature or vibration conditions during service, storage or transportation. The Diagnostic menu shows how the system interprets a problem. The test functions and alarm indicators identify "hidden" problems automatically. If a problem seems unsolvable, call our Technical Service Department or your local Siemens Representative for expert help.

Flow Computer Messages

Certain actions or conditions invoke messages that may appear as a pop-up window, in the right-hand column of a given menu cell, or the highlighted prompt line at the top of the display screen.

The following is a list of messages that you may encounter along with explanations, and in some cases, a recommended action.

MESSAGE	DESCRIPTION
Memory Full!	Response to an attempt to save site data, when data memory is full. Delete an obsolete site or clear Datalogger memory to make room for the new data.
Memory Corrupted!	Memory read error occurred while accessing the active site data.
Chan Not Setup	Response to an attempt to invoke an operation that requires a channel to be enabled. Enable the channel *[Channel Setup ➔ Channel Enable ➔ Yes]*. Note that a channel cannot be enabled until its transducers are operating.
Clr All Data?	Response to pressing and holding <ENTER> key during power-up. Use this function to restore operation if a severe event (e.g., a violent power surge) disrupts system operation.
Clr Dynamic Memory?	Response to pressing and holding <ENTER> key during power-up and then pressing <Right Arrow>.This function eliminates all data stored in RAM. To invoke in RS-232 serial mode, type @@@ and then press <ENTER>.
<EOT>	Response to a request to output datalogger data to the printer or the Graphics screen when no datalogger data exists. Set up the Datalogger.
Empty Pipe - Press [ENTER]	Prompt to empty the pipe during the Actual MTY procedure. After emptying pipe, press <ENTER>.
Fill Pipe - Press [ENTER]	Prompt to fill the pipe during the Actual MTY procedure. After filling the pipe, press [ENTER].
No Sites	Response while trying to recall/delete a site setup when no Sites are stored.
Not Installed	Response to an attempt to access a menu function that is not included.
Re-space Index	Upon measuring the liquid sonic velocity (Vs), the meter recommends respacing the transducers to improve performance.
Invalid Setup (use Direct Mount)	During the Initial Makeup, the system detects invalid transducer spacing, erroneous liquid/pipe parameters, or some other factor that prevents it from completing the Initial Makeup. This may be due to one of the following: • An out-of-range data entry. • An invalid condition; (e.g., overlapping transducers in Reflect Mode). If selecting Direct Mode does not resolve, review all site setup and transducer installation choices; particularly data entered for the pipe and liquid.

(continued)

MESSAGE	DESCRIPTION
Invalid Setup (use Direct Mount)	• In Reflect Mode, the flow computer detects that the pipe wall signal may infringe upon the liquid signal. Use Direct Mode instead. Press <ENTER>, <UP Arrow>, <DOWN Arrow>, or <LEFT Arrow> to abort install routine. Continue programming other site data in anticipation of resolving the difficulty later. Call technical support for help if necessary.
Low Signal - Press [ENTER]	During the Initial Makeup, the meter decides that the level of the receive signal is insufficient for proper operation. Some reasons for low signal are: • Invoking [Install Completed?] on an empty pipe. • Coupling compound insufficient, not applied, or evaporated. • A disconnected or broken transducer cable. • You need to condition the pipe at the mounting location. • A large air bubble needs to be "flushed out." • The Xdcr cables are defective or not connected to the correct channel. • The Set Empty routine performed when pipe was NOT actually empty. If you locate and correct the improper condition immediately, press <ENTER> to resume the installation procedure. Otherwise, press the <LEFT Arrow> to abort the installation and conduct a thorough investigation.
Detection Fault	Appears if the meter cannot complete an Initial Makeup. It means that the pipe and/or liquid conditions do not permit a receive signal that meets the flow detection standards. The system will not be able to operate. Attempt to improve operating conditions by reinstalling the transducers at a different spacing offset, or even at a different location on the pipe. In addition, switching from Reflect to Direct Mount may solve the problem. However, operation may not be possible if there is poor liquid or pipe wall sonic conductivity or extreme liquid aeration.

NOTE: If you receive a Detection Fault message, it is strongly recommended that the Technical Service Department be contacted for further orientation.

7.8 USING THE 1020 RESET SEQUENCE

Should you encounter an operating problem that blocks access to the System Menu, or the meter operates erratically after exposure to a power transient or some other traumatic event, this might require the use of the reset sequence in order to restore proper operation. System 1020 provides two system resets. The first uses the KeyPad and the second method uses a PC command sent via the RS-232 interface (providing you have access to the flow computer in this way). This section describes both system reset methods.

The reset sequence operates on two levels. The first level deletes all the data currently in Active Memory, but leaves Datalogger data and all stored Site Setups intact. This is the most desirable method since to restore operation all you have to do is reload a saved Site Setup. If this fails then you have to use the second level, which clears ALL Dynamic Memory. *Be aware that this action erases all saved Site Setups (**including flow calibrated sites**), any logged data and any user-defined pipe and transducer tables.* This will require you to re-initialize the flow computer and transducers and repeat all desired site settings, custom pipe tables, etc.

7.8.1 SYSTEM RESET USING THE KEYPAD

As mentioned previously, there is a power-on delay of approximately 30 seconds from the time that you apply power to the 1020 flow computer to when the 16 x 2 Character LCD becomes active. The reason for the delay is to give you a chance to perform the following system reset procedure.

To clear Active Memory using the KeyPad:

Turn off power (if it is currently on) and the reapply power to the system.

Press and hold ENTER ◎ during the power-on delay. Examine the left-hand figure below and note the message on the LCD display:
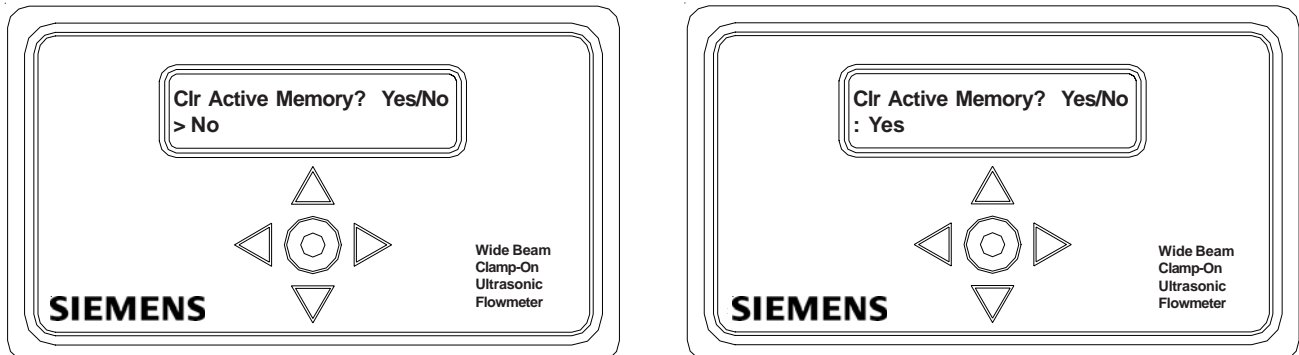
Press ▷. Note that the greater than (>) symbol changes to a (:) colon. Press ▽ to change the second line to [Yes] (as shown in the right-hand figure above).

Press ENTER ◎ to clear the contents of Active Memory (but preserve any stored Site Setups).

To restore operation, create a new site setup or recall a stored site setup and then re-select any Meter Facilities items (e.g., RS-232 setup parameters) that you may have edited originally.

To clear ALL Dynamic Memory using the KeyPad:

**CAUTION: Before proceeding further it is essential to understand that this function elimi-
nates ALL data stored in RAM. This means that all saved Site Setups including the
site data of a flow-calibrated site will be erased! In addition, the entire Datalogger
file plus any custom factory or user-created pipe or transducer tables will be elimi-
nated. The impact of this is such that we strongly recommend that you consult the
Technical Service Department before continuing with this procedure. If you choose
to continue, be aware that you will have to create a new Site Setup, re-enter all site
specific parameters including pipe or transducer tables, plus all desired Meter
Facilities entries.**

Turn off power (if it is currently on) and then reapply power to the system.

Perform steps 1 and 2 in the "Clear Active Memory" instructions above.

Press ▷. Note that the greater than (>) symbol changes to a (:) colon. Press ENTER ◎. The
display switches to [Clr Saved Data? Yes/No] as shown on the left-hand figure (see below).
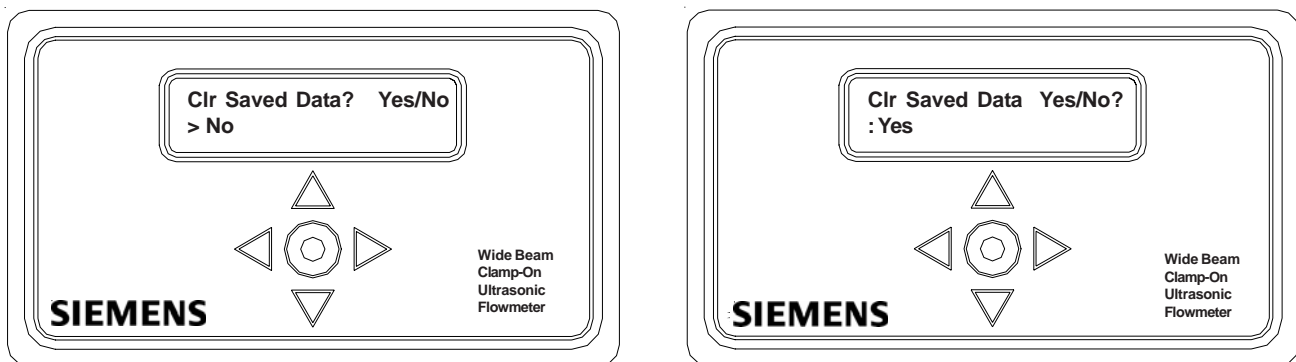
Press ▷. Note that the greater than (>) symbol changes to a (:) colon. Press ▽ to change the
second line to [Yes] (as shown in the right-hand figure above). Press ENTER ◎ to clear all
Dynamic Memory.

To restore operation, create a new Site Setup and then re-select any Meter Facilities items
(e.g., RS-232 setup parameters) that you may have edited originally.

7.8.2 SYSTEM RESET USING THE RS-232 INTERFACE

The 1020 flow computer also allows you to perform a system reset via its RS-232 interface. The
following instructions require the flow computer to be connected serially to a PC. Refer to paragraph
2.7.1 for details on how to setup an RS-232 interface with a PC.

To clear Active Memory using the RS-232 Interface:

Turn off power (if it is currently on). Turn power on. As soon as you apply power type the @
character three times. The prompt: **[Clr Active Memory?   Yes/No]** appears at the top of the
screen.

Press the <Right Arrow> and then the <Down Arrow> to switch the option list to **[Clr Active Memory?   Yes]**. Press <ENTER> to clear all Active Site Data (but not saved Site Setups).

To restore operation, type: MENU and press <ENTER> to access the Installation Menu. Create a new Site Setup or recall a stored Site Setup. Re-select any Meter Facilities items (e.g., RS-232 setup parameters).

<u>To clear ALL Dynamic Memory using the RS-232 Interface:</u>

Turn off power (if it is currently on).

Turn power on. As soon as you apply power type the @ character three times. The prompt: **[Clr Saved Data?   Yes/No]** appears at the top of the screen. Press the <Down Arrow>. Note that the prompt switches to **[Clr Saved Data?   No]**.

Press the <Right Arrow> and then the <Down Arrow> to switch the option list to **[Clr Saved Data?   Yes]**. Press <ENTER> to clear all Dynamic Memory.

To restore operation, type: MENU and press <ENTER> to access the installation menu. Create a new site setup and complete the installation procedure. Re-select desired Meter Facilities items (e.g., RS-232 setup parameters).

APPENDIX A
ENGINEERING DRAWINGS

<u>FUS1020 NEMA-4 FLOWMETER</u>

4 | 3 | 2 | 1

1020N OR 1020DN SERIES FDC SHOWN WITH COVER REMOVED

KEYPAD ENABLE
SWITCH
(SEE 1020 FIELD MANUAL)

UN-LOCK S1
LOCK

J1
(SEE NOTE 5)

TB1 1 ... 10

TB2 10 ... 1

CAUTION
HIGH
VOLTAGE

CAUTION: HIGH VOLTAGE DO NOT REMOVE

DISABLED POWER
BEFORE SERVICING
FUSE

FILL BOOTS WITH CC110
(SUPPLIED WITH CABLE SET)
TO ASSURE WEATHERTIGHT
CONNECTION

1012CN SERIES
TRANSDUCER CABLES

UP   UP

POWER INPUT AND FUSE COVER

DATA/CONTROL
CABLES

POWER
CABLE

CUSTOMER SUPPLIED CONDUIT
FITTING OR SUPPLIED CABLE GLAND
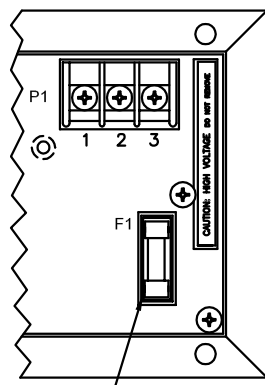
POWER INPUT TO BARRIER STRIP P1
(SHOWN WITH POWER INPUT/FUSE
COVER REMOVED)

P1   1 2 3

F1

CAUTION: HIGH VOLTAGE DO NOT REMOVE

TERM.#	AC	DC
1	HOT	+
2	NEU	−
3	GND	GND

INPUT POWER REQUIREMENTS
AC: 90–230V, 50/60Hz
DC: 9–36VDC

BARRIER STRIP P1 IS A LUG–LESS, WIRE CLAMP
TYPE SCREW TERMINAL CONNECTOR PROVIDING RELIABLE
CONNECTION TO STRIPPED WIRE, AWG 12–18

FUSE: TYPE GMA, 2A
DISABLE POWER BEFORE
SERVICING FUSE

SINGLE CHANNEL

DUAL CHANNEL

CH.1   CH.2

UP   UP

DN   DN

UP
DN

TO DOWNSTREAM
TRANSDUCER
TO UPSTREAM
TRANSDUCER

CHANNEL 2

TO DOWNSTREAM
TRANSDUCER
TO UPSTREAM
TRANSDUCER

CHANNEL 1
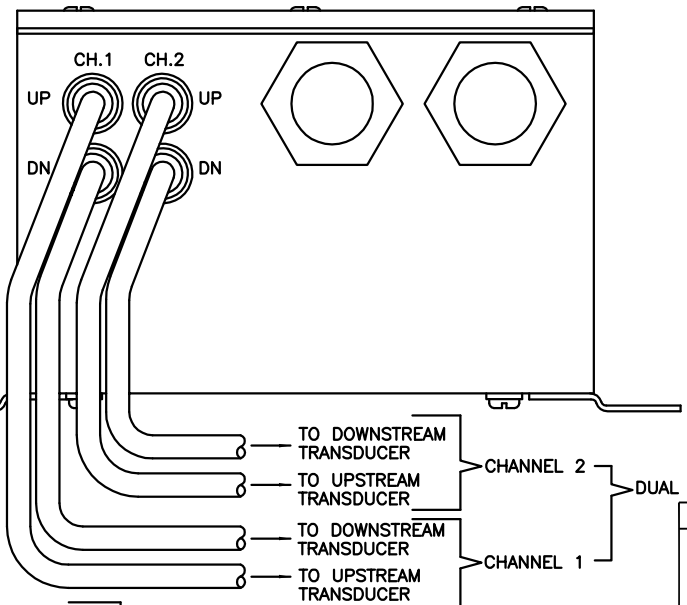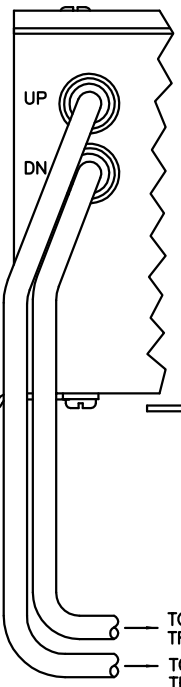
DUAL CHANNEL

TO DOWNSTREAM
TRANSDUCER
TO UPSTREAM
TRANSDUCER

SINGLE CHANNEL

NOTES:

1. SEE DRAWING 1020–8 FOR FLOW COMPUTER OUTLINE DIMENSIONS.

2. SEE SHEET 2 FOR I/O DATA AND CONTROL WIRING FOR 1020N SERIES
SINGLE CHANNEL FLOW COMPUTERS.

3. SEE SHEET 3 FOR I/O DATA AND CONTROL WIRING FOR 1020DN SERIES
DUAL CHANNEL FLOW COMPUTERS.

4. TERMINAL BLOCKS TBI AND TB2 ARE LUG–LESS WIRE CLAMP TYPE
PROVIDING RELIABLE CONNECTION TO STRIPPED, STRANDED WIRE, AWG
14–24.

5. J1 IS A DEDICATED RS232 PORT (DB9 STYLE CONNECTOR) INTENDED
FOR TEMPORARY USE WITH THE FLOW COMPUTER COVER REMOVED.
CONSULT THE 1020 FIELD MANUAL FOR USE OF THIS PORT.

DO NOT SCALE THIS DRAWING
UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES (MM)
TOLERANCES ON-
INCHES   (MM)
± .1   ± 2

CONTROLLED DRAWING
CHANGES TO THIS DRAWING REQUIRE
RELEVANT AGENCY APPROVAL

DR   H.J   DATE 11/07/02
CHK ____ DATE ____
ENG ____ DATE ____
PROD ____ DATE ____
APPD ____ DATE ____
CERTIFIED ____
DATE ____

SIEMENS
Siemens Energy & Automation, Inc.
Process Instrumentation Business Unit
CoC Ultrasonic Flow - Hauppauge, Long Island, NY 11788

INSTALLATION WIRING,
1020 SERIES FLOW COMPUTER

SIZE | CODE IDENT NO. | | REV.
C | 21614 | 1020-7 | C

SCALE: NONE | WT. | SHEET 1 OF 4

5231

TERMINAL BLOCK WIRING CONNECTIONS FOR SINGLE CHANNEL 1020N SERIES

	PIN #	SIGNAL	FUNCTION	DESCRIPTION		USE	LOAD	WIRING	CABLE LENGTH	NOTES
TB1	1	N/C								
	2	N/C								
	3	Io1−	ISOLATED LOOP RETURN	4−20mA PROPORTIONAL TO SPANNED, SELECTED VARIABLE,		ASSIGNABLE AND SPANNABLE UNDER MENU CONTROL	SEE SCHEMATIC A	SHIELDED 24 GA. INSTRUMENT CABLE	1000 FT. MAX. WITHOUT FACTORY APPROVAL	
	4	Io1+	ISOLATED LOOP SUPPLY							
	5	+5	+5 V DC POWER	250 mA MAX 5 V SOURCE		FOR CONTROLOTRON SUPPLIED ACCESSORIES ONLY				
	6	GND	GROUND	GROUND						
	7	DIGOUT 1 −/K2−A	STATUS BIT RETURN/RELAY	STATUS/ALARM EMITTER	SEE NOTE	USER ASSIGNABLE VIA. MENU SELECTION	SEE SCHEMATIC C FOR DIGITAL OUTPUT CONNECTION			SINGLE DRY CONTACT RELAY CLOSURE WHEN RELAY OPTION IS INSTALLED
	8	DIGOUT 1 +/K2−B	STATUS OUTPUT/RELAY	STATUS/ALARM COLLECTOR						
	9	PGEN −	PULSE GENERATOR RETURN	ISOLATED PGEN EMITTER		0−5000 Hz SIGNAL PROPORTIONAL TO MENU SELECTED VARIABLE	SEE SCHEMATIC C			
	10	PGEN +	PULSE GENERATOR OUTPUT	ISOLATED PGEN COLLECTOR						
TB2	1	GND	GROUND	GROUND				SHIELDED 24 GA. DATA CABLE MINIMUM	1000 FT. MAX. WITHOUT FACTORY APPROVAL	
	2	DIGIN 1 +	DIGITAL INPUT 1	ISOLATED DIGITAL COMMAND LINES		NO TOT INPUT	499Ω: USE 2 TO 10 VDC TO DRIVE INPUT SEE SCHEMATIC D BELOW			REF. SCHEMATIC D
	3	DIGIN 1 −	DIGITAL RETURN			NO TOT RETURN				
	4	DIGIN 2 +	DIGITAL INPUT 2			CLR TOT INPUT				
	5	DIGIN 2 −	DIGITAL RETURN			CLR TOT RETURN				
	6	Rx	RS232 RECEIVE	STANDARD RS232 SIGNALS		STANDARD RS232 COMMUNICATION PORT			50 FT. MAX. AS PER EIA RS232 FOR GREATER RANGE, CONSULT FACTORY	RS−232 RANGE CAN BE INCREASED BY: a) USE OF SHORT HAUL MODEMS. b) USE OF SPECIAL DATA CABLES AND OR SLOWER DATA RATES. c) USE OF TELEPHONE LINE MODEM. CONSULT FACTORY FOR DETAILS.
	7	Tx	RS232 TRANSMIT							
	8	GND	GROUND							
	9	RTS	RS232 REQUEST TO SEND							
	10	CTS	RS232 CLEAR TO SEND							

J1 (DB9) RS232 CONNECTOR

1 2 3 4 5
6 7 8 9

PIN	SIGNAL	DESCRIPTION	EIA CKT	WIRING	CABLE LENGTH
1	N/C	STANDARD RS 232 SIGNAL LEVELS ALL CONTROL LINES ARE DEFAULTED TO READY STATE		SHIELDED DATA CABLE 24 GA. MIN.	DEPENDS UPON BAUD RATE 50 FEET AT 9600 BAUD WITH STANDARD CABLE
2	RXD		BB		
3	TXD		BA		
4	DTR		CD		
5	GND		AB		
6	N/C				
7	RTS		CA		
8	CTS		CB		

SCHEMATIC A
ISOLATED 4−20mA OUTPUT

Vc:24VDC TYPICAL
R_L:1000 Ω TYPICAL
I = 4−20mA
R_L = LOOP WIRE RESISTANCE PLUS USER'S INPUT LOAD RESISTANCE

SCHEMATIC C
DIGITAL OUTPUTS

Vc: 24 VDC MAX.
SELECT R_L:
VALUE: (125 × Vc) −340 Ω MIN.
POWER RATING: (1/100 × Vc) WATTS MIN.
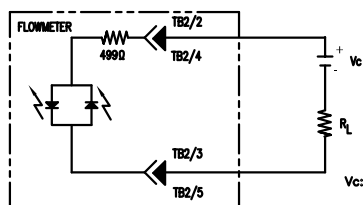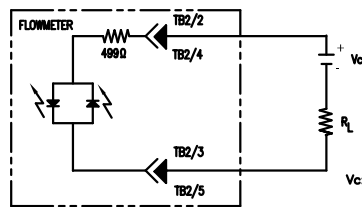
SCHEMATIC D
DIGITAL INPUTS

Vc: 2 VDC MIN.
10 VDC MAX.
I = 0.8mA MIN.
R_L = OPTIONAL (SELECT TO ACHIEVE CORRECT I)

DO NOT SCALE THIS DRAWING
UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES (MM) TOLERANCES ON−
INCHES (MM)
± .1 ± 2

		DATE
DR	H.J	11/07/02
CHK		
ENG		
PROD		
APPD		
CERTIFIED		
DATE		

CONTROLLED DRAWING
CHANGES TO THIS DRAWING REQUIRE RELEVANT AGENCY APPROVAL

SIEMENS
Siemens Energy & Automation, Inc.
Process Instrumentation Business Unit
CoC Ultrasonic Flow - Hauppauge, Long Island, NY 11788

INSTALLATION WIRING, 1020 SERIES FLOW COMPUTER

SIZE: C | CODE IDENT NO. 21614 | 1020-7 | REV. C

SCALE: NONE | WT. | SHEET 2 OF 4

5231

TERMINAL BLOCK WIRING CONNECTIONS FOR DUAL CHANNEL 1020DN SERIES

	PIN #	SIGNAL	FUNCTION	DESCRIPTION	USE	LOAD	WIRING	CABLE LENGTH	NOTES
TB1	1	Io2−	ISOLATED LOOP RETURN (CH 2)	4−20mA PROPORTIONAL TO SPANNED, SELECTED VARIABLE,	4−20mA ASSIGNABLE AND SPANNABLE UNDER MENU CONTROL	SEE SCHEMATIC A	SHIELDED 24 GA. INSTRUMENT CABLE	1000 FT. MAX. WITHOUT FACTORY APPROVAL	
	2	Io2+	ISOLATED LOOP SUPPLY (CH 2)						
	3	Io1−	ISOLATED LOOP RETURN (CH 1)						
	4	Io1+	ISOLATED LOOP SUPPLY (CH 1)						
	5	+5	+5 V DC POWER	250 mA MAX 5 V SOURCE	FOR CONTROLOTRON SUPPLIED ACCESSORIES ONLY				
	6	GND	GROUND	GROUND					
	7	DIGOUT 2 −/K2−A	STATUS BIT RETURN/RELAY	STATUS/ALARM EMITTER / SEE NOTE	USER ASSIGNABLE VIA. MENU SELECTION	SEE SCHEMATIC C FOR DIGITAL OUTPUT CONNECTION			SINGLE DRY CONTACT RELAY CLOSURE WHEN RELAY OPTION IS INSTALLED
	8	DIGOUT 2 +/K2−B	STATUS OUTPUT/RELAY	STATUS/ALARM COLLECTOR					
	9	DIGOUT 1 −/K1−A	STATUS BIT RETURN/RLY	STATUS/ALARM EMITTER / SEE NOTE	USER ASSIGNABLE VIA. MENU SELECTION	SEE SCHEMATIC C FOR DIGITAL OUTPUT CONNECTION			SINGLE DRY CONTACT RELAY CLOSURE WHEN RELAY OPTION IS INSTALLED
	10	DIGOUT 1 +/K1−B	STATUS OUTPUT/RLY	STATUS/ALARM COLLECTOR					
TB2	1	GND	GROUND	GROUND		499Ω: USE 2 TO 10 VDC TO DRIVE INPUT SEE SCHEMATIC D BELOW	SHIELDED 24 GA. DATA CABLE MINIMUM	1000 FT. MAX. WITHOUT FACTORY APPROVAL	REF. SCHEMATIC D
	2	DIGIN 1 +	DIGITAL INPUT 1	ISOLATED DIGITAL COMMAND LINES	NO TOT CH1 INPUT				
	3	DIGIN 1 −	DIGITAL RETURN		NO TOT CH1 RETURN				
	4	DIGIN 2 +	DIGITAL INPUT 2		NO TOT CH2 INPUT				
	5	DIGIN 2 −	DIGITAL RETURN		NO TOT CH2 RETURN				
	6	Rx	RS232 RECEIVE	STANDARD RS232 SIGNALS	STANDARD RS232 COMMUNICATION PORT			50 FT. MAX. AS PER EIA RS232 FOR GREATER RANGE, CONSULT FACTORY	RS−232 RANGE CAN BE INCREASED BY: a) USE OF SHORT HAUL MODEMS. b) USE OF SPECIAL DATA CABLES AND OR SLOWER DATA RATES. c) USE OF TELEPHONE LINE MODEM. CONSULT FACTORY FOR DETAILS.
	7	Tx	RS232 TRANSMIT						
	8	GND	GROUND						
	9	RTS	RS232 REQUEST TO SEND						
	10	CTS	RS232 CLEAR TO SEND						

J1 (DB9) RS232 CONNECTOR

1 2 3 4 5
6 7 8 9

PIN	SIGNAL	DESCRIPTION	EIA CKT	WIRING	CABLE LENGTH
1	N/C	STANDARD RS 232 SIGNAL LEVELS ALL CONTROL LINES ARE DEFAULTED TO READY STATE		SHIELDED DATA CABLE 24 GA. MIN.	DEPENDS UPON BAUD RATE 50 FEET AT 9600 BAUD WITH STANDARD CABLE
2	RXD		BB		
3	TXD		BA		
4	DTR		CD		
5	GND		AB		
6	N/C				
7	RTS		CA		
8	CTS		CB		

SCHEMATIC A
ISOLATED 4−20mA OUTPUT

FLOWMETER
TB1/2
TB1/4
Io +
USER SUPPLY Vc
TB1/1
TB1/3
Io −
I
R_L

Vc:24VDC TYPICAL
R_L:1000 Ω TYPICAL
I = 4−20mA
R_L = LOOP WIRE RESISTANCE PLUS USER'S INPUT LOAD RESISTANCE

SCHEMATIC C
DIGITAL OUTPUTS

FLOWMETER
TB1/8
TB1/10
R_L
OUTPUT V
Vc
TB1/7
TB1/9

FLOWMETER
TB1/8
TB1/10
Vc
TB1/7
TB1/9
R_L
OUTPUT V

Vc: 24 VDC MAX.
SELECT R_L:
VALUE: (125 x Vc) −340 Ω MIN.
POWER RATING: (1/100 x Vc) WATTS MIN.

SCHEMATIC D
DIGITAL INPUTS

FLOWMETER
TB2/2
499Ω
TB2/4
Vc
TB2/3
R_L
TB2/5

Vc: 2 VDC MIN.
10 VDC MAX.
I = 0.8mA MIN.
R_L = OPTIONAL (SELECT TO ACHIEVE CORRECT I)

DO NOT SCALE THIS DRAWING
UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES (MM)
TOLERANCES ON−
INCHES (MM)
± .1   ± 2

CONTROLLED DRAWING
CHANGES TO THIS DRAWING REQUIRE RELEVANT AGENCY APPROVAL

DR H.J   DATE 11/07/02
CHK ___ DATE ___
ENG ___ DATE ___
PROD ___ DATE ___
APPD ___ DATE ___
CERTIFIED ___
DATE ___

INSTALLATION WIRING, 1020 SERIES FLOW COMPUTER

SIZE C | CODE IDENT NO. 21614 | 1020-7 | REV. C

SCALE: NONE | WT. | SHEET 3 OF 4

5231

1020N SERIES
FLOW COMPUTER

SEAL WASHER 2 REQUIRED
SEE NOTES

CABLE GLANDS 2 REQUIRED
SEE NOTES

TRANSDUCER CABLES
(2 OR 4)

SEAL SCREWS
8-32 x 1/2" (4)

1' NPT THREADS

MULTI-HOLE BUSHING WITH
PLUGS REMOVED TO ACCOMMODATE
2 OR 4 CABLES

F - CONNECTOR
(2 OR 4)

GASKET

CONDUIT / GLAND
ADAPTER

GLAND BODY

GLAND CAP

UNTERMINATED
CABLE END

CONDUIT/CABLE GLAND INSTALLATION INSTRUCTIONS:

FEED THE UNTERMINATED END OF THE TRANSDUCER CABLES
THROUGH THE GASKET AND THE ADAPTER BODY.

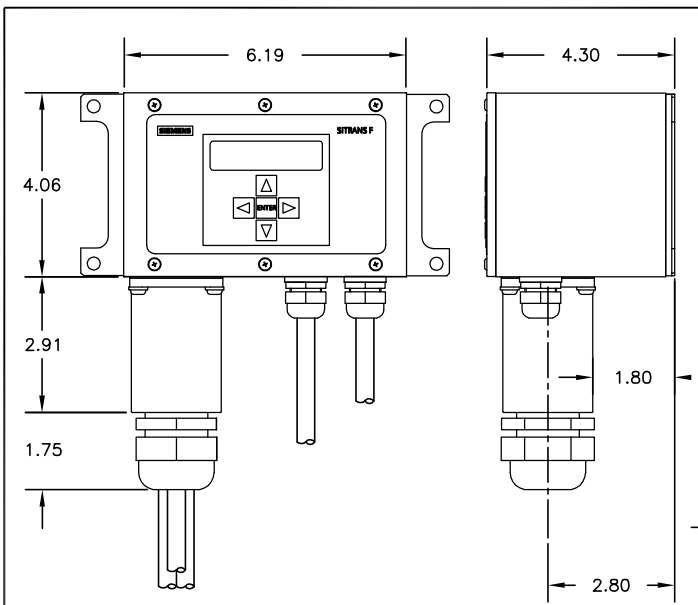MATE THE TRANSDUCER CABLES TO THE F CONNECTORS ON THE
FLOW COMPUTER.

SLIDE THE GASKET AND ADAPTER BODY UP THE CABLE AND SECURE
TO THE FLOW COMPUTER ENCLOSURE USING THE SEAL SCREWS
SUPPLIED.

IF CONDUIT IS TO BE USED, INSTALL A 1" NPT FITTING AND PROCEED
WITH 1" CONDUIT AND/OR ADAPTERS IN A SUITABLE CONFIGURATION
FOR THE APPLICATION.

IF THE CABLE GLAND IS TO BE USED, FEED THE UNTERMINATED CABLE ENDS
THROUGH THE GLAND BODY AND MULTI-HOLE BUSHING. REMOVE BUSHING
HOLE PLUGS AS REQUIRED. SECURE THE CABLES BY TIGHTENING THE
GLAND CAP NUT. HAND TIGHT ENGAGEMENT IS SUFFICIENT.

TERMINATE THE CABLES AT THE TRANSDUCER END IN ACCORDANCE WITH
THE CABLE ASSEMBLY DRAWING.

TO MAINTAIN IP65 RATING THE UNIT MUST HAVE THE ADAPTER
AND (2) CABLE GLANDS AND (2) SEALING WASHERS
INSTALLED AS SHOWN OR USE WATERTIGHT
CONDUIT AT GLAND LOCATIONS.

4 3 2 1

D

7.77
(197)

7.25
(184)

4.30
(109)

SITRANS F

4.06
(103)

3.38
(86)

2.91

1.80

FDC IDENTIFICATION LABEL

1.75

POWER
CABLE

TRANSDUCER CABLE
CONNECTORS ('F' TYPE)
(SEE ZONES A4, A3)

DATA/CONTROL
CABLES

2.80

6.19
(157)

2.78
(71)

1.06
(27)

.88 (22) DIA.
CABLE ENTRY PORTS
FOR CUSTOMER'S CONDUIT
OR SUPPLIED CABLE GLAND

NOTES:

1. NET WT. 3.0 lbs. (1.4 Kg)

2. SEE DRAWING 1020-7 AND THE SYSTEM 1020 FIELD MANUAL
   FOR WIRING AND OPERATION INSTRUCTIONS.

3. USE CONDUIT FITTINGS OR SUPPLIED CABLE GLANDS AT ALL CABLE
   ENTRIES. INSTALL WEATHER TIGHT SEALS AT ALL UNUSED
   HOLES.

SINGLE CHANNEL
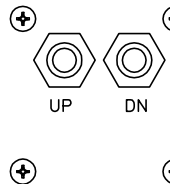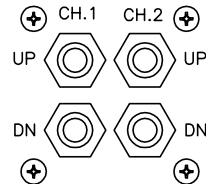
UP   DN

DUAL CHANNEL

CH.1   CH.2
UP   UP

DN   DN

DO NOT SCALE THIS DRAWING

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES (MM)
TOLERANCES ON-

	INCHES	(MM)
	± .1	± 2

DR H.J   DATE 6/19/06
CHK   DATE
ENG   DATE
PROD   DATE
APPD   DATE
CERTIFIED
DATE

CONTROLLED DRAWING
CHANGES TO THIS DRAWING REQUIRE
RELEVANT AGENCY APPROVAL

SIEMENS
Siemens Energy & Automation, Inc.
Process Instrumentation Business Unit
CoC Ultrasonic Flow - Hauppauge, Long Island, NY 11788

OUTLINE DRAWING
1020 SERIES
FLOW COMPUTER

SIZE C   CODE IDENT NO. 21614   1020 - 8   REV. D

SCALE: NONE   WT.   SHEET 1 OF 1

CN5231

"F" CONNECTOR MATED WITH 1022CN SERIES CABLE
OR INTEGRAL XDCER ENCLOSURE CABLE

.4
(10)

"H"

"L"

"W"

CONTROLOTRON
HAUPPAUGE, NY 11788
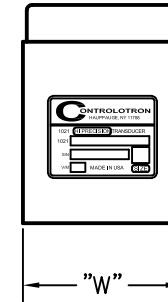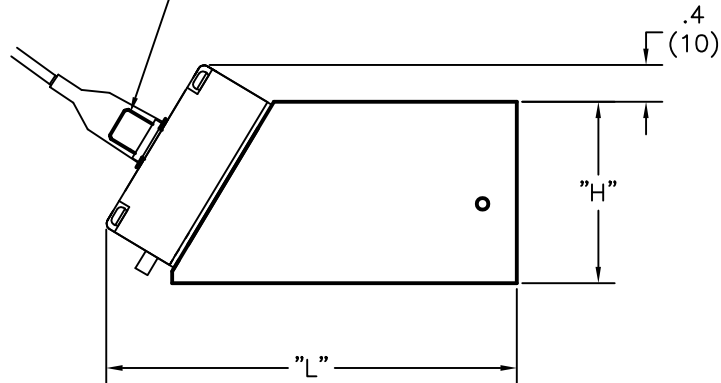
TRANSDUCER PART NUMBER	L	W	H
1021A1/2/3	2.3 (58)	1.25 (32)	1.4 (36)
1021B1/2	3.2 (81)	1.25 (32)	1.4 (36)
1021C1/2	4.5 (114)	1.25 (32)	2.0 (51)
1021D1/2	6.6 (168)	1.75 (44)	3.0 (76)

NOTES :

1. TRANSDUCERS ARE SUPPLIED IN MATCHED PAIRS, BOTH TRANSDUCERS
   OF A PAIR HAVE THE SAME SERIAL NUMBER.

DO NOT SCALE THIS DRAWING

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES
TOLERANCES ON–

INCHES   (MM)
± .1   ± 2

CONTRACT NO.

DR M.KEENAN   DATE 2/4/03
CHK _____ DATE _____
ENG _____ DATE _____
PROD _____ DATE _____
APPD _____ DATE _____

CERTIFIED
_____
DATE

CONTROLOTRON
HAUPPAUGE , NY 11788

OUTLINE DIMENSIONS
1021 SERIES PLASTIC
BODY TRANSDUCERS

SIZE | CODE IDENT NO. | | REV.
C | 21614 | 1021- 8 | A

SCALE: NONE | WT. | SHEET 1 OF 1

ER1671

4 3 2 1

D

*"A"
SEE CHART

4.50(114) BEND ALLOWANCE

INTEGRALLY MOUNTED 1020 SERIES FDC OPTION SHOWN
TRANSDUCER CABLES

SERIES 1022CN OR 1022-51 CABLE ASSY'S SEE NOTE 1.5

REMOVABLE TOP COVER

1022 SERIES DUAL TRACK

4.13 (105)

"L"

TO REMOTE FLOW COMPUTER IF SELECTED

45° SEE NOTE 1.4

"Hr" "Hc"

TRACK IDENTIFICATION LABEL

SPACER STRIP

HORIZONTAL PLANE

90° SEE NOTE 1.4

CUSTOMER SUPPLIED PIPE

1022MS-* ORDERED SEPARATELY SEE NOTE 1.2

REFLECT MODE SHOWN

TRACK ASSY NUMBER	DIM "A" (SEE NOTE 1.3)	INDEX RANGE	DIM "L"	DIM "Hr"	DIM "Hc"	XDCER
1022D2C/1022D2R	17.1(749)MIN/80.6(2047)MAX	13-62	10.5 (267)	4.3 (109)	8.5 (216)	D
1022C2C/1022C2R	17.1(434)MIN/50.5(1283)MAX	13-51	8.5 (216)	3.8 (97)	8.0 (203)	C
1022B2C/1022B2R	17.1(434)MIN/50.5(1283)MAX	13-51	8.5 (216)	3.1 (79)	7.3 (185)	B

NOTES:

1.1 FOR INSTALLATION PROCEDURE SEE 1020 FIELD MANUAL SECTION 3.

1.2 1022MS-* MOUNTING STRAP KITS ARE ORDERED TO MATCH PIPE SIZE. SEE 1022MS-8 TWO MOUNTING STRAP KITS REQUIRED.

1.3 DIMENSION "A" IS DETERMINED BY TRANSDUCER SPACING . TRANSDUCER SPACING IS DEPENDENT ON PIPE SIZE AND FLUID SONIC VELOCITY.

1.4 ON HORIZONTAL PIPES, MOUNT TRACKS WITHIN 45° OF THE HORIZONTAL PLANE IF POSSIBLE. REFER TO THE 1020 FIELD MANUAL FOR ADDITIONAL MOUNTING LOCATION SELECTION CRITERIA.

1.5 EACH DUAL TRACK ASSEMBLY CONSIST OF TWO TRACKS WITH TRANSDUCER CLAMPS,COVERS AND A SPACING STRIP. "INTEGRAL MOUNT" TRACKS TYPE 1022D2C,1022C2C AND 1022B2C INCLUDE MOUNTING HARDWARE FOR THE 1020 SERIES FLOW COMPUTER AND TRANSDUCER CABLE SET, P/N 1022-51-(SIZE CODE).
TRACK MODELS 1022D2R,1022C2R AND 1022B2R TO BE USED WITH A REMOTE MOUNTED 1020 SERIES FLOW COMPUTER DO NOT INCLUDE TRANSDUCER CABLES.

DUAL TRACK REFLECT MODE (INTEGRAL OR REMOTE FLOW COMPUTER)

DO NOT SCALE THIS DRAWING
UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES (MM) TOLERANCES ON-

INCHES (MM)
± .1 ± 2

CONTRACT NO.

Controlotron
HAUPPAUGE , NY 11788

DR M.KEENAN DATE 2/5/03
CHK _____ DATE _____
ENG _____ DATE _____
PROD _____ DATE _____
APPD _____ DATE _____

OUTLINE DRAWING
1020 MOUNTING TRACKS

CERTIFIED
_____
DATE

SIZE C | CODE IDENT NO. 21614 | 1022-8 | REV. A

SCALE: 1/4 | WT. | SHEET 1 OF 3

ER1671

SERIES 1022CN
OR 1022-51 CABLE ASS'Y'S
SEE NOTE 2.5

4.13
(105)

45°

HORIZONTAL PLANE

"Hr"   "Hc"

90°
SEE NOTE 2.4

REFLECT MODE SHOWN

4.50(114) BEND ALLOWANCE

INTEGRALLY MOUNTED 1020 SERIES FDC
OPTION SHOWN

REMOVABLE TOP COVER

TRANSDUCER CABLES

1022 SERIES
SINGLE TRACK

TO REMOTE
FLOW COMPUTER

"L"

TRACK
IDENTIFICATION LABEL

1022MS-*
ORDERED SEPARATELY
SEE NOTE 2.2

CUSTOMER SUPPLIED PIPE

TRACK ASSY NUMBER	INDEX RANGE	DIM "L"	DIM "Hr"	DIM "Hc"	XDCER
1022C1C/1022C1R	8-29	23.5(597)	3.8 (97)	8.0 (203)	C
1022B1C/1022B1R	8-22	16.5(419)	3.1 (79)	7.3 (185)	B
1022A1C/1022A1R	8-22	14.5(368)	3.1 (79)	7.3 (185)	A

SINGLE TRACK (INTEGRAL OR REMOTE FLOW COMPUTER)

NOTES:

2.1 FOR INSTALLATION PROCEDURE SEE 1020 FIELD MANUAL SECTION 3.

2.2 1022MS-* MOUNTING STRAP KITS ARE ORDERED TO
     MATCH PIPE SIZE. SEE 1022MS-8
     TWO MOUNTING STRAP KITS REQUIRED.

2.3 TRANSDUCER SPACING IS DEPENDENT ON PIPE SIZE AND FLUID SONIC VELOCITY.

2.4 ON HORIZONTAL PIPES, MOUNT TRACK WITHIN 45° OF THE HORIZONTAL PLANE IF POSSIBLE.
     REFER TO THE 1020 FIELD MANUAL FOR ADDITIONAL
     MOUNTING LOCATION SELECTION CRITERIA.

2.5 EACH TRACK ASSEMBLY CONSIST OF A TRACK WITH TRANSDUCER CLAMPS, AND A COVER.
     "INTEGRAL MOUNT" TRACK TYPES 1022D1C,1022C1C AND 1022B1C INCLUDE MOUNTING HARDWARE
     FOR THE 1020 SERIES FLOW COMPUTER AND TRANSDUCER CABLE SET
     P/N 1022-51-(SIZE CODE).
     TRACK MODELS 1022D1R,1022C1R AND 1022B1R TO BE USED WITH A REMOTE MOUNTED 1020
     SERIES FLOW COMPUTER DO NOT INCLUDE TRANSDUCER CABLES.

SERIES 1022CN
OR 1022-51 CABLE ASSY'S
SEE NOTE 3.5.

4.13
(105)

180°

45° SEE NOTE 3.4
HORIZONTAL PLANE

90°
SEE NOTE 3.4

"Hc"

"Hr"

DIRECT MODE SHOWN

*"A"
SEE CHART

4.50(114) BEND ALLOWANCE

"L"

INTEGRALLY MOUNTED 1020 SERIES FDC
OPTION SHOWN

TRANSDUCER CABLES

SPACER STRIP

1022MS-*
ORDERED SEPARATELY
SEE NOTE 3.2

TO REMOTE
FLOW COMPUTER
IF SELECTED

TRACK
IDENTIFICATION LABEL

CUSTOMER SUPPLIED PIPE

REMOVABLE TOP COVER

1022 SERIES
DUAL TRACK

TRACK ASSY NUMBER	DIM "A" (SEE NOTE 3)	INDEX RANGE	DIM "L"	DIM "Hr"	DIM "Hc"	XDCER
1022D2C/1022D2R	17.1(749)MIN/80.6(2047)MAX	13-62	10.5 (267)	4.3 (109)	8.5 (216)	D
1022C2C/1022C2R	17.1(434)MIN/50.5(1283)MAX	13-51	8.5 (216)	3.8 (97)	8.0 (203)	C
1022B2C/1022B2R	17.1(434)MIN/50.5(1283)MAX	13-51	8.5 (216)	3.1 (79)	7.3 (185)	B

NOTES:

3.1 FOR INSTALLATION PROCEDURE SEE 1020 FIELD MANUAL SECTION 3.

3.2 1022MS-* MOUNTING STRAP KITS ARE ORDERED TO
     MATCH PIPE SIZE. SEE 1022MS-8. FOR DIRECT MODE, USE SPACING GUIDE SUPPLIED
     WITH STRAP MOUNTING KIT. TWO MOUNTING STRAP KITS REQUIRED.

3.3 DIMENSION "A" IS DETERMINED BY TRANSDUCER SPACING.
     TRANSDUCER SPACING IS DEPENDENT ON PIPE SIZE AND FLUID SONIC VELOCITY.
     FOR A GIVEN APPLICATION DIRECT MODE HAS A SHORTER "A" DIMENSION THAN REFLECT MODE

3.4 ON HORIZONTAL PIPES, MOUNT TRACKS WITHIN 45° OF THE HORIZONTAL PLANE IF POSSIBLE.
     REFER TO THE 1020 FIELD MANUAL FOR ADDITIONAL
     MOUNTING LOCATION SELECTION CRITERIA.

3.5 EACH DUAL TRACK ASSEMBLY CONSIST OF TWO TRACKS WITH TRANSDUCER CLAMPS,COVERS
     AND A SPACING STRIP. "INTEGRAL MOUNT" TRACKS TYPE 1022D2C,1022C2C AND 1022B2C
     INCLUDE MOUNTING HARDWARE FOR THE 1020 SERIES FLOW COMPUTER AND TRANSDUCER CABLE
     SET, P/N 1022-51-(SIZE CODE).
     TRACK MODELS 1022D2R,1022C2R AND 1022B2R TO BE USED WITH A REMOTE MOUNTED 1020
     SERIES FLOW COMPUTER DO NOT INCLUDE TRANSDUCER CABLES.

DUAL TRACK DIRECT MODE   (INTEGRAL OR REMOTE FLOW COMPUTER)

CONTRACT NO.

DR M.KEENAN   DATE 2/5/03
CHK _____ DATE _____
ENG _____ DATE _____
PROD _____ DATE _____
APPD _____ DATE _____

CERTIFIED
_____
DATE

CONTROLOTRON
HAUPPAUGE , NY 11788

OUTLINE DRAWING
1020 MOUNTING TRACKS

SIZE C   CODE IDENT NO. 21614   1022-8   REV. A

SCALE: 1/4   WT.   SHEET 3 OF 3

ER1671

STRAP GUIDE WITH CENTERING PIN

SPACER BAR INCLUDED UP TO 13" DIA FOR LARGER DIA SEE FIELD MANUAL FOR INSTALLATION INSTRUCTIONS

1021 SERIES TRANSDUCER

CUSTOMER'S PIPE

BARE BONES MOUNT SHOWN IN REFLECT MODE

MOUNTING STRAP

1022MS-* STRAP MOUNTING KIT SEE CHART
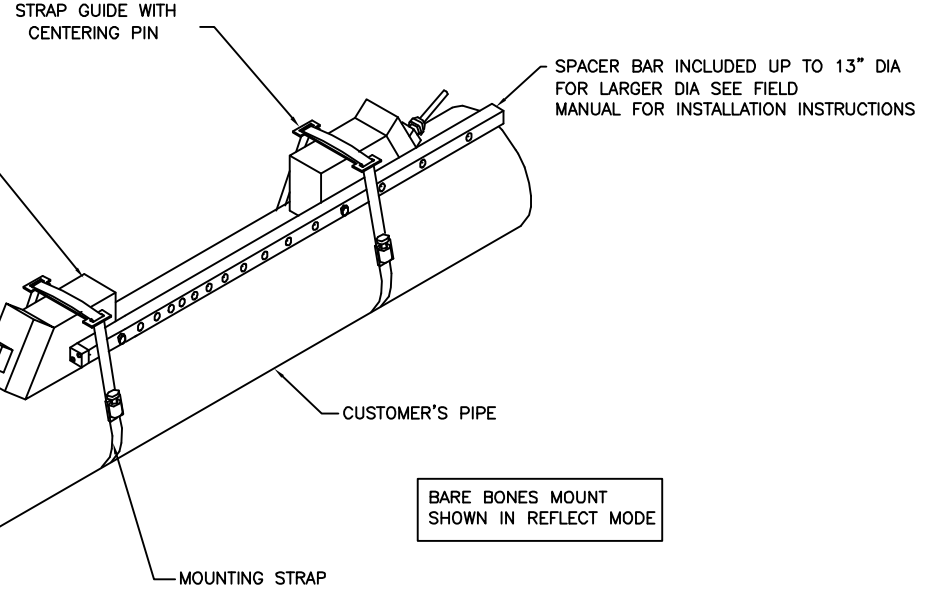
BARE BONES MTG PART No.	PIPE DIA.	SPACER BAR	STRAP MTG KIT P/N
1022B-1A	2"-7"	1022-52-1	1022MS-1A
1022B-1	2"-13"	1022-52-1	1022MS-1
1022B-2	13"-24"	N/A	1022MS-2
1022B-3	24"-48"	N/A	1022MS-3
1022B-4	48"-60"	N/A	1022MS-4
1022B-5	60"-84'	N/A	1022MS-5
1022B-6	84"-120"	N/A	1022MS-6
1022B-7	120"-216"	N/A	1022MS-7
1022B-8	216"-360"	N/A	1022MS-8
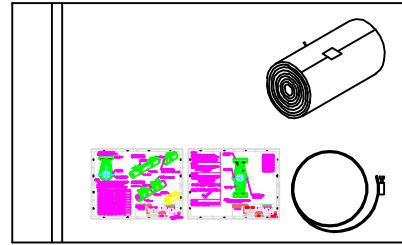
NOTES:
1. ALL KITS INCLUDE A STRAP MOUNTING KIT AND A PAIR OF STRAP GUIDES. SIZE 1 AND 1A KITS INCLUDE A SPACER BAR TO ALIGN AND SPACE TRANSDUCERS.

DO NOT SCALE THIS DRAWING

CONTRACT NO.

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES (MM)
TOLERANCES ON—
INCHES   (MM)
± .1   ± 2

DR M.KEENAN   DATE 2/20/03
CHK _____ DATE _____
ENG _____ DATE _____
PROD _____ DATE _____
APPD _____ DATE _____

CERTIFIED
_____
DATE

CONTROLOTRON
HAUPPAUGE , NY 11788

OUTLINE
BARE BONES MOUNTING

SIZE C | CODE IDENT NO. 21614 | 1022B-8 | REV. A

SCALE: NONE | WT. | SHEET 1 OF 1

CN4627 REV A

| 4 | 3 | 2 | 1 |

- 1020N SERIES FLOW COMPUTER
- SEAL WASHER 2 REQUIRED SEE NOTES
- CABLE GLANDS 2 REQUIRED SEE NOTES
- TRANSDUCER CABLES (2 OR 4)
- SEAL SCREWS 8-32 x 1/2" (4)
- 1' NPT THREADS
- MULTI-HOLE BUSHING WITH PLUGS REMOVED TO ACCOMMODATE 2 OR 4 CABLES
- F - CONNECTOR (2 OR 4)
- GASKET
- CONDUIT / GLAND ADAPTER
- GLAND BODY
- GLAND CAP
- UNTERMINATED CABLE END

Dimensions: 6.19, 4.30, 4.06, 2.91, 1.75, 1.80, 2.80, 2.00, 2.00, 2.88, 1" NPT

USING THE 1022CGA ADAPTER:

FEED THE UNTERMINATED END OF THE TRANSDUCER CABLES THROUGH THE GASKET AND THE ADAPTER BODY.

REMOVE THE FOUR #8-32 X 1/2 SEAL SCREWS FROM THE FLOW COMPUTER ENCLOSURE.

MATE THE TRANSDUCER CABLES TO THE F CONNECTORS ON THE FLOW COMPUTER.

SLIDE THE GASKET AND ADAPTER BODY UP THE CABLE AND SECURE TO THE FLOW COMPUTER ENCLOSURE USING THE SEAL SCREWS REMOVED EARLIER.

IF CONDUIT IS TO BE USED, INSTALL A 1" NPT FITTING AND PROCEED WITH 1" CONDUIT AND/OR ADAPTERS IN A SUITABLE CONFIGURATION FOR THE APPLICATION.

IF THE CABLE GLAND IS TO BE USED, FEED THE UNTERMINATED CABLE ENDS THROUGH THE GLAND BODY AND MULTI-HOLE BUSHING. REMOVE BUSHING HOLE PLUGS AS REQUIRED. SECURE THE CABLES BY TIGHTENING THE GLAND CAP NUT. HAND TIGHT ENGAGEMENT IS SUFFICIENT.

TERMINATE THE CABLES AT THE TRANSDUCER END IN ACCORDANCE WITH THE CABLE ASSEMBLY DRAWING.

TO MAINTAIN IP65 RATING THE UNIT MUST HAVE THE ADAPTER AND (2) CABLE GLANDS AND (2) SEALING WASHERS INSTALLED AS SHOWN OR USE WATERTIGHT CONDUIT AT GLAND LOCATIONS.

CONTROLLED DRAWING
CHANGES TO THIS DRAWING REQUIRE RELEVANT AGENCY APPROVAL

DO NOT SCALE THIS DRAWING	CONTRACT NO.

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES
TOLERANCES ON—

	INCHES	(MM)
	± .1	± 2

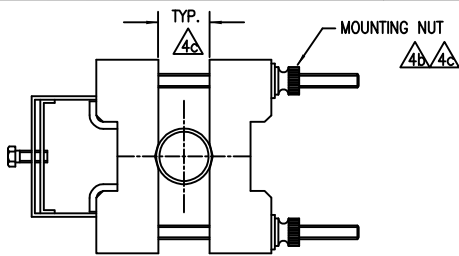|			
DR	H.J	DATE	12/14/04
CHK		DATE	
ENG		DATE	
PROD		DATE	
APPD		DATE	

CERTIFIED

DATE

SIEMENS
Siemens Energy & Automation, Inc.
Process Instrumentation Business Unit
CoC Ultrasonic Flow - Hauppauge, Long Island, NY 11788

ASSEMBLY, 1020 SERIES FLOW COMPUTER

SIZE	CODE IDENT NO.		REV.
C	21614	1022CGA-8	B
SCALE: NONE	WT.	SHEET 1 OF 1	

CN5231

TYP.

MOUNTING NUT

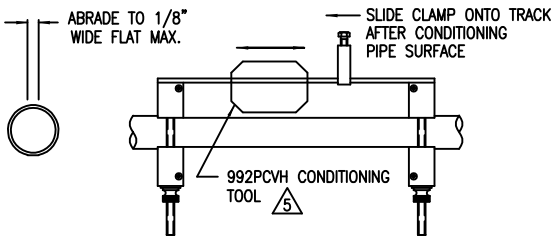SELECT AND PREPARE THE TRANSDUCER MOUNTING LOCATION,
SECURE TRACKS TO PIPE WITH MOUNTING NUTS.
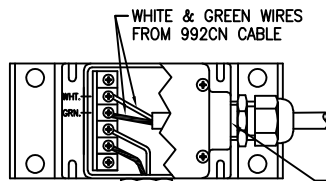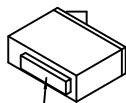HORIZONTAL ₵ SHOWN

TRANSDUCER INDEX PIN ORIENTATION

INDEX PINS

ORIENTATION OF PROPERLY
INSTALLED TRANSDUCERS IN
DIRECT MODE OPERATION

PIPE CONDITIONING: WITH TRACKS IN PLACE, CONDITION PIPE SURFACE
USING 992PCVH PIPE CONDITIONING TOOL AND ABRASIVE PAPER STRIPS
SUPPLIED. IN ELEVATED TEMP. ENVIRONMENT, PERIODICALLY DIP THE
CONDITIONING TOOL IN WATER BATH TO COOL. THIS WILL ASSURE BEST
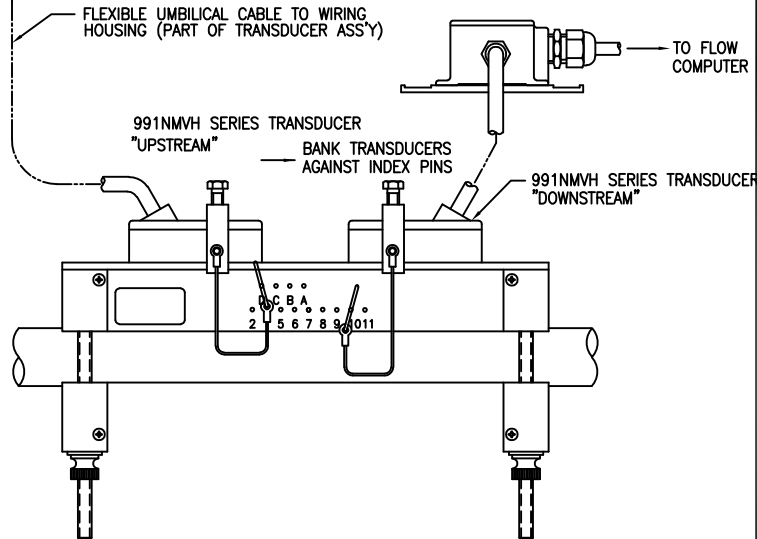GRIP OF WATERPROOF ADHESIVE ON THE ABRASIVE STRIPS.

992PCVH CONDITIONING
TOOL

SLIDE CLAMP ONTO TRACK
AFTER CONDITIONING
PIPE SURFACE
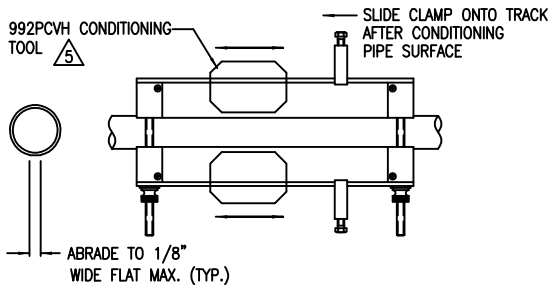
ABRADE TO 1/8"
WIDE FLAT MAX. (TYP.)

APPLY THIN BAND OF COUPLANT
(SUPPLIED) TO BASE OF EACH
TRANSDUCER BEFORE INSTALLING
IN MOUNTING TRACK

WHITE & GREEN WIRES
FROM 992CN CABLE

WHT.
GRN.
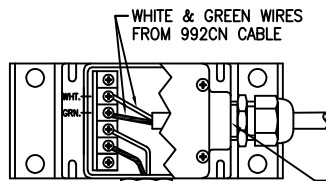
991NMVH TRANSDUCERS WITH 992CN CABLE:
−ATTACH WHITE WIRE TO TERMINAL "1"
−ATTACH GREEN WIRE TO TERMINAL "2"
AFTER WIRING, REPLACE COVER & GASKET
991PMVH TRANSDUCERS HAVE BNC CONNECTORS
FOR USE WITH 992CP CABLES.

991NMVH WIRING HOUSING: 1/2" N.P.T THREAD
ACCEPTS CUSTOMER'S FITTING FOR CONDUIT OR
CABLE ENTRY GLAND (1/4" CABLE O.D.).
AVOID USE OF RIGID CONDUIT TO PREVENT
TRANSDUCER MOVEMENT AS A RESULT OF CONDUIT
STRESS OR VIBRATION.

FLEXIBLE UMBILICAL CABLE TO WIRING
HOUSING (PART OF TRANSDUCER ASS'Y)

991NMVH SERIES TRANSDUCER
"UPSTREAM"

BANK TRANSDUCERS
AGAINST INDEX PINS

C B A
0 1 2 3 4

0 3 6 7 8 9 10 11
2 5

INSERT INDEX PINS IN
APPROPRIATE HOLES

TRANSDUCER CLAMP

991NMVH SERIES TRANSDUCER
"DOWNSTREAM"

TO FLOW
COMPUTER

INSTALLATION PROCEDURE − SEE DRAWING REFERENCES

1. USING THE INSTALLATION MENU PROCEDURES PRESENTED
   IN THE FIELD MANUAL, CONFIRM THAT YOU HAVE THE
   APPROPRIATE TRANSDUCERS AND TRACK FOR REFLECT MODE
   OPERATION ON THE CHOSEN PIPE.

2. SELECT MOUNTING LOCATION;
   a) CHOOSE LOCATION WHICH REMAINS FULL AT ZERO FLOW.
   b) WHERE POSSIBLE LOCATE TRACK ASS'Y TEN (10) PIPE
      DIAMETERS OR MORE FROM BEND TO ENSURE FULLY
      DEVELOPED AND STABLE FLOW PROFILE.
   c) ON HORIZONTAL PIPE, SELECT HORIZONTAL PLANE, IF
      POSSIBLE, TO AVOID SEDIMENT BLOCKAGE OF TRANSDUCER
      SIGNAL.

3. PREPARE PIPE FOR TRACK MOUNT;
   a) REMOVE GRIT, CORROSION, COATING OR HEAVY PAINT
   b) CLEAN AND DEGREASE SURFACE
   c) DO NOT MOUNT OVER FROST.

4. MOUNT TRACK ON PIPE;
   a) PLACE TRACK RAIL ASS'Y (ASS'Y WITH 1/4−20 STUDS) AGAINST PIPE.
      WHILE HOLDING TRACK, SLIDE THE SECOND TRACK ONTO THE STUDS
      AND HOLD TOGETHER IN PLACE
      (MAKE SURE "V"s COME TOGETHER A SHOWN).

   b) INSTALL MOUNTING NUTS, SNUG BUT NOT OVERLY TIGHT.
      ROTATE ASS'Y AROUND THE PIPE FOR PROPER POSITIONING,
      ONCE THAT HAS BEEN ACHIEVED, SECURE THE TRACK RAIL ASS'Y
      TO THE PIPE WITH THE MOUNTING NUTS.

   c) IMPORTANT: KEEP EQUAL SPACING BETWEEN THE TWO TRACK RAIL
      ASSEMBLIES WHILE TIGHTENING THE MOUNTING NUTS. (ZONE D4)

5. CONDITION PIPE SURFACE;
   LOCALLY SMOOTH THE PIPE SURFACE TO ACCEPT THE
   TRANSDUCERS. USE THE 992PCVH CONDITIONING TOOL
   AND ABRASIVE PAPER (ADHESIVE BACKED) PROVIDED.
   FINISHED SURFACE SHOULD BE APPROXIMATELY 1/8"
   WIDE FLAT AT CENTER OF MOUNTING TRACK.

6. LOCATE TRANSDUCERS;
   a) CONSULTING THE FIELD MANUAL, USE THE
      INSTALLATION MENU TO DETERMINE THE APPROPRIATE
      INDEX HOLES FOR YOUR APPLICATION AND INSERT PINS.
   b) APPLY A THIN BAND OF THE ULTRASONIC COUPLANT
      PROVIDED TO THE BASE OF EACH TRANSDUCER.
   c) INSERT TRANSDUCERS INTO TRACK AS SHOWN, BANKING
      AGAINST INDEX PINS. SECURE TRANSDUCERS WITH CLAMPS.

7. MAKE TRANSDUCER CABLE CONNECTIONS IN ACCORDANCE WITH
   THE APPROPRIATE FLOW COMPUTER INSTALLATION DRAWING
   AND 990 FIELD MANUAL.

8. SEE DRAWING 990TDMVH−8A AND 990THMVH−8A FOR TRACK AND
   TRANSDUCER OUTLINE DIMENSIONS.

WRAP MOUNTING GUIDE AROUND PIPE AND MARK AT OVERLAPPING EDGE. UNWRAP GUIDE, MEASURE DISTANCE "L" FROM EDGE TO MARK, MARK AGAIN AT 1/2 "L". RE-INSTALL THE MOUNTING GUIDE, TAPE IN PLACE WITH BOTH MARKS VISIBLE.

MARK
PIPE
GUIDE
MARK
4a

1/2 "L"
"L"

WRAP STRAP WITH MOUNTING NUT AROUND THE PIPE, ALIGN WITH MOUNTING GUIDE, SECURE WITH STRAP TENSION ADJUST SCREWS AFTER POSITIONING MOUNTING NUTS AT MOUNTING GUIDE MARKS. MOUNT SECOND STRAP ON THE PIPE ALIGNING THE MOUNTING NUTS AND SPACED TO MATCH THE TRACK RAIL MOUNTING SCREWS.

MOUNTING TRACK NUT (2)
4b
ALTERNATE STYLES OF TRACK MOUNTING NUTS

STRAP TENSION ADJUST SCREW

SPACE TO MATCH TRACK RAIL SCREWS

LONGER MOUNTING TRACKS ASSEMBLIES INCLUDE A THIRD STRAP AND MOVEABLE MOUNTING SCREW. POSITION MOVEABLE SCREW FOR BEST ADVANTAGE AFTER TRANSDUCER INDEX HOLES HAVE BEEN SELECTED.

PREFERRED MOUNTING PLANE OF TRANSDUCERS 2c
CUSTOMER'S PIPE
MOUNTING TRACK
TRANSDUCER
HORIZONTAL ℄

PIPE CONDITIONING: WITH TRACKS IN PLACE, CONDITION PIPE SURFACE USING 992PCVH PIPE CONDITIONING TOOL AND ABRASIVE PAPER STRIPS SUPPLIED. IN ELEVATED TEMP. ENVIRONMENT, PERIODICALLY DIP THE CONDITIONING TOOL IN WATER BATH TO COOL. THIS WILL ASSURE BEST GRIP OF WATERPROOF ADHESIVE ON THE ABRASIVE STRIPS.

SLIDE CLAMP ONTO TRACK AFTER CONDITIONING PIPE SURFACE
5
ABRADE TO 1/8" WIDE FLAT MAX. (TYP.)
992PCVH CONDITIONING TOOL

WIRING HOUSING
FINGER TIGHT ENGAGEMENT OF 'F' CONNECTOR IS SUFFICIENT – DO NOT OVER TIGHTEN
GLAND BODY
1012CN SERIES CABLE
TO FLOW COMPUTER
NPT ADAPTER
GLAND CAP
CONNECTOR ADAPTER

FLEXIBLE UMBILICAL CABLE TO WIRING HOUSING (PART OF TRANSDUCER ASS'Y)
TRACK MOUNTING STRAP
4b
991N SERIES TRANSDUCER "UPSTREAM"
TRACK RAIL MOUNTING SCREW 4c
TRACK MOUNTING NUT
BANK TRANSDUCERS AGAINST INDEX PINS 6c
MOUNTING GUIDE
FLOW
ULTRASONIC COUPLANT (SEE ZONE B2)
TRACK I.D. LABEL
992MTNDM TRACK ASS'Y TWO PARTS LETTER INDICES & NUMBER INDICES (OR 992MTNHMSH PARTS "R" & "D")
991N SERIES TRANSDUCER "DOWNSTREAM"
INSERT INDEX PINS IN APPROPRIATE HOLES 6d

TRANSDUCER INDEX PIN ORIENTATION
6c
INDEX PINS

ORIENTATION OF PROPERLY INSTALLED TRANSDUCERS IN DIRECT MODE OPERATION

APPLY THIN BAND OF COUPLANT (SUPPLIED) TO BASE OF EACH TRANSDUCER BEFORE INSTALLING IN MOUNTING TRACK 6b

SIEMENS
Siemens Energy & Automation, Inc.
Process Instrumentation Business Unit
CoC Ultrasonic Flow - Hauppauge, Long Island, NY 11788

DO NOT SCALE THIS DRAWING
CONTRACT NO.
UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES (MM)
TOLERANCES ON–
INCHES (MM)
± .1   ± 2
DR H.J   DATE 11/03/04
CHK   DATE
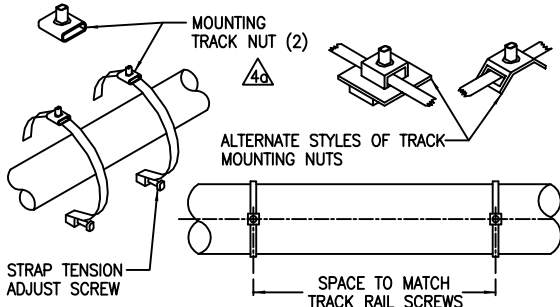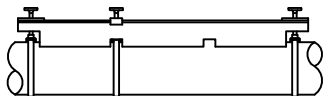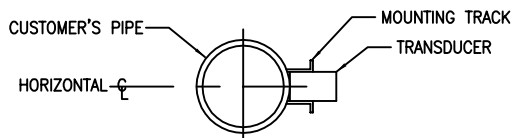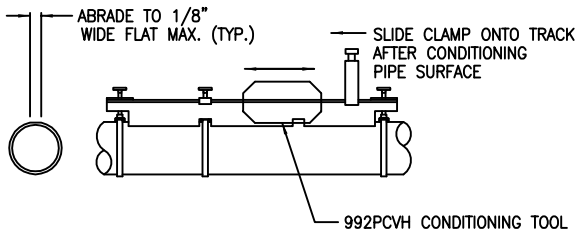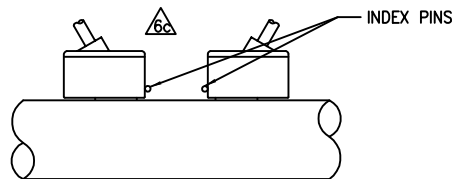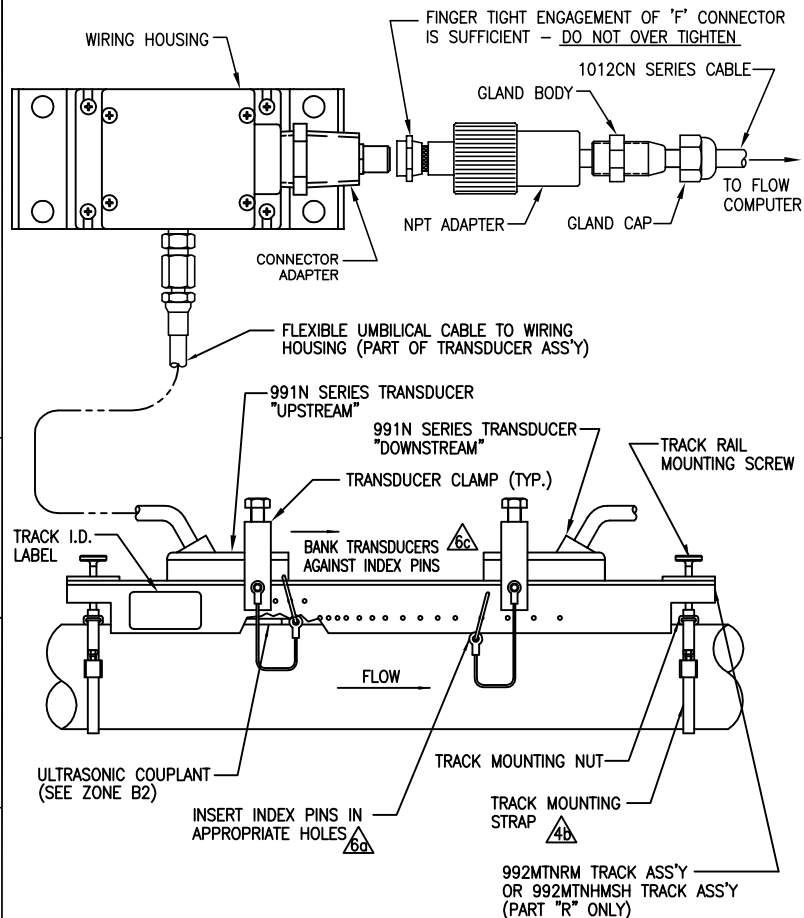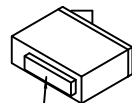ENG   DATE
PROD   DATE
APPD   DATE
CERTIFIED
DATE

INSTALLATION DRAWING
990 SERIES TRANSDUCER
DIRECT MODE, VERY HIGH TEMP.

SIZE C
CODE IDENT NO. 21614
990TDMVH-7B
REV. F

SCALE: NONE   WT.   SHEET 1 OF 1

CN#5216

TYP.
/4c\

MOUNTING NUT

/4b\ /4c\

SELECT AND PREPARE THE TRANSDUCER MOUNTING LOCATION,
SECURE TRACK TO PIPE WITH MOUNTING NUTS.
HORIZONTAL ℄ SHOWN

TRANSDUCER INDEX PIN ORIENTATION

INDEX PINS /6c\

ORIENTATION OF PROPERLY INSTALLED TRANSDUCERS
IN REFLECT MODE OPERATION

PIPE CONDITIONING: WITH TRACKS IN PLACE, CONDITION PIPE SURFACE
USING 992PCVH PIPE CONDITIONING TOOL AND ABRASIVE PAPER STRIPS
SUPPLIED. IN ELEVATED TEMP. ENVIRONMENT, PERIODICALLY DIP THE
CONDITIONING TOOL IN WATER BATH TO COOL. THIS WILL ASSURE BEST
GRIP OF WATERPROOF ADHESIVE ON THE ABRASIVE STRIPS.

ABRADE TO 1/8"
WIDE FLAT MAX.

SLIDE CLAMP ONTO TRACK
AFTER CONDITIONING
PIPE SURFACE

992PCVH CONDITIONING
TOOL /5\

APPLY THIN BAND OF COUPLANT
(SUPPLIED) TO BASE OF EACH
TRANSDUCER BEFORE INSTALLING
IN MOUNTING TRACK /6b\

WHITE & GREEN WIRES
FROM 992CN CABLE

WHT.
GRN.

991NMVH TRANSDUCERS WITH 992CN CABLE:

—ATTACH WHITE WIRE TO TERMINAL "1"
—ATTACH GREEN WIRE TO TERMINAL "2"
AFTER WIRING, REPLACE COVER & GASKET

991PMVH TRANSDUCERS HAVE BNC CONNECTORS
FOR USE WITH 992CP CABLES. /7\

991NMVH WIRING HOUSING: 1/2" N.P.T THREAD
ACCEPTS CUSTOMER'S FITTING FOR CONDUIT OR
CABLE ENTRY GLAND (1/4" CABLE O.D.).
AVOID USE OF RIGID CONDUIT TO PREVENT
TRANSDUCER MOVEMENT AS A RESULT OF CONDUIT
STRESS OR VIBRATION.

FLEXIBLE UMBILICAL CABLE TO WIRING
HOUSING (PART OF TRANSDUCER ASS'Y)

TO FLOW
COMPUTER

991NMVH SERIES TRANSDUCER
"UPSTREAM"

BANK TRANSDUCERS
AGAINST INDEX PINS

991NMVH SERIES TRANSDUCER
"DOWNSTREAM"

1. USING THE INSTALLATION MENU PROCEDURES PRESENTED
IN THE FIELD MANUAL, CONFIRM THAT YOU HAVE THE
APPROPRIATE TRANSDUCERS AND TRACK FOR REFLECT MODE
OPERATION ON THE CHOSEN PIPE.

2. SELECT MOUNTING LOCATION;
   a) CHOOSE LOCATION WHICH REMAINS FULL AT ZERO FLOW.
   b) WHERE POSSIBLE LOCATE TRACK ASS'Y TEN (10) PIPE
      DIAMETERS OR MORE FROM BEND TO ENSURE FULLY
      DEVELOPED AND STABLE FLOW PROFILE.
   c) ON HORIZONTAL PIPE, SELECT HORIZONTAL PLANE, IF
      POSSIBLE, TO AVOID SEDIMENT BLOCKAGE OF TRANSDUCER
      SIGNAL.

3. PREPARE PIPE FOR TRACK MOUNT;
   a) REMOVE GRIT, CORROSION, COATING OR HEAVY PAINT
   b) CLEAN AND DEGREASE SURFACE
   c) DO NOT MOUNT OVER FROST.

4. MOUNT TRACK ON PIPE;
   a) PLACE TRACK RAIL ASS'Y (ASS'Y WITH 1/4–20 STUDS) AGAINST PIPE.
      WHILE HOLDING TRACK, SLIDE THE POSITIONING BLOCK ONTO THE
      STUDS AND HOLD TOGETHER IN PLACE
      (MAKE SURE "V"s COME TOGETHER A SHOWN).

   b) INSTALL MOUNTING NUTS, SNUG BUT NOT OVERLY TIGHT.
      ROTATE ASS'Y AROUND THE PIPE FOR PROPER POSITIONING,
      ONCE THAT HAS BEEN ACHIEVED, SECURE THE TRACK RAIL ASS'Y
      TO THE PIPE WITH THE MOUNTING NUTS.

   c) IMPORTANT: KEEP EQUAL SPACING BETWEEN THE TWO TRACK RAIL
      ASSEMBLIES WHILE TIGHTENING THE MOUNTING NUTS. (ZONE D4)

5. CONDITION PIPE SURFACE;
   LOCALLY SMOOTH THE PIPE SURFACE TO ACCEPT THE
   TRANSDUCERS. USE THE 992PCVH CONDITIONING TOOL
   AND ABRASIVE PAPER (ADHESIVE BACKED) PROVIDED.
   FINISHED SURFACE SHOULD BE APPROXIMATELY 1/8"
   WIDE FLAT AT CENTER OF MOUNTING TRACK.

6. LOCATE TRANSDUCERS;
   a) CONSULTING THE FIELD MANUAL, USE THE
      INSTALLATION MENU TO DETERMINE THE APPROPRIATE
      INDEX HOLES FOR YOUR APPLICATION AND INSERT PINS.
   b) APPLY A THIN BAND OF THE ULTRASONIC COUPLANT
      PROVIDED TO THE BASE OF EACH TRANSDUCER.
   c) INSERT TRANSDUCERS INTO TRACK AS SHOWN, BANKING
      AGAINST INDEX PINS. SECURE TRANSDUCERS WITH CLAMPS.

7. MAKE TRANSDUCER CABLE CONNECTIONS IN ACCORDANCE WITH
   THE APPROPRIATE FLOW COMPUTER INSTALLATION DRAWING
   AND 990 FIELD MANUAL.

8. SEE DRAWING 990TRMVH–8A AND 990THMVH–8A FOR TRACK AND
   TRANSDUCER OUTLINE DIMENSIONS.

DO NOT SCALE THIS DRAWING

CONTRACT NO.

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES (MM)
TOLERANCES ON–

DR H.J   DATE 11/03/04
CHK ____ DATE ____
ENG ____ DATE ____
PROD ____ DATE ____
APPD ____ DATE ____

CERTIFIED
____
DATE

CONTROLOTRON
HAUPPAUGE , NY 11788

INSTALLATION DRAWING
990 SERIES TRANSDUCER
DIRECT MODE, VERY HIGH TEMP.

SIZE C | CODE IDENT NO. 21614 | 990TRMVH-7A | REV. A
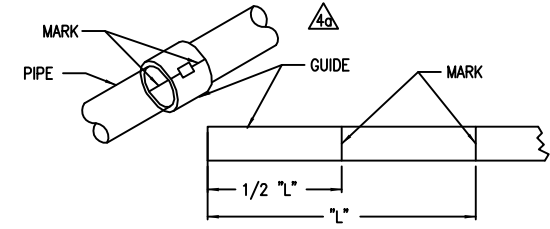
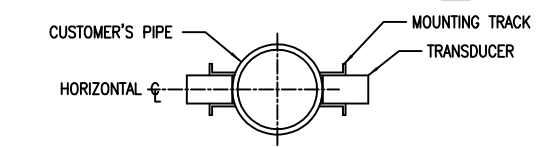SCALE: NONE | WT. | SHEET 1 OF 1

WRAP STRAP WITH MOUNTING NUT AROUND THE PIPE, ALIGN WITH MOUNTING GUIDE, SECURE WITH STRAP TENSION ADJUST SCREWS AFTER POSITIONING MOUNTING NUTS AT MOUNTING GUIDE MARKS. MOUNT SECOND STRAP ON THE PIPE ALIGNING THE MOUNTING NUTS AND SPACED TO MATCH THE TRACK RAIL MOUNTING SCREWS.
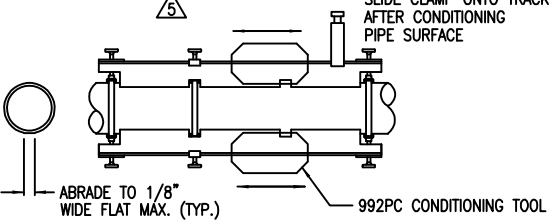
MOUNTING TRACK NUT (2)
⚠️4a

ALTERNATE STYLES OF TRACK MOUNTING NUTS

STRAP TENSION ADJUST SCREW

SPACE TO MATCH TRACK RAIL SCREWS

LONGER MOUNTING TRACKS ASSEMBLIES INCLUDE A THIRD STRAP AND MOVEABLE MOUNTING SCREW. POSITION MOVEABLE SCREW FOR BEST ADVANTAGE AFTER TRANSDUCER INDEX HOLES HAVE BEEN SELECTED.

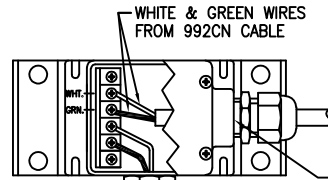PREFERRED MOUNTING PLANE OF TRANSDUCERS ⚠️2c

CUSTOMER'S PIPE
MOUNTING TRACK
TRANSDUCER
HORIZONTAL-℄

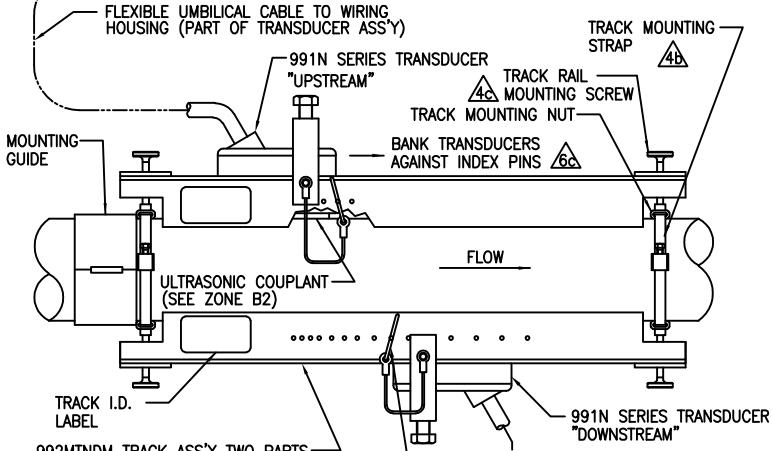PIPE CONDITIONING: WITH TRACKS IN PLACE, CONDITION PIPE SURFACE USING 992PCVH PIPE CONDITIONING TOOL AND ABRASIVE PAPER STRIPS SUPPLIED. IN ELEVATED TEMP. ENVIRONMENT, PERIODICALLY DIP THE CONDITIONING TOOL IN WATER BATH TO COOL. THIS WILL ASSURE BEST GRIP OF WATERPROOF ADHESIVE ON THE ABRASIVE STRIPS. ⚠️5

ABRADE TO 1/8" WIDE FLAT MAX. (TYP.)
SLIDE CLAMP ONTO TRACK AFTER CONDITIONING PIPE SURFACE

992PCVH CONDITIONING TOOL

TRANSDUCER INDEX PIN ORIENTATION
⚠️6a
INDEX PINS

ORIENTATION OF PROPERLY INSTALLED TRANSDUCERS IN REFLECT MODE OPERATION

WIRING HOUSING
FINGER TIGHT ENGAGEMENT OF 'F' CONNECTOR IS SUFFICIENT – DO NOT OVER TIGHTEN
1012CN SERIES CABLE
GLAND BODY
NPT ADAPTER
GLAND CAP
TO FLOW COMPUTER
CONNECTOR ADAPTER

FLEXIBLE UMBILICAL CABLE TO WIRING HOUSING (PART OF TRANSDUCER ASS'Y)

991N SERIES TRANSDUCER "UPSTREAM"
991N SERIES TRANSDUCER "DOWNSTREAM"
TRACK RAIL MOUNTING SCREW
TRANSDUCER CLAMP (TYP.)
TRACK I.D. LABEL
BANK TRANSDUCERS AGAINST INDEX PINS ⚠️6c
FLOW
TRACK MOUNTING NUT
ULTRASONIC COUPLANT (SEE ZONE B2)
INSERT INDEX PINS IN APPROPRIATE HOLES ⚠️6a
TRACK MOUNTING STRAP ⚠️4b
992MTNRM TRACK ASS'Y OR 992MTNHMSH TRACK ASS'Y (PART "R" ONLY)

APPLY THIN BAND OF COUPLANT (SUPPLIED) TO BASE OF EACH TRANSDUCER BEFORE INSTALLING IN MOUNTING TRACK ⚠️6b

INSTALLATION PROCEDURE – SEE DRAWING REFERENCES ⚠️

1. USING THE INSTALLATION MENU PROCEDURES PRESENTED IN THE FIELD MANUAL, CONFIRM THAT YOU HAVE THE APPROPRIATE TRANSDUCERS AND TRACK FOR REFLECT MODE OPERATION ON THE CHOSEN PIPE.

2. SELECT MOUNTING LOCATION:
   a) CHOOSE LOCATION WHICH REMAINS FULL AT ZERO FLOW.
   b) WHERE POSSIBLE LOCATE TRACK ASS'Y TEN (10) PIPE DIAMETERS OR MORE FROM BEND TO ENSURE FULLY DEVELOPED AND STABLE FLOW PROFILE.
   c) ON HORIZONTAL PIPE, SELECT HORIZONTAL PLANE, IF POSSIBLE, TO AVOID SEDIMENT BLOCKAGE OF TRANSDUCER SIGNAL.

3. PREPARE PIPE FOR TRACK MOUNT;
   a) REMOVE GRIT, CORROSION, COATING OR HEAVY PAINT
   b) CLEAN AND DEGREASE SURFACE
   c) DO NOT MOUNT OVER FROST.

4. MOUNT TRACK ON PIPE:
   a) SLIP ONE OF THE MOUNTING NUTS PROVIDED ONTO EACH OF THE MOUNTING STRAPS. WRAP THE STRAPS AROUND THE PIPE AT THE SELECTED LOCATION AND ENGAGE THE ADJUSTING SCREWS. POSITION THE MOUNTING NUTS IN LINE WITH THE FLOW AXIS AND SPACED TO MATE WITH THE SCREWS AT EITHER END OF THE TRACK ASSEMBLY. SECURE THE STRAPS (AND NUTS) BY TIGHTENING THE MOUNTING STRAP ADJUSTING SCREWS.
   b) SECURE THE TRACK RAIL ASSEMBLIES TO THE PIPE USING THE TRACK RAIL MOUNTING SCREWS.

5. CONDITION PIPE SURFACE;
   LOCALLY SMOOTH THE PIPE SURFACE TO ACCEPT THE TRANSDUCERS. USE THE 992PCVH CONDITIONING TOOL AND ABRASIVE PAPER (ADHESIVE BACKED) PROVIDED. FINISHED SURFACE SHOULD BE APPROXIMATELY 1/8" WIDE FLAT AT CENTER OF MOUNTING TRACK.

6. LOCATE TRANSDUCERS;
   a) CONSULTING THE FIELD MANUAL, USE THE INSTALLATION MENU TO DETERMINE THE APPROPRIATE INDEX HOLES FOR YOUR APPLICATION AND INSERT PINS.
   b) APPLY A THIN BAND OF THE ULTRASONIC COUPLANT PROVIDED TO THE BASE OF EACH TRANSDUCER.
   c) INSERT TRANSDUCERS INTO TRACK AS SHOWN, BANKING AGAINST INDEX PINS. SECURE TRANSDUCERS WITH CLAMPS.

7. MAKE TRANSDUCER CABLE CONNECTIONS IN ACCORDANCE WITH THE APPROPRIATE FLOW COMPUTER INSTALLATION DRAWING AND 990 FIELD MANUAL.

8. SEE DRAWING 99TRMVH-8 AND 990THMVH-8 FOR TRACK AND TRANSDUCER OUTLINE DIMENSIONS.

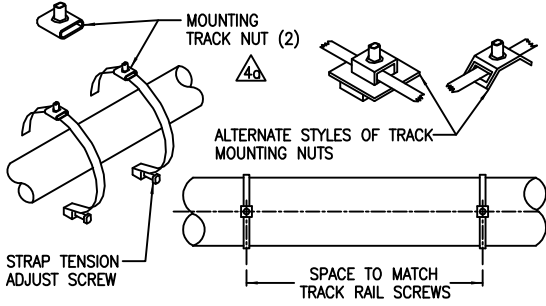9. SEE DRAWING 992-60-7 FOR ASSEMBLY OF CUT-TO-FIT ADJUSTABLE MOUNTING STRAPS.

DO NOT SCALE THIS DRAWING
CONTRACT NO.

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES (MM)
TOLERANCES ON-

INCHES	(MM)
± .1	± 2

DR H.J   DATE 11/03/04
CHK   DATE
ENG   DATE
PROD   DATE
APPD   DATE

CERTIFIED

DATE

SIEMENS
Siemens Energy & Automation, Inc.
Process Instrumentation Business Unit
CoC Ultrasonic Flow - Hauppauge, Long Island, NY 11788

INSTALLATION DRAWING
990 SERIES TRANSDUCER
REFLECT MODE, VERY HIGH TEMP.

SIZE C
CODE IDENT NO. 21614
990TRMVH-7B
REV. F

SCALE: NONE   WT.   SHEET 1 OF 1

CN#5216

WRAP MOUNTING GUIDE AROUND PIPE AND MARK AT OVERLAPPING EDGE. UNWRAP GUIDE, MEASURE DISTANCE "L" FROM EDGE TO MARK, MARK AGAIN AT 1/2 "L". RE-INSTALL THE MOUNTING GUIDE, TAPE IN PLACE WITH BOTH MARKS VISIBLE.

MARK
PIPE
GUIDE
MARK
△4a

— 1/2 "L" —
— "L" —

WRAP STRAP WITH MOUNTING NUT AROUND THE PIPE, ALIGN WITH MOUNTING GUIDE, SECURE WITH STRAP TENSION ADJUST SCREWS AFTER POSITIONING MOUNTING NUTS AT MOUNTING GUIDE MARKS. MOUNT SECOND STRAP ON THE PIPE ALIGNING THE MOUNTING NUTS AND SPACED TO MATCH THE TRACK RAIL MOUNTING SCREWS.

MOUNTING TRACK NUT (2)
△4b
ALTERNATE STYLES OF TRACK MOUNTING NUTS
STRAP TENSION ADJUST SCREW
SPACE TO MATCH TRACK RAIL SCREWS

LONGER MOUNTING TRACKS ASSEMBLIES INCLUDE A THIRD STRAP AND MOVEABLE MOUNTING SCREW. POSITION MOVEABLE SCREW FOR BEST ADVANTAGE AFTER TRANSDUCER INDEX HOLES HAVE BEEN SELECTED.

PREFERRED MOUNTING PLANE OF TRANSDUCERS △2c
CUSTOMER'S PIPE
MOUNTING TRACK
TRANSDUCER
HORIZONTAL ℄

PIPE CONDITIONING: WITH TRACKS IN PLACE, CONDITION PIPE SURFACE USING 992PC PIPE CONDITIONING TOOL AND ABRASIVE PAPER STRIPS SUPPLIED
△5
SLIDE CLAMP ONTO TRACK AFTER CONDITIONING PIPE SURFACE
ABRADE TO 1/8" WIDE FLAT MAX. (TYP.)
992PC CONDITIONING TOOL

WHITE & GREEN WIRES FROM 992CN CABLE

991NMH TRANSDUCERS WITH 992CN CABLE:
—ATTACH WHITE WIRE TO TERMINAL "1"
—ATTACH GREEN WIRE TO TERMINAL "2"
  AFTER WIRING, REPLACE COVER & GASKET
991PMH TRANSDUCERS HAVE BNC CONNECTORS FOR USE WITH 992CP CABLES.
△7

991NMH WIRING HOUSING: 1/2" N.P.T THREAD ACCEPTS CUSTOMER'S FITTING FOR CONDUIT OR CABLE ENTRY GLAND (1/4" CABLE O.D.). AVOID USE OF RIGID CONDUIT TO PREVENT TRANSDUCER MOVEMENT AS A RESULT OF CONDUIT STRESS OR VIBRATION.

FLEXIBLE UMBILICAL CABLE TO WIRING HOUSING (PART OF TRANSDUCER ASS'Y)

MOUNTING GUIDE
991N SERIES TRANSDUCER "UPSTREAM"
TRACK RAIL △4c MOUNTING SCREW
TRACK MOUNTING STRAP △4b
TRACK MOUNTING NUT
BANK TRANSDUCERS AGAINST INDEX PINS △6c
FLOW
ULTRASONIC COUPLANT (SEE ZONE B2)
991N SERIES TRANSDUCER "DOWNSTREAM"
TRACK I.D. LABEL
992MTNDM TRACK ASS'Y TWO PARTS LETTER INDICES & NUMBER INDICES (OR 992MTNHM PARTS "R" & "D")
INSERT INDEX PINS IN APPROPRIATE HOLES △6a
TO FLOW COMPUTER

TRANSDUCER INDEX PIN ORIENTATION
△6c
INDEX PINS
ORIENTATION OF PROPERLY INSTALLED TRANSDUCERS IN DIRECT MODE OPERATION

APPLY THIN BAND OF COUPLANT (SUPPLIED) TO BASE OF EACH TRANSDUCER BEFORE INSTALLING IN MOUNTING TRACK △6b

INSTALLATION PROCEDURE – SEE DRAWING REFERENCES △#

1. USING THE INSTALLATION MENU PROCEDURES PRESENTED IN THE FIELD MANUAL, CONFIRM THAT YOU HAVE THE APPROPRIATE TRANSDUCERS AND TRACK FOR REFLECT MODE OPERATION ON THE CHOSEN PIPE.

2. SELECT MOUNTING LOCATION;
   a) CHOOSE LOCATION WHICH REMAINS FULL AT ZERO FLOW.
   b) WHERE POSSIBLE LOCATE TRACK ASS'Y TEN (10) PIPE DIAMETERS OR MORE FROM BEND TO ENSURE FULLY DEVELOPED AND STABLE FLOW PROFILE.
   c) ON HORIZONTAL PIPE, SELECT HORIZONTAL PLANE, IF POSSIBLE, TO AVOID SEDIMENT BLOCKAGE OF TRANSDUCER SIGNAL.

3. PREPARE PIPE FOR TRACK MOUNT;
   a) REMOVE GRIT, CORROSION, COATING OR HEAVY PAINT
   b) CLEAN AND DEGREASE SURFACE
   c) DO NOT MOUNT OVER FROST.

4. MOUNT TRACK ON PIPE;
   a) WRAP THE MOUNTING GUIDE AROUND THE PIPE. POSITION SO THAT THE OVERLAPPING LENGTHS ARE EDGE-ALIGNED. MARK THE OVERLAPPING PORTION OF THE GUIDE AT THE END OF THE OVERLAPPING PORTION. REMOVE THE GUIDE. MEASURE THE DISTANCE FROM THE END TO THE MARK AND MARK AGAIN HALFWAY BETWEEN. RE-POSITION THE GUIDE ON THE PIPE AND TAPE IN PLACE SO THAT THE MARKS ON THE MOUNTING GUIDE APPEAR AT THE SELECTED TRACK MOUNTING LOCATIONS.
   b) SLIP TWO OF THE TRACK MOUNTING NUTS PROVIDED ONTO EACH OF THE MOUNTING STRAPS. WRAP ONE OF THE STRAPS AROUND PIPE, USING THE MOUNTING GUIDE TO ALIGN THE STRAP PERPENDICULAR TO THE FLOW AXIS. ENGAGE THE STRAP TENSION ADJUST SCREWS AND TIGHTEN SECURELY AFTER POSITIONING THE MOUNTING NUTS SO THAT THEY ARE CENTERED ON THE MOUNTING GUIDE MARKS MADE EARLIER, 180° OPPOSED. WRAP THE SECOND MOUNTING STRAP AROUND THE PIPE, POSITIONING THE MOUNTING NUTS SO THAT THEY ARE ALIGNED ALONG THE FLOW AXIS WITH THE NUTS ON THE FIRST STRAP AND SPACED TO MATE WITH THE SCREWS AT EITHER END OF THE TRACK RAIL ASSEMBLIES TIGHTEN THE STRAP TENSION ADJUST SCREWS.
   c) SECURE THE TRACK RAIL ASSEMBLIES TO THE PIPE USING THE TRACK RAIL MOUNTING SCREWS.

5. CONDITION PIPE SURFACE;
   LOCALLY SMOOTH THE PIPE SURFACE TO ACCEPT THE TRANSDUCERS. USE THE 992PC CONDITIONING TOOL AND ABRASIVE PAPER (ADHESIVE BACKED) PROVIDED. FINISHED SURFACE SHOULD BE APPROXIMATELY 1/8" WIDE FLAT AT CENTER OF MOUNTING TRACK.

6. LOCATE TRANSDUCERS;
   a) CONSULTING THE FIELD MANUAL, USE THE INSTALLATION MENU TO DETERMINE THE APPROPRIATE INDEX HOLES FOR YOUR APPLICATION AND INSERT PINS.
   b) APPLY A THIN BAND OF THE ULTRASONIC COUPLANT PROVIDED TO THE BASE OF EACH TRANSDUCER.
   c) INSERT TRANSDUCERS INTO TRACK AS SHOWN, BANKING AGAINST INDEX PINS. SECURE TRANSDUCERS WITH CLAMPS.

7. MAKE TRANSDUCER CABLE CONNECTIONS IN ACCORDANCE WITH THE APPROPRIATE FLOW COMPUTER INSTALLATION DRAWING AND 990 FIELD MANUAL.

8. SEE DRAWING 99TNDM-8 AND 990TNHM-8 FOR TRACK AND TRANSDUCER OUTLINE DIMENSIONS.

9. SEE DRAWING 992-60-7 FOR ASSEMBLY OF CUT-TO-FIT ADJUSTABLE MOUNTING STRAPS.

DO NOT SCALE THIS DRAWING
UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES (MM) TOLERANCES ON—
CONTRACT NO.
DR H.J   DATE 10/1/97
CHK ___ DATE ___
ENG ___ DATE ___
PROD ___ DATE ___
APPD ___ DATE ___
CERTIFIED
___
DATE

CONTROLOTRON
HAUPPAUGE , NY 11788
INSTALLATION DRAWING
990 SERIES TRANSDUCER
DIRECT MODE, HIGH TEMP.

SIZE C   CODE IDENT NO. 21614   990TDMH-7B   REV. D
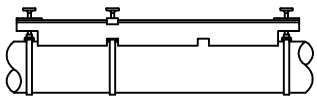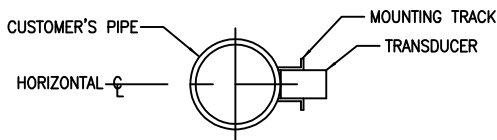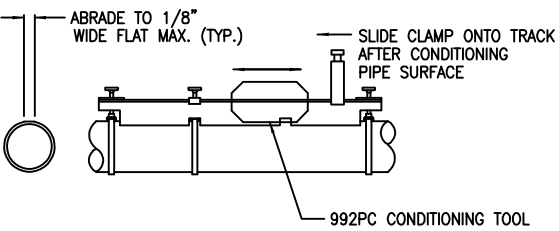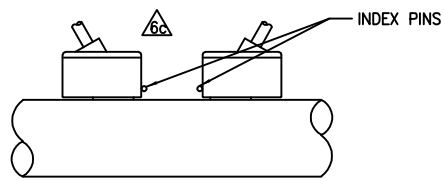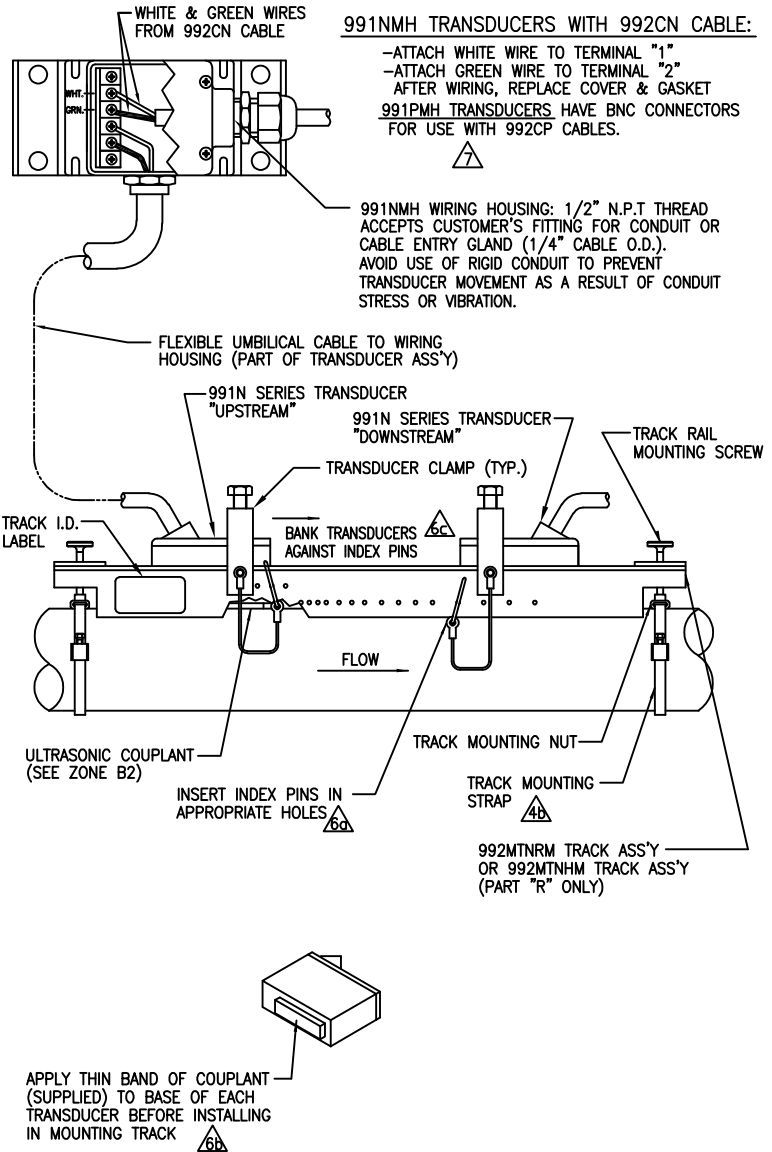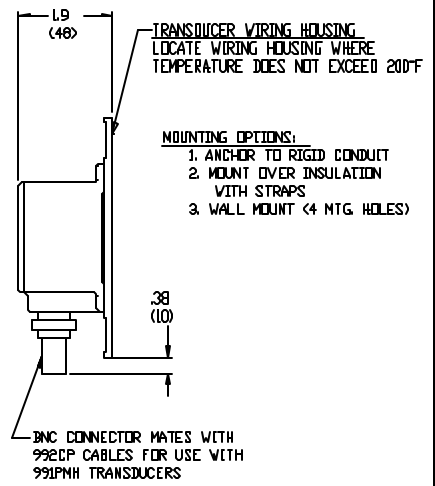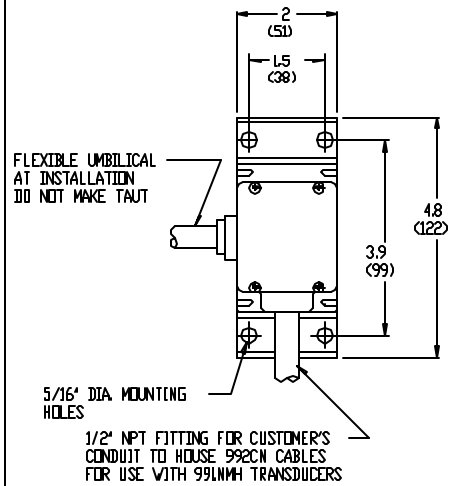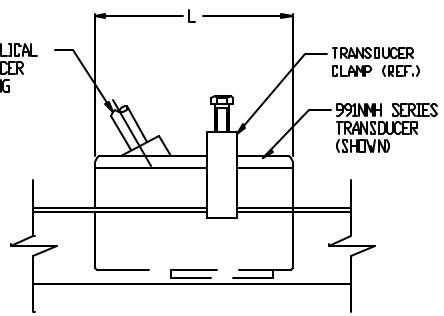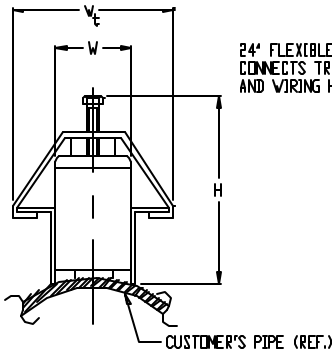SCALE: NONE   WT.   SHEET 1 OF 1
R14: 990TDMH-7B

WRAP STRAP WITH MOUNTING NUT AROUND THE PIPE, ALIGN WITH
MOUNTING GUIDE, SECURE WITH STRAP TENSION ADJUST SCREWS
AFTER POSITIONING MOUNTING NUTS AT MOUNTING GUIDE MARKS.
MOUNT SECOND STRAP ON THE PIPE ALIGNING THE MOUNTING NUTS
AND SPACED TO MATCH THE TRACK RAIL MOUNTING SCREWS.

MOUNTING
TRACK NUT (2)

⚠4d

ALTERNATE STYLES OF TRACK
MOUNTING NUTS

STRAP TENSION
ADJUST SCREW

SPACE TO MATCH
TRACK RAIL SCREWS

LONGER MOUNTING TRACKS ASSEMBLIES INCLUDE A THIRD STRAP AND
MOVEABLE MOUNTING SCREW. POSITION MOVEABLE SCREW FOR BEST
ADVANTAGE AFTER TRANSDUCER INDEX HOLES HAVE BEEN SELECTED.

PREFERRED MOUNTING PLANE OF TRANSDUCERS ⚠2c

CUSTOMER'S PIPE

MOUNTING TRACK

TRANSDUCER

HORIZONTAL ℄

PIPE CONDITIONING: WITH TRACKS IN PLACE, CONDITION PIPE SURFACE
USING 992PC PIPE CONDITIONING TOOL AND ABRASIVE PAPER STRIPS
SUPPLIED

⚠5

ABRADE TO 1/8"
WIDE FLAT MAX. (TYP.)

SLIDE CLAMP ONTO TRACK
AFTER CONDITIONING
PIPE SURFACE

992PC CONDITIONING TOOL

TRANSDUCER INDEX PIN ORIENTATION

⚠6c

INDEX PINS

ORIENTATION OF PROPERLY INSTALLED TRANSDUCERS
IN REFLECT MODE OPERATION

WHITE & GREEN WIRES
FROM 992CN CABLE

WHT.
GRN.

991NMH TRANSDUCERS WITH 992CN CABLE:
–ATTACH WHITE WIRE TO TERMINAL "1"
–ATTACH GREEN WIRE TO TERMINAL "2"
AFTER WIRING, REPLACE COVER & GASKET
991PMH TRANSDUCERS HAVE BNC CONNECTORS
FOR USE WITH 992CP CABLES.

⚠7

991NMH WIRING HOUSING: 1/2" N.P.T THREAD
ACCEPTS CUSTOMER'S FITTING FOR CONDUIT OR
CABLE ENTRY GLAND (1/4" CABLE O.D.).
AVOID USE OF RIGID CONDUIT TO PREVENT
TRANSDUCER MOVEMENT AS A RESULT OF CONDUIT
STRESS OR VIBRATION.

FLEXIBLE UMBILICAL CABLE TO WIRING
HOUSING (PART OF TRANSDUCER ASS'Y)

991N SERIES TRANSDUCER
"UPSTREAM"

991N SERIES TRANSDUCER
"DOWNSTREAM"

TRANSDUCER CLAMP (TYP.)

TRACK RAIL
MOUNTING SCREW

TRACK I.D.
LABEL

BANK TRANSDUCERS
AGAINST INDEX PINS ⚠6c

FLOW

ULTRASONIC COUPLANT
(SEE ZONE B2)

TRACK MOUNTING NUT

INSERT INDEX PINS IN
APPROPRIATE HOLES ⚠6d

TRACK MOUNTING
STRAP ⚠4b

992MTNRM TRACK ASS'Y
OR 992MTNHM TRACK ASS'Y
(PART "R" ONLY)

APPLY THIN BAND OF COUPLANT
(SUPPLIED) TO BASE OF EACH
TRANSDUCER BEFORE INSTALLING
IN MOUNTING TRACK ⚠6b

INSTALLATION PROCEDURE – SEE DRAWING REFERENCES ⚠#

1. USING THE INSTALLATION MENU PROCEDURES PRESENTED
   IN THE FIELD MANUAL, CONFIRM THAT YOU HAVE THE
   APPROPRIATE TRANSDUCERS AND TRACK FOR REFLECT MODE
   OPERATION ON THE CHOSEN PIPE.

2. SELECT MOUNTING LOCATION;
   a) CHOOSE LOCATION WHICH REMAINS FULL AT ZERO FLOW.
   b) WHERE POSSIBLE LOCATE TRACK ASS'Y TEN (10) PIPE
      DIAMETERS OR MORE FROM BEND TO ENSURE FULLY
      DEVELOPED AND STABLE FLOW PROFILE.
   c) ON HORIZONTAL PIPE, SELECT HORIZONTAL PLANE, IF
      POSSIBLE, TO AVOID SEDIMENT BLOCKAGE OF TRANSDUCER
      SIGNAL.

3. PREPARE PIPE FOR TRACK MOUNT;
   a) REMOVE GRIT, CORROSION, COATING OR HEAVY PAINT
   b) CLEAN AND DEGREASE SURFACE
   c) DO NOT MOUNT OVER FROST.

4. MOUNT TRACK ON PIPE:
   a) SLIP ONE OF THE MOUNTING NUTS PROVIDED ONTO EACH
      OF THE MOUNTING STRAPS. WRAP THE STRAPS AROUND THE
      PIPE AT THE SELECTED LOCATION AND ENGAGE THE ADJUSTING
      SCREWS. POSITION THE MOUNTING NUTS IN LINE WITH THE
      FLOW AXIS AND SPACED TO MATE WITH THE SCREWS AT EITHER
      END OF THE TRACK ASSEMBLY. SECURE THE STRAPS (AND NUTS)
      BY TIGHTENING THE MOUNTING STRAP ADJUSTING SCREWS.

   b) SECURE THE TRACK RAIL ASSEMBLIES TO THE PIPE USING
      THE TRACK RAIL MOUNTING SCREWS.

5. CONDITION PIPE SURFACE;
   LOCALLY SMOOTH THE PIPE SURFACE TO ACCEPT THE
   TRANSDUCERS. USE THE 992PC CONDITIONING TOOL
   AND ABRASIVE PAPER (ADHESIVE BACKED) PROVIDED.
   FINISHED SURFACE SHOULD BE APPROXIMATELY 1/8"
   WIDE FLAT AT CENTER OF MOUNTING TRACK.

6. LOCATE TRANSDUCERS;
   a) CONSULTING THE FIELD MANUAL, USE THE
      INSTALLATION MENU TO DETERMINE THE APPROPRIATE
      INDEX HOLES FOR YOUR APPLICATION AND INSERT PINS.
   b) APPLY A THIN BAND OF THE ULTRASONIC COUPLANT
      PROVIDED TO THE BASE OF EACH TRANSDUCER.
   c) INSERT TRANSDUCERS INTO TRACK AS SHOWN, BANKING
      AGAINST INDEX PINS. SECURE TRANSDUCERS WITH CLAMPS.

7. MAKE TRANSDUCER CABLE CONNECTIONS IN ACCORDANCE WITH
   THE APPROPRIATE FLOW COMPUTER INSTALLATION DRAWING
   AND 990 FIELD MANUAL.

8. SEE DRAWING 99TNRM-8 AND 990TNHM-8 FOR TRACK AND
   TRANSDUCER OUTLINE DIMENSIONS.

9. SEE DRAWING 992-60-7 FOR ASSEMBLY OF CUT-TO-FIT
   ADJUSTABLE MOUNTING STRAPS.

TRANSDUCER P/N	L	W	H	Vt	NET VT PAIR
991NMH-1	2.1 (53)	1.0 (25)	3.0 (76)	2.1 (53)	2.4# (1.0Kg)
991PMH-1					
991NMH-2/2A	2.5 (64)	1.0 (25)	3.6 (91)	2.1 (53)	2.9# (1.3Kg)
991PMH-2/2A					
991NMH-3/3A	3.2 (81)	1.2 (30)	4.4 (112)	2.3 (58)	4.1# (1.8Kg)
991PMH-3/3A					
991NMH-4/4A	4.4 (112)	1.3 (33)	5.9 (150)	2.9 (74)	7.0# (3.1Kg)
991PMH-4/4A					

24" FLEXIBLE UMBILICAL CONNECTS TRANSDUCER AND WIRING HOUSING

TRANSDUCER CLAMP (REF.)

991NMH SERIES TRANSDUCER (SHOWN)

CUSTOMER'S PIPE (REF.)

FLEXIBLE UMBILICAL AT INSTALLATION DO NOT MAKE TAUT

5/16" DIA MOUNTING HOLES

1/2" NPT FITTING FOR CUSTOMER'S CONDUIT TO HOUSE 992CN CABLES FOR USE WITH 991NMH TRANSDUCERS

TRANSDUCER WIRING HOUSING LOCATE WIRING HOUSING WHERE TEMPERATURE DOES NOT EXCEED 200°F

MOUNTING OPTIONS:
1. ANCHOR TO RIGID CONDUIT
2. MOUNT OVER INSULATION WITH STRAPS
3. WALL MOUNT (4 MTG. HOLES)

BNC CONNECTOR MATES WITH 992CP CABLES FOR USE WITH 991PMH TRANSDUCERS

REMOVE COATING FROM PIPE FULL CIRCUMFERENCE 1" MIN. BEYOND TRACK, BOTH ENDS

DIRECT MODE INSTALLATION

REMOVE COATING FROM PIPE FULL CIRCUMFERENCE 1" MIN. BEYOND TRACK, BOTH ENDS

REFLECT MODE INSTALLATION

992MTNHM MOUNTING TRACK (PARTS 'D' AND 'R')

TO WIRING HOUSING (TYP.)

MOUNTING STRAP (TYP.)

TRACK MOUNTING SCREW (TYP.)

CUSTOMER'S PIPE (TYP.)

992MTNHM MOUNTING TRACK (PART 'R' ONLY)

TRACK SIZE	Lt	NET VT. ALUM.	NET VT. ST.STL
1	11.0 (279)	1.0# (.45Kg)	2.1# (.95Kg)
2A	9.5 (240)	1.0# (.45Kg)	2.1# (.95Kg)
2B	11.8 (298)	1.2# (.54Kg)	2.5# (1.1Kg)
2	15.6 (396)	1.4# (.63Kg)	3.0# (1.4Kg)
3A	16.6 (422)	1.6# (.72Kg)	3.4# (1.5Kg)
3B	21.3 (541)	2.2# (1.0Kg)	4.8# (2.2Kg)
3	27.8 (706)	2.6# (1.1Kg)	5.7# (2.6Kg)
4A	30.4 (772)	2.8# (1.2Kg)	6.2# (2.8Kg)
4B	37.7 (956)	3.6# (1.6Kg)	8.0# (3.6Kg)
4	46.5 (1180)	4.6# (2.0Kg)	10.3# (4.7Kg)

NOTES:

1. TRACK PART NUMBER:
   FOR ALUMINUM 992MTNHMA - (TRACK SIZE)
   FOR STAINLESS STEEL: 992MTNHMS - (TRACK SIZE)

2. SEE DRAWING 990TDMH-7B, 990TRMH-7B FOR INSTALLATION INSTRUCTIONS.

3. TRANSDUCER NET WEIGHTS INCLUDE WIRING HOUSING.

TRANSDUCER P/N table

TRANSDUCER P/N	L	W	H	Wt	NET WT PAIR
991NMS-1	3.1 (79)	1.4 (35)	3.0 (75)	2.1 (53)	.8# (.36Kg)
991NMS-2	3.1 (79)	1.4 (35)	3.6 (91)	2.1 (53)	1.3# (.59Kg)
991NMS-3	3.8 (97)	1.5 (38)	4.4 (112)	2.3 (58)	2.5# (1.13Kg)
991NMS-4	5.0 (127)	1.5 (38)	5.9 (149)	2.9 (74)	5.4# (2.45Kg)

TRACK SIZE table
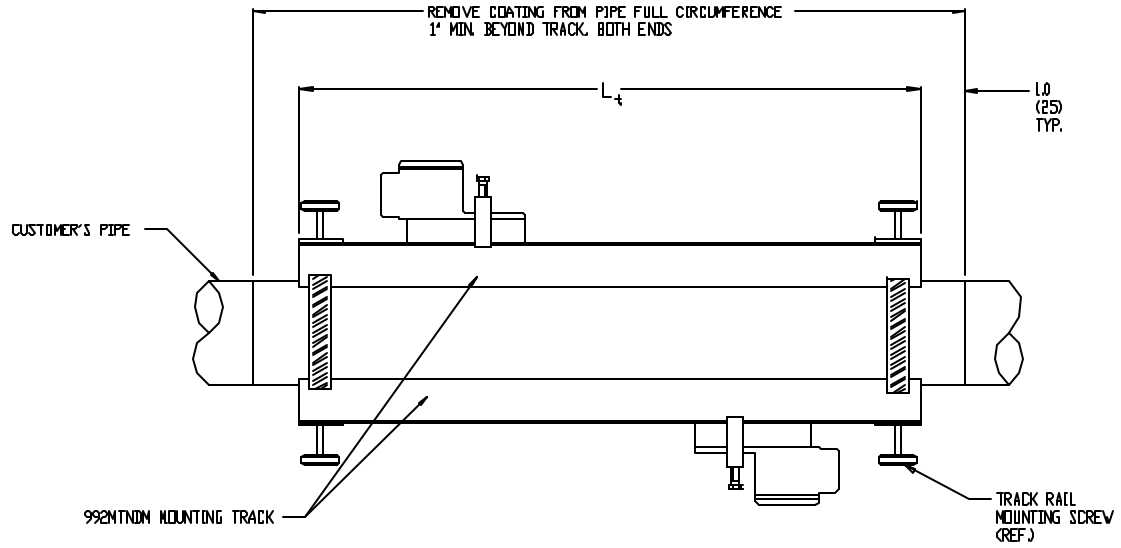
TRACK SIZE	Lt	NET WT. ALUM.	NET WT. ST.STL.
1	9.0 (229)	.9# (.40Kg)	1.75# (.8Kg)
2A	8.2 (208)	.9# (.40Kg)	1.75# (.8Kg)
2B	9.5 (242)	1.0# (.45Kg)	2.0# (.91Kg)
2	11.7 (297)	1.2# (.54Kg)	2.5# (1.14Kg)
3A	12.8 (325)	1.4# (.63Kg)	3.0# (1.36Kg)
3B	15.4 (392)	1.5# (.68Kg)	3.3# (1.5Kg)
3	19.1 (485)	1.7# (.77Kg)	3.8# (1.73Kg)
4A	21.2 (539)	2.0# (.90Kg)	4.5# (2.05Kg)
4B	25.3 (642)	2.3# (1.0Kg)	5.3# (2.4Kg)
4	30.2 (768)	2.6# (1.17Kg)	6.0# (2.72Kg)

Labels:
- 99LNMS SERIES TRANSDUCER
- 1/2" N.P.T. FOR CUSTOMER'S CONDUIT FITTING OR CABLE GLAND
- IDENTIFICATION LABEL (REF.)
- TRANSDUCER CLAMP (REF.)
- MOUNTING TRACK (REF.)
- CUSTOMER'S PIPE (REF.)
- REMOVE COATING FROM PIPE FULL CIRCUMFERENCE 1" MIN. BEYOND TRACK, BOTH ENDS
- 1.0 (25) TYP.
- CUSTOMER'S PIPE
- 992NTNDM MOUNTING TRACK
- TRACK RAIL MOUNTING SCREW (REF.)

NOTES:

1. TRACK PART NUMBER:
   FOR ALUMINUM: 992NTNDMA - (TRACK SIZE)
   FOR STAINLESS STEEL: 992NTNDMS - (TRACK SIZE)

2. SEE DRAWING 990TNDM-7 FOR INSTALLATION INSTRUCTIONS.

Title block

DO NOT SCALE THIS DRAWING
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES (MM) TOLERANCES ON-
INCHES ± 1   (MM) ± 2

CONTRACT NO.
DR HJ DATE 1/2/96
CHK ___ DATE
ENG ___ DATE
PROD ___ DATE
APPD ___ DATE
CERTIFIED ___
DATE ___

CONTROLOTRON
HAUPPAUGE, NY 11788

OUTLINE DIMENSIONS,
TRANSDUCERS & TRACKS
DEDICATED, DIRECT MODE

SIZE C | CODE IDENT NO. 21614 | 990TNDM - 8 | REV. D
SCALE: NONE | WT. | SHEET 1 OF 1

FILE No. 990TNDM8.PRT

991NMS SERIES TRANSDUCER (SHOWN)

1/2" N.P.T. FOR CUSTOMER'S CONDUIT FITTING OR CABLE GLAND

IDENTIFICATION LABEL (REF.)

TRANSDUCER CLAMP (REF.)

MOUNTING TRACK (REF.)

CUSTOMER'S PIPE (REF.)
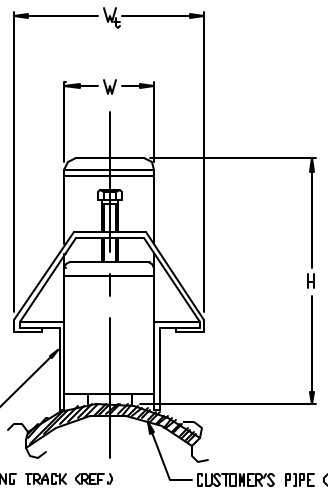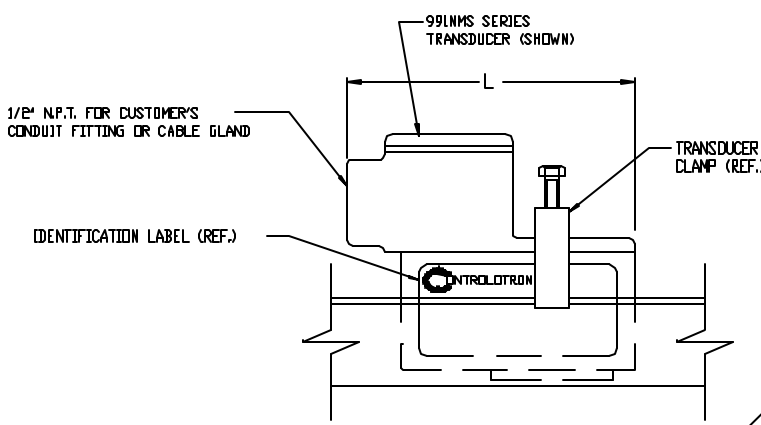
TRANSDUCER P/N	L	W	H	W_t	NET WT PAIR
991NMS-1	3.1 (79)	1.4 (35)	3.0 (75)	2.1 (53)	.8# (.36Kg)
991PMS-1					
991NMS-2/2A	3.1 (79)	1.4 (35)	3.6 (91)	2.1 (53)	1.3# (.59Kg)
991PMS-2/2A					
991NMS-3/3A	3.8 (97)	1.5 (38)	4.4 (112)	2.3 (58)	2.5# (1.13Kg)
991PMS-3/3A					
991NMS-4/4A	5.0 (127)	1.5 (38)	5.9 (149)	2.9 (74)	5.4# (2.45Kg)
991PMS-4/4A					

DIRECT MODE INSTALLATION

REMOVE COATING FROM PIPE FULL CIRCUMFERENCE 1" MIN. BEYOND TRACK, BOTH ENDS

L_t

992MTNHM MOUNTING TRACK (PARTS 'D' AND 'R')

MOUNTING STRAP (TYP.)

TRACK MOUNTING SCREW (TYP.)

REFLECT MODE INSTALLATION

REMOVE COATING FROM PIPE FULL CIRCUMFERENCE 1" MIN. BEYOND TRACK, BOTH ENDS

L_t

CUSTOMER'S PIPE (TYP.)

992MTNHM MOUNTING TRACK (PART 'R' ONLY)
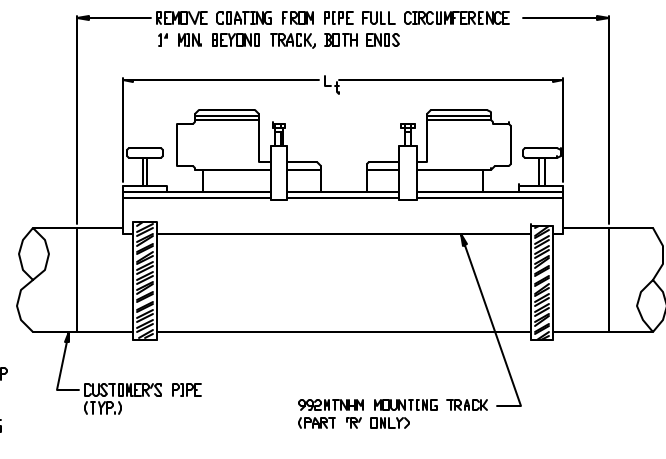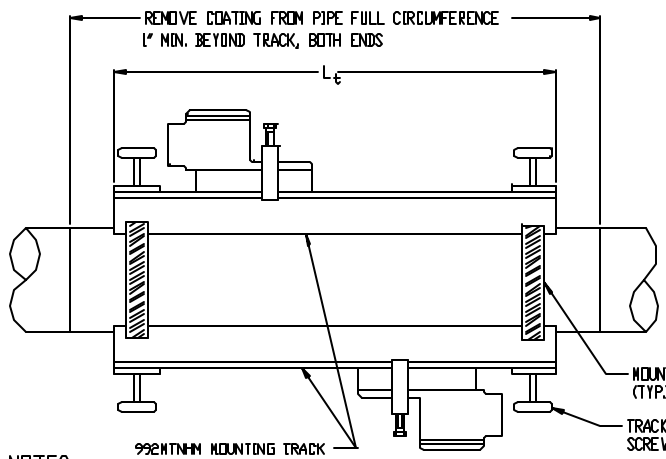
TRACK SIZE	L_t	NET WT. ALUM.	NET WT. ST.STL
1	11.0 (279)	1.0# (.45Kg)	2.1# (.95Kg)
2A	9.5 (240)	1.0# (.45Kg)	2.1# (.95Kg)
2B	11.8 (298)	1.2# (.54Kg)	2.5# (1.1Kg)
2	15.6 (396)	1.4# (.63Kg)	3.0# (1.4Kg)
3A	16.6 (422)	1.6# (.72Kg)	3.4# (1.5Kg)
3B	21.3 (541)	2.2# (1.0Kg)	4.8# (2.2Kg)
3	27.8 (706)	2.6# (1.1Kg)	5.7# (2.6Kg)
4A	30.4 (772)	2.8# (1.2Kg)	6.2# (2.8Kg)
4B	37.7 (956)	3.6# (1.6Kg)	8.0# (3.6Kg)
4	46.5 (1180)	4.6# (2.0Kg)	10.3# (4.7Kg)

NOTES:

1. TRACK PART NUMBER:
   FOR ALUMINUM: 992MTNHMA - (TRACK SIZE)
   FOR STAINLESS STEEL: 992MTNHMS - (TRACK SIZE)

2. SEE DRAWING 990TNDM-7B OR 990TNRM-7B FOR INSTALLATION INSTRUCTIONS.

NOTES:

1. ALL WETTED PARTS ARE TYPE 316 STAINLESS STEEL.

2. TO PREVENT ENTRAPMENT OF GASES, FLOW TUBE MOUNTING ORIENTATION SHOULD BE HORIZONTAL AS SHOWN ABOVE.

3. CONSULT THE 1010 FIELD MANUAL FOR MOUNTING LOCATION SELECTION CRITERIA.

4. FLOW TUBES ARE SUPPLIED WITH INTEGRAL COMPRESSION TYPE TUBING FITTINGS TO MATE WITH CUSTOMER'S TUBE. SELECT INSTALLATION SITE WITH SUFFICIENT CLEARANCE FOR WRENCHING OF FITTING NUT. INLET AND OUTLET TUBES MUST HAVE A MINIMUM STRAIGHT RUN OF 1 1/2" (38 MM) BEFORE ANY BEND OR FITTING IN ORDER TO PROPERLY MATE WITH THE SWAGELOK® CONNECTOR.

5. FOR LINES NOT ABLE TO ADEQUATELY SUPPORT THE WEIGHT OF THE FLOW TUBE, USE THE MOUNTING HOLES INDICATED TO ATTACH TO SUITABLE STRUCTURE.

6. OBSERVE CABLE PAIR ORIENTATION RELATIVE TO FLOW DIRECTION. CONNECT CABLE MARKED "UP" TO UPSTREAM TRANSDUCER, CONNECT CABLE MARKED "DN" TO DOWNSTREAM TRANSDUCER.

7. SEE APPROPRIATE FLOW COMPUTER INSTALLATION DRAWING FOR WIRING TO THE FLOW COMPUTER.

8. FLOW TUBES ARE TAGGED WITH A CALIBRATION FACTOR DETERMINED AT THE INDICATED FLOW DIRECTION. CONSULT THE 1010 FIELD MANUAL FOR USE OF THE CALIBRATION FACTOR.

FLOWTUBE MODEL No.	LINE CONNECTION	"L"	"W"	"H"	"A"	"B"	"C"	MAXIMUM LINE PRESSURE	NET WT.
1011FTP-1S	5/8" DIA.	9.87 (250.1)	1.53 (38.8)	2.56 (65.0)	5.50 (140.0)	2.80 (71.0)	.38 (10.0)	5000 psi (340 bar)	
1011FTP-2S	1" DIA.	11.12 (282.4)	1.93 (49.0)	3.05 (77.5)	6.00 (152.4)	3.00 (76.2)	.38 (10.0)	3000 psi (204 bar)	

DO NOT SCALE THIS DRAWING

CONTRACT NO.

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES TOLERANCES ON-

INCHES ± .1   (MM) ± 2

DR H.J   DATE 3/19/97
CHK   DATE
ENG   DATE
PROD   DATE
APPD   DATE

CERTIFIED
DATE

**CONTROLOTRON**
HAUPPAUGE , NY 11788

INSTALLATION/OUTLINE
1010 SERIES FLOWTUBE

SIZE C   CODE IDENT NO. 21614   1011FTP-8   REV. B

SCALE: NONE   WT.   SHEET 1 OF 1

R14: 1011FTP-8
ECN#3873

FLOWTUBE MODEL No.	LINE CONNECTION	"L"	"W"	"H"	"A"	"B"	"C"	MAXIMUM LINE PRESSURE	NET WT.
1011FTNF-1S	5/8" DIA.	9.87 (250.1)	1.53 (38.8)	2.56 (65.0)	5.50 (140.0)	2.80 (71.0)	.38 (10.0)	5000 psi (340 bar)	2 lbs.
1011FTNF-2S	1" DIA.	11.12 (282.4)	1.93 (49.0)	3.05 (77.5)	6.00 (152.4)	3.00 (76.2)	.38 (10.0)	3000 psi (204 bar)	

NOTES:

1. ALL WETTED PARTS ARE TYPE 316 STAINLESS STEEL.

2. TO PREVENT ENTRAPMENT OF GASES, FLOW TUBE MOUNTING ORIENTATION SHOULD BE HORIZONTAL AS SHOWN ABOVE.

3. CONSULT THE 1010 FIELD MANUAL FOR MOUNTING LOCATION SELECTION CRITERIA.

4. FLOW TUBES ARE SUPPLIED WITH INTEGRAL COMPRESSION TYPE TUBING FITTINGS TO MATE WITH CUSTOMER'S TUBE. SELECT INSTALLATION SITE WITH SUFFICIENT CLEARANCE FOR WRENCHING OF FITTING NUT. INLET AND OUTLET TUBES MUST HAVE A MINIMUM STRAIGHT RUN OF 1 1/2" (38 MM) BEFORE ANY BEND OR FITTING IN ORDER TO PROPERLY MATE WITH THE SWAGELOK® CONNECTOR.

5. FOR LINES NOT ABLE TO ADEQUATELY SUPPORT THE WEIGHT OF THE FLOW TUBE, USE THE MOUNTING HOLES INDICATED TO ATTACH TO SUITABLE STRUCTURE.

6. OBSERVE CABLE PAIR ORIENTATION RELATIVE TO FLOW DIRECTION. CONNECT CABLE MARKED "UP" TO UPSTREAM TRANSDUCER. CONNECT CABLE MARKED "DN" TO DOWNSTREAM TRANSDUCER.

7. SEE APPROPRIATE FLOW COMPUTER INSTALLATION DRAWING FOR WIRING TO THE FLOW COMPUTER.

8. FLOW TUBES ARE TAGGED WITH A CALIBRATION FACTOR DETERMINED AT THE INDICATED FLOW DIRECTION. CONSULT THE 1010 FIELD MANUAL FOR USE OF THE CALIBRATION FACTOR.

CONTRACT NO.

DR HJ   DATE 7/19/99
CHK ____ DATE ____
ENG ____ DATE ____
PROD ____ DATE ____
APPD ____ DATE ____
CERTIFIED
____
DATE

CONTROLOTRON
HAUPPAUGE, NY 11788

INSTALLATION/OUTLINE
1010 SERIES FLOWTUBE

SIZE C | CODE IDENT NO. 21614 | 1011FTNF-8 | REV. A

SCALE: NONE | WT. | SHEET 1 OF 1

R14: 1011FTNF-8 sht.1 rev.A
ER/1447

Labels and callouts:

- 3.0 (76.2) MIN. CABLE CLEARANCE
- CUSTOMER SUPPLIED INLET LINE CONNECTION (SEE NOTE 3)
- CUSTOMER SUPPLIED OUTLET LINE CONNECTION (SEE NOTE 3)
- "FLUORDWARE" FLARED NUT (SUPPLIED WITH UNIT)
- DIRECTION OF POSITIVE FLOW (SEE NOTE 7)
- BNC CONNECTOR
- IF DIS-ASSEMBLY IS DESIRED, REMOVE FOUR (4) SCREWS ON REAR OF PLATE TO REMOVE UNIT FROM BACKPLATE
- UP
- DN
- FLOW COMPUTER (SEE NOTE 6)
- 992C OR 1012C SERIES CABLES (SEE NOTE 5)
- IDENTIFICATION LABEL
- .28 (7.1) DIA. THRU (TYP.) (SEE NOTE 4)
- H1, H, W

FLOWTUBE MODEL No.	MATERIAL	LINE CONNECTION BORE DIA.	LINE CONNECTION TUBING SIZE	L	W	H	H₁	A	B	C	D	MAXIMUM LINE PRESSURE	NET WT.
992DFTP-1T	PFA	.37 (9.4)	1/2" FLUOROLINE x 1/16" WALL (BT-062)-OR- 1/2" CHEMFLOW x 1/16" WALL (AT500-062)	10.14 (257.6)	1.63 (41.4)	3.83 (97.3)	2.33 (59.1)	11.5 (292.1)	8.50 (215.9)	.38 (9.7)	5.06 (128.5)	125 psi	.13# (.06 Kg)
992DFTP-2T	PFA	.62 (15.7)	3/4" FLUOROLINE x 1/16" WALL (12T-062)-OR- 3/4" CHEMFLOW x 1/16" WALL (AT750-062)	11.54 (293.1)	1.88 (47.8)	4.06 (103.1)	2.80 (71.1)	11.5 (292.1)	8.50 (215.9)	.38 (9.7)	5.86 (148.8)	125 psi	

NOTES:

1. TO PREVENT ENTRAPMENT OF GASES, FLOW TUBE MOUNTING ORIENTATION SHOULD BE HORIZONTAL AS SHOWN ABOVE.

2. CONSULT THE FLOW COMPUTER FIELD MANUAL FOR MOUNTING LOCATION SELECTION CRITERIA.

3. FLOW TUBES ARE SUPPLIED WITH INTEGRAL LINE CONNECTIONS AS TABULATED. ADAPTORS TO CUSTOMER'S FLOW LINE (NOT SUPPLIED) SHOULD BE MADE OF FLUOROLINE OR CHEMFLOW TUBING (SEE TABLE FOR SIZE) AND FLARED SO THEY ARE COMPATIBLE WITH THE FLARETEK FITTINGS. FLUOROLINE, CHEMFLOW AND FLARETEK ARE REGISTERED TRADEMARKS OF: FLUOROWARE
    102 JONATHAN BLVD.
    CHASKS, MINN. SS318
    PHONE: (612) 448-8181

4. FOR LINES NOT ABLE TO ADEQUATELY SUPPORT THE WEIGHT OF THE FLOW TUBE, USE THE MOUNTING HOLES INDICATED TO ATTACH TO SUITABLE STRUCTURE.

5. OBSERVE CABLE PAIR ORIENTATION RELATIVE TO FLOW DIRECTION. CONNECT CABLE MARKED "UP" TO UPSTREAM TRANSDUCER, CONNECT CABLE MARKED "DN" TO DOWNSTREAM TRANSDUCER.

6. SEE APPROPRIATE FLOW COMPUTER INSTALLATION DRAWING FOR WIRING TO THE FLOW COMPUTER.

7. FLOW TUBES ARE TAGGED WITH A CALIBRATION FACTOR DETERMINED AT THE INDICATED FLOW DIRECTION. CONSULT THE FLOW COMPUTER FIELD MANUAL FOR USE OF THE CALIBRATION FACTOR.

CAUTION: SCREWED FITTINGS SHOULD BE STARTED CAREFULLY AND HAND TIGHTENED. FURTHER TIGHTENING MAY NOT BE NECESSARY TO MAKE A LEAK-PROOF JOINT. TEFLON TAPE MANUFACTURED FOR PLASTIC PIPE SHOULD BE USED, NOT MORE THAN 3 TO 3 1/2 MIL THICKNESS IS RECOMMENDED. WRAP THE TAPE TIGHTLY, APPROXIMATELY 2-3 TURNS IN A CLOCKWISE DIRECTION AROUND THE PIPE END. INSERT THE MALE END OF THE JOINT INTO THE FEMALE END, ROTATING IT CLOCKWISE UNTIL IT IS HAND TIGHT. IF FURTHER TIGHTENING IS REQUIRED USE A STRAP WRENCH OR A NON-MARRING TOOL TO TIGHTEN THE JOINT AN ADDITIONAL 1/2 TO 1 1/2 TURNS.
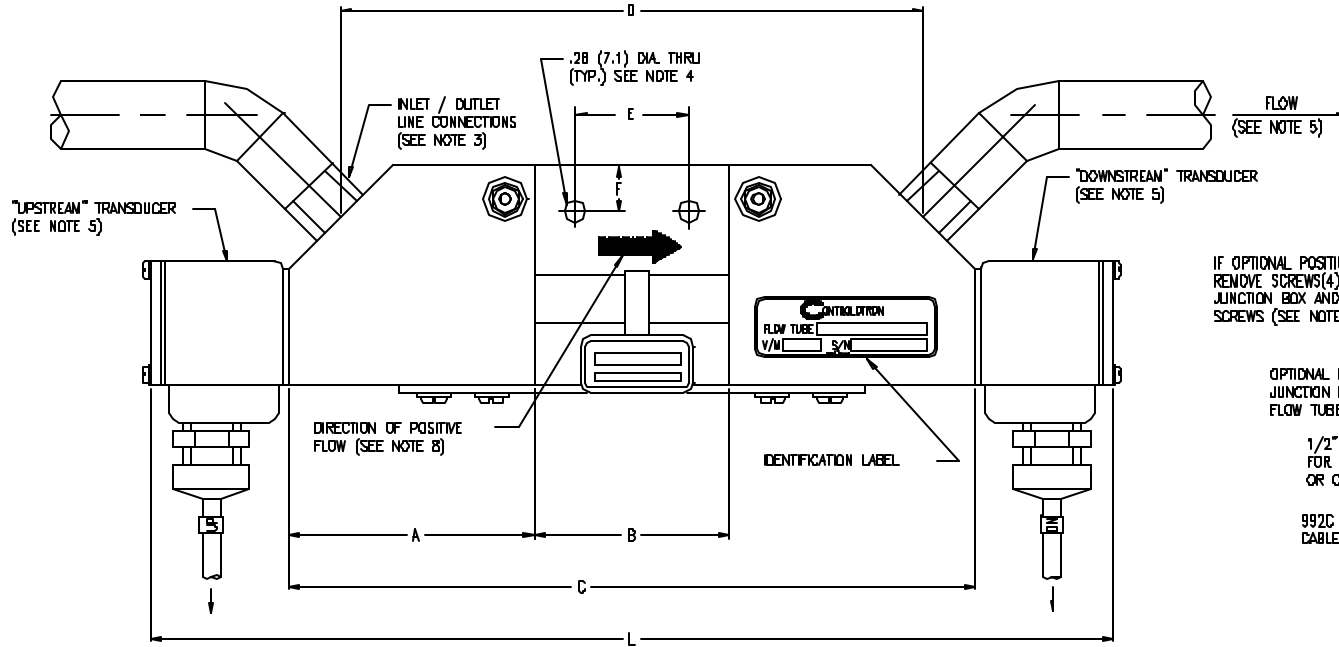
TRANSDUCER WIRING (TYPICAL)
-ATTACH WHITE WIRE TO TERMINAL "1"
-ATTACH GREEN WIRE TO TERMINAL "2"
AFTER WIRING, REPLACE COVER & GASKET.
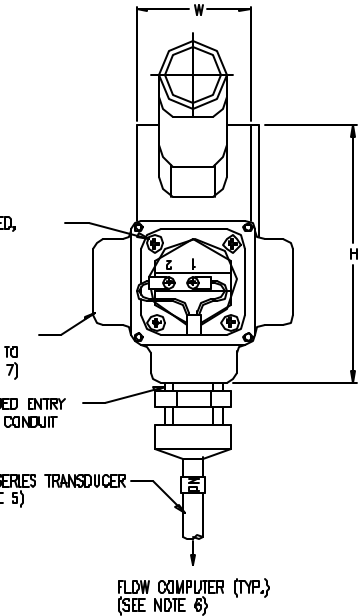
IF OPTIONAL POSITION IS DESIRED, REMOVE SCREWS(4), ROTATE JUNCTION BOX AND REPLACE SCREWS (SEE NOTE 7)

OPTIONAL POSITION OF JUNCTION BOX W/REF. TO FLOW TUBE (SEE NOTE 7)

1/2" NPT THREADED ENTRY FOR CUSTOMER'S CONDUIT OR CABLE GLAND

992C OR 1012C SERIES TRANSDUCER CABLES (SEE NOTE 5)

FLOW COMPUTER (TYP.) (SEE NOTE 6)

.28 (7.1) DIA. THRU (TYP.) SEE NOTE 4

INLET / OUTLET LINE CONNECTIONS (SEE NOTE 3)

FLOW (SEE NOTE 5)

"UPSTREAM" TRANSDUCER (SEE NOTE 5)

"DOWNSTREAM" TRANSDUCER (SEE NOTE 5)

DIRECTION OF POSITIVE FLOW (SEE NOTE 8)

IDENTIFICATION LABEL

FLOWTUBE MODEL No.	MATERIAL	LINE CONNECTION	L	W	H	A	B	C	D	E	F	MAXIMUM LINE PRESSURE	NET WT.
992DFTN-1P	CPVC	3/8" FPT	11.4 (289.0)	1.8 (44.5)	2.8 (71.1)	2.6 (67.0)	2.6 (66.0)	7.9 (200.2)	7.2 (182.2)	1.5 (38.1)	.6 (15.2)	125 psi	1.4# (.64Kg)
992DFTN-1K	PVDF (KYNAR)	3/8" FPT	11.4 (289.0)	1.8 (44.5)	2.8 (71.1)	2.6 (67.0)	2.6 (66.0)	7.9 (200.2)	7.2 (182.2)	1.5 (38.1)	.6 (15.2)	125 psi	1.4# (.64Kg)
992DFTN-2P	CPVC	3/4" FPT	14.6 (371.0)	1.8 (44.5)	3.5 (88.9)	3.7 (93.5)	3.8 (95.3)	11.1 (282.2)	10.2 (258.7)	2.5 (63.5)	1.3 (33.0)	125 psi	2.4# (1.1Kg)
992DFTN-2K	PVDF (KYNAR)	3/4" FPT	14.6 (371.0)	1.8 (44.5)	3.5 (88.9)	3.7 (93.5)	3.8 (95.3)	11.1 (282.2)	10.2 (258.7)	2.5 (63.5)	1.3 (33.0)	125 psi	2.4# (1.1Kg)

NOTES:

1. TO PREVENT ENTRAPMENT OF GASES, FLOW TUBE MOUNTING ORIENTATION SHOULD BE HORIZONTAL AS SHOWN ABOVE.

2. CONSULT THE FLOW COMPUTER FIELD MANUAL FOR MOUNTING LOCATION SELECTION CRITERIA.

3. FLOW TUBES ARE SUPPLIED WITH INTEGRAL LINE CONNECTIONS AS TABULATED. ADAPTORS TO CUSTOMER'S FLOW LINE (IF REQUIRED) ARE NOT SUPPLIED. (SEE CAUTION NOTE, ZONE D4).

4. FOR LINES NOT ABLE TO ADEQUATELY SUPPORT THE WEIGHT OF THE FLOW TUBE, USE THE MOUNTING HOLES INDICATED TO ATTACH TO SUITABLE STRUCTURE.

5. OBSERVE CABLE PAIR ORIENTATION RELATIVE TO FLOW DIRECTION. CONNECT CABLE MARKED "UP" TO UPSTREAM TRANSDUCER, CONNECT CABLE MARKED "DN" TO DOWNSTREAM TRANSDUCER.

6. SEE APPROPRIATE FLOW COMPUTER INSTALLATION DRAWING FOR WIRING TO THE FLOW COMPUTER.

7. FLOW TUBES ARE SUPPLIED WITH 1/2"NPT THREADS IN EACH JUNCTION BOX. ADAPTORS TO CUSTOMER'S CONDUIT ARE NOT SUPPLIED. JUNCTION BOXES MAY BE ROTATED TO (3) POSITIONS TO SATISFY CUSTOMER INSTALLATION REQUIREMENTS. IF ROTATION IS NECESSARY, REMOVE COVER, GASKET & SCREWS (4) ON FAR WALL, ROTATE BOX TO DESIRED POSITION AND RE-INSTALL SCREWS. ATTACH WIRES TO TERMINALS. AFTER WIRING REPLACE COVER & GASKET.

8. FLOW TUBES ARE TAGGED WITH A CALIBRATION FACTOR DETERMINED AT THE INDICATED FLOW DIRECTION. CONSULT THE FLOW COMPUTER FIELD MANUAL FOR USE OF THE CALIBRATION FACTOR.

DO NOT SCALE THIS DRAWING
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES (MM)
TOLERANCES ON—
INCHES (MM)
± .1 ± 2

CONTRACT NO.

DR H.J DATE 1/28/98
CHK DATE
ENG DATE
PROD DATE
APPD DATE

CERTIFIED

DATE

CONTROLOTRON
HAUPPAUGE , NY 11788

INSTALLATION / OUTLINE
992 SERIES EXTENDED FLOWTUBE

SIZE	CODE IDENT NO.		REV.
C	21614	992DFTN - 8	F

SCALE: NONE | WT. | SHEET 1 OF 1

R14: 992DFTN-8 sht.1 rev.F
1/3579,ECN#4089

FLOATING FLANGE RING (2-PLCS.)
BOLT CIRCLE PER ANSI B16.5/150 lb. PATTERN

FLANGE ADAPTOR (SERRATED FACE)
(2-PLCS.)

TRANSDUCER WIRING (TYPICAL)
-ATTACH WHITE WIRE TO TERMINAL "1"
-ATTACH GREEN WIRE TO TERMINAL "2"
AFTER WIRING, REPLACE COVER & GASKET.

.28 (7.1) DIA. THRU
(TYP.) SEE NOTE 3

"DOWNSTREAM" TRANSDUCER
(NOTE 4)

"UPSTREAM" TRANSDUCER
(NOTE 4)

IF OPTIONAL POSITION IS DESIRED,
REMOVE SCREWS(4), ROTATE
JUNCTION BOX AND REPLACE
SCREWS (SEE NOTE 6)

DIRECTION OF POSITIVE
FLOW (NOTE 7)

CONTROLOTRON
FLOW TUBE

IDENTIFICATION LABEL

CALIBRATION LABEL (NOTE 7)

OPTIONAL POSITION OF
JUNCTION BOX W/REF. TO
FLOW TUBE (SEE NOTE 6)

1/2" NPT THREADED ENTRY
FOR CUSTOMER'S CONDUIT
OR CABLE GLAND

992DN SERIES TRANSDUCER
CABLES (SEE NOTE 4)

TO 994FT SERIES
FLOW COMPUTER (TYP.)

FLOWTUBE MODEL No.	MATERIAL	LINE CONNECTION	L1	L2 ±.15	W	H1	H2	A	B	C	D	MAXIMUM LINE PRESSURE	NET WT.
992DFTN-1K-1914	PVDF (KYNAR)	"1/2 INCH" (20 MM)	11.2 (284.8)	14.82 (376.4)	1.5 (38.1)	2.9 (74.5)	2.63 (66.8)	1.50 (38.1)	0.60 (15.2)	1.34 (34.0)	3.50 (89.0)	125 psi	3.8# (1.7Kg)
992DFTN-2K-1914	PVDF (KYNAR)	1 INCH (32 MM)	14.5 (368.1)	19.06 (484.1)	1.5 (38.1)	3.3 (83.9)	3.55 (90.2)	2.50 (63.5)	0.97 (24.6)	1.97 (50.0)	4.25 (108.0)	125 psi	5.0# (2.3Kg)

NOTES:

1. CONSULT THE 990DFT FIELD MANUAL FOR MOUNTING LOCATION SELECTION CRITERIA.
2. FLOW TUBES SUPPLIED WITH FLOATING FLANGE/SERRATED FACE ADAPTORS FOR CUSTOMER'S LINE CONNECTION. ALL INTEGRAL COMPONENT PARTS ARE FUSION WELDED.
3. FOR LINES NOT ABLE TO ADEQUATELY SUPPORT THE WEIGHT OF THE FLOW TUBE, USE THE MOUNTING HOLES INDICATED TO ATTACH TO SUITABLE STRUCTURE.
4. OBSERVE CABLE PAIR ORIENTATION RELATIVE TO FLOW DIRECTION. CONNECT CABLE MARKED "UP" TO UPSTREAM TRANSDUCER, CONNECT CABLE MARKED "DN" TO DOWNSTREAM TRANSDUCER.
5. SEE APPROPRIATE FLOW COMPUTER INSTALLATION DRAWING FOR WIRING TO THE FLOW COMPUTER.
6. FLOW TUBES ARE SUPPLIED WITH 1/2"NPT THREADS IN EACH JUNCTION BOX. ADAPTORS TO CUSTOMER'S CONDUIT ARE NOT SUPPLIED. JUNCTION BOXES MAY BE ROTATED TO (3) POSITIONS TO SATISFY CUSTOMER INSTALLATION REQUIREMENTS. IF ROTATION IS NECESSARY, REMOVE COVER, GASKET & SCREWS (4) ON FAR WALL, ROTATE BOX TO DESIRED POSITION AND RE-INSTALL SCREWS. ATTACH WIRES TO TERMINALS. AFTER WIRING REPLACE COVER & GASKET.

7. FLOW TUBES ARE TAGGED WITH A CALIBRATION FACTOR DETERMINED AT THE INDICATED FLOW DIRECTION. CONSULT THW 990DFT FIELD MANUAL FOR USE OF THE CALIBRATION FACTOR.

CLASS			DO NOT SCALE THIS DRAWING	CONTRACT NO.	CONTROLOTRON HAUPPAUGE , NY 11788
APPROVED			UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES (MM) TOLERANCES ON- INCHES (MM) ± .1 ± 2	DR H.J DATE 5/30/95 CHK DATE ENG DATE PROD DATE APPD DATE	INSTALLATION/OUTLINE 992 SERIES EXTENDED FLOW TUBE
			MATERIAL:	CERTIFIED	SIZE C	CODE IDENT NO. 21614	992DFTN-1914-B	REV. C
NEXT ASS'Y	USED ON		FINISH:	DATE	SCALE NONE	WT.	SHEET 1 OF 1
APPLICATION					

FILE No. 1914DFTN

APPENDIX B

SITE SETUP CONSIDERATIONS FOR 1010/1020N BLIND SYSTEMS

Siemens offers an economical "blind" 1010/1020 NEMA system (without a local keypad and graphic display screen). This supplement describes the hardware and software requirements for programming these models. Site setup for a blind unit requires a PC connected to the RS-232 serial port. These models include a serial interface cable for this purpose. The serial interface cable includes 9-pin and 25-pin connectors to accommodate both types of IBM-compatible serial ports. A PC communication program such as Terminal (Windows 3.x) or HyperTerminal (Windows 95/98/NT/2000/XP) serves as the data entry interface. These programs reproduce the menu screens that would appear on the system's graphic screen. In fact, the example screens in this manual are actual HyperTerminal screen captures. Once the serial interface is established, the site setup procedure for blind and graphic display systems are identical. You could choose to program a graphic display system using a PC and a communications program. However, note that *for models with a local display screen, the serial interface cable is an option.*

NOTE: You can use a DOS-based communications program also. Make sure that your PC is loading the ANSI.SYS driver via your Config.sys file. Set the program's RS-232 parameters to match those of the flowmeter (see HyperTerminal example screen on the following pages).

NOTE: Many newer Laptop PC's are not equipped with serial ports, having USB ports only. These PC's will require a USB RS-232 adaptor that can be purchased commercially. Not all of these adaptors are suitable. *Siemens has found the best performance is achieved with the adaptor from Radio Shack, (Part# 26-183).*

THE RS-232 INTERFACE CABLE

The physical connection between the flow computer and your PC is accomplished using a serial interface cable, part number: 1015CPC-N. The schematic below shows the configuration of the cable. The wire ends for the flow computer termination are tinned for easy insertion into TB1 on the flow computer. Each wire is labeled to identify the correct terminal pin on TB1. In addition, both connectors have their CTS pin shorted to the RTS pin (pins 4 - 5 on 25-pin connector and pins 7 - 8 on 9-pin connector). This eliminates the need for hardware "handshaking."
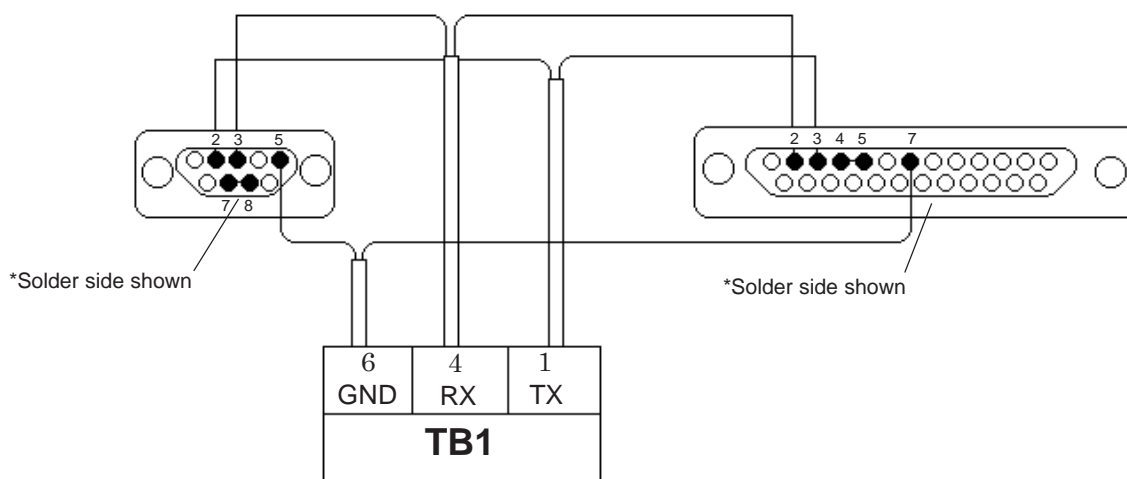
1015CPC-N SERIAL INTERFACE CABLE

Due to the different System 1010/1020 meter configurations, there are 3 types of RS-232 communication cables employed. You can determine which cable is required for the your model flowmeter from the table below. Be sure you have the appropriate cable available for use.

Meter Type	Cable Type	Controlotron Part Number	Notes
Weatherproof Portable	DB-9F – Amphenol	1015CPC-WP	Except Energy
1010P/1020N	DB-9F – DB-9F	1015CPC-P	Use for Energy WP
All NEMA4X	DB-9F – 3 Wire	1015CPC-N	
NEMA 4X with Expanded I/O Module	DB-9F - DB-9F	1015CPC-P	For 1010N with "A1" option (1010N-7 module)
All 1010X	DB-9F – 3 Wire	1015CPC-N	

For those who would prefer to make the cables themselves, the required parts (except for the RS-232 connector for the 1010WP meter types) should be available at most computer or electronics stores. You will find drawings of the terminations for these cables with the reference table below. It provides the signal names, PC termination and 1010/1020 meter termination for each type of flowmeter.

Also, in most computer stores or online, you will be able to find or you may already have a serial "LapLink" cable or "Null Modem" cable. These cables can be used to communicate with the 1010P/DP and 1020N systems.

If you purchased a 1010W model, you may have received the special connector used for the RS-232 terminal in a packet included with your 1010W. This will enable you to construct the appropriate cable for this meter type.

If you prefer to construct your own cable, the following conventions apply in the table:

PC: Refers to an IBM compatible, DB-9 serial Com port.

1010N: Includes all models (N, DN, MN, E, EXCEPT those with "A1" option). Termination is made to the 1010N-2 I/O Data Module. Flowmeter end of cable is unterminated wire.

1010N With "A1" Option: Meters that carry "A1" option have 1010N-7 module installed that houses a DB-9 connector for RS-232 communication.

1010P/1020N: Includes all models (P/DP). Termination is made to the RS-232 port DB-9 connector. A DB-9 Female connector is needed to mate with the meter connector.

1010WP: Includes all models (WP, WDP except energy meters). Termination is made to the RS-232 port on the connector panel. A special cable terminal is required and can be obtained from Controlotron (Part #1015XWP).

1010X: Includes all models (X, DX). Termination is made to the 1010X-8 I/O module Terminal TB2. Flowmeter end of cable is unterminated wire.

Signal Name	PC DB-9 Terminal	1010P/1020N Terminal	1010WP Terminal	1010N Terminal	1010X Terminal
Ground	Pin 5	Pin 5	Pin E	TB1- pin 6	TB2-pin 16
Tx	Pin 2	Pin 3	Pin C	TB1- pin 1	TB2-pin 11
Rx	Pin 3	Pin 2	Pin B	TB1- pin 4	TB2-pin 14

PC DB-9 Connector
1010P/1020N/990P Connector
(Wiring Side View)

1010WP/WDP Connector
(Wiring Side View)
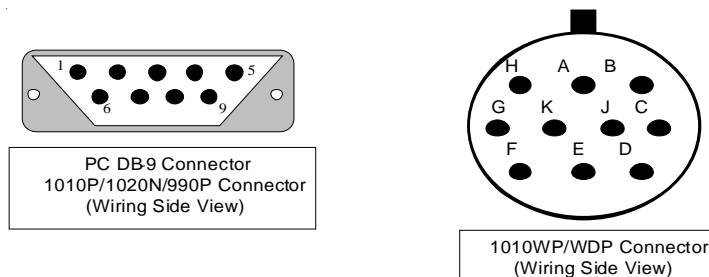
COMMUNICATING WITH SYSTEM 1010/1020 VIA THE RS-232 INTERFACE

The following sections assume that you are familiar with the basics of using a Windows 3.x or Windows 95/98/NT/2000/XP based communications program. All PC computers provide at least one serial port using either a 9-pin or 25-pin D-type connector. The port designation can be either COM 1 or COM 2. Usually, when a computer includes two serial ports, COM 1 will be the 9-pin connector and COM 2 will be the 25-pin connector. However, port designations can vary from manufacturer to manufacturer, so you will have to positively identify the COM port you wish to use for the flowmeter interface. Connect the cable between the flowmeter and your PC using either the 25-pin, 9-pin or USB to RS-232 adapter connector, depending upon the port's architecture.

HOW TO USE THE Windows HyperTerminal PROGRAM

Windows provides a communication program called HyperTerminal, which is ideal for interfacing your computer with the flowmeter. The following underline example explains how to set up HyperTerminal. *NOTE: Depending upon the Windows applications being used this setup procedure may vary.*

1. From the Windows desktop, left-click on the [START] button.

2. Holding down the left mouse button, move the highlight up to [Programs], then across to [Accessories]. Slide the highlight down to [HyperTerminal], then release the left mouse button.

3. Within the HyperTerminal window, move the mouse pointer down to [Hyperterm.exe] and then double-click the left mouse button.

4. This selects the [Connection Description] dialog box. Enter a name for your connection (e.g., 1010N). You can optionally select an icon for this connection by clicking on one of the icons displayed in the scrolling frame at the bottom of the window. Click [OK].

5. This selects the [Phone Number] dialog box. Move the cursor to the arrow at the right of the [Connect Using] field. Left click on the arrow to expand the field and then move the highlight down to [Direct to Com 1 (or 2)] depending on the port connected to the interface cable. Click [OK] to select the [Com 1 (or 2) Properties] Dialog box. Set up your RS-232 parameters as shown in the example below. Left-click on the [OK] button.
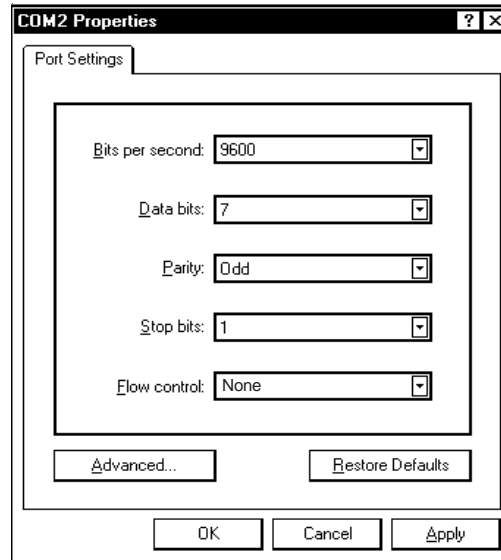
6. You will now see a blank terminal screen. Next left-click [File] on the top menu bar. Drag the highlight down to [Properties] and then left-click.

7. Left-click the [Settings] tab. Expand the [Emulation] box by left-clicking the <Down Arrow> on the right-hand side. Drag the highlight down to [VT-100] and then left-click to select it (as shown below).
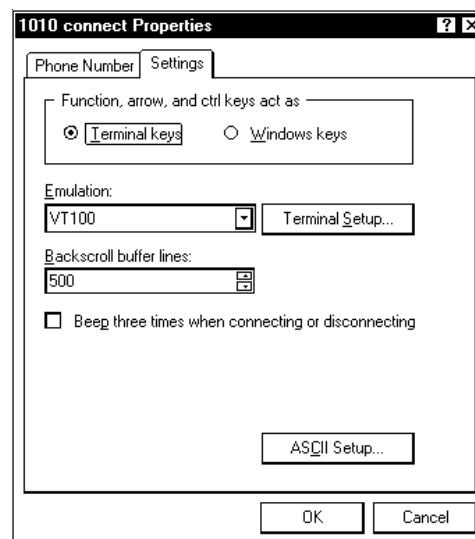
8. Next, left-click on the [ASCII Setup] button (see screen above). In the [ASCII Sending] dialog box, make sure that both [send line ends with line feeds] and [Echo Typed characters locally] are <u>UNCHECKED</u>. In the [ASCII Receiving] dialog box, left-click to place a check mark before the [Append line feeds to incoming line ends] dialog. When your screen looks like the example below, left-click the [OK] button.
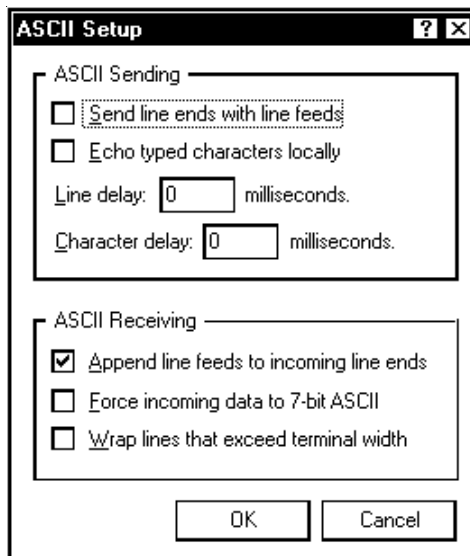
9. You are now ready to communicate with the 1010 flowmeter. But first, save your settings by moving the mouse cursor to [File], sliding the cursor to [Save], then clicking [OK] on the Save dialog box.

10. The next time you want to use HyperTerminal:

Click on *Start.*

Drag to *Programs.*

Drag to *Accessories.* Drag to *HyperTerminal,* and click.

Double-click the icon you selected for the connection.

NOTE: For easier access, create a shortcut to the connect icon from your desktop. Right-click on the icon to open its dialog box. Left-click on [Copy] or [Create a Short Cut] and then move the mouse cursor to a blank area on your desktop. Right-click to open dialog box and then left-click on [Paste] to place a shortcut to the connect icon on your desktop.

Accessing the Installation Menu

Once the parameters are set, HyperTerminal automatically initiates *Command* mode. You will see a blank screen.

Press <ENT> a few times until you see [? For Help] on the screen.

Type: ? (question mark) and then press <ENT> to see a list of the available commands.

Use the MENU command (type [Menu] and then press <ENT>) to access the top level of the Installation Menu. You will see a screen similar to the example below.

```
 Siemens                  Site          [1]
 Select Meter Type

   Meter Type          Single Channel
   Meter Facilities
```
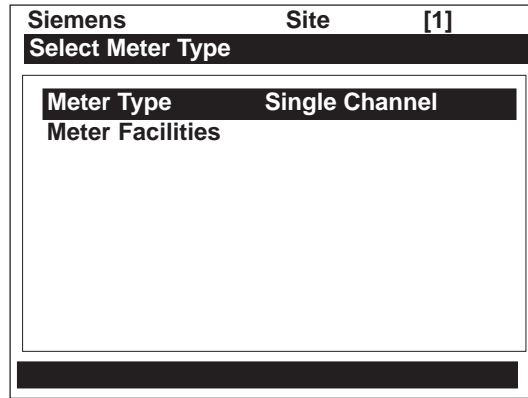
NOTE: To facilitate connecting through modems, the [Menu] command times out after three minutes of inactivity. To maintain a longer connection type: Menu 1000 and press <ENT>. The optional number is the amount in minutes that the connection will be maintained. Typing [Menu 1000] essentially keeps the interface alive until you cancel it.

Data Display Mode

After you complete the installation, you can toggle between Installation Menu mode to Data Display mode. This is the same as using the <MENU> key on the 1010 keypad (see manual). The PC keyboard equivalent to the <MENU> key is <CNTRL> + <L>. Note that the 1010 RS-232 interface does not support graphics. Therefore, when you use HyperTerminal to view the data display screens, you will see the same data in alphanumeric form only (as shown below). You can still use the <Up Arrow> and <Down Arrow> to switch between available display screens.

```
 1010 connect - HyperTerminal
 File  Edit  View  Call  Transfer  Help

 Controlotron        Site    [1]     ABC
             FLOW GAL/MIN
             -7.8




             TOTAL   KGAL     Vs
             -1.32            1481_



 Connected 10:46:36    VT100    9600 7-0-1    SCROLL
```

This is the current flow reading and flow units. (This would be a large graphic character on the 1010 screen

This is the name of the current active site setup. The [1] indicates that the measurement channel is currently active.

This is the flow Total display

This is the current measured liquid sonic velocity (Vs).

Navigating Through the Installation Menu

After accessing the Installation Menu, you can begin to setup your flowmeter according to the instructions in this manual. The chart below shows the PC keyboard equivalents to the 1010 keypad keys while you are in the menu.

1010 Keyboard	PC Keyboard	Description
<Up Arrow>	<Up Arrow>	Move up 1 menu cell (or Flow Display screen)
<Down Arrow>	<Down Arrow>	Move down 1 menu cell (or Flow Display screen)
<Right Arrow>	<Right Arrow>	Move right 1 menu cell (or Flow Display screen)
<Left Arrow>	<Left Arrow>	Move left 1 menu cell (or Flow Display screen)
<Menu>	^L (Cntrl L)	Toggle between Menu and Flow Display
<Datalog>	^D (Cntrl D)	Generate Datalogger report
<CLR>	<Backspace> or <DEL>	Deselect list selection
<ALT+Up Arrow>	^U (Cntrl U)	Logger Display Page Advance
<+/-> (chg sign)	| (bar, shift + backslash)	Change numeric sign. Can also type (-) key.
<ENT>	<Carriage Return>	Enter Key
Digits	Digits	Numerals zero through 9
/	/	Divide by
X	* (upper case 8)	Multiply by
+	+	Plus
-	-	Minus
=	=	Equals
.	.	Decimal Point

Terminal Mode Menu Commands

In addition to Menu, the following commands (followed by the <ENT> key) can be used to control the flowmeter while in Terminal Mode.

Note that "n" refers to the flowmeter Channel number. For a dual channel Arithmetic site (Ch1 + Ch2 or Ch1 – Ch2) the virtual Channel is number 3.

Logger – Invokes the download of all data stored in the datalogger. Note that the datalogger data is not erased from the flowmeter memory when it is downloaded. It is recommended to capture this information into a file with a "csv" extension, which can be easily imported into MS EXCEL.

SITE – Invokes a full site download for a single channel or multi-path 1010 flowmeter.

SITE "n" – Invokes a site download for channel "n", where "n" = the Channel # (1, 2, 3, 4, etc.).

DP "n" – Commands the flowmeter to download the digitized receive signal data for Channel or Path "n".

CLRTOT – Clears the Totalizer for a single channel or multi-path 1010 flowmeter.

CLRTOT "n" – Clears the Totalizer for Channel "n" of a multi-channel flowmeter.

Lf on – Turns on the Line Feed at the end of any text string sent by the flowmeter.

Lf off – Turns off the Line Feed at the end of any text string sent by the flowmeter.

? – Provides a list of available Terminal Mode meter commands.

Transfer of Information from a 1010/1020 Flowmeter to the PC

With HyperTerminal active:

1. Point to *Transfers,* and click.

2. Select *Capture Text.*

3. Select desired drive path or directory, enter a file name, and click the *Start* button.

4. Use the following conventions for data file names:

> For site data or Waveshape data: *filename.txt*
> For Datalogger data: *filename.csv*

5. On PC type the proper command for the data desired (*Logger, Site, or DP)* and then [Enter].

6. The data should begin streaming on the HyperTerminal screen.

7. Wait for EOT (End OF Transmission) to be displayed.

8. Close the file by pointing to *Transfer,* drag to *Capture Text* and click *Stop* button.

Close the Terminal or HyperTerminal Program.

You may now close the Terminal program. The file(s) you have downloaded are now saved in the location you selected. You may now import the file you have saved into the appropriate program (i.e., MS word for site data, or MS Excel for Datalogger or Waveshape data for graphing or analysis).

The datalogger contains data that has its fields separated by commas. By using the file extension ".csv" (comma separated values) suggested earlier, the data will import directly into MS Excel without any further modification. For the waveshape data, the fields are separated by spaces, therefore, it is best to save those files as .txt, then use the MS Excel Import Wizard to select "Space Delimiters" for importation of the data.

Site data is downloaded in plain text and can be imported directly into MS Word.

RESET PROCEDURE FOR BLIND SYSTEMS

1010N Blind systems allow you to perform a system reset via the RS-232 interface. The following instructions require the flowmeter to be connected serially to a PC.

NOTE: Custom RS-232 settings for baud rate, parity and data bits may not be preserved. Therefore, be prepared to set your communications program back to the default (9600, Odd, 7) settings.

To Clear Active Memory Using the RS-232 Interface

1. Turn off power (if it is currently on). Turn power on. As soon as you apply power, immediately type the @ character three times. The prompt: **[Clr Active Memory?   No]** appears at the top of the screen.

2. Press the <Right Arrow> and then the <Down Arrow> to switch the option list to: **[Clr Active Memory? Yes]** Press <ENT> to clear all Active Site Data (but not saved site setups).

3. To restore operation, press <MENU> to access the Installation Menu. Create a new site setup or recall a stored site setup. Re-select any Meter Facilities items (e.g., RS-232 setup parameters).

To Clear All Dynamic Memory Using the RS-232 Interface:

CAUTION: Before proceeding further , it is essential to understand that this function eliminates all data stored in RAM. This means that all saved site setups, including the site data of a flow-calibrated site will be erased! Also, the entire Datalogger file plus any custom factory or user-created pipe or transducer tables will be eliminated. The impact of this is such that we strongly recommend that you consult our technical service department before continuing with this procedure. If you choose to continue, be aware that you will have to create a new site setup, re-enter all site specific parameters including pipe or transducer tables, plus all desired Meter Facilities entries.

1. Turn off power (if it is currently on).

2. Turn the power on. As soon as you apply power, type the @ character three times.

The prompt: **[Clr Active Memory?]** appears at the top of the screen. Press the <Down Arrow>.

Note that the prompt switches to **[Clr Saved Data? No]** .

3. Press the <Right Arrow> and then the <Down Arrow> to switch the option list to: **[Clr Saved Data? Yes]**

4. Press <ENT> to clear all Saved Site Data, Datalogger Data, user created Pipe Data and Transducer Data.

5. To restore operation, press <MENU> to access the Installation Menu. Create a new site setup or recall a stored site setup. Reselect any Meter Facilities items (e.g., RS-232 setup parameters).

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D

TRADEMARKS

TradeMarks of Siemens Energy & Automation Inc.

AutoZero
MultiPulse
Reflexor
ReversaMatic
SmartSlew
UniMass
Widebeam
ZeroMatic

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SIEMENS

DUCTILE IRON PIPE

Nominal Diameter	Actual O.D.	CLASS 50		CLASS 51		CLASS 52		CLASS 53		CLASS 54		CLASS 55		CLASS 56		Liner (Cement)	
		Wall	I.D.	Wall	I.D.	Wall	I.D.	Wall	I.D.	Wall	I.D.	Wall	I.D.	Wall	I.D.	Single	Double
3	3.96	N/A	N/A	0.25	3.46	0.28	3.40	0.31	3.34	0.34	3.28	0.37	3.22	0.40	3.16	0.125	0.250
4	4.80	N/A	N/A	0.26	4.28	0.29	4.22	0.32	4.16	0.35	4.10	0.38	4.04	0.41	3.98	0.125	0.250
6	6.90	0.25	6.40	0.28	6.34	0.31	6.28	0.34	6.22	0.37	6.16	0.40	6.10	0.43	6.04	0.125	0.250
8	9.05	0.27	8.51	0.30	8.45	0.33	8.39	0.36	8.33	0.39	8.27	0.42	8.21	0.45	8.15	0.125	0.250
10	11.10	0.29	10.52	0.32	10.46	0.35	10.40	0.38	10.34	0.41	10.28	0.44	10.22	0.47	10.16	0.125	0.250
12	13.20	0.31	12.58	0.34	12.52	0.37	12.46	0.40	12.40	0.43	12.34	0.46	12.28	0.49	12.22	0.125	0.250
14	15.30	0.33	14.64	0.36	14.58	0.39	14.52	0.42	14.46	0.45	14.40	0.48	14.34	0.51	14.28	0.1875	0.375
16	17.40	0.34	16.72	0.37	16.66	0.40	16.60	0.43	16.54	0.46	16.48	0.49	16.42	0.52	16.36	0.1875	0.375
18	19.50	0.35	18.80	0.38	18.74	0.41	18.68	0.44	18.62	0.47	18.56	0.50	18.50	0.53	18.44	0.1875	0.375
20	21.60	0.36	20.88	0.39	20.82	0.42	20.76	0.45	20.70	0.48	20.64	0.51	20.58	0.54	20.52	0.1875	0.375
24	25.80	0.38	25.04	0.41	24.98	0.44	24.92	0.47	24.86	0.50	24.80	0.53	24.74	0.56	24.68	0.1875	0.375
30	32.00	0.39	31.22	0.43	31.14	0.47	31.06	0.51	30.99	0.55	30.90	0.59	30.82	0.63	30.74	0.250	0.500
36	38.30	0.43	37.44	0.48	37.34	0.53	37.24	0.58	37.14	0.63	37.04	0.68	36.94	0.73	36.84	0.250	0.500
42	44.50	0.47	43.56	0.53	43.44	0.59	43.32	0.65	43.20	0.71	43.08	0.77	42.96	0.83	42.84	0.250	0.500
48	50.80	0.51	49.78	0.58	49.64	0.65	49.50	0.72	49.36	0.79	49.22	0.86	49.08	0.93	48.94	0.250	0.500
54	57.56	0.57	56.42	0.65	56.26	0.73	56.10	0.81	55.94	0.89	55.78	0.97	55.62	1.05	55.46	0.250	0.500

CAST IRON PIPE - AWWA STANDARD

Pipe Size	CLASS A			CLASS B			CLASS C			CLASS D			CLASS E			CLASS F			CLASS G			CLASS H		
	O.D	Wall	I.D.	O.D	Wall	I.D.	O.D	Wall	I.D.	O.D	Wall	I.D.	O.D	Wall	I.D.	O.D	Wall	I.D.	O.D	Wall	I.D.	O.D	Wall	I.D.
3	3.80	0.39	3.02	3.96	0.42	3.12	3.96	0.45	3.06	3.96	0.48	3.00												
4	4.80	0.42	3.96	5.00	0.45	4.10	5.00	0.48	4.04	5.00	0.52	3.96												
6	6.90	0.44	6.02	7.10	0.48	6.14	7.10	0.51	6.08	7.10	0.55	6.00	7.22	0.58	6.06	7.22	0.61	6.00	7.38	0.65	6.08	7.38	0.69	6.00
8	9.05	0.46	8.13	9.05	0.51	8.03	9.30	0.56	8.18	9.30	0.60	8.10	9.42	0.66	8.10	9.42	0.71	8.00	9.60	0.75	8.10	9.60	0.80	8.00
10	11.10	0.50	10.10	11.10	0.57	9.96	11.40	0.62	10.16	11.40	0.68	10.04	11.60	0.74	10.12	11.60	0.80	10.00	11.84	0.86	10.12	11.84	0.92	10.00
12	13.20	0.54	12.12	13.20	0.62	11.96	13.50	0.68	12.14	13.50	0.75	12.00	13.78	0.82	12.14	13.78	0.89	12.00	14.08	0.97	12.14	14.08	1.04	12.00
14	15.30	0.57	14.16	15.30	0.66	13.96	15.65	0.74	14.17	15.65	0.82	14.01	15.98	0.90	14.18	15.98	0.99	14.00	16.32	1.07	14.18	16.32	1.16	14.00
16	17.40	0.60	16.20	17.40	0.70	16.00	17.80	0.80	16.20	17.80	0.89	16.02	18.16	0.98	16.20	18.16	1.08	16.00	18.54	1.18	16.18	18.54	1.27	16.00
18	19.50	0.64	18.22	19.50	0.75	18.00	19.92	0.87	18.18	19.92	0.96	18.00	20.34	1.07	18.20	20.34	1.17	18.00	20.78	1.28	18.22	20.78	1.39	18.00
20	21.60	0.67	20.26	21.60	0.80	20.00	22.06	0.92	20.22	22.06	1.03	20.00	22.54	1.15	20.24	22.54	1.27	20.00	23.02	1.39	20.24	23.02	1.51	20.00
24	25.80	0.76	24.28	25.80	0.89	24.02	26.32	1.04	24.22	26.32	1.16	24.00	26.90	1.31	24.28	26.90	1.45	24.00	27.76	1.75	24.26	27.76	1.88	24.00
30	31.74	0.88	29.98	32.00	1.03	29.94	32.40	1.20	30.00	32.74	1.37	30.00	33.10	1.55	30.00	33.46	1.73	30.00						
36	37.96	0.99	35.98	38.30	1.15	36.00	38.70	1.36	39.98	39.16	1.58	36.00	39.60	1.80	36.00	40.04	2.02	36.00						
42	44.20	1.10	42.00	44.50	1.28	41.94	45.10	1.54	42.02	45.58	1.78	42.02												
48	50.50	1.26	47.98	50.80	1.42	47.96	51.40	1.71	47.98	51.98	1.96	48.06												
54	56.66	1.35	53.96	57.10	1.55	54.00	57.80	1.90	54.00	58.40	2.23	53.94												
60	62.80	1.39	60.02	64.40	1.67	60.06	64.20	2.00	60.20	64.82	2.38	60.06												
72	75.34	1.62	72.10	76.00	1.95	72.10	76.88	2.39	72.10															
84	87.54	1.72	84.10	88.54	2.22	84.10																		

STAINLESS STEEL, HASTELLOY "C" & TITANIUM△ PIPE

Sched.	Size	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	3 1/2	4	5	6	8	10	12	14	16	18	20	22	24
5S◇	O.D.	0.840	1.050	1.315	1.660	1.900	2.375	2.875	3.500	4.000	4.500	5.563	6.625	8.625	10.750	12.750	14.000	16.000	18.000	20.000	22.000	24.000
	I.D.	0.710	0.920	1.185	1.530	1.770	2.245	2.709	3.334	3.834	4.334	5.345	6.407	8.407	10.482	12.438	13.688	15.670	17.670	19.634	21.624	23.563
	Wall	0.065	0.065	0.065	0.065	0.065	0.065	0.083	0.083	0.083	0.083	0.109	0.109	0.109	0.134	0.156	0.156	0.165	0.165	0.188	0.188	0.218
10S◇	I.D.	0.674	0.884	1.097	1.442	1.682	2.157	2.635	3.260	3.760	4.260	5.295	6.357	8.329	10.420	12.390	13.624	15.624	17.624	19.564	21.564	23.500
	Wall	0.083	0.083	0.109	0.109	0.109	0.109	0.120	0.120	0.120	0.120	0.134	0.134	0.148	0.165	0.180	0.188	0.188	0.188	0.218	0.218	0.250
40S	I.D.	0.622	0.824	1.049	1.380	1.610	2.067	2.469	3.068	3.548	4.026	5.047	6.065	7.981	10.020	12.000						
	Wall	0.109⊗	0.113⊗	0.133⊗	0.140⊗	0.145⊗	0.154⊗	0.203⊗	0.216⊗	0.226⊗	0.237⊗	0.258⊗	0.280⊗	0.322⊗	0.365⊗	* .375						
80S	I.D.	0.546	0.742	0.957	1.278	1.500	1.939	2.323	2.900	3.364	3.826	4.813	5.761	7.625	9.750	11.750						
	Wall	^.147	^.154	^.179	^.191	^.200	^.218	^.276	^.300	^.318	^.337	^.375	^.432	^.500	^.500	* .500						

CARBON STEEL and PVC△ PIPE

Pipe	Size	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	3 1/2	4	5	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	42
	O.D.	0.840	1.050	1.315	1.660	1.900	2.375	2.875	3.500	4.000	4.500	5.563	6.625	8.625	10.750	12.750	14.000	16.000	18.000	20.000	22.000	24.000	26.000	28.000	30.000	32.000	34.000	36.000	42.000
Standard	I.D.	0.622	0.824	1.049	1.380	1.610	2.067	2.469	3.068	3.548	4.026	5.047	6.065	7.981	10.020	12.000	13.250	15.250	17.250	19.250	21.250	23.250	25.250	27.250	29.250	31.250	33.250	35.250	41.250
	Wall	0.109	0.113	0.133	0.140	0.145	0.154	0.203	0.216	0.226	0.237	0.258	0.280	0.322	0.365	0.375	0.375	0.375	0.375	0.375	0.375	0.375	0.375	0.375	0.375	0.375	0.375	0.375	* .375
Extra Strong (XS)	I.D.	0.546	0.742	0.957	1.278	1.500	1.939	2.323	2.900	3.364	3.826	4.813	5.761	7.625	9.750	11.750	13.000	15.000	17.000	19.000	21.000	23.000	25.000	27.000	29.000	31.000	33.000	35.000	41.000
	Wall	0.147	0.154	0.179	0.191	0.200	0.218	0.276	0.300	0.318	0.337	0.375	0.432	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	* .500
Double Extra Strong (XXS)	I.D	0.252	0.434	0.599	0.896	1.100	1.503	1.771	2.300	2.728	3.152	4.063	4.897	6.875	8.750	10.750													
	Wall	0.294	0.308	0.358	0.382	0.400	0.436	0.552	0.600	0.636	0.674	0.750	0.864	0.875	1.000	1.000													
Sched. 10	I.D.																13.500	15.500	17.500	19.500	21.500	23.500	25.376	27.376	29.376	31.376	33.376	35.376	
	Wall																0.250	0.250	0.250	0.250	0.250	0.250	0.312	0.312	0.312	0.312	0.312	0.312	
Sched. 20	I.D.													8.125	10.250	12.250	13.376	15.376	17.376	19.250	21.250	23.250	25.000	27.000	29.000	31.000	33.000	35.000	41.000
	Wall													0.250	0.250	0.250	0.312	0.312	0.312	0.375⊗	0.375⊗	0.375⊗	^.500	^.500	^.500	^.500	^.500	^.500	^.500
Sched. 30	I.D.													8.071	10.136	12.090	13.250	15.250	17.124	19.000	21.000	22.876		26.750	28.750	30.750	32.750	34.750	40.750
	Wall													0.277	0.307	0.330	0.375⊗	0.375⊗	0.438	^.500	^.500	0.562		0.625	0.625	0.625	0.625	0.625	* .625
Sched. 40	I.D.	0.622	0.824	1.049	1.380	1.610	2.067	2.469	3.068	3.548	4.026	5.047	6.065	7.981	10.020	11.938	13.124	15.000	16.876	18.184			22.626						
	Wall	0.109⊗	0.113⊗	0.133⊗	0.140⊗	0.145⊗	0.154⊗	0.203⊗	0.216⊗	0.226⊗	0.237⊗	0.258⊗	0.280⊗	0.322⊗	0.365⊗	0.406	0.438	^.500	0.562	0.593			0.687						
Sched. 60	I.D.													7.813	9.750	11.626	12.814	14.688	16.500	18.376	20.250	22.064							
	Wall													0.406	^.500	0.562	0.593	0.656	0.750	0.812	0.875	0.968							
Sched. 80	I.D.	0.546	0.742	0.957	1.278	1.500	1.939	2.323	2.900	3.364	3.826	4.813	5.761	7.625	9.564	11.376	12.500	14.314	16.126	17.938	19.750	21.564							
	Wall	^.147	^.154	^.179	^.191	^.200	^.218	^.276	^.300	^.318	^.337	^.375	^.432	^.500	0.593	0.687	0.750	0.843	0.937	1.031	1.125	1.218							
Sched. 100	I.D.													7.439	9.314	11.064	12.126	13.938	15.688	17.438	19.250	20.938							
	Wall													0.593	0.718	0.843	0.937	1.031	1.156	1.281	1.375	1.531							
Sched. 120	I.D.										3.624	4.563	5.501	7.189	9.064	10.750	11.814	13.564	15.250	17.000	18.750	20.376							
	Wall										0.438	0.500	0.562	0.718	0.843	1.000	1.093	1.218	1.375	1.500	1.625	1.812							
Sched. 140	I.D.													7.001	8.750	10.500	11.500	13.124	14.876	16.500	18.250	19.876							
	Wall													0.812	1.000	1.125	1.250	1.438	1.562	1.750	1.875	2.062							
Sched. 160	I.D.	0.466	0.614	0.815	1.160	1.338	1.689	2.125	2.624		3.438	4.313	5.189	6.813	8.500	10.126	11.188	12.814	14.438	16.064	17.750	19.314							
	Wall	0.187	0.218	0.250	0.250	0.281	0.343	0.375	0.438		0.531	0.625	0.718	0.906	1.125	1.312	1.406	1.593	1.781	1.968	2.125	2.343							

NON-STANDARD CARBON

Size	10	20	24	24
O.D.	10.750	20.000	24.000	24.000
I.D.	10.192	19.375	23.375	22.126
Wall	0.279	0.312	0.312	0.937

The above sizes are produced by pipe mills but dimensions do not conform to any regular standard or schedule.

△ These materials are generally available in Schedules 40 and 80 only.

◇ Wall Thickness of Schedule 5S & 10S does not permit threading in accordance with the American Standard for Pipe Threads (ASA No. B2.1)

⊗ Wall thickness identical with thickness of "Standard Weight" pipe.

^ Wall Thickness identical with thickness of "Extra-Heavy" pipe.

* These do not conform to American Standard B36. 10.

PIPE WEIGHT FORMULA FOR STEEL PIPE (lbs per foot)

10.68 (D-t) t, where D=Outside Diameter and t=Wall Thickness

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