Ultrasonic flowmeters

SITRANS FUS1010 IP65 NEMA 7 Compact Gross Volume 7ME3531

Operating Instructions - September 2008

SITRANS F

SIEMENS

Special Cautionary Note Regarding Input Power Wiring for 1010X Flowmeters

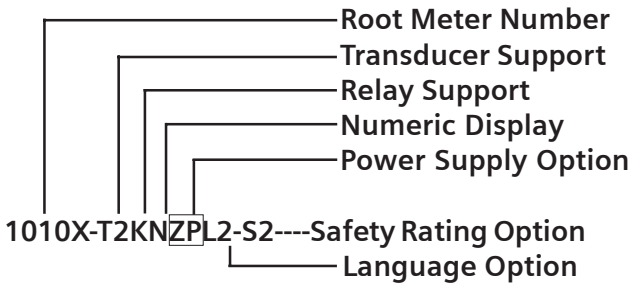
The compact area of the power wiring compartment located under the 1010X Rear Housing Cover does not permit labeling for connecting the flowmeter to its AC or DC power source. The labeled numbers 1,2 and 3 of connector P8 prompt the user to consult the 1010X-7 installation diagram in Appendix B for wiring details. To avoid damage to the flowmeter, especially in cases where it is difficult or impossible to consult the 1010X-7 diagram, the correct power supply wiring procedure and corresponding part numbers are listed below. Also see Section 2, paragraph 2-2 Power Connections in this manual for details on power supply wiring procedures.

1. In addition to confirming the part number of the flowmeter, it is recommended that the actual power supply module part number be checked for conformation to the power available in the field. *Before applying power to the unit*, you may visually confirm the part number of the power supply by removing the front housing cover.

NOTES

1. **The Model 1010X part number is on the identification label that is located on the top (Agency Approved models) or on the right side of the flowmeter housing.**
2. **The Power Supply Module identification label is located inside the rear housing cover.**

***Typical 1010X Part Number Construction:**



Meter Part Number *	Power Supply P/N	User Supplied Power
Contains S prior to S_Code	1010X-6SS2	90-230 VAC Single Phase
Contains a ZN prior to S_Code	1010X-6ZNS2	9-36 VDC Negative Ground
Contains a ZP prior to S_Code	1010X-6ZPS2	9-36 VDC Positive Ground
Contains a Z at end of P/N	1010X-6Z	9-36 VDC Floating

2. Once the flowmeter's power supply type has been established and conforms to the available line power in the field, the P8 power connector can be wired per the table below. See paragraph 2-2 in this manual for complete power supply wiring procedures.

Terminal Number	1010X-6SS2	1010X-6ZNS2	1010X-6ZPS2	1010X-6Z
1	Hot	Positive	Positive (Gnd)	Positive
2	Neutral	Negative (Gnd)	Negative	Negative
3	Ground	Ground	Ground	Ground

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IMPORTANT NOTICE

Controlotron is now part of:

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

SITRANS FUS 1010X DEDICATED NEMA-7 EXPLOSION PROOF 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:1010XFM-3
September 2008

For use with Operating System
Software Version 3.01.5B or later

Made in the USA

Manual Changes

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

MANUAL ADDENDUM

SETUP PROCEDURE FOR WET-FLOW CALIBRATED Sitrans F SYSTEMS

Sitrans F Uniflow Portable & NEMA Flowmeter Systems

Manual Addendum
July 2002

Made in the USA

SETUP PROCEDURE FOR "WET-FLOW CALIBRATED" 1010 SYSTEM

Caution: DO NOT use the field manual installation procedure to startup a wet-flow calibrated system. Doing so could void the calibration by corrupting essential data. This addendum contains the only authorized instructions to be used when commissioning a wet-flow calibrated 1010 system.

1. INTRODUCTION

When the system 1010 is wet-flow calibrated, the flow computer stores the installation parameters in its storage memory. Each flow calibration is assigned a unique site name. Usually, the site name corresponds to the pipe size. For example, a 3-inch carbon steel, schedule 40 pipe would be given the name "3CS40."

The flow calibration report issued with each wet-flow calibration, includes a flow calibration "Diagnostic Data Sheet." This data sheet lists the site name and other necessary information (such as transducer serial number and spacing information), for setting-up the flowmeter. A wet-flow calibration applies to a specific flowmeter and set of transducers; identified by serial numbers on the diagnostic data sheet.

NOTE: In order for the flow calibration to be valid, the flow computer and transducers being used must have the same serial numbers as those listed for the site on the Calibration Diagnostic Data Sheet.

2. SETUP PROCEDURE

2.1 Transducer Installation

2.1.1 Refer to the diagnostic data sheet to find the mounting mode (Direct or Reflect) used during the wet-flow calibration. Review the transducer installation guidelines in your 1010 field manual.

2.1.2 Refer to the diagnostic data sheet for the transducer spacing index utilized during the flow calibration. Using the mounting configuration employed during the flow calibration, install the transducers on the pipe at the above noted spacing positions in accordance with the instructions provided on the transducer installation drawings.

2.1.3 Attach the transducer cables noting that the cable marked "UP" attaches to the transducer closest to the source of flow.

NOTE: Before proceeding further, ensure that the pipe is full of liquid. It is not important at this point that it be flowing.

2.2 Flowmeter Setup

NOTE: The following instructions require the use of the keypad and the menu. The installer should become familiar with their use before proceeding further.

2.2.1 Switch the flowmeter on. Press the <MENU> key.

2.2.2 On multi-channel flowmeters, use the arrow keys to select [Dual Channel Flow] or [Dual Beam Flow] depending on the mode utilized for the wet-flow calibration.

2.2.3 Use the arrow keys to select either [Clamp-on], [Flow Tube] or [Clamp-on Spool].

2.2.4 Select [Full Site Setup] and use the <Right Arrow> to select [Channel Setup]; then select [Recall Site Setup].

2.2.5 Use the <Down Arrow> to scroll to the site name indicated on the Calibration Diagnostic Data Sheet. Then press <ENT>.

2.2.6 The meter will perform a momentary “Makeup” routine that will take a few seconds and then begin operation.

2.2.7 Refer to your 1010 field manual for instructions on setting zero flow.

NOTE: Setting zero flow must be performed each time the transducers are installed. The zero adjustment has no effect on the wet-flow calibration data or the calibration (Kc) factor.

2.2.8 Using the arrow keys, scroll to the Data Span/Set/Cal menu location. Verify that the [Kc] (calibration) factor matches the value indicated on the diagnostic data sheet.

2.2.9 If you are measuring a liquid other than ambient water, select the [Liquid Class] menu cell and <Down Arrow> from there to [Viscosity]. Enter the correct viscosity for the liquid you will be monitoring.

2.2.10 Setup is now complete. Press the <MENU> key twice to view the flow rate display. DO NOT utilize the [Save Site] command when it appears.

2.2.11 When measurements are completed, simply turn off the meter. DO NOT save the site. This might contaminate the wet-flow calibration data already stored.

NOTE: Contact Siemens’ Technical Services Department if any flow calibration data is accidentally removed or overwritten.

3. TRANSFER INSTALL FUNCTION

All 1010 flowmeter operating systems (version 3.00.20 and greater) include the installation facility called “Transfer Install.” This function permits the transducers to be repositioned while maintaining all calibration parameters and operation established during the water calibration. The Transfer Install function allows the transducers to be optimally positioned for a different fluid, without the need for a new Initial Makeup procedure.

NOTE: Prior to performing Transfer Install make sure that the water calibration procedure was performed and a saved active site exists.

3.1 Transfer Install Procedure

To initiate the Transfer Install function, proceed as follows:

3.1.1 In the Application Menu press the <Right Arrow> to select the [Liquid Class] menu cell. Scroll and highlight [Estimated Vs m/s] from the option list.

3.1.2 Use the numeric keys to change the Estimated Vs to the Estimated Vs value of the customer selected liquid.

3.1.3 To enter new Estimated Vs value press <ENT>.

3.1.4 Proceed to the Pick/Install Xdcr menu and select the same transducer, mounting mode and spacing offset that was selected for the water calibration.

3.1.5 Re-space the transducers to the index position indicated by the flowmeter.

3.1.6 Scroll to the [Install Completed?] menu cell and select [Transfer Install] from the option list.

NOTE: If [Transfer Install] does not appear in the option list then either the Estimated Vs or the transducer size was improperly entered. In this case, recall the water calibration site and start the procedure again at Step 3.1.1 above.

3.1.7 For MultiPath systems repeat Step 3.1.6 above for the remaining paths.

3.1.8 The flowmeter should now be operational at the new spacing location.

NOTE: Depending on the size of the pipeline, the change in the estimated sonic velocity (Vs) and the repositioning of transducers, the flowmeter may not operate out of Fault even if the spool or pipe is filled with liquid. This can be expected when performing a Transfer Install for liquified gases or for clamp-on natural gas flowmeters.

3.2 Saving New Transfer Install Site

3.2.1 To save the Transfer Installed site, scroll to the Channel Setup menu and press the <Right Arrow>. Press the <Right Arrow> again to select the [Save/Rename] menu cell.

3.2.2 Use the numeric keys to rename the Transfer Installed site with the same site name used in Step 3.1.2 above, but with a “T” appended to the end of the site name (e.g., 3CS40T).

3.2.3 Press <ENT> to store data.

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1. INTRODUCTION TO THE SITRANS FUS 1010X NEMA-7 FLOWMETER

Congratulations on purchasing the SITRANS FUS 1010X NEMA-7 flowmeter. For use in dedicated applications, the 1010X utilizes the latest "cutting edge" technology yet is easy to setup and use. It will not take long for you to appreciate its unmatched performance and its many features such as the unique enhanced transit-time digitally coded MultiPulse technology.

System 1010X is a compact NEMA-7/EExd-rated explosion-proof transit-time flow computer. Functionally, it's similar to the standard 1010N NEMA-4X flow computer and operates as a stand-alone flowmeter using conventional clamp-on transducers or in-line tubes.

1.1 SYSTEM HARDWARE DESCRIPTION

System 1010X is housed inside a cylindrical explosion-proof NEMA-7 aluminum, epoxy painted case. The main metering compartment front and rear sections are sealed with an O-Ring with separate threaded covers. The front section houses the main electronics and the optional Magnetic Touch-Panel User Interface with a 2 x 16 character LCD Alphanumeric Display viewable through a tempered glass window. The rear section contains terminal blocks for the fused power input and data I/O wiring. The primary instrumentation output is an isolated 4-20 mA current loop. The meter includes a conventional RS-232 I/O port.

The main metering compartment is connected to the secondary housing by an aluminum pipe that provides a pass-through for flow transducer and temperature sensor cabling. The secondary housing provides screw-on wire clamp terminals for flow and temperature sensors. To maintain the NEMA-7 explosion-proof rating, all cabling and the transducer physical and electrical design must be in compliance with hazardous area specifications.

Temperature *Operational and Storage*	**Operating Temperature** Electronics: 14ºF to 122ºF (-10ºC to 50ºC) LCD Display: 14ºF to 122ºF (10ºC to 50ºC) **Storage Temperature** Electronics: -4ºF to 140ºF (-20ºC toº60 C) **Transducer temperature ratings depend on the individual transducer type(s).*
Power Consumption	110/220 VAC, less than 10 Watts; 9-36 Vdc
G-Force Rating	Instrument survives 3" drop onto 1" plywood (standard industrial drop test). Mechanical design supports operation in a high vibration environment.
For Hazardous Area Use	Explosion-proof case designed for installation in Division 1/Zone hazardous environments when installed per our instructions. Agency approvals: CE (for EM) and FM/CENELEC pending. International approvals pending.
Provisions for User Menu Access	Magnetic triggers (4-Arrows + Enter). RS-232 Interface for menu access and datalogger dump.
Options	Dial-up Modem One RTD temperature sensing channel (measures clamp-on liquid temperature) Blind System (programming via serial link only)

1.2 INTRODUCTION TO THE 1010X OPERATING SYSTEM

The System 1010X software resides on Flash ROM chips. Software upgrades are easily implemented by accessing the Flash memory through the serial port connection of the 1010X. All 1010 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 System 1010 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 to be 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 then make it available to be converted to output data by the Data I/O and Display subsystem. Since System 1010 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

- Same features as the 1010 family of NEMA 4X flow computers except constructed in a compact NEMA-7 explosion-proof housing.
- Flexible setup options using either the Magnetic Wand and touch panel sensors, or a laptop PC connected to RS-232 port.
- Integral 2x16 Character LCD panel display shows real-time data and Installation Menu for Magnetic Wand programming.
- Flexible mounting - either on pipe or located up to 300 feet (100m) from the transducers. For distances greater then 300 feet, please contact Siemens Customer Service.
- Rotating Display Module permits horizontal or vertical mounting.
- Menu Lockout Switch prevents unauthorized access to site setup data.
- External power and control wiring located in a separate compartment utilizing a hazardous area compliant safety interface to flow and temperature (optional) transducers.

Integral Datalogger

System 1010X 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 laptop computer where the report format is comma-delimited ASCII text to facilitate its import to spreadsheet or database software.

Analog Outputs

Isolated current loop varies from 4-20 mA in proportion to any user-selected data function. Isolated Pulse rate output varies from 0-5000 Hz in proportion to any user-selected data function.

Buffered open collector relay trigger output provides TTL logic levels (3-5 Vdc High, 0-1 Vdc Low) for response to user-assigned alarm functions.

Performance

Typical performance on a 6-inch (DN 150) Schedule 40 steel pipe, flow above 2 ft/sec:

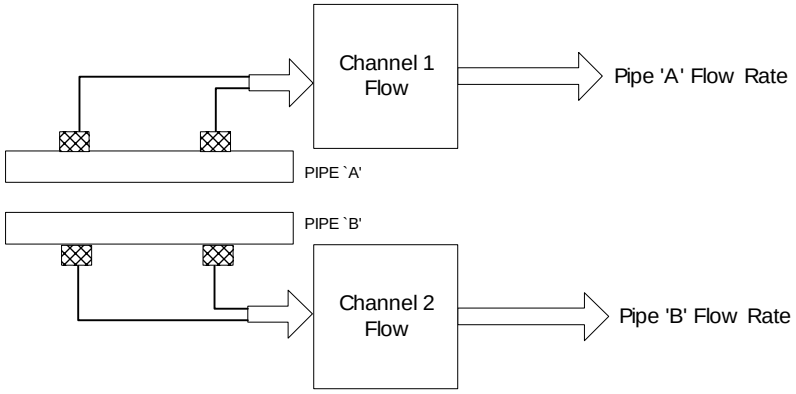
Calibratable Accuracy	0.25% to 0.5% of rate (High Precision Transducers 1.0 % to 2.0% of rate (Universal Transducers)
Repeatability	0.15% (High Precision Transducers) 0.25% (Universal Transducers)
Resolution	0.01 fps (0.003 m/s)
Flow Slew Rate	80 ft/sec^2

1.3 DESCRIPTION OF CHANNEL FUNCTIONS (1010DX Systems only)

Dual channel 1010DX systems provide two flow measurement channels that allow its operation as two completely independent single-channel flowmeters. 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.

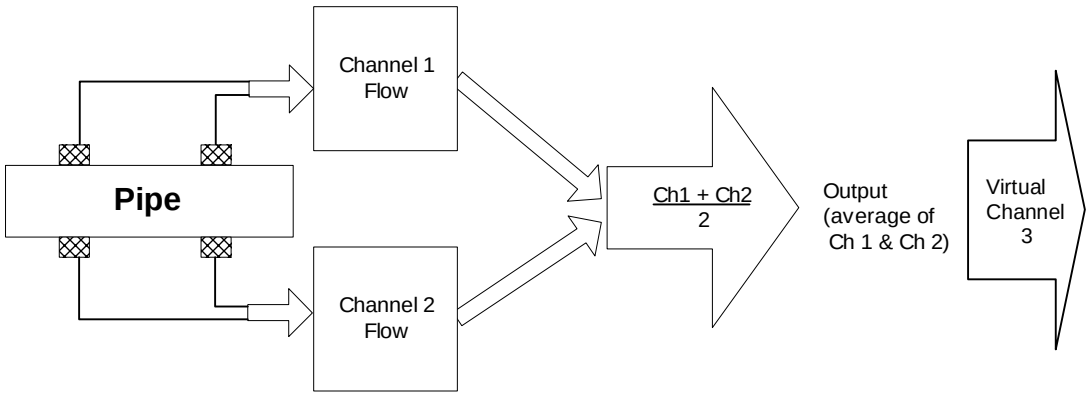
Dual Channel Flow

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



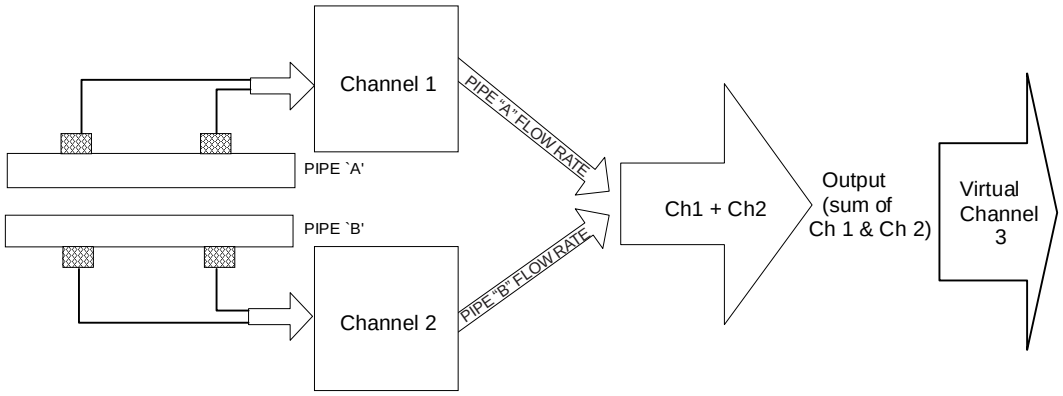
Dual Path Flow

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.



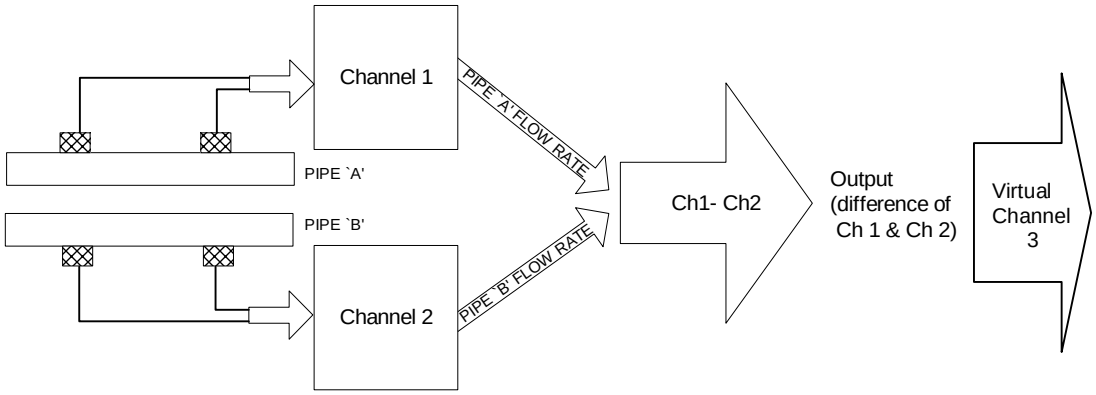
Channel 1+2 Flow

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.



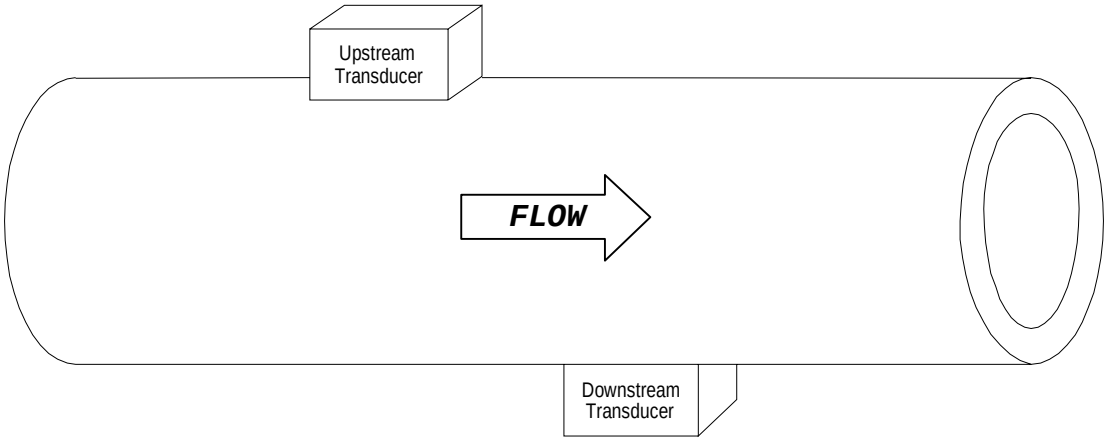
Channel 1-2 Flow

Channel 1-2 produces a data output via a virtual channel 3 (proportional to the difference of the flow of two independent pipes). You have to setup the two flow channels independently. Note that you can still select the individual channel outputs with this configuration.

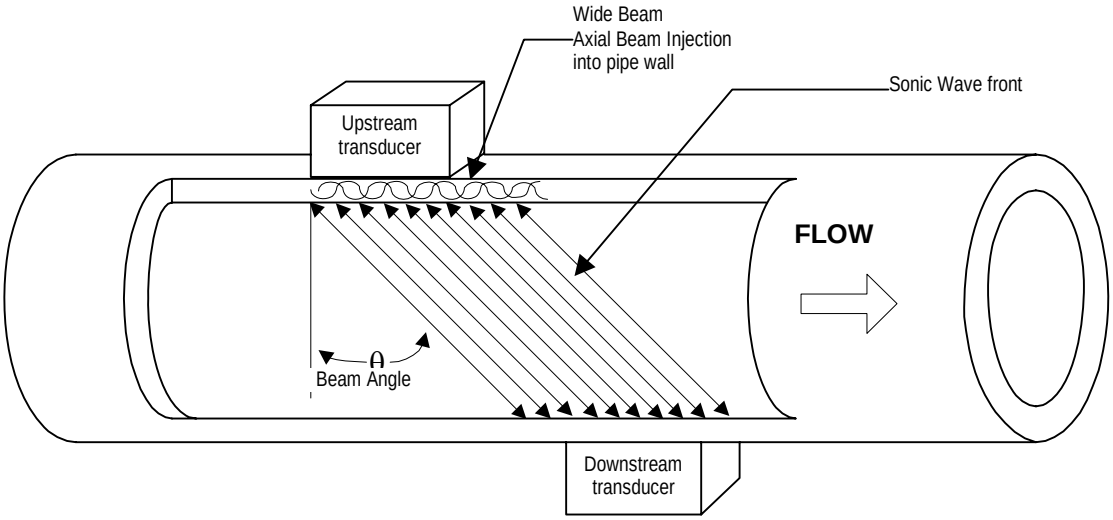


1.4 CLAMP-ON TRANSIT-TIME THEORY OF OPERATION

Note that in the figure on the next page, 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.

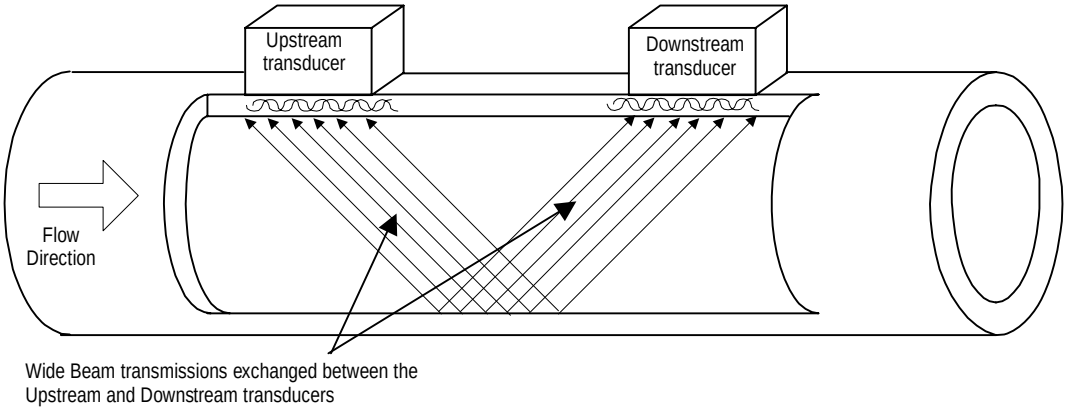
$$\text{Beam Angle} = \text{Arc Sine}\left(\frac{\text{Liquid Sonic Propagation Velocity}}{\text{Transducer Phase Velocity}}\right)$$

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.

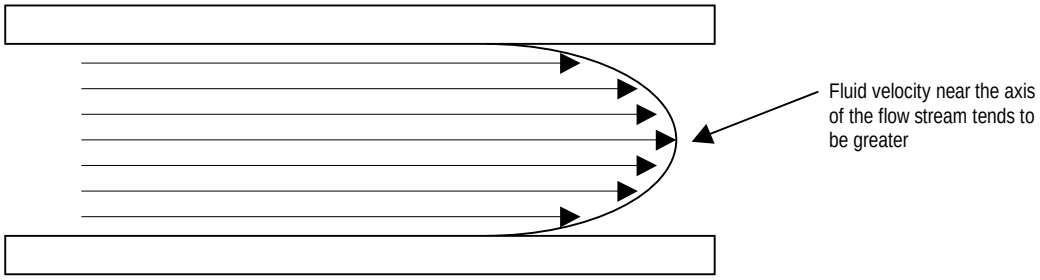
Flow Calibration Factor

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.



The degree of the flow profile curvature is directly proportional to the Reynolds number of the flowing liquid. System 1010X 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. Certain 1010 models infer 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 1010X flowmeter. Instructions include how to navigate through the Installation Menu using either a magnetic wand 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 System 1010X 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. If this equipment is used for a hazardous application (high line pressure, hostile liquid characteristics, perilous atmosphere, etc.), it is the user's responsibility to ensure that only properly trained personnel install and operate it.

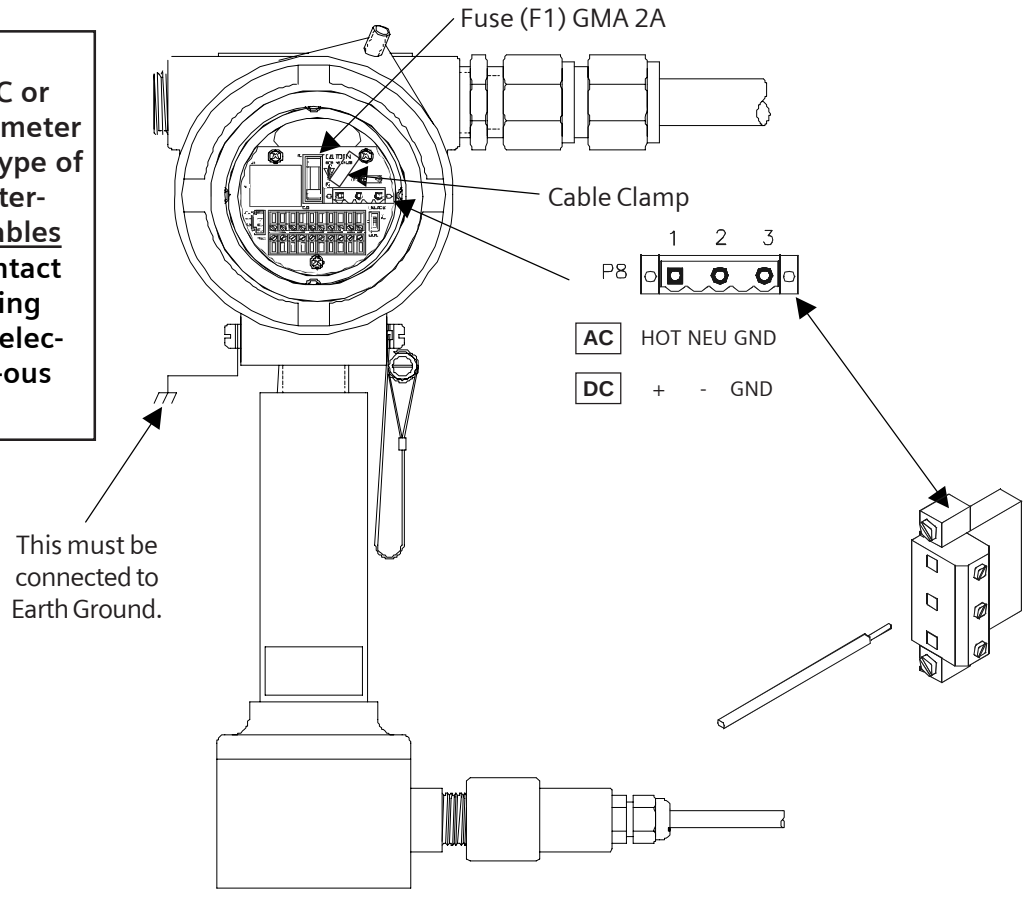
2.2 POWER CONNECTIONS - [Refer to dwgs 1010X-7 (1 of 3) & 1010DX-7 (1 of 3)]

2.2.1 INPUT POWER CONNECTOR (P8) AND FUSE (F1) LOCATIONS

The standard 1010X flow computer either requires 100/120/230 VAC or one of two 9-36 VDC power sources for its power input. The power input is protected by a GMA 2A fuse (F1). Please replace this fuse with the exact type if it becomes necessary to do so.

WARNING

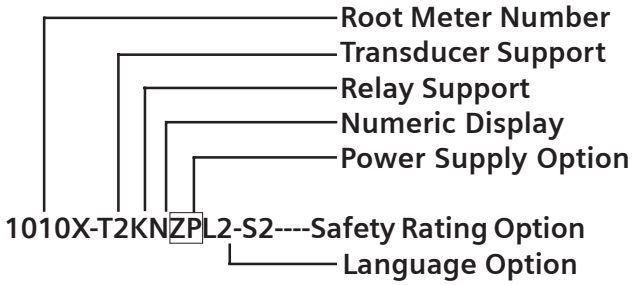
Do not connect AC or DC power to flowmeter until the correct type of input power is determined. See P/N tables on next page. Contact with exposed wiring may lead to fire, electric shock, or seri-ous personal injury.



2.2 .2 POWER SUPPLY WIRING

- Using a 1/16" Hex key, loosen the 1010X Rear Housing Cover locking setscrew.
- Unscrew the Rear Housing Cover and remove.
- Locate power supply connector J8. Use the tables below and the part number of your unit to determine the correct input power source. (See ID label on right side of housing.)

***Typical 1010X Part Number Construction:**

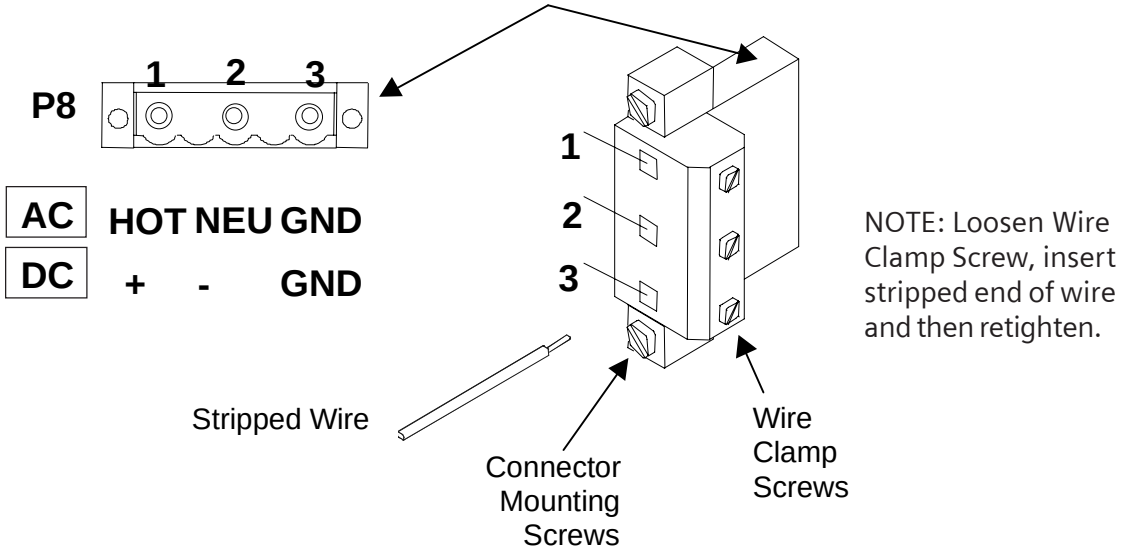


Meter Part Number *	Power Supply P/N	User Supplied Power
Contains S prior to S_Code	1010X-6SS2	90-230 VAC Single Phase
Contains a ZN prior to S_Code	1010X-6ZNS2	9-36 VDC Negative Ground
Contains a ZP prior to S_Code	1010X-6ZPS2	9-36 VDC Positive Ground
Contains a Z at end of P/N	1010X-6Z	9-36 VDC Floating

NOTE: Power Supply Module P/N label is located inside the front housing cover.

- Pull wires through flowmeter case conduit cable hole.
- Wire input power connector P8 for AC or DC power as shown below. Insert wires into wire entry holes and secure by tightening wire clamp screws (see note on next page).

Terminal Number	1010X-6SS2	1010X-6ZNS2	1010X-6ZPS2	1010X-6Z
1	Hot	Positive	Positive (Gnd)	Positive
2	Neutral	Negative (Gnd)	Negative	Negative
3	Ground	Ground	Ground	Ground



NOTE: Power Supply connector wires should be stripped stranded or solid conductors AWG 12 -18.

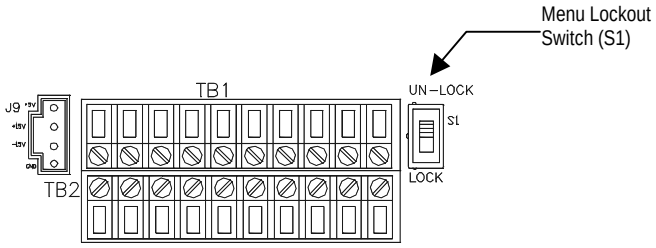
Input Power Connector (P8) Wiring

NOTE: The input power connector consists of a removable wire plug and PCB header located on the 1010X-8 I/O module. Two screws secure the wire plug to the header. The connector assembly is fully polarized for fast and easy mating. The wire plug accepts stranded or solid conductors of AWG 12 - 18. To insert a wire into the wire plug, strip back the insulation by 0.31" (8 mm), loosen the wire clamp screw, insert the stripped wire end and then re-tighten the wire clamp screw.

- Plug input power connector P8 into connector J8 and secure using two captive connector mounting screws as indicated above.
- Secure power-input cable with cable clamp to prevent wire breakage.
- Replace Rear Housing Cover and tighten setscrew.
- Connect the power cables to the appropriate power source previously selected from the tables above and power up unit.
- If unit is operational, turn power off and install transducer cables.

2.3 THE MENU LOCKOUT SWITCH

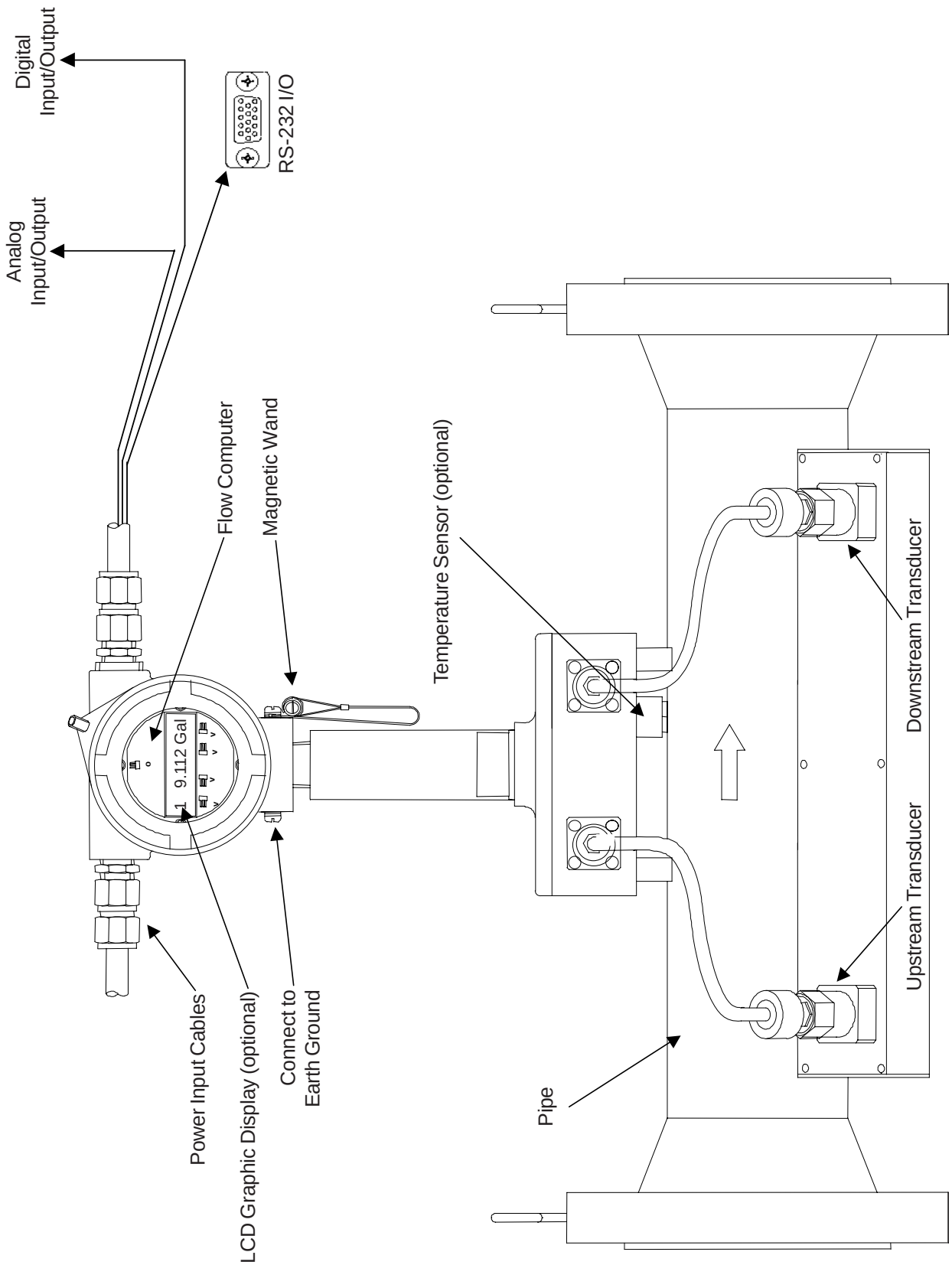
System 1010X includes a menu lockout switch to prevent unauthorized access to the Installation Menu. In addition, a password entry option is available (see Channel Setup). The menu lockout switch (S1) resides on the I/O module on the right side of I/O wiring terminal block TB1 (see below). Please switch to the unlocked position before attempting to program the flowmeter. We recommend that the installation menu remains locked during normal operation. (Refer to Section 3, paragraph 3-2 Input/Output Wiring for TB1 and TB2 signal wiring.)



2.4 FLOWMETER INSTALLATION SUMMARY

System 1010X is computerized instrumentation that requires you to perform hardware and software installation procedures to obtain operation. As you will see in the following sections, System 1010X 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. System 1010X 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 1010X 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 flow computer at the selected location.
- Connect power to the flow computer.
- 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.



1010X Interconnection Diagram

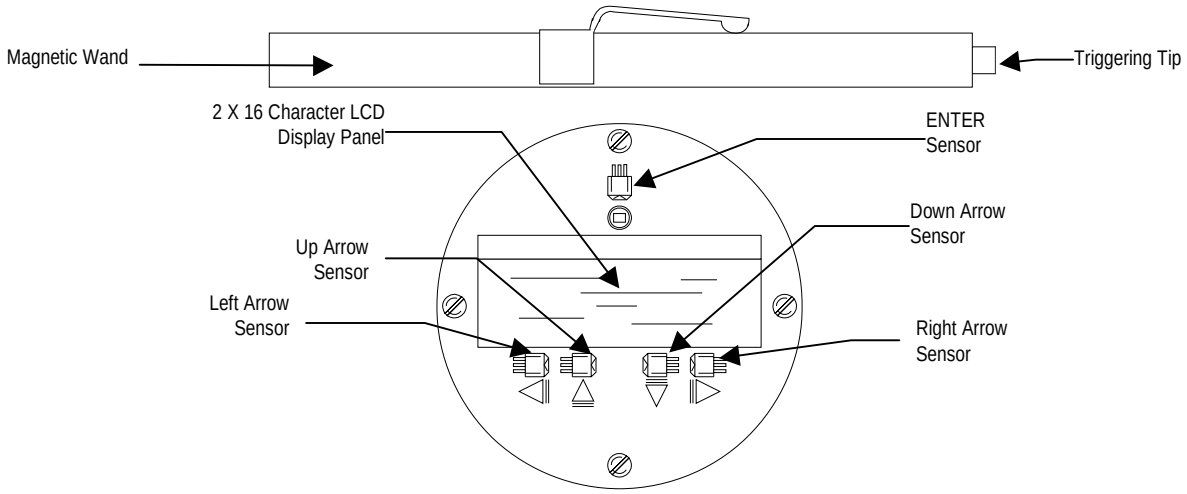
- Mount transducers on pipe and connect to flow computer.
- Complete transducer install menu operation.
- Set zero levels (generally Direct Mount applications only).

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 1010X 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 a *Magnetic Wand* 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 MAGNETIC WAND INTERFACE

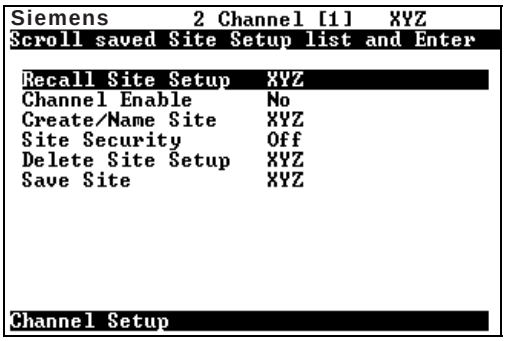
A Magnetic Wand interface provides a simple data entry method. It is not necessary to open the housing to effect data entry, thus avoiding the need for hot-work permits and the like for user menu access. This occurs through the explosion-proof sight glass. Be sure to tighten the enclosure cover properly for the best operation. Individual functions and parameters are selected from a hierarchical menu structure. Menu control and navigation is accomplished by placing the tip of a magnetic wand (see below) directly over a magnetic sensor. The LCD panel display provides five sensors. Four of the sensors are used for directional navigation within the menu. A symbol below each sensor shows the effective direction of the sensor. The fifth magnetic sensor provides the ENTER function (bull's-eye).



SYSTEM 1010X MAGNETIC WAND AND LCD DISPLAY PANEL

2.5.2 OVERVIEW OF THE RS-232 INTERFACE

System 1010X site parameters can also be programmed using a PC connected to the RS-232 serial port. This requires a special serial interface cable (1015CPC-N) and a communication software package. 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 interface. These programs reproduce the menu screens that appear on 1010 systems equipped with graphic display screens. Setup procedures for the 1010X and portable, 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. In addition, it allows you to access System 1010's comprehensive on-line help text. The following example screen is an actual HyperTerminal screen capture.



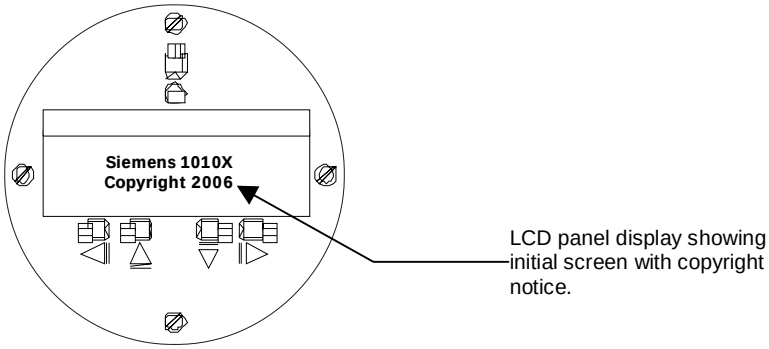
TYPICAL MENU SCREEN AS IT APPEARS IN A COMMUNICATION PROGRAM

2.6 INSTALLATION MENU OPERATION WITH THE MAGNETIC WAND

This section describes how to use the Magnetic Wand 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 Engineering Drawing 1010X-7 (or 1010DX-7) for wiring instructions before turning on unit.

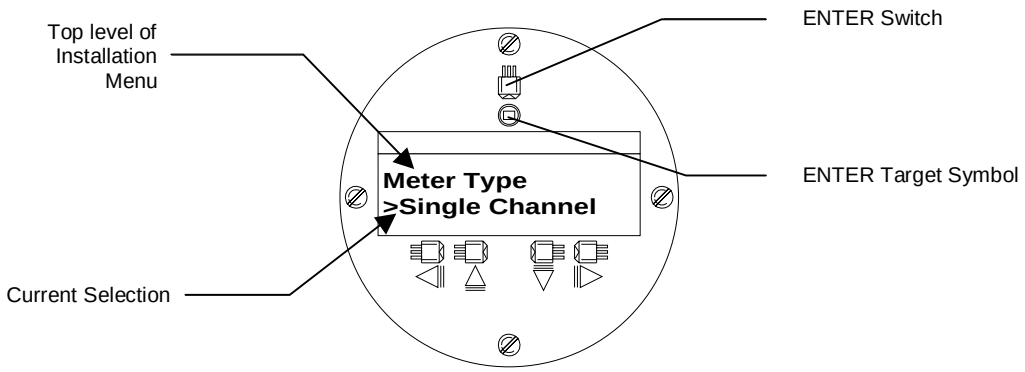
2.6.1 ACCESSING AND LEAVING THE INSTALLATION MENU

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 sensor to toggle between the local flow display screen and the last accessed menu location.



To access the Installation Menu:

- Make sure the Menu Lockout Switch is in the unlocked position (see paragraph 2.3).
- Momentarily place the Magnetic Wand tip over the [ENTER] switch (located above the target symbol). 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 (>).



Triggering the ENTER sensor 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 sensor 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 1010X INSTALLATION MENU STRUCTURE

The Single Channel 1010X 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, triggering the <Right Arrow> from [Meter Type] changes the display to [Single Channel]. Similarly, triggering 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 Temp. Range Pipe Config Anomaly Diams
		Pick/Install Xdcr ⇨	⇳ Transducer Model Transducer Size Xdcr Mount Mode Spacing Offset Number Index Spacing Method Ltn Value

(continued)

INSTALLATION MENU STRUCTURE *(continued)*

Meter Type ⇨	Single Channel ⇨	Pick/Install Xdcr ⇨	⇳ Install Complete?	
		⇳	Empty Pipe Set	
			Zero Flow Adjust	
		Operation Adjust ⇨	⇳ Damping Control	
		⇳	Deadband Control	
			Memory/Fault Set	
		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 ⇨	⇳ Max Flow
			⇳	Min Flow
				Max Vs m/s
		⇳		Min Vs m/s
			Set Alarm Levels ⇨	⇳ High Flow
			⇳	Low Flow
	⇳			Interface Vs m/s
				Aeration %
				Makeup Latch
			Calib. Flowrate	
		Datalogger Setup ⇨	⇳ Datalogger Mode	
		⇳	Datalogger Data	
			Log Time Interval	
			Datalogger Events	
		I/O Data Control ⇨	Analog Out Setup ⇨	⇳ Io1
		⇳		Pgen 1 (Single Ch)
			Relay Setup ⇨	Relay 1
		Diagnostic Data ⇨	Flow Data ⇨	⇳ Flow
				Velocity 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 #

(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	
			Date Site Create	

THE METER FACILITIES MENU STRUCTURE

Meter Facilities ⇨	Preferred Units ⇨	English ⇨	⇳ 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 1011 Hi Precision 991 Universal	
	Datalogger Control ⇨	⇳ Output Datalogger Est Log Time Left Clear Datalogger		
	Memory Control ⇨	Data memory left		
	Analog Output Trim ⇨	⇳ Trim Io 1 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		

2.6.3 HOW TO USE THE MAGNETIC WAND 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 Magnetic Wand 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:

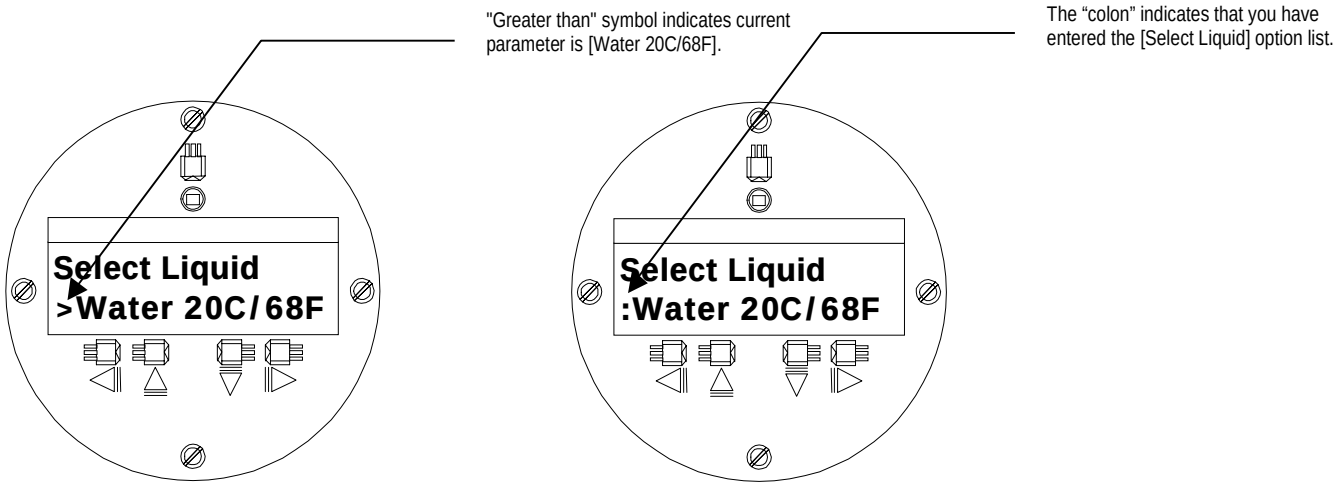
Right Arrow	▷
Left Arrow	◁
Down Arrow	▽
Up Arrow	△
Enter	◎

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.)

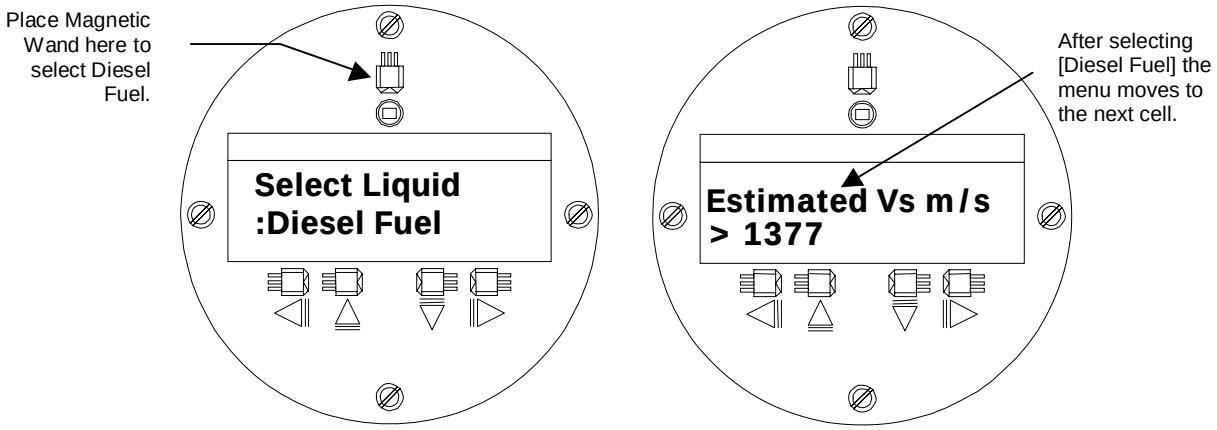
NOTE: Use the menu chart to see how to get to the [Select Liquid] menu cell.

- Place the magnetic tip over the switch above the ▷symbol. Note that the (>) symbol changes to a colon (:) as shown on the *right-hand* 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.



- Place the magnetic tip above the ▽ switch symbol. Note that the selection changes to [Water 50C/86F]. This is the next item on the [Select Liquid] option list. Keeping the tip over the sensor activates an auto-repeat function to scroll the list automatically. Note that every trigger 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 triggering when the screen shows [Diesel Fuel]. Place Magnetic Wand over 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.



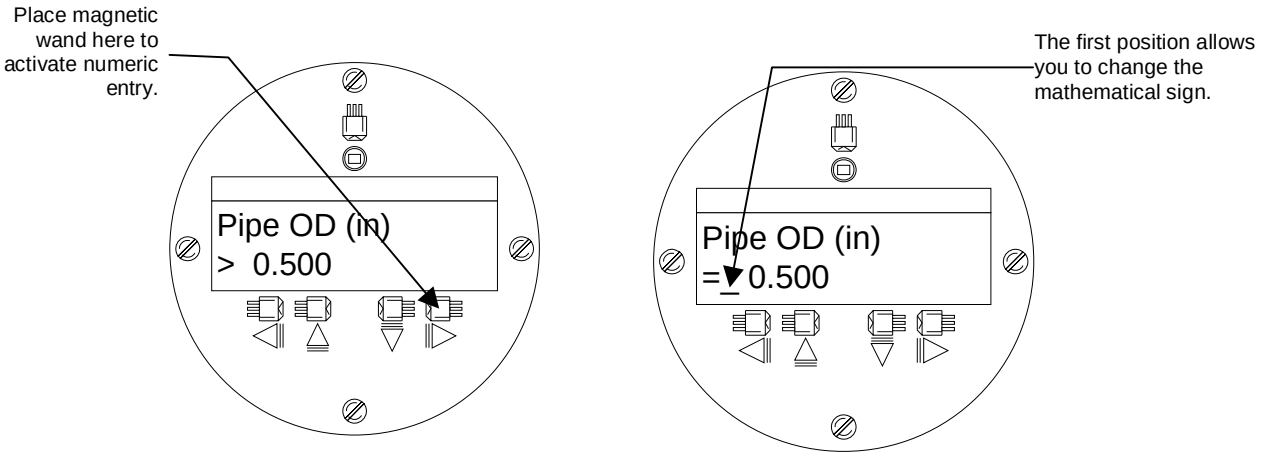
A Note on Multiple Select Option Lists

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 ◎.

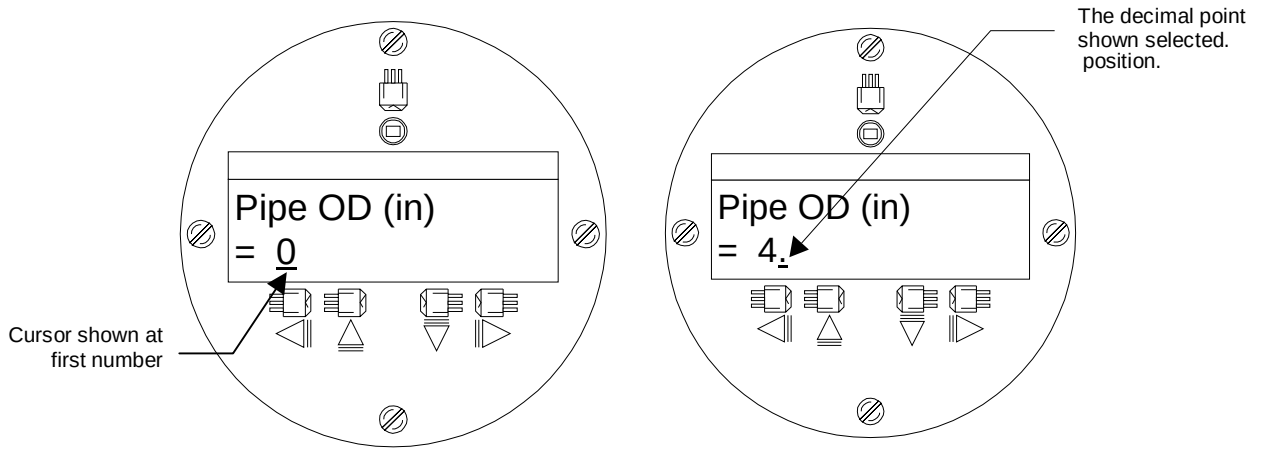
After selecting all the desired items, use ◁ to leave a multiple select option list.

How To Enter Numeric Data

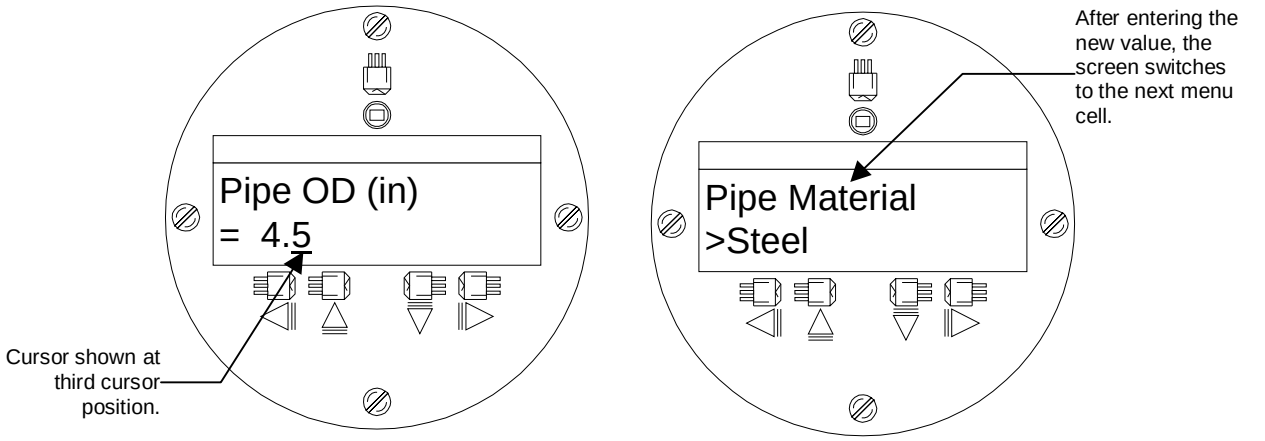
This section shows how to edit a numeric menu cell. The following example uses the [Pipe OD] menu cell. The left-hand figure on the next page shows the [Pipe OD] menu cell. Notice that the second line shows the current outer diameter value: [0.500]. (The "greater than" symbol placed before the parameter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



- 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.



- 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.



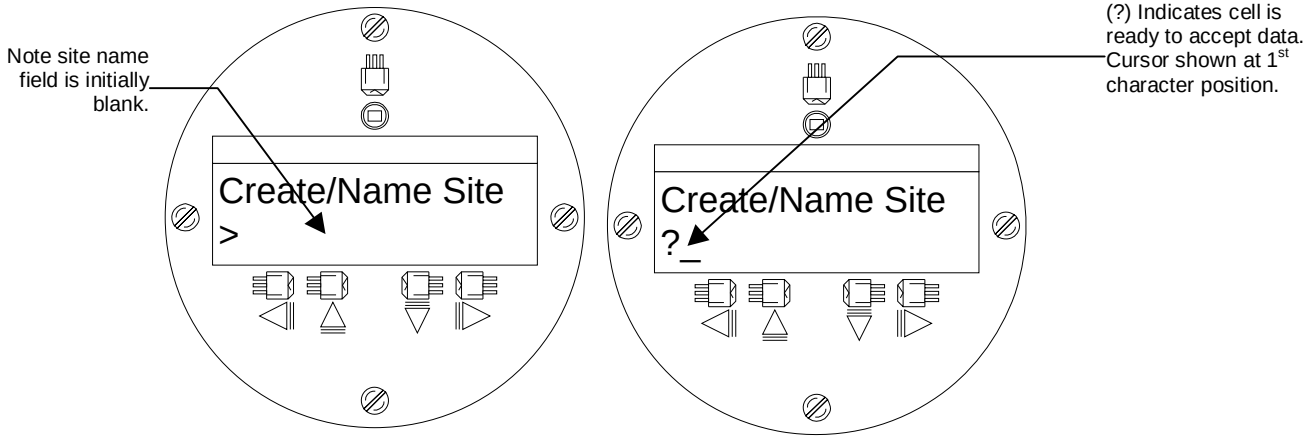
- Use ▷ to move cursor to move to the third number position. Use △ to scroll the number list to [5]. Use ◎ to register the new pipe outer diameter. This moves the screen to the next menu cell [Pipe Material] as shown in the right-hand figure above. You can use △ to move back to [Pipe OD] to check that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

How to Enter Alphanumeric Strings

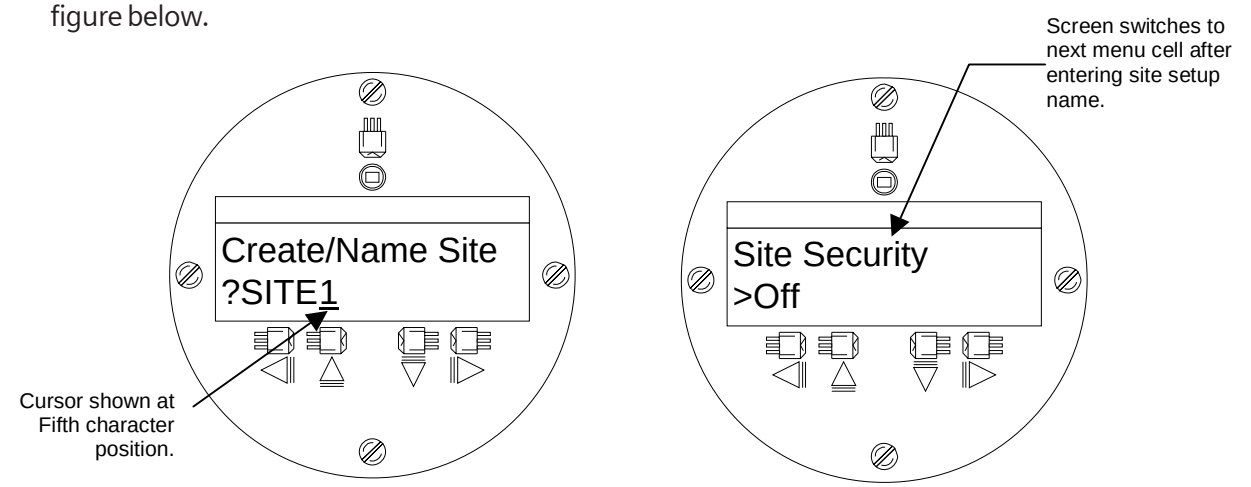
This section shows how to edit an alphanumeric menu cell. An alphanumeric string is a series of numbers and letters including the Quotation Mark, the Pound Sign symbols and/or a space. The meter uses these symbols to identify a specific site setup or user-modified table. Menu cells that accept alphanumeric 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.



- 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.



2.7 HOW TO USE THE RS-232 INTERFACE

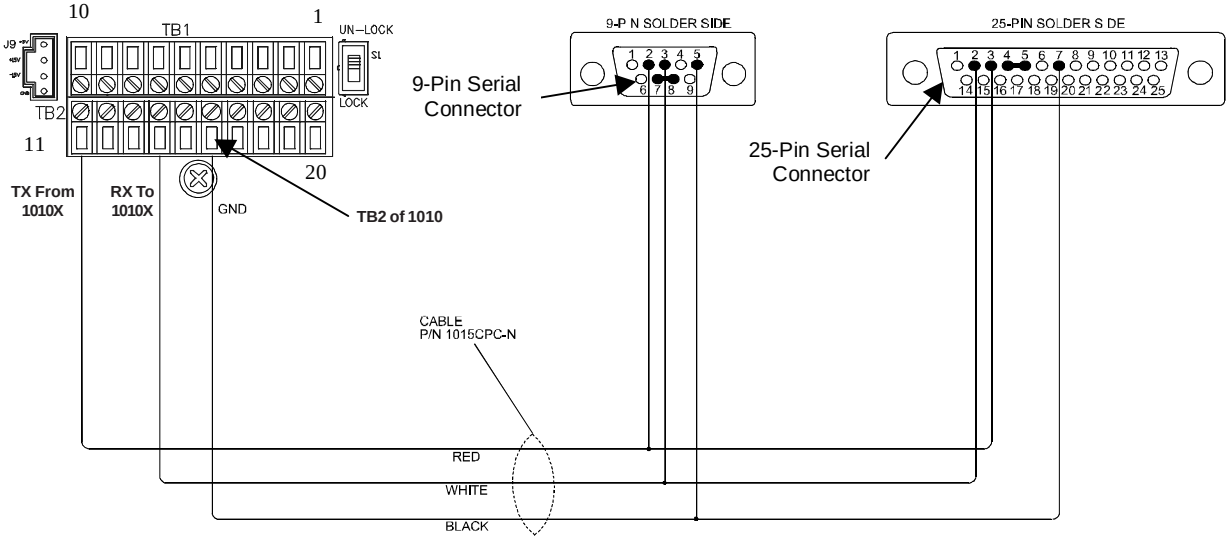
This section describes the hardware, software and procedural requirements for programming System 1010X using a PC connected to its RS-232 serial I/O port. Although you can construct your own interface cable, it is probably more convenient to purchase our serial interface cable (1015CPC-N) made specifically for this purpose. The Siemens serial interface cable provides both 9-pin and 25-pin connectors to accommodate all IBM-compatible serial port configurations. 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. 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: 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 is the schematic of the serial interface cable (part number: 1015CPC-N) needed to make the physical connection between the 1010X flow computer and your PC. The wire ends for the flow computer termination are stripped for easy insertion into TB2 on the flow computer. Note that 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."



SCHEMATIC OF 1015CPC-N INTERFACE CABLE

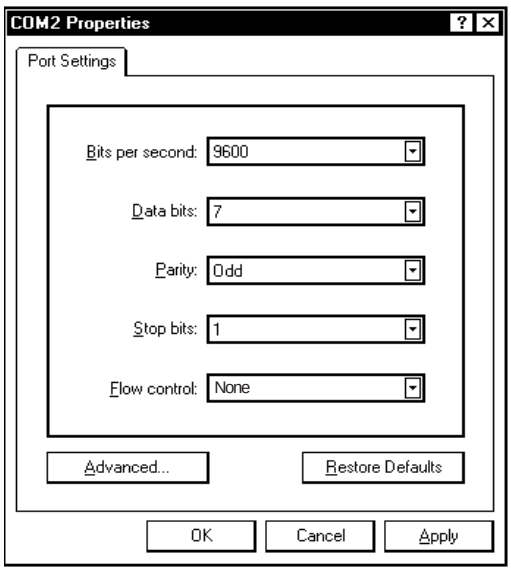
2.7.2 COMMUNICATING WITH SYSTEM 1010X VIA THE RS-232 INTERFACE

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 flow meter interface. Connect the cable between the flometer 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

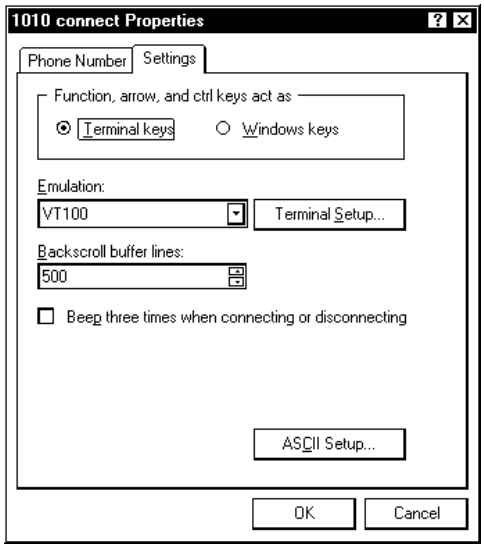
Windows provides a communication program called HyperTerminal, which is ideal for interfacing your computer with the flowmeter. The following typical example explains how to set up HyperTerminal. *NOTE: Depending upon the Windows applications being used this setup procedure may vary.*

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., 1010X). 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.

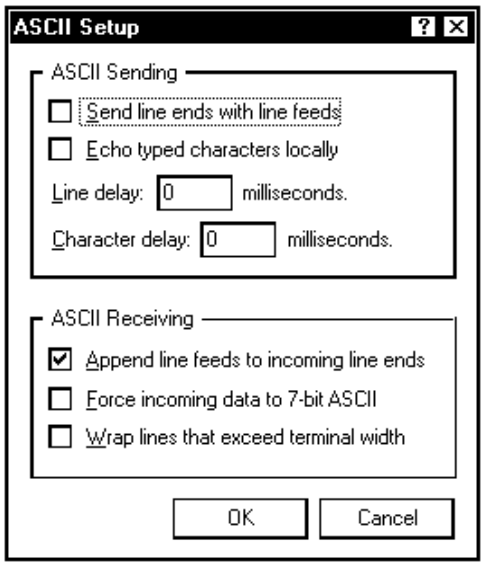


6. You will now see a blank terminal screen. Next left-click [File] on the top menu bar. Drag the highlight down to [Properties] and then left-click.

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 UNCHECKED. In the [ASCII Receiving] dialog box, left-click to place a check mark before the [Append line feeds to incoming line ends] dialog box. 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.

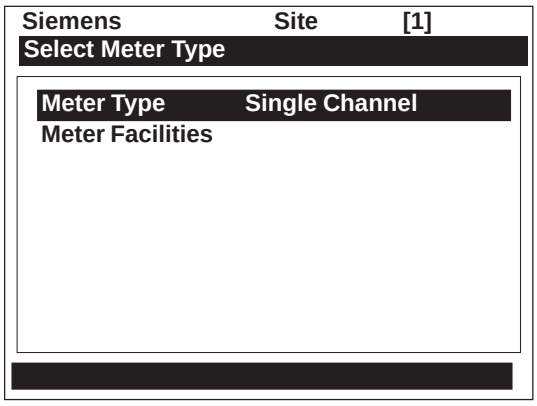
2.7.3 ACCESSING THE INSTALLATION MENU

Once the parameters are set, HyperTerminal automatically initiates *Command* mode. You will see a blank screen.

Press <ENTER> a few times until you see [? For Help] on the screen.

Type: ? (question mark) and then press <ENTER> to see a list of the available commands.

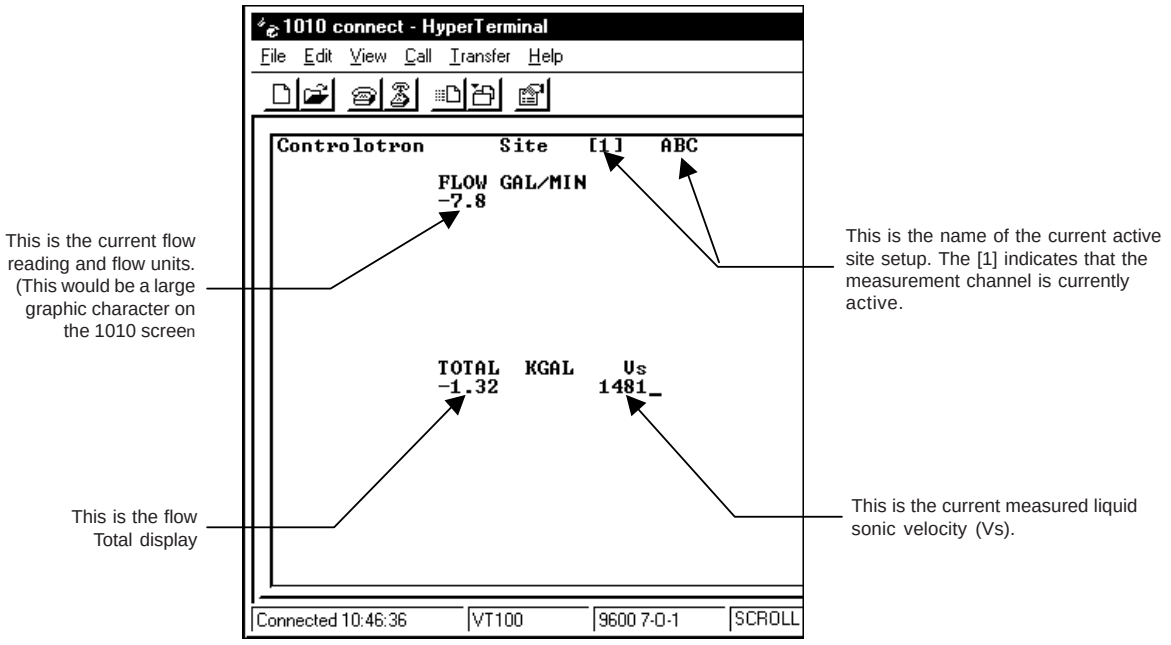
Use the MENU command (type [Menu] and then press <ENTER> to access the top level of the Installation Menu. You will see a screen similar to the example below.



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 <ENTER>. 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 System 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.



2.7.4 NAVIGATING THROUGH THE INSTALLATION MENU

After successfully accessing the Installation Menu, you can begin to set up the 1010X. 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 (or change Flow Display screen).
<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. Toggle between Menu and Flow Display.
^D (Cntrl D)	Generate Datalogger report.
^U (Cntrl U)	Logger Display Page Advance
<ENTER> (Carriage Return)	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.
/	Divide by
* (upper case 8)	Multiply by
+	Plus
-	Minus
=	Equals
●	Decimal Point.
@	System Reset (refer to paragraph 7.8.2).

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" extention, 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)* & [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.

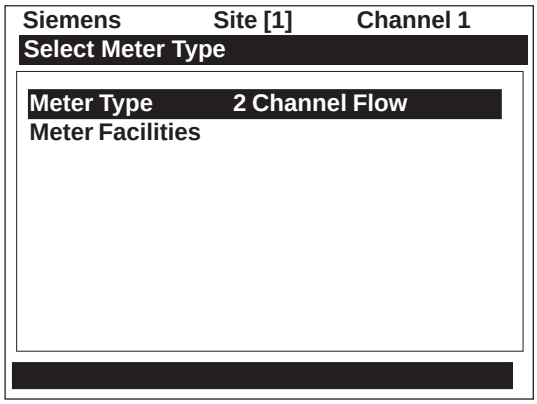
2.7.5 DATA ENTRY USING THE RS-232 INTERFACE

The following is a step-by-step example of how to enter data for a Single-Channel 1010X 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 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 <ENT> to select the top level of the Installation Menu.

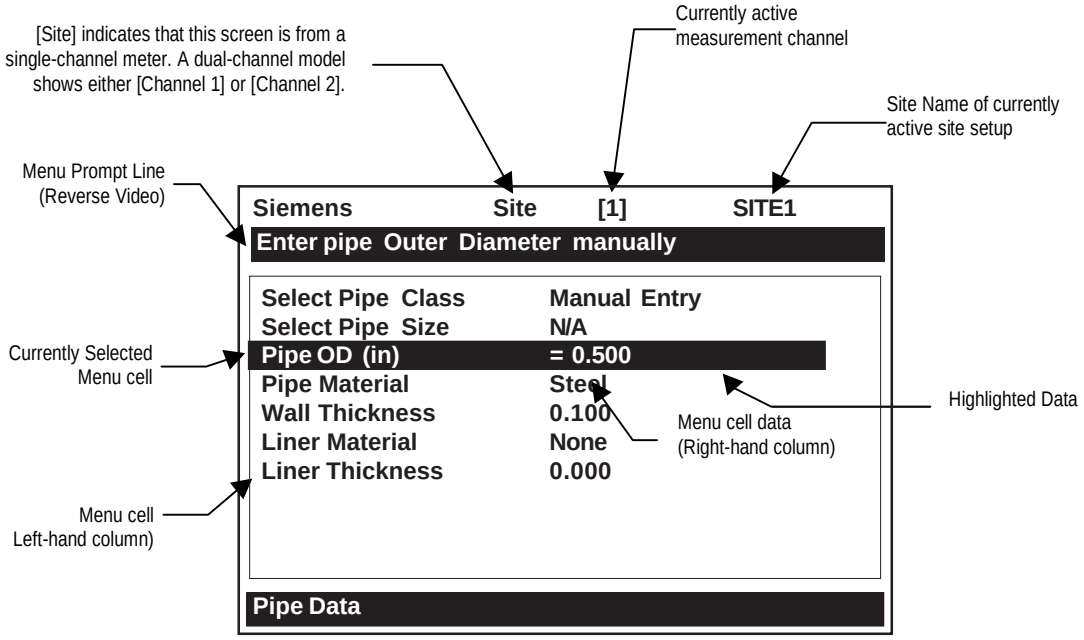
NOTE: Type <Menu> to enter Installation Menu. After programming is complete, repeated <Left Arrow> key will access the Flow Display. Key <Enter> from Flow Display to re-enter menu. Key <Ctrl L> to exit menu.



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.

2.7.6 INTRODUCTION TO THE 1010X MENU SCREENS

This section introduces the System 1010X 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.



TYPICAL 1010X 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).

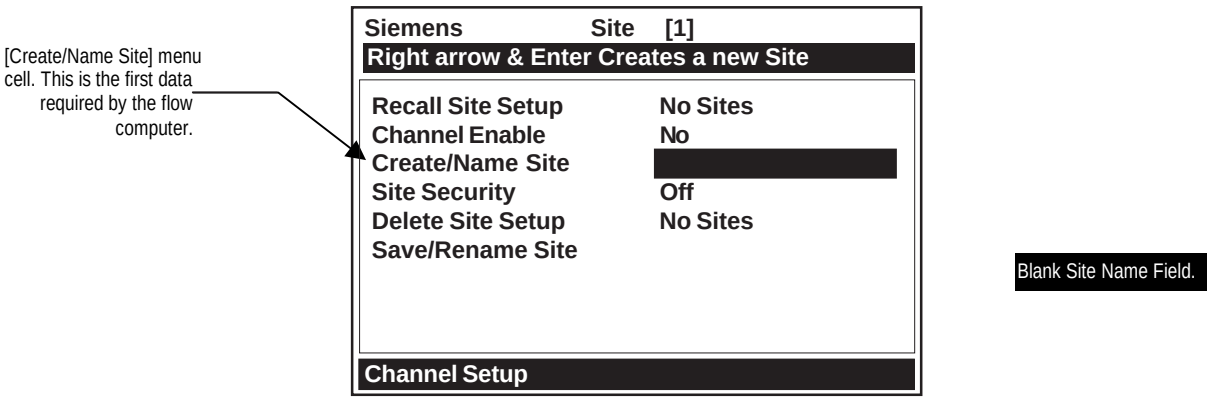
2.8 DATA ENTRY PROCEDURES USING THE RS-232 INTERFACE

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:

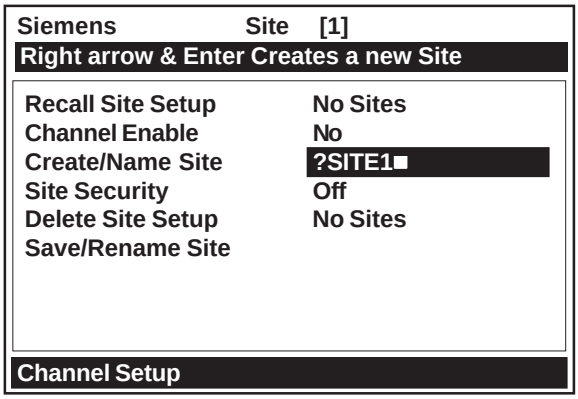
- Another series of menu cells (that become left-hand column items when selected).
- An alphanumeric string (e.g., a site name).
- An item from a scrollable option list (e.g., a class of liquids).
- A numeric entry (e.g., a pipe outer diameter).

2.8.1 ENTERING ALPHANUMERIC STRINGS

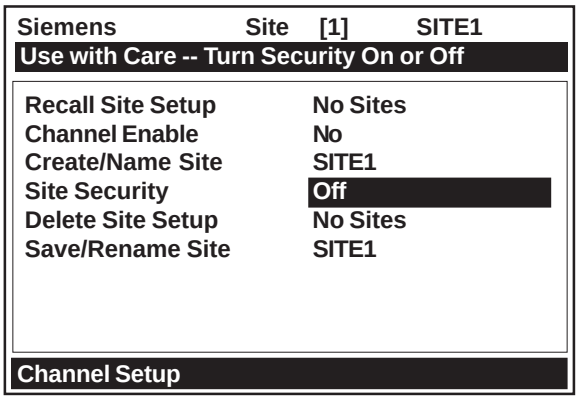
An alphanumeric string is a series of numbers and letters including the Quotation Mark and the Pound Sign symbols. You can also use a space. The meter uses these to identify a site setup or user-modified table. Menu cells that use these strings provide an 8-character (max.) field for data entry. Entering alphanumeric strings are easy since the 1010X 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.



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.)

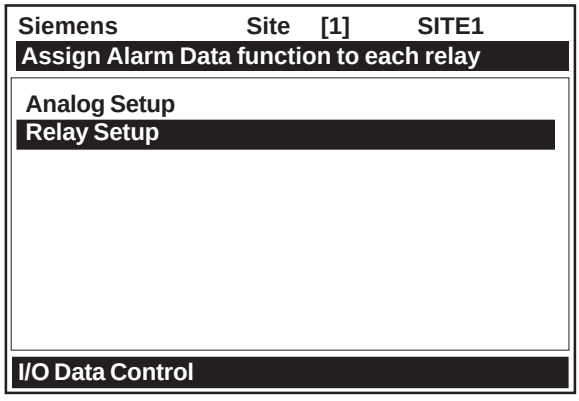


After you finish typing the string, press <ENT> to register it. This creates a new site setup called [SITE1]. This action prepares the 1010X for installation by loading default parameters in all the appropriate menu cells. Note that the [Recall Site] menu cell shows: [No Sites] and that the [Save/ Rename 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.

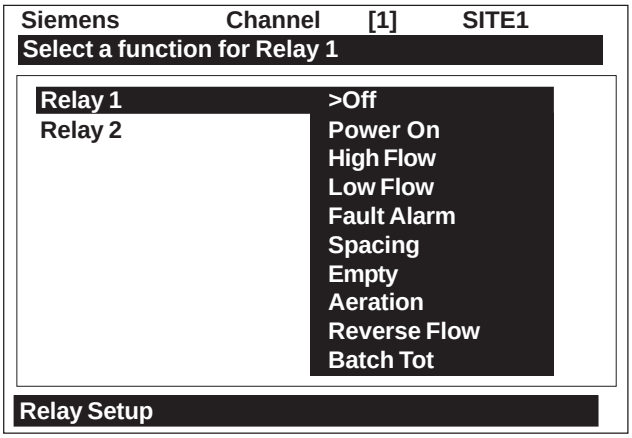


2.8.2 SELECTING ITEMS FROM AN OPTION LIST

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.*

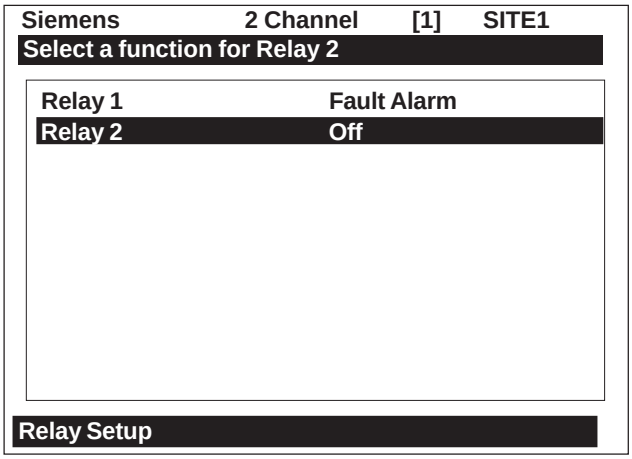


Pressing the <Right Arrow> changes the left-hand column to [Relay 1]. Pressing the <Right Arrow> again accesses the option list. This expands the highlighted area to show the contents of the list. Note that a "greater than" symbol (>) points to the top item on the list.



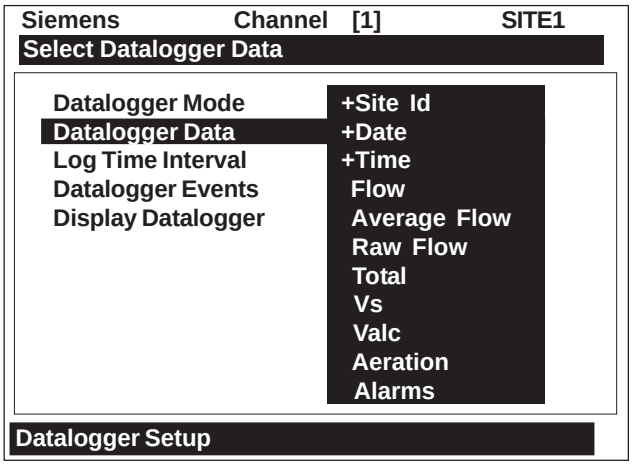
The <Up and Down Arrows> allow you to scroll the option lists. Every key press sequentially moves the cursor to the next item. Due to the size of the display screen, some option lists include more items than the display can show. For example, on the screen above the last option shown is [Batch Tot]. 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 <ENT> 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. Note that this menu cell appears on the right-hand column and that the highlighted area moves to the next menu cell in the menu sequence: [Relay 2].



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 <ENT> 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.

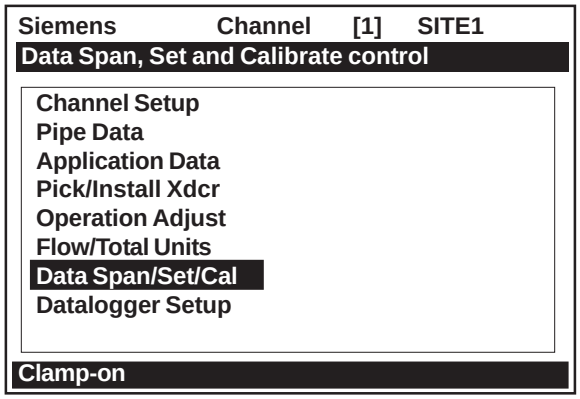


2.8.3 ENTERING NUMERIC DATA

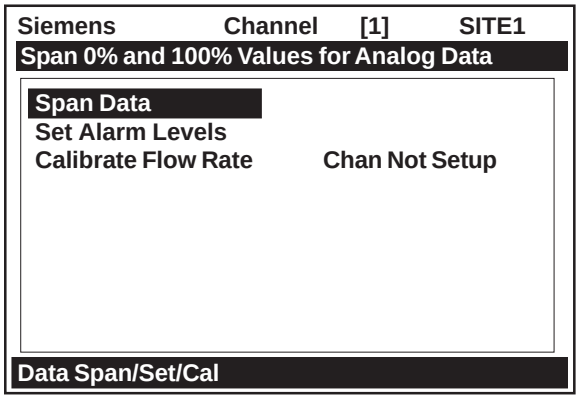
When a menu cell requires a numeric answer, press the <Right Arrow> to access a number entry field. *Note that an equal sign (=) appears before the current entry.* You can now use the number keys and the decimal point key to type a new value. If applicable, you can use <+/-> keys to change the mathematical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

NOTE: All Numeric Data cells provide a four-function calculator via the arithmetic function keys of the PC keyboard.

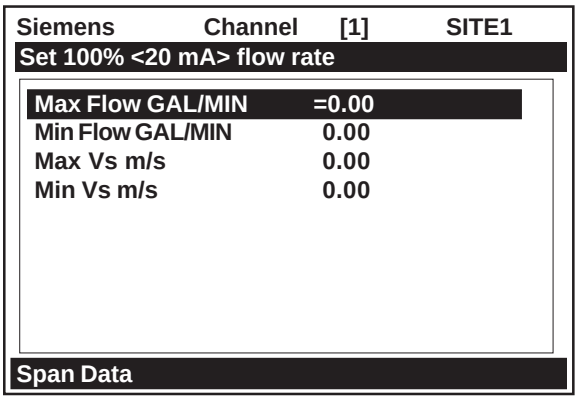
For example, to set the Span Data use the <Down Arrow> to scroll down the Clamp-on menu and highlight [Data Span/Set/Cal].

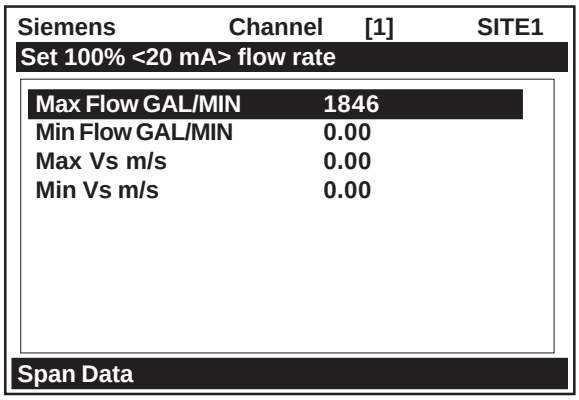


- Press the <Right Arrow> and [Span Data] is highlighted.



- 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 <ENT> key to store the numeric data.





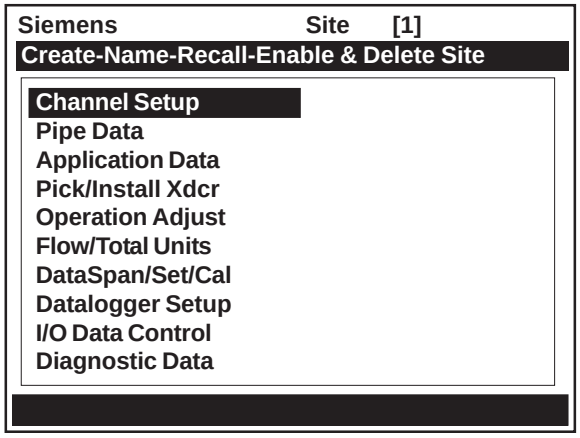
2.9 HOW TO SET UP A CHANNEL FOR TRANSIT-TIME OPERATION

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.

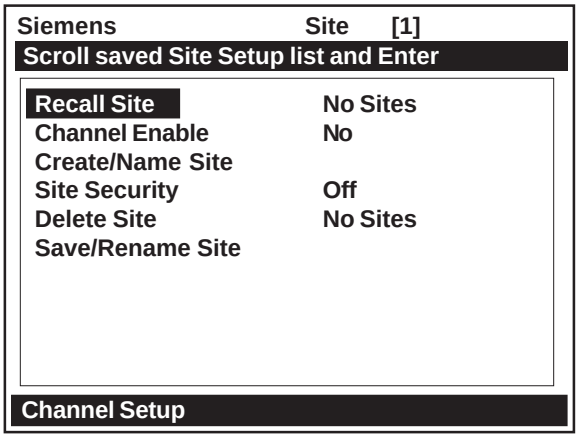
NOTE: Always begin a new installation by issuing the [Create/Name Site] command. This action prepares the flow computer for site programming by loading system defaults into the appropriate menu cells.

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).



- 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].



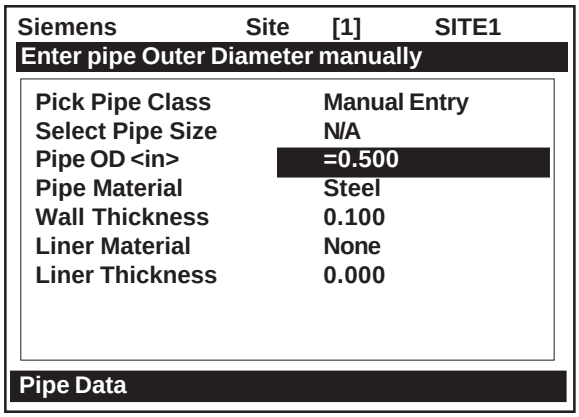
- Use the <Down Arrow> to move the highlight to [Create/Name Site]. Create a site named: SITE1 (as detailed in paragraph 2.8.1).

2.9.2 HOW TO ENTER PIPE DATA

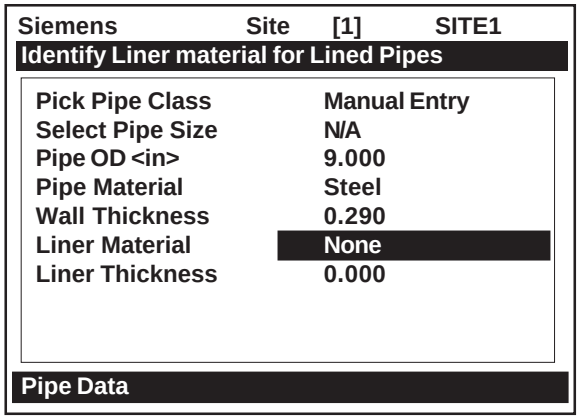
After creating the site, the next step is to enter the Pipe Data. The Pipe Data menu allows you to either enter the pipe data manually or select a preset pipe configuration from an option list. This section explains how to enter the data manually. The two mandatory entries to be entered in this menu 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.

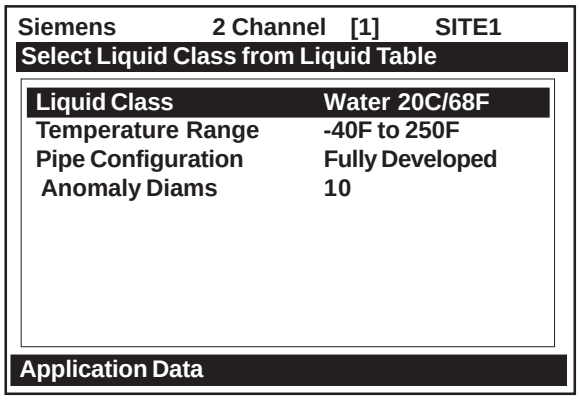


- Type digit 9 and then press <ENT>. Next, move the highlight to [Wall Thickness]. Press the <Right Arrow>, type 0.29, and then press <ENT>. The [Pipe Data] screen will show these changes as seen below.

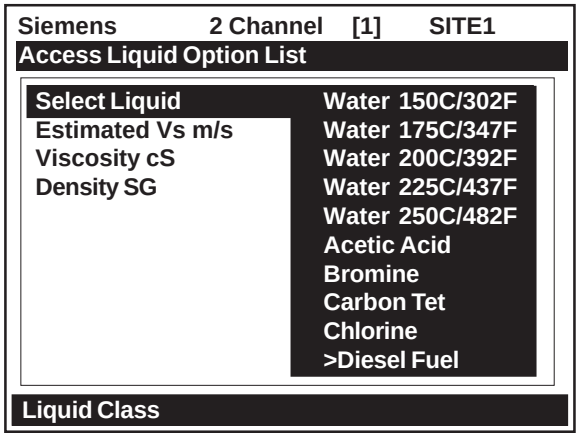


2.9.3 HOW TO SELECT A LIQUID TYPE

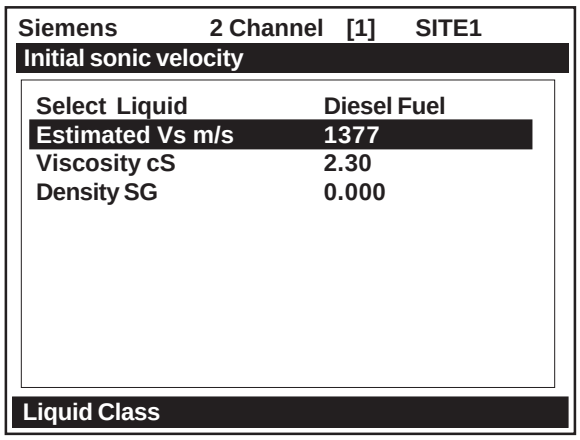
Next, we will select a liquid type. Liquid selection is optional. However, selecting a liquid makes it more likely that the meter's initial transducer spacing recommendation will be valid. In addition, it allows the meter to adjust its flow profile compensation curve to the viscosity of the liquid. You 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.



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

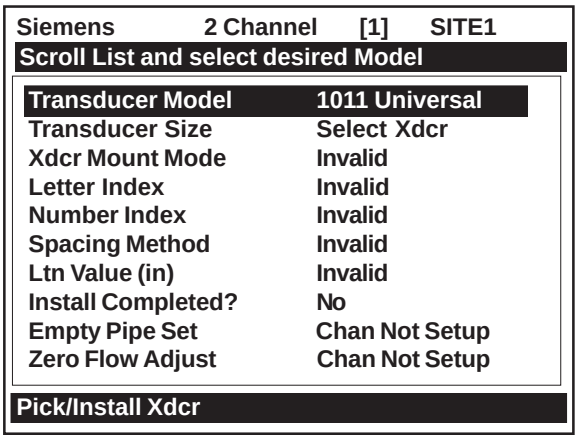


- Press the [ENT] key to select [Diesel Fuel]. Note that the screen now lists an estimate of the liquid's Sonic Velocity (Vs), its Viscosity (in centistokes) and its Specific Gravity (Density SG). All these parameters can be edited. This allows you to "fine-tune" the liquid so that it is as close as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

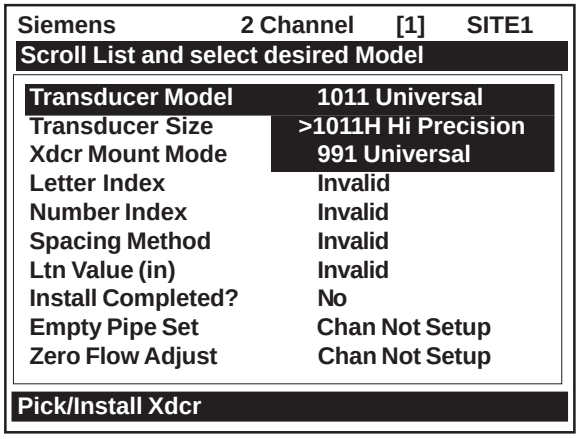


2.9.4 HOW TO MANUALLY SELECT TRANSDUCERS AND A MOUNTING MODE

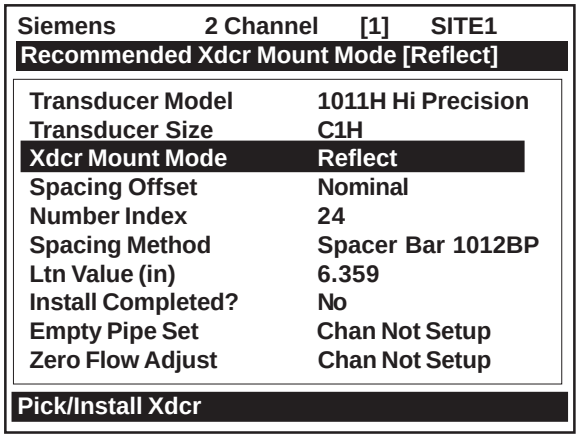
In this section, we'll explore how to override the meter recommendations. Please note that the modifications shown in the following example are only intended to provide examples of the meter's flexibility. For this example, we will discuss the procedures required to mount a set of 1011 Universal transducers of size [C2] in Reflect Mode (see next page).



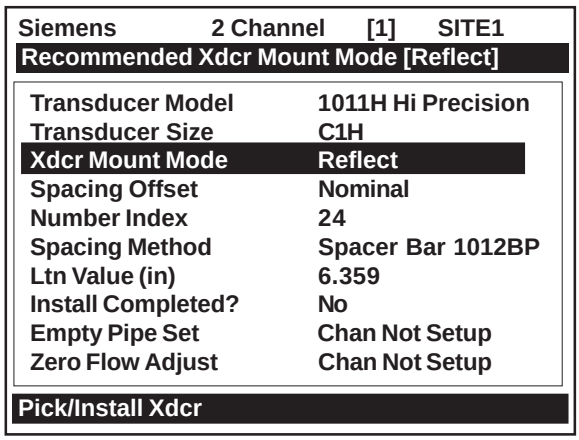
- To change the Transducer Model, press the <Right Arrow> to access the [Transducer Model] option list and move the cursor down to [1011H Hi Precision]. Press the [ENT] key to select *1011H Hi Precision*.



- 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.



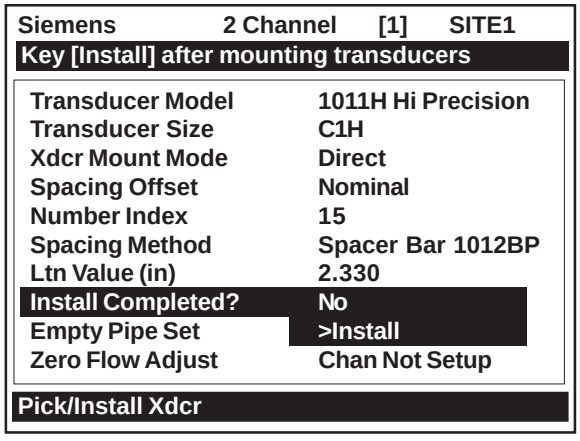
- To select the recommended transducer, press the <Right Arrow> to access the 1011H Hi Precision transducer option list. Move the cursor down to [C1H]. Press the [ENT] key to select the transducer size. This prompts the meter to calculate the install parameters. As shown below, the meter accepts the size [C1H] entry, and adjusts the transducer data accordingly.



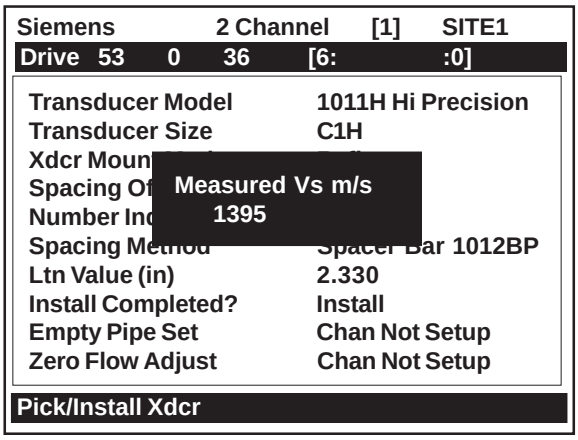
- To exercise the flexibility of the meter, we can now override the [Xdcr Mount Mode] recommendation by selecting the Direct Mount Mode instead. Press the <Right Arrow> and scroll the cursor to [Direct], then press the [ENT] key to make the selection. The transducer Number Index and Ltn values are automatically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

Installing The Transducers

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

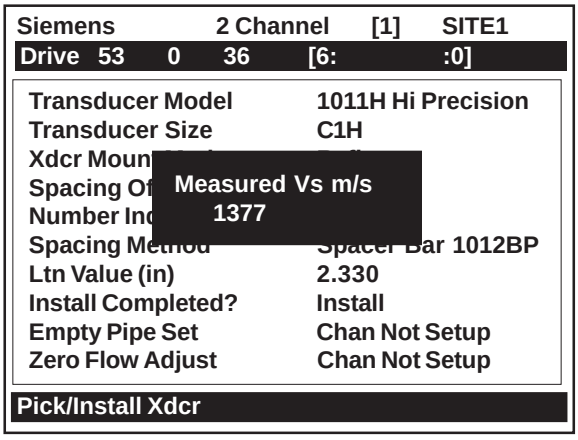


- Use the [Install Completed?] menu cell to inform the meter that the transducers are mount-ed. Use the <Right Arrow> then the <Down Arrow> to move the cursor to [Install]. Press the [ENT] key. As mentioned previously, the meter adjusts its operation to accommodate the transducers, mounting mode, pipe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

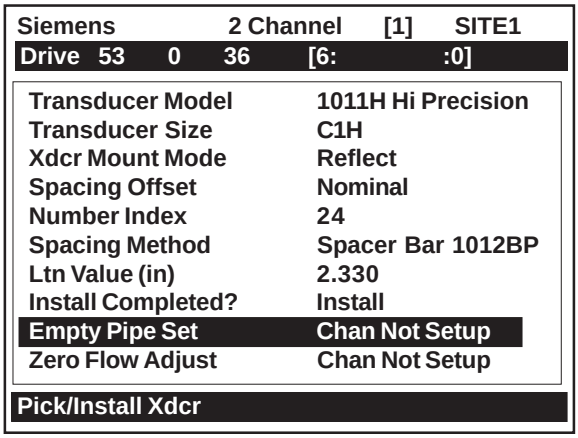


- However, as an example, assume that the liquid's sonic velocity is very well known and is actually 1377 m/s. Press the <Right Arrow>. Note that an "equal sign" appears before the displayed sonic velocity. Type [1377] and then press the [ENT] key.

NOTE: As your 1010 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.



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



- 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 (AutoZero) 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:

- Actual Zero*: requires zero flow in pipe.*

- ReversaMatic: *obtain a zero by Xdcr reversal.*

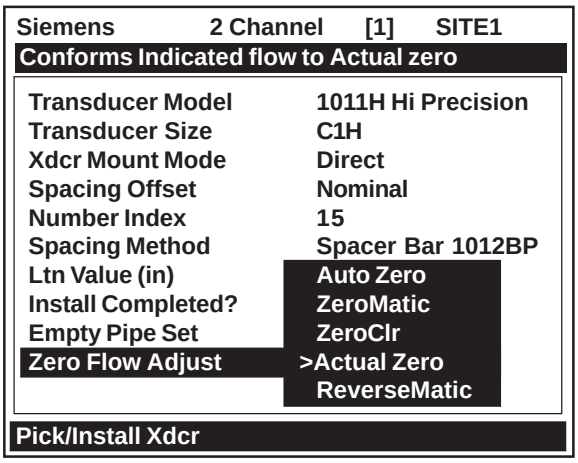
Zero Flow Adjust helps the meter to remove a possible zero offset due to pipe or transducer asymmetry. Setting the zero flow level allows the meter to sense absolute flow direction and magnitude under low flow conditions. Zero Flow Adjust also provides a ZeroClr routine to remove a zero offset setting (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

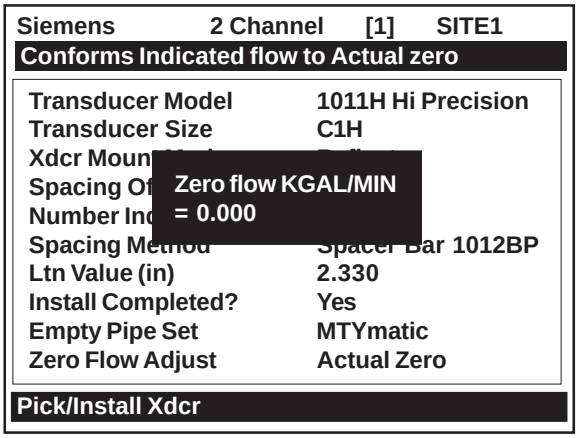
NOTE: Please reduce flow through the pipe to zero.

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).

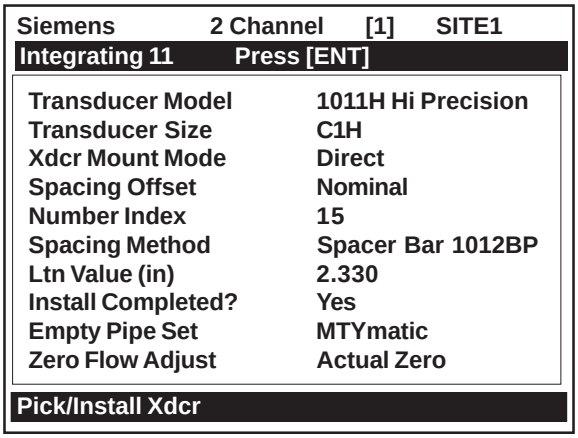
- Press the <Right Arrow> to access the [Zero Flow Adjust] option list.



- Press [ENT]. 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).



Assuming no numeric offset, press [ENT]. 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 [ENT] 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 [ENT] key twice in rapid succession.



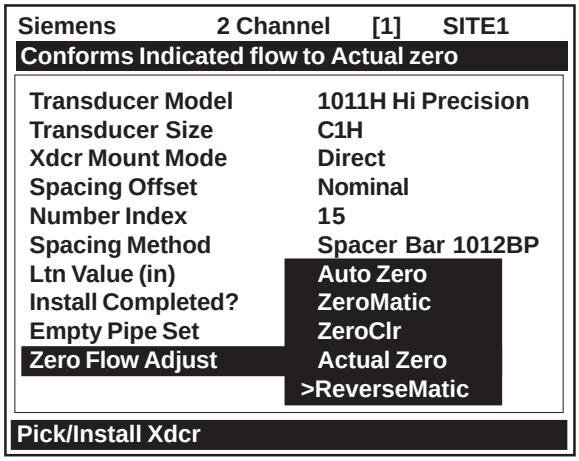
- Upon completion, the meter moves the cursor to [Operation Adjust] on the Installation Menu.

Using The ReversaMatic Routine

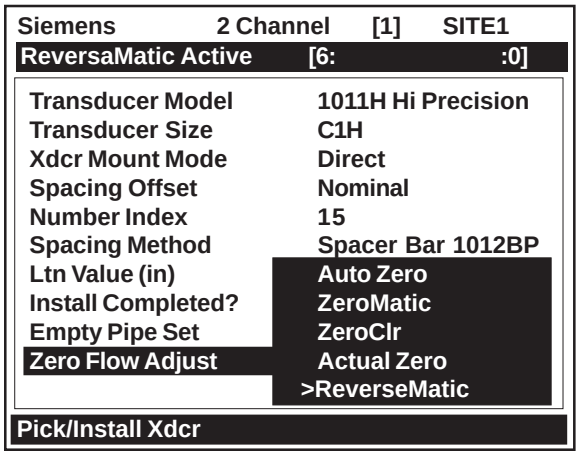
As an example, we have successfully installed 1011H Hi Precision Transducers, Size C1H, in Direct Mode. However, conditions at the site will not allow us to change the flow rate at the mounting location. In this case, we will use the ReversaMatic routine to establish a zero flow level.

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 [ENT] to invoke the routine.



- 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).

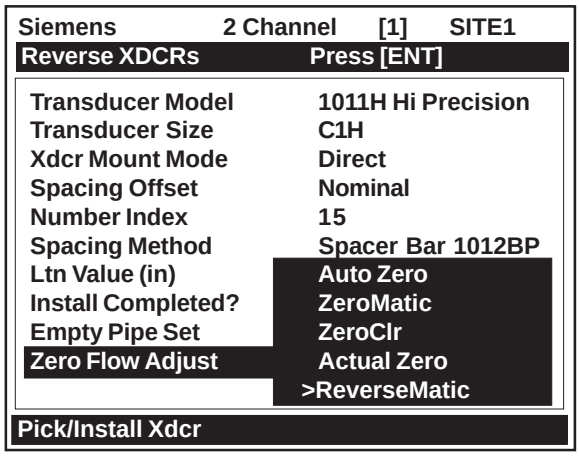


- Upon completion, the meter beeps and the LCD screen shows the prompt:

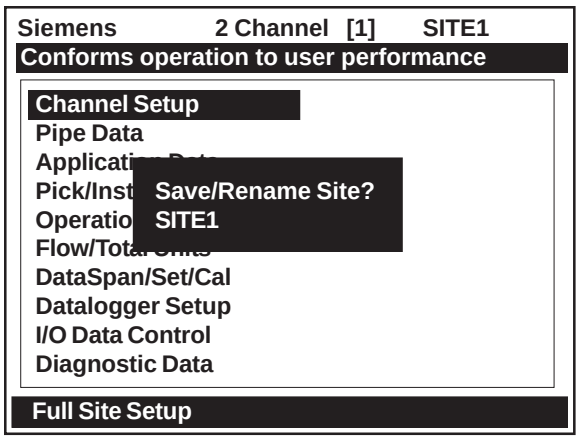
Reverse XDCRs Press [ENT].

- 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 [ENT]. 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.



This completes the ReversaMatic procedure. The system's zero accuracy will be close to that obtainable using the Actual Zero method. Press the [MENU] 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.

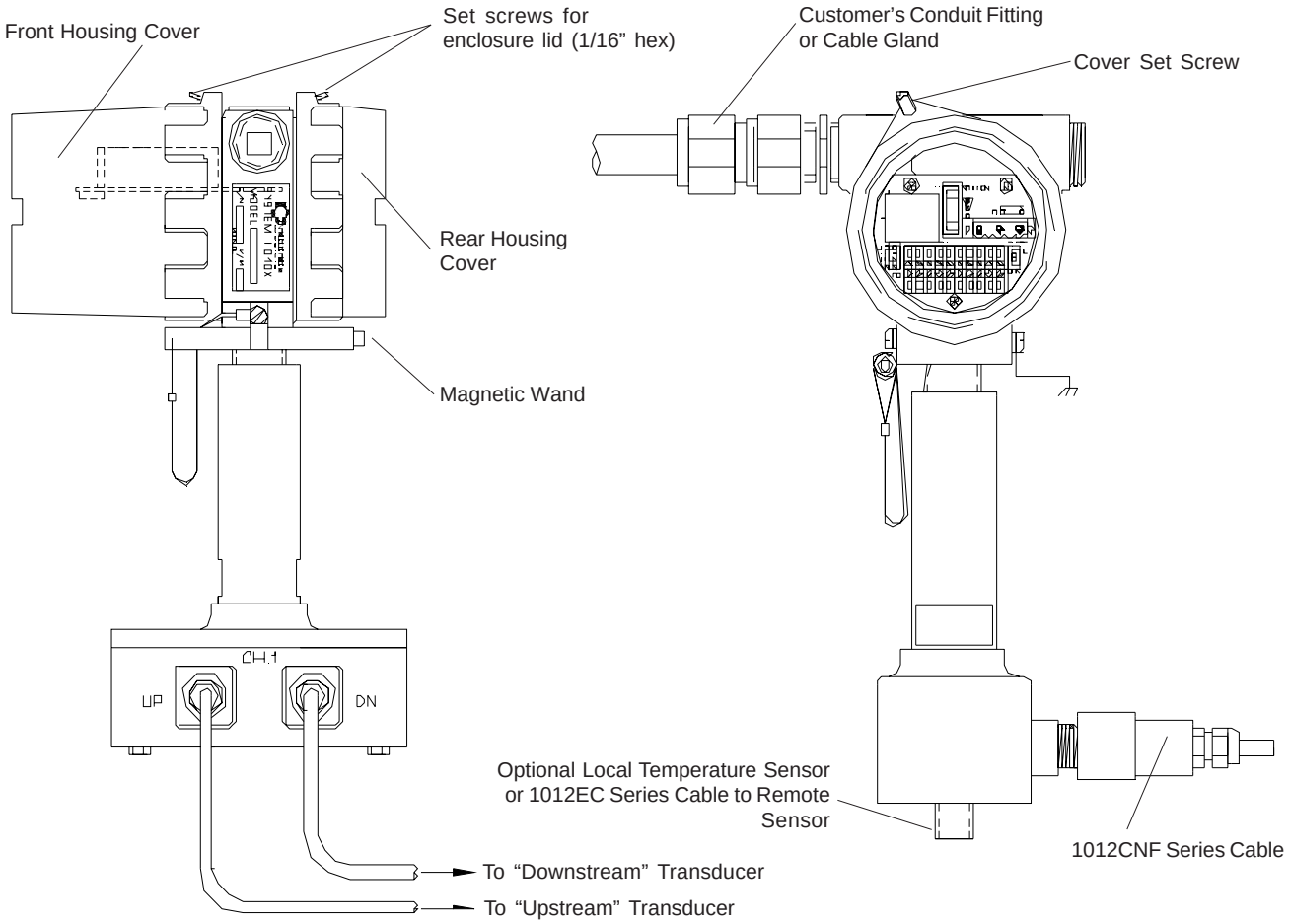


3. HARDWARE INSTALLATION GUIDE

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 engineering drawings located in Appendix B that provide important installation information that does not appear in this section.

3.1 MOUNTING THE 1010X FLOW COMPUTER

The FUS 1010X Flow Computer is shown below in the standard upright mounting position. Please refer to Engineering Drawing 1010X-8 in Appendix B of this field manual for outline dimensions, etc.



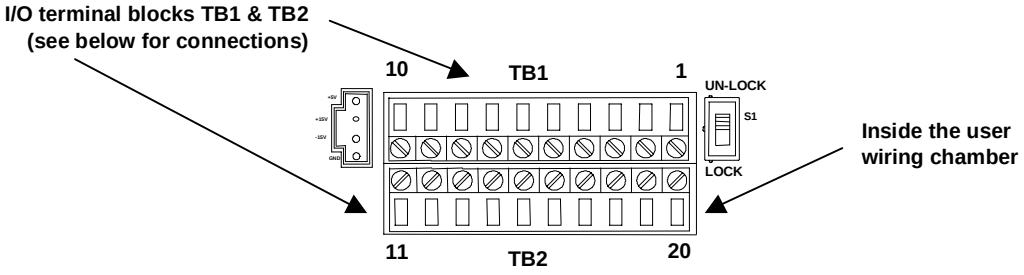
STANDARD UPRIGHT MOUNTING

NOTE: All enclosure lids are secured with setscrews. This is required to maintain the explosion-proof ratings. You will need a 1/16" hex key to remove and replace enclosure lids.

3.2 INPUT/OUTPUT WIRING

The following tables and illustrations describe both the 1010X and 1010DX input/output signals. Consult the Installation Drawings in Appendix B for details regarding I/O and transducer connections for your specific model.

3.2.1 1010X INPUT/OUTPUT WIRING (TB1 and TB2)



1010X INPUT/OUTPUT WIRING (TB1)

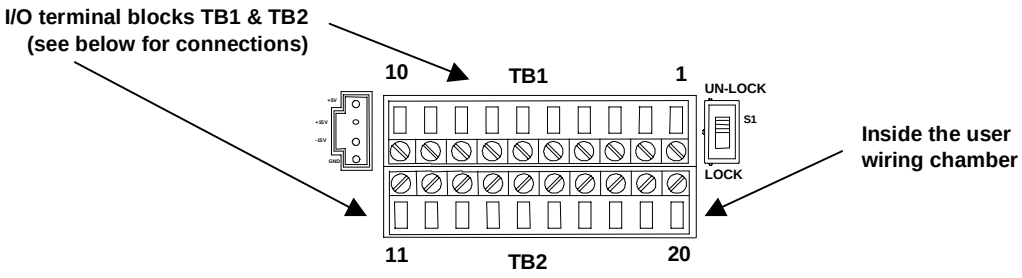
PIN#	SIGNAL	FUNCTION	NOTES
1	N/C	NOT DEFINED	Reserved for future implementation.
2	N/C	NOT DEFINED	
3	Io1 (-)	ISOLATED LOOP RETURN	Spannable 4-20 mA output proportional to any available data variable assigned under menu control. See drawing 1010X-7 Schematic A.
4	Io1 (+)	ISOLATED LOOP SUPP.	
5	ANIN (-)	ANALOG IN RETURN	Receives 4-20 mA input from external instrumentation. Optional function depends on specific 1010X model.
6	ANIN (+)	ANALOG IN (4-20mA)	
7	STATUS (-)	STATUS BIT RETURN	Status output responds to any available alarm function assigned under menu control.
8	STATUS (+)	STATUS OUTPUT	
9	PGEN (-)	PULSE GEN. RETURN	0-5000 Hz output proportional to any available data variable assigned under menu control.
10	PGEN (+)	PULSE GEN. OUTPUT	

1010X INPUT/OUTPUT WIRING (TB2)

PIN#	SIGNAL	FUNCTION	NOTES
11	Tx	STANDARD RS-232 SIGNALS	RS-232 compliant full-duplex communication port. Used for data uploading/downloading and flowmeter programming via PC and communications software.
12	RTS		
13	DTR		
14	Rx		
15	CTS		
16	GND		
17	D1 INPUT	ISOLATED DIGITAL COMMAND LINES	Input Signal to reset internal totalizer.
18	D1 RETURN		Input Signal return for totalizer reset.
19	D2 INPUT		Input Signal to freeze internal totalizer (NOTOT).
20	D2 RETURN		Input Signal return for NOTOT command.

3.2.2 1010DX INPUT/OUTPUT WIRING (TB1 and TB2)

This following describes the 1010DX (i.e., the dual-channel version of the 1010X) input/output signals. Consult the Installation Drawings in Appendix B for details regarding both I/O and transducer connections for your specific model.



1010DX INPUT/OUTPUT WIRING (TB1)

PIN#	SIGNAL	FUNCTION	NOTES
1	Io2 (-)	ISOLATED LOOP RETURN	Spannable 4-20mA output proportional to any available CH 2 data. Variable assigned under menu controls. See drawing 1010DX-7 Schematic A.
2	Io2 (+)	ISOLATED LOOP SUPP.	
3	Io1 (-)	ISOLATED LOOP RETURN	Spannable 4-20 mA output proportional to any available data variable assigned under menu control. See drawing 1010DX-7 Schematic A.
4	Io1 (+)	ISOLATED LOOP SUPP.	
5	ANIN (-)	ANALOG IN CH 2	Receives 4-20 mA input from external instrumentation. Optional function depends on specific 1010X model. Use RS-232 ground for return.
6	ANIN (+)	ANALOG IN CH 1	
7	STATUS (-) CH1	STATUS RETURN CH 1	Status output responds to any available alarm CH 1 function assigned under menu control.
8	STATUS (+) CH1	STATUS OUTPUT CH 1	
9	STATUS (-) CH2	STATUS RETURN CH2	Status output responds to any available alarm CH 2 function assigned under menu control.
10	STATUS (+) CH2	STATUS OUTPUT CH2	

1010DX INPUT/OUTPUT WIRING (TB2)

PIN#	SIGNAL	FUNCTION	NOTES
11	Tx	STANDARD RS-232 SIGNALS	RS-232 compliant full-duplex communication port. Used for data uploading/downloading and flowmeter programming via PC and communications software.
12	RTS		
13	DTR		
14	Rx		
15	CTS		
16	GND		
17	CH 1 INPUT	ISOLATED NOTOT COMMAND LINES	Input Signal to reset internal totalizer – CH 1
18	CH 2 RETURN		Input Signal return – CH 1
19	CH 2 INPUT		Input Signal to freeze internal totalizer – CH 2
20	CH 2 RETURN		Input Signal return – CH 2

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 had 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.

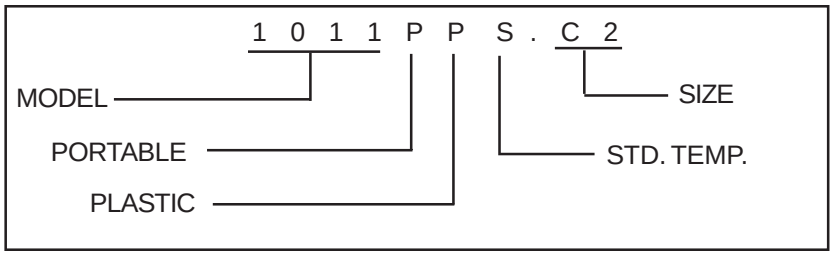
3.3.1 HOW TO IDENTIFY 1011 TRANSDUCERS AND MOUNTING HARDWARE

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

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

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

For example, the Part Number: 1011PPS-C2 means:



3.3.2 SELECTING A LOCATION FOR CLAMP- ON TRANSDUCERS

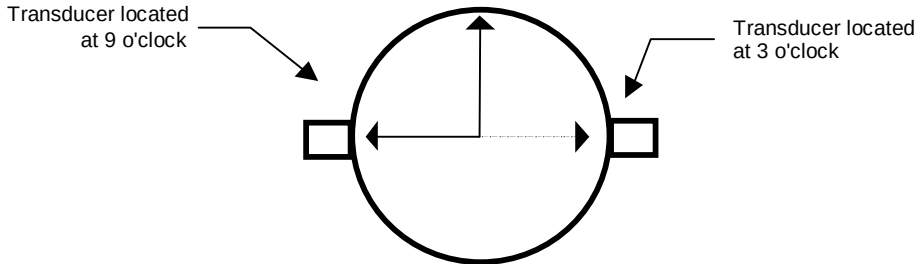
- Locate the transducers downstream from the center of the longest available straight run. A location ten pipe diameters or greater downstream from the nearest bend will provide the best flow profile conditions.
- Do not (if possible) install the transducers downstream from a throttling valve, a mixing 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 Siemens systems, or any type of ultrasonic equipment. You can run these cables through a common conduit ONLY 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.

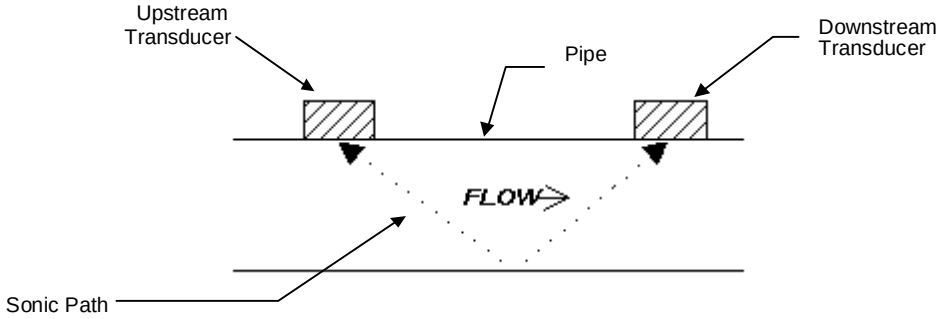
- Never mount transducers on the top or bottom of a horizontal pipe. The best placement on a horizontal pipe is either the nine o'clock or three o'clock position for Reflect Mode, or one transducer at nine o'clock and one transducer at three o'clock for Direct Mode. Mounting on a vertical pipe is recommended 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*.



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.

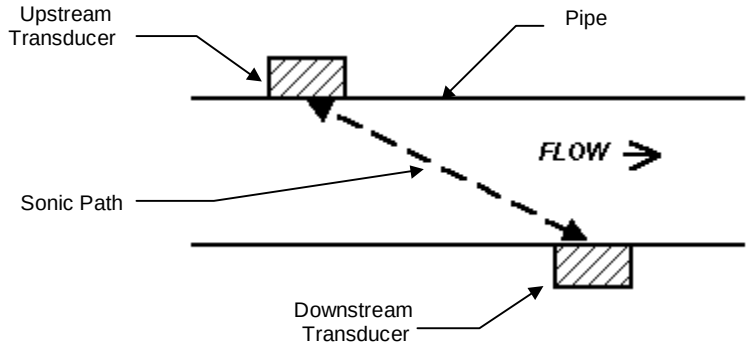


REFLECT MOUNT

(Pipe shown in top view for ease in visualizing sonic path)

We recommend Reflect mount 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 user-participation. In addition, Reflect mount 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 usually improves performance with sonically attenuative liquids or pipe materials. We recommend using Direct mount for plastic pipes. Compared to Direct mounting, Reflect mount requires almost double the amount of a straight pipe run. 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

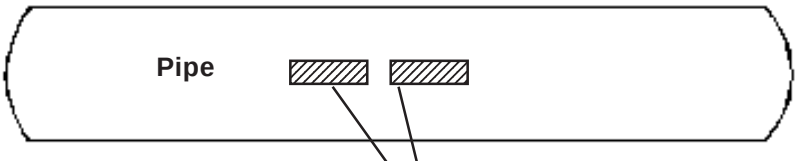
- Pick a mounting location with the longest straight run. You must have easy access to at least one side of your pipe. The mounting location must remain full, even at zero flow.

- Decide on your mounting mode (Direct or Reflect). Always use Reflect Mode whenever possible. You may only need to use Direct Mode if your pipe is plastic.

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

- Refer to the next sections for illustrated instructions on how to locate each area to be cleaned and how to use each mounting option.

Please note that the instructions show vertical mounting for clarity purposes only. 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 half again the length of the transducer on the front and back.

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 Siemens.

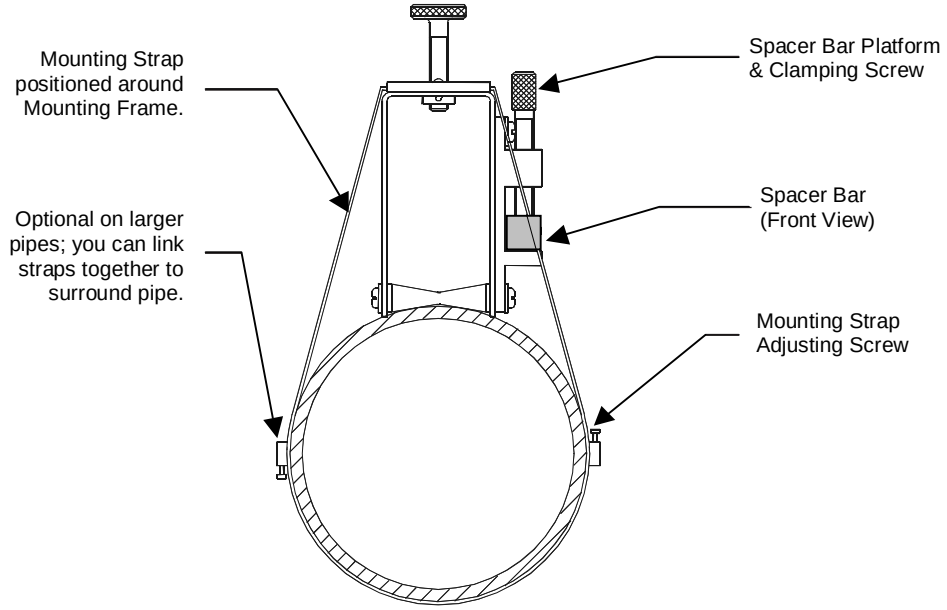
RECOMMENDED SONIC COUPLING COMPOUNDS

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	110	High temp. temporary couplant to be used when setting up high temp. plastic flow transducers. Temp. range: 255°F to 450°F.	Resists breakdown and thinning out at high temperatures.
5	111	Permanent high temp. couplant for plastic flow transducers. Temp. range: 255°F to 450°F.	Room temperature vulcanizing silicone rubber.
6	112	Permanent ambient temperature couplant for plastic flow transducers. Temp. range: -40°F to 250°F.	Room temperature vulcanizing silicone rubber.
7	113	Protective spray for providing corrosion resistance to exposed transducer and track parts.	Spray on liquid. Excellent resistance to salt water atmosphere.
8	114	Temporary and long term couplant for all flow transducer types. Temp. range: -40°F to 255°F.	Teflon filled grease. Water resistant.
9	117	Long term and permanent couplant for Clamp-On transducers. Temp. range: -40°F to 450°F.	Silicone grease loaded with metal oxides. Resists Breakdown and thinning at high temperatures.
10	120	Submersible couplant. To be used on all submerged transducer applications.	Extremely water resistant. Consult Controlotron before using.
11	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.
12	124	Long term and permanent couplant for Clamp-On transducers. Temp. range: -40°F to 250°F.	Two part room temperature cure adhesive.
13	128	Temporary and long term couplant for all flow transducer types. Temp. range: -40°F to 375°F.	High viscosity silicone grease. Water resistant.
14	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.*

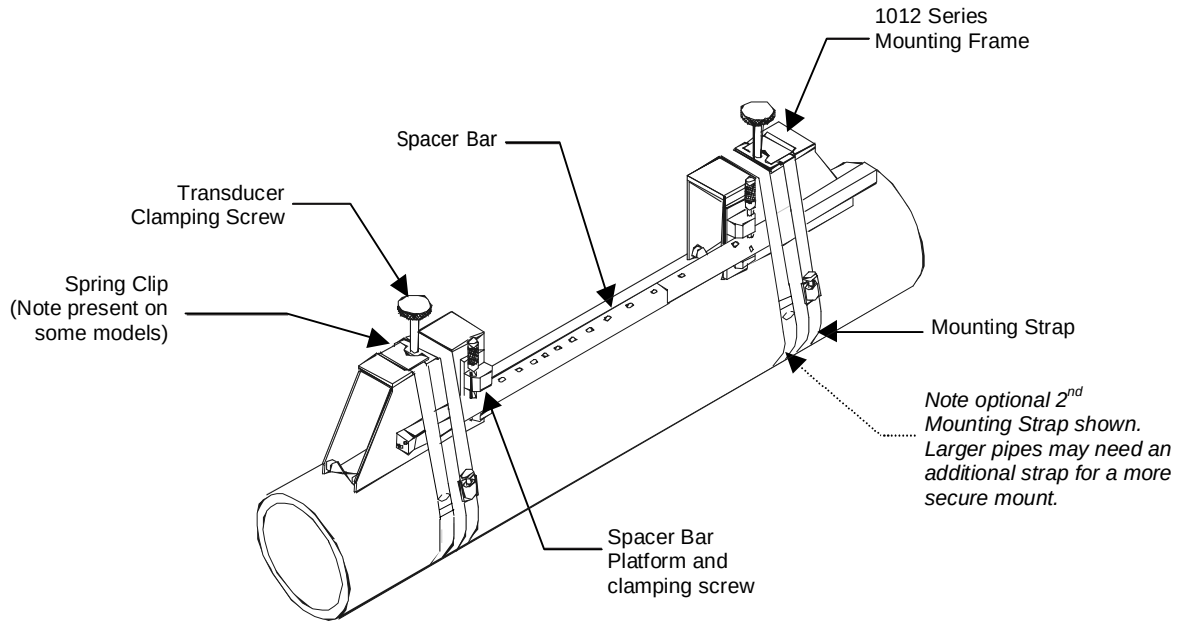
3.3.6 REFLECT MODE - MOUNTING FRAMES AND SPACER BAR

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 <ENT> 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 1010X-7, Single Channel or 1010DX-7 Dual-Channel.

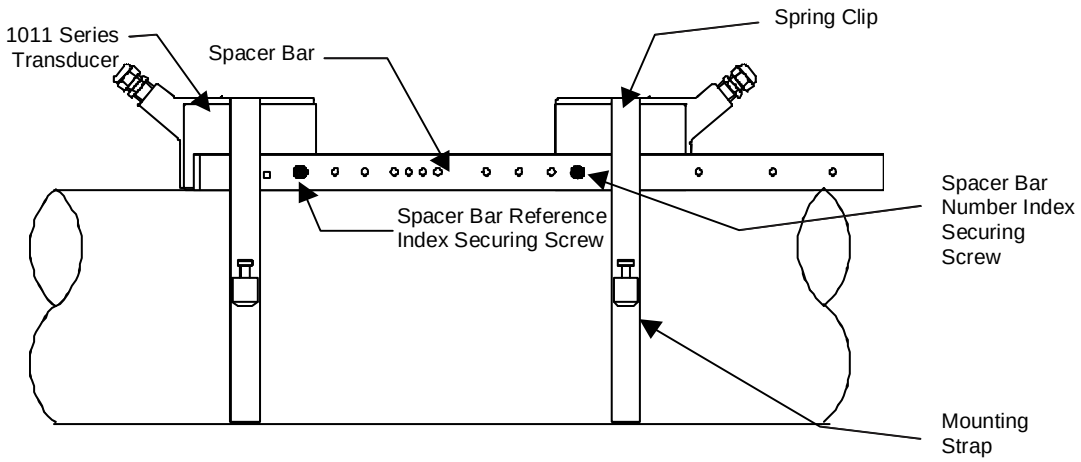
7. You can now press <ENT> to finish the transducer install routine.

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)

3.3.7 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 <ENT> 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 determined 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-inch 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.

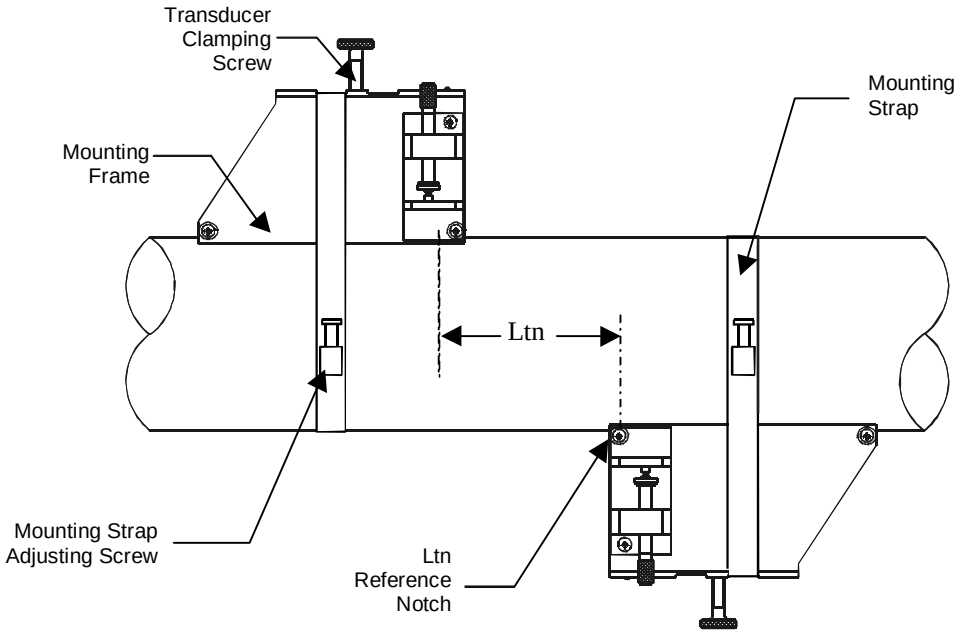
Put mounting strap around transducer and tighten as in Step 5. Sight along spacer bar to ensure axial alignment to the pipe. Adjust if necessary and do not overtighten. Ensure that the transducers do not move while tightening.

7. Connect the transducer cable, ensuring that you have observed the upstream/downstream 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.

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

3.3.8 DIRECT MODE - MOUNTING FRAMES, SPACER BAR AND SPACING GUIDES

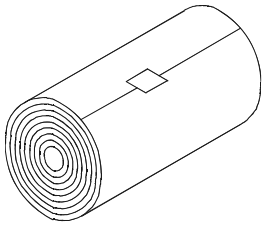
The combination of mounting frames, spacer bar and spacing guides is the recommended way to mount Direct Mode transducers. The mounting frame establishes the axial alignment of the transducers, and allows you to remove and replace either transducer while preserving their exact mounting location.



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 spacing 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 spacing guide comes in various lengths and widths to accommodate most pipe sizes (see list below).

Spacing 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 SPACING GUIDE

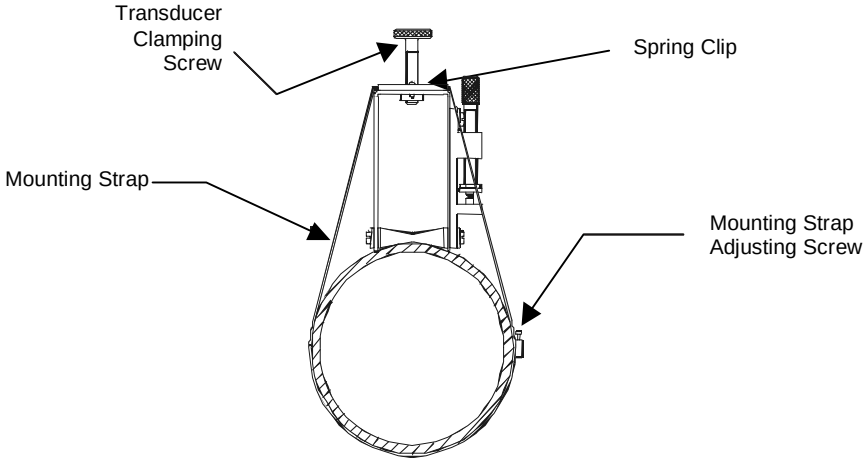
1. Perform all the required menu steps up until the point where the flow computer issues the number index and prompts you to press <ENT> to finish the transducer install routine.

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.

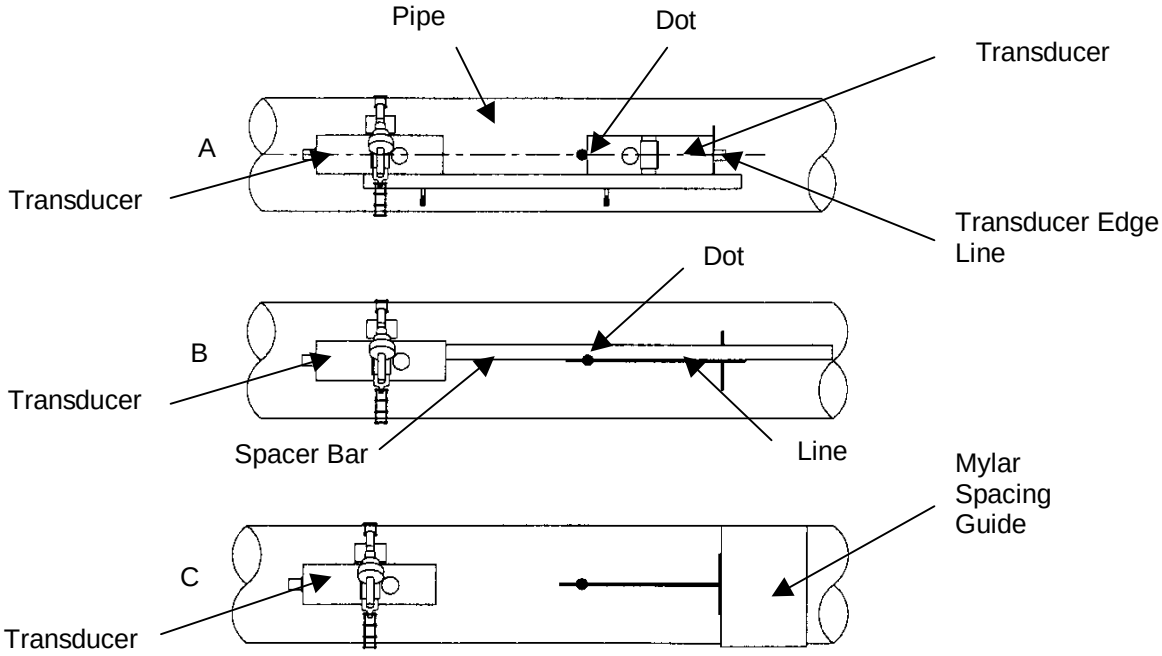
4. Put a mounting strap around the pipe and engage an end into adjusting screw (screw should be pointing up). Position frame in the middle of area you have cleaned and centered on the pipe with its angled end facing away from where the other frame will sit.



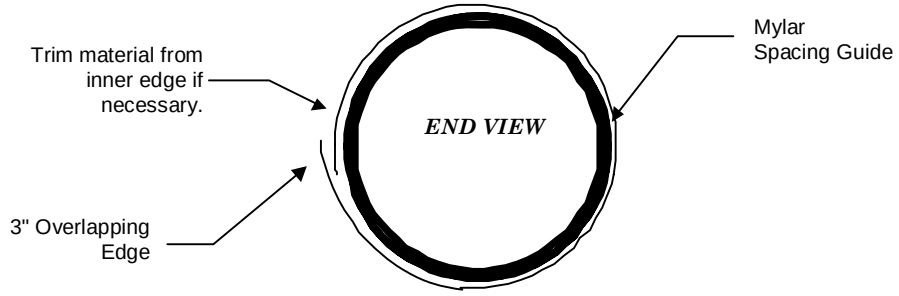
WRAPPING STRAP UNDER PIPE AND ATTACHING TO ADJUSTING SCREW

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 below). While holding, also mark along the front edge of the frame with pencil or fine chalk line (see B below).



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" above). Set the bar aside.

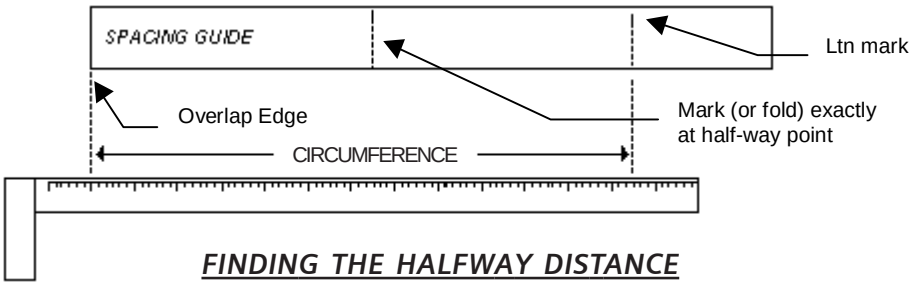


WRAPPING THE MYLAR SPACING GUIDE AROUND THE PIPE

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

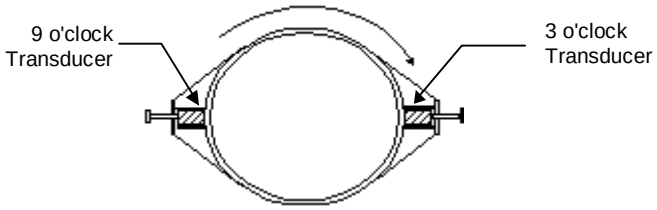
9. Realign left edge of the guide with the transducer edge mark. Line up both vertical edges of the guide and ensuring that it is snug around the pipe, mark along the overlapping edge.

10. Remove Mylar spacing 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 next page).



FINDING THE HALFWAY DISTANCE

11. Reinstall the spacing 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.



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 <ENT> to finish the transducer install routine.

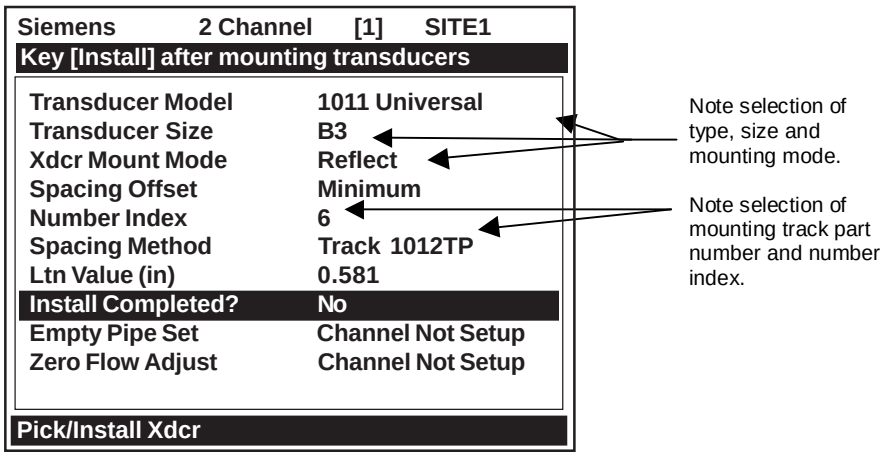
3.3.9 USING 1012T MOUNTING TRACKS

The 1012TP and 1012THP Mounting Tracks provide a rigid mounting platform for Series 1011 universal or high precision size A or B transducers. The mounting tracks service pipe sizes up to a maximum of 5.00" (140 mm) outer diameter. Operating temperatures are supported up to 250°F (121°C). 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. Please refer to Engineering Drawing 1012THP-7A for reflect mounting of high precision transducers and 1012THP-7B for direct mounting of high precision 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 6.4 for details on the Transducer Installation procedure. If necessary, review paragraphs 3.3.2 through 3.3.4 for details on how to select and prepare a mounting location on your pipe.

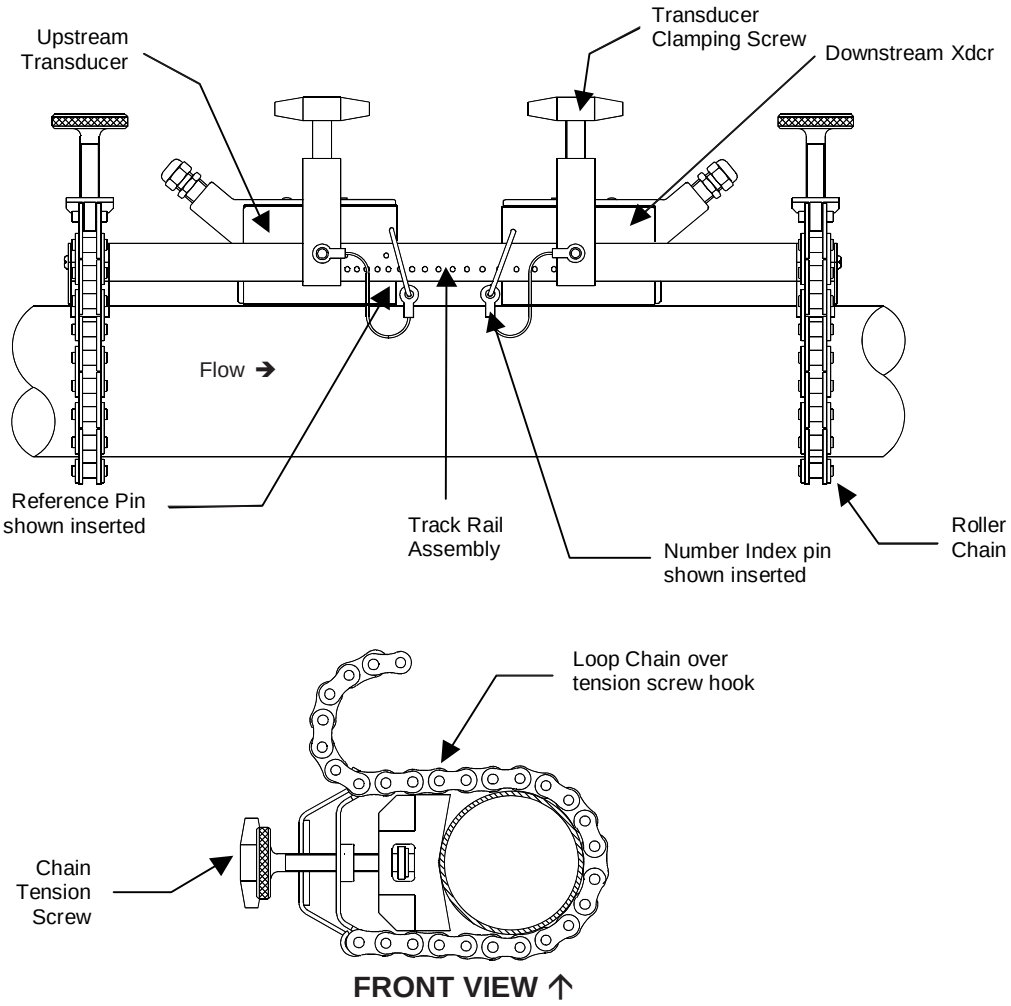
Installing a 1012T Mounting Track in Reflect Mode

Paragraph 6.4 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, plus the designation of the number index.



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 Completed?] 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).



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.

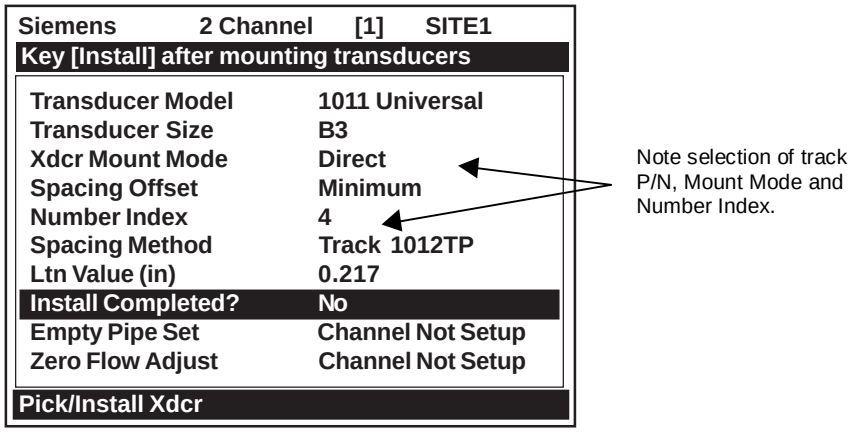
3. Mark a generous area around the transducers (1/2-inch on either side and half again the length front and back) with a pencil or chalk. Loosen and move the assembly away from marked area. Prepare the two areas you marked by de-greasing the surface if needed and removing any grit, corrosion, rust, loose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

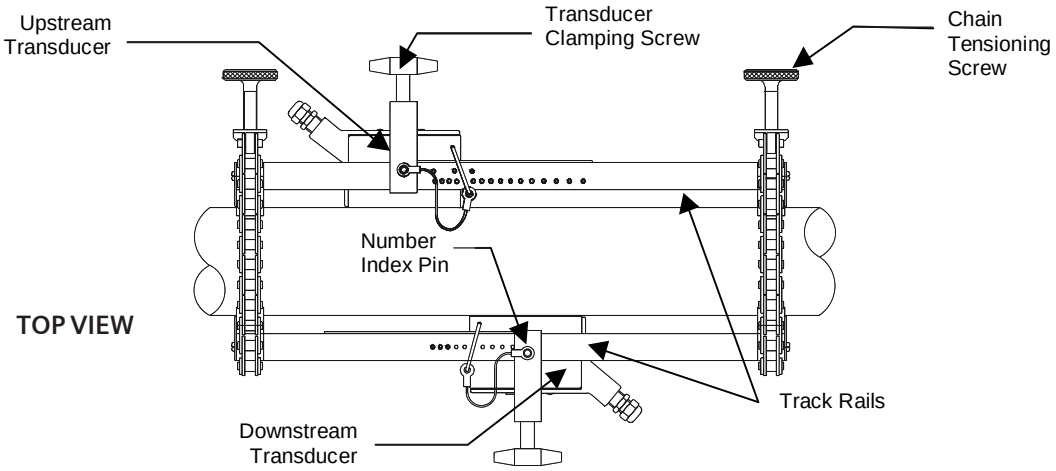
Paragraph 6.4 describes the installation procedures that lead up to the automatic selection of transducers, mounting mode and spacing method. Shown is a Model 1012T mounting track to accommodate size B3 universal transducers. Examine the figure below which shows a typical Pick/Install Xdcr menu screen. Note the automatic assignment of model numbers for the transducer and mounting track, plus the designation of number index.



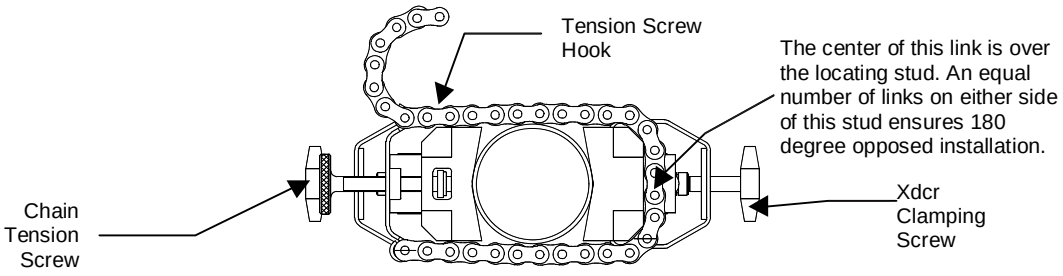
1. Perform all required menu steps up until the point where the flow computer prompts you to press <ENT> to finish the transducer install routine. Note the reported number index.

   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 180° 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 180° OPPOSED WITH MOUNTING TRACK



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 spacing 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 before placing the transducer in the tracks.

10. 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 input jacks.

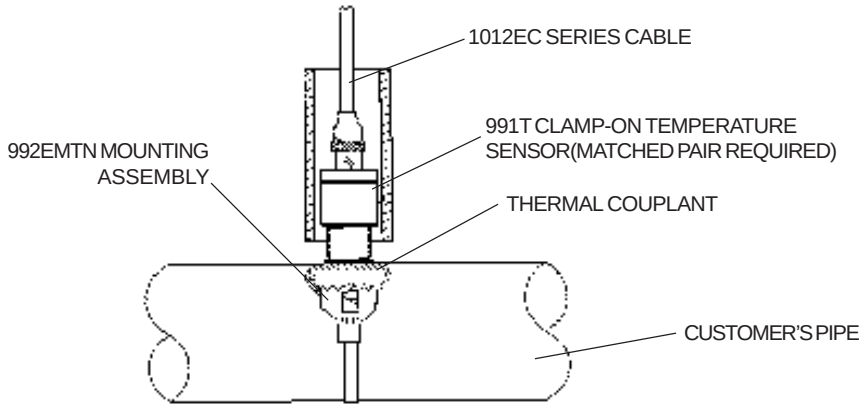
3.4 TEMPERATURE SENSORS (optional)

In order to accurately measure the liquid temperature, the System 1010X flowmeter can operate with a Resistive Temperature Device (RTD) sensor. These sensors are available in clamp-on style Model 991T, or in insert (Thermowell) style Model 991TW. Both styles incorporate 1000 ohm platinum RTD's for high precision.

WARNING: Turn flowmeter power OFF before connecting cables to the Temperature Sensor input.

3.4.1 991T CLAMP-ON TEMPERATURE SENSOR

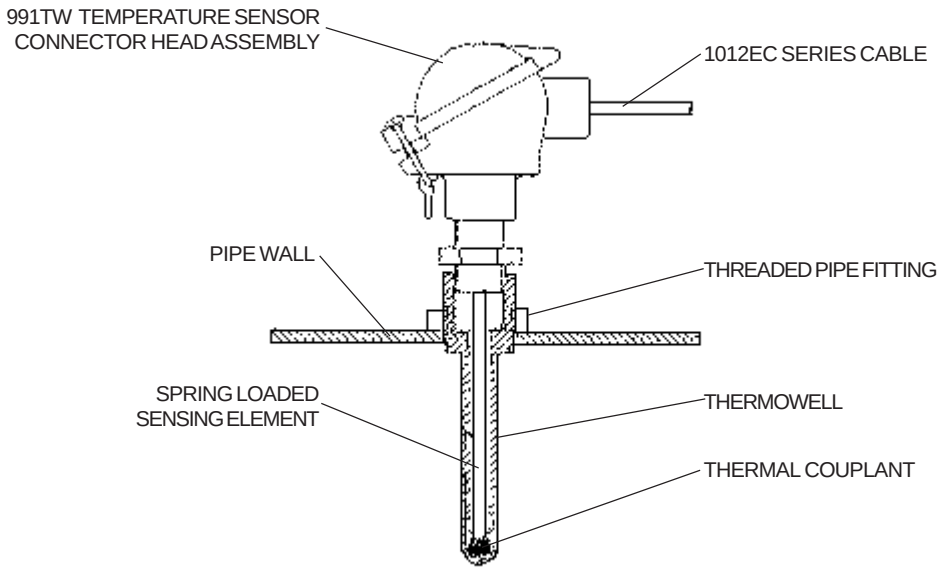
Clamp-on style sensors are mounted on the surface of the monitored pipe using 992EMT series mounting assemblies. Apply a generous quantity of the thermal couplant provided to the tip of the sensor and attach it securely to the cleaned pipe surface with the proper mounting assembly. Temperature measurement anomalies resulting from variations in ambient temperature conditions can be minimized by insulating the pipe and sensor after clamp-on installation is complete.



3.4.2 991TW THERMOWELL TEMPERATURE SENSOR

The 991TW insert sensors are designed to be used in pipes equipped with Thermowells. These are spring-loaded 1/4-inch diameter sensors with 1/2-inch NPT integral connection heads, available in several lengths to accommodate a range of pipe sizes. Thermowells for new installations are available from Alloy Engineering Company in Bridgeport, Connecticut.

Both types of temperature sensors are connected to the energy flowmeter via 1012EC series cables. These four wire cables, associated drive and sensing circuits assure that measurement accuracy at the RTD is independent of cable length.



991TW Thermowell Temperature Sensor

3.5 NOTES ON SYSTEM 1010 ANALOG INPUT MODULES

Single Channel Models

- System 1010 NEMA flowmeters report input module temperature sensor connections T1 and T2 as system variables.

Dual Channel/Path Models

- The Dual Channel flowmeters report both T1 and T2 as generic variables for both channels.
- The Dual Path flowmeter uses T1 to report liquid temperature. (Note that T2 is used to report ambient temperature in some Leak Detector systems.)
- The Analog Input of temperature takes priority over the built-in RTD (Resistive Thermal Device) measurement of temperature.

3.6 CLAMP-ON RESISTIVE TEMPERATURE DEVICE (RTD) INSTALLATION NOTES

The Clamp-On RTD sensor, with which your 1010X is supplied, is extremely sensitive and precise. Its contribution to the performance of your meter can be as important as that of the liquid flow sensors. Please consult the installation drawings for details on physical installation and wiring of the RTD. In order to produce the best possible tracking of the true liquid temperature, try to make your installation conform to the notes on the installation drawing and these following tips:

- Prepare the pipe surface by removing paint to expose bare metal and by smoothing out any remaining rough spots.
- Use the thermal couplant compound (CC#117) between the face of the RTD element and the pipe surface to improve the conductivity of the metal-to-metal contact.

- Keep the RTD out of direct sunlight or other non-pipe sources of heat or cold that may affect their temperature sensing. The foam insulator supplied helps in this regard, but consider using additional pipe insulation for all installations exposed to extreme ambient conditions. Consider mounting the RTD under the pipe in order to keep it out of direct sunlight.
- In installations where RTD elements are exposed to harsh conditions such as condensation, salt spray, etc., use CC#110 couplant compound to coat the connection between the cable and the RTD sensor. Consult Installation Drawing 991TN-7 for details.

4. OPERATING SYSTEM 1010X WITH FLOW TUBES

Only the 1010FTX flow computer supports the software (optional) for the 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. Note the following essential elements for a successful installation:

- Mounting in accordance with the guidelines presented in this section and the Installation/Outline drawings accompanying the specific Flow Tube.
- The completion of the Installation Menu procedures described in this field manual.
- Satisfactory performance depends also on the accuracy of the entered data.

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 Siemens may be able to provide the correct liquid viscosity and data for your application. Siemens 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 CORRECT 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.

1. 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.

2. 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.

3. 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.

4. 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.
5. DO NOT run the transmit/receive cables in common bundles with cables from any other equipment.
6. 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 1010 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 1010X FOR FLOW TUBE OPERATION

The example in this section shows how to set up channel 1 of a 1010 dual channel system for use with a 1011FT stainless steel Flow Tube. Note that Series 1010 dual-channel models allow flow tube operation with either measurement channel. In addition, all 1010 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

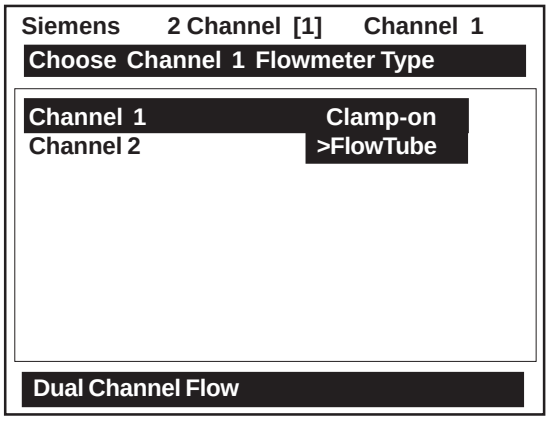
Setting up the measurement channel for Flow Tube operation consists of the following tasks:

- 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.

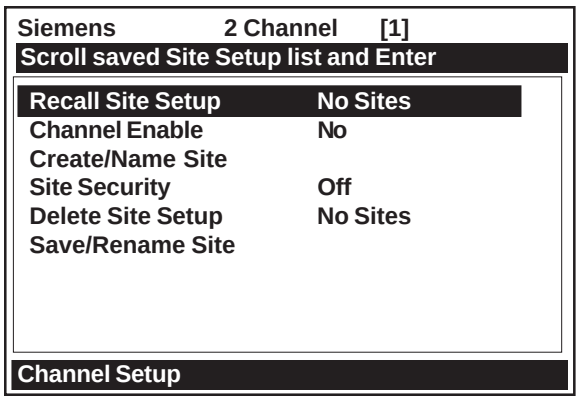
4.3.2 SETUP PROCEDURE

From the Channel Select screen:

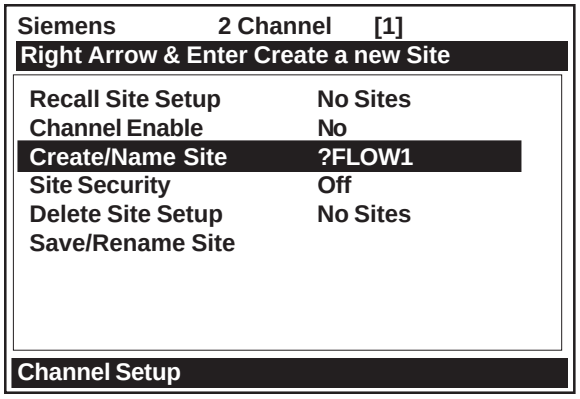
1. Press the <Right Arrow> to access the option list, then press the <Down Arrow> to move the cursor to [FlowTube] (if required).



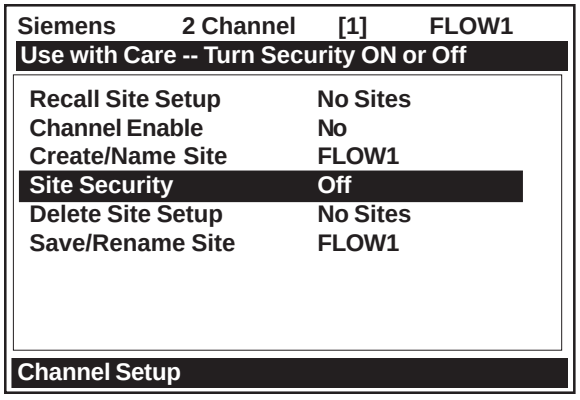
2. To select [Flow Tube], press <ENT>. This enables the [Flow Tube] menu. Press the <Right Arrow> to access the [Channel Setup] menu.



3. Move the highlight by pressing the <Up/Down Arrows> 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.

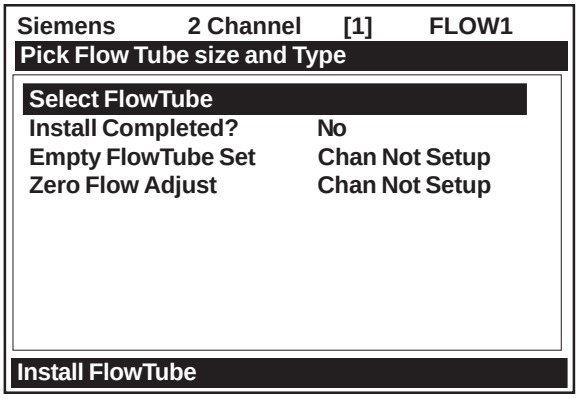


4. Press <ENT> to create a new site and register the site name: FLOW1. Note that the name now appears in the site name field on the upper right of the display and in the [Save/Rename Site] menu cell.

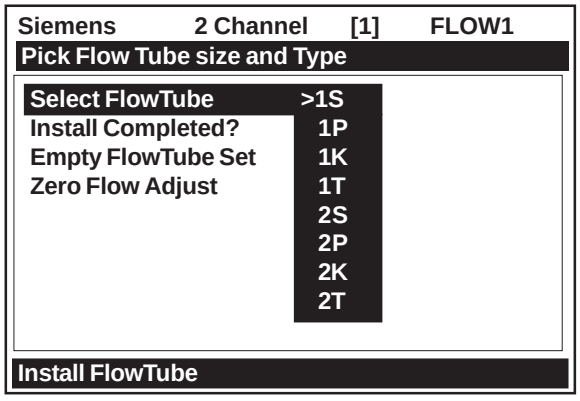


5. Press the <Left Arrow> to leave the [Channel Setup] menu.

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 Technical Service Group may be able to provide the viscosity data for the liquid to be measured.



7. To access the [Select 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.

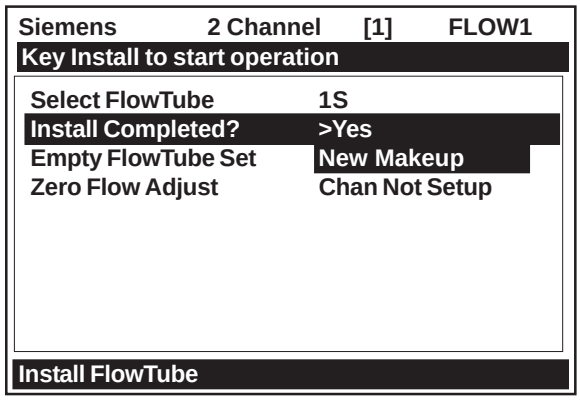


8. To select size ***1S*** press <ENT>. This moves the highlight to [Install Completed?].

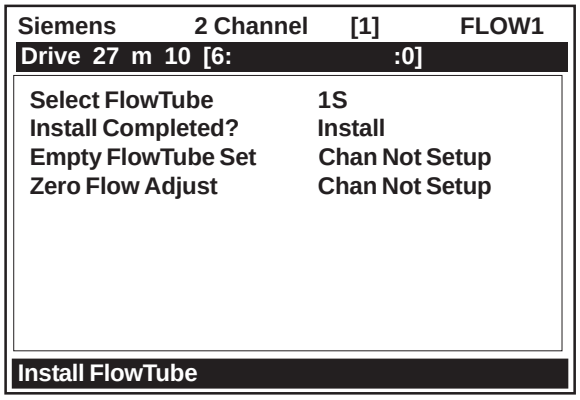
You can complete the Installation procedure without actually mounting the flow tube at its intended location. Fill the flow tube completely with liquid and connect the Up and DN cables according to the Installation/Outline Drawing. Complete the instructions in this section. If you choose to mount the 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.

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

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



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



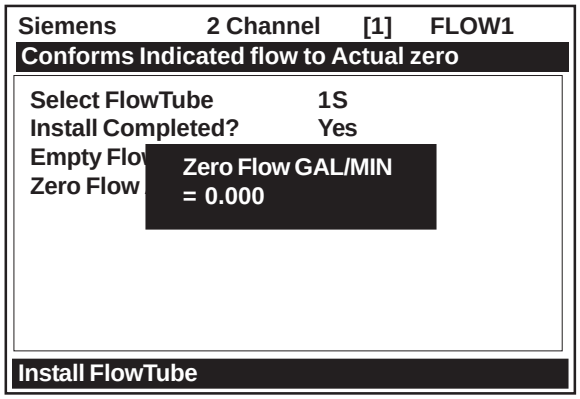
11. Upon completion, the computer reports the measured sonic velocity. You can accept this reading or press the <Right Arrow> to adjust it (see paragraph 6.7.4).

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

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

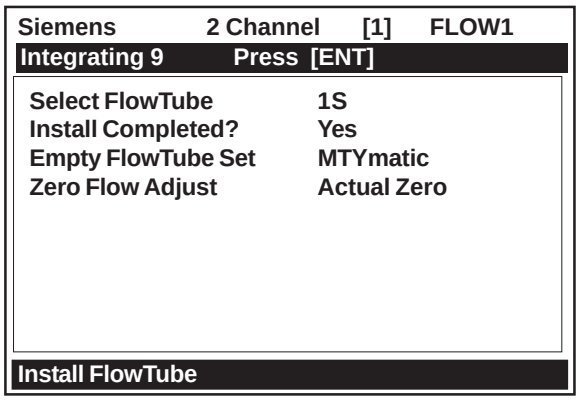
13. Press the <Down Arrow> to move the highlight to [Zero Flow Adjust]. Press the <Right Arrow>. This triggers the Zero Flow pop-up window (see below). You can accept the default zero setting: [0.000] or enter a zero offset with the Magnetic Wand or numeric keys.

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



14. To start the zero acquisition routine press <ENT>. 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 <ENT>.

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



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

    A pop-up window prompts you to save the site. Do so by pressing the <Right Arrow>, then <ENT>. 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

**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

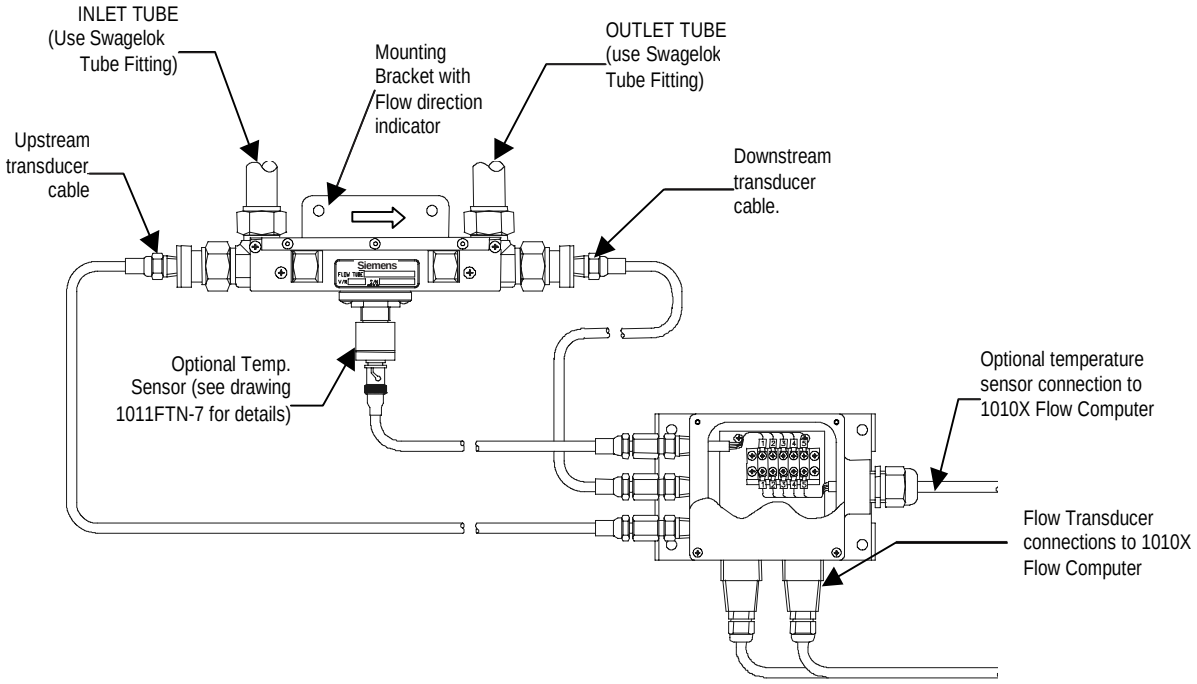
4.7 SPECIFICATIONS – 316 STAINLESS STEEL FLOW TUBE

**Subject to change without notice*

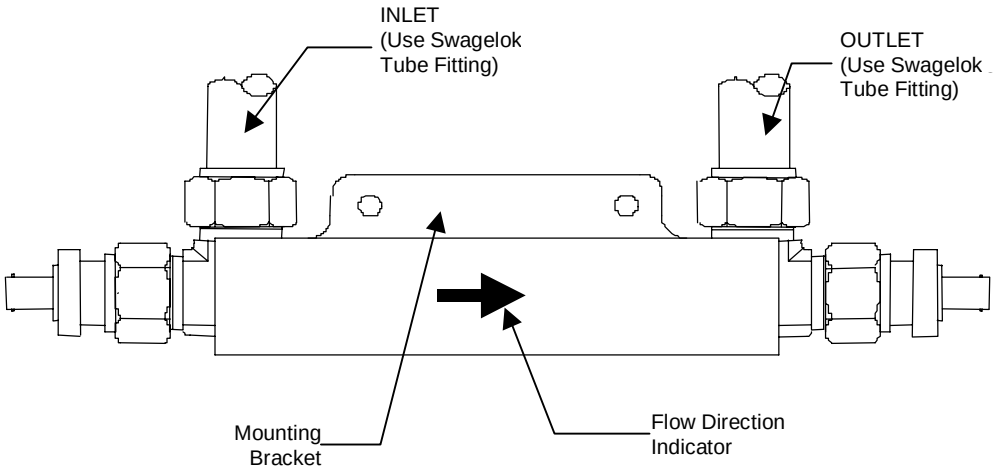
	Size 1	Size 2
Liquid	Must be compatible with 316SS under operating conditions and free of suspended gasses or solids.	Must be compatible with 316SS under operating conditions and free of suspend-pended gasses or solids.
Pressure Drop	0.21 psi @ 1.6 GPM (6.0 LPM) flowing water at 68°F	0.20 psi @ 4.5 GPM (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

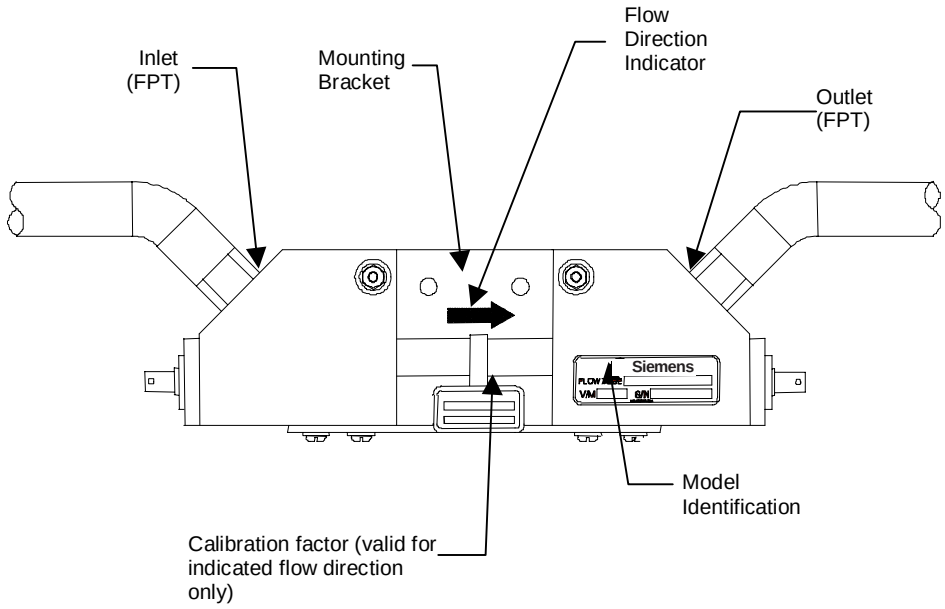
- All Siemens Flow Tubes are supplied with integral line connections. The end-user must supply any adapters, etc. required for line connection.
- When connecting a screwed fitting to a Kynar, Teflon (PFA) or CPVC Flow Tube, please start the thread carefully to avoid cross threading. Hand-tighten only. If necessary, use Teflon tape manufactured for plastic piping to effect a leak-proof seal (refer to Appendix B - 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.



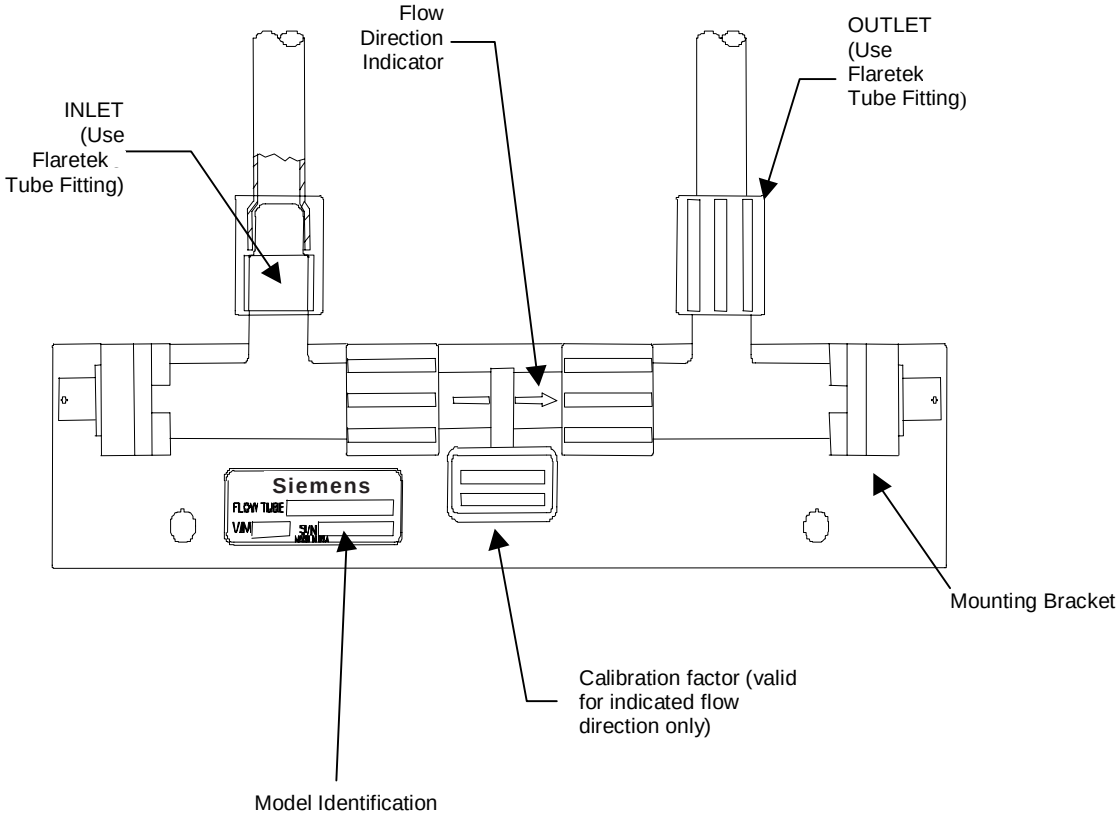
1011FT Series 316 Stainless Steel NEMA Flow Tube



1011 Series 316 Stainless Steel Flow Tube



992DFT Series CPVC or Kynar PDFA Flow Tube



992DFT Series Teflon PDA Flow Tube

5. SYSTEM 1010X APPLICATION NOTES

System FUS 1010X 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 FUS 1010X 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 1010 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 1010’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 1010 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 1010 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 1010 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 1010 operating system provides a considerable degree of control over the stability/agility of the flow rate output. System 1010 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 1010 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 1010's response speed is ideal for tracking fast flow transients. However, if this performance is unnecessary, you can smooth the System 1010's response time to suit any application.

System 1010 Damping and Slewing Controls

System 1010 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 1010 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 1010 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.

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 1010 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 standard (universal) transducers for operation up to 250°F. We offer High (H) temperature flow transducers rated for operation up to 375°F. We also manufacture Very High (VH) temperature transducers for applications where the temperature exceeds 375°F, but is less than 450°F. Please refer to Section 4 for flow tube pressure and temperature ratings.

5.5 OVERVIEW OF SYSTEM 1010X MEMORY RESOURCES

System 1010X's 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 1010 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 1010 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.
CLR (Clear) Key	Use the <CLR> key to erase a numeric value or clear a selection from a multiple select option list.
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.
ENT (Enter) Key	Use the <ENT> 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 suited 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 overridden by the installer.

(continued)

TERM	EXPLANATION
Local Display	Refers to the 1010X's integral display screen.
Menu	Sub-sections of the Installation Menu that you to define specific operational functions (e.g., RS-232 Setup).
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 the 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 a 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.
RTD	Temperature sensors used with energy flow of mass flow systems.
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).1010 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 flowmeter uses Site Storage Memory to store configurable operating parameters such as pipe and liquid tables.
TOTCNT	A totalizer pulse count function used for Batching or Sampling. Clamp-on flow
Transducer	sensors that the meter uses to measure the flow rate.
Register	Refers to a memory location used by the flow computer to store data such as the flow total, etc.
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.
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-CHANNEL MENU CHART

This section shows the 1010 Permanent Dual Channel Menu Chart. The Dual Beam Flow, Ch 1+2 Flow, 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 Beam 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 (in) Wall Thickness (in) Liner Material Liner Thickness
			⇨ Delete Pipe	⇨ Choose Pipe Class Pick Pipe Name
		⇨ Transducer Type	⇨ 1011 Universal 1011H High Prec. 991 Universal	
	⇨ Datalogger Cntrl	⇨ Output Datalogger Circular Memory Est Log Time Left Clear Datalogger	(Multi-channel units only)	
	⇨ Memory Control	⇨ Data Memory Left Defragment		
	⇨ Analog Output Trim	⇨ Trim Io 1	⇨ Operate Trim @ 4mA	
		⇨ Trim Io 2	⇨ Operate (Dual Chan) Trim @ 4mA	
		⇨ Trim Pgen 1	⇨ Operate (Single Chan) Trim @ 1Khz	
	⇨ RTD Calibrate (optional)	⇨ RTD1	⇨ User Cal. Factory	

(continued)

METER FACILITIES MENU *(continued)*

⇨ Meter Facilities ⇳	⇨ 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

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) Pipe Material Wall Thickness Liner Material Liner Thickness	
	⇨ Application Data ⇳	⇨ Liquid Class ⇳	⇨ Select Liquid ⇳ Estimated Vs m/s Viscosity cS Density S.G.
		⇨ UniMass Table ⇳	Disabled ⇳ Constant Temp Changing Temp & Vs
		⇨ Temp Range ⇳	-40F to 250F ⇳ -40F to 375F -40F to 450F
		⇨ Pipe Config ⇳	⇳ Fully Developed 1 Elbow Dbl Elbow + Dbl Elbow - Valve Expander Reducer Norm Entry Header Inlet Intrusions
		Anomaly Diams	xxxx (numeric entry)
	⇨ Pick/Install Xdcr ⇳	⇨ ⇳ Transducer Model Transducer Size Xdcr Mount Mode Spacing Offset Number Index Spacing Method Ltn Value Install Complete?	

(continued)

THE CLAMP-ON MENU *(continued)*

⇨ Clamp-On	⇨ Pick/Install Xdcr	⇨ Empty Pipe Set ⇳ Zero Flow Adjust	
	⇨ Operation Adjust ⇳	⇨ Damping Control	⇨⇳ Time Average SmartSlew
		⇨ Memory/Fault Set	⇨⇳ Fault Memory
		⇨ Memory Delay (s)	⇨ N/A
	⇨ 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 Tot Reset Totalizer	
⇳	⇨ Data Span/Set/Cal ⇳	⇨ Span Data ⇳	⇨⇳ Max Flow (Units) Min Flow (Units) Max Vs m/s Min Vs m/s Max S.G. Min S.G. Max Viscosity cS Min Viscosity cS Max Temperature Min Tmperature
		⇨ Set Alarm Levels ⇳	⇨⇳ Hi Flow (Units) Low Flow (Units) High S.G. Low S.G. Hi Viscosity cS Low Viscoisty cS High Temeprature Low Temperature Interface Vs m/s Aeration % Makeup Latch
		⇨ Calib. Flowrate	
	⇨ Datalogger Setup ⇳	⇨ Datalogger Mode ⇳ Datalogger Data LogTime Interval Datalog Events	
	⇨ I/O Data Control ⇳	⇨ Analog Out Setup	⇨⇳ Io1 Pgen1 (Single Chan)
		⇨ Relay Setup	⇨ Relay 1
		⇨ Analog Inp Setup	⇨ Iin1/Iin2
	⇨ Diagnostic Data ⇳	⇨ Flow Data ⇳	⇨⇳ Flow Velocity F/S Total Vs m/s Signal mV Valc % Vaer % Alarm Status AnCal HiFlow LoFlow

(continued)

THE CLAMP-ON MENU *(continued)*

⇨Clamp-On ⇳	⇨ Diagnostic Data ⇳	⇨Application Info ⇳	⇨⇳ TN uSec TL uSec DeltaT nSec Burst/Sec % Accepted Last Makeup Makeup Status
		⇨Liquid Data ⇳	⇨⇳ Temp 1/2 Reynolds # Specific Gravity Viscosity cP Pressure Viscosity cS
		⇨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
		⇨Site Created:	xx.xx.xx xx.xx.xx

6. THE 1010X INSTALLATION MENU

Programming System FUS 1010X 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 1010 NEMA flowmeters.

This section contains a general description of how to enter site setup data via the 1010X 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:

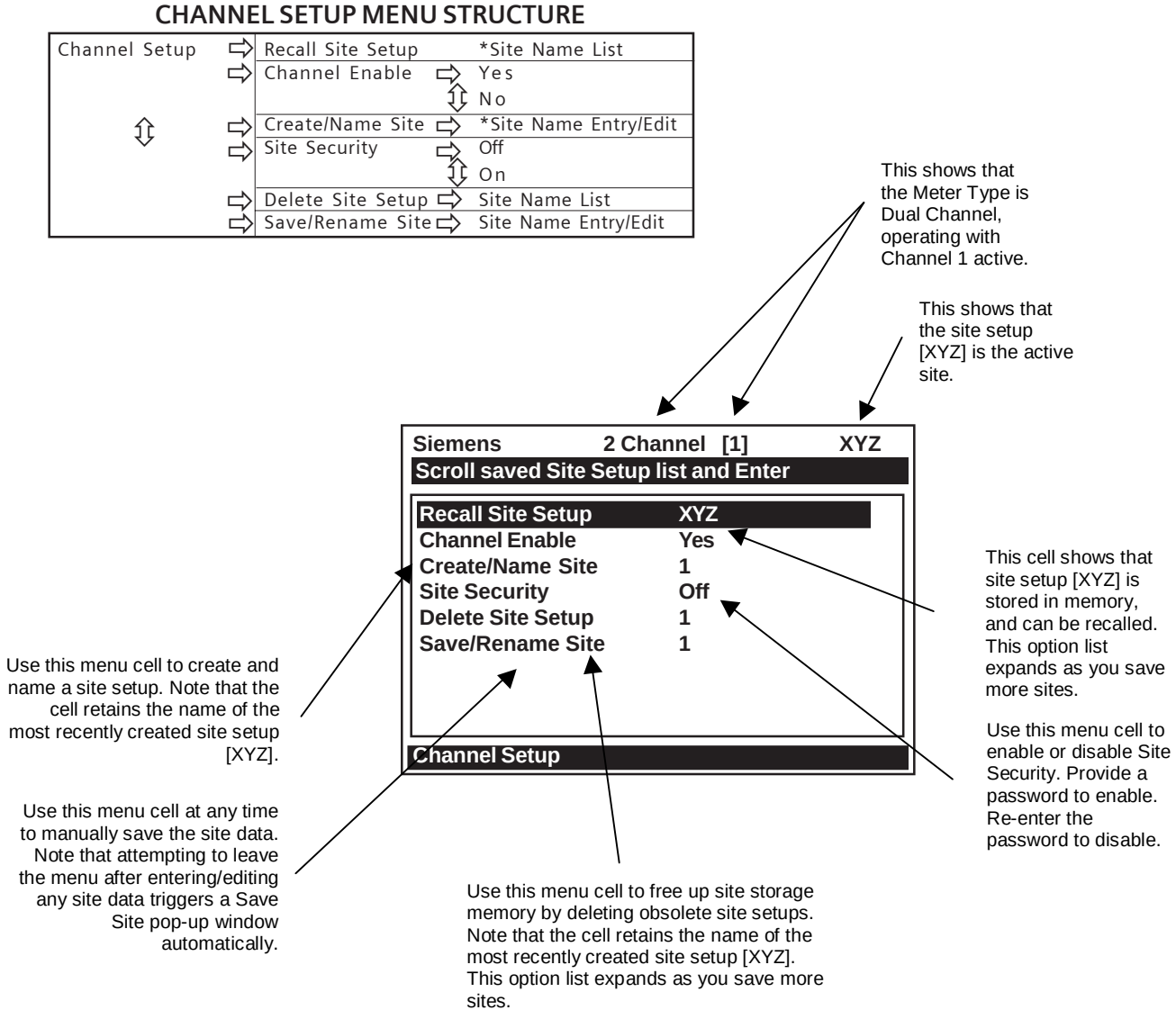
- When the text refers to a sensor or keyboard key, it will be enclosed in "less than" (<) and "greater than" (>) symbols (e.g., <MENU>, <ENT>, <Up Arrow>, etc).
- Where a visual of the key is shown; this means press this key.
- When the text refers to a menu or menu cell name, it will be enclosed with 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.*



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 <ENT> 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 PC or use Magnetic Wand.)*

To access the list of saved site names press 

To move the cursor to the Site Name press 

Press  . 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  to change the pop-up list from [Original] to [New].

Press  . 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:

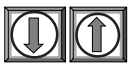
To access the [Channel Enable] option list press 

Move the cursor to [No] by pressing 

To disable the measurement channel press 

To enable a channel:

To access the [Channel Enable] option list press 

Move the cursor to [Yes] by pressing 

To enable the measurement channel press 

6.1.3 HOW TO CREATE/NAME A SITE SETUP

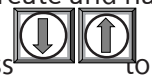
Use this command to create a new Site Setup. This is the first action required for an original installation. [Create/Name Site] inserts system defaults in all the appropriate menu cells. You can edit these defaults as necessary to suit your needs.

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 <ENT>. 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 

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

Press  to select a character, then press  to highlight to next character position.

To select the second character press 

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 ENT

NOTE: If you decide to use numbers or a decimal point 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. The flowmeter will allow a <F4> Reset Sequence when the Security is active, however, it also contains a Menu Enable switch that allows you to inhibit this function (see drawing 1010X-7).

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 Siemens. 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 SECURE LOCATION.

To activate Site Security:

To access [Site Security] option list press 

To scroll the option list to [On] press ⇩ ⇧ then ENT. [Enter Code?] appears at the top of the display screen.

Type your password on the PC keyboard, use numeric keys, or press ⇩ ⇧ with the Magnetic Wand to select the first character.

To move the cursor to the second character position press ⇨.

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 ENT. [Confirm Code ?] appears at top of the display screen. Retype code exactly as described above.

Press ENT. This moves the cursor to the [Site Security] option list.

To scroll the option list to [Site Security: On] press the ⇩ ⇧. Once you turn on Site Security, you must enter the correct code to turn it off.

To activate Site Security press ENT

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 Facility/Memory Control Menu).

To delete a stored Site Setup:

To highlight [Delete Site] press ⇩.

To access the Delete Site option list press ⇨.

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

To delete the obsolete site setup press ENT.

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 (see Create/Name Site) appears automatically. If this name is acceptable, you can press <ENT> to save the Site Setup. You can change the listed site name by following the procedure below. 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 Magnetic Wand and press the sensor to access the first character position.

To select a character press then to highlight to next character position.

To select the second character press . Repeat this process to select all the characters (8 max.).

To save the site data present in Active Memory press ENT.

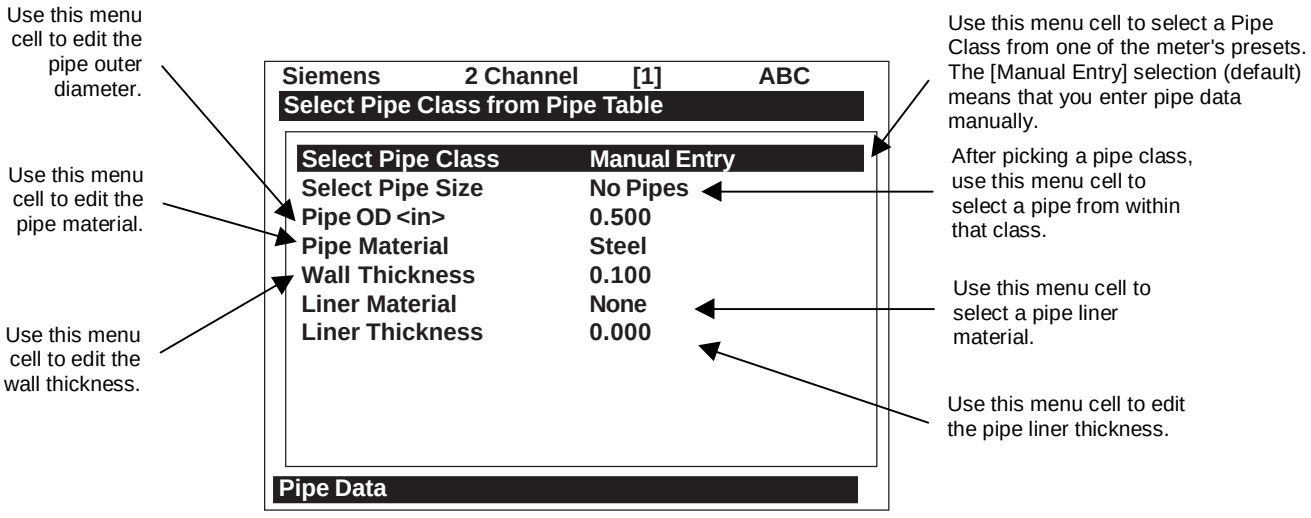
6.2 THE PIPE DATA MENU

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.



THE PIPE DATA MENU STRUCTURE

Pipe Data ⇨	Select Pipe Class ⇨	⇳ Manual Entry **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 ⇨	Manual Entry	*Set pipe parameters manually*	
	⇳	⇳ **ASA Stainless Steel***	⇨ ASA Carbon Steel	⇨ ASA Plastic
		1SS10	⇳ 1CS40	⇳ 1P40
		2SS10	1CS80	1P80
		3SS10	2CS40	2P40
		4SS10	2CS80	2P80
		6SS10	3CS40	3P40
		8SS10	3CS80	3P80
	⇨	⇳ Metric DN Steel	4CS40	4CS40
		50 DN	4CS80	4P80
		100 DN	6CS40	6P40
		200 DN	6CS80	6P80
		400 DN	8CS40	8P40
		800 DN	8CS80	8P80
	⇨	⇳ Metric SGP Steel	10CS XS	10P XS
		20A-SGP	10CS40	10P40
		25A-SGP	12CS STD	12P STD
		32A-SGP	12CS XS	12P XS
		40A-SGP	16CS STD	16P STD
		50A-SGP	16CS XS	16P XS
		65A-SGP	18CS STD	18P STD
	⇳	80A-SGP	18CS XS	18P XS
		90A-SGP	20CS STD	20P STD
		100A-SGP	20CS XS	20P XS
		125A-SGP	24CS STD	24P STD
		150A-SGP	24CS XS	24P XS
		175A-SGP	30CS STD	30P STD
		200A-SGP	30CS XS	30P XS
		225A-SGP	36CS STD	36P STD
		250A-SGP	36CS XS	36P XS
		300A-SGP	⇨ Cast Iron Table	⇨ Ductile Iron Table
		350A-SGP	⇳ 6” cls C	⇳ 6” cls 52
		400A-SGP	10” cls C	8” cls 52
		450A-SGP	12” cls C	10” cls 52
		500A-SGP	16” cls C	12” cls 52
	⇨	⇳ Copper Tube Table	20” cls C	16” cls 52
		1” type M		24” cls 52
		1” type K		
		1” type L		
		2” type M		
		2” type K		
		2” type L		
		4” type M		
		4” type K		
		4” type L		
		6” type M		
		6” type K		
		6” type L		
	Pipe OD (in / mm)	*xx.xx (numeric entry).*	*Auto if specific pipe is selected)*	

*NOTE: The highlighted selection in the above table illustrates how to choose the ***ASA Stainless Steel* Pipe Class** and all its available Pipe Size 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 (cont.) ⇨	Pipe Material ⇨	⇳ Steel ABS Aluminum Black Iron Brass Cast Iron CuNi (70/30) CuNi (90/10) Copper Ductile Iron FRP Glass Hastelloy Inconel Kynar (PVDF) Monel Nickel Polyethylene PVC (Plastic) Silicone 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)*

6.2.1 HOW TO SELECT A PIPE CLASS

The 1010X 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 

To scroll through the available classes press 

To select the class that fits your application press 

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.

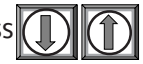
NOTE: Create custom pipe data via the Pipe Table editor in the Meter Facilities menu.

6.2.2 HOW TO SELECT A PIPE SIZE

Selecting a Pipe Size installs the selected pipe parameters into the balance of the Pipe Datamenu cells and prepares the 1010X 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 

To scroll to the required pipe press 

To register selection press 

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 

Use the numeric keys or Magnetic Wand to enter the exact outer diameter of the pipe in inches or millimeters.

To register the Pipe OD press 

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 

To scroll to the required pipe material press 

To register selection press 

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).

NOTE: Do not use ASA schedule code to specify the wall thickness. You must enter actual dimensions. We recommend that you use a thickness gauge to obtain an accurate dimension.

To enter the Pipe Wall Thickness:

To enable numeric entry press 

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

To register the pipe wall thickness press 

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 Controlotron 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 

To scroll to the required Liner material press 

To register selection press 

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 

Use numeric keys or Magnetic Wand to enter the exact line thickness value.

To register the data press 

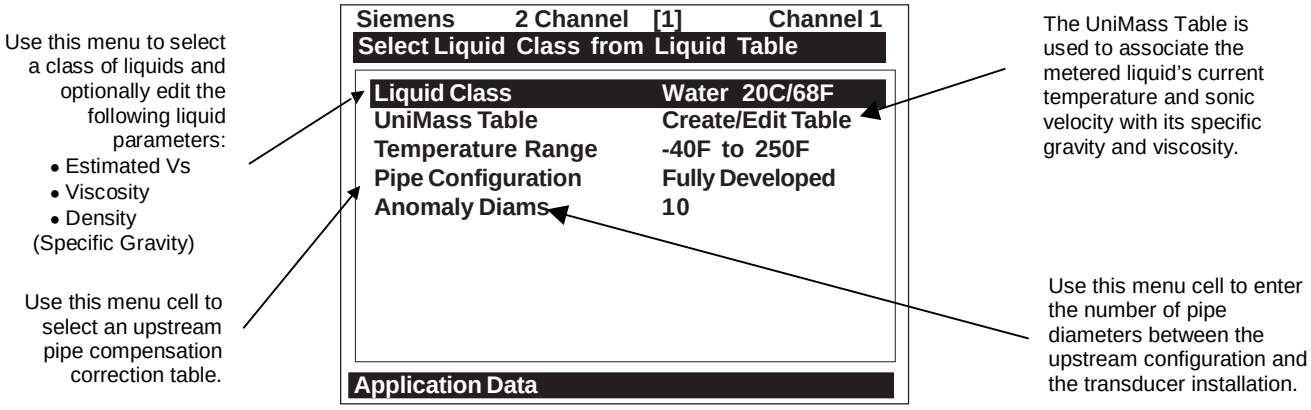
6.3 THE APPLICATION DATA MENU

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).

The [Temperature Range] menu cell allows you to specify the expected temperature range at the transducer mounting location. The default setting (-40^{0}F to 250^{0}F) matches the standard 991 and 1011 series of transducers, but not the 1011H. For higher pipe temperatures, selecting the proper temperature range allows the flow computer to recommend the appropriate transducers.



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 ⇨	Select Liquid	*Enter selection*		
	⇳	Liquid Class	Estimated Vs m/s xxxx *(numeric entry)*		
		Viscosity cS	x.xx *(numeric entry)*		
		Density SG	x.xxx *(numeric entry)*		
	UniMass Table ⇨	Disabled			
	⇨	Constant Temp ⇨	Create/Edit Table ⇨	Table Point	New
			⇳	Vs	xx.xxx
				S.G.	xx.xx
		⇳		Viscosity (cS)	x.xxx
				Accept	⇳ Yes / Clear Pt.
		⇨	Clear Table ⇨	No/Yes	
		⇨	Table Active ⇨	Yes/No	
	⇳ ⇨	Constant Vs ⇨	Create/Edit Table ⇨	Table Point	New
			⇳	Temperature	xx.xxx *
⇳		⇳		S.G.	x.xxx
				Viscosity (cS)	x.xxx
				Accept	⇳ Yes / Clear Pt.
		⇨	Clear Table ⇨	No/Yes	
		⇨	Table Active ⇨	Yes/No	
	⇨	Changing Temp & Vs ⇨	Table Active ⇨	Yes/No **	
	Temp Range ⇨	⇳ -40F to 450F -40F to 250F -40F to 375F			
	⇳				
	Pipe Config ⇨ (Change to Up-stream Piping)	⇳ Fully Developed*** 1 Elbow Dbl Elbow + Dbl Elbow - Valve Expander Reducer Norm Entry Header Inlet Intrusions			
	Anomaly Diams	xxxx (numeric entry)			

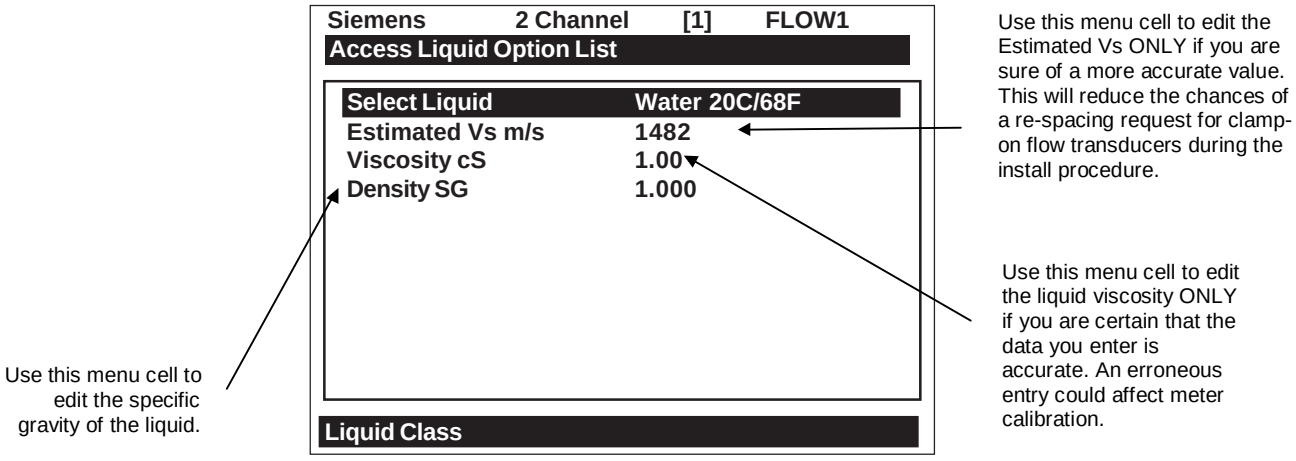
* Must recognize degrees C, degrees F selection.
** Vs, SG and Viscosity must be greater than 0.0 to allow enable.
*** Default

NOTE: The currently active table will be shown highlighted next to the [UniMass Table] menu cell. If no table is active then [Disable] will appear highlighted next to the [UniMass Table] menu cell.

NOTE: The [Changing Temp & Vs] lookup table must be serially loaded using the HyperTerminal "Send Text" command. This table can be generated using a utility provided by Siemens, which converts the Vs and temperature data into a uniform 10x10 grid array and formats it appropriately for serial download.

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.



To select a Liquid Class:

To access the option list press 

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

To register selection press 

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 

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

To register the data press ENT

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

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

To register the data press ENT

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

Use PC numeric keys or Magnetic Wand to enter the Density SG value.

To register the data press ENT

6.3.2 UniMass TABLE

Some 1010 family meters provide a feature referred to as UniMass. These meters support a UniMass Table which associates the metered liquid's current temperature and sonic velocity (Vs) with its specific gravity and viscosity. These variables are then used to provide mass metering and real-time flow profile compensation based on Reynolds number. For hydrocarbon liquids requiring standard volume compensating, a 1010DV flowmeter should be specified.

Note that the UniMass option will provide value to the extent that the table is accurately prepared for your particular liquid and installed correctly. The table scanning routine can function with as few as two (completely) defined data points. If the sensed variable(s) assume values beyond the table limits, the routinedoes not extrapolate, but rather produces "flat" data.

The table is built by inputting a series of data points—two inputs and two outputs each:

- Input data consists of sonic velocity (Vs) and/or temperature.
- Output data consists of specific gravity (S.G.) and viscosity (cS) at that Vs and temperature.

Ideally, each point contains four empirically derived values. However, when enough data exists to permit it, the table editing routine interpolates missing values based on prior user-entered data.

The UniMass feature expands the basic utility of the flowmeter by synergistically combining its ability to measure sonic velocity and temperature with user-provided data regarding the process liquid or family of liquids. The resulting instrument is virtually a liquid analyzer, in addition to measuring mass flowrate and automatically compensating for viscosity variation.

UniMass table operations are most successfully employed when the application liquids or family of liquids are fairly well-controlled. Basic table data can be obtained by a variety of means:

- From handbooks of physical or chemical data.
- Directly measured in the laboratory using your 1010, its RTD temperature sensor and a non-flowing measurement cell (standpipe).
- After installation on the process pipe if specific gravity and/or viscosity data regarding the liquid can be locally obtained via samples or from on-line instrumentation.

Although the UniMass Table is designed to permit both temperature and sonic velocity to be active input variables, we provide Constant Vs and Constant Temp table editing capabilities as well. The resulting lookup function then associates specific gravity and/or viscosity with either temperature or sonic velocity only.

Application Data Menu Explanations For UniMass Table

The UniMass table resides within the Application Data main menu subsection [UniMass Table] menu cell. For the FT instruments it resides within the [Liquid Data] menu subsection menu cell.

[UniMass Table] - Press the <Right Arrow> to access the UniMass data point editor.

[Disable] - Press the <Right Arrow> to access.

The currently active table will be shown highlighted next to the [UniMass Table] menu cell. If no table is active then [Disable] will appear highlighted next to the [UniMass Table] menu cell.

[Constant Temp] - Press the <Right Arrow> to access.

- ***Create/Edit Table Point [New Point + Points List (1-32)]***

  You may Create or Edit up to 32 points. If you need support for multiple liquid classes, you may create additional identical flow sensing sites to accommodate them, altering only the UniMass Table entries. Then each site may be called up as needed for each liquid class.

- ***Vs [Vs Value]***

  This is the sonic velocity at which the S.G. and Viscosity were measured for this class of liquids. This data may be obtained from tables of physical constants, measured with your 1010 in a test cell standpipe while also measuring temperature, or directly measured in the monitored process line if S.G. and viscosity can also be obtained.

- ***Temperature [Liquid Temperature]*** - Same as Vs above only for temperature.

- ***S.G. [Specific Gravity]***

  This is the specific gravity of the process liquid at the Vs and Temperature for this table entry. The specific gravity is defined as the density of the sample divided by the density of water at 20° C or 68° F.

- ***Viscosity [Liquid Viscosity (cS)]***

  This is the viscosity of the process liquid at the Vs and Temperature for this table entry.

- ***Clear Table [Yes/No]***

  Use this item to remove all table points. You will need to re-enter all table data if you answer [Yes] to this menu item.

- ***Table Active [Yes/No]***

  Use this item to tell the 1010 meter whether to use the UniMass Table as the source of S.G. and Viscosity parameters for the currently active site.

[Constant Vs] - Press the <Right Arrow> to access.

Contains the same menu option list as the **[Constant Temp]** menu cell above but includes a Temperature input data option instead of the Vs (Sonic Velocity) option.

Alternate Data Entry Method

You may input the [Constant Temp] or [Constant Vs] data table via meter's serial port. To accomplish this, the meter must be in Direct Command Mode (not Menu Mode or Data Display Mode). You can recognize this mode by noting that the meter responds to a <CR> input with a "? for menu" prompt. The meter will accept a text file of the correct format into the UniMass table data structure directly. An example of the format for a four point data file is as follows:

```
MTABLE 1 4
1510.0 30.0 1.1 2.7
1520.0 40.0 1.5 3.4
1530.0 50.0 1.9 5.5
1540.0 60.0 2.2 6.8
```

MTABLE is the special keyword indicating that UniMass data follows, 1 stands for the channel number where the data is being installed, and 4 indicates the number of lines (data points). The last number must match the number of lines or else the table will not be correctly formed.

Each line corresponds to each point. Sonic velocity is first, followed by temperature (the input variables). Then comes specific gravity followed by viscosity (the output variables). Do not use commas between the items, only single spaces. A carriage return is expected after each line, EXCEPT for the last one.

For example, line 1 of MTABLE 1 4 *(1510.0 30.0 1.1 2.7)* shown above is read as follows:

1510.0 (Sonic Velocity) **30.0** (Temperature) **1.1** (Specific Gravity) **2.7** (Viscosity)

You may save this file by using a name suggested by the liquid in question. Once the file is saved use HyperTerminal to send it as a simple text file to the PC serial port of the 1010 flowmeter. It is suggested that a moderate data rate be used (1200 baud) for this function since the meter is fairly busy computing and interpolating during the installation of the table.

[Changing Temp & Vs] - Press the <Right Arrow> to access.

The [Changing Temp & Vs] lookup table must be serially loaded using the HyperTerminal "Send Text" command. This table can be generated using a utility provided by Controlotron, which converts the Vs and temperature data into a uniform 10x10 grid array and formats it appropriately for serial download.

Below is a sample input data file for gasoline and diesel fuel that was empirically derived from sound velocity data obtained using a 1010 flowmeter installed on a fuel pipeline. The task of obtaining sound velocity, as a function of density and temperature, can also be performed in a laboratory environment under conditions of controlled temperature and liquid properties.

Gasoline and Diesel fuel UniMass input file.

```
START
-40,    1625,  0.8838,        92.4
-20,    1579,  0.8762,        53
  0,    1533,  0.8685,        26
 20,    1487,  0.8608,        16
 40,    1441,  0.8530,        9.7
-40,    1445,  0.7755,        1.362
-20,    1393,  0.7658,        1.022
  0,    1341,  0.7560,        0.83
 20,    1289,  0.7460,        0.72
 40,    1237,  0.7360,        0.64
END
```

The file must be in the form shown in the example above, with a START and END keyword to denote the limits of the data. The data does not have to be sorted in any particular order. A description of the data can be included at the top of the file since this will be ignored by the 10x10 grid generating program.

The four comma separated columns within the data should be formatted in the following order and with the units indicated:

Column	Parameter	Units
1	Temperature	Deg C or F
2	Sound Velocity (Vs)	meters/second
3	Specific Gravity *(relative to water @ 20°C)*	
4	Viscosity (kinematic)	Centistokes

Once the input data is properly formatted it can then be processed using Siemens PC based UniMass grid generating program. Follow the instructions included with this program to generate the final grid data, which can be directly downloaded to the 1010 flowmeter using HyperTerminal "Send Text File" command.

NOTE: To properly download and direct the UniMass table to the appropriate flowmeter channel, follow the instructions outlined below:

1. Establish communication with the flowmeter at 9600 baud or less.

2. Disable all channels (select [Channel Disable] menu cell then [Yes]) if they are actively measuring flow.

3. Select the desired default channel for download of the UniMass table. In HyperTerminal type "cv 0" for Channel 1, "cv 1" for Channel 2 or "cv 2" for the virtual channel of a dual beam system.

4. Select the "Send Text File" command from the HyperTerminal menu and proceed to download the UniMass grid file.

Enable channel operation then select [Table Active] then [Yes] for the Changing Temp & Vs table.

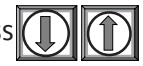
6.3.3 HOW TO SELECT A PIPE TEMPERATURE RANGE

This menu cell informs the flow computer about the expected temperatures that the transducers will be subjected to during operation. The default setting, -40^{0}F to 250^{0}F corresponds with the rated temperature range of our standard 991 or 1011 series transducers. The other selections provide higher upper limits of 375^{0}F and 450^{0}F respectively.

If you know that the pipe temperature will exceed 250^{0}F at the transducer mounting location, please use this menu cell to select the appropriate range. This will allow the flow computer to restrict its transducer recommendations to the appropriate environmentally rated types.

<u>To select a temperature range:</u>

To access the option list press 

To highlight the desired range press 

To register your selection press 

6.3.4 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 

To highlight the desired piping configuration press 

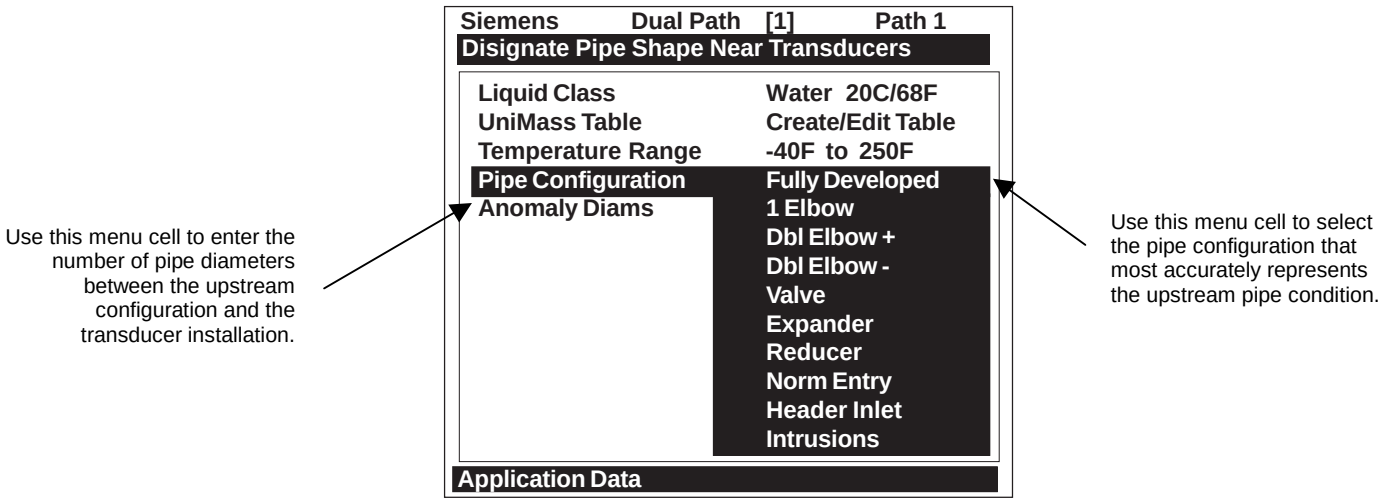
To register selection press 

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

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.

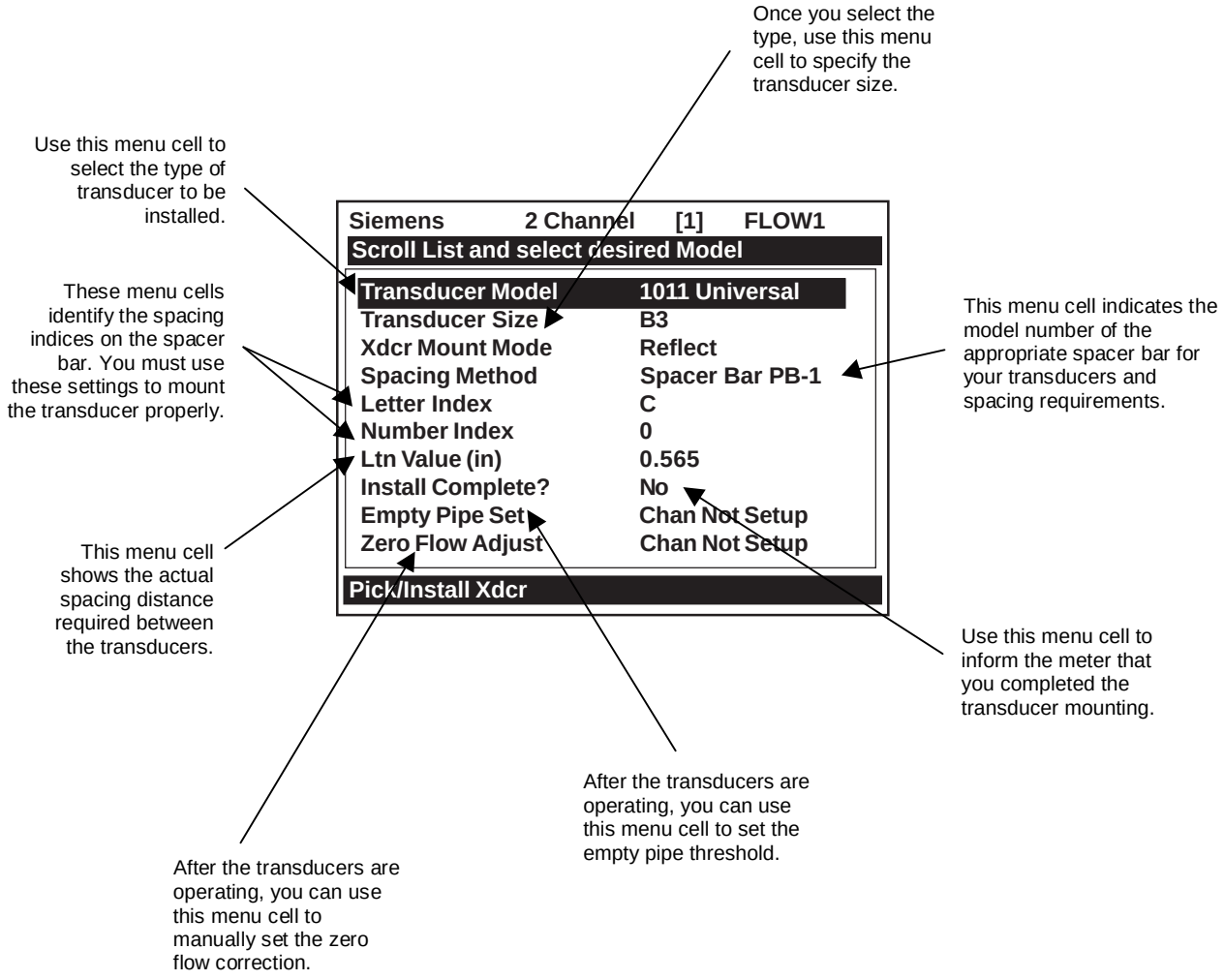
6.4 THE PICK/INSTALL XDCR (TRANSDUCER) MENU

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 optional 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 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.

NOTE: Before proceeding to mount transducers, it is recommended that Section 3- HARDWARE INSTALLATION GUIDE be reviewed. Refer to the Pick/Install Xdcr menu and menu structure shown below for menu cell descriptions and details.



PICK/INSTALL XDCR MENU STRUCTURE

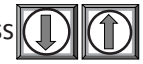
Pick/Install Xdcr ⇨	Transducer Model ⇨ ⇳	991 Universal 1011 Universal 1011 Hi Precision		
⇳	Transducer Size ⇨	*1011 Universal*	*991 Universal*	*1011H High Precision*
	⇳	⇳ A1 A2 B1 B2 B3 C1 C2 C3 D1 D2 D3 E1 E2 E3	⇳ 0A 0 1 2A 2 3A 3 4A 4 5A 5	⇳ A1H A2H A3H B1H B2H C1H C2H D1H D2H D3H
	Xdcr Mount Mode ⇨ ⇳	⇳ Direct Reflect		
	Spacing Offset ⇨ ⇳	⇳ Minimum Nominal Maximum		
	Number Index ⇨	4 *(generated)*		
	Spacing Method ⇨	Spacer Bar [P/N]	⇨ *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 either the [1011 Universal] or [1011H High Precision] transducer lists, or from a list of [991 Universal] models. You should consider using high precision transducers for extremely critical applications. We usually recommend these transducers for custody transfer, leak detection or nuclear power applications. The system default is [1011 Universal]. 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 

To move the cursor to the required transducer model press 

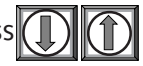
To store your selection press 

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: D3,D2,D1,C1,C3]**. The flow computer generates this list automatically based on your pipe and your application data entries. The left-most transducer size (e.g., D3) is the primary (most appropriate) choice. The right-most transducer (e.g., C3) 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 

To move the cursor to the desired transducer size press 

To select the transducer size press 

6.4.3 HOW TO SELECT A XDCR MOUNT MODE

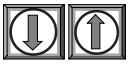
The flow computer recommends the transducer mounting mode [Direct or Reflect]. In almost all cases it will be Reflect, since this is the most desirable configuration. Reflect Mode allows you to mount the transducers on pipes that do not permit back or side access. Reflect Mode provides inherent compensation 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 

To move the cursor to the required mounting type press 

To store selection press 

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.

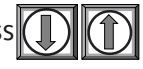
If the flow computer reports "Use Ltn," you have to measure the distance between the upstream and downstream transducers. The flow computer issues the actual distance between the transducers in inches or millimeters (See paragraph 6.4.7 Ltn Menu Cell). Note that, even though using Ltn does not call for the physical use of the Number Index, you can still change the Spacing Offset to influence the strength of the transmit signal.

System 1010X 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.

<u>To select a different Spacing Offset</u>

To access to [Spacing Offset] option list press 

To move the cursor to the desired offset press 

To store selection press 

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 Completed?] 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).

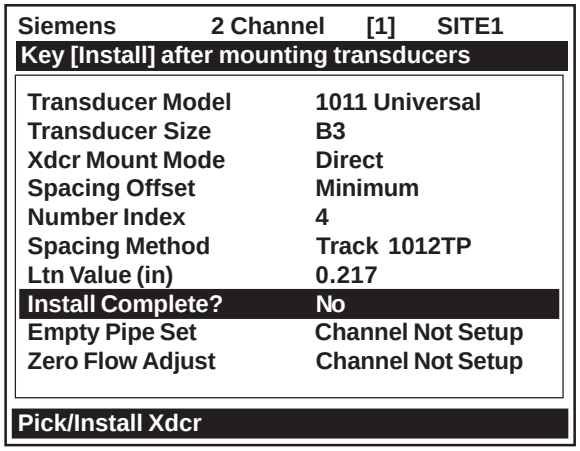
NOTES

- *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 you are mounting the transducers 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.*

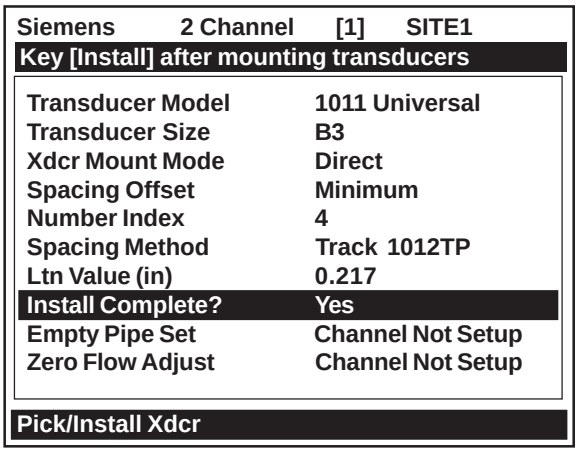
After transducers are properly mounted, the flow computer completes its Initial Makeup command and the [Install Complete?] menu cell appears.

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 <ENT> (unless otherwise directed to do so by the Technical Service Department).



Press <ENT>. The [Install Complete?] menu cell will indicate [Yes] after the 1010 is successfully installed.



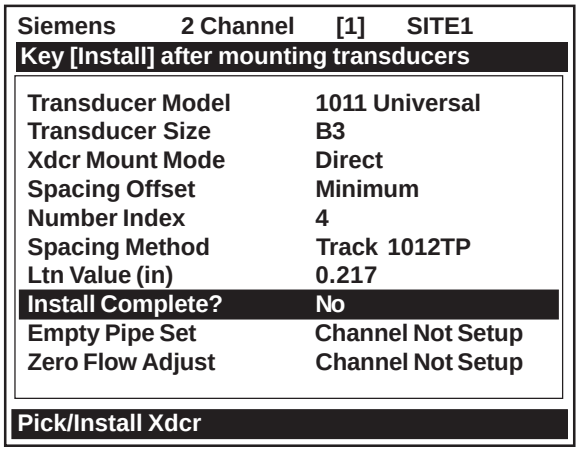
<u>To complete the Install process</u> disregard the following paragraphs explaining the Force Transmit and Force Frequency diagnostic software routines. Proceed to the Install process completion steps immediately following the Force Transmit procedures.

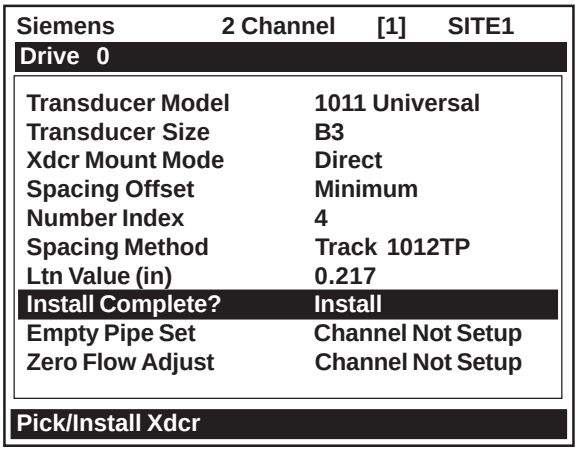
NOTE: If the transducers have been installed successfully but the Estimated Vs (sonic velocity) has been changed, the Pick/Install Xdcr menu cell [Install Complete?] option list will also display the [Transfer Install] function selection. The Transfer Install function allows the transducers to be optimally 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

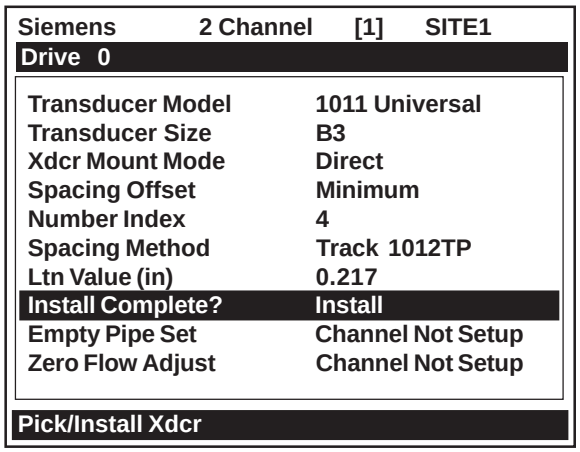
This diagnostic software routine allows the user to "force" a transmitting condition that can be use to search for an amplitude level (ALC) when Detection Fault or Low Signal alarms are present. The routine forces the flowmeter to generate constant transmit bursts while reporting current receive signal strength for the user. To initiate the *Force Transmit* function, refer to the example that follows:

1. After the detection mode is selected press <ENT>. While the flowmeter is going through the drives (see menu screen below), press the <ALT> and <MENU> keys simultaneously.



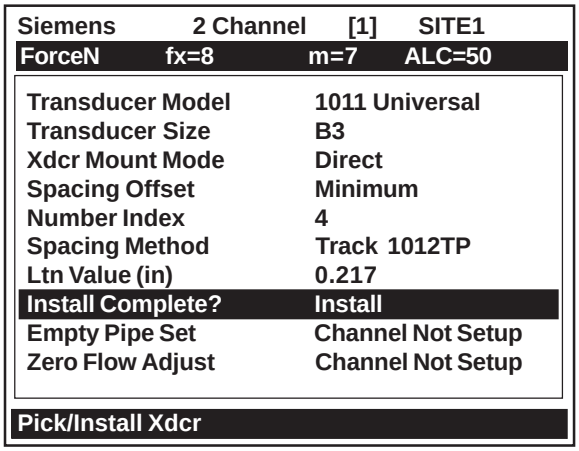


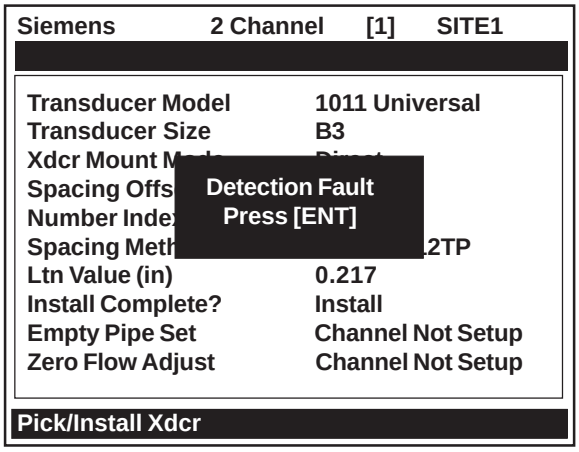
NOTE: The <ALT> and <MENU> keys must be pressed before the meter scans through all the drives, or the selection of the detection mode and the Force Transmit function must be initiated again.



2. A typical menu screen will appear as shown below and indicate the current ALC (e.g., 50).

   This ALC number indicates the current receive signal strength and can be used for further diagnostic purposes.





3. To exit Force Transmit, press the <Left Arrow> and a [Detection Fault] prompt will appear (see above). 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 enter the frequency and press <ENT>.

5. *If the Force Transmit diagnostic procedure is not used*, the normal [Install Complete?] function occurs as follows:

To complete the Install process after mounting the transducers press <ENT>.

Immediately after you press <ENT>, the computer starts an internal process called an Initial Makeup. The current Initial Makeup activity, for example: **Drive 14 m 10 [—]** appears at the top of display screen. During the Initial Makeup, the flowmeter verifies your site data, records the sonic characteristics of the pipe and liquid 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 successful completion of the initial makeup, the 1010X will show the measured Vs on the top prompt line as shown below.

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 pop-up window allows you to "fine-tune" the Measured Vs by pressing the <Right Arrow> to activate numeric entry. You can then use the numeric keys or Magnetic Wand to type a different value. However, only edit the Measured Vs when you are certain of your liquids 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 MENU 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 <ENT> 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 inaccuracy. 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  or  moves the cursor to the [Empty Pipe Set] menu cell.

If you decide to edit the Measured Vs:

To activate numeric entry press 

Use numeric keys or Magnetic Wand to type the new Vs value (in meters-per-second).

To store the corrected Vs press ENT

The flow computer may recommend a new Number Index and prompt you to press ENT. Remount the transducer at the new Number Index.

To repeat the Initial Makeup process press ENT

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 ENT. 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 Make-up 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: NEVER perform this procedure when the pipe is full.

To perform the Actual MTY Procedure:

To access the [Empty Pipe Set] option list press 

To move the cursor to [Actual MTY] press  then press ENT.

[Empty Pipe Press Enter] appears on the menu prompt line.

Empty the pipe completely, then press ENT. [Fill Pipe Press Enter] appears on the menu prompt line.

Refill the pipe completely, then press ENT.

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 

Move the cursor next to [MTYmatic] by pressing 

To invoke MTYmatic press ENT

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 

To move the cursor to [Set Empty] press 

Press ENT. The current empty threshold number appears in the prompt.

Use PC numeric keys or Magnetic Wand to enter a new [Set Empty] number.

To store the [Set Empty] number press ENT

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 Siemens 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 one-time 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 cannot be mounted in the Reflect Mode configuration. Flow must be stable during the entire process.

ZeroMatic *(not present in MultiPulse operation)*

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 

Press ENT. 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 ENT 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 <ENT> 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 
- Move the cursor to [ReversaMatic]. Press ENT 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 <ENT> (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 <ENT> (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 misregistration) 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 for Op System 3 units)

NOTE: ZeroMatic is used in the Reflect Mode only.

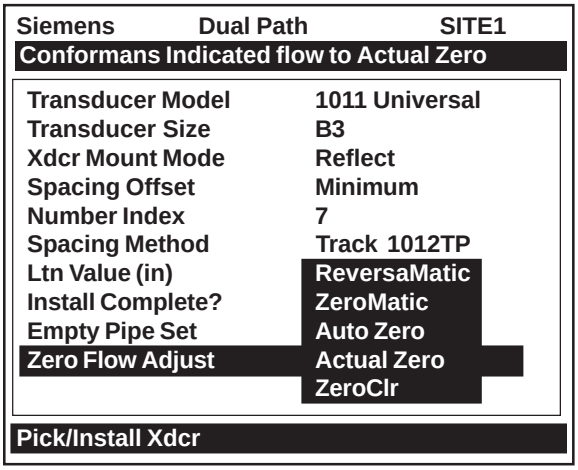
Use this menu cell to select the ZeroMatic option. If conditions permit the use of the Auto Zero function then the ZeroMatic option can be used as well. ZeroMatic is similar to Auto Zero, but differs in that its averaging function is continuously updated and virtually eliminates zero drift.

To select and enable the ZeroMatic option:

In the Pick/Install Xdcr menu, press  to scroll to the [Zero Flow Adjust] menu cell.

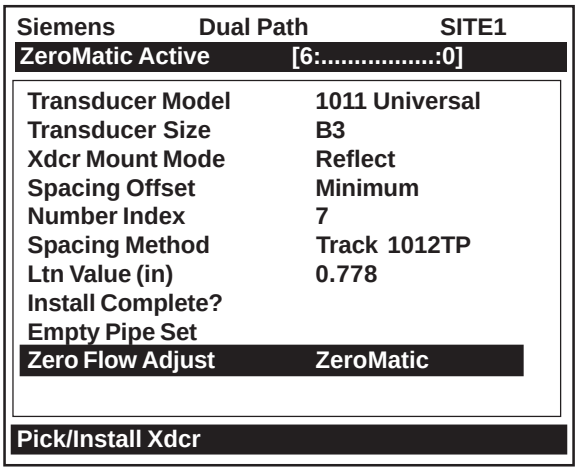
To access the [Zero Flow Adjust] option list press 

NOTE: If ZeroMatic is not running, the [Actual Zero] menu item will be displayed next to the [Zero Flow Adjust] menu cell.

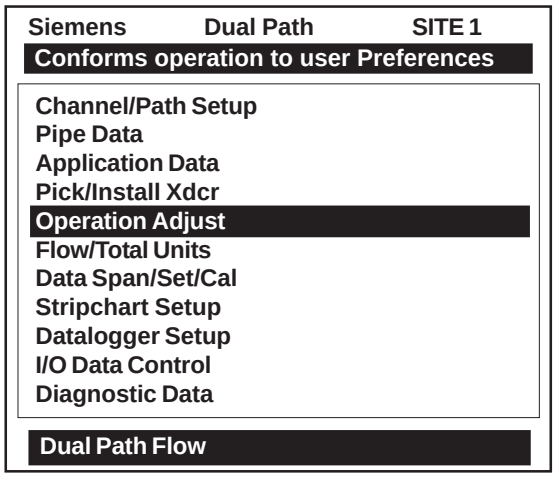


Select the [ZeroMatic] menu cell by pressing 

Press ENT to enable ZeroMatic.



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.



To disable the ZeroMatic function:

Select the [Pick/Install Xdcr] menu cell from the Dual Path Flow menu.

Scroll down to the [Zero Flow Adjust] menu cell by pressing 

NOTE: The highlighted [ZeroMatic] menu item is the only indication that ZeroMatic is functioning.

Invoke the ZeroMatic initial makeup procedure as previously described above.

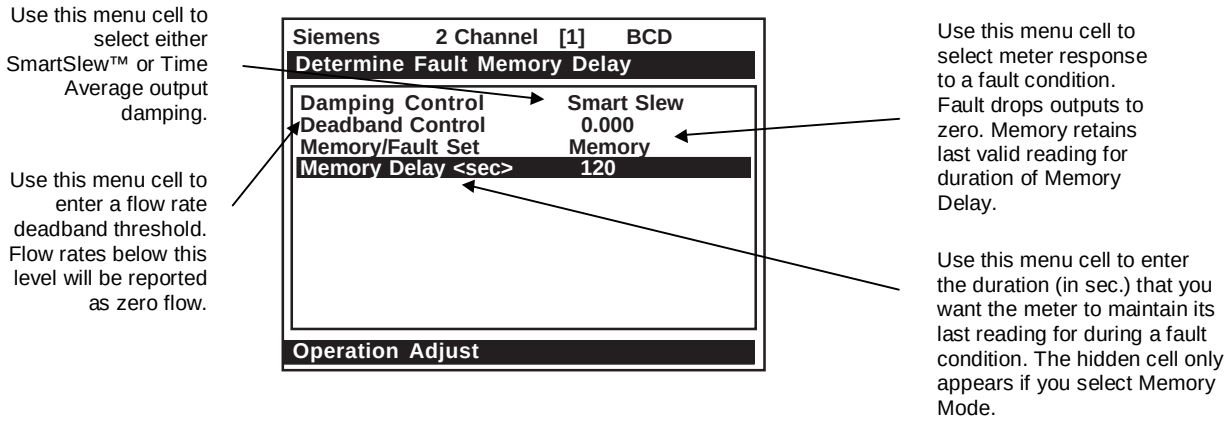
While ZeroMatic initial makeup is running, press  to abort the process thereby disabling the function.

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.



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 (sec) ⇨		xxx *(numeric entry) (hidden in Fault Mode)*

6.5.1 DAMPING CONTROL

System 1010 provides two different data output filter types, Time Average and SmartSlew. Time Average (recommended) integrates the instantaneous flow rate over a selectable time period. Use the Time Average function when stability in flow reading is essential. A value entered (in seconds) 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.

SmartSlew performs data scatter damping during steady flow periods while maintaining the ability to respond to changing flow rates. SmartSlew values range from [1 to 9]. Pick a higher number to slow meter response to a rate change.

To select Time Average (default):

To access the Damping Control option list press 

To move the cursor down to [Time Average] press 

To enable Time Average entry press 

Use PC numeric keys or Magnetic Wand to enter the new Time Average setting.

To register the new value press 

To edit the default SmartSlew setting:

To access the SmartSlew option list press  three times.

Scroll the numeric list to the desired choice by pressing 

To register the new value press 

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 

Use numeric keys or Magnetic Wand to enter the desired rate (using selected flow rate units).

To register the new value press 

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] option list press 

Move the cursor down to [Memory] by pressing 

To make selection press 

This moves the highlight to [Memory Delay <sec>].

Memory Delay <sec>

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 

Use PC numeric keys or Magnetic Wand to enter the delay in seconds.

To register the new value press 

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)*

TOTALIZER CONTROLS *(the "n" in <Fn> = channel number)**

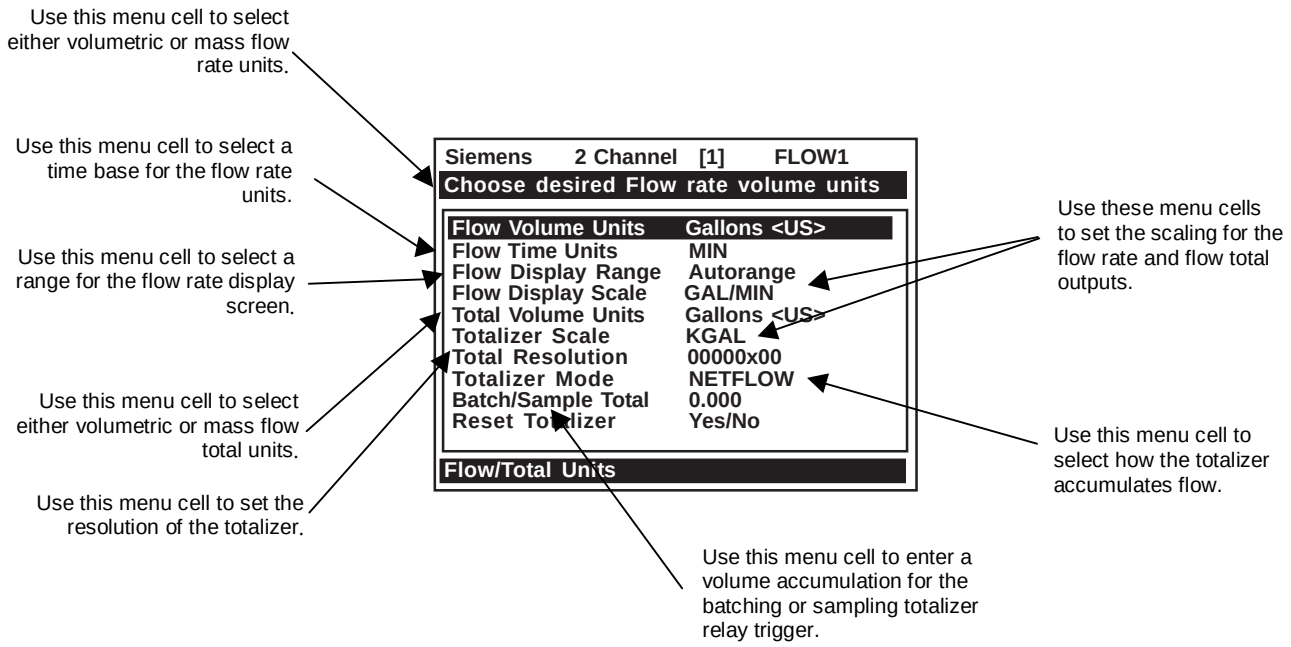
F1 F2 F3 F4 + 1	CLEAR (also clears overflow)	Resetting the Totalizer registers clears all total data accumulated during operation. **NOTE: The Clear Totalizer function (CLRTOT) can only be invoked from the keypad or an external PC keyboard via the RS-232 port.**
F1 F2 F3 F4 + 2	NOTOT (Totalizer Freeze)	Invoking the NOTOT command disables the Totaizer. 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 F3 F4 + 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 F3 F4 + 4	CLEAR (Batch/Tot Register)	Clears the Batch Sample totalizer register. See Batch/ Sample Total.
F1 F2 F3 F4 + 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.

*Use the F1 key as the "Lead-in command" for 4-Path Totalizer operations.

The flow computer stores positive and negative accumulations in separate independent registers. You use the magnetic switches 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 ⇨	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 Display Range ⇨ ⇳	⇳ Autorange High
		Flow Display Scale ⇨ ⇳	mGAL/MIN ⇳ GAL/MIN KGAL/MIN
		Total Volume Units ⇨ ⇳	⇳ *Same list as Flow Volume Units*
		Totalizer Scale ⇨ ⇳	⇳ GAL KGAL mGAL
		Total Resolution ⇨ ⇳	000x0000 ⇳ 0000x000 00000x00
		Totalizer Mode ⇨ ⇳	⇳ NEGFLOW NETFLOW POSFLOW
		Batch/Sample Total ⇨	x.xxx *(numeric entry)*
		Reset Totalizer ⇨	⇳ Yes No



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 

To move the cursor to the required units press 

To store selection press 

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 to bypass this menu cell.

To select Flow Time Units:

To select the desired time unit press  to access the [Flow Time Units] option list.

To move the cursor to the required time units press 

To store the time units press 

6.6.3 FLOW DISPLAY RANGE

The [Flow Display 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 

To move the cursor to the required display range press 

To store selection press 

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 

Move the cursor to the desired display scale by pressing 

To register selection 

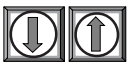
6.6.5 TOTAL VOLUME UNITS

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  to bypass this menu cell.

To change the default setting:

To access the [Total Volume Units] option list press 

To move the cursor to the desired Total Volume Units press 

To store selection press 

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 

Move the cursor to the desired display scale press 

To register selection press 

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 pulses 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 

Move the cursor to the required resolution by pressing 

To store selection press 

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 

Move the cursor to the required Totalizer mode by pressing 

To store selection press 

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 accumulation.

NOTE: The Batch/Sample total relay requires the same consideration for ex-ceeding 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 

Use PC numeric keys or Magnetic Wand to enter the desired Batch/Sample TOT accumulation.

To store data press 

6.6.10 RESET TOTALIZER

Use this function to set all 1010X 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).

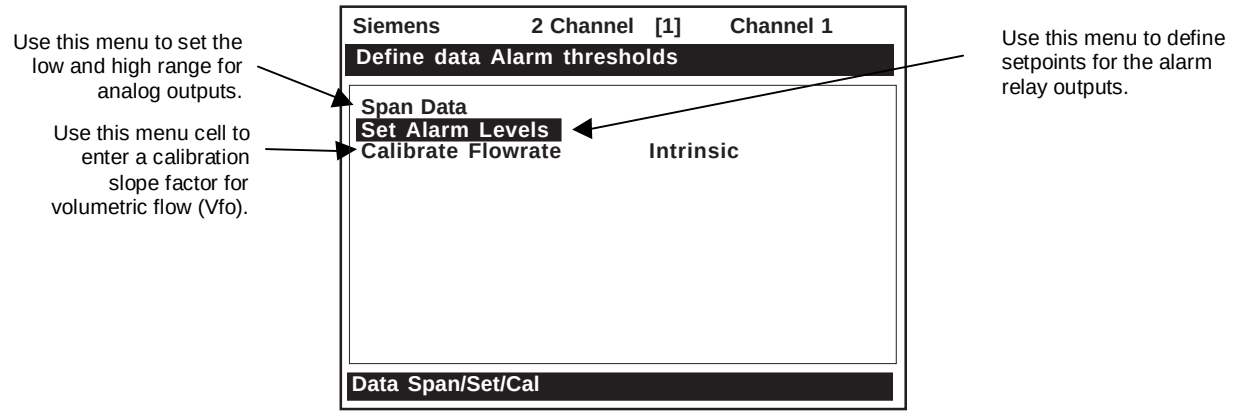
6.7 THE DATA SPAN/SET/CAL MENU

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 ⇨	⇳ 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)	
		Max S.G. ⇨	x.xxx (numeric entry)	
		Min S.G. ⇨	x.xxx (numeric entry)	
		Max Viscosity cS ⇨	x.xxx (numeric entry)	
		Min Viscosity cS ⇨	x.xxx (numeric entry)	
		Max Temperature ⇨	x.xxx (numeric entry)	
		Min Temperature ⇨	x.xxx (numeric entry)	
	Set Alarm Level ⇨	⇳ High Flow ⇨	⇳ x.xxx (numeric entry)	
		Low Flow ⇨	x.xxx (numeric entry)	
		High S.G. ⇨	x.xxx (numeric entry)	
		Low S.G. ⇨	x.xxx (numeric entry)	
		Hi Viscosity ⇨	x.xxx (numeric entry)	
		Low Viscosity ⇨	x.xxx (numeric entry)	
		High Temperature ⇨	x.xxx (numeric entry)	
		Low Temperature ⇨	x.xxx (numeric entry)	
		Interface Vs m/s ⇨	x.xxx (numeric entry)	
		Aeration % ⇨	x.xxx (numeric entry)	
		Makeup Latch ⇨	⇳ Off / On	
	Calibrate Flowrate ⇨	⇳ Intrinsic		
		Kc ⇨	x.xxx (numeric entry)	
		⇨	Multipoint Point # ⇨	xx (numeric entry)
			⇨ Indicated Rate ⇨	x.xxx (numeric entry)
			⇨ % Correction ⇨	x.xxx (numeric entry)



6.7.1 SPAN DATA

The Span Data menu allows you to set 0% and 100% output limits for volumetric flow (Vfo), absolute flow (Vf) 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 Flow Rate:*	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.

Maximum span values represent:	**Minimum span values represent:**
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
Pulse output of 5000 Hz	Pulse output of 0 Hz

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 

Use PC numeric keys or Magnetic Wand to enter the maximum flow rate (100% of range).

To store the data press ENT

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 

Use PC numeric keys or Magnetic Wand to enter the minimum flow rate (0% of range).

To store data press ENT

The following Span Data items are set in the same way as the previously shown examples by entering numeric values and storing the data.

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.

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.

Max S.G.

The [Max S. G.] menu cell stores the maximum range value for the specific gravity of a liquid. The specific gravity (S.G.) will be displayed as the maximum on the Stripchart.

Min S.G.

The [Min S.G.] menu cell stores the minimum range value for the specific gravity of a liquid. The specific gravity will be displayed as the minimum on the Stripchart.

Max Viscosity cS

The [Max Viscosity cS] menu cell stores the maximum range for the analog span. The viscosity units are centistokes with no alternatives offered.

Min Viscosity cS

The [Min Viscosity cS] menu cell stores the minimum range for the analog span. The viscosity units are centistokes with no alternatives offered.

Max Temperature

The [Max Temperature] menu cell stores the maximum temperature range for the analog span. If metric preferences are selected *prior to site creation* the temperature units will be in Centigrade. If English preferences are selected *prior to site creation* the temperature units will be in Fahrenheit.

Min Temperature

The [Min Temperature] menu cell stores the minimum temperature range for the analog span. If metric preferences are selected *prior to site creation* the temperature units will be in Centigrade. If English preferences are selected *prior to site creation* the temperature units will be in Fahrenheit.

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 magnetic senors.

To access the [Set Alarm Levels] menu press 

High Flow

The [High Flow] alarm menu cell allows you to set the HI alarm relay trip-point.

To set the High Flow alarm:

To activate numeric entry press 

Use PC numeric keys or Magnetic Wand to enter the High Flow alarm setpoint in the selected flow rate units.

To store data press 

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 

Use PC numeric keys or Magnetic Wand to enter the Low Flow alarm setpoint in selected flow rate units.

To store data press 

The following Alarm Relay Setpoints are set in the same way as the two previously shown examples by entering numeric values and storing the data.

High S.G.

This selection sets the High S.G. alarm function the specific gravity of a selected liquid.

Low S.G.

This selection sets the Low S.G. alarm function the specific gravity of a selected liquid.

High Viscosity cS

The [High Viscosity cS] menu cell sets the high liquid viscosity alarm relay setpoint. The viscosity units are centistokes with no alternatives offered.

Low Viscosity cS

The [Low Viscosity cS] menu cell sets the low liquid viscosity alarm relay setpoint. The viscosity units are centistokes with no alternatives offered.

High Temperature

The [High Temperature] menu cell sets the high temperature alarm relay setpoint. If metric preferences are selected *prior to site creation* the temperature units will be in Centigrade. If English preferences are selected *prior to site creation* the temperature units will be in Fahrenheit.

Low Temperature

The [Low Temperature] menu cell sets the low temperature alarm relay setpoint. If metric preferences are selected *prior to site creation* the temperature units will be in Centigrade. If English preferences are selected *prior to site creation* the temperature units will be in Fahrenheit.

Interface Vs m/s (meters-per-second)

The [Interface Vs m/s] menu cell sets the Interface Vs set point. The relay changes state when the variable exceeds the user set point.

NOTE: The valid Interface Vs range is: 400 to 2100 m/s.

To enter an Interface Vs alarm setpoint:

To activate numeric entry press 

Use PC numeric keys or Magnetic Wand to enter the Interface Vs value in meters-per-second.

To store the data press 

Aeration %

The System 1010X 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 

Use PC numeric keys or Magnetic Wand to enter the Aeration percentage setpoint.

To store data press 

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 

Move the cursor to select either [On or Off] by pressing 

To turn Makeup Latch [On] or [Off] press 

6.7.3 CALIBRATE FLOWRATE

The 1010X's 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 1010X 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 percentage increase (+) or decrease (-) that is necessary to produce the best average correlation between System 1010X and the reference standard. For example, entering [-0.29] will produce a reduction of 0.29% in the calibration at all flow rates.

To calculate Kc: $$Kc = \left[\frac{\text{Actual Rate}}{\text{Indicated Rate}} - 1 \right] \times 100$$

To enter the Kc Factor:

To enable numeric entry press 

Use PC numeric keys or Magnetic Wand 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 ENT. 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 1010X 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 System 1010X 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 System 1010X'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.

<u>To perform a MultiPoint Calibration:</u>

To access the [Calibrate Flowrate] option list press the <Right Arrow>.

Move the cursor up to [MultiPoint], then press <ENT>.

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 Magnetic Wand to enter a flow rate for point #1, then press <ENT>. The highlight moves to the [% Correction] field for point #1.

Press the <Right Arrow> to enable numeric entry.

Use PC numeric keys or Magnetic Wand to enter the required % correction for point #1.

Press the <ENT>. 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 Magnetic Wand 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 <ENT>. The cursor moves to the [% Correction] field.

To enable numeric entry press <ENT>.

Use PC numeric keys or Magnetic Wand to enter the required % correction for point #2.

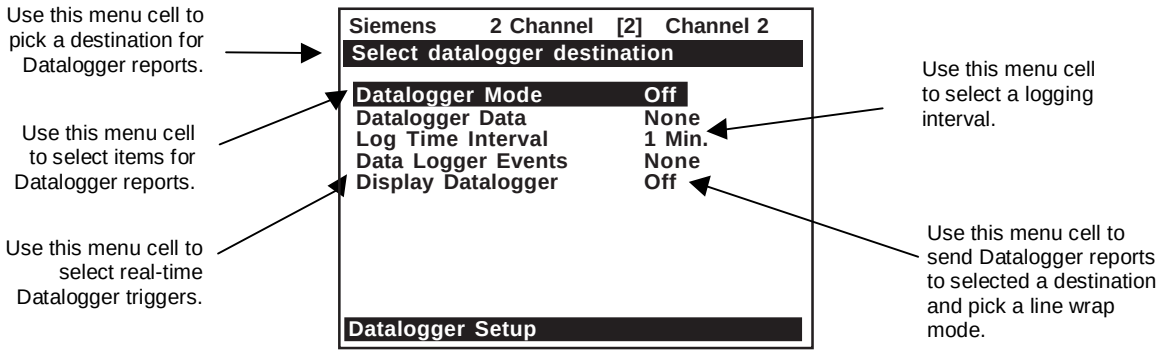
Press <ENT>.

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.



THE DATALOGGER SETUP MENU STRUCTURE

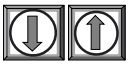
⇨ Datalogger Setup ⇳	⇨ Datalogger Mode ⇳	⇨ ⇳ Off Memory RS-232 Output
	⇨ Datalogger Data ⇳	⇨ ⇳ None Site Id Date Time Flow Average Flow Raw Flow Total Vs Valc Aeration Alarms Delta T (usecs) Temperature Analog Inputs
	⇨ Log Time Interval ⇳	⇨ ⇳ 5 Sec. 10 Sec. 15 Sec. 30 Sec. 1 Min. 5 Min. 15 Min. 30 Min. 1 Hr. 2 Hr. 4 Hr. 6 Hr. 12 Hr. 24 Hr. Demand
	⇨ Datalogger Events ⇳	⇨ ⇳ None Fault Alarm Memory Makeup Spacing Empty Aeration Interface Flow Alarm

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 

Move the cursor to the desired mode by pressing 

To store the selection press 

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.
Temperature	The instantaneous supply and return temperatures at the time for the report (optional).
Analog Inputs	Any data appearing on an auxiliary input 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 next page).

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

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  . Move the cursor to the desired data item by pressing  then press  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  . Note that this removes the plus sign (+) from the item.

After selecting/deselecting all desired items press  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 

Move the cursor to desired interval by pressing 

To store your selection press 

6.8.4 DATALOGGER EVENTS

System 1010X 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 → . Move cursor to desired item by pressing ↓ ↑ then ENT 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 ↓ ↑ then CLR. Note that this removes the plus sign (+) from the item.

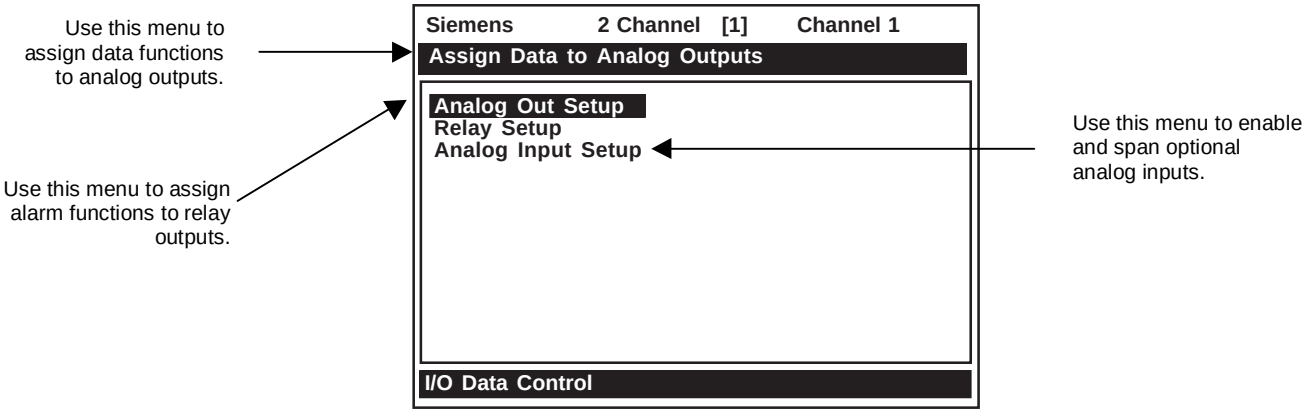
After selecting all desired items press ← to leave the Datalogger Events option list.

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.



NOTE: The *Analog Input Setup* has two function levels. Level 1 is the X-option auxiliary function. Level 2 is the F-option. It allows expanded functions (i.e., Aux, PSI [BAR], SG, Viscosity [cS], and Temp). The F-option has the highest variable priority level and overrides all others. It assigns an active analog input to a channel. For example, when using the viscosity function the numeric variables might be as follows: 4mA=1 (water) and 20mA=100 (thicker liquid). The meter uses this constant numerical change to improve calibration in real time.

THE I/O DATA CONTROL MENU STRUCTURE

⇨ I/O Data Control	⇨ Analog Output Setup	⇨ Io	⇳ Vfo Vfab Vs Valc Vaer Vsg Viscosity T1 Iin1
		⇨ Pgen	**See Io option list*
	⇨ Relay Setup	⇨ Relay 1	⇳ Off Power On S.G. Hi Temperature Low Temperature High Flow Low Flow Flow Alarm Fault Alarm Soft Fault Spacing Empty Aeration Interface Reverse Flow BatchTot Pos Total Neg Total
	⇨ Analog Input Setup	⇨ Iin	⇳ Off Aux S.G. (F option) cS (F option) Cp (F option) PSIA (F option) BARA (F option) Deg F (F option) Deg C (F option)
		⇨ 4 mA	**numeric entry*
		⇨ 20 mA	**numeric entry*

6.9.1 ANALOG OUTPUT SETUP

System 1010X 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 1010X Analog Outputs

Io (Isolated current)	4 to 20 mA varies in proportion to an assigned data function.
Pgen (TTL logic)	0 to 5000 Hz varies in proportion to an assigned data function.

Analog Out Setup Data Categories

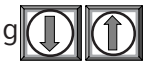
Vfo	Spanned volumetric/mass flow rate
Vf	Spanned unsigned flow magnitude
Vs	Spanned liquid sonic velocity
Valc	Receive signal amplitude
Vaer	Relative degree of liquid aeration/cavitation
Vsg	Spanned specific gravity
Viscosity	Liquid viscosity in centistoke units
T1	Current liquid temperature
Iin1, Iin2	Represents a re-transmit of the analog signals (e.g., Pressure and Temp inputs can be transmitted on the 4/20 mA output).

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, press  twice to access the Io option list.

Move the cursor to the desired data function by pressing 

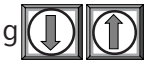
To store selection press 

Assigning Pgen Output Functions (see paragraph 6.10.6)

The Pgen analog output is a opto-coupled pulse rate signal whose configuration is detailed in Installation Drawing 1010X-7. It varies linearly from 0-5000 Hz in relation to a selected data function.

To assign a function to the Pgen output:

To access the Pgen option list press 

Move the cursor to the desired data function by pressing 

To store selection press 

6.9.2 RELAY SETUP

Use this menu to assign a function to channel relays. System 1010X 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 2.5 pulses 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: Using the <F1> key Totalizer clear command also clears all channel totalizers plus the overflow register described in the last paragraph. The Reset Totalizer [Yes/No] menu command will also accomplish this.

Assigning Relay 1 Functions

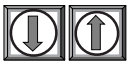
System 1010X provides one alarm relay. Please refer to the appropriate Installation Drawing in Appendix B for wiring details. Relays respond to any of the alarm conditions/data functions included on the [Relay 1] option list.

Relay 1 Option List

Off	Power off alarm
Power On	Power on alarm
S.G.	Specific gravity value relay trip-point
Hi Temperature	High temperature value relay trip-point
Low Temperature	Low temperature value relay trip-point
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
Interface	Liquid interface setpoint exceeded
Aeration	Aeration percentage exceeds alarm setpoint
Reverse Flow	Flow is in negative direction
BatchTot	Batch/Sample total advances
Pos Total	Positive total volume advances by 1 digit
Neg Total	Negative total volume advances by 1 digit

To assign functions to Relay 1:

To access the [Relay 1] option list press 

Move the cursor to the desired relay assignment by pressing 

To store selection press ENT.

6.9.3 ANALOG INPUT SETUP (optional function)

The Analog Input Setup function assigns an active analog input to a measurement channel/path. The meter provides four DC current input ports for single channel or Dual Channel units. The DC current input ranges from a zero level of 4 mA to a full scale of 20 mA. The [Analog Input Setup] menu cell allows you to enable this port and then span it to any desired scaling. For example, when using the analog input viscosity function the numeric variables might be spanned as follows: 4mA=14.7 PSIA and 20mA=1000 PSIA.

The various flowmeter models allow you to associate the analog input to active system variables such as specific gravity, viscosity and others (see table below).

NOTE: Refer to the Installation Drawings (1010X-7 and 1010DX-7) or I/O Module markings for the locations of these inputs and wiring procedures.

I/O Data Control ⇨	Analog Inp Setup ⇨	Iin1 ⇨	Input	⇳ Off Aux cS PSIA BARA T1 Deg F T1 Deg C T2 Deg F T2 Deg C
⇳	⇳	⇳	⇳	
			4 mA	*numeric entry*
			20 mA	*numeric entry*
		Iin2	See Iin1 option list	

Note that the flowmeter recognizes the first analog input variable that is assigned to any given parameter and ignores any subsequent input with the same assignment. For example, if Iin1 and Iin2 are both assigned to represent pressure (PSIA), the meter will only use the pressure input from Iin1.

Setting up the Analog Current Input

The first step is to enable the DC current input port.

From the [Analog Input Setup] menu cell:

Access the [Iin] option list by pressing ⇨ twice.

Move the cursor down to [Aux (n)] by pressing ⇩ and then ENT. This enables the port to receive an input current. The cursor moves to [4 mA].

To enable numeric entry press ⇨.

Enter a numeric value corresponding to a 4 mA input signal.

To store the data press ENT. This moves the cursor to [20 mA].

To enable numeric entry press ⇨.

Enter the numeric value corresponding to a 20 mA input signal.

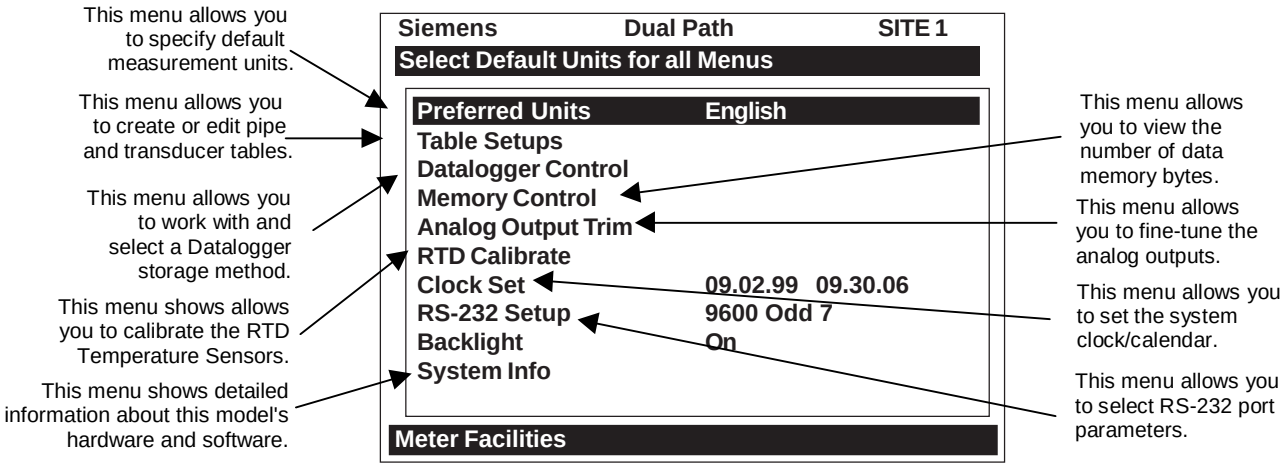
To store the data and press ENT.

6.10 THE METER FACILITIES MENU

Meter Facilities functions are available by using the magnetic wand to select <Meter Facilities>. 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.
- Calibrate the RTD temperature sensors.
- Set the system clock/calendar.
- Obtain detailed software/hardware identification.



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 

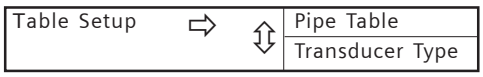
Move the cursor to [Metric] by pressing 

To register your selection press 

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 



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 è 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 

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** ⇨	ASA Carbon Steel ⇨	ASA Plastic ⇨
	⇳ **1SS10**	⇳ 1CS40	⇳ 1P40
	2SS10	1CS80	1P80
	3SS10	2CS40	2P40
	4SS10	2CS80	2P80
	6SS10	3CS40	3P40
	8SS10	3CS80	3P80
⇨	Metric DN Steel	4CS40	4P40
	⇳ 50 DN	4CS80	4P80
	100 DN	6CS40	6P40
	200 DN	6CS80	6P80
	400 DN	8CS40	8P40
	800 DN	8CS80	8P80
⇨	Metric SGP Steel	10CS XS	10P XS
⇳	⇳ 20A-SGP	10CS40	10P40
	25A-SGP	12CS STD	12P STD
	32A-SGP	12CS XS	12P XS
	40A-SGP	16CS STD	16P STD
	50A-SGP	16CS XS	16P XS
	65A-SGP	18CS STD	18P STD
	80A-SGP	18CS XS	18P STD
	90A-SGP	20CS STD	20P STD
	100A-SGP	20CS XS	20P XS
	125A-SGP	24CS STD	24P STD
	150A-SGP	24CS XS	24P XS
	175A-SGP	30CS STD	30P STD
	200A-SGP	30CS XS	30P XS
	225A-SGP	36CS STD	36P STD
	250A-SGP	36CS XS	36P XS
	300A-SGP ⇨	Cast Iron Table	⇨ Copper Tube Table
	350A-SGP	⇳ 6” cls C	⇳ 1” type M
	400A-SGP	10” cls C	1” type K
	450A-SGP	12” cls C	1” type L
	500A-SGP	16” cls C	2” type M
		20” cls C	2” type K
	⇨	Ductile Iron Table	2” type L
		⇳ 6” cls 52	4” type M
		8” cls 52	4” type K
		10” cls 52	4” type L
		12” cls 56”	6” type M
		16” cls 52	6” type K
		24” cls 52	6” type L

(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*	
	Choose 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 <ENT>. 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 <ENT>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 <ENT> 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 <ENT>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 <ENT> to use this name.

To use a new name, press the <Right Arrow> and then use the appropriate arrow keys or Magnetic Wand to rename the pipe (8 chars. Max.).

Press <ENT>. 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  . To access the [Choose Pipe Class] option list press  .

Press  scroll the option list to the class that contains the pipe to be deleted.

To select the pipe class press ENT. This moves the highlight to [Choose Pipe Name].

To access the [Choose Pipe Name] option list press  .

Press  to scroll the option list to the pipe to be deleted .

To remove it from the pipe table press ENT.

6.10.3 TRANSDUCER TYPE MENU

During the Transducer Install procedure, System 1010X 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 

Press  to scroll the highlight to a transducer type (e.g., 1011H High Precision) then press  to access the size option list.

Scroll through the option list by pressing  and press ENT 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 CLR key. Note that this removes the plus sign.

To leave an option list press 

TRANSDUCER TYPE MENU STRUCTURE

Transducer Type ⇨	1011 Universal ⇨	⇳ A1 A2 B1 B2 B3 C1 C2 C3 D1 D2 D3 E1 E2 E3
	1011H High Precision ⇨	⇳ A1H A2H A3H B1H B2H C1H C2H D1H D2H D4H
	991 Universal ⇨	⇳ 0A 0 1 2 2A 3 3A 4 4A 5 5A

6.10.4 THE DATALOGGER CONTROL MENU

The [Datalogger Control] menu in the Channel Setup 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 

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 1010X meter interfaces with most serial printers or personal computers. Controlotron 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 6.10.9 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.

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 6.10.9 RS-232 Setup).

To access the [Output Datalogger] option list press 

Scroll the cursor to [Yes] by pressing 

To transmit Datalogger contents to external device via the serial port press 

To stop printout press 

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 and pre-allocates a substantial amount of memory for this function, removing it from site storage memory.

NOTE: To avoid potential data loss, the flowmeter prevents you from altering the Circular Memory setting when a channel is active.

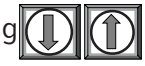
To setup and enable Circular Memory:

The Datalogger Mode menu must have the [Memory] menu cell selected.

Datalogger items must be selected (e.g., Site ID, Date, Time, etc.).

In the Datalogger Control menu, select [Circular Memory].

Press  to access the [Circular Memory] option list.

Move the cursor to [Yes] by pressing 

To store selection press 

Lastly, re-enable the channels that you disabled earlier to begin logging.

Est Log Time Left

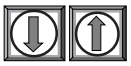
Est Log Time Left is a "view-only" menu cell that shows an estimate of the amount of Datalogger time remaining in hours and minutes. This menu cell becomes active after you enable datalogging. Selecting Circular Memory and/or event-based datalogging (see Datalogger Setup), blanks the field [Est Log Time 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 decide to 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.

To clear Datalogger Data Memory:

To access the [Clear Datalogger] option list press 

Move the cursor to [Yes] by pressing 

To clear the memory press 

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. Capacity is also affected by the RAM option with which your 1010X is equipped with - either 900k expanded or 170k standard RAM.

MEMORY CONTROL MENU

Data Memory Left	⇨	⇩ **XXXXX**
Memory Map	⇨	⇩ **Yes** **No**
Defragment	⇨	⇩ **No** **Yes**

Data Memory Left: 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.

Memory Map: Selecting YES for this item enables a snapshot display of current memory usage. In this display, the asterisk indicates a used block, a space indicates a free block, while a dash character indicates unused filler.

Defragment: 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 

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 1010X's 4-20mA current loop.

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 

ANALOG OUTPUT TRIM MENU STRUCTURE

Analog Output Trim ⇨	Io1 ⇨	⇳ Operate Trim @ 4mA ⇨ *Indicated mA = x.xx*
⇳ ⇨	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.)

To calibrate a current output (Io1 or Io2):

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 →, then press ↓ to move the cursor to Trim @ 4mA.

Press ENT. 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 Magnetic Wand to enter the multimeter reading.

Press ENT 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.)

To calibrate a pulse rate output (Pgen1):

Connect a frequency counter to the supply and return terminals of the pulse rate output under test.

Move the highlight to the port to be tested by pressing ↓ ↑. Press →, then press ↓ to move the cursor to Trim @ 1kHz.

Press ENT. 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 Magnetic Wand to enter the frequency counter reading.

Press ENT 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 RTD CALIBRATE MENU *(optional)*

The RTD Calibrate Menu appears on 1010X-3 models only. Use this menu to calibrate the 991T or 1011TN Restive Temperature Device (RTD) temperature sensors to an external standard. It is important to note that Siemens RTD temperature sensors are factory-calibrated for high accuracy. We recommend that before deciding to perform the calibration, check the current RTD reading in [Diagnostics/Liquid Data]. You may find that you do not even need to calibrate the sensor. In any case, make sure that the temperature reading stabilizes before proceeding further. The RTD Calibrate menu allows you to perform an external calibration, which can be accomplished either by data entry of the current RTD temperature or by a 32^0F (0^0C) Ice-Bath procedure. You can switch between the intrinsic and external calibration modes at any time.

NOTE: If you perform an external temperature calibration, you should mark and record the location of each connector and sensor-cable. Once you have re-calibrated the temperature sensors, changing the sensor/connector orientation established during the procedure may void the calibration.

To access the RTD Calibrate menu press 

RTD Calibrate ⇨	RTD 1 ⇨	⇳ Factory User Cal

RTD Calibration By Data Entry

The [RTD Calibrate] menu allows you to adjust the intrinsic RTD reading to match an external reference thermometer by directly entering its reading. Only perform this procedure while the RTD under test is installed and currently measuring temperature.

To enter the current RTD temperature:

Move the highlight to from [RTD Calibrate] to [RTD 1] by pressing  .

To access the [RTD 1] option list press  .

Move the highlight to [User Cal] or [Factory] calibration then press ENT. This triggers the prompt:

Calib @ deg F=32.0

To enable numeric entry press  , then enter the reading of the reference thermometer (e.g., 72.0).

Calib @ deg F=72.0

To recalibrate the RTD sensor press ENT. To verify the calibrated reading, go to the [Diagnostics/Liquid Data] menu cell to check the current RTD output. Make sure that it coincides with the reading of the reference thermometer.

NOTE: Factory Calibration provides an additional prompt after a new temperature is entered: *[Are you Sure? No Yes]*. It is recommended that you use *[User Cal]* to avoid alteration of preset factory calibration.

Ice Bath RTD Calibration

Use distilled, deionized water and ice mixture at 32°F (0°C) equilibrium for an ice bath. Ensure temperature with a reference thermometer. Controlotron can not assume responsibility for the incorrect design, construction or operation of an Ice Bath.

CAUTION: DO NOT ALLOW AN RTD SENSOR TO MAKE DIRECT CONTACT WITH ICE DURING AN ICE BATH CALIBRATION.

To perform a 32°F (0°C) RTD calibration:

Immerse RTD sensor in deionized water and ice mixture. Stir the mixture constantly.

Move the highlight to [RTD1] by pressing  .

To access the [RTD] option list press  .

Move the highlight to [User Cal] then press ENT.

This triggers the prompt:

Calib @ deg F=32.0

When you are sure that the RTD sensor is at 32°F (0°C), press ENT to recalibrate the RTD sensor. To verify the calibrated reading, go to the [Diagnostics/Liquid Data] menu cell to check the current RTD output. Make sure that it coincides with the reading of the reference thermometer.

6.10.8 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 Siemens 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" has 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 1010X 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 <CLR> key to remove the current setting.

To set the Date:

To enable numeric entry press 

Use PC numeric keys or Magnetic Wand to enter the date (MM.DD.YY).

To store the date press ENT. 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 <CLR> key to remove the current setting.

To set the clock:

To enable numeric entry press 

Use PC numeric keys or Magnetic Wand to enter the time (HH.MM).

To store the time press ENT. This moves the cursor to [RS-232 Setup] menu cell.

6.10.9 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

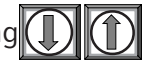
RS-232 Setup ⇨	Baud Rate ⇨	⇕ 300 1200 2400 4800 9600 38400
⇨	Parity ⇨	⇕ None Odd Space Even Mark
⇕ ⇨	Data Bits ⇨	⇕ 7 8
⇨	Line Feed ⇨	⇕ No Yes
⇨	Network ID ⇨	xx *(numeric entry)*
⇨	RTS Key Time ⇨	⇕ 0.2 Sec. 0.4 Sec. 0.6 Sec. 0.8 Sec. 1.0 Sec. 2.0 Sec. 3.0 Sec. 4.0 Sec.

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.

To change the Baud Rate:

To access the [Baud Rate] option list press 

Move the cursor to the required baud rate by pressing 

To store selection press ENT. 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].

To edit the Parity setting:

To access the [Parity] option list press 

Move the cursor to the required parity setting by pressing 

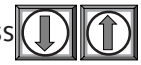
To store the data press ENT. This moves the cursor to [Data Bits].

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].)

To set the Data word length:

To access the [Data Bits] option list press 

To move the asterisk to the required bit setting press 

Press ENT 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 

Press  to move the asterisk to [Yes] Line Feed enabled, or [No] Line Feed disable.

To store the data press ENT. 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 

Use PC numeric keys or Magnetic Wand to enter the [Network ID] number.

To store Network ID press ENT. This moves the cursor to [RTS Key Time].

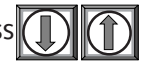
RTS Key Time

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 1010 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 

To move the asterisk to the required RTS time press 

To store the data press ENT

6.10.10 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 <F4> reset.
Op System P/N	Meter's operating system part number.
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.
System Time	Use to set system time and date. Format: xx.xx.xx xx.xx.xx

6.10.11 DATA DISPLAY SCREEN

The alphanumeric display of the 1010X 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 1010X 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 1010X system. On power-up the 1010X will display one of the following:

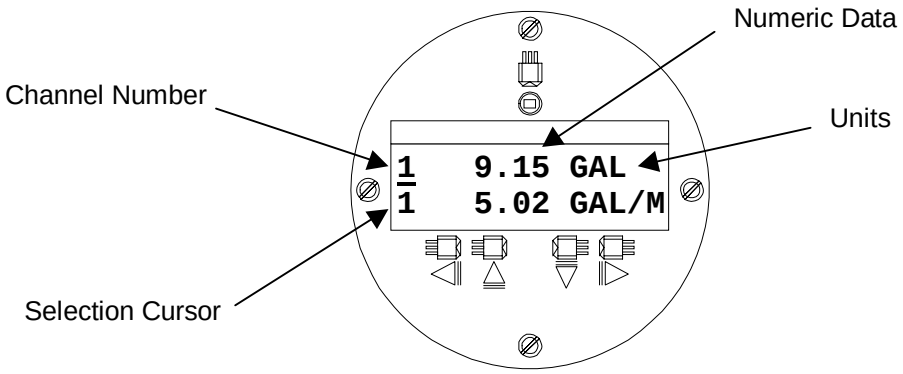
- The scrolling Controlotron Welcome Screen (i.e., if no channel had been previously activated), or
- The active channel's last data screen displayed prior to turning off the instrument.

After successful channel installation, use the Magnetic Wand and repeatedly trigger <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 activating the <Right Arrow> key with the Magnetic Wand, a selection cursor will appear under one of the channel indicator numerals (i.e., 1, 2, or 3). Activating the <Right Arrow> 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 activating the ¥ Enter Bull's Eye with the Magnetic Wand.

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 [Dual Channel Flow], [Ch 1+2 Flow] or [Ch 1-2 Flow] modes. In [Dual Beam Flow] mode, all diagnostic items are available for [Path 1] or [Path 2]. Some items are not available (N/A) when you select virtual channel [1 and 2]. In addition, selecting virtual Channel 3, in either the [1+2 Flow] or [1-2 Flow] modes will limit the list to flow data only.

DIAGNOSTIC DATA MENU STRUCTURE

⇨ Diagnostic Data ⇳	⇨ Flow Data ⇳	⇨ ⇳ Flow Velocity 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 ⇳	⇨ ⇳ Temp 1 Reynolds # Specific Garvity Viscosity cP Pressure Viscosity cS
	⇨ 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

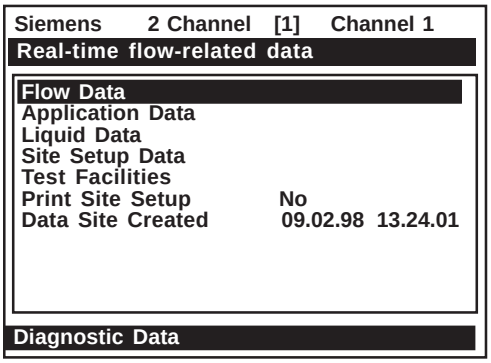
(continued)

DIAGNOSTIC DATA MENU STRUCTURE *(continued)*

Diagnostic Data	⇨ Test Facilities ⇳	⇨⇳ Makeup Tx Up Tx Dn Fixed ALC Tx Up Fixed ALC Tx Dn Fixed ALC
	⇨ Print Site Setup	
	⇨ Date Site Created	

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.

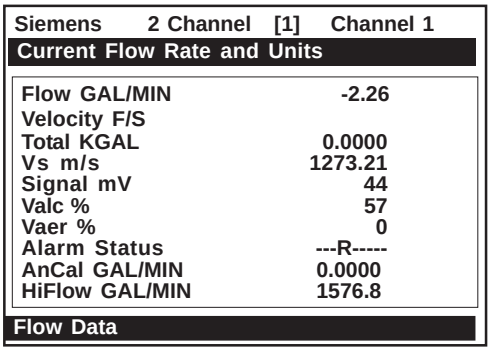


MAIN DIAGNOSTIC MENU DESCRIPTION

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 # and RTD temperature readings (if this system includes optional RTD Temperature measurement capability).
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.



FLOW DATA MENU ITEMS

Flow	This is a real-time (updated) flow rate display in current rate units (e.g., GAL/MIN).
Velocity F/S	Linear fluid flow velocity in F/S or m/s depending on preferred units (e.g., English or Metric).
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 [+] key (coarse adjustment) or the [1] key (fine adjustment) to increase the reading, or the [-] key (coarse adjustment) or the [2] key (fine adjustment) 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 receive 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	Most positive expected flow rate for application (adjustable). GAL/MIN
LoFlow	Most negative expected flow rate for application (adjustable). GAL/MIN

** Vs m/s fine adjustment readings are only available with RS-232 serial port communication. See Vs m/s explanation for coarse adjustments using the magnetic wand on the next page.*

Vs m/s - Using the RS-232 Connection

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 [-] key for coarse adjustment or the [2] key for fine adjustment. The pipe diameter and transmission frequency determines the effective increase or decrease per key press.

Vs m/s - Using the Magnetic Wand

To increase the Vs reading (coarse adjustment), touch the Enter sensor with the magnetic wand. To decrease the Vs reading (coarse adjustment), touch the <Right Arrow> sensor with the magnetic wand. **Note: Fine adjustments are only available when using RS-232 serial port communication.** Sonic velocity (Vs) adjustment is a diagnostic tool intended for our technicians or experienced users only. Improper use will affect the meter accuracy.

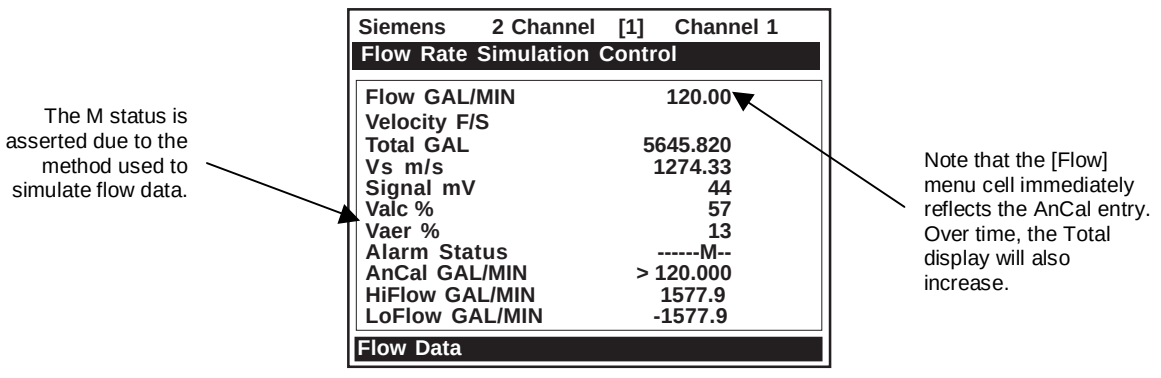
HiFlow and LoFlow

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 Siemens 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 misregistration) 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.

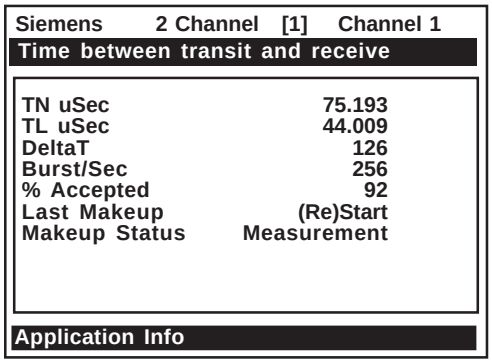


To activate AnCal:

- Move the cursor to the [AnCal] menu cell by pressing  . Press the  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  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.

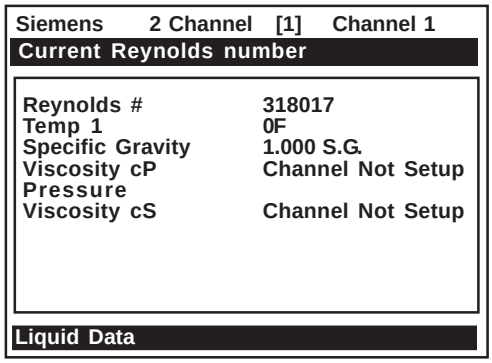


APPLICATION INFO MENU ITEMS

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	The running tally of accepted up/down transmit 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. In addition, systems equipped with optional temperature inputs show the current temperature measured by RTD (temperature sensors) connected to the meter's temperature input port. Meters equipped with the "F" option will display additional data (specific gravity, viscosity, pressure and expanded temperature).

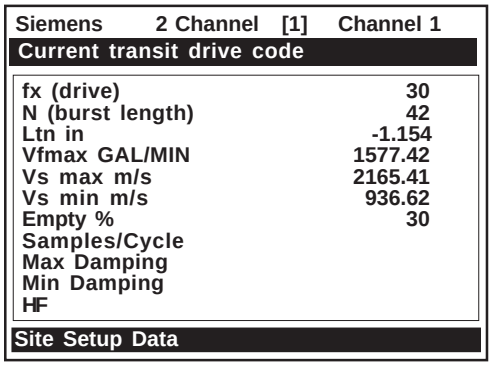


LIQUID DATA MENU ITEMS

Reynolds #	1010X 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.
Temp 1	Current (updated) liquid temperature.
Specific Gravity	Current specific gravity
Viscosity cP	The absolute viscosity of a liquid dynamically measured in centipose.
Pressure	Measured pressure (from Analog Input).
Viscosity cS	Kinematic viscosity of a liquid measured in centistokes.

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.



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.

(continued)

SITE SETUP MENU ITEMS *(continued)*

Max Damping	Maximum signal damping. Use to average digital data when an unstable conditions occurs.
Min Damping	Minimal signal damping. Use to average digital data when an unstable conditions occurs.
HF	Flow registration correction parameter.

The [HF] Menu Item

All 1010 flowmeters with version 3.01.02 and later operating systems include a 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 1011 flowmeters. This algorithm provides the most benefit for clamp-on gas meters.

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 any attempt to manually install a larger value will cause the flowmeter to abort the installation of the parameter.

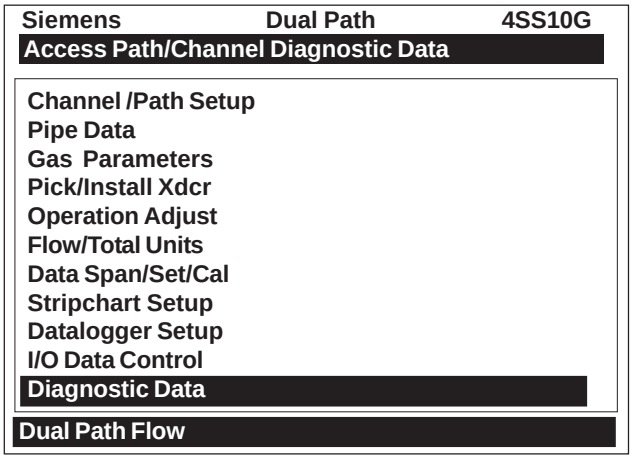
NOTE: Pressing the <Left Arrow> at any stage prior to accepting the measured value will abort the installation and return to the previous setting.

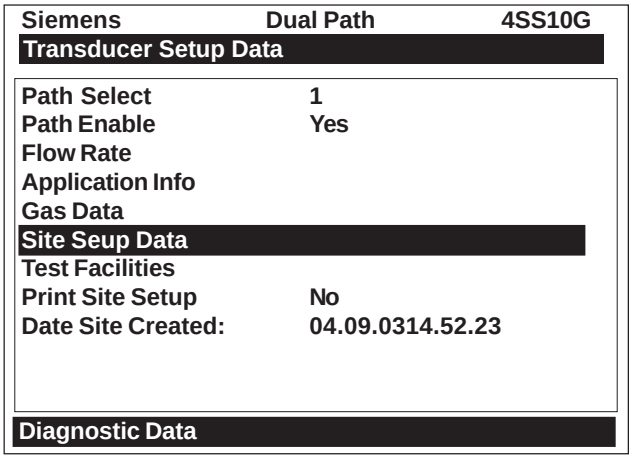
To access this [HF] menu item proceed as follows:

- At the [Meter Type] Menu, press the <Right Arrow> and then <ENT> 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.

- In the [Diagnostic Data] Menu, highlight [Path Select] and select the desired transducer path. Press <ENT> to select path.

- Press the <Down Arrow> and scroll to the [Site Setup Data] menu cell. Press the <Right Arrow> to select it.

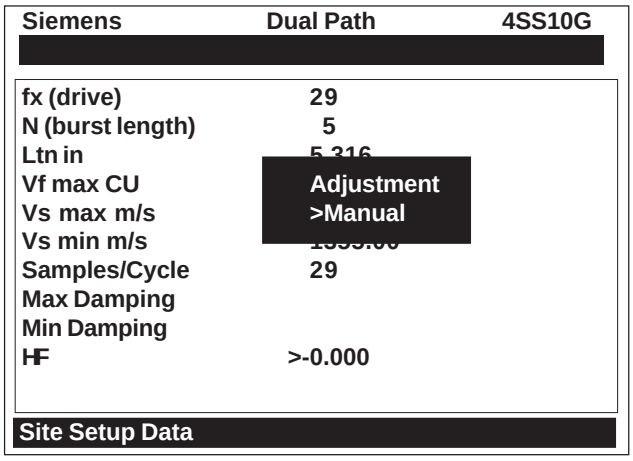


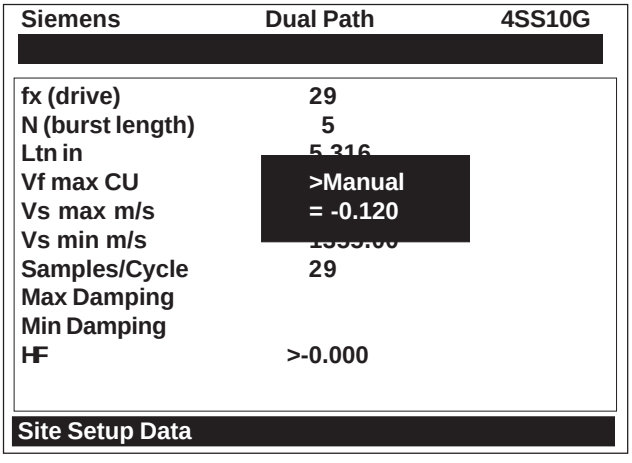


"Manual" Adjustment Procedure

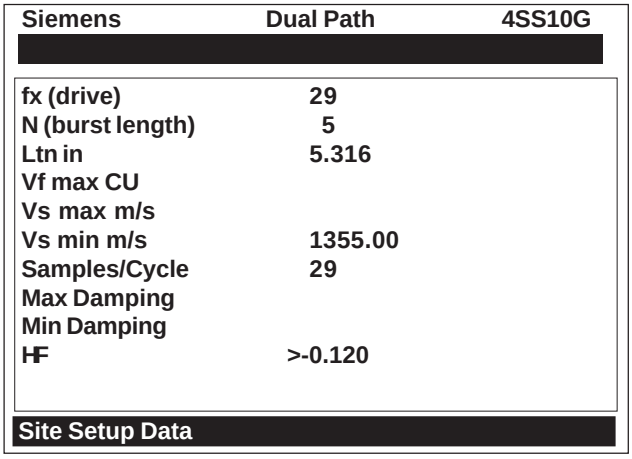
- In the [Site Setup Data] Menu, press the <Down Arrow> and scroll to the [HF] menu cell. Press the <Right Arrow> and a pop-up [Manual] prompt will appear as shown below. *Note: Press the <Up/Down Arrow> to select [Automatic], if desired.*

- Use the numerical keys to input the desired correction value. Press <ENT> to input value.





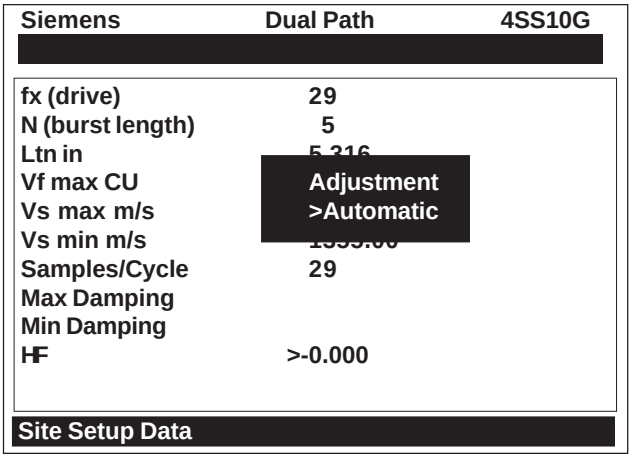
- The new correction value will appear next to the [HF] menu cell as shown below.

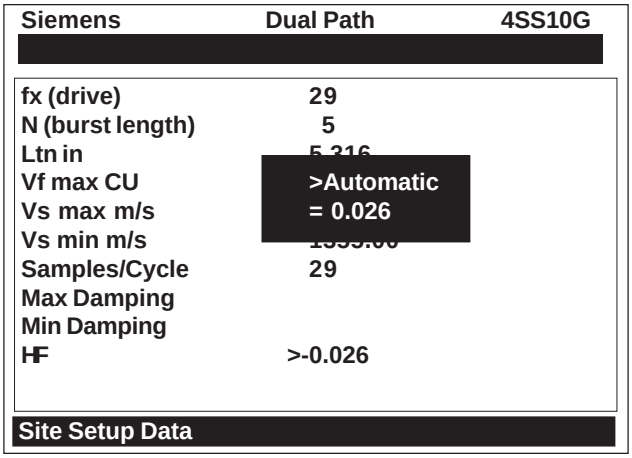


"Automatic" Adjustment

- 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 <ENT>.
- The current measured correction value is displayed (see below).
- Press <ENT> 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.

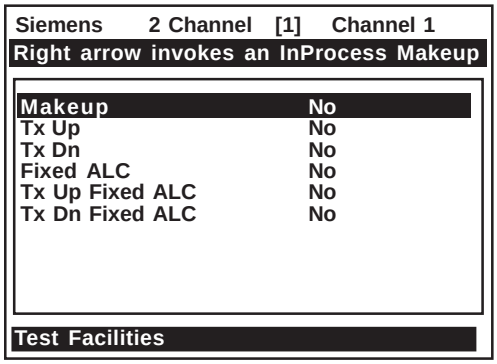




- If you decide not to use the [Automatic] selection, press any key other than <ENT> to abort the operation.

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.



To start a Test Routine:

- To scroll the cursor to the test routine press ⇩ ⇧
- To access the test option list press →. Press ⇩ ⇧ to move the asterisk to [Yes].
- To start the routine press ENT
- To end the routine press ←

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).

To invoke the Makeup routine:

- Press ⇩ ⇧ to scroll the cursor to [Makeup].
- Press → to access the test option list. Press ⇩ ⇧ to move the cursor to [Yes].
- Press ENT to start the makeup routine.

7.7 TROUBLESHOOTING TIPS

The System 1010X 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 Ultrasonic Flow 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 Active Memory?	Use this function to restore operation if a severe event (e.g., a violent power surge) disrupts system operation.
Clr Saved Data?	Use this function to clear Dynamic Memeory.
<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 -	Prompt to empty the pipe during the Actual MTY procedure. After emptying pipe, press <ENT>.
Fill Pipe - Press [ENT] Press [ENT]	Prompt to fill the pipe during the Actual MTY procedure. After filling the pipe, press [ENT].
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 re-spacing 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. • In Reflect Mode, the flow computer detects that the pipe wall signal may infringe upon the liquid signal. Use Direct Mode instead. Press <ENT>, <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.

(continued)

(continued)

Low Signal - Press [ENT]	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 <ENT> 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 1010X 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 1010X provides two system resets. The first uses the magnetic wand 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.

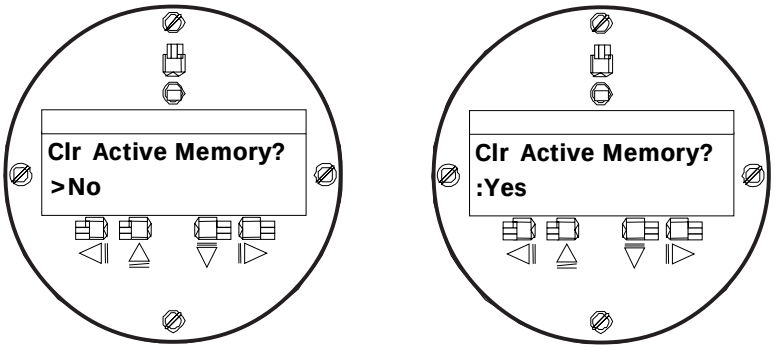
The reset sequence operates on two levels. The first level deletes all the data currently in Active Memory, but leaves Datalogger data and all stored Site Setups intact. This is the most desirable method since to restore operation all you have to do is reload a saved Site Setup. If this fails then you 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 MAGNETIC WAND

As mentioned previously, there is a power-on delay of approximately 30 seconds from the time that you apply power to the 1010X 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 Magnetic Wand:

- Turn off power (if it is currently on) and the reapply power to the system.
- Trigger ◎ during the power-on delay. Examine the left-hand figure below and note the message on the LCD display: **[Clr Active Memory?]**

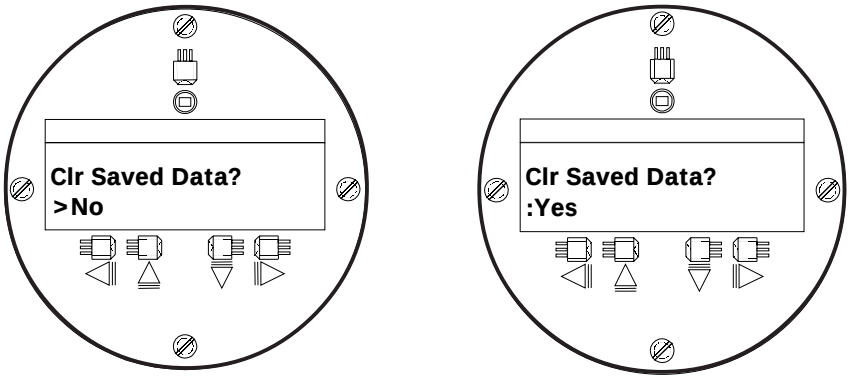


- Trigger ▷. Note that the greater than (>) symbol changes to a (:) colon. Trigger ▽ to change the second line to **[Yes]** (as shown in the right-hand figure above).
- Trigger ◎ to clear the contents of Active Memory (but preserve any stored Site Setups).
- To restore operation, create a new site setup 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 Magnetic Wand:

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! In addition, 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 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.
- Trigger ▷. Note that the greater than (>) symbol changes to a (:) colon. Trigger ◎. The display switches to **[Clr Saved Data?]** as shown on the left-hand figure (see below).



- Trigger ▷. Note that the greater than (>) symbol changes to a (:) colon. Trigger ▽ to change the second line to **[Yes]** (as shown in the right-hand figure above). Trigger ◎ 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 1010X 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.

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:

- 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? 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, 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:

- 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? 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, press <MENU> 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).

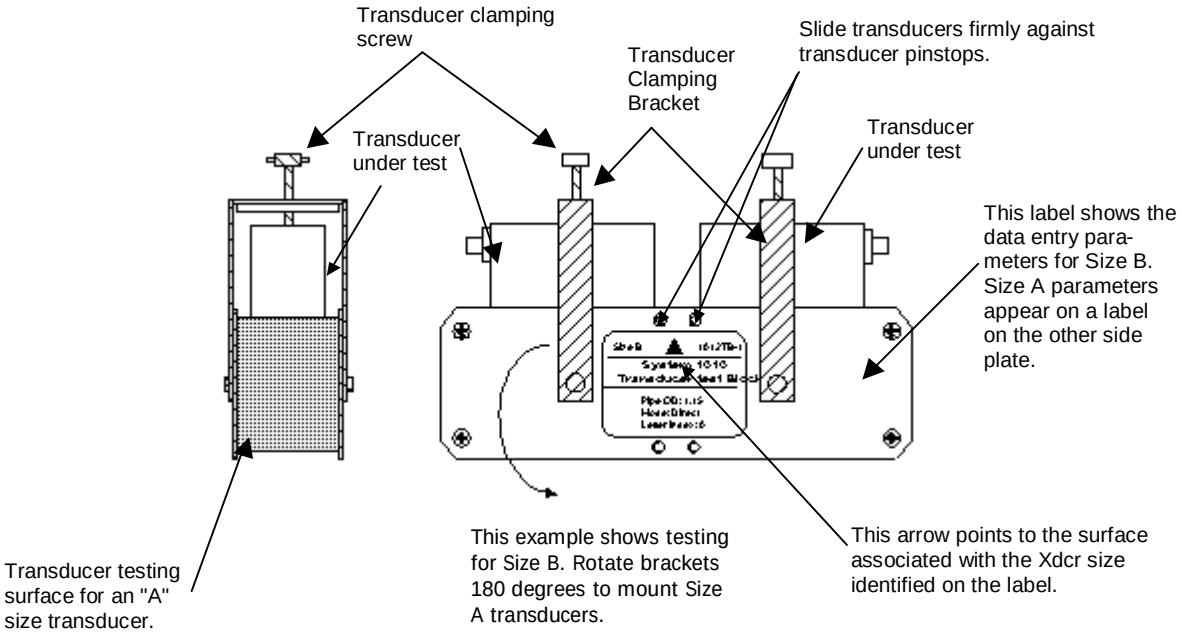
7.9 TROUBLESHOOTING WITH TRANSDUCER TEST BLOCKS

To resolve an apparent system malfunction, you have to determine whether the problem is due to equipment failure or an application condition. Our 1012 and 996 Transducer Test Blocks allow you to bench test the 1010X, transducers and their cables. If the system operates properly using the test block, then focus on application conditions as the source of the problem. Series A and B 1011 transducers use the 1012TB-1 Test Block and series C and D use the 1012TB-2 Test Block. At the present time, neither one support the 1011 High Precision transducers.

The 996PSP-Pipe Simulator allows you test a 1010 series computer and 991 transducers from size 0 to size 3. Note that although the 1010 computer operates with our 991 size 4 and 5 transducers, testing of these sizes with a 1010 computer is not currently supported.

7.9.1 USING THE 1012TB-1 AND 2 TEST BLOCKS

The 1012TB-1 and 1012TB-2 test blocks provide two test surfaces. Each surface supports a specific transducer size. For example, one surface of the 1010TB-1 supports Size “A” transducers and the other supports Size “B” transducers. The 1012 pipe simulators include two labels, one on each side-plate. The labels identify the transducer size, data to be entered, and the surface to be used with the specific transducer size. See drawing on next page.



MOUNTING TRANSDUCERS ON A 1012 TRANSDUCER TEST BLOCK

- Identify the side of the simulator that applies to the transducers under test. Rotate the clamping bracket as required to mount transducers on the test surface.

- Using a coupling compound (preferably CC-102), mount the transducers on the pipe simulator as shown above. Slide each transducer until it presses against the pin-stop. Use the clamping screws to hold the transducers in place.

- Connect transducer cables between each transducer and the meter connectors for the channel under test. The Up and Down orientation is not important.

- Access the Installation Menu. Select [Meter Type] [Single, Dual, or Quad Channel] depending on meter type. Select the meter channel (1,2,3, or 4) depending on which measurement channel you intend to test. Select [Clamp-On] and then [Channel Setup].

- Access the [Channel/Path Setup] menu. Move the highlight to [Create/Name Site]. Create a new Site Setup (e.g., TEST1). You can now enter data without altering an existing Site Setup.

- Select the [Pipe Data] Menu. Referencing either the English or metric pipe simulator chart below, enter the pipe data corresponding to the transducer size under test.

1012TB-1 & 2 Universal Transducer Test Block Chart (English)

Part Number	Xdcr Size	Pipe OD (in)	Pipe Mat'l	Wall Thk (in)	Mount Mode	Spacing Offset	Number Index
1012TB-1	A	0.650	Steel*	0.100*	Reflect	Nominal	7
1012TB-1	B	1.150	Steel*	0.100*	Direct	Minimum	4
1012TB-2	C	2.000	Steel*	0.100*	Reflect	Nominal	11
1012TB-2	D	3.500	Steel*	0.100*	Direct	Minimum	Use Ltn

**System Default*

1012TB-1 & 2 Universal Transducer Test Block Chart (Metric)

Part Number	Xdcr Size	Pipe OD (mm)	Pipe Mat'l	Wall Thk (mm)	Mount Mode	Spacing Offset	Number Index
1012TB-1	A	16.5	Steel*	2.54*	Reflect	Nominal	7
1012TB-1	B	29.2	Steel*	2.54*	Direct	Minimum	4
1012TB-2	C	50.8	Steel*	2.54*	Reflect	Nominal	11
1012TB-2	D	88.9	Steel*	2.54*	Direct	Minimum	Use Ltn

**System Defaults*

- Access the [Pick/Install Xdcr] menu. Check the [Transducer Size] menu cell. If necessary, enter the [Xdcr Size] option list and pick the transducer under test.

- Check the [Xdcr Mount Mode] menu cell. Adjust to match the simulator chart above.

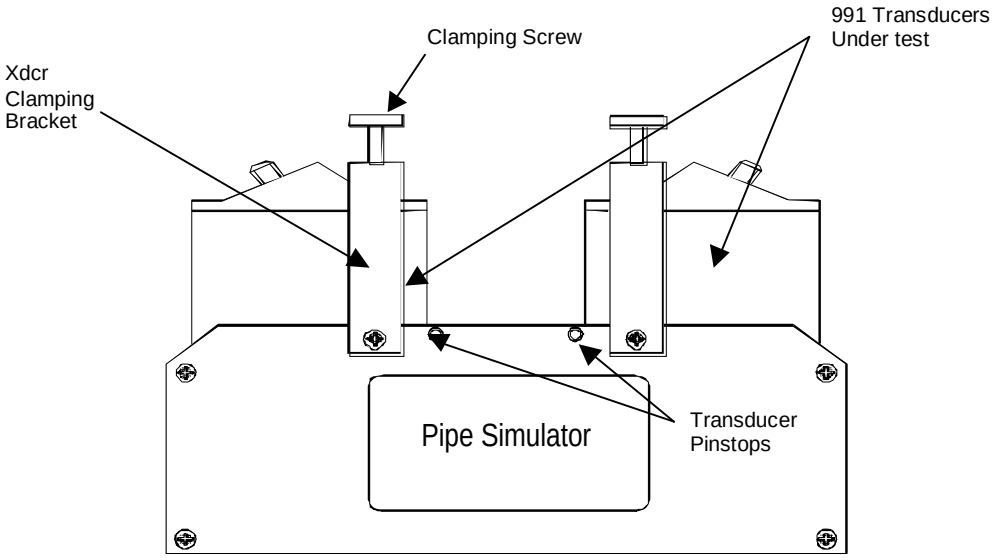
- Move the highlight down to [Install Completed?]  . Access the option list. Move the cursor to [Install] by pressing  . Press  to start the transducer install routine.

NOTE: Since Sizes A and C transducers are installed in Reflect Mode, you will see a pop-up window that prompts you to: [Use Actual Zero]. You can ignore this by pressing the <Down Arrow>.

Upon the completion of the [Install] procedure, the computer should report a sonic velocity within the range of approximately 1350m/s to 1700 m/s (depending on the transducer size under test). Next, check the **[Diagnostic Data]** menu. The [Valc %] item must be >35 for dependable operation. In addition, note the reading, then compare it to the [Vf max] item in the **[Diagnostic Data/Site Setup Data]** menu. The value of the reading should be less that 2% of the published Vf max. Confirming these values certifies that the entire system (computer, transducers, cables) is operating correctly. The investigation should proceed to a review of all site conditions to locate the operating problem.

7.9.2 USING THE 996PSP PIPE SIMULATOR

Using the proper coupling compound, mount the transducers on the pipe simulator as shown below. Slide each transducer until it presses against a pin-stop. Use the clamping screws to hold the transducers in place.



To mount transducers on a 996PSP Pipe Simulator:

- Using coupling compound, mount the transducers on the pipe simulator as shown on the previous page. Slide each transducer until it presses against a pin-stop. Use the clamps to hold the transducer in place.
- Connect cables between each transducer and the computer connectors for the channel under test. The Up and Down orientation is not important.
- Access the Installation Menu. Select [Meter Type] [Single, Dual, or Quad Channel] depending on flowmeter type. Select the meter channel (1,2,3, or 4) depending on which measurement channel you intend to test. Select [Clamp-On] and then [Channel Setup].
- Access [Channel/Path Setup] menu. Move highlight to [Create/Name Site]. Create a new Site Setup (e.g., TEST1). You can now enter data without altering an existing Site Setup.
- Select the [Pipe Data] Menu. Referencing either the English or metric pipe simulator chart below, enter the pipe parameters corresponding to the transducer size under test.

996PSP PIPE SIMULATOR CHART (English)

Part Number	Xdcr Size	Pipe OD (in)	Pipe Mat'l	Wall Thk (in)	Mount Mode	Letter Index	Number Index*
996PSP-0	0	2.420	PVC	0.076	Direct	A	6
996PSP-1	1	2.481	PVC	0.077	Direct	A	9
996PSP-2	2	2.743	PVC	0.136	Direct	A	6
996PSP-3	3	3.758	PVC	0.344	Direct	A	1
996PSP-4	4	6.500	PVC	1.000	Direct**	A	0

** The computer generates the Number Index.*

*** See note below.*

996PSP PIPE SIMULATOR CHART (Metric)

Part Number	Xdcr Size	Pipe OD (mm)	Pipe Mat'	Wall Thk (mm)	Mount Mode	Letter Index	Number Index*
996PSP-0	0	61.47	PVC	1.93	Direct	A	6
996PSP-1	1	63.02	PVC	1.96	Direct	A	9
996PSP-2	2	69.67	PVC	3.45	Direct	A	6
996PSP-3	3	95.45	PVC	8.74	Direct	A	1
996PSP-4	4	165.1	PVC	5.4	Direct**	A	0

** The computer generates the Number Index.*

*** See note below.*

NOTE: When using a 996PS-4 Simulator, you must access the [Application Data] menu, select [Liquid Type] - [Other], then program the [Estimated Vs] for a value of 2100 m/s.

- Access the [Pick/Install Xdcr] menu. Access the [Transducer Model] menu cell. Enter the Transducer Model option list. Select [991 Universal].
- Check the [Transducer Size] menu cell. If necessary, enter the Transducer Size option list and pick the actual transducer under test.
- Check the [Xdcr Mount Mode] menu cell. Adjust as necessary to match the simulator chart above.

- Move the highlight down to [Install Completed?]. Access the option list. Move the cursor to [Install]. Press <ENT> to start the transducer install routine.

- Check to make sure that the computer returns the Number Index listed in the chart above. Next, review and verify the Diagnostics data items as described previously. If the computer, cables and transducers are operating properly, then review all site conditions to locate the operating problem.

If a Pipe Simulator/Test-Block Test Fails:

- Replace the transducer cables. If this allows you to complete the test as described above, then the cables were defective.

- If the cables are proven to be good, replace the transducers on the pipe simulator with a “known good” set. If the system functions properly, then the original transducers under test are defective. Please return any defective transducers to Controlotron for repair.

- If you replace the transducers and cables, and the system still fails to function correctly, then it is likely that the computer has a malfunctioning circuit module. If you have spare modules you may try module substitution to identify the defective module. Otherwise, please call our Technical Service Department for further instructions and assistance.

APPENDIX A

Couplant Installation Instructions

Made in the USA

NOTE

Currently there are no Couplant Installation Instructions included in this field manual for this unit.

APPENDIX B
ENGINEERING DRAWINGS

SYSTEM 1010X NEMA-7 FLOWMETER

Flow Computer Drawings

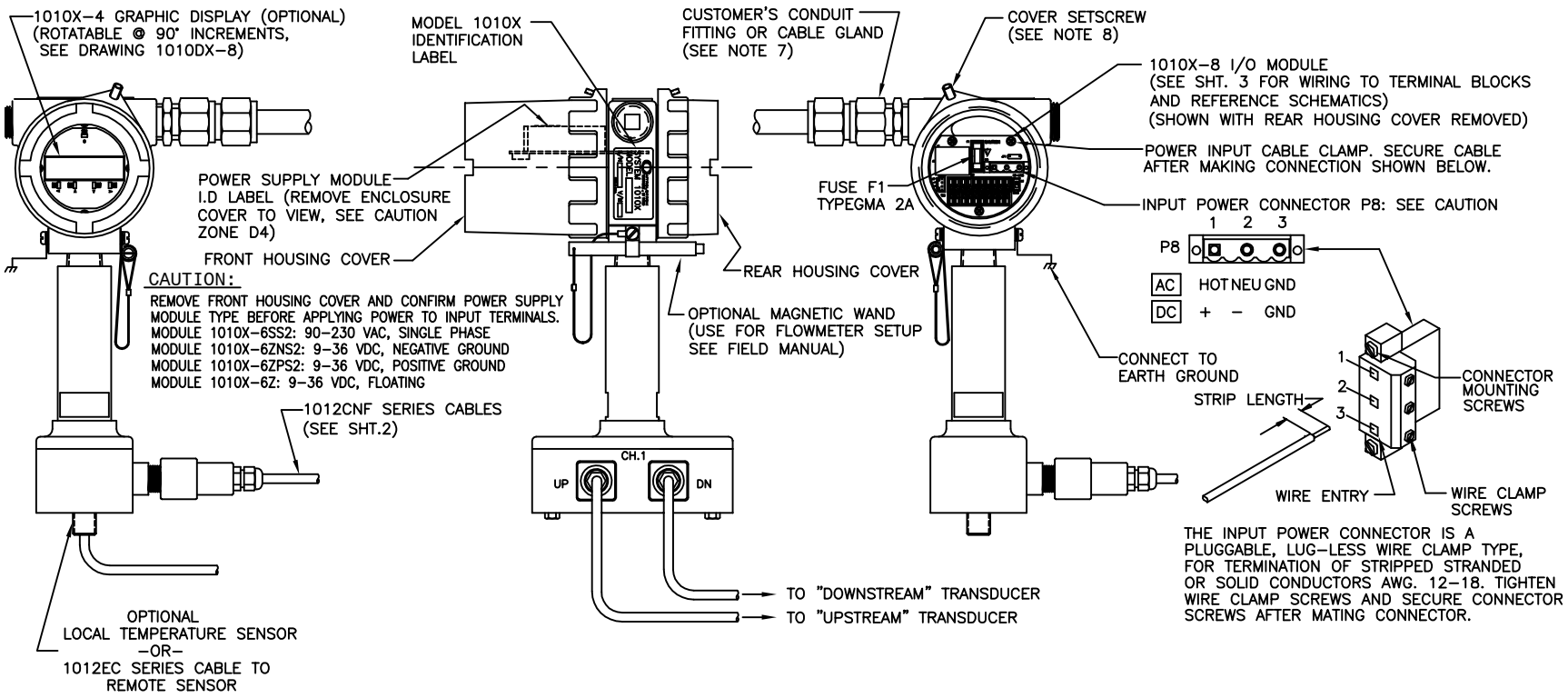
1010X-7 ..... Installation Wiring, 1010X Series Flow Computer Agency Approved
1010X-8 ..... Outline Dimensions, 1010X Series Flow Computer
1010DX-7 ..... Installation Wiring, 1010DX Series Flow Computer Agency Approved
1010DX-8 ..... Outline Dimensions, 1010DX Series Flow Computer
1012XMB-1-8 ..... Outline Dimensions, 1010X Mounting Kit
1010-341 ..... Connection Diagram, 1010 System, Explosion Proof/Flameproof Flow Computer
1010-342 ..... Connection Diagram, 1010 System, Explosion Proof/Flameproof Flow Computer

Transducer And Accessory Drawings

1011HNFS-7 ..... Installation, 1011HNFS Series Dedicated Plastic Body Transducer
1011HNFS-8 ..... Outline Dimensions, 1011HNFS Series Dedicated Plastic Body Transducer
1011NFPS-7 ..... Installation, 1011NFPS Series Dedicated Plastic Body Transducer
1011NFPS-8 ..... Outline Dimensions, 1011NFPS Series Dedicated Plastic Body Transducer
1012BN-8 ..... Outline Dimensions, 1010 Series Spacer Bar
1012FN-8 ..... Outline Dimensions, 1011 Series Dedicated Transducer Mounting Frames
1012FNH-8 ..... Outline Dimensions, 1011HN Series Dedicated Transducer Mounting Frames
1012MS-8 ..... Installation/Outline, Adjustable Mounting Strap
1012TB-8 ..... Installation/Outline, 1011 Series Test Block
1012TN-7 ..... Installation Drawing, 1010 Series Transducer and Mount Tracks
1012TN-8 ..... Outline Dimensions, 1012 Series Mounting Tracks
1012TNH-7 ..... Installation Drawing, 1010 Series Transducer and Mounting Tracks
1012TNH-8 ..... Outline Dimensions, 1012 Series Mounting Tracks
1011FTNF-7 ..... Installation, 1010 Series Flow Tube
1011FTNF-8 ..... Outline Dimensions, 1010 Series Flow Tube
992DFTN-8 ..... Installation/Outline 992 Series Extended Flow Tube
992DFTP-T-8 ..... Installation/Outline PFA-DFT Flow Tube
1012F-DB-7 ..... Installation Drawing, Dual-Path Transducer Set w/Mounting Frames

Temperature Sensor Drawings

991TN-7 ..... Installation Drawing, Temperature Sensor, NEMA-4
991TN-8 ..... Outline Dimensions, Temperature Sensor, NEMA-4
991TW-8 ..... Installation/Outline Dimensions, Insert Temperature Sensor, 990E System



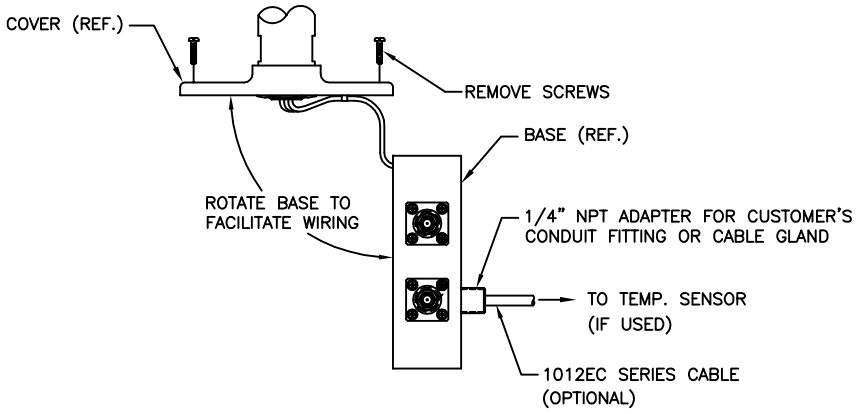
NOTES:

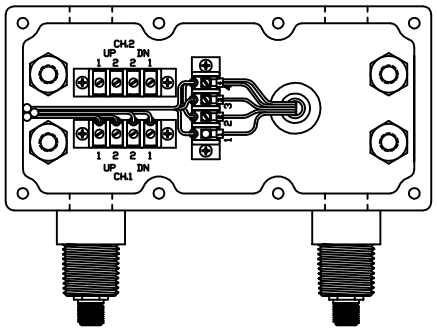
1. SEE DRAWING 1010X–8 FOR OUTLINE DIMENSIONS.
2. SEE 1010X FIELD MANUAL AND TRANSDUCER INSTALLATION DRAWINGS FOR WIRING TO FLOW TRANSDUCER.
3. TEMPERATURE SENSOR TERMINAL BLOCK IS USED ONLY IN UNITS REQUIRING TEMPERATURE SENSOR INPUTS. SEE SHEET 2 AND TEMPERATURE SENSOR INSTALLATION DRAWING.
4. SET POWER INPUT OFF BEFORE OPENING COVERS, SERVICING FUSE OR CONNECTIONS.
5. ALL TRANSDUCER AND TEMPERATURE SENSOR CABLES ORIGINATING AT THE SAME FLOWMETER MAY SHARE THE SAME CONDUIT. NO OTHER CABLE SHOULD BE HOUSED IN THIS CONDUIT. CONNECT METALLIC CONDUITS TO EARTH GROUND.
6. OBSERVE FOLLOWING LIMITS WHEN INSTALLING TRANSDUCER CABLES IN CONDUIT:
   MAX. PULL TENSION: 80 lbs.
   MIN. BEND RADIUS: 2–1/2 INCHES
7. USE EExd CABLE GLANDS OR INSTALL EXPLOSION PROOF CONDUIT SEALS WITHIN 2" OF FLOWMETER. INSTALL EXPLOSION PROOF PLUGS AT ALL UNUSED CABLE ENTRY HOLES.
8. ALL ENCLOSURE COVERS (2) ARE SECURED BY SET SCREWS. LOOSEN SET SCREWS UNSCREW COVERS TO GAIN ACCESS TO WIRING CONNECTIONS AND DISPLAY MODULE. TIGHTEN SET SCREWS WHEN UNIT SECURED.
9. RTD TEMPERATURE SENSING OPTION IS AVAILABLE TO EITHER FLOW CHANNEL UNDER MENU CONTROL.

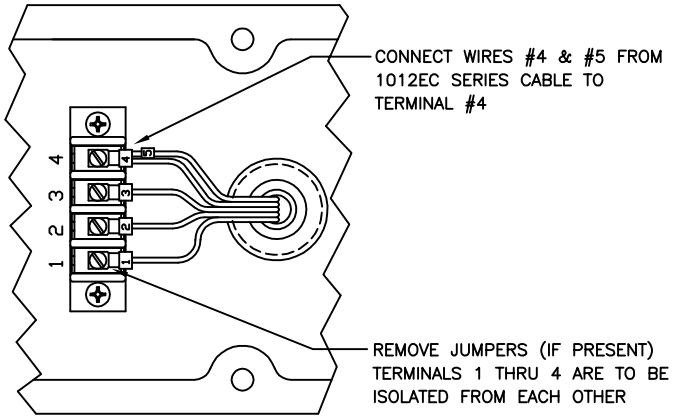
DO NOT SCALE THIS DRAWING UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES (MM) TOLERANCES ON– INCHES ± .1 (MM) ± 2	CONTRACT NO. DR H.J DATE 1/25/01 CHK DATE ENG DATE PROD DATE APPD DATE CERTIFIED DATE	CONTROLOTRON HAUPPAUGE , NY 11788 INSTALLATION WIRING 1010X SERIES FLOWMETER SIZE C · CODE IDENT NO. 21614 · 1010X - 7 · REV. F SCALE: NONE · WT. · SHEET 1 OF 3

R14: 1010X–7 sht.1 revF
CN#4865

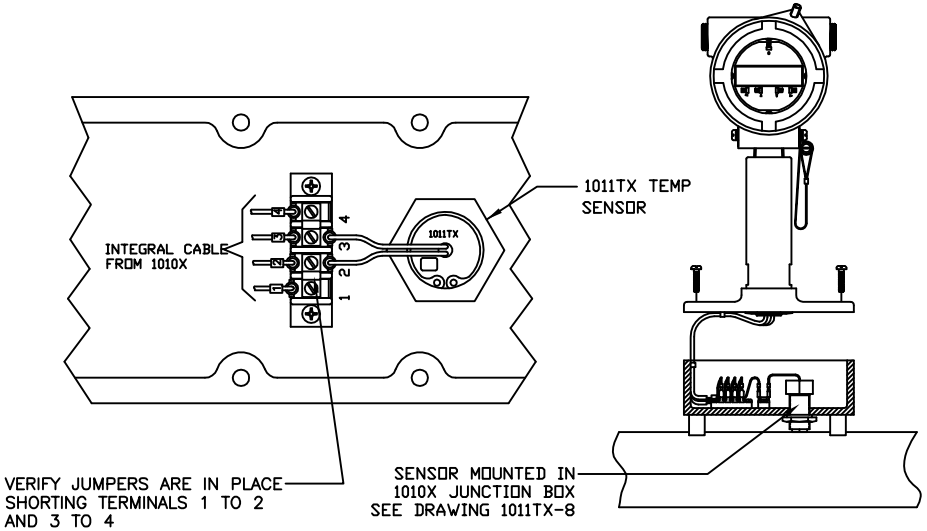
TEMPERATURE SENSOR CABLE CONNECTION/REMOTE SENSOR



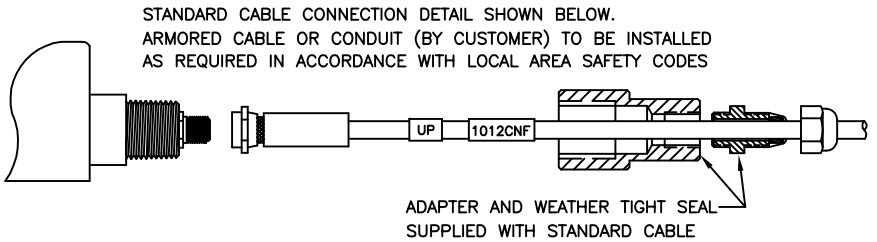




LOCAL TEMPERATURE SENSOR CONNECTION
FOR UNITS WITH LOCAL TEMPERATURE SENSOR OPTION



FLOW TRANSDUCER CABLE CONNECTION



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	1/25/01
CHK		DATE	
ENG		DATE	
PROD		DATE	
APPD		DATE	

CERTIFIED

DATE

CONTROLOTRON
HAUPPAUGE , NY 11788

INSTALLATION WIRING
1010X SERIES FLOWMETER

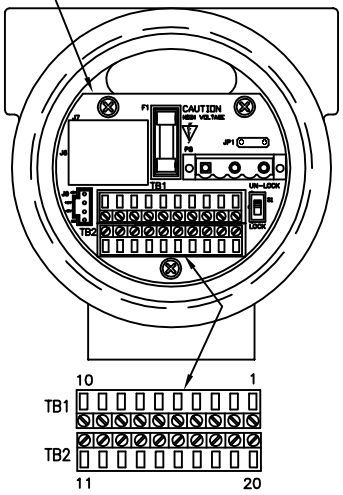
SIZE	CODE IDENT NO.		REV.
C	21614	1010X - 7	F

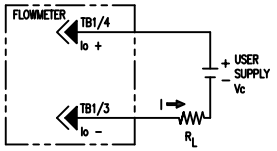
SCALE: NONE | WT. | SHEET 2 OF 3

TERMINAL BLOCK WIRING CONNECTIONS

	PIN #	SIGNAL	FUNCTION	DESCRIPTION	USE	LOAD	WIRING	CABLE LENGTH	NOTES
TB1	1	SPARE							
	2	SPARE							
	3	Io1−	ISOLATED LOOP RETURN	4−20mA PROPORTIONAL TO SPANNED, SELECTED VARIABLE,	4−20mA ASSIGNABLE AND SPANNABLE UNDER MENU CONTROL	1000 Ω MAX. WHEN USING 24VDC LOOP SUPPLY	SHIELDED 24 GA. INSTRUMENT CABLE	1000 FT. MAX. WITHOUT FACTORY APPROVAL	REF. SCHEMATIC "A" CONNECT USER LOOP SUPPLY TO +30VDC MAX.
	4	Io1+	ISOLATED LOOP SUPPLY						
	5	ANIN−	ANALOG INPUT RETURN	4−20mA ANALOG INPUT NON−ISOLATED	USER ASSIGNABLE DEPENDING ON MODEL − MAY BE AUX, PSI, ETC.	200 Ω RESISTIVE, APPLIED VOLTAGE MAY NOT BE NEGATIVE OR >+15VDC TO METER GROUND			REF. SCHEMATIC "B"
	6	ANIN+	4−20mA INPUT						
	7	STATUS −	STATUS BIT RETURN	STATUS ALARM EMITTER	USER ASSIGNABLE VIA. MENU SELECTION				REF. SCHEMATIC "C"
	8	STATUS +	STATUS OUTPUT	STATUS ALARM COLLECTOR					
	9	PGEN −	PULSE GENERATOR RETURN	ISOLATED PGEN EMITTER	0−5000 Hz SIGNAL PROPORTIONAL TO MENU SELECTED VARIABLE				
	10	PGEN +	PULSE GENERATOR OUTPUT	ISOLATED PGEN COLLECTOR					
TB2	11	Tx	RS232 TRANSMIT	STANDARD RS232 SIGNALS	STANDARD RS232 COMMUNICATION PORT		SHIELDED 24 GA. DATA CABLE MINIMUM	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.
	12	RTS	RS232 REQUEST TO SEND						
	13	DTR	RS232 DATA TERM. READY						
	14	Rx	RS232 RECEIVE						
	15	CTS	RS232 CLEAR TO SEND						
	16	GND	GROUND						
	17	D1 INPUT	DIGITAL INPUT 1	ISOLATED DIGITAL COMMAND LINES	FREEZE TOTALIZER	499Ω USE 2 TO 10 VDC TO DRIVE INPUT SEE SCHEMATIC BELOW		1000 FT. MAX. WITHOUT FACTORY APPROVAL	REF. SCHEMATIC "D" SEE FIELD MANUAL FOR FULL EXPLANATION OF TOTALIZER FUNCTION OPTIONS
	18	D1 RETURN	DIGITAL RETURN		RETURN (NON−POLARIZED)				
	19	D2 INPUT	DIGITAL INPUT 2		RESET TOTALIZER				
	20	D2 RETURN	DIGITAL RETURN		RETURN (NON−POLARIZED)				

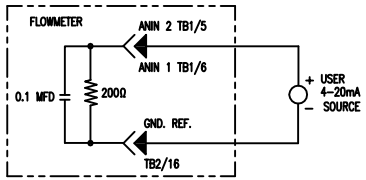
1010X−8 I/O MODULE (SEE TABLE FOR TB1 & TB2 WIRING CONNECTIONS)





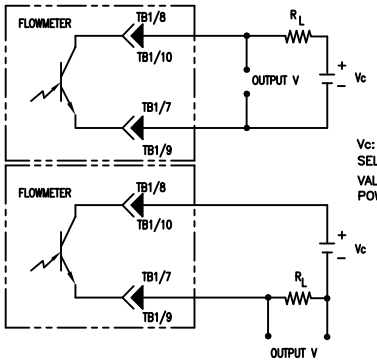
Vc:24VDC TYPICAL
R_L:1000 Ω TYPICAL
I = 4−20mA
R_L= LOOP WIRE RESISTANCE PLUS USER'S INPUT LOAD RESISTANCE

SCHEMATIC "A"
ISOLATED 4-20mA OUTPUT



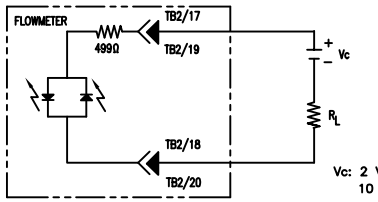
DO NOT EXCEED +13 VAC OR REVERSE POLARITY

SCHEMATIC "B"
4-20mA ANALOG INPUT



Vc: 24 VDC MAX.
SELECT R_L:
VALUE: (125 x Vc) −340 Ω MIN.
POWER RATING: (1/100 x Vc) WATTS MIN.

SCHEMATIC "C"



Vc: 2 VDC MIN.
10 VDC MAX.
I = 0.8mA MIN.
R_L= OPTIONAL (SELECT TO ACHIEVE CORRECT I)

SCHEMATIC "D"
DIGITAL INPUTS

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	1/25/01
CHK		DATE	
ENG		DATE	
PROD		DATE	
APPD		DATE	

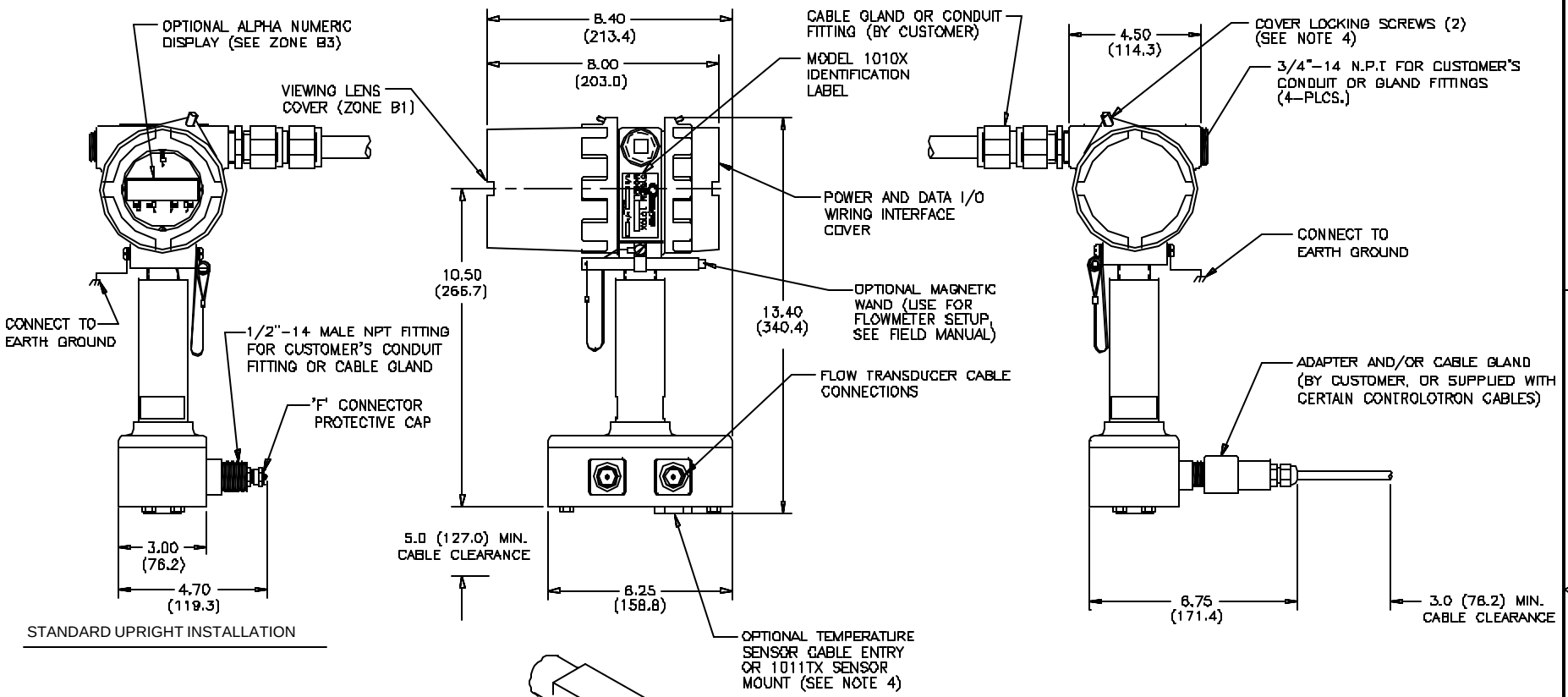
CERTIFIED

DATE

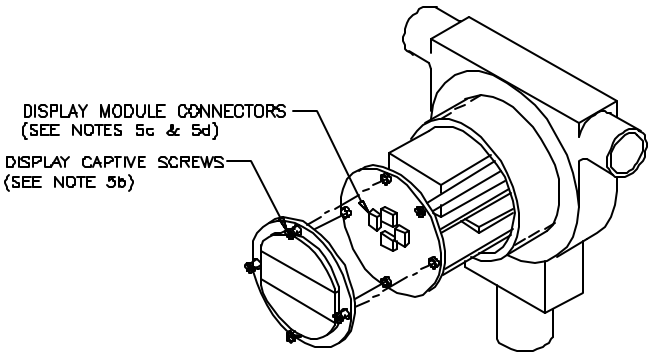
CONTROLOTRON
HAUPPAUGE , NY 11788

INSTALLATION WIRING 1010X SERIES FLOWMETER

SIZE	CODE IDENT NO.		REV.
C	21614	1010X - 7	F
SCALE: NONE	WT.	SHEET 3 OF 3	



STANDARD UPRIGHT INSTALLATION



*SHOWN WITH VIEWING LENS

5. FLOWMETER DISPLAY MODULE CAN BE ROTATED AT 90° INCREMENTS TO ACCOMMODATE HORIZONTAL OR INVERTED MOUNTING CONFIGURATION:
   a) LOOSEN COVER LOCKING SCREW, REMOVE VIEWING LENS COVER.
   b) LOOSEN (4) CAPTIVE SCREWS SECURING THE DISPLAY MODULE.
   c) CAREFULLY UNPLUG THE MODULE FROM IT'S CONNECTOR.
   d) ROTATE TO DESIRED ORIENTATION, PLUG IN AND SECURE WITH CAPTIVE SCREWS.
   e) REPLACE VIEWING LENS COVER.

NOTES:

1. NET WEIGHT: 9.8 lbs. (4.4 Kg) MAX.
2. SEE DRAWING 1010X-7 AND THE 101D INSTALLATION MANUAL FOR INSTALLATION WIRING AND SETUP INSTRUCTIONS.
3. SECURE ALL COVERS BY TIGHTENING COVER LOCKING SETSCREWS. (1/16" HEX KEY)
4. SEE DRAWING 1011TX-8 FOR INSTALLATION AND WIRING OF OPTIONAL INTEGRAL TEMPERATURE SENSOR.

DO NOT SCALE THIS DRAWING

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES (MM) TOLERANCES ON-

INCHES	(MM)
± .1	± 2

CONTRACT NO.

DR	HJ	DATE 1/25/01
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ENG		DATE
PROD		DATE
APPD		DATE

CERTIFIED

DATE

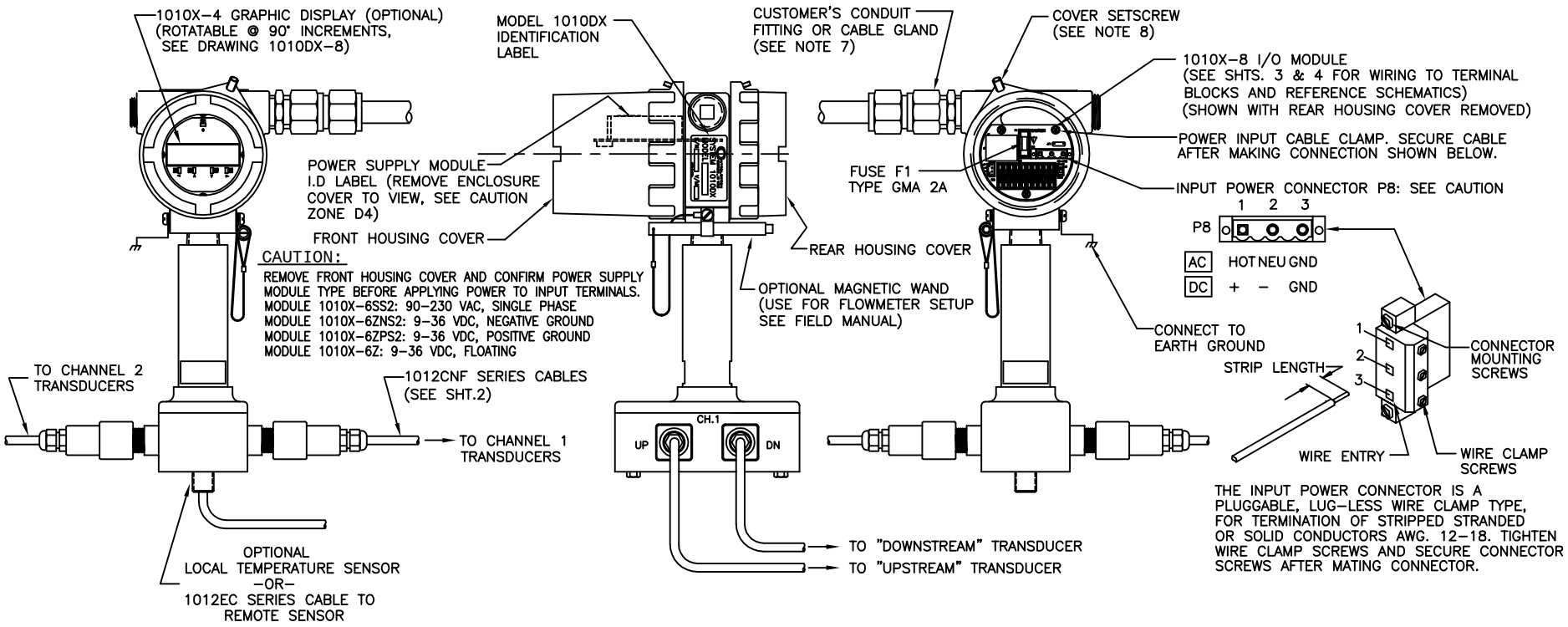
CONTROLOTRON
HAUPPAUGE, NY 11788

OUTLINE DIMENSIONS 1010X SERIES FLOWMETER

SIZE	CODE IDENT NO.		REV.
C	21614	1010X - 8	B

SCALE: NONE | WT. | SHEET 1 OF 1

R14: 1010X-8 rev.B
CN#4297



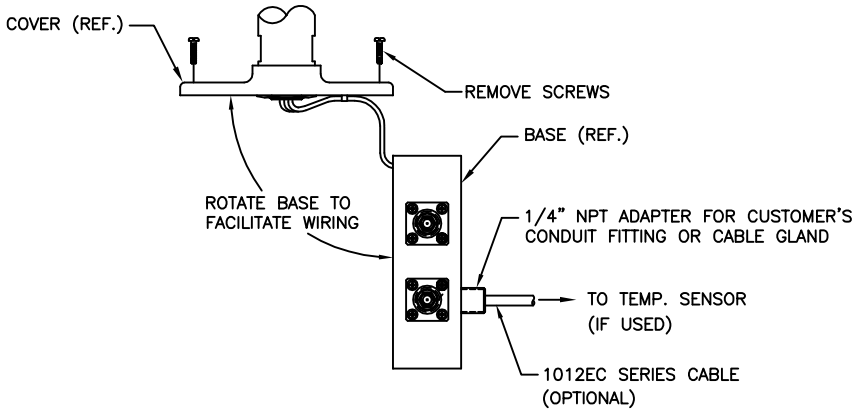
NOTES:

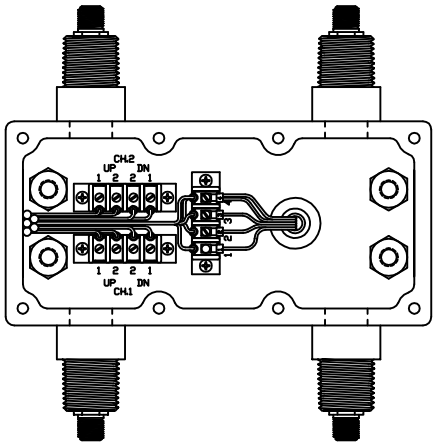
1. SEE DRAWING 1010DX–8 FOR OUTLINE DIMENSIONS.
2. SEE 1010X FIELD MANUAL AND TRANSDUCER INSTALLATION DRAWINGS FOR WIRING TO FLOW TRANSDUCER.
3. TEMPERATURE SENSOR TERMINAL BLOCK IS USED ONLY IN UNITS REQUIRING TEMPERATURE SENSOR INPUTS. SEE SHEET 2 AND TEMPERATURE SENSOR INSTALLATION DRAWING.
4. SET POWER INPUT OFF BEFORE OPENING COVERS, SERVICING FUSE OR CONNECTIONS.
5. ALL TRANSDUCER AND TEMPERATURE SENSOR CABLES ORIGINATING AT THE SAME FLOWMETER MAY SHARE THE SAME CONDUIT. NO OTHER CABLE SHOULD BE HOUSED IN THIS CONDUIT. CONNECT METALLIC CONDUITS TO EARTH GROUND.
6. OBSERVE FOLLOWING LIMITS WHEN INSTALLING TRANSDUCER CABLES IN CONDUIT:
   MAX. PULL TENSION: 80 lbs.
   MIN. BEND RADIUS: 2–1/2 INCHES
7. USE EExd CABLE GLANDS OR INSTALL EXPLOSION PROOF CONDUIT SEALS WITHIN 2" OF FLOWMETER. INSTALL EXPLOSION PROOF PLUGS AT ALL UNUSED CABLE ENTRY HOLES.
8. ALL ENCLOSURE COVERS (2) ARE SECURED BY SET SCREWS. LOOSEN SET SCREWS UNSCREW COVERS TO GAIN ACCESS TO WIRING CONNECTIONS AND DISPLAY MODULE. TIGHTEN SET SCREWS WHEN UNIT SECURED.
9. RTD TEMPERATURE SENSING OPTION IS AVAILABLE TO EITHER FLOW CHANNEL UNDER MENU CONTROL.

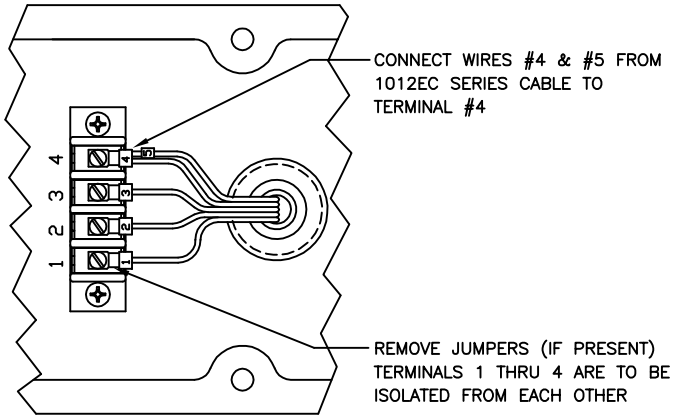
DO NOT SCALE THIS DRAWING UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES (MM) TOLERANCES ON– INCHES ± .1 (MM) ± 2	CONTRACT NO. DR H.J DATE 1/25/01 CHK DATE ENG DATE PROD DATE APPD DATE CERTIFIED DATE	CONTROLOTRON HAUPPAUGE , NY 11788 INSTALLATION WIRING 1010DX SERIES FLOWMETER SIZE C · CODE IDENT NO. 21614 · 1010DX - 7 · REV. D SCALE: NONE · WT. · SHEET 1 OF 4

CN#4865

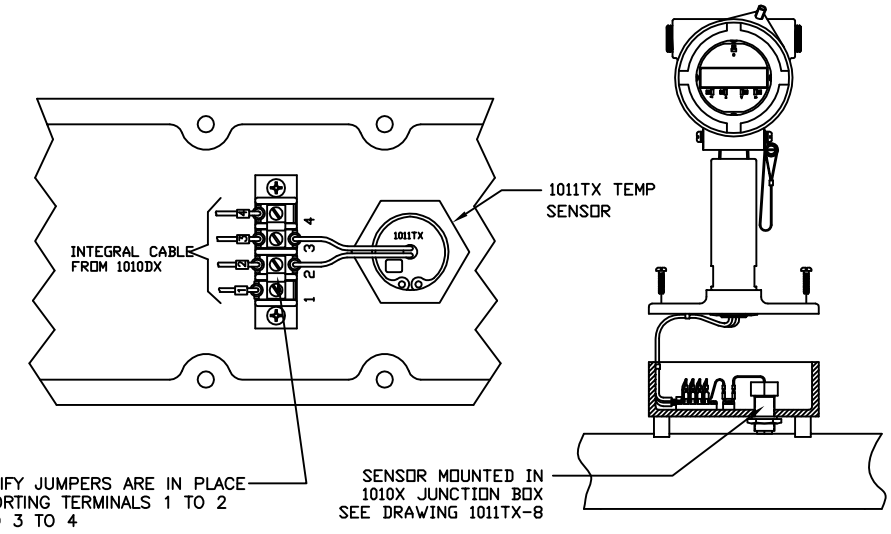
TEMPERATURE SENSOR CABLE CONNECTION/REMOTE SENSOR



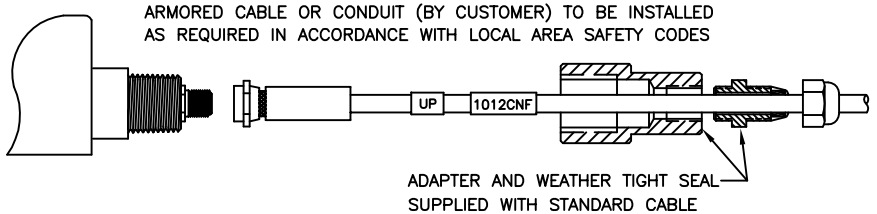




LOCAL TEMPERATURE SENSOR CONNECTION
FOR UNITS WITH LOCAL TEMPERATURE SENSOR OPTION



FLOW TRANSDUCER CABLE CONNECTION



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TOLERANCES ON–

INCHES	(MM)
± .1	± 2

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DATE

CONTROLOTRON
HAUPPAUGE , NY 11788

INSTALLATION WIRING
1010DX SERIES FLOWMETER

SIZE	CODE IDENT NO.		REV.
C	21614	1010DX - 7	D

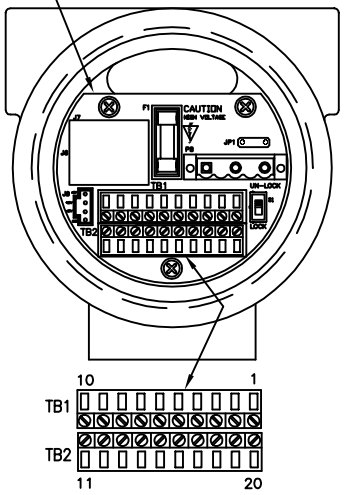
SCALE: NONE | WT. | SHEET 2 OF 4

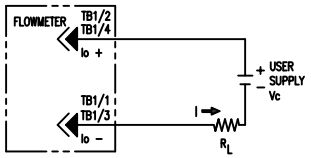
CN#4865

TERMINAL BLOCK WIRING CONNECTIONS (FOR STANDARD, HIGH PRECISION AND ENHANCED PERFORMANCE FLOWMETERS, SEE ZONE B1 FOR ORIENTATION)

	PIN #	SIGNAL	FUNCTION	DESCRIPTION	USE	LOAD	WIRING	CABLE LENGTH	NOTES
TB1	1	Io2−	ISOLATED LOOP RETURN	4−20mA PROPORTIONAL TO SPANNED, SELECTED VARIABLE,	4−20mA ASSIGNABLE AND SPANNABLE UNDER MENU CONTROL	1000 Ω MAX. WHEN USING 24VDC LOOP SUPPLY	SHIELDED 24 GA. INSTRUMENT CABLE	1000 FT. MAX. WITHOUT FACTORY APPROVAL	REF. SCHEMATIC "A" CONNECT USER LOOP SUPPLY TO +30VDC MAX.
	2	Io2+	ISOLATED LOOP SUPPLY						
	3	Io1−	ISOLATED LOOP RETURN						
	4	Io1+	ISOLATED LOOP SUPPLY						
	5	ANIN 2	4−20mA INPUT CH.2	4−20mA ANALOG INPUT NON−ISOLATED (GROUND REF.)	USER ASSIGNABLE DEPENDING ON MODEL − MAY BE AUX, PSI, ETC.	200 Ω RESISTIVE, APPLIED VOLTAGE MAY NOT BE NEGATIVE OR >+15VDC TO METER GROUND			REF. SCHEMATIC "B"
	6	ANIN 1	4−20mA INPUT CH.1						
	7	STATUS −1	STATUS BIT RETURN	CH.2 STATUS ALARM EMITTER	USER ASSIGNABLE VIA. MENU SELECTION				REF. SCHEMATIC "C"
	8	STATUS +1	STATUS OUTPUT	CH.2 STATUS ALARM COLLECTOR					
	9	STATUS −2	STATUS BIT RETURN	CH.1 STATUS ALARM EMITTER					
	10	STATUS +2	STATUS OUTPUT	CH.1 STATUS ALARM COLLECTOR					
TB2	11	Tx	RS232 TRANSMIT	STANDARD RS232 SIGNALS	STANDARD RS232 COMMUNICATION PORT		SHIELDED 24 GA. DATA CABLE MINIMUM	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.
	12	RTS	RS232 REQUEST TO SEND						
	13	DTR	RS232 DATA TERM. READY						
	14	Rx	RS232 RECEIVE						
	15	CTS	RS232 CLEAR TO SEND						
	16	GND	GROUND						
	17	D1 INPUT	DIGITAL INPUT CH.1	ISOLATED DIGITAL COMMAND LINES	FREEZE TOTALIZER CH.1	499Ω USE 2 TO 10 VDC TO DRIVE INPUT SEE SCHEMATIC BELOW		1000 FT. MAX. WITHOUT FACTORY APPROVAL	REF. SCHEMATIC "D" SEE FIELD MANUAL FOR FULL EXPLANATION OF TOTALIZER FUNCTION OPTIONS
	18	D1 RETURN	DIGITAL RETURN		RETURN (NON−POLARIZED)				
	19	D2 INPUT	DIGITAL INPUT CH.2		FREEZE TOTALIZER CH.2				
	20	D2 RETURN	DIGITAL RETURN		RETURN (NON−POLARIZED)				

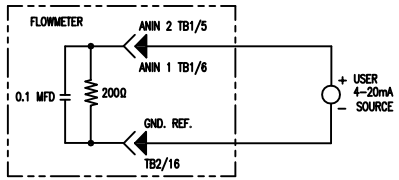
1010X−8 I/O MODULE (SEE TABLE FOR TB1 & TB2 WIRING CONNECTIONS)





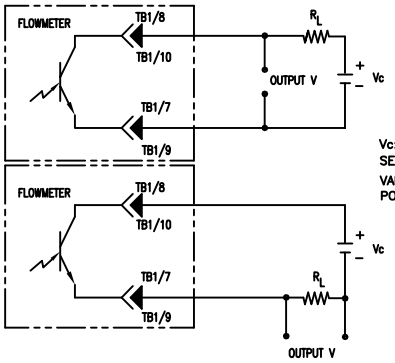
Vc:24VDC MAX.
R_L:575Ω max.
I = 4−20mA
R_L = LOOP WIRE RESISTANCE PLUS USER'S INPUT LOAD RESISTANCE

SCHEMATIC "A"
ISOLATED 4-20mA OUTPUT



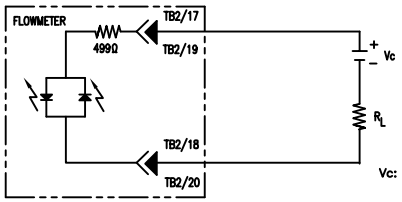
DO NOT EXCEED +13 VAC OR REVERSE POLARITY

SCHEMATIC "B"
4-20mA ANALOG INPUT



Vc: 24 VDC MAX.
SELECT R_L:
VALUE: (125 x Vc) Ω-340 MIN.
POWER RATING: (1/100 x Vc) WATTS MIN.

SCHEMATIC "C"
STATUS / ALARM OUTPUT



Vc: 2 VDC MIN.
10 VDC MAX.
I = 0.8mA MIN.
R_L = OPTIONAL (SELECT TO ACHIEVE CORRECT I)

SCHEMATIC "D"
DIGITAL INPUTS

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	1/25/01
CHK		DATE	
ENG		DATE	
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DATE

CONTROLOTRON
HAUPPAUGE , NY 11788

INSTALLATION WIRING 1010DX SERIES FLOWMETER

SIZE	CODE IDENT NO.		REV.
C	21614	1010DX - 7	D

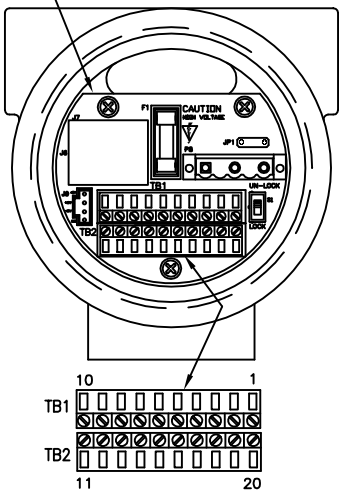
SCALE: NONE | WT. | SHEET 3 OF 4

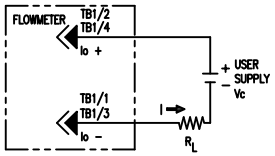
CN#4865

TERMINAL BLOCK WIRING CONNECTIONS (FOR ULTRA PERFORMANCE FLOWMETERS, SEE ZONE B1 FOR ORIENTATION)

	PIN #	SIGNAL	FUNCTION	DESCRIPTION	USE	LOAD	WIRING	CABLE LENGTH	NOTES
TB1	1	Io2−	ISOLATED LOOP RETURN	4−20mA PROPORTIONAL TO SPANNED, SELECTED VARIABLE,	4−20mA ASSIGNABLE AND SPANNABLE UNDER MENU CONTROL	1000 Ω MAX. WHEN USING 24VDC LOOP SUPPLY	SHIELDED 24 GA. INSTRUMENT CABLE	1000 FT. MAX. WITHOUT FACTORY APPROVAL	REF. SCHEMATIC "A" CONNECT USER LOOP SUPPLY TO +30VDC MAX.
	2	Io2+	ISOLATED LOOP SUPPLY						
	3	Io1−	ISOLATED LOOP RETURN						
	4	Io1+	ISOLATED LOOP SUPPLY						
	5	ANIN 2	4−20mA INPUT CH.2	4−20mA ANALOG INPUT NON−ISOLATED	USER ASSIGNABLE DEPENDING ON MODEL − MAY BE AUX, PSI, ETC.	200 Ω RESISTIVE, APPLIED VOLTAGE MAY NOT BE NEGATIVE OR >+15VDC TO METER GROUND			REF. SCHEMATIC "B"
	6	ANIN 1	4−20mA INPUT CH.1						
	7	STATUS −	STATUS BIT RETURN	STATUS ALARM EMITTER	USER ASSIGNABLE VIA. MENU SELECTION				REF. SCHEMATIC "C"
	8	STATUS +	STATUS OUTPUT	STATUS ALARM COLLECTOR					
	9	PGEN −	PULSE GENERATOR RETURN	ISOLATED PGEN EMITTER	DIGITALLY SYNTHESIZED PULSES USER SPANNED AND PROPORTIONAL TO FLOW RATE				
	10	PGEN +	PULSE GENERATOR OUTPUT	ISOLATED PGEN COLLECTOR					
TB2	11	Tx	RS232 TRANSMIT	STANDARD RS232 SIGNALS	STANDARD RS232 COMMUNICATION PORT		SHIELDED 24 GA. DATA CABLE MINIMUM	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.
	12	RTS	RS232 REQUEST TO SEND						
	13	DTR	RS232 DATA TERM. READY						
	14	Rx	RS232 RECEIVE						
	15	CTS	RS232 CLEAR TO SEND						
	16	GND	GROUND						
	17	D1 INPUT	DIGITAL INPUT 1	ISOLATED DIGITAL COMMAND LINES	FREEZE TOTALIZER	499Ω USE 2 TO 10 VDC TO DRIVE INPUT SEE SCHEMATIC BELOW		1000 FT. MAX. WITHOUT FACTORY APPROVAL	REF. SCHEMATIC "D" SEE FIELD MANUAL FOR FULL EXPLANATION OF TOTALIZER FUNCTION OPTIONS
	18	D1 RETURN	DIGITAL RETURN		RETURN (NON−POLARIZED)				
	19	D2 INPUT	DIGITAL INPUT 2		RESET TOTALIZER				
	20	D2 RETURN	DIGITAL RETURN		RETURN (NON−POLARIZED)				

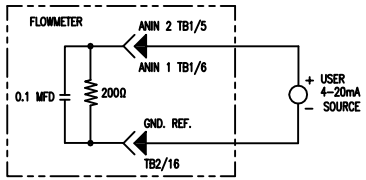
1010X−8 I/O MODULE (SEE TABLE FOR TB1 & TB2 WIRING CONNECTIONS)





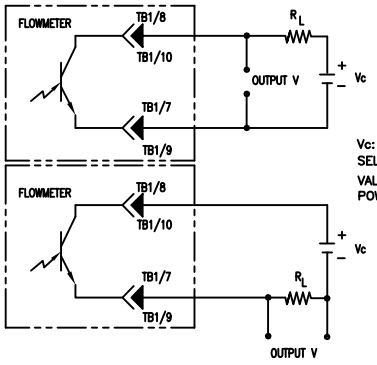
Vc:24VDC TYPICAL
R_L:1000 Ω TYPICAL
I = 4−20mA
R_L = LOOP WIRE RESISTANCE PLUS USER'S INPUT LOAD RESISTANCE

SCHEMATIC "A"
ISOLATED 4-20mA OUTPUT



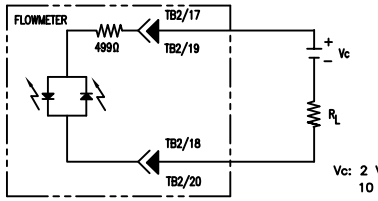
DO NOT EXCEED +13 VAC OR REVERSE POLARITY

SCHEMATIC "B"
4-20mA ANALOG INPUT



Vc: 24 VDC MAX.
SELECT R_L:
VALUE: (125 x Vc) −340 Ω MIN.
POWER RATING: (1/100 x Vc) WATTS MIN.

SCHEMATIC "C"
STATUS / ALARM OR PGEN OUTPUT



Vc: 2 VDC MIN.
10 VDC MAX.
I = 0.8mA MIN.
R_L = OPTIONAL (SELECT TO ACHIEVE CORRECT I)

SCHEMATIC "D"
DIGITAL INPUTS

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	1/25/01
CHK		DATE	
ENG		DATE	
PROD		DATE	
APPD		DATE	

CERTIFIED

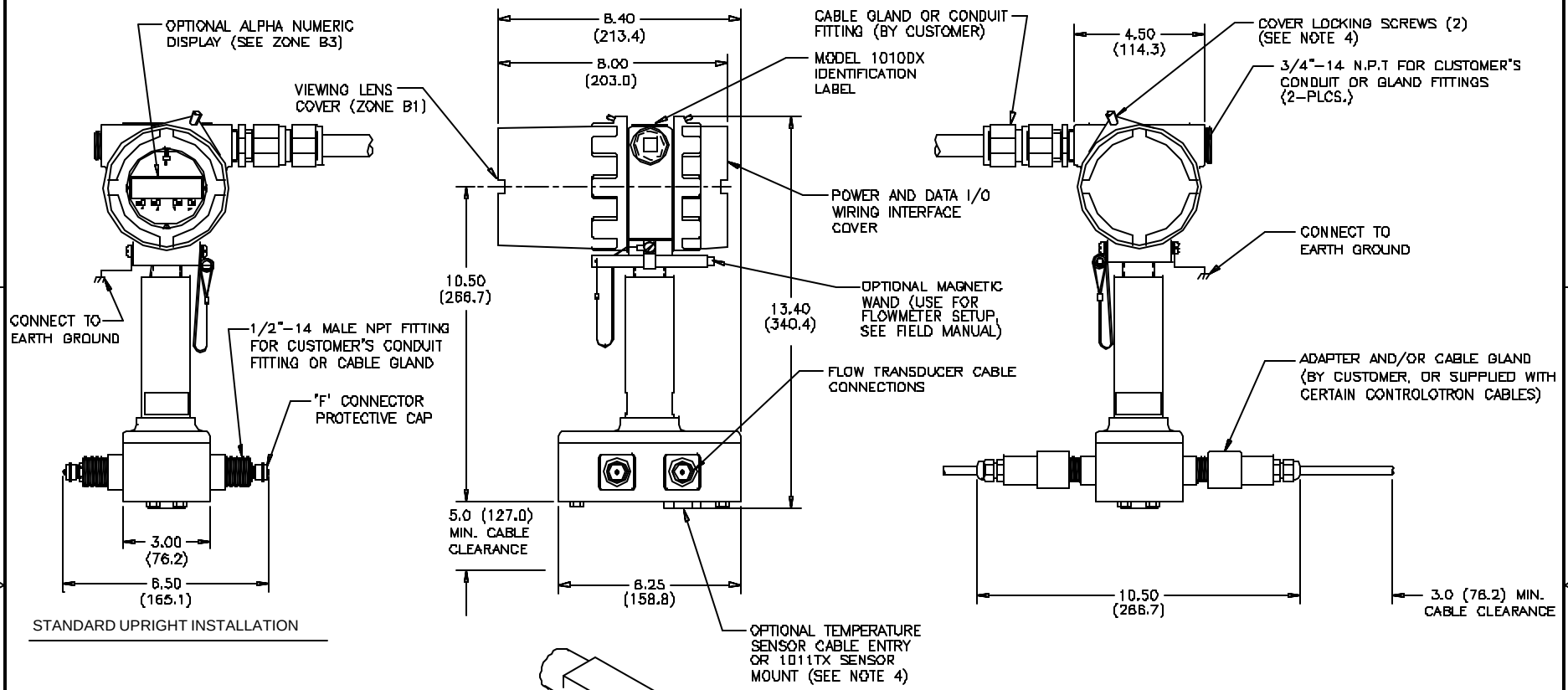
DATE

CONTROLOTRON
HAUPPAUGE , NY 11788

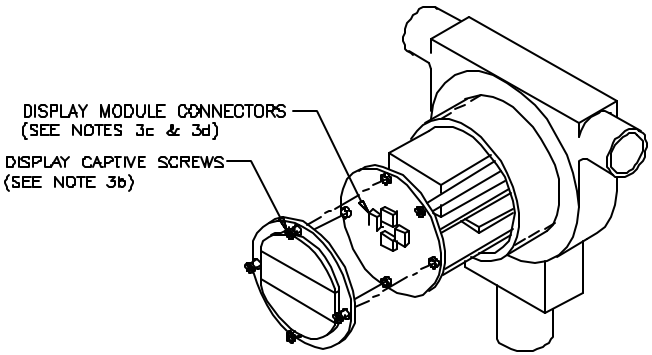
INSTALLATION WIRING 1010DX SERIES FLOWMETER

SIZE	CODE IDENT NO.		REV.
C	21614	1010DX - 7	D
SCALE: NONE	WT.	SHEET 4 OF 4	

CN#4865



STANDARD UPRIGHT INSTALLATION



*SHOWN WITH VIEWING LENS

FLOWMETER DISPLAY MODULE CAN BE ROTATED AT 90° INCREMENTS TO ACCOMMODATE HORIZONTAL OR INVERTED MOUNTING CONFIGURATION:

a) LOOSEN COVER LOCKING SCREW, REMOVE VIEWING LENS COVER.
b) LOOSEN (4) CAPTIVE SCREWS SECURING THE DISPLAY MODULE.
c) CAREFULLY UNPLUG THE MODULE FROM IT'S CONNECTOR.
d) ROTATE TO DESIRED ORIENTATION, PLUG IN AND SECURE WITH CAPTIVE SCREWS.
e) REPLACE VIEWING LENS COVER.

NOTES:

1. NET WEIGHT: 9.8 lbs. (4.4 Kg) MAX.
2. SEE DRAWING 1010DX-7 AND THE 1D10 INSTALLATION MANUAL FOR INSTALLATION WIRING AND SETUP INSTRUCTIONS.
3. SECURE ALL COVERS BY TIGHTENING COVER LOCKING SETSCREWS. (1/16" HEX KEY)
4. SEE DRAWING 1011TX-8 FOR INSTALLATION AND WIRING OF OPTIONAL INTEGRAL TEMPERATURE SENSOR.

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 1/25/01
CHK		DATE
ENG		DATE
PROD		DATE
APPD		DATE

CERTIFIED

DATE

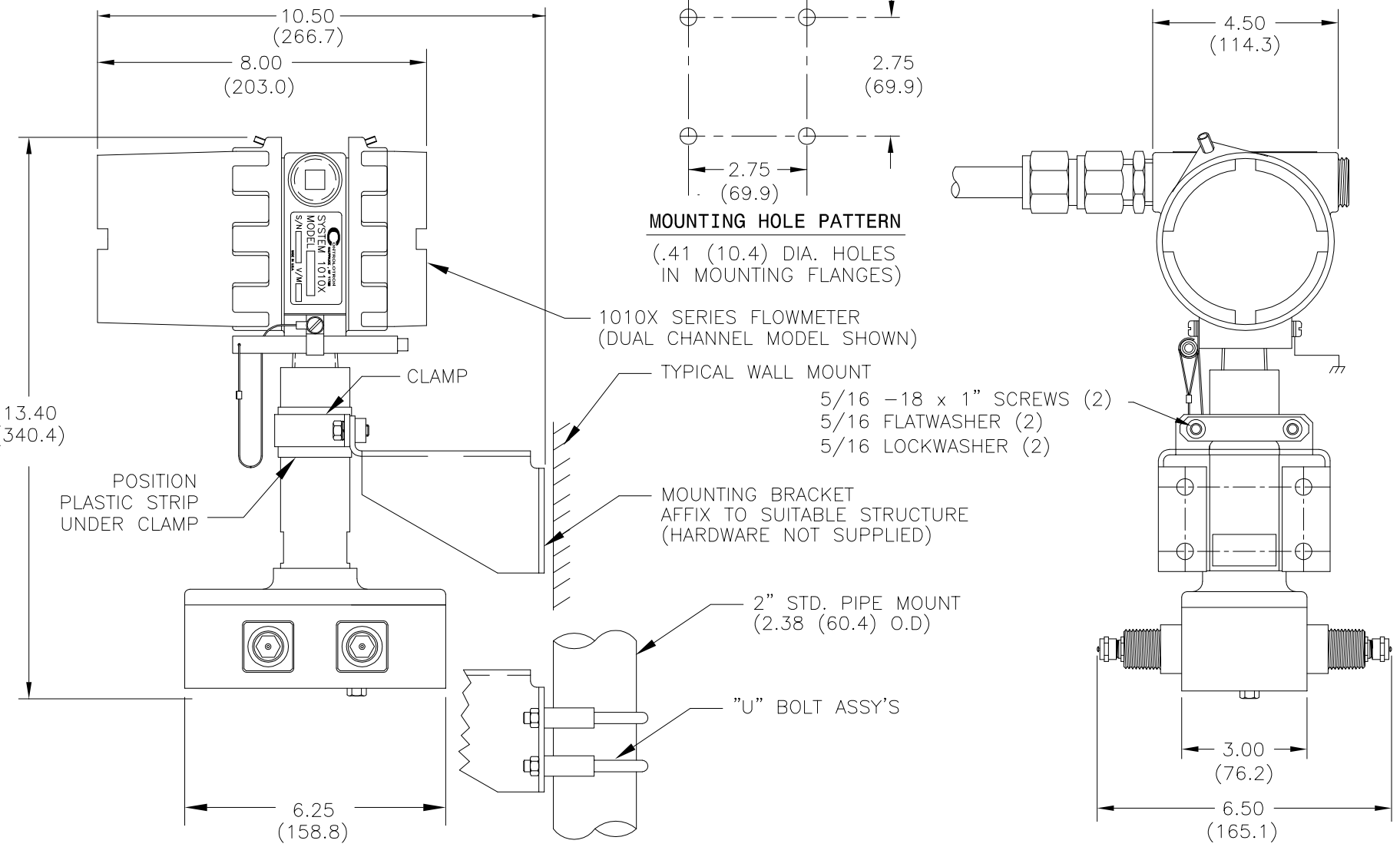
CONTROLOTRON
HAUPPAUGE, NY 11788

OUTLINE DIMENSIONS 1010X SERIES FLOWMETER

SIZE	CODE IDENT NO.		REV.
C	21614	1010DX - 8	B

SCALE: NONE | WT. | SHEET 1 OF 1

R14: 1010DX-8 rev.B
CN#4297



NOTES:

1. 1012XMB−1 MOUNTING KIT CONSISTS OF
(1) BRACKET, (1) CLAMP, (2) 5/16 −18 x 1" HEX.HD. SCREWS
(2) 5/16 FLATWASHERS, (2) 5/16 LOCKWASHERS
(2) "U" BOLT ASSY'S, (1) PLASTIC STRIP (2" (51) X 5" (127))
HARDWARE FOR WALL MOUNT NOT INCLUDED.
U−BOLT ASSY'S INCLUDED IN KIT WILL ADAPT
SUPPORT BRACKET TO 2" (2.38 O.D.) PIPE.

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 4/26/01
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

OUTLINE DIMENSIONS
1010X MOUNTING KIT

SIZE	CODE IDENT NO.		REV.
C	21614	1012XMB-1-8	D

SCALE: NONE | WT. | SHEET 1 OF 1

CN#5277

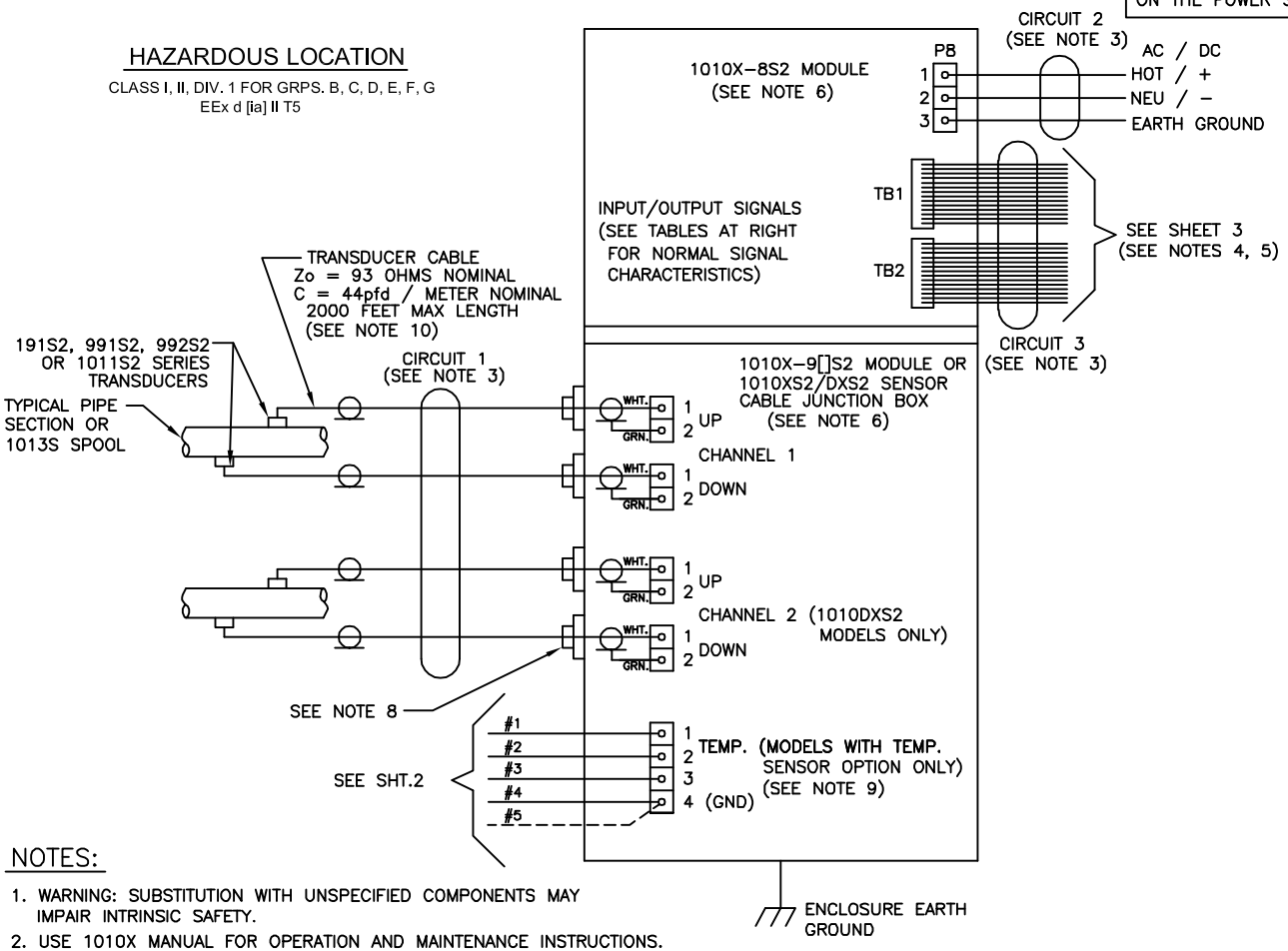
1010XS2 OR 1010DXS2 SERIES FLOW COMPUTER EXPLOSIONPROOF / FLAMEPROOF ENCLOSURE

POWER INPUT: 250VAC RMS OR 36VDC MAX.

INPUT VOLTAGE MUST MATCH RATING ON THE POWER SUPPLY LABEL

HAZARDOUS LOCATION

CLASS I, II, DIV. 1 FOR GRPS. B, C, D, E, F, G
EEx d [ia] II T5



1010XS2 MODELS	NORMAL SIGNAL CHARACTERISTICS			
	LOCATION	FUNCTION	NORMAL VOLTAGE	CURRENT
1010X–8S2	TB1–1	N/C		
	TB1–2	N/C		
	TB1–3	Io1–	0 TO 24 VDC	4–20mA
	TB1–4	Io1+	24 VDC	4–20mA
	TB1–5	ANIN –	0 VDC	4–20mA
	TB1–6	ANIN +	0.8 TO 4 VDC	4–20mA
	TB1–7	STATUS –	0 TO 24 VDC	7mA MAX.
	TB1–8	STATUS +	0 TO 24 VDC	7mA MAX.
	TB1–9	PGEN –	0 TO 24 VDC	7mA MAX.
	TB1–10	PGEN +	0 TO 24 VDC	7mA MAX.
	TB2–11	TX	–12 TO 12 VDC	4mA
	TB2–12	RTS	–12 TO 12 VDC	4mA
	TB2–13	DTR	–12 TO 12 VDC	4mA
	TB2–14	RX	–12 TO 12 VDC	4mA
	TB2–15	CTS	–12 TO 12 VDC	4mA
	TB2–16	GND	0 VDC	20mA MAX.
	TB2–17	D1 INPUT	0 TO 12 VDC	4mA
	TB2–18	D1 RETURN	0 VDC	4mA
	TB2–19	D2 INPUT	0 TO 12 VDC	4mA
	TB2–20	D2 RETURN	0 VDC	4mA

1010DXS2 MODELS EXCEPT ULTRA PERFORMANCE GRADE	NORMAL SIGNAL CHARACTERISTICS			
	LOCATION	FUNCTION	NORMAL VOLTAGE	CURRENT
1010X–8S2	TB1–1	Io2–	0 TO 24 VDC	4–20mA
	TB1–2	Io2+	24 VDC	4–20mA
	TB1–3	Io1–	0 TO 24 VDC	4–20mA
	TB1–4	Io1+	24 VDC	4–20mA
	TB1–5	ANIN 2	0.8 TO 4 VDC	4–20mA
	TB1–6	ANIN 1	0.8 TO 4 VDC	4–20mA
	TB1–7	STATUS –1	0 TO 24 VDC	7mA MAX.
	TB1–8	STATUS +1	0 TO 24 VDC	7mA MAX.
	TB1–9	STATUS –2	0 TO 24 VDC	7mA MAX.
	TB1–10	STATUS +2	0 TO 24 VDC	7mA MAX.
	TB2–11	TX	–12 TO 12 VDC	4mA
	TB2–12	RTS	–12 TO 12 VDC	4mA
	TB2–13	DTR	–12 TO 12 VDC	4mA
	TB2–14	RX	–12 TO 12 VDC	4mA
	TB2–15	CTS	–12 TO 12 VDC	4mA
	TB2–16	GND	0 VDC	60mA MAX.
	TB2–17	D1 INPUT	0 TO 12 VDC	4mA
	TB2–18	D1 RETURN	0 VDC	4mA
	TB2–19	D2 INPUT	0 TO 12 VDC	4mA
	TB2–20	D2 RETURN	0 VDC	4mA

ULTRA PERFORMANCE GRADE 1010DXS2 MODELS	NORMAL SIGNAL CHARACTERISTICS			
	LOCATION	FUNCTION	NORMAL VOLTAGE	CURRENT
1010X–8S2	TB1–1	Io2–	0 TO 24 VDC	4–20mA
	TB1–2	Io2+	24 VDC	4–20mA
	TB1–3	Io1–	0 TO 24 VDC	4–20mA
	TB1–4	Io1+	24 VDC	4–20mA
	TB1–5	ANIN 2	0.8 TO 4 VDC	4–20mA
	TB1–6	ANIN 1	0.8 TO 4 VDC	4–20mA
	TB1–7	STATUS –	0 TO 24 VDC	7mA MAX.
	TB1–8	STATUS +	0 TO 24 VDC	7mA MAX.
	TB1–9	PGEN –	0 TO 24 VDC	7mA MAX.
	TB1–10	PGEN +	0 TO 24 VDC	7mA MAX.
	TB2–11	TX	–12 TO 12 VDC	4mA
	TB2–12	RTS	–12 TO 12 VDC	4mA
	TB2–13	DTR	–12 TO 12 VDC	4mA
	TB2–14	RX	–12 TO 12 VDC	4mA
	TB2–15	CTS	–12 TO 12 VDC	4mA
	TB2–16	GND	0 VDC	60mA MAX.
	TB2–17	D1 INPUT	0 TO 12 VDC	4mA
	TB2–18	D1 RETURN	0 VDC	4mA
	TB2–19	D2 INPUT	0 TO 12 VDC	4mA
	TB2–20	D2 RETURN	0 VDC	4mA

NOTES:

1. WARNING: SUBSTITUTION WITH UNSPECIFIED COMPONENTS MAY IMPAIR INTRINSIC SAFETY.
2. USE 1010X MANUAL FOR OPERATION AND MAINTENANCE INSTRUCTIONS.
3. CIRCUITS 1, 2, AND 3 MUST BE IN SEPARATE CONDUIT.
4. ALL SIGNAL AND POWER WIRING MUST MEET APPLICABLE ELECTRICAL CODE FOR THE HAZARDOUS LOCATION.
5. IF EITHER THE TRANSDUCER OR FLOW DISPLAY COMPUTER ARE IN A DIV. 1 (ZONE 0,1) LOCATION, CONNECTIONS TO THE FLOW DISPLAY COMPUTER MUST BE THROUGH BARRIERS. SEE SHEET 3.
6. MODULE PART NUMBER MAY VARY DEPENDING ON FLOW COMPUTER MODEL.
7. SEE INSTALLATION DRAWINGS 1010XS2–7 AND/OR 1010DXS2–7 FOR ADDITIONAL USER I/O CONNECTION INFORMATION, INCLUDING VOLTAGE AND LOAD RESTRICTIONS FOR PROPER OPERATION.
8. TRANSDUCER CABLE CONNECTIONS ARE VIA. EXTERNAL 'F' CONNECTORS ON MODELS EQUIPPED WITH SENSOR CABLE JUNCTION BOX.
9. FOR 5 CONDUCTOR TEMPERATURE SENSOR CABLES, CONNECT WIRES No. 4 & 5 TO TERMINAL #4 IN MODELS EQUIPPED WITH SENSOR CABLE JUNCTION BOX.
10. CABLE LENGTHS GREATER THAN 300 FEET REQUIRE CONTROLOTRON APPROVAL.

CHANGES TO THIS DOCUMENT REQUIRE SAFETY AGENCY APPROVAL

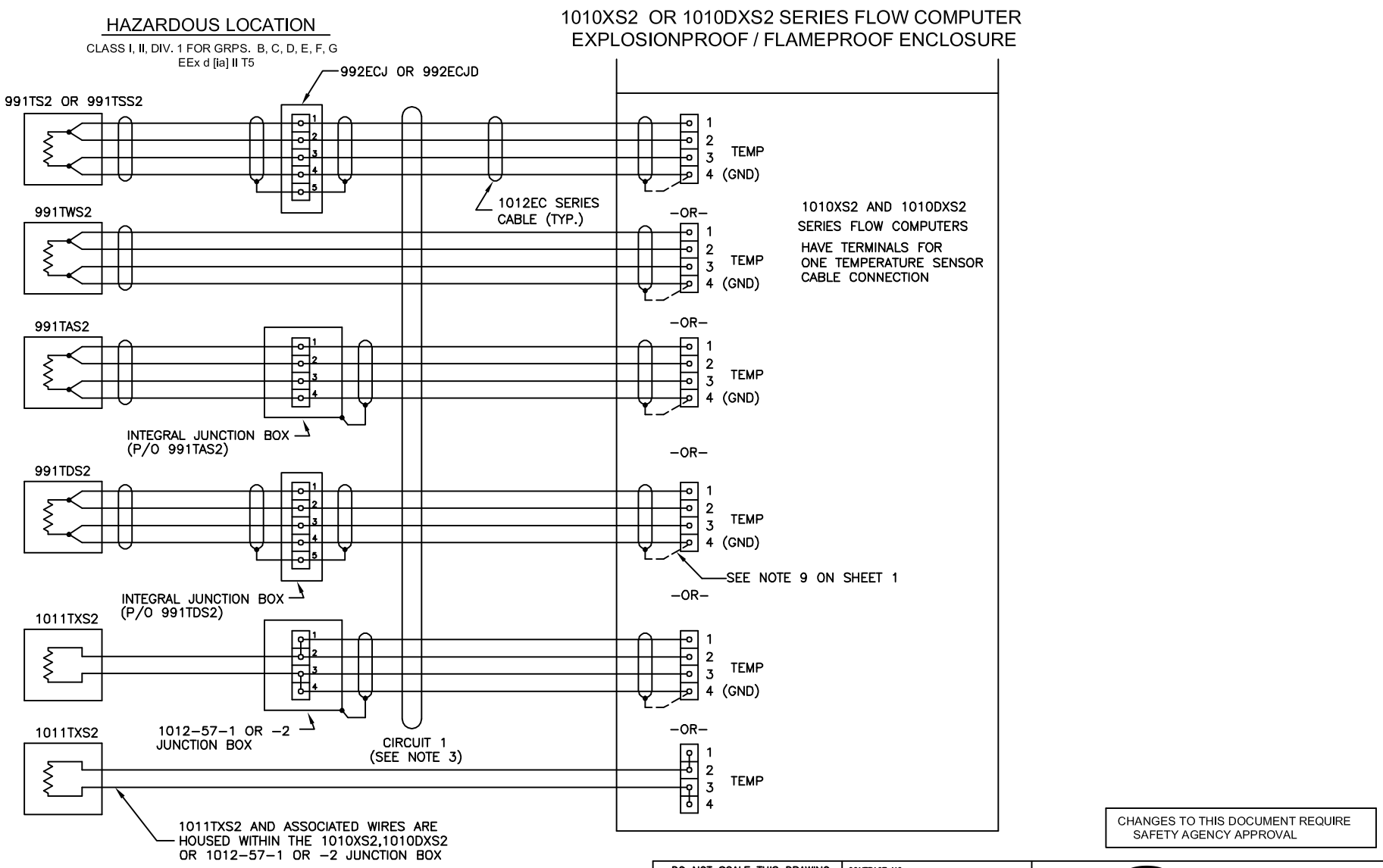
CONTRACT NO.			
DR	H.J	DATE	3/25/99
CHK		DATE	
ENG		DATE	
PROD		DATE	
APPD		DATE	
CERTIFIED			
DATE			

CONTROLOTRON
HAUPPAUGE , NY 11788

CONNECTION DIAGRAM
1010 SYSTEM, EXPLOSIONPROOF/FLAMEPROOF FLOW COMPUTER

SIZE	CODE IDENT NO.		REV.
C	21614	1010-341	G
SCALE: NONE	WT.	SHEET 1 OF 4	

CN4737



CHANGES TO THIS DOCUMENT REQUIRE SAFETY AGENCY APPROVAL

DO NOT SCALE THIS DRAWING

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES
TOLERANCES ON-
FRACTIONS- +/- 0.015
DECIMALS- XX+/-0.01 XXX+/-0.005
ANGLES- +/-0°30'

CONTRACT NO.

DR	H.J	DATE 3/25/99
CHK		DATE
ENG		DATE
PROD		DATE
APPD		DATE

CERTIFIED

DATE

CONTROLOTRON
HAUPPAUGE , NY 11788

CONNECTION DIAGRAM
1010 SYSTEM, EXPLOSIONPROOF/FLAMEPROOF FLOW COMPUTER

SIZE	CODE IDENT NO.		REV.
C	21614	1010-341	G

SCALE: NONE | WT. | SHEET 2 OF 4

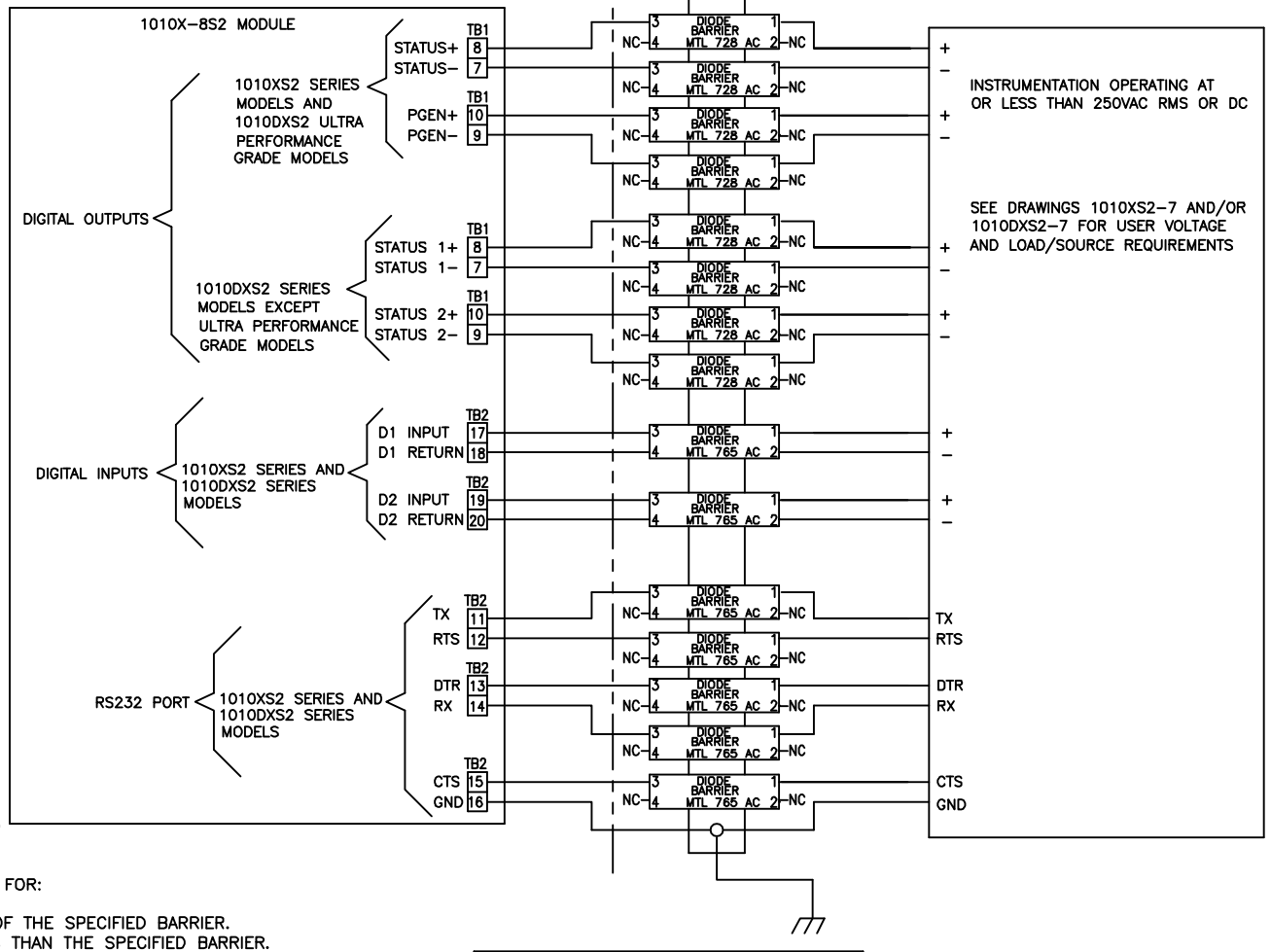
CN4737

1010XS2 OR 1010DXS2 SERIES FLOW COMPUTER EXPLOSIONPROOF / FLAMEPROOF ENCLOSURE

HAZARDOUS LOCATION

CLASS I, II, DIV. 1 FOR GRPS. B, C, D, E, F, G
EEx d [ia] II T5

NON-HAZARDOUS OR ZONE 2/DIVISION 2 LOCATION



DIODE BARRIER (SAFETY) DESCRIPTION		
PART NO.	MTL 765 AC	MTL 728 AC
VOLTAGE	15 VOLT	28 VOLT
RESISTANCE	100 OHM	300 OHM
CURRENT	150 mA	93 mA
WORKING VOLTAGE	12 VOLT	24.5 VOLT
FUSE CURRENT	50 mA	50 mA
END TO END RESISTANCE	135 OHM	340 OHM

DIODE BARRIERS AND BARRIER GROUNDING BAR NOT SUPPLIED BY CONTROLOTRON SEE NOTES AND TABLE (ZONE C4)

CHANGES TO THIS DOCUMENT REQUIRE SAFETY AGENCY APPROVAL

NOTES: (CONT'D FROM SHT.1)

11. ANY COMBINATION OF OUTPUTS MAY BE USED WHEN EACH IS CONNECTED TO DIODE BARRIERS AS SHOWN.
12. DIODE BARRIERS PINS 3 AND 1 MAY BE INTERCHANGED WITH PINS 4 AND 2 ON MTL 765AC BARRIERS.
13. ANY SAFETY BARRIER MAY BE USED IF IT IS CERTIFIED FOR:
    a) THE APPLICABLE HAZARDOUS LOCATION RATING.
    b) MEETS OR EXCEEDS THE WORKING VOLTAGE RATING OF THE SPECIFIED BARRIER.
    c) THE END TO END RESISTANCE IS EQUAL TO OR LESS THAN THE SPECIFIED BARRIER.

    DIODE BARRIERS SUGGESTED SOURCE OF SUPPLY:

    MEASUREMENT TECHNOLOGY LTD
    POWER COURT, LUTON
    ENGLAND LU 13JJ
    TEL: 44 (0) 1582 23633

    IN USA:
    MTL INC.
    8576 WELLINGTON RD
    MANASSAS, VA 22110–1690
    (703) 361–0111

    (SEE TABLE, ZONE C4 FOR DIODE BARRIER CHARACTERISTICS)
14. "NC" INDICATES NO CONNECTION
15. PINS 2 AND 4 ON MTL 728AC ARE GROUNDED.

CONTRACT NO.	CONTROLOTRON HAUPPAUGE , NY 11788
DR H.J DATE 3/25/99	CONNECTION DIAGRAM
CHK DATE	1010 SYSTEM, EXPLOSIONPROOF/FLAMEPROOF FLOW COMPUTER
ENG DATE	
PROD DATE	
APPD DATE	
CERTIFIED / DATE	SIZE C · CODE IDENT NO. 21614 · 1010-341 · REV. G
	SCALE: NONE · WT. · SHEET 3 OF 4

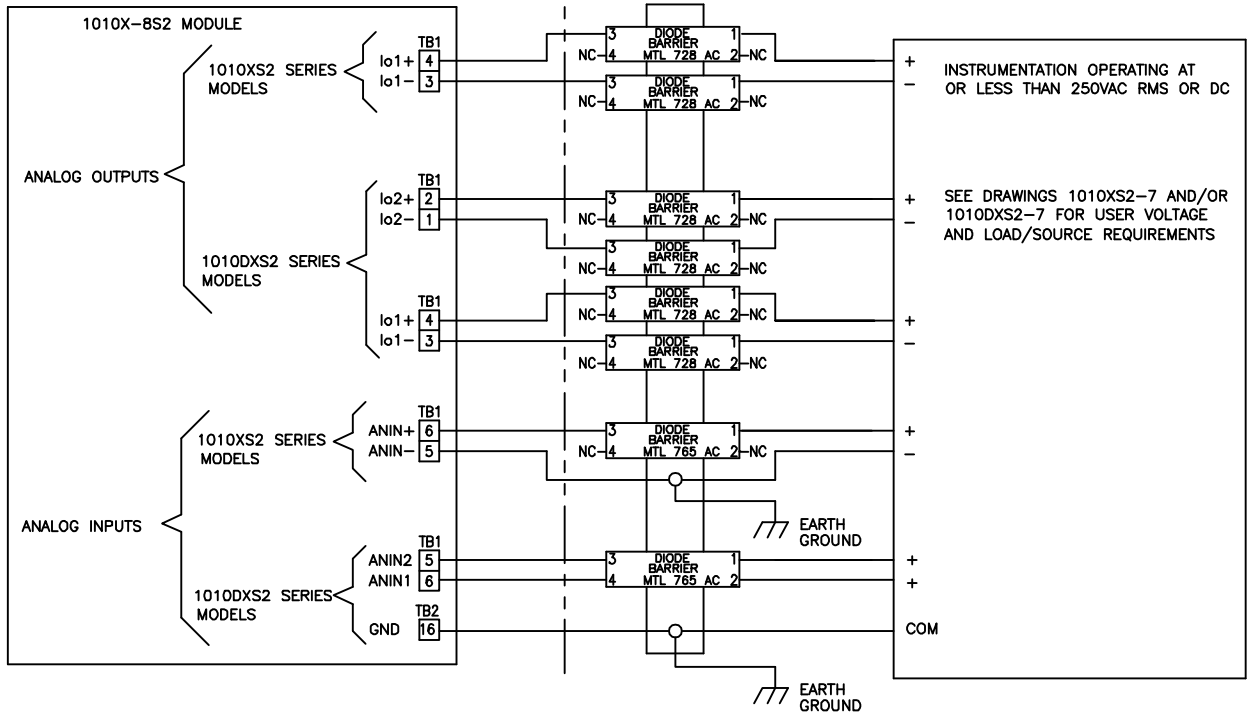
CN4737

1010XS2 OR 1010DXS2 SERIES FLOW COMPUTER
EXPLOSIONPROOF / FLAMEPROOF ENCLOSURE

NON-HAZARDOUS OR ZONE 2/DIVISION 2 LOCATION

HAZARDOUS LOCATION

CLASS I, II, DIV. 1 FOR GRPS. B, C, D, E, F, G
EEx d [ia] II T5



DIODE BARRIERS AND BARRIER GROUNDING BAR NOT SUPPLIED BY CONTROLOTRON
SEE NOTES AND TABLE ON SHEET 3 (ZONE C4)

CHANGES TO THIS DOCUMENT REQUIRE SAFETY AGENCY APPROVAL

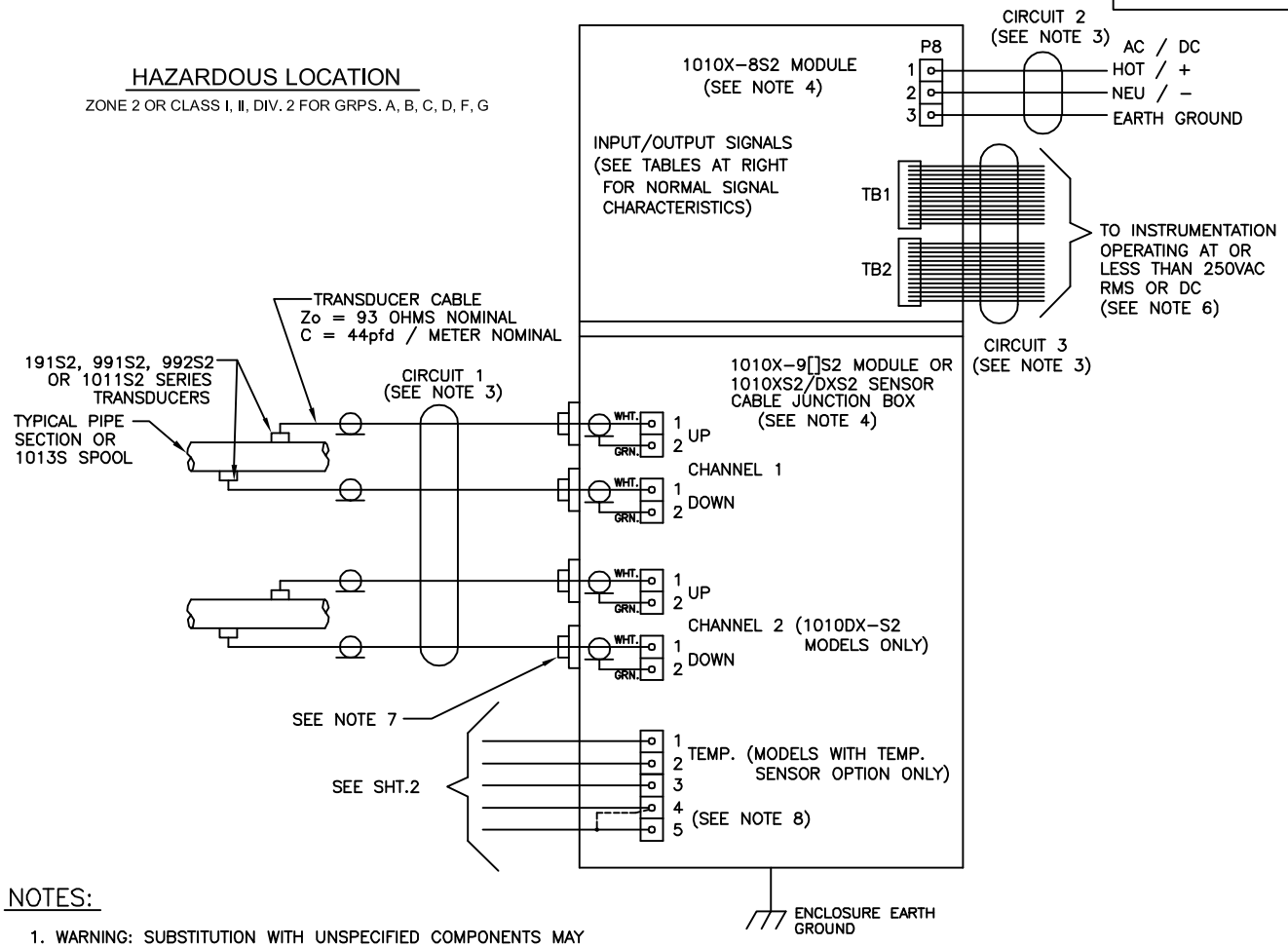
CONTRACT NO.	CONTROLOTRON HAUPPAUGE , NY 11788	
DR H.J DATE 3/25/99	CONNECTION DIAGRAM	
CHK DATE	1010 SYSTEM, EXPLOSIONPROOF/FLAMEPROOF FLOW COMPUTER	
ENG DATE		
PROD DATE		
APPD DATE		
CERTIFIED	SIZE C / CODE IDENT NO. 21614 / 1010-341 / REV. G	
DATE	SCALE: NONE / WT. / SHEET 4 OF 4	

CN4737

1010XS2 OR 1010DXS2 SERIES FLOW COMPUTER EXPLOSIONPROOF / FLAMEPROOF ENCLOSURE

POWER INPUT: 250VAC RMS OR 36VDC MAX.

INPUT VOLTAGE MUST MATCH RATING ON THE POWER SUPPLY LABEL



1010XS2 MODELS	NORMAL SIGNAL CHARACTERISTICS			
1010X-8S2	LOCATION	FUNCTION	NORMAL VOLTAGE	CURRENT
	TB1-1	N/C		
	TB1-2	N/C		
	TB1-3	Io1–	0 TO 24 VDC	4–20mA
	TB1-4	Io1+	24 VDC	4–20mA
	TB1-5	ANIN –	0 VDC	4–20mA
	TB1-6	ANIN +	0.8 TO 4 VDC	4–20mA
	TB1-7	STATUS –	0 TO 24 VDC	7mA MAX.
	TB1-8	STATUS +	0 TO 24 VDC	7mA MAX.
	TB1-9	PGEN –	0 TO 24 VDC	7mA MAX.
	TB1-10	PGEN +	0 TO 24 VDC	7mA MAX.
	TB2-11	TX	–12 TO 12 VDC	4mA
	TB2-12	RTS	–12 TO 12 VDC	4mA
	TB2-13	DTR	–12 TO 12 VDC	4mA
	TB2-14	RX	–12 TO 12 VDC	4mA
	TB2-15	CTS	–12 TO 12 VDC	4mA
	TB2-16	GND	0 VDC	20mA MAX.
	TB2-17	D1 INPUT	0 TO 12 VDC	4mA
	TB2-18	D1 RETURN	0 VDC	4mA
	TB2-19	D2 INPUT	0 TO 12 VDC	4mA
	TB2-20	D2 RETURN	0 VDC	4mA

1010DXS2 MODELS EXCEPT ULTRA PERFORMANCE GRADE	NORMAL SIGNAL CHARACTERISTICS			
1010X-8S2	LOCATION	FUNCTION	NORMAL VOLTAGE	CURRENT
	TB1-1	Io2–	0 TO 24 VDC	4–20mA
	TB1-2	Io2+	24 VDC	4–20mA
	TB1-3	Io1–	0 TO 24 VDC	4–20mA
	TB1-4	Io1+	24 VDC	4–20mA
	TB1-5	ANIN 2	0.8 TO 4 VDC	4–20mA
	TB1-6	ANIN 1	0.8 TO 4 VDC	4–20mA
	TB1-7	STATUS –1	0 TO 24 VDC	7mA MAX.
	TB1-8	STATUS +1	0 TO 24 VDC	7mA MAX.
	TB1-9	STATUS –2	0 TO 24 VDC	7mA MAX.
	TB1-10	STATUS +2	0 TO 24 VDC	7mA MAX.
	TB2-11	TX	–12 TO 12 VDC	4mA
	TB2-12	RTS	–12 TO 12 VDC	4mA
	TB2-13	DTR	–12 TO 12 VDC	4mA
	TB2-14	RX	–12 TO 12 VDC	4mA
	TB2-15	CTS	–12 TO 12 VDC	4mA
	TB2-16	GND	0 VDC	60mA MAX.
	TB2-17	D1 INPUT	0 TO 12 VDC	4mA
	TB2-18	D1 RETURN	0 VDC	4mA
	TB2-19	D2 INPUT	0 TO 12 VDC	4mA
	TB2-20	D2 RETURN	0 VDC	4mA

ULTRA PERFORMANCE GRADE 1010DXS2 MODELS	NORMAL SIGNAL CHARACTERISTICS			
1010X-8S2	LOCATION	FUNCTION	NORMAL VOLTAGE	CURRENT
	TB1-1	Io2–	0 TO 24 VDC	4–20mA
	TB1-2	Io2+	24 VDC	4–20mA
	TB1-3	Io1–	0 TO 24 VDC	4–20mA
	TB1-4	Io1+	24 VDC	4–20mA
	TB1-5	ANIN 2	0.8 TO 4 VDC	4–20mA
	TB1-6	ANIN 1	0.8 TO 4 VDC	4–20mA
	TB1-7	STATUS –	0 TO 24 VDC	7mA MAX.
	TB1-8	STATUS +	0 TO 24 VDC	7mA MAX.
	TB1-9	PGEN –	0 TO 24 VDC	7mA MAX.
	TB1-10	PGEN +	0 TO 24 VDC	7mA MAX.
	TB2-11	TX	–12 TO 12 VDC	4mA
	TB2-12	RTS	–12 TO 12 VDC	4mA
	TB2-13	DTR	–12 TO 12 VDC	4mA
	TB2-14	RX	–12 TO 12 VDC	4mA
	TB2-15	CTS	–12 TO 12 VDC	4mA
	TB2-16	GND	0 VDC	60mA MAX.
	TB2-17	D1 INPUT	0 TO 12 VDC	4mA
	TB2-18	D1 RETURN	0 VDC	4mA
	TB2-19	D2 INPUT	0 TO 12 VDC	4mA
	TB2-20	D2 RETURN	0 VDC	4mA

NOTES:

1. WARNING: SUBSTITUTION WITH UNSPECIFIED COMPONENTS MAY IMPAIR NON–INCENDIVE CIRCUITS.
2. USE 1010X MANUAL FOR OPERATION AND MAINTENANCE INSTRUCTIONS.
3. CIRCUITS 1, 2, AND 3 MUST BE IN SEPARATE CONDUIT.
4. MODULE PART NUMBER SUFFIX MAY VARY DEPENDING ON FLOW COMPUTER MODEL.
5. SEE INSTALLATION WIRING DRAWING 1010XS2–7 OR 1010DXS2–7.
6. ALL SIGNAL AND POWER WIRING MUST MEET APPLICABLE ELECTRICAL CODE FOR THE HAZARDOUS LOCATION.
7. TRANSDUCER CABLE CONNECTIONS ARE VIA. EXTERNAL 'F' CONNECTORS ON MODELS EQUIPPED WITH SENSOR CABLE JUNCTION BOX.
8. FOR 5 CONDUCTOR TEMPERATURE SENSOR CABLES, CONNECT WIRES No. 4 & 5 TO TERMINAL #4 IN MODELS EQUIPPED WITH SENSOR CABLE JUNCTION BOX.

CHANGES TO THIS DOCUMENT REQUIRE SAFETY AGENCY APPROVAL

CONTRACT NO.

DR H.J DATE 3/25/99
CHK DATE
ENG DATE
PROD DATE
APPD DATE

CERTIFIED

DATE

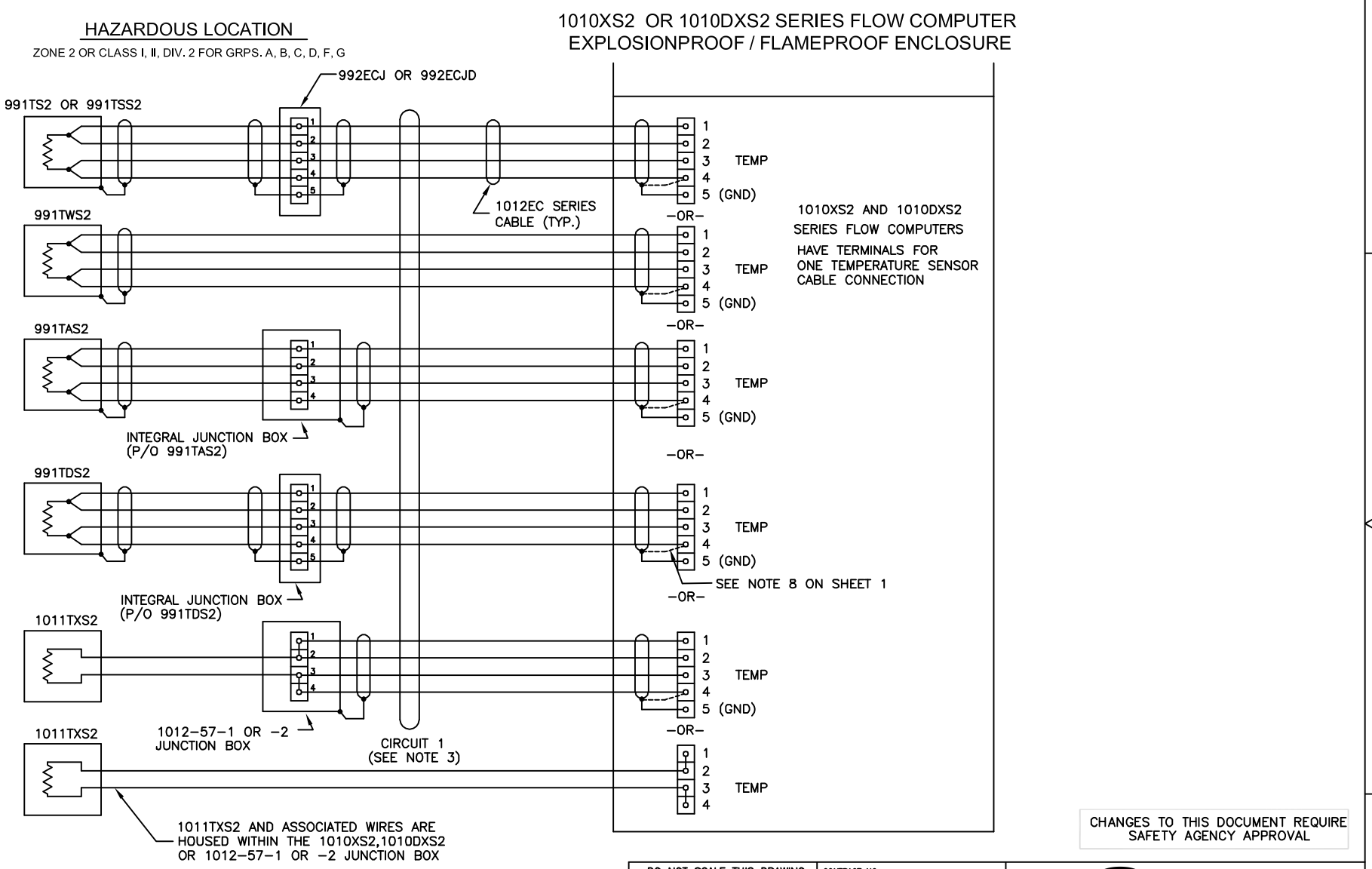
CONTROLOTRON
HAUPPAUGE , NY 11788

CONNECTION DIAGRAM
1010 SYSTEM, EXPLOSIONPROOF/FLAMEPROOF FLOW COMPUTER

SIZE	CODE IDENT NO.		REV.
C	21614	1010-342	F

SCALE: NONE | WT. | SHEET 1 OF 2

CN4737



TYPICAL TEMPERATURE SENSOR CONNECTIONS

CHANGES TO THIS DOCUMENT REQUIRE SAFETY AGENCY APPROVAL

DO NOT SCALE THIS DRAWING

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES
TOLERANCES ON-
FRACTIONS- +/- 0.015
DECIMALS- XX+/-0.01 XXX+/-0.005
ANGLES- +/-0°30'

CONTRACT NO.

DR	H.J	DATE 3/25/99
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CONTROLOTRON
HAUPPAUGE , NY 11788

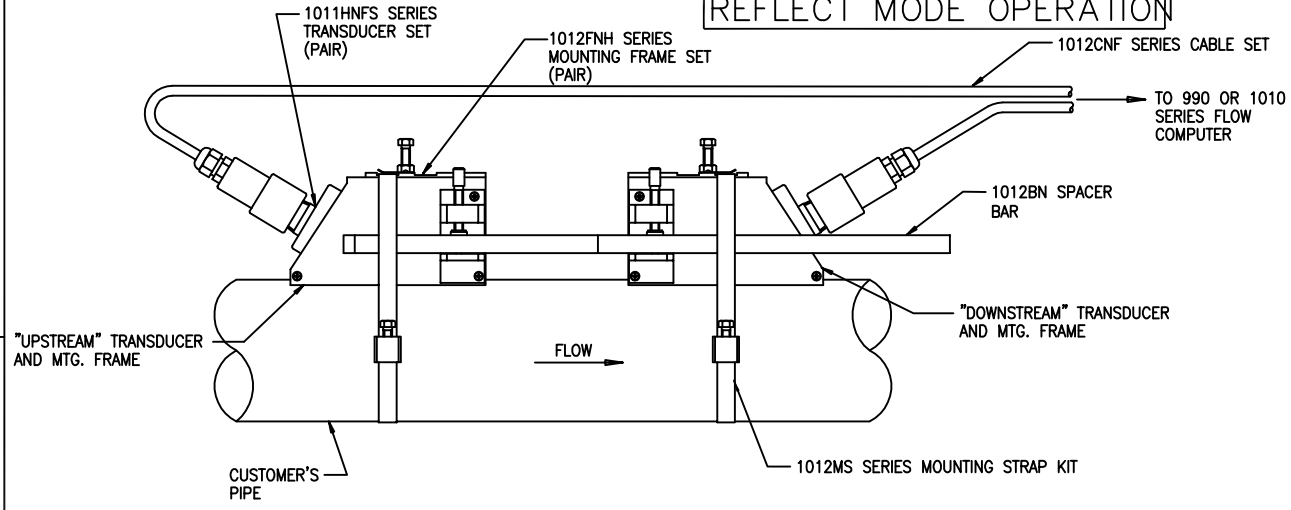
CONNECTION DIAGRAM
1010 SYSTEM, EXPLOSIONPROOF/FLAMEPROOF FLOW COMPUTER

SIZE	CODE IDENT NO.		REV.
C	21614	1010-342	F

SCALE: NONE | WT. | SHEET 2 OF 2

CN4737

REFLECT MODE OPERATION



INSTALLATION NOTES – SEE DRAWING REFERENCE ⚠#

1. USING THE INSTALLATION MENU AND THE PROCEDURE OUTLINED IN THE FLOW COMPUTER FIELD MANUAL, CONFIRM THAT YOU HAVE THE APPROPRIATE TRANSDUCERS AND SPACER BAR (IF USED) FOR REFLECT MODE OPERATION ON THE CHOSEN PIPE.

2. SELECT MOUNTING LOCATION;
2.1 CHOOSE LOCATION WHICH REMAINS FULL AT ZERO FLOW.
2.2 WHERE POSSIBLE LOCATE TRACK ASS'Y 10 PIPE DIAMETERS OR MORE FROM BEND TO ENSURE FULLY DEVELOPED AND STABLE FLOW PROFILE.
2.3 ON HORIZONTAL PIPE, SELECT HORIZONTAL PLANE, IF POSSIBLE TO AVOID SEDIMENT BLOCKAGE OF ULTRASONIC BEAM.

3. PREPARE PIPE FOR TRACK MOUNT;
3.1 REMOVE GRIT, CORROSION, COATING OR HEAVY PAINT
3.2 CLEAN AND DEGREASE SURFACE
3.3 DO NOT MOUNT OVER FROST.
3.4 CONDITION PIPE SURFACE;
LOCALLY SMOOTH THE PIPE SURFACE TO ACCEPT THE TRANSDUCERS. USE THE ABRASIVE PAD PROVIDED.

4. LOCATE MOUNTING FRAMES;
4.1 CONSULT THE 1010 FIELD MANUAL AND USE THE INSTALLATION MENU TO SELECT THE APPROPRIATE INDEX HOLE OR SPACING (LTN) FOR YOUR APPLICATION.

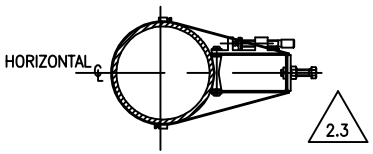
4.2 IF SPACER BAR IS USED:
4.2.1 CLAMP ONE MOUNTING FRAME AT THE UN–NUMBERED REFERENCE POSITION OF THE SPACER BAR. BE SURE THE INDEX PIN AND SPACER BAR INDEX SCREW ENGAGE THE HOLE IN THE SPACER BAR.
4.2.2 CLAMP THE SECOND MOUNTING FRAME TO THE SPACER BAR IN THE SAME MANNER AT THE INDEX HOLE INDICATED DURING STEP 4.1.
4.2.3 HOLD THE MOUNTING FRAME/SPACER BAR ASSEMBLY ON THE PIPE AT THE SELECTED LOCATION AND TEMPORARILY SECURE IT TO THE PIPE USING STRAPS FROM THE 1012MS STRAP MOUNTING KIT. GO TO 4.4.

4.3 IF MOUNTING FRAMES ARE SPACED BY MEASURING "LTN":
4.3.1 TEMPORARILY SECURE ONE OF THE MOUNTING FRAMES TO THE PIPE USING STRAPS FROM THE 1012MS STRAP MOUNTING KIT.
4.3.2 MEASURE ALONG THE PIPE AND TEMPORARILY SECURE THE SECOND MOUNTING FRAME TO THE PIPE SO THAT SPACING "LTN" DETERMINED IN STEP 4.1 IS MEASURED BETWEEN THE SPACING MARKS ON THE MOUNTING FRAMES.

4.4 IF THE PIPE SURFACE IS CLEAN AND SMOOTH, PROCEED TO TRANSDUCER INSTALLATION ON SHT.3. IF PIPE SURFACE NEEDS CONDITIONING; MARK THE MOUNTING FRAME POSITION CAREFULLY, LOOSEN STRAPS AND MOVE THE MOUNTING FRAMES ASIDE. LOCALLY SMOOTH THE PIPE SURFACE IN THE MARKED AREAS USING THE ABRASIVE PAD SUPPLIED. SHIFT THE MOUNTING FRAMES BACK INTO THEIR APPROPRIATE LOCATIONS AND TIGHTEN THE THE MOUNTING STRAPS SECURELY.

** SEE SHEET 3 FOR INSTRUCTIONS TO COMPLETE TRANSDUCER INSTALLATION.

PREFERRED MOUNTING PLANE

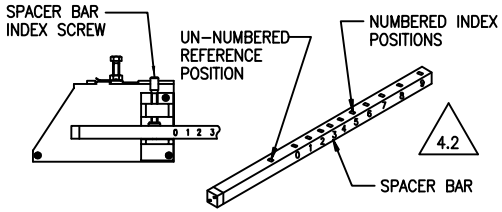


MOUNT TRANSDUCERS/MOUNTING FRAMES IN HORIZONTAL PLANE TO PREVENT BLOCKING OF ULTRASONIC BEAM BY AIR OR SEDIMENT.

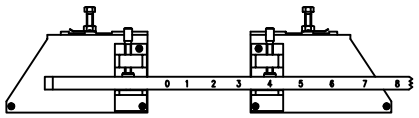
USING THE SPACER BAR TO SET TRANSDUCER MOUNTING FRAME SPACING

USING THE INSTALLATION MENU, AS OUTLINED IN THE FLOW COMPUTER FIELD MANUAL, DETERMINE THE SPACING INDEX NUMBER FOR THE SELECTED APPLICATION.

USE THE SPACER BAR INDEX SCREW TO SECURE THE SPACER BAR TO ONE OF THE MOUNTING FRAMES AT THE UN–NUMBERED REFERENCE POSITION.

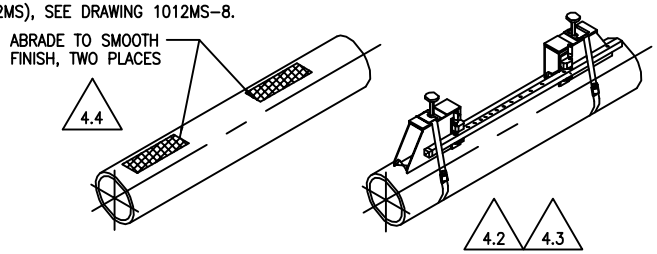


SECURE THE SECOND MOUNTING FRAME TO THE SPACER BAR AT THE NUMBERED INDEX POSITION DETERMINED FROM THE INSTALLATION MENU.



SECURING MOUNTING FRAMES TO THE PIPE SURFACE

HOLD THE MOUNTING FRAME/SPACER BAR ASSEMBLY AGAINST THE PIPE AT THE SELECTED MOUNTING LOCATION. MARK THE APPROXIMATE OUTLINE OF THE MOUNTING FRAMES ON THE PIPE SURFACE. USING THE ABRASIVE PAD SUPPLIED, SMOOTH THE PIPE SURFACE IN THE MARKED AREAS. SECURE THE MOUNTING FRAMES TO THE PIPE USING THE MOUNTING STRAP KIT (1012MS), SEE DRAWING 1012MS–8.



DO NOT SCALE THIS DRAWING	CONTRACT NO.
UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES (MM) TOLERANCES ON– INCHES ± .1 (MM) ± 2	DR H.J DATE 7/6/99 CHK DATE ENG DATE PROD DATE APPD DATE
	CERTIFIED DATE

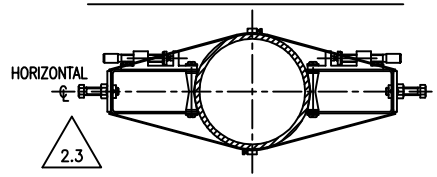
CONTROLOTRON
HAUPPAUGE , NY 11788

INSTALLATION, 1011HNFS SERIES DEDICATED PLASTIC BODY TRANSDUCER

SIZE	CODE IDENT NO.		REV.
C	21614	1011HNFS-7	A1
SCALE: NONE	WT.	SHEET 1 OF 3	

1011HNFS–7 sht.1 rev.A1
CN4944

PREFERRED MOUNTING PLANE

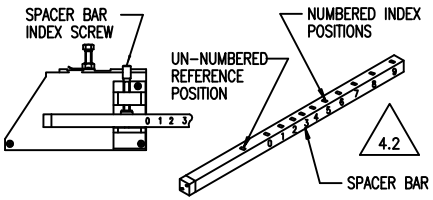


MOUNT TRANSDUCERS/MOUNTING FRAMES IN HORIZONTAL PLANE TO PREVENT BLOCKING OF ULTRASONIC BEAM BY AIR OR SEDIMENT.

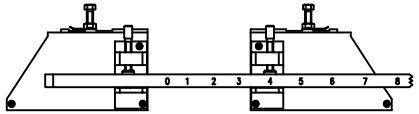
USING THE SPACER BAR TO SET TRANSDUCER MOUNTING FRAME SPACING

USING THE INSTALLATION MENU, AS OUTLINED IN THE FLOW COMPUTER FIELD MANUAL, DETERMINE THE SPACING INDEX NUMBER FOR THE SELECTED APPLICATION.

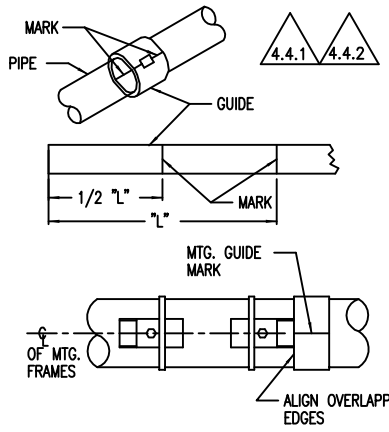
USE THE SPACER BAR INDEX SCREW TO SECURE THE SPACER BAR TO ONE OF THE MOUNTING FRAMES AT THE UN-NUMBERED REFERENCE POSITION.



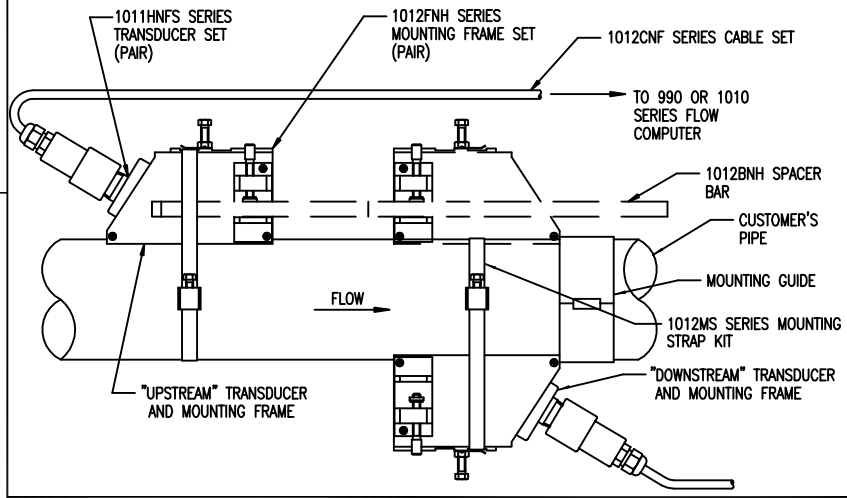
SECURE THE SECOND MOUNTING FRAME TO THE SPACER BAR AT THE NUMBERED INDEX POSITION DETERMINED FROM THE INSTALLATION MENU.



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, ALIGN ONE MARK WITH THE CENTER LINE OF THE MOUNTING FRAMES.

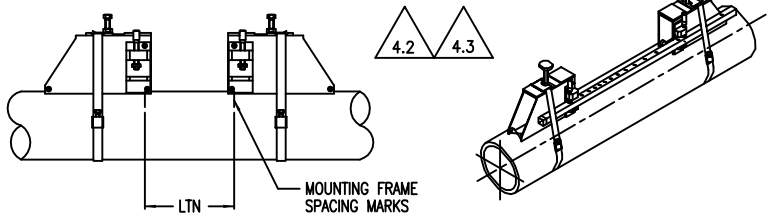


DIRECT MODE OPERATION

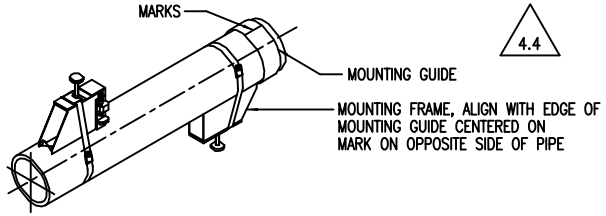


SECURING MOUNTING FRAMES TO THE PIPE SURFACE

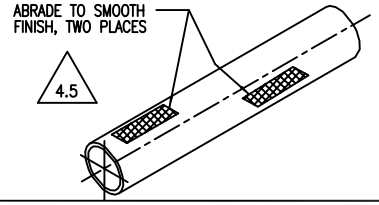
HOLD THE MOUNTING FRAME/SPACER BAR ASSEMBLY AGAINST THE PIPE AT THE SELECTED MOUNTING LOCATION OR POSITION USING LTN, TEMPORARILY STRAP IN PLACE.



USE THE MOUNTING GUIDE TO TRANSFER ONE OF THE MOUNTING FRAMES TO THE OPPOSITE SIDE OF THE PIPE.



IF NECESSARY, USE THE ABRASIVE PAD SUPPLIED TO PRODUCE A SMOOTH FINISH ON THE PIPE AT THE TRANSDUCER MOUNTING POSITIONS.



INSTALLATION NOTES – SEE DRAWING REFERENCE ⚠

1. USING THE INSTALLATION MENU AND THE PROCEDURE OUTLINED IN THE FLOW COMPUTER FIELD MANUAL, CONFIRM THAT YOU HAVE THE APPROPRIATE TRANSDUCERS AND SPACER BAR (IF USED) FOR DIRECT MODE OPERATION ON THE CHOSEN PIPE.
2. SELECT MOUNTING LOCATION;
2.1 CHOOSE LOCATION WHICH REMAINS FULL AT ZERO FLOW.
2.2 WHERE POSSIBLE LOCATE TRACK ASS'Y 10 PIPE DIAMETERS OR MORE FROM BEND TO ENSURE FULLY DEVELOPED AND STABLE FLOW PROFILE.
2.3 ON HORIZONTAL PIPE, SELECT HORIZONTAL PLANE, IF POSSIBLE TO AVOID SEDIMENT BLOCKAGE OF ULTRASONIC BEAM.
3. PREPARE PIPE FOR TRACK MOUNT;
3.1 REMOVE GRIT, CORROSION, COATING OR HEAVY PAINT
3.2 CLEAN AND DEGREASE SURFACE
3.3 DO NOT MOUNT OVER FROST.
3.4 CONDITION PIPE SURFACE;
LOCALLY SMOOTH THE PIPE SURFACE TO ACCEPT THE TRANSDUCERS. USE THE ABRASIVE PAD PROVIDED.
4. LOCATE MOUNTING FRAMES;
4.1 CONSULT THE 1010 FIELD MANUAL AND USE THE INSTALLATION MENU TO SELECT THE APPROPRIATE INDEX HOLE OR SPACING (LTN) FOR YOUR APPLICATION.
4.2 IF SPACER BAR IS USED:
4.2.1 CLAMP ONE MOUNTING FRAME AT THE UN-NUMBERED REFERENCE POSITION OF THE SPACER BAR. BE SURE THE INDEX PIN AND SPACER BAR INDEX SCREW ENGAGE THE HOLE IN THE SPACER BAR.
4.2.2 CLAMP THE SECOND MOUNTING FRAME TO THE SPACER BAR IN THE SAME MANNER AT THE INDEX HOLE INDICATED DURING STEP 4.1.
4.2.3 HOLD THE MOUNTING FRAME/SPACER BAR ASSEMBLY ON THE PIPE AT THE SELECTED LOCATION AND TEMPORARILY SECURE IT TO THE PIPE USING STRAPS FROM THE 1012MS STRAP MOUNTING KIT. GO TO 4.4.
4.3 IF MOUNTING FRAMES ARE SPACED BY MEASURING "LTN":
4.3.1 TEMPORARILY SECURE ONE OF THE MOUNTING FRAMES TO THE PIPE USING STRAPS FROM THE 1012MS STRAP MOUNTING KIT.
4.3.2 MEASURE ALONG THE PIPE AND TEMPORARILY SECURE THE SECOND MOUNTING FRAME TO THE PIPE SO THAT SPACING "LTN" DETERMINED IN STEP 4.1 IS MEASURED BETWEEN THE SPACING MARKS ON THE MOUNTING FRAMES. USE STRAIGHT EDGE OR OTHER MEANS TO ALIGN BOTH MOUNTING FRAMES WITH PIPE AXIS:
4.4 USE THE MOUNTING GUIDE INCLUDED WITH THE 1012MS STRAP MOUNTING KIT TO TRANSFER ONE OF THE MOUNTING FRAMES TO THE OPPOSITE SIDE OF THE PIPE.
4.4.1 WRAP THE MOUNTING GUIDE AROUND THE PIPE. POSITION IT SO THAT THE OVERLAPPING LENGTHS ARE EDGE-ALIGNED, MARK THE OVERLAPPED PORTION OF THE GUIDE AT THE EDGE OF THE OVERLAPPING PORTION. REMOVE THE GUIDE, MEASURE THE DISTANCE FROM THE END TO THE MARK AND MARK AGAIN HALFWAY BETWEEN.
4.4.2 RE-POSITION THE GUIDE ON THE PIPE AND TAPE IN PLACE SO THAT ONE OF THE MARKS INDICATES THE CENTERLINE OF THE INSTALLED MOUNTING FRAMES AND THE MOUNTING GUIDE EDGE IS AGAINST THE END OF ONE OF THE MOUNTING FRAMES. MAKE SURE THE OVERLAPPING LENGTHS OF THE MOUNTING GUIDE ARE EDGE-ALIGNED. THIS ASSURES A DIAMETRICAL TRANSFER OF THE MOUNTING FRAME POSITION.
4.4.3 LOOSEN THE MOUNTING STRAP ON THE MOUNTING FRAME WITH WHICH THE MOUNTING GUIDE HAS BEEN ALIGNED. ROTATE IT AROUND THE PIPE SURFACE UNTIL IT IS CENTERED ON THE OPPOSITE SIDE MOUNTING GUIDE MARK MADE IN STEP 4.4.1. TIGHTEN THE STRAP, REMOVE THE MOUNTING GUIDE.
4.5 IF THE PIPE SURFACE IS CLEAN AND SMOOTH, PROCEED TO TRANSDUCER INSTALLATION ON SHT.3, IF PIPE SURFACE NEEDS CONDITIONING; MARK THE MOUNTING FRAME POSITION CAREFULLY, LOOSEN STRAPS AND MOVE THE MOUNTING FRAMES ASIDE. LOCALLY SMOOTH THE PIPE SURFACE IN THE MARKED AREAS USING THE ABRASIVE PAD SUPPLIED. SHIFT THE MOUNTING FRAMES BACK INTO THEIR APPROPRIATE LOCATIONS AND TIGHTEN THE MOUNTING STRAPS SECURELY.

** SEE SHEET 3 FOR INSTRUCTIONS TO COMPLETE TRANSDUCER INSTALLATION.

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	7/6/99
CHK		DATE	
ENG		DATE	
PROD		DATE	
APPD		DATE	

CERTIFIED

DATE

CONTROLOTRON
HAUPPAUGE , NY 11788

INSTALLATION, 1011HNFS SERIES DEDICATED PLASTIC BODY TRANSDUCER

SIZE	CODE IDENT NO.		REV.
C	21614	1011HNFS-7	A1

SCALE: NONE | WT. | SHEET 2 OF 3

1011HNFS-7 sht.2 rev.A1
CN4944

MATING 1012CNF SERIES TRANSDUCER CABLES WITH 1011HNF SERIES TRANSDUCERS

a) REMOVE PROTECTIVE CAPS.

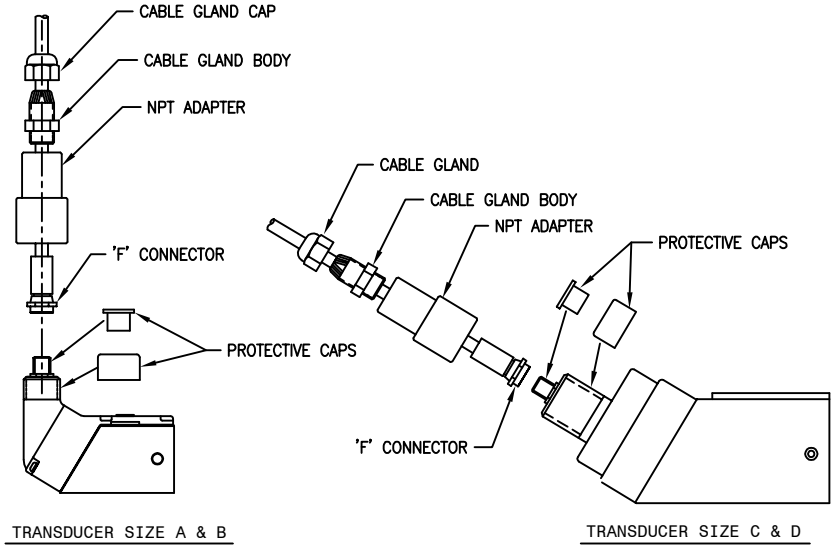
b) SEE APPROPRIATE CABLE ASSEBMLY DRAWING FOR 'F' CONNECTOR, NPT ADAPTER AND GLAND ASSEMBLY DETAIL.

c) MATE 'F' CONNECTORS, CABLES TO TRANSDUCER.

d) FOR BEST WEATHER SEAL, WRAP TEFLON PIPE TAPE (NOT SUPPLIED) AROUND MALE NPT THREADS ON TRANSDUCER HOUSING.

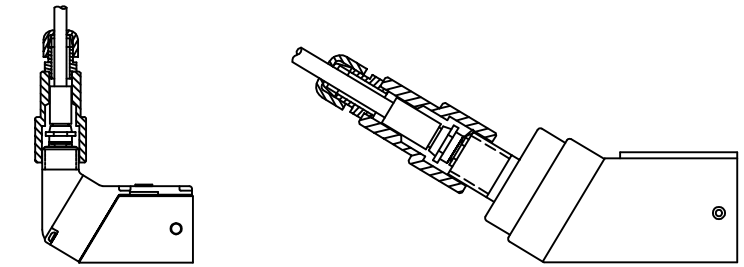
e) SCREW NPT ADAPTER TO TRANSDUCER HOUSING (HAND TIGHT IS SUFFICIENT).

f) TIGHTEN GLAND BODY WITH NPT ADAPTER AND SECURE CABLE BY TIGHTENING GLAND TOP NUT. (HAND TIGHT IS SUFFICIENT).



TRANSDUCER SIZE A & B

TRANSDUCER SIZE C & D



TRANSDUCER SIZE A & B

TRANSDUCER SIZE C & D

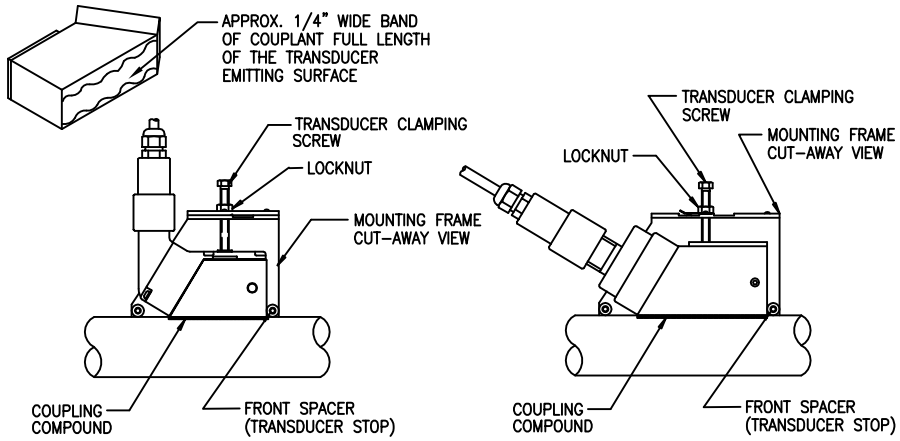
INSTALLATION NOTES – CONT'D FROM SHT. 1 OR SHT. 2

5. MAKE CABLE CONNECTIONS AT FLOW COMPUTER IN ACCORDANCE WITH APPROPRIATE FLOW COMPUTER INSTALLATION DRAWING AND 1010 FIELD MANUAL.

6. SEE DRAWINGS 1012FHN–8 AND 1011HNFS–8 FOR MOUNTING FRAME AND TRANSDUCER OUTLINE DIMENSIONS.

INSTALLING TRANSDUCERS IN MOUNTING FRAMES

APPLY A THIN BAND OF COUPLANT TO THE EMITTING SURFACE OF THE TRANSDUCERS. SLIP THE TRANSDUCERS INTO THE MOUNTING FRAMES, SEATING THEM SQUARELY ON THE PIPE SURFACE, PUSH FORWARD INTO THE FRAMES AGAINST THE FRONT SPACER. LOCATE CLAMPING SCREW IN PROPER POSITION TIGHTEN THE TRANSDUCER CLAMPING SCREW, FIRMLY SEATING THE TRANSDUCERS ON THE PIPE SURFACE. SECURE THE CLAMPING SCREW WITH LOCK NUT.



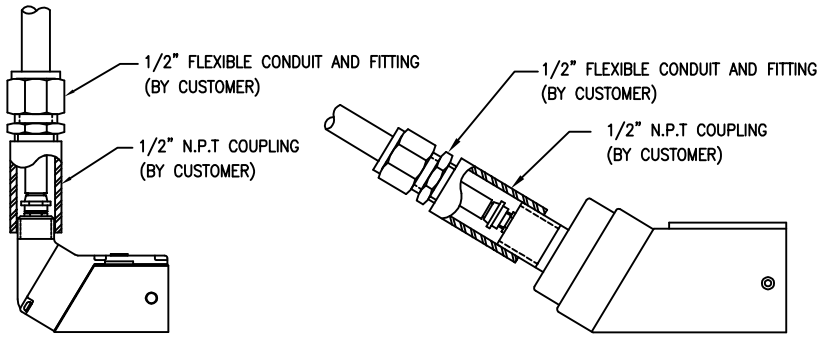
TRANSDUCER SIZE A & B

TRANSDUCER SIZE C & D

**SEE DRAWING 1012THP–7 FOR INSTALLATION USING 1012THP SERIES MOUNTING TRACKS.

USE OF FLEXIBLE CONDUIT WITH TRANSDUCERS

THE TRANSDUCER WIRING HOUSING HAS INTEGRAL 1/2" N.P.T THREADS TO ACCEPT A CONDUIT COUPLING IF FLEXIBLE CONDUIT IS USED. MAKE CONNECTION AS SHOWN, THEN PASS COUPLING AND CONDUIT OVER THE CABLE, SECURE TO THE TRANSDUCER WIRING HOUSING.



DO NOT SCALE THIS DRAWING

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES (MM) TOLERANCES ON–

INCHES ± .1 (MM) ± 2

CONTRACT NO.

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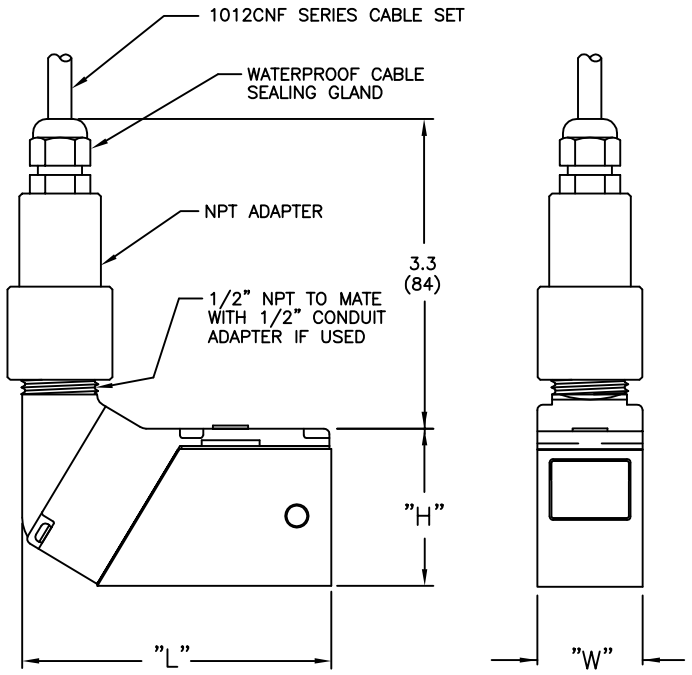
CONTROLOTRON
HAUPPAUGE , NY 11788

INSTALLATION, 1011HNFS SERIES DEDICATED PLASTIC BODY TRANSDUCER

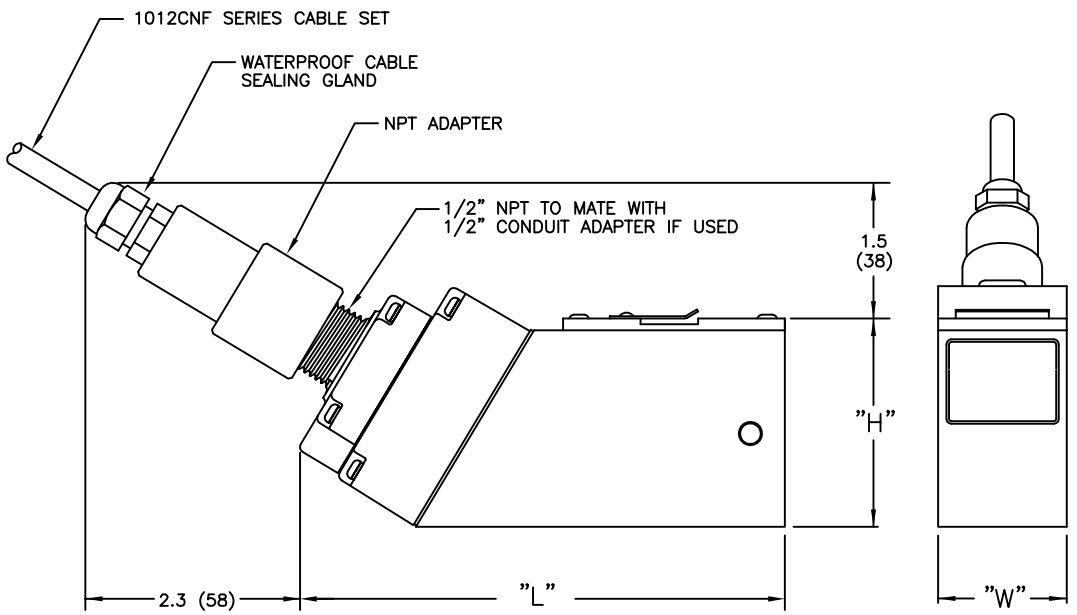
SIZE	CODE IDENT NO.		REV.
C	21614	1011HNFS-7	A1

SCALE: NONE | WT. | SHEET 3 OF 3

1011HNFS–7 sht.3 rev.A1
CN4944



SIZE "A" & "B"



SIZE "C" & "D"

TRANSDUCER PART NUMBER	L	W	H
1011HNFS–A1/2/3 1011GCHNFS–A1/2/3	2.2 (56)	1.1 (28)	1.7 (43)
1011HNFS–B1/2/3 1011GCHNFS–B2/3	3.3 (84)	1.1 (28)	1.7 (43)
1011GCHNFS–B1	2.6 (66)		
1011HNFS–C1/2 1011GCHNFS–C2	5.0 (127)	1.3 (33)	2.2 (56)
1011GCHNFS–C1	4.1 (104)		
1011HNFS–D1/2/3/4 1011GCHNFS–D2/4	7.5 (191)	2.0 (51)	3.3 (84)
1011GCHNFS–D1/3	6.8 (173)		

* SEE NOTE 3

NOTES :

1. TRANSDUCERS ARE SUPPLIED IN MATCHED PAIRS, BOTH TRANSDUCERS OF A PAIR HAVE THE SAME SERIAL NUMBER.
2. SEE THE APPROPRIATE TRANSDUCER INSTALLATION DRAWING FOR COMPLETE INSTALLED DIMENSIONS.
3. TRANSDUCER PART NUMBER VARIES WITH OPERATING FREQUENCY AND APPLICATION TEMPERATURE.

DO NOT SCALE THIS DRAWING

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES TOLERANCES ON–
INCHES ± .1 (MM) ± 2

MATERIAL:

FINISH:

CONTRACT NO.

DR H.J DATE 7/6/99
CHK DATE
ENG DATE
PROD DATE
APPD DATE

CERTIFIED
DATE

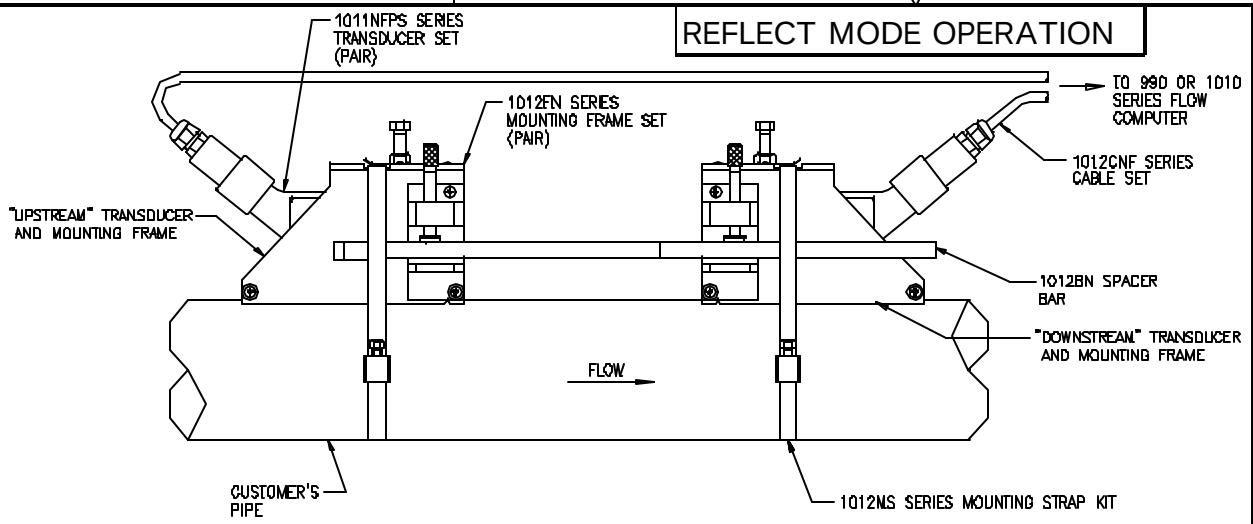
SIEMENS
Siemens Energy & Automation, Inc.
Process Instrumentation Business Unit
CoC Ultrasonic Flow - Hauppauge, Long Island, NY 11788

OUTLINE DIMENSIONS 1011HNF SERIES DEDICATED PLASTIC BODY TRANSDUCERS

SIZE	CODE IDENT NO.		REV.
C	21614	1011HNFS-8	A2
SCALE: NONE	WT.		SHEET 1 OF 1

CN4995, CN5315

REFLECT MODE OPERATION



INSTALLATION NOTES – SEE DRAWING REFERENCE ⚠

1. USING THE INSTALLATION MENU AND THE PROCEDURE OUTLINED IN THE FLOW COMPUTER FIELD MANUAL, CONFIRM THAT YOU HAVE THE APPROPRIATE TRANSDUCERS AND SPACER BAR (IF USED) FOR REFLECT MODE OPERATION ON THE CHOSEN PIPE.

2. SELECT MOUNTING LOCATION:
2.1 CHOOSE LOCATION WHICH REMAINS FULL AT ZERO FLOW.
2.2 WHERE POSSIBLE LOCATE TRANSDUCERS 10 PIPE DIAMETERS OR MORE FROM BEND TO ENSURE FULLY DEVELOPED AND STABLE FLOW PROFILE.
2.3 ON HORIZONTAL PIPE, SELECT HORIZONTAL PLANE, IF POSSIBLE TO AVOID SEDIMENT BLOCKAGE OF ULTRASONIC BEAM.

3. PREPARE PIPE FOR TRANSDUCER MOUNTING:
3.1 REMOVE GRIT, CORROSION, COATING OR HEAVY PAINT
3.2 CLEAN AND DEGREASE SURFACE
3.3 DO NOT MOUNT OVER FROST.
3.4 CONDITION PIPE SURFACE:
LOCALLY SMOOTH THE PIPE SURFACE TO ACCEPT THE TRANSDUCERS. USE THE ABRASIVE PAD PROVIDED.

4. INSTALLATION WITH MOUNTING FRAMES
4.1 CONSULT THE 1010 FIELD MANUAL AND USE THE INSTALLATION MENU TO SELECT THE APPROPRIATE INDEX HOLE OR SPACING (LTN) FOR YOUR APPLICATION.

4.2 IF SPACER BAR IS USED:
4.2.1 CLAMP ONE MOUNTING FRAME AT THE UN-NUMBERED REFERENCE POSITION OF THE SPACER BAR. BE SURE THE INDEX PIN AND SPACER BAR INDEX SCREW ENGAGE THE HOLE IN THE SPACER BAR.

4.2.2 CLAMP THE SECOND MOUNTING FRAME TO THE SPACER BAR IN THE SAME MANNER AT THE INDEX HOLE INDICATED DURING STEP 4.1.

4.2.3 HOLD THE MOUNTING FRAME/SPACER BAR ASSEMBLY ON THE PIPE AT THE SELECTED LOCATION AND TEMPORARILY SECURE IT TO THE PIPE USING STRAPS FROM THE 1012MS STRAP MOUNTING KIT. GO TO 4.4.

4.3 IF MOUNTING FRAMES ARE SPACED BY MEASURING "LTN":

4.3.1 TEMPORARILY SECURE ONE OF THE MOUNTING FRAMES TO THE PIPE USING STRAPS FROM THE 1012MS STRAP MOUNTING KIT.

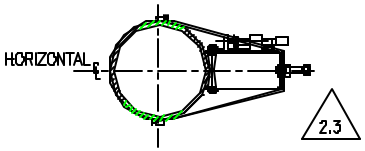
4.3.2 MEASURE ALONG THE PIPE AND TEMPORARILY SECURE THE SECOND MOUNTING FRAME TO THE PIPE SO THAT SPACING "LTN" DETERMINED IN STEP 4.1 IS MEASURED BETWEEN THE SPACING MARKS ON THE MOUNTING FRAMES.

4.4 IF THE PIPE SURFACE IS CLEAN AND SMOOTH, PROCEED TO TRANSDUCER INSTALLATION ON SHT.3. IF PIPE SURFACE NEEDS CONDITIONING: MARK THE MOUNTING FRAME POSITION CAREFULLY, LOOSEN STRAPS AND MOVE THE MOUNTING FRAMES ASIDE. LOCALLY SMOOTH THE PIPE SURFACE IN THE MARKED AREAS USING THE ABRASIVE PAD SUPPLIED. SHIFT THE MOUNTING FRAMES BACK INTO THEIR APPROPRIATE LOCATIONS AND TIGHTEN THE THE MOUNTING STRAPS SECURELY.

** SEE SHEET 3 FOR INSTRUCTIONS TO COMPLETE TRANSDUCER INSTALLATION.

SEE SHEET 4 FOR TRANSDUCER INSTALLATION WITHOUT MOUNTING FRAMES

PREFERRED MOUNTING PLANE

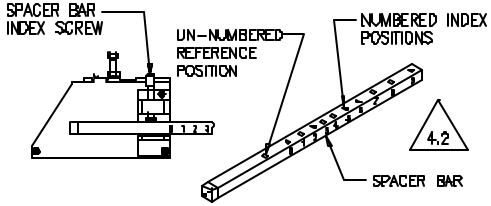


MOUNT TRANSDUCERS/MOUNTING FRAMES IN HORIZONTAL PLANE TO PREVENT BLOCKING OF ULTRASONIC BEAM BY AIR OR SEDIMENT.

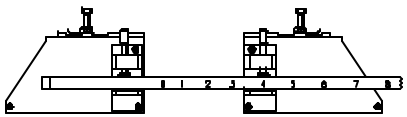
USING THE SPACER BAR TO SET TRANSDUCER MOUNTING FRAME SPACING

USING THE INSTALLATION MENU, AS OUTLINED IN THE FLOW COMPUTER FIELD MANUAL, DETERMINE THE SPACING INDEX NUMBER FOR THE SELECTED APPLICATION.

USE THE SPACER BAR INDEX SCREW TO SECURE THE SPACER BAR TO ONE OF THE MOUNTING FRAMES AT THE UN-NUMBERED REFERENCE POSITION.

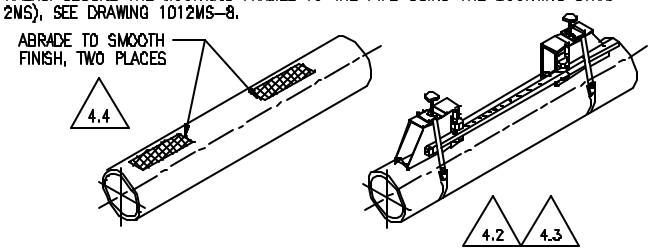


SECURE THE SECOND MOUNTING FRAME TO THE SPACER BAR AT THE NUMBERED INDEX POSITION DETERMINED FROM THE INSTALLATION MENU.



SECURING MOUNTING FRAMES TO THE PIPE SURFACE

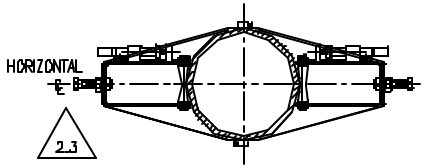
HOLD THE MOUNTING FRAME/SPACER BAR ASSEMBLY AGAINST THE PIPE AT THE SELECTED MOUNTING LOCATION. MARK THE APPROXIMATE OUTLINE OF THE MOUNTING FRAMES ON THE PIPE SURFACE. USING THE ABRASIVE PAD SUPPLIED, SMOOTH THE PIPE SURFACE IN THE MARKED AREAS. SECURE THE MOUNTING FRAMES TO THE PIPE USING THE MOUNTING STRAP KIT (1012MS), SEE DRAWING 1012MS-8.



DO NOT SCALE THIS DRAWING	CONTRACT NO.	CONTRADICTRON HAUPPAUGE, NY 11788	
UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES (MM) TOLERANCES ON- INCHES ± .1 (MM) ± 2	DR HJ DATE 7/7/98 CHK DATE ENG DATE PROD DATE APPD DATE	INSTALLATION, 1011NFPS SERIES DEDICATED PLASTIC BODY TRANSDUCER	
	CERTIFIED DATE	SIZE C / CODE IDENT NO. 21614 / 1011NFPS - 7 / REV. B	
		SCALE: NONE / WT. / SHEET 1 OF 4	

R14: 1011NFPS-7 rev.B
CN4333

PREFERRED MOUNTING PLANE

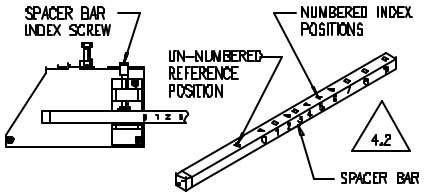


MOUNT TRANSDUCERS/MOUNTING FRAMES IN HORIZONTAL PLANE TO PREVENT BLOCKING OF ULTRASONIC BEAM BY AIR OR SEDIMENT.

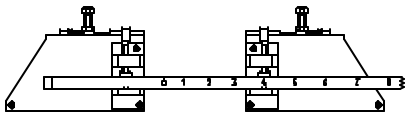
USING THE SPACER BAR TO SET TRANSDUCER MOUNTING FRAME SPACING

USING THE INSTALLATION MENU, AS OUTLINED IN THE FLOW COMPUTER FIELD MANUAL, DETERMINE THE SPACING INDEX NUMBER FOR THE SELECTED APPLICATION.

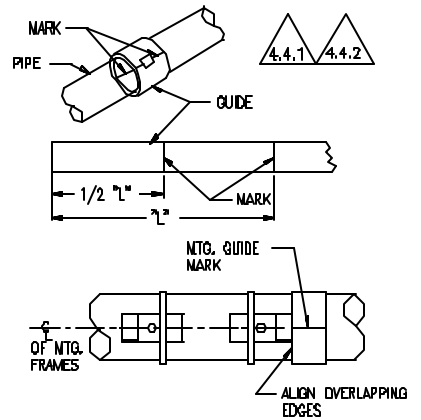
USE THE SPACER BAR INDEX SCREW TO SECURE THE SPACER BAR TO ONE OF THE MOUNTING FRAMES AT THE UN-NUMBERED REFERENCE POSITION.



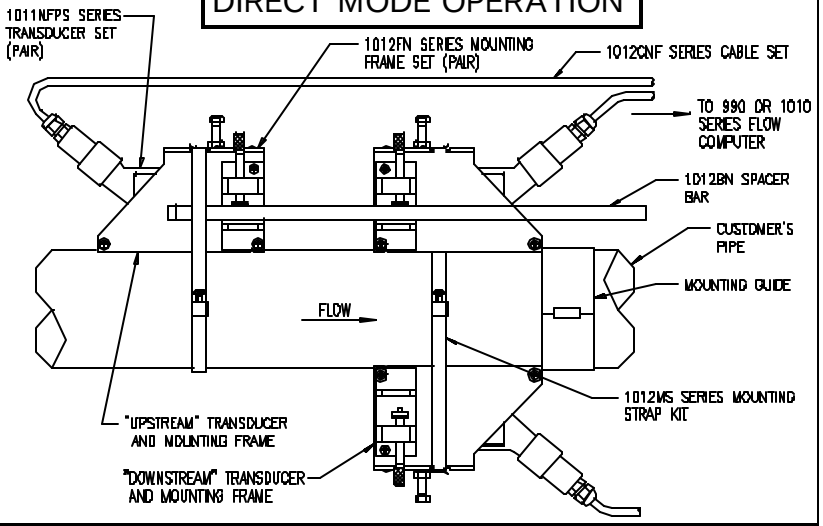
SECURE THE SECOND MOUNTING FRAME TO THE SPACER BAR AT THE NUMBERED INDEX POSITION DETERMINED FROM THE INSTALLATION MENU.



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, ALIGN ONE MARK WITH THE CENTER LINE OF THE MOUNTING FRAMES.

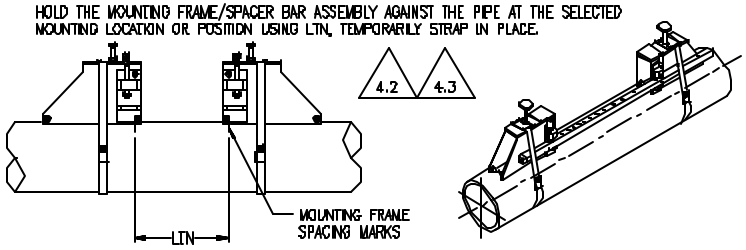


DIRECT MODE OPERATION

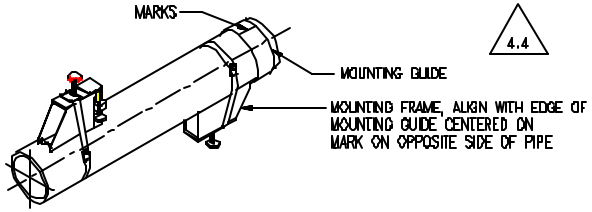


SECURING MOUNTING FRAMES TO THE PIPE SURFACE

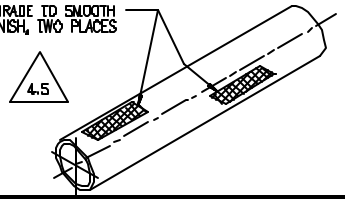
HOLD THE MOUNTING FRAME/SPACER BAR ASSEMBLY AGAINST THE PIPE AT THE SELECTED MOUNTING LOCATION OR POSITION USING LTN, TEMPORARILY STRAP IN PLACE.



USE THE MOUNTING GUIDE TO TRANSFER ONE OF THE MOUNTING FRAMES TO THE OPPOSITE SIDE OF THE PIPE.



IF NECESSARY, USE THE ABRASIVE PAD SUPPLIED TO PRODUCE A SMOOTH FINISH ON THE PIPE AT THE TRANSDUCER MOUNTING POSITIONS.



INSTALLATION NOTES – SEE DRAWING REFERENCE

1. USING THE INSTALLATION MENU AND THE PROCEDURE OUTLINED IN THE FLOW COMPUTER FIELD MANUAL, CONFIRM THAT YOU HAVE THE APPROPRIATE TRANSDUCERS AND SPACER BAR (IF USED) FOR DIRECT MODE OPERATION ON THE CHOSEN PIPE.
2. SELECT MOUNTING LOCATION:
   2.1 CHOOSE LOCATION WHICH REMAINS FULL AT ZERO FLOW.
   2.2 WHERE POSSIBLE LOCATE TRANSDUCERS 10 PIPE DIAMETERS OR MORE FROM BEND TO ENSURE FULLY DEVELOPED AND STABLE FLOW PROFILE.
   2.3 ON HORIZONTAL PIPE, SELECT HORIZONTAL PLANE, IF POSSIBLE TO AVOID SEDIMENT BLOCKAGE OF ULTRASONIC BEAM.
3. PREPARE PIPE FOR TRANSDUCER MOUNTING
   3.1 REMOVE GRIT, CORROSION, COATING OR HEAVY PAINT
   3.2 CLEAN AND DEGREASE SURFACE
   3.3 DO NOT MOUNT OVER FROST.
   3.4 CONDITION PIPE SURFACE:
   LOCALLY SMOOTH THE PIPE SURFACE TO ACCEPT THE TRANSDUCERS. USE THE ABRASIVE PAD PROVIDED.
4. INSTALLATION WITH MOUNTING FRAMES
   4.1 CONSULT THE 1010 FIELD MANUAL AND USE THE INSTALLATION MENU TO SELECT THE APPROPRIATE INDEX HOLE OR SPACING (LTN) FOR YOUR APPLICATION.
   4.2 IF SPACER BAR IS USED:
   4.2.1 CLAMP ONE MOUNTING FRAME AT THE UN-NUMBERED REFERENCE POSITION OF THE SPACER BAR. BE SURE THE INDEX PIN AND SPACER BAR INDEX SCREW ENGAGE THE HOLE IN THE SPACER BAR.
   4.2.2 CLAMP THE SECOND MOUNTING FRAME TO THE SPACER BAR IN THE SAME MANNER AT THE INDEX HOLE INDICATED DURING STEP 4.1.
   4.2.3 HOLD THE MOUNTING FRAME/SPACER BAR ASSEMBLY ON THE PIPE AT THE SELECTED LOCATION AND TEMPORARILY SECURE IT TO THE PIPE USING STRAPS FROM THE 1012MS STRAP MOUNTING KIT. GO TO 4.4.
   4.3 IF MOUNTING FRAMES ARE SPACED BY MEASURING "LTN":
   4.3.1 TEMPORARILY SECURE ONE OF THE MOUNTING FRAMES TO THE PIPE USING STRAPS FROM THE 1012MS STRAP MOUNTING KIT.
   4.3.2 MEASURE ALONG THE PIPE AND TEMPORARILY SECURE THE SECOND MOUNTING FRAME TO THE PIPE SO THAT SPACING "LTN" DETERMINED IN STEP 4.1 IS MEASURED BETWEEN THE SPACING MARKS ON THE MOUNTING FRAMES. USE STRAIGHT EDGE OR OTHER MEANS TO ALIGN BOTH MOUNTING FRAMES WITH PIPE AXIS:
   4.4 USE THE MOUNTING GUIDE INCLUDED WITH THE 1012MS STRAP MOUNTING KIT TO TRANSFER ONE OF THE MOUNTING FRAMES TO THE OPPOSITE SIDE OF THE PIPE.
   4.4.1 WRAP THE MOUNTING GUIDE AROUND THE PIPE, POSITION IT SO THAT THE OVERLAPPING LENGTHS ARE EDGE-ALIGNED. MARK THE OVERLAPPED PORTION OF THE GUIDE AT THE EDGE OF THE OVERLAPPING PORTION. REMOVE THE GUIDE, MEASURE THE DISTANCE FROM THE END TO THE MARK AND MARK AGAIN HALFWAY BETWEEN.
   4.4.2 RE-POSITION THE GUIDE ON THE PIPE AND TAPE IN PLACE SO THAT ONE OF THE MARKS INDICATES THE CENTERLINE OF THE INSTALLED MOUNTING FRAMES AND THE MOUNTING GUIDE EDGE IS AGAINST THE END OF ONE OF THE MOUNTING FRAMES. MAKE SURE THE OVERLAPPING LENGTHS OF THE MOUNTING GUIDE ARE EDGE-ALIGNED. THIS ASSURES A DIAMETRICAL TRANSFER OF THE MOUNTING FRAME POSITION.
   4.4.3 LOOSEN THE MOUNTING STRAP ON THE MOUNTING FRAME WITH WHICH THE MOUNTING GUIDE HAS BEEN ALIGNED. ROTATE IT AROUND THE PIPE SURFACE UNTIL IT IS CENTERED ON THE OPPOSITE SIDE MOUNTING GUIDE MARK MADE IN STEP 4.4.1. TIGHTEN THE STRAP, REMOVE THE MOUNTING GUIDE.
   4.5 IF THE PIPE SURFACE IS CLEAN AND SMOOTH, PROCEED TO TRANSDUCER INSTALLATION ON SHT.3. IF PIPE SURFACE NEEDS CONDITIONING; MARK THE MOUNTING FRAME POSITION CAREFULLY, LOOSEN STRAPS AND MOVE THE MOUNTING FRAMES ASIDE. LOCALLY SMOOTH THE PIPE SURFACE IN THE MARKED AREAS USING THE ABRASIVE PAD SUPPLIED. SHIFT THE MOUNTING FRAMES BACK INTO THEIR APPROPRIATE LOCATIONS AND TIGHTEN THE MOUNTING STRAPS SECURELY.

** SEE SHEET 3 FOR INSTRUCTIONS TO COMPLETE TRANSDUCER INSTALLATION.

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 7/7/89
CHK		DATE
ENG		DATE
PROD		DATE
APPD		DATE

CERTIFIED

DATE

CONTROLOTRON
HAUPPAUGE, NY 11788

INSTALLATION, 1011NPFS SERIES DEDICATED PLASTIC BODY TRANSDUCER

SIZE	CODE IDENT NO.		REV.
C	21614	1011NFPS - 7	B

SCALE: NONE | WT. | SHEET 2 OF 4

R14: 1011NFPS-7 rev.B
CN4333

MATING 1012CNF SERIES TRANSDUCER CABLES WITH 1011NFPS SERIES TRANSDUCERS

a) REMOVE PROTECTIVE CAPS.

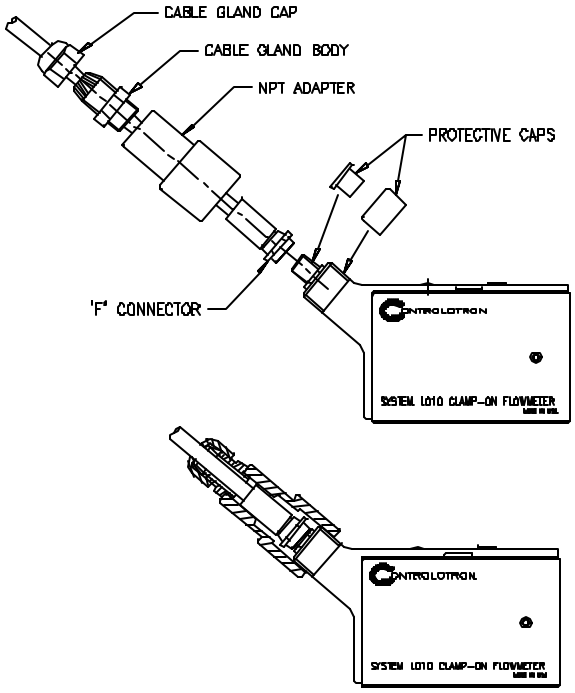
b) SEE APPROPRIATE CABLE ASSEMBLY DRAWING FOR 'F' CONNECTOR, NPT ADAPTER AND GLAND ASSEMBLY DETAIL.

c) MATE 'F' CONNECTORS, CABLES TO TRANSDUCER.

d) FOR BEST WEATHER SEAL, WRAP TEFLON PIPE TAPE (NOT SUPPLIED) AROUND MALE NPT THREADS ON TRANSDUCER HOUSING.

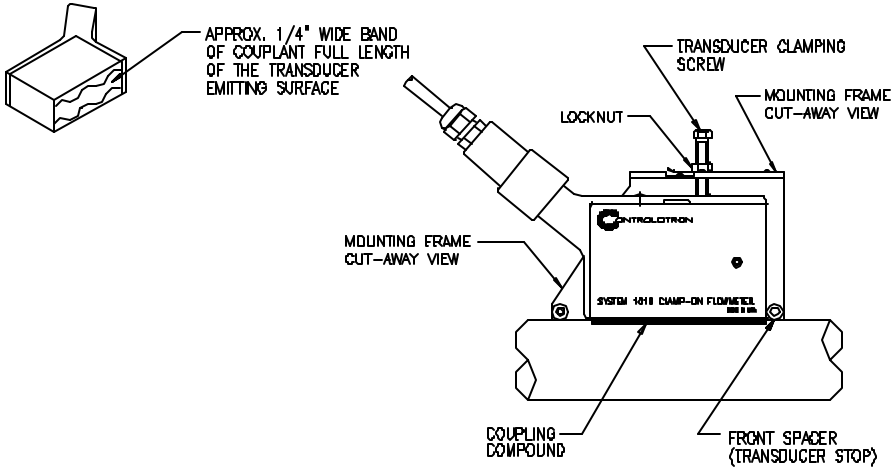
e) SCREW NPT ADAPTER TO TRANSDUCER HOUSING (HAND TIGHT IS SUFFICIENT).

f) TIGHTEN GLAND BODY WITH NPT ADAPTER AND SECURE CABLE BY TIGHTENING GLAND TOP NUT. (HAND TIGHT IS SUFFICIENT).



INSTALLING TRANSDUCERS IN MOUNTING FRAMES

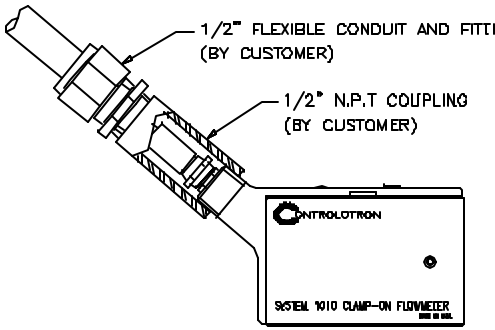
APPLY A THIN BAND OF COUPLANT TO THE EMITTING SURFACE OF THE TRANSDUCERS. SLIP THE TRANSDUCERS INTO THE MOUNTING FRAMES, SEATING THEM SQUARELY ON THE PIPE SURFACE. PUSH FORWARD INTO THE FRAMES AGAINST THE FRONT SPACER. TIGHTEN THE TRANSDUCER CLAMPING SCREW, FIRMLY SEATING THE TRANSDUCERS ON THE PIPE SURFACE. SECURE THE CLAMPING SCREW WITH THE LOCKNUT.



**SEE DRAWING 1012TP-7 FOR INSTALLATION USING 1012TP SERIES MOUNTING TRACKS.

USE OF FLEXIBLE CONDUIT WITH TRANSDUCERS

THE TRANSDUCER WIRING HOUSING HAS INTEGRAL 1/2" N.P.T THREADS TO ACCEPT A CONDUIT COUPLING IF FLEXIBLE CONDUIT IS USED. MAKE CONNECTION AS SHOWN, THEN PASS COUPLING AND CONDUIT OVER THE CABLE, SECURE TO THE TRANSDUCER WIRING HOUSING.



INSTALLATION NOTES – CONT'D FROM SHT. 1 OR SHT. 2

5. MAKE CABLE CONNECTIONS AT FLOW COMPUTER IN ACCORDANCE WITH APPROPRIATE FLOW COMPUTER INSTALLATION DRAWING AND 1010 FIELD MANUAL.

6. SEE DRAWINGS 1012FN-8 AND 1011NFPS-8 FOR MOUNTING FRAME AND TRANSDUCER OUTLINE DIMENSIONS.

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 7/7/98
CHK		DATE
ENG		DATE
PROD		DATE
APPD		DATE

CERTIFIED

DATE

CONTROLOTRON
HAUPPAUGE , NY 11788

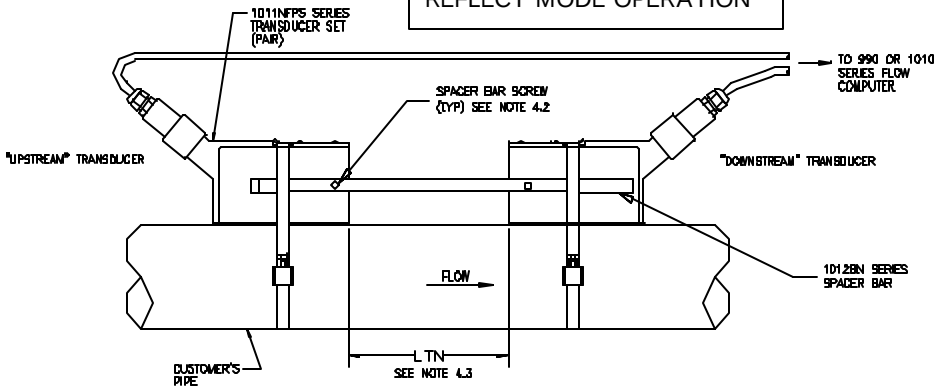
INSTALLATION, 1011NPFS SERIES DEDICATED PLASTIC BODY TRANSDUCER

SIZE	CODE IDENT NO.		REV.
C	21614	1011NFPS - 7	B

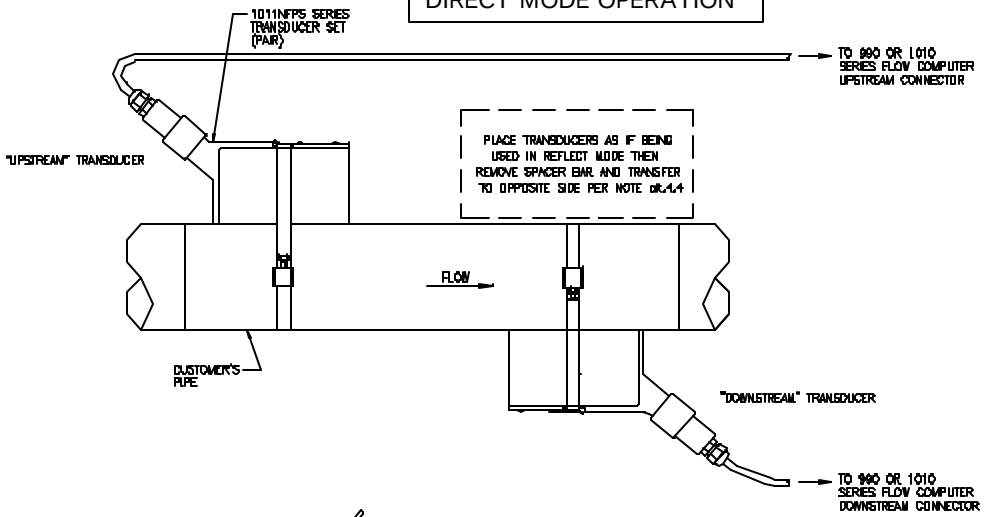
SCALE: NONE | WT. | SHEET 3 OF 4

R14: 1011NFPS-7 rev.B
CN4333

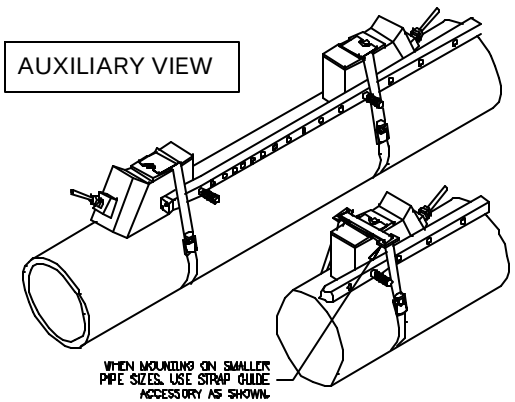
REFLECT MODE OPERATION



DIRECT MODE OPERATION



AUXILIARY VIEW



INSTALLATION OF TRANSDUCERS WITHOUT MOUNTING FRAMES

THE SAME GENERAL NOTES AND PROCEDURES APPLY WHEN INSTALLING TRANSDUCERS WITHOUT THE BENEFIT OF MOUNTING FRAMES. APPLY THE FOLLOWING ALTERNATES TO THE INSTALLATION NOTES ON SHEETS 1 & 2.

4.2 IF SPACER BAR IS USED:

alt.4.2.1 SECURE ONE TRANSDUCER AT THE UN-NUMBERED REFERENCE POSITION OF THE SPACER BAR BY ENGAGING ONE OF THE SCREWS STOWED IN THE SPACER BAR CAP WITH THE THREADED INSERT IN THE SIDE OF THE TRANSDUCER BLOCK.

alt.4.2.2 SECURE THE SECOND TRANSDUCER TO THE SPACER BAR IN THE SAME MANNER AT THE INDEX HOLE INDICATED DURING STEP 4.1.

alt.4.2.3 HOLD TRANSDUCER/SPACER BAR ASSEMBLY ON THE PIPE AT THE SELECTED LOCATION AND TEMPORARILY SECURE IT TO THE PIPE USING STRAPS FROM THE 1012NS STRAP MOUNTING KIT.

4.3 IF TRANSDUCERS ARE SPACED BY MEASURING "LTN":

alt.4.3.1 TEMPORARILY SECURE ONE OF THE TRANSDUCERS TO THE PIPE USING STRAPS FROM THE 1012NS STRAP MOUNTING KIT.

alt.4.3.2 MEASURE ALONG THE PIPE AND TEMPORARILY SECURE THE SECOND TRANSDUCER TO THE PIPE SO THAT SPACING "LTN" DETERMINED IN STEP 4.1 IS MEASURED BETWEEN THE SPACING MARKS ON THE FRONT FACES OF THE TRANSDUCERS. USE A STRAIGHT EDGE OR OTHER MEANS TO ALIGN BOTH TRANSDUCERS WITH THE PIPE AXIS.

FOR REFLECT MODE INSTALLATION GO TO STEP alt.4.5
FOR DIRECT MODE INSTALLATION CONTINUE WITH alt.4.4

alt.4.4 USE THE MOUNTING GUIDE INCLUDED WITH THE 1012N5 STRAP MOUNTING KIT TO TRANSFER ONE OF THE TRANSDUCERS TO THE OPPOSITE SIDE OF THE PIPE. (SEE SHEET 2, ZONE A4)

alt.4.4.1 WRAP THE MOUNTING GUIDE AROUND THE PIPE. POSITION IT SO THAT THE OVERLAPPING LENGTHS ARE EDGE-ALIGNED, MARK THE OVERLAPPED PORTION OF THE GUIDE AT THE EDGE OF THE OVERLAPPING PORTION. REMOVE THE GUIDE, MEASURE THE DISTANCE FROM THE END TO THE MARK AND MARK AGAIN HALFWAY BETWEEN.

alt.4.4.2 RE-POSITION THE GUIDE ON THE PIPE AND TAPE IN PLACE SO THAT ONE OF THE MARKS INDICATES THE CENTERLINE OF THE INSTALLED TRANSDUCER AND THE MOUNTING GUIDE EDGE IS AGAINST THE END OF ONE OF THE TRANSDUCERS. MAKE SURE THE OVERLAPPING LENGTHS OF THE MOUNTING GUIDE ARE EDGE-ALIGNED. THIS ASSURES A DIAMETRICAL TRANSFER OF THE TRANSDUCER POSITION.

alt.4.4.3 LOOSEN THE MOUNTING STRAP ON THE TRANSDUCER WITH WHICH THE MOUNTING GUIDE HAS BEEN ALIGNED, ROTATE IT AROUND THE PIPE SURFACE UNTIL IT IS CENTERED ON THE OPPOSITE SIDE MOUNTING GUIDE MARK MADE IN STEP alt.4.4.1. TIGHTEN THE STRAP. REMOVE THE MOUNTING GUIDE.

alt.4.5 WITH THE TRANSDUCERS TEMPORARILY STRAPPED IN PLACE, MARK THE PIPE SURFACE AT THE TRANSDUCER PERIMETER. REMOVE THE TRANSDUCERS FROM THE PIPE. IF THE PIPE SURFACE IS CLEAN AND SMOOTH, PROCEED TO STEP alt.4.6. IF THE PIPE SURFACE NEEDS CONDITIONING, LOCALLY SMOOTH THE SURFACE IN THE MARKED AREAS USING THE ABRASIVE PAD SUPPLIED. DO NOT OBSCURE THE MARKED TRANSDUCER LOCATIONS.

alt.4.6 APPLY A THIN BAND OF COUPLANT TO THE EMITTING SURFACE OF BOTH TRANSDUCERS. CAREFULLY REPLACE THE TRANSDUCERS ON THE PIPE, REPEATING THE PROCEDURE ABOVE, IF REQUIRED, TO ASSURE ACCURATE POSITIONING.

CONTINUE WITH INSTALLATION NOTE 5 AND CABLE CONNECTING INSTRUCTIONS ON SHEET 3.

DO NOT SCALE THIS DRAWING

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES (MM)
TOLERANCES ON-

INCHES	(MM)
± .1	± 2

CONTRACT NO.

DR	HJ	DATE 7/7/89
CHK		DATE
ENG		DATE
PROD		DATE
APPD		DATE

CERTIFIED

DATE

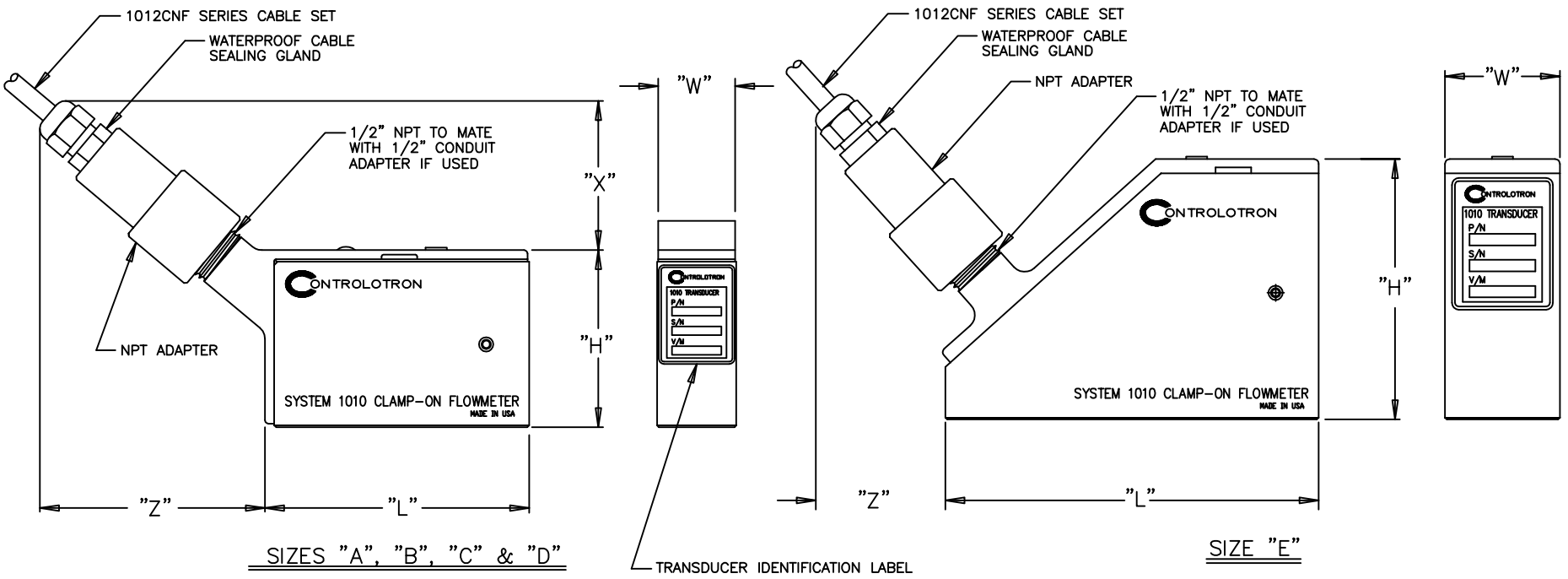
CONTROLOTRON
HAUPPAUGE, NY 11788

INSTALLATION, 1011NFPS SERIES DEDICATED PLASTIC BODY TRANSDUCER

SIZE	CODE IDENT NO.		REV.
C	21614	1011NFPS - 7	B

SCALE: NONE | WT. | SHEET 4 OF 4

R14: 1011NFPS-7 rev.B
CN4333



TRANSDUCER PART NUMBER	L	H	W	X	Z	NET WT. (PAIR)
1011NFPS-A1/2 1011GCNFPS-A1/2	1.9(47)	1.4(36)	1.0 (25)	1.9 (48)	2.1 (53)	0.4 # (0.2kg)
1011NFPS-B1/2/3 1011GCNFPS-B1/2/3	1.9(47)	1.4(36)	1.0 (25)	1.9 (48)	2.1 (53)	0.4 # (0.2kg)
1011NFPS-C1/2/3 1011GCNFPS-C1/2/3	3.1(79)	2.2(55)	1.4 (35)	1.9 (48)	2.1 (53)	1.0 # (0.5kg)
1011NFPS-D1/2/3 1011GCNFPS-D1/2/3	4.6(117)	3.0 (77)	1.4 (35)	1.9 (48)	2.1 (53)	2.1 # (1.0kg)
1011NFPS-E1/2/3 1011GCNFPS-E1/2/3	6.5 (165)	4.5 (114)	2.0 (51)	———	1.4 (40)	2.5 # (1.1kg)

NOTES:

1. TRANSDUCERS ARE SUPPLIED IN MATCHED PAIRS,BOTH TRANSDUCERS OF A PAIR HAVE THE SAME SERIAL NUMBER.
2. SEE THE APPROPRIATE TRANSDUCER INSTALLATION DRAWING FOR COMPLETE INSTALLED DIMENSIONS.

DO NOT SCALE THIS DRAWING

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES (MM) TOLERANCES ON-

INCHES-	(MM)-
+/- 0.1	+/- 2

CONTRACT NO.

DR	H.J.	DATE 7/7/99
CHK		DATE
ENG		DATE
PROD		DATE
APPD		DATE

CERTIFIED

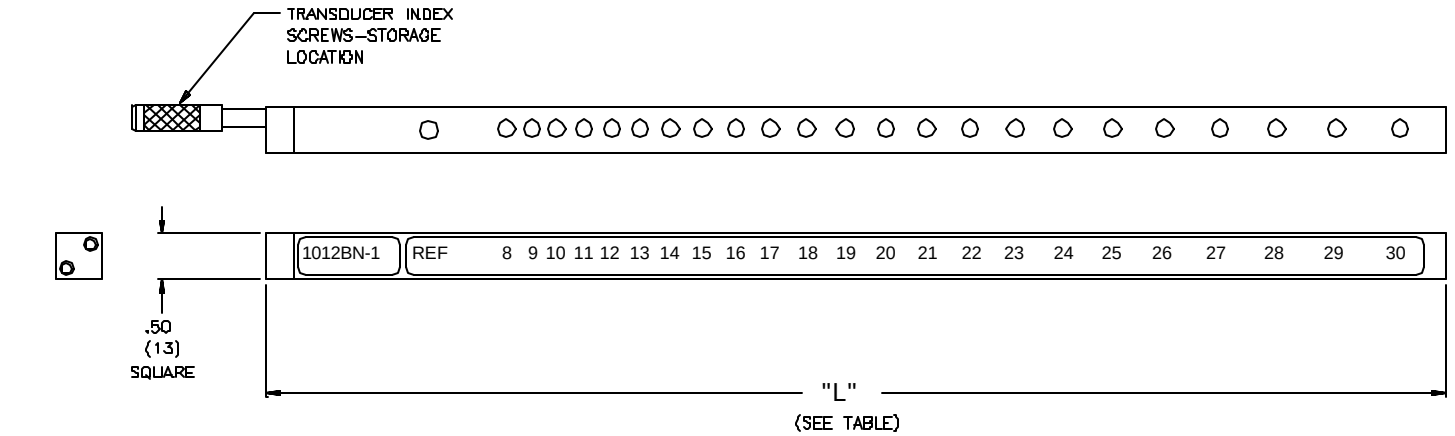
DATE

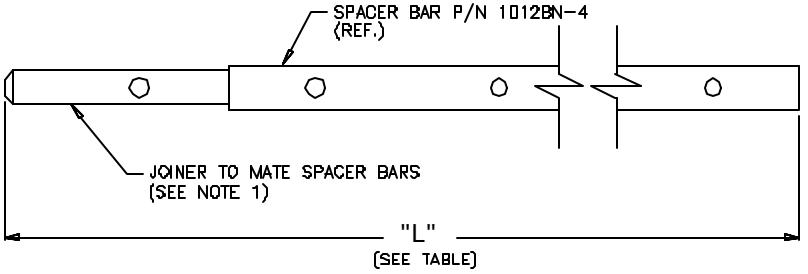
CONTROLOTRON
HAUPPAUGE , NY 11788

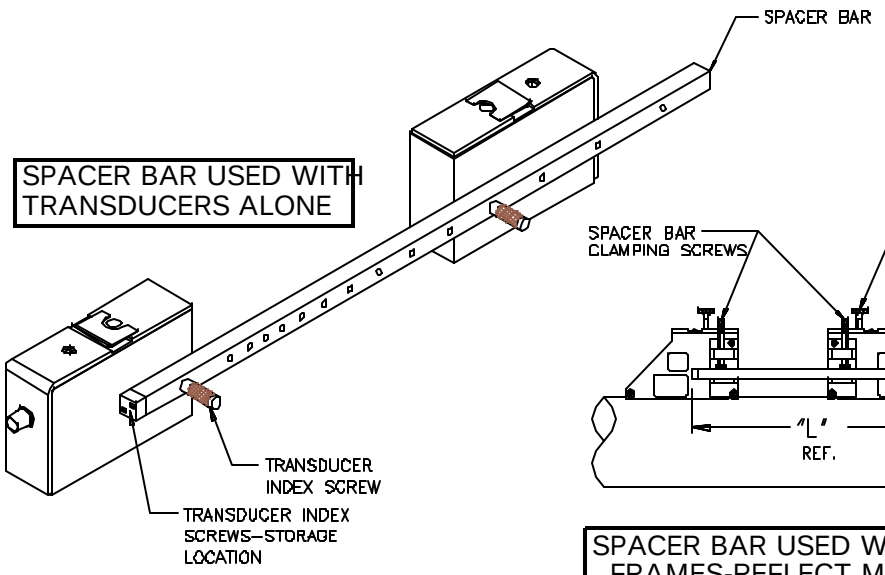
OUTLINE DIMENSIONS 1011NFPS SERIES DEDICATED PLASTIC BODY TRANSDUCERS

SIZE	CODE IDENT NO.		REV.
C	21614	1011NFPS-8	B1
SCALE: NONE	WT.		SHEET 1 of 1

CN4995







SPACER BAR USED WITH TRANSDUCERS ALONE

SPACER BAR USED WITH MOUNTING FRAMES-REFLECT MODE SHOWN

	SPACER BAR PART NUMBER	"L"	PIPE O.D.RANGE (SEE NOTE 2)
(SHOWN)	1012BN–1	13.16 (334)	UP TO 8" (203)
	1012BN–2	25.87 (657)	UP TO 18" (457)
	1012BN–3	40.47 (1028)	UP TO 30" (762)
	1012BN–4	27.05 (687)	UP TO 48" (1219)

NOTES:

1. SPACER BAR PART NUMBER 1012BN–4 MUST BE USED IN CONJUNCTION WITH SPACER BAR PART NUMBER 1012BN–3.
2. PIPE O.D. RANGES ARE NOMINAL VALUES. ACTUAL DIAMETER LIMITS ARE DEPENDENT ON TRANSDUCER USED, APPLICATION PIPE AND LIQUID.

DO NOT SCALE THIS DRAWING

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES (MM) TOLERANCES ON-
INCHES- +/- .1 (MM)- +/- 2

CONTRACT NO.

DR HJ DATE 8/11/98
CHK DATE
ENG DATE
PROD DATE
APP'D DATE

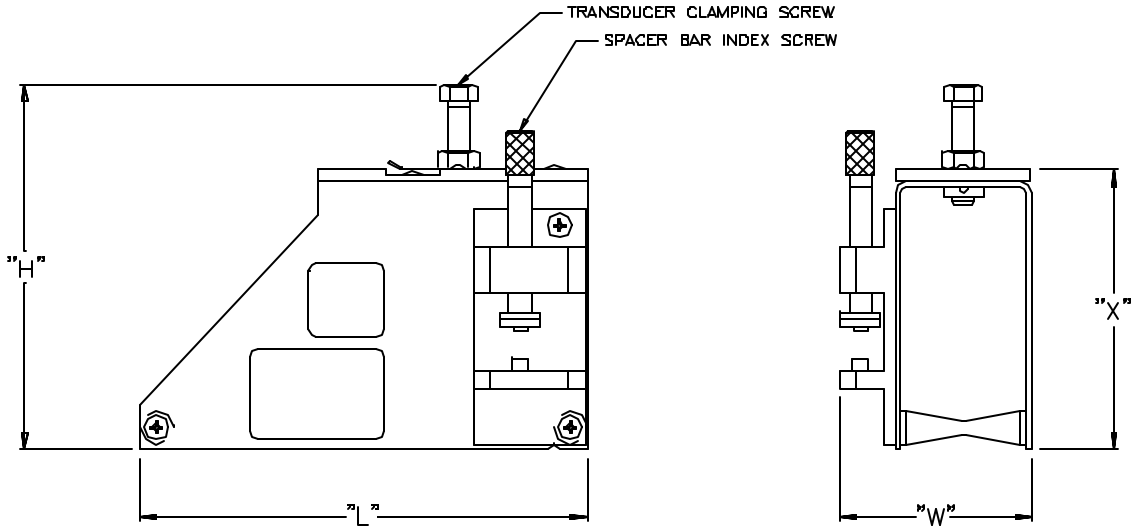
CERTIFIED
DATE

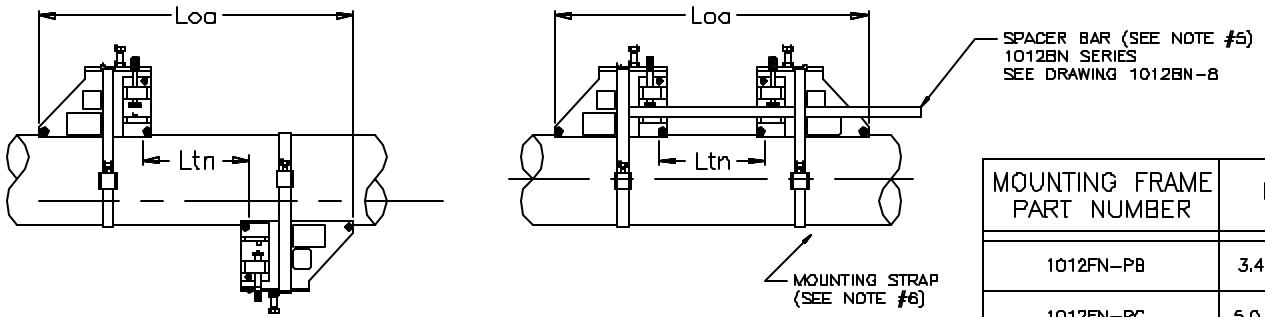
CONTROLOTRON
HAUPPAUGE, NY 11788

OUTLINE DIMENSIONS 1010 SERIES SPACER BAR

SIZE	CODE IDENT NO.		REV.
C	21614	1012BN-8	B
SCALE: NONE	VT.	SHEET 1 OF 1	

R14: 1012BN–8
ECN#3980





DIRECT MODE REFLECT MODE

INSTALLED ON PIPE

MOUNTING FRAME PART NUMBER	L	W	H	X	Loa
1012FN-PB	3.4 (86)	1.8 (46)	3.4 (86)	2.4 (61)	Ltn +6.0 (153)
1012FN-PC	5.0 (127)	2.2 (56)	4.1 (104)	3.1 (79)	Ltn +9.3 (236)
1012FN-PD	6.3 (160)	2.2 (56)	4.9 (124)	3.9 (100)	Ltn +11.8 (300)
1012FN-PE	8.0 (203)	2.8 (71)	6.3 (160)	5.3 (135)	Ltn +15.3 (389)

NOTES :

1. TRANSDUCER MOUNTING FRAMES ARE SUPPLIED IN SETS OF TWO.
2. MOUNTING CHAINS OR STRAPS ARE SUPPLIED SEPARATELY.
3. Ltn IS SPACING BETWEEN TRANSDUCERS. Ltn VARIES WITH APPLICATION.
4. Loa IS OVERALL INSTALLED LENGTH ON PIPE.
5. TRANSDUCERS MAY BE SPACED BY Ltn OR BY SPACER BAR INDEX NUMBER.
6. MOUNTING STRAP KIT SHOWN, SEE APPROPRIATE INSTALLATION DRAWING FOR OTHER MOUNTING KIT OPTIONS.

DO NOT SCALE THIS DRAWING

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES TOLERANCES ON- INCHES +/- .1 (MM) +/- 2

CONTRACT NO.

DR H.J DATE 9/16/97
CHK DATE
ENG DATE
PROJ DATE
APPD DATE

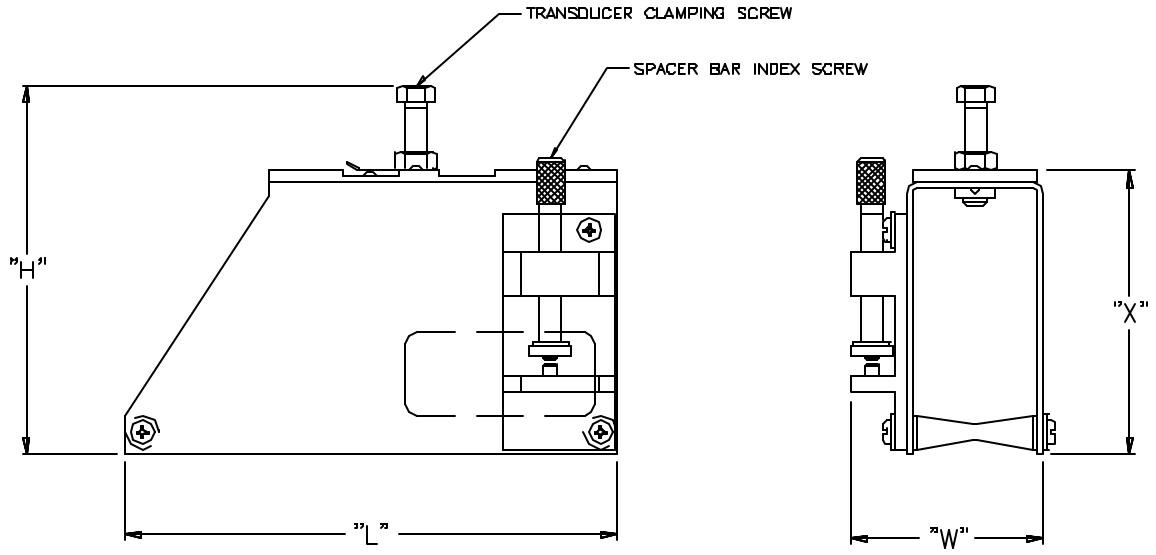
CERTIFIED
DATE

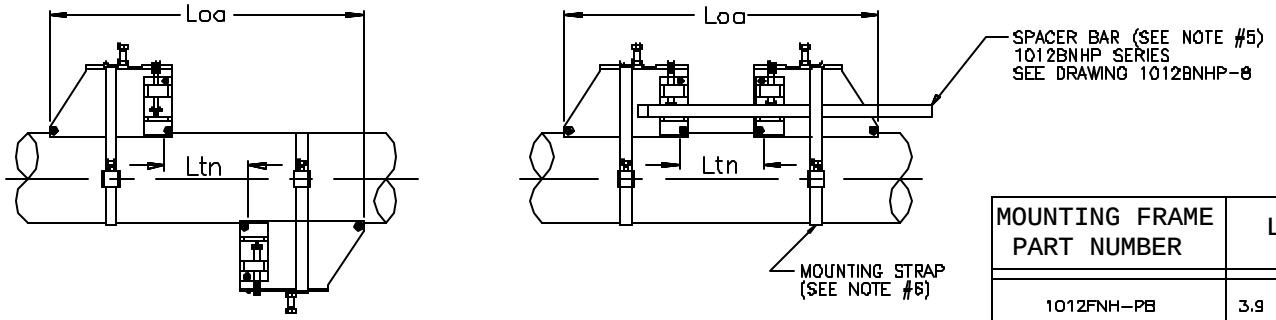
CONTROLOTRON
HAUPPAUGE, NY 11788

OUTLINE DIMENSIONS 1011 SERIES DEDICATED TRANSDUCER MTG. FRAMES

SIZE	CODE IDENT NO.		REV.
C	21614	1012FN-8	B
SCALE: NONE	WT.	SHEET 1 of 1	

R14: 1012FN-8
ER#1315 ECN#3849





DIRECT MODE

REFLECT MODE

INSTALLED ON PIPE

MOUNTING FRAME PART NUMBER	L	W	H	X	Loa
1012FNH-PB	3.9 (100)	1.8 (46)	3.4 (86)	2.5 (63)	Ltn + 6.3 (162)
1012FNH-PC	5.5 (140)	2.0 (51)	4.1 (104)	3.2 (81)	Ltn + 10.2 (260)
1012FNH-PD	8.8 (224)	2.7 (69)	5.7 (145)	4.8 (122)	Ltn + 16.6 (420)

NOTES :

1. TRANSDUCER MOUNTING FRAMES ARE SUPPLIED IN SETS OF TWO.
2. MOUNTING STRAPS OR CHAINS ARE SUPPLIED SEPARATELY.
3. Ltn IS SPACING BETWEEN TRANSDUCERS. Ltn VARIES WITH APPLICATION.
4. Loa IS OVERALL INSTALLED LENGTH ON PIPE.
5. TRANSDUCERS MAY BE SPACED BY Ltn OR BY SPACER BAR INDEX NUMBER.
6. MOUNTING STRAP KIT SHOWN,SEE APPROPRIATE INSTALLATION DRAWING FOR OTHER MOUNTING KIT OPTIONS.

DO NOT SCALE THIS DRAWING

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES TOLERANCES ON-

INCHES	(MM)
+/- .1	+/- 2

CONTRACT NO.

DR HJ DATE 3/6/97
CHK DATE
ENG DATE
PROD DATE
APP'D DATE

CERTIFIED

DATE

CONTROLOTRON
HAUPPAUGE , NY 11788

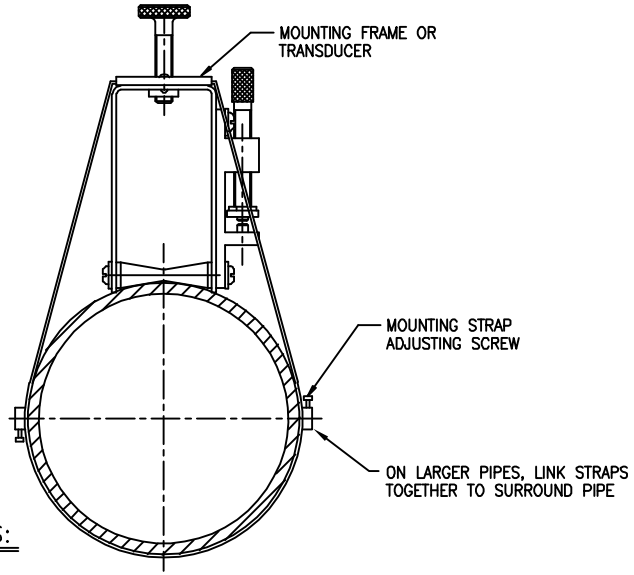
OUTLINE DIMENSIONS 1011HN SERIES DEDICATED TRANSDUCER MTG. FRAMES

SIZE	CODE IDENT NO.		REV.
C	21614	1012FNH-8	A
SCALE: NONE	VT.	SHEET 1 OF 1	

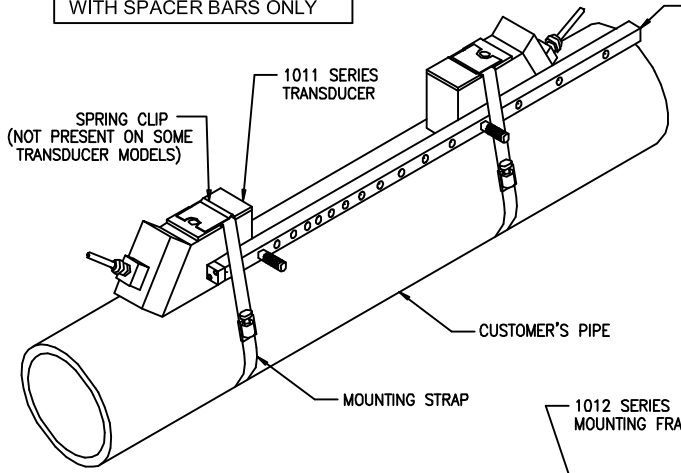
R14: 1012FNH-8
ER#1268

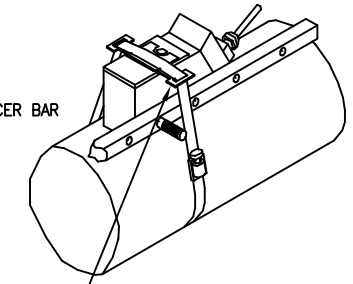
INSTALLATION PROCEDURE

MOUNTING STRAP KITS ARE TO FASTEN TRANSDUCERS OR MOUNTING FRAMES TO THE PIPE.

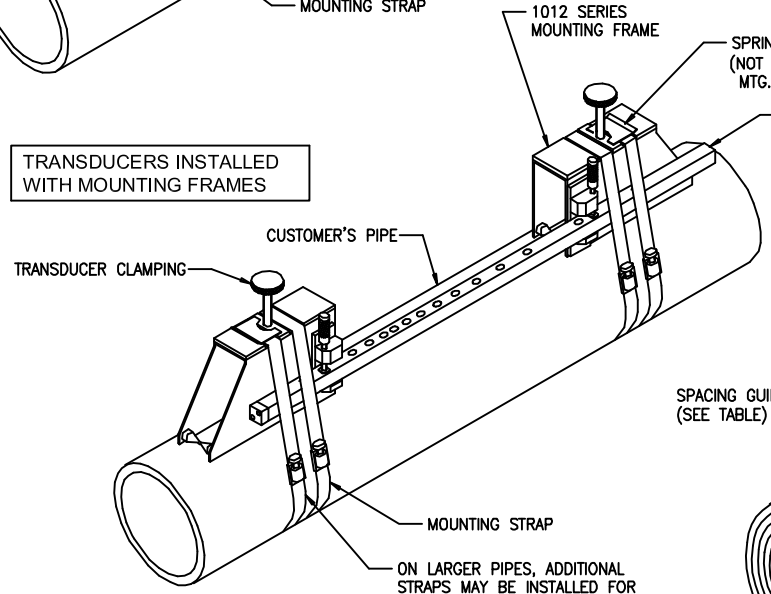


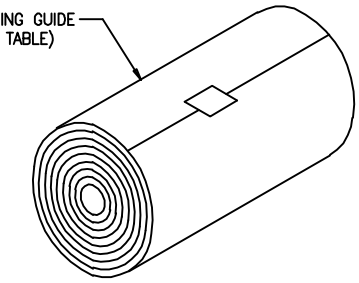
TRANSDUCERS INSTALLED WITH SPACER BARS ONLY





TRANSDUCERS INSTALLED WITH MOUNTING FRAMES





NOTES:

1. WRAP THE MOUNTING STRAP AROUND THE PIPE, PULL TAUT AND ENGAGE THE END OF MOUNTING STRAP WITH THE MOUNTING STRAP ADJUSTING SCREW.
2. TIGHTEN THE ADJUSTING SCREW TO SECURE THE ASSEMBLY TO THE PIPE.
3. TO SURROUND LARGER PIPES, LINK MOUNTING STRAP SECTIONS TOGETHER AS SHOWN.

STRAP MTG. KIT PART No.	PIPE DIA.	BAND SIZE (QTY)	SPACING GUIDE P/N (DESCRIPTION)	KIT NET WT.
1012MS-1A	2"-7"	#88 (2) #128 (2)	1012-145-1A (2" x 26")	
1012MS-1	2"-13"	#88 (2) #152 (2)	1012-145-1 (2" x 45")	
1012MS-2	13"-24"	#188 (2) #280 (2)	1012-145-2 (4" x 81")	
1012MS-3	24"-48"	#152 (4) #312 (4)	1012-145-3 (4" x 155")	
1012MS-4	48"-60"	36' OF 1/2" BAND AND FASTENER	1012-145-4 (6" x 196")	
1012MS-5	60"-84'	46' OF 1/2" BAND AND FASTENER	NOT SUPPLIED	
1012MS-6	84"-120"	65' OF 1/2" BAND AND FASTENER	NOT SUPPLIED	
1012MS-7	120"-216"	116' OF 1/2" BAND AND FASTENER	NOT SUPPLIED	
1012MS-8	216"-360"	190' OF 1/2" BAND AND FASTENER	NOT SUPPLIED	

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 2/14/97
CHK		DATE
ENG		DATE
PROD		DATE
APPD		DATE

CERTIFIED

DATE

CONTROLOTRON
HAUPPAUGE , NY 11788

INSTALLATION / OUTLINE ADJUSTABLE MOUNTING STRAP

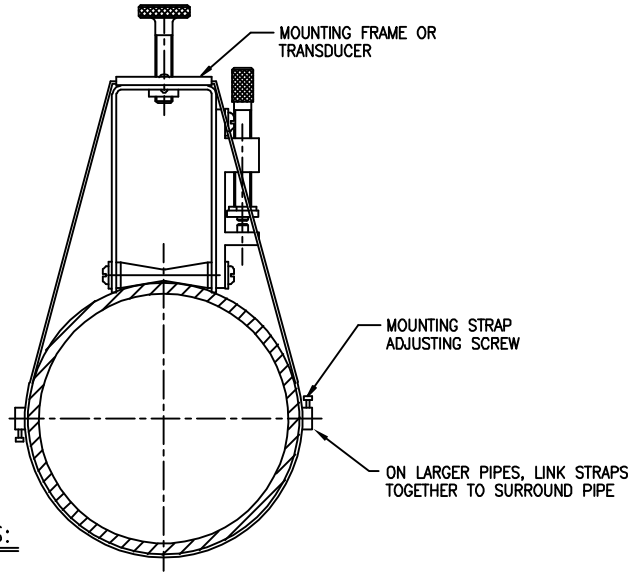
SIZE	CODE IDENT NO.		REV.
C	21614	1012MS - 8	F

SCALE: NONE | WT. | SHEET 1 OF 2

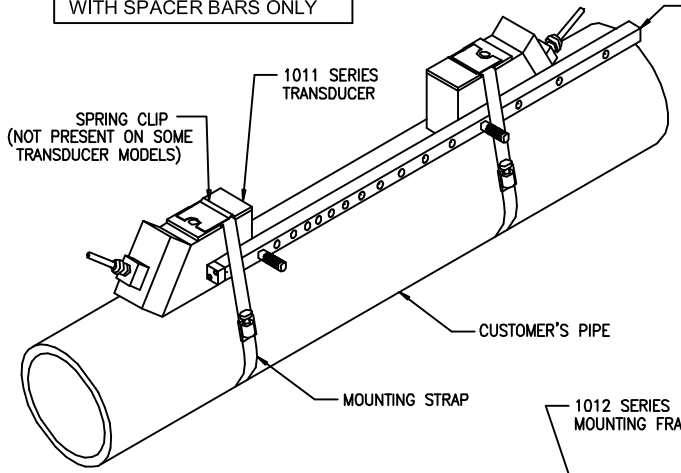
R14: 1012MS-8 sht.1 rev.F
ECN#3974, ECN#4022

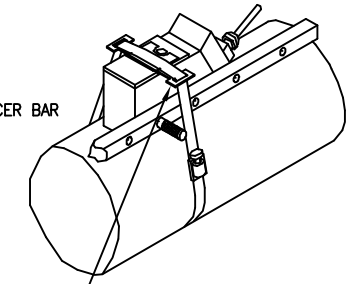
INSTALLATION PROCEDURE

MOUNTING STRAP KITS ARE TO FASTEN TRANSDUCERS OR MOUNTING FRAMES TO THE PIPE.

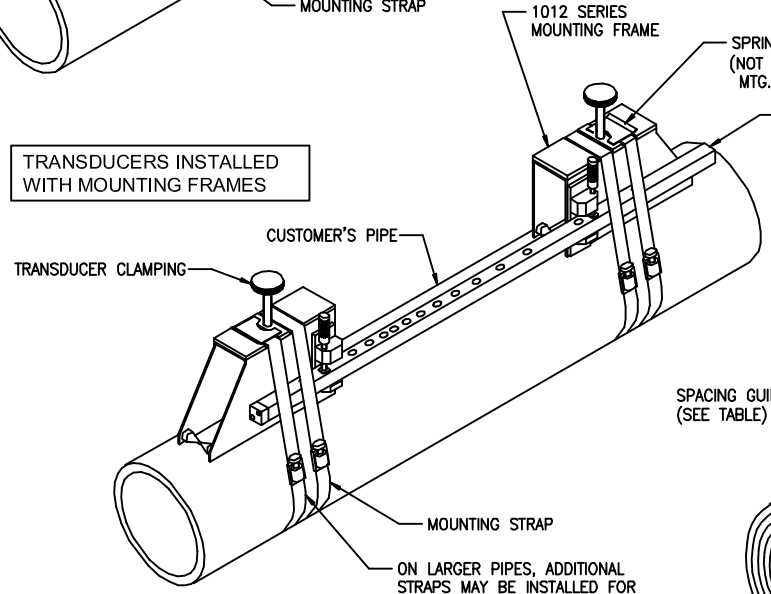


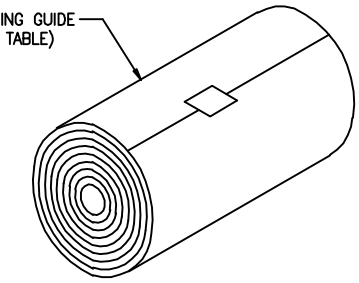
TRANSDUCERS INSTALLED WITH SPACER BARS ONLY





TRANSDUCERS INSTALLED WITH MOUNTING FRAMES





NOTES:

1. WRAP THE MOUNTING STRAP AROUND THE PIPE, PULL TAUT AND ENGAGE THE END OF MOUNTING STRAP WITH THE MOUNTING STRAP ADJUSTING SCREW.
2. TIGHTEN THE ADJUSTING SCREW TO SECURE THE ASSEMBLY TO THE PIPE.
3. TO SURROUND LARGER PIPES, LINK MOUNTING STRAP SECTIONS TOGETHER AS SHOWN.

STRAP MTG. KIT PART No.	PIPE DIA.	BAND SIZE (QTY)	SPACING GUIDE P/N (DESCRIPTION)	KIT NET WT.
1012MS-1A	2"-7"	#88 (2) #128 (2)	1012-145-1A (2" x 26")	
1012MS-1	2"-13"	#88 (2) #152 (2)	1012-145-1 (2" x 45")	
1012MS-2	13"-24"	#188 (2) #280 (2)	1012-145-2 (4" x 81")	
1012MS-3	24"-48"	#152 (4) #312 (4)	1012-145-3 (4" x 155")	
1012MS-4	48"-60"	36' OF 1/2" BAND AND FASTENER	1012-145-4 (6" x 196")	
1012MS-5	60"-84'	46' OF 1/2" BAND AND FASTENER	NOT SUPPLIED	
1012MS-6	84"-120"	65' OF 1/2" BAND AND FASTENER	NOT SUPPLIED	
1012MS-7	120"-216"	116' OF 1/2" BAND AND FASTENER	NOT SUPPLIED	
1012MS-8	216"-360"	190' OF 1/2" BAND AND FASTENER	NOT SUPPLIED	

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 2/14/97
CHK		DATE
ENG		DATE
PROD		DATE
APPD		DATE

CERTIFIED

DATE

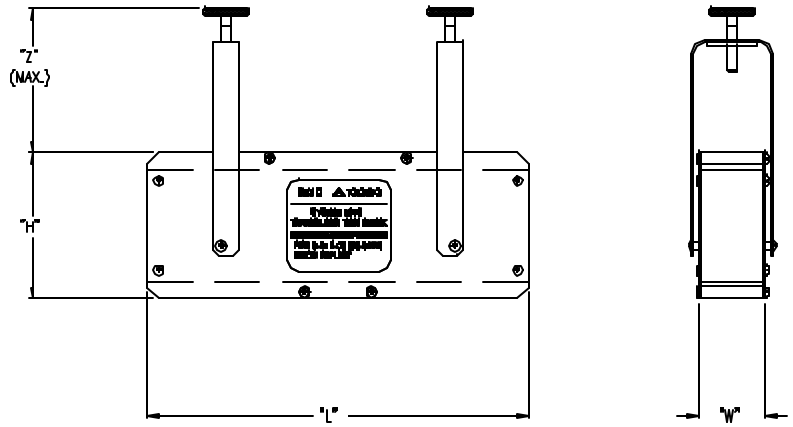
CONTROLOTRON
HAUPPAUGE , NY 11788

INSTALLATION / OUTLINE ADJUSTABLE MOUNTING STRAP

SIZE	CODE IDENT NO.		REV.
C	21614	1012MS - 8	F

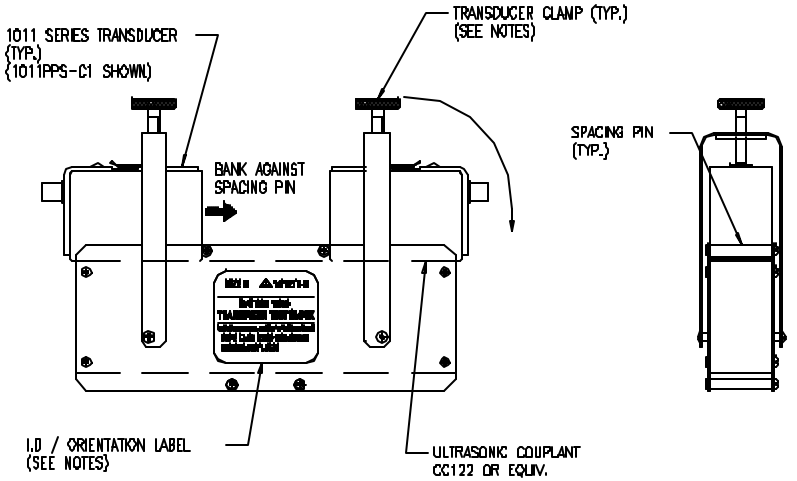
SCALE: NONE | WT. | SHEET 1 OF 2

R14: 1012MS-8 sht.1 rev.F
ECN#3974, ECN#4022



TEST BLOCK PART No.	"L"	"H"	"W"	"Z"	USED ON 1011N, 1011P TRANSDUCER SIZE
1012TB-1	4.41 (112.0)	1.52 (38.6)	1.06 (26.9)	2.62 (66.5)	A , B
1012TB-2	8.51 (216.1)	3.26 (82.8)	1.48 (37.6)	4.38 (111.2)	C , D

(SHOWN)



NOTES:

1. SEE FIELD MANUAL FOR FLOW COMPUTER SET-UP FOR TRANSDUCER TEST.
2. ROTATE TRANSDUCER CLAMP 180° FOR INSTALLATION OF LARGER TRANSDUCERS FOR TEST.
3. NOTE ORIENTATION OF LABEL BEFORE INSTALLING TRANSDUCERS FOR TEST.

DO NOT SCALE THIS DRAWING

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES (MM) TOLERANCES ON-

INCHES	(MM)
± .1	± 2

CONTRACT NO.

DR HJ DATE 1/4/17
CHK DATE
ENG DATE
PROD DATE
APPD DATE

CERTIFIED

DATE

CONTROLOTRON
HAUPPAUGE , NY 11788

INSTALLATION/OUTLINE 1011 SERIES TEST BLOCK

SIZE	CODE IDENT NO.		REV.
C	21614	1012TB - 8	B

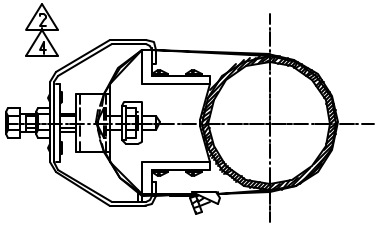
SCALE: NONE WT. SHEET 1 OF 1

R14: 1012TB-8 sht.1 rev.B
ER#1311

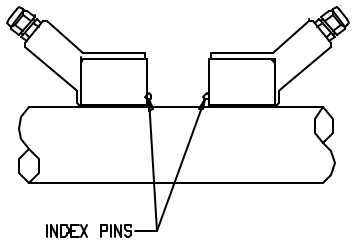
REFLECT MODE INSTALLATION

1011N UNIVERSAL TRANSDUCER AND TRACK

SELECT AND PREPARE THE TRANSDUCER MOUNTING LOCATION, SECURE TRACKS TO PIPE WITH STRAP

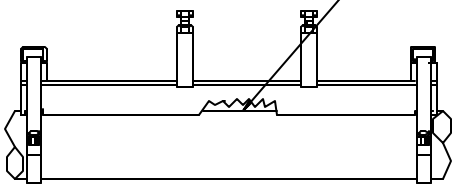


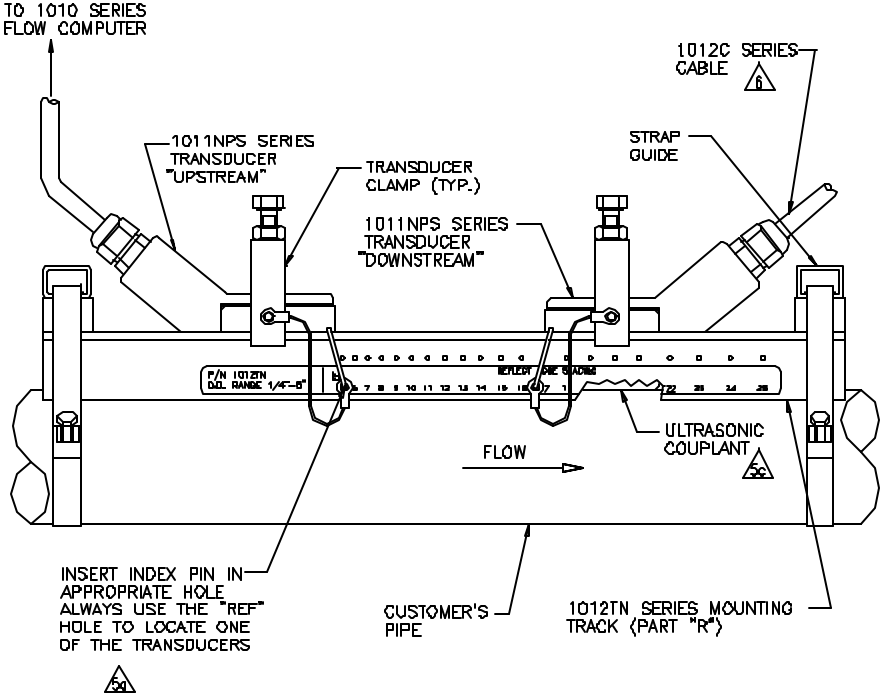
TRANSDUCER INDEX PIN ORIENTATION



ORIENTATION OF PROPERLY INSTALLED TRANSDUCERS IN REFLECT MODE OPERATION

CONDITION PIPE SURFACE AT THE TRANSDUCER MOUNTING LOCATION USING THE ABRASIVE PAD SUPPLIED. 3





INSTALLATION PROCEDURE – SEE DRAWING REFERENCES 4

1. USING THE INSTALLATION MENU PROCEDURES PRESENTED IN THE 1010 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.
   d) CONDITION PIPE SURFACE; LOCALLY SMOOTH THE PIPE SURFACE TO ACCEPT THE TRANSDUCERS. USE THE ABRASIVE PAD PROVIDED.
4. MOUNT TRACK ON PIPE;
   a) PLACE TRACK RAIL ASS'Y (ASS'Y WITH STRAP) AGAINST PIPE. WHILE HOLDING TRACK, WRAP STRAP AROUND PIPE AND TIGHTEN.
   b) 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 STRAP.
5. LOCATE TRANSDUCERS;
   a) CONSULTING THE 1010 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.
6. MAKE TRANSDUCER CABLE CONNECTIONS IN ACCORDANCE WITH THE APPROPRIATE FLOW COMPUTER INSTALLATION DRAWING AND 1010 FIELD MANUAL.
7. SEE DRAWING 1012TN-8 AND 1011NPS-8 FOR TRACK AND TRANSDUCER OUTLINE DIMENSIONS.

DO NOT SCALE THIS DRAWING

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES (MM) TOLERANCES ON-

INCHES	(MM)
+/- .1	+/- 1

CONTRACT NO.

DR	H.J	DATE 8/10/98
CHK		DATE
ENG		DATE
PROD		DATE
APPD		DATE

CERTIFIED

DATE

CONTROLOTRON
HAUPPAUGE, NY 11788

INSTALLATION DRAWING 1010 SERIES TRANSDUCERS AND MOUNTING TRACKS

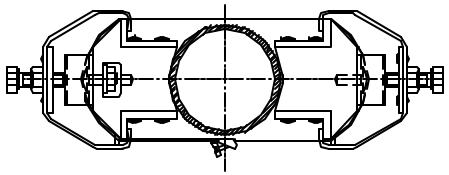
SIZE	CODE IDENT NO.		REV.
C	21614	1012TN-7	A
SCALE: NONE	VT.	SHEET 1 OF 2	

R14: 1012TN-7A rev.A

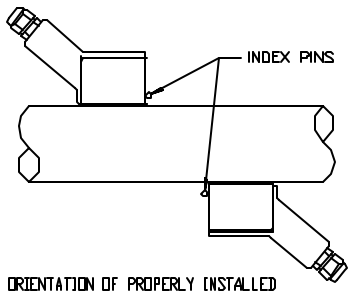
DIRECT MODE INSTALLATION

1011N UNIVERSAL TRANSDUCER AND TRACK

SELECT AND PREPARE THE TRANSDUCER MOUNTING LOCATION, SECURE TRACKS TO PIPE WITH STRAP

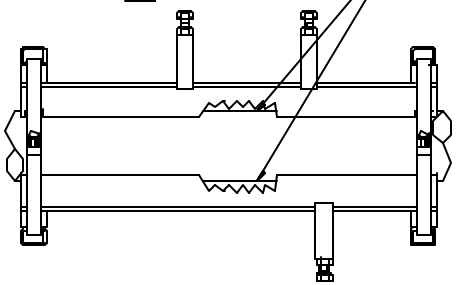


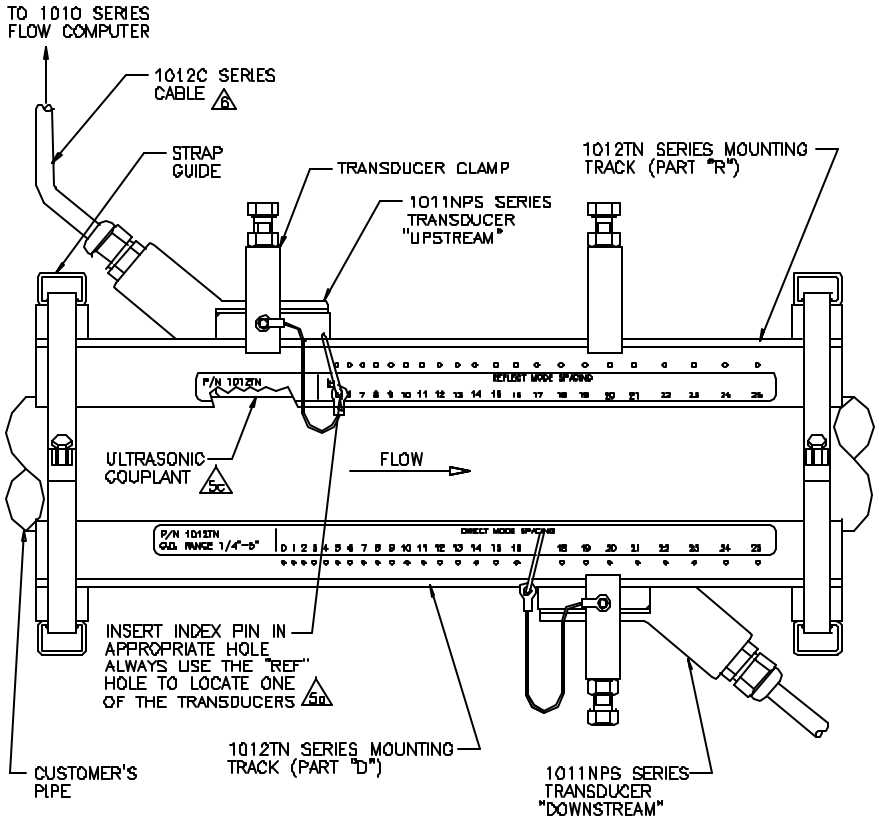
TRANSDUCER INDEX PIN ORIENTATION



ORIENTATION OF PROPERLY INSTALLED TRANSDUCERS IN DIRECT MODE OPERATION

CONDITION PIPE SURFACE AT THE TRANSDUCER MOUNTING LOCATION USING THE ABRASIVE PAD SUPPLIED.





INSTALLATION PROCEDURE – SEE DRAWING REFERENCES

1. USING THE INSTALLATION MENU, PROCEDURES PRESENTED IN THE 1010 FIELD MANUAL, CONFIRM THAT YOU HAVE THE APPROPRIATE TRANSDUCERS AND TRACK FOR DIRECT 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.
   d) CONDITION PIPE SURFACE;
   LOCALLY SMOOTH THE PIPE SURFACE TO ACCEPT THE TRANSDUCERS. USE THE ABRASIVE PAD PROVIDED.

4. MOUNT TRACK ON PIPE;
   a) PLACE TRACK RAIL ASS'Y (ASS'Y WITH STRAP) AGAINST PIPE. WHILE HOLDING TRACK, PLACE THE SECOND TRACK ONTO THE PIPE AND HOLD TOGETHER IN PLACE.
   b) 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 STRAP.

5. LOCATE TRANSDUCERS;
   a) CONSULTING THE 1010 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.

6. MAKE TRANSDUCER CABLE CONNECTIONS IN ACCORDANCE WITH THE APPROPRIATE FLOW COMPUTER INSTALLATION DRAWING AND 1010 FIELD MANUAL.

7. SEE DRAWING 1012TN-8 AND 1011NPS-8 FOR TRACK AND TRANSDUCER OUTLINE DIMENSIONS.

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 6/10/98
CHK		DATE
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PROD		DATE
APPD		DATE

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DATE

CONTROLOTRON
HAUPPAUGE , NY 11788

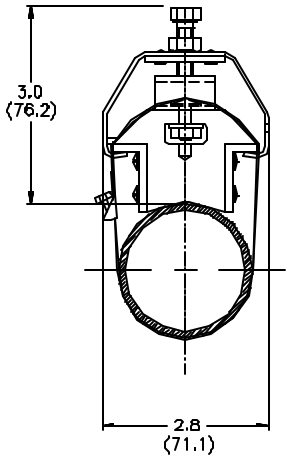
INSTALLATION DRAWING 1010 SERIES TRANSDUCERS AND MOUNTING TRACKS

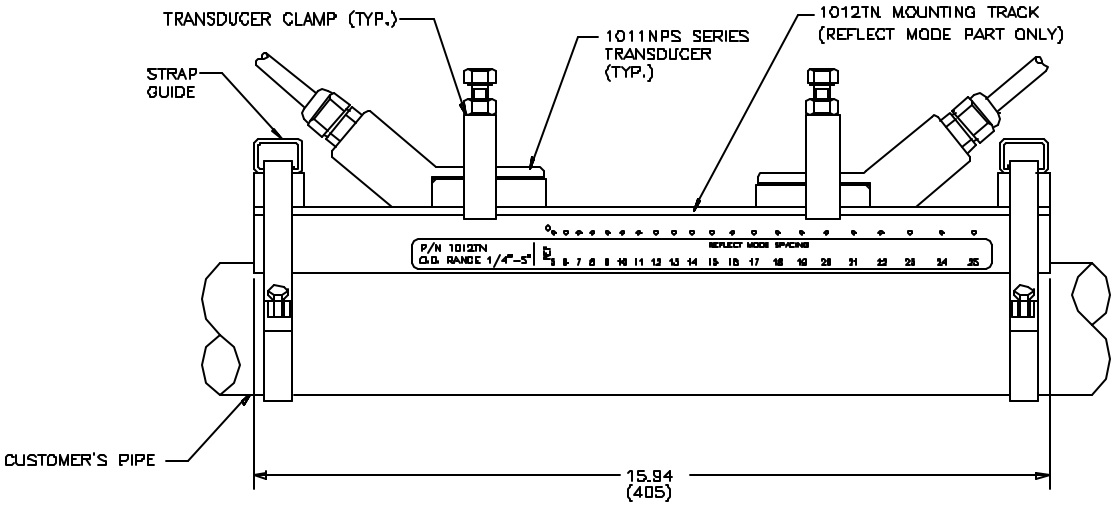
SIZE	CODE IDENT NO.		REV.
C	21614	1012TN-7	A

SCALE: NONE | VT. | SHEET 2 OF 2

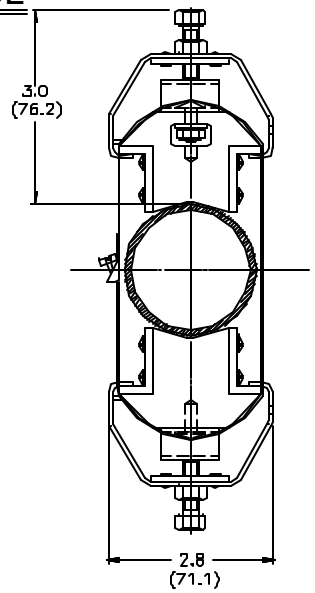
R14: 1012TN-7B rev.A

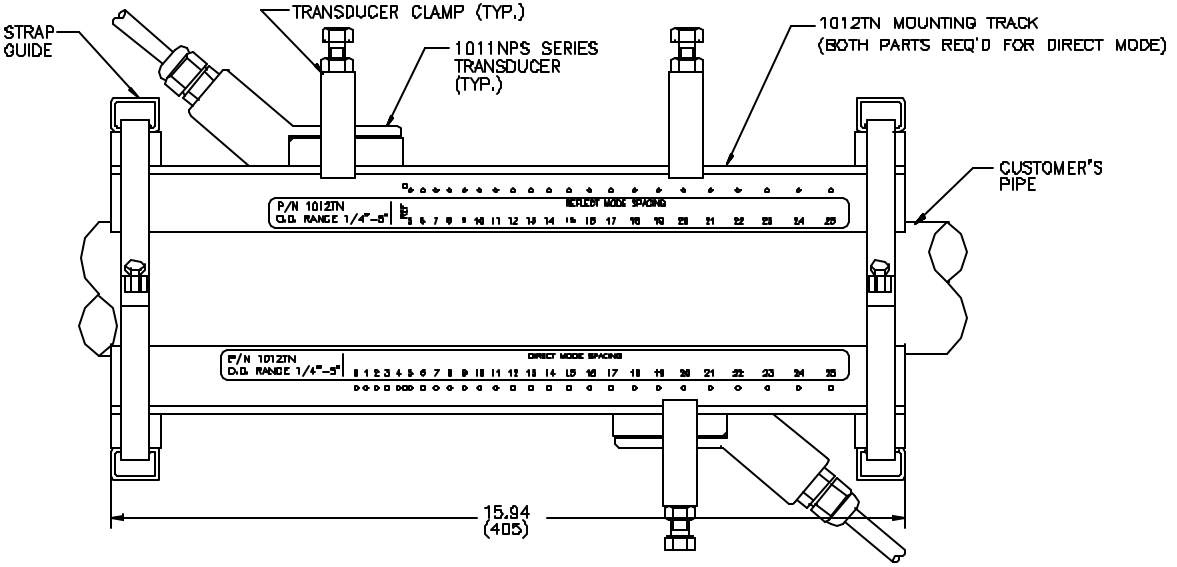
REFLECT MODE





DIRECT MODE





NOTE:

1. SEE DRAWING 1012TN-7 FOR TRANSDUCER AND MOUNTING TRACK INSTALLATION INSTRUCTIONS.
2. SEE DRAWING 1011NPS-8 FOR TRANSDUCER OUTLINE DIMENSIONS.

DO NOT SCALE THIS DRAWING

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES (MM) TOLERANCES ON-

INCHES	(MM)
± .1	± 2

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CONTROLOTRON
HAUPPAUGE, NY 11788

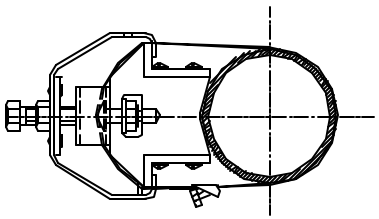
OUTLINE DIMENSIONS 1012TN SERIES MOUNTING TRACK

SIZE	CODE IDENT NO.		REV.
C	21614	1012TN - 8	A
SCALE: NONE	WT.	SHEET 1 OF 1	

R14: 1012TN-8 rev.A

REFLECT MODE INSTALLATION

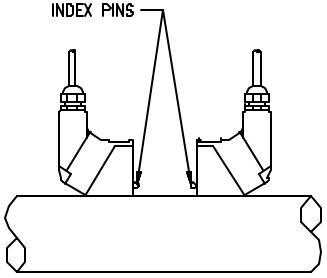
1011HN HIGH PRECISION TRANSDUCER AND TRACK



2
4

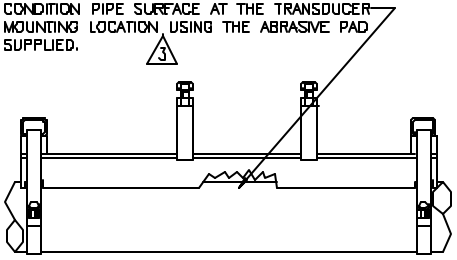
SELECT AND PREPARE THE TRANSDUCER MOUNTING LOCATION, SECURE TRACKS TO PIPE WITH STRAP

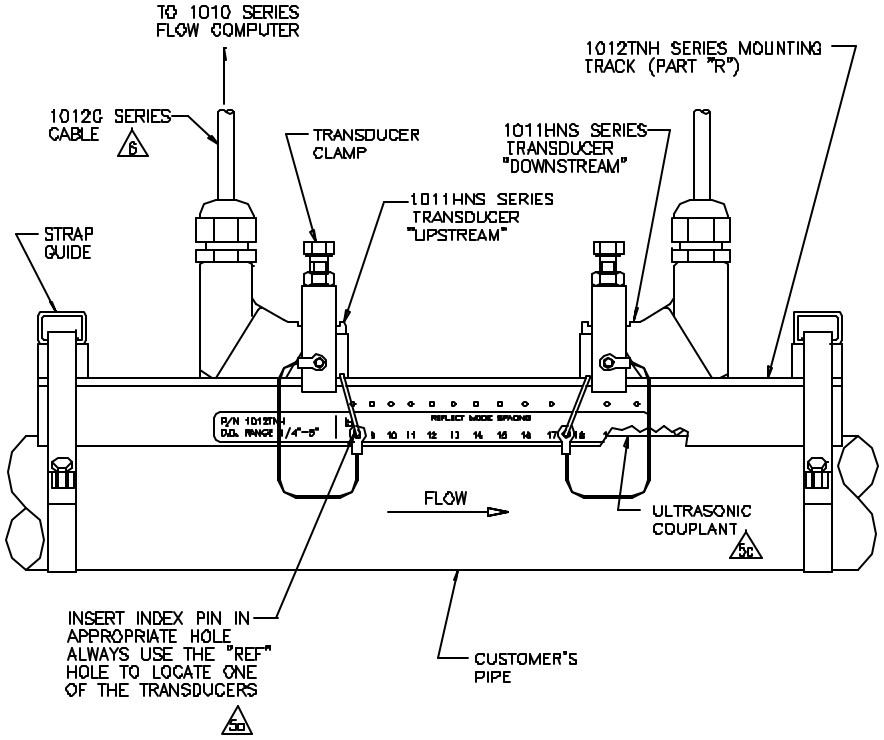
TRANSDUCER INDEX PIN ORIENTATION



ORIENTATION OF PROPERLY INSTALLED TRANSDUCERS IN REFLECT MODE OPERATION

CONDITION PIPE SURFACE AT THE TRANSDUCER MOUNTING LOCATION USING THE ABRASIVE PAD SUPPLIED. 3





INSTALLATION PROCEDURE – SEE DRAWING REFERENCES 4

1. USING THE INSTALLATION MENU PROCEDURES PRESENTED IN THE 1010 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.
   d) CONDITION PIPE SURFACE;
      LOCALLY SMOOTH THE PIPE SURFACE TO ACCEPT THE TRANSDUCERS. USE THE ABRASIVE PAD PROVIDED.

4. MOUNT TRACK ON PIPE;
   a) PLACE TRACK RAIL ASS'Y (ASS'Y WITH STRAP) AGAINST PIPE. WHILE HOLDING TRACK, WRAP STRAP AROUND PIPE AND TIGHTEN.
   b) 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 STRAP.

5. LOCATE TRANSDUCERS;
   a) CONSULTING THE 1010 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.

6. MAKE TRANSDUCER CABLE CONNECTIONS IN ACCORDANCE WITH THE APPROPRIATE FLOW COMPUTER INSTALLATION DRAWING AND 1010 FIELD MANUAL.

7. SEE DRAWING 1012TNH-8 AND 1011HNS-8 FOR TRACK AND TRANSDUCER OUTLINE DIMENSIONS.

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 8/10/98
CHK		DATE
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CERTIFIED

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CONTROLOTRON
HAUPPAUGE, NY 11788

INSTALLATION DRAWING 1010 SERIES TRANSDUCERS AND MOUNTING TRACKS

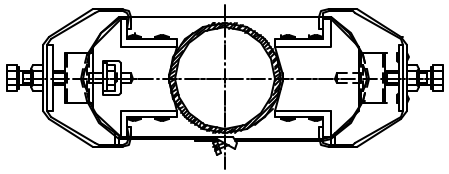
SIZE	CODE IDENT NO.		REV.
C	21614	1012TNH-7	A
SCALE: NONE	VT.	SHEET 1 OF 2	

R14: 1012TNH-7A rev.A

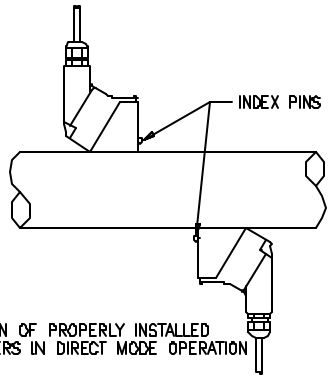
DIRECT MODE INSTALLATION

1011HN HIGH PRECISION TRANSDUCER AND TRACK

SELECT AND PREPARE THE TRANSDUCER MOUNTING LOCATION, SECURE TRACKS TO PIPE WITH STRAP

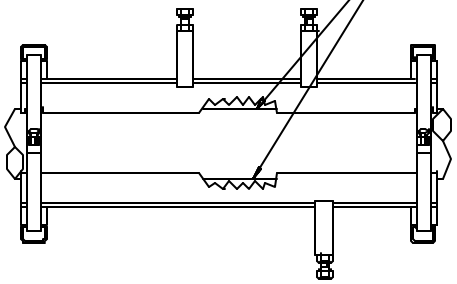


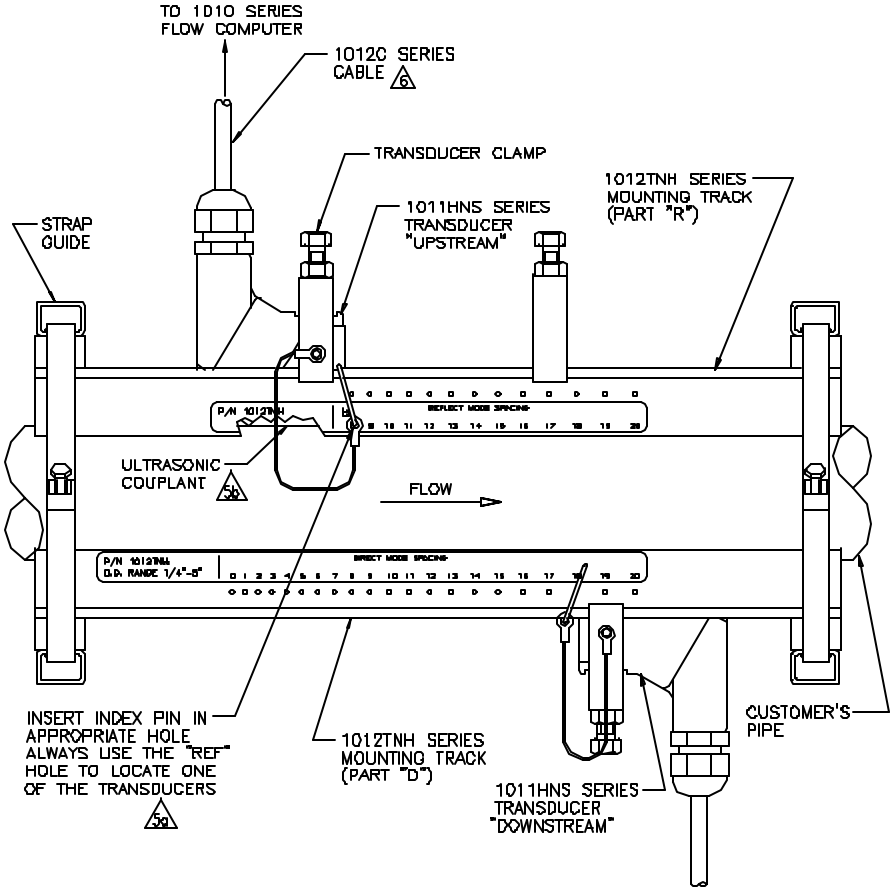
TRANSDUCER INDEX PIN ORIENTATION



ORIENTATION OF PROPERLY INSTALLED TRANSDUCERS IN DIRECT MODE OPERATION

CONDITION PIPE SURFACE AT THE TRANSDUCER MOUNTING LOCATION USING THE ABRASIVE PAD SUPPLIED.





INSTALLATION PROCEDURE – SEE DRAWING REFERENCES 4

1. USING THE INSTALLATION MENU, PROCEDURES PRESENTED IN THE 1010 FIELD MANUAL, CONFIRM THAT YOU HAVE THE APPROPRIATE TRANSDUCERS AND TRACK FOR DIRECT MODE OPERATION ON THE CHOSEN PIPE.

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   c) ON HORIZONTAL PIPE, SELECT HORIZONTAL PLANE, IF POSSIBLE, TO AVOID SEDIMENT BLOCKAGE OF TRANSDUCER SIGNAL.

3. PREPARE PIPE FOR TRACK MOUNT;
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   c) DO NOT MOUNT OVER FROST.
   d) CONDITION PIPE SURFACE;
   LOCALLY SMOOTH THE PIPE SURFACE TO ACCEPT THE TRANSDUCERS. USE THE ABRASIVE PAD PROVIDED.

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5. LOCATE TRANSDUCERS;
   a) CONSULTING THE 1010 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.

6. MAKE TRANSDUCER CABLE CONNECTIONS IN ACCORDANCE WITH THE APPROPRIATE FLOW COMPUTER INSTALLATION DRAWING AND 1010 FIELD MANUAL.

7. SEE DRAWING 1012TNH-8 AND 1011HNS-8 FOR TRACK AND TRANSDUCER OUTLINE DIMENSIONS.

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 6/10/98
CHK		DATE
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PROD		DATE
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CONTROLOTRON
HAUPPAUGE , NY 11788

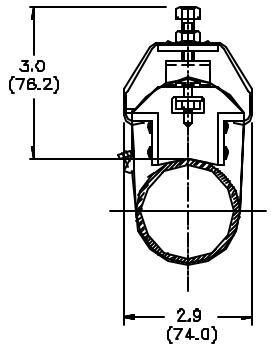
INSTALLATION DRAWING 1010 SERIES TRANSDUCERS AND MOUNTING TRACKS

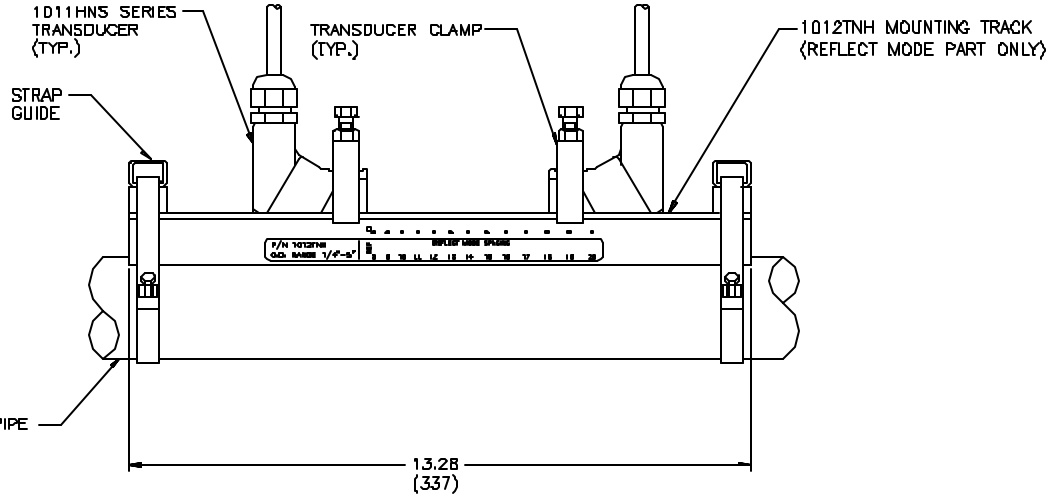
SIZE	CODE IDENT NO.		REV.
C	21614	1012TNH-7	A

SCALE: NONE | WT. | SHEET 2 OF 2

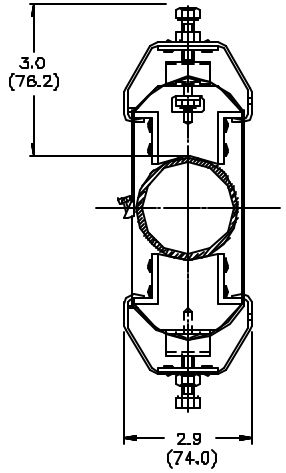
R14: 1012TNH-7B rev.A

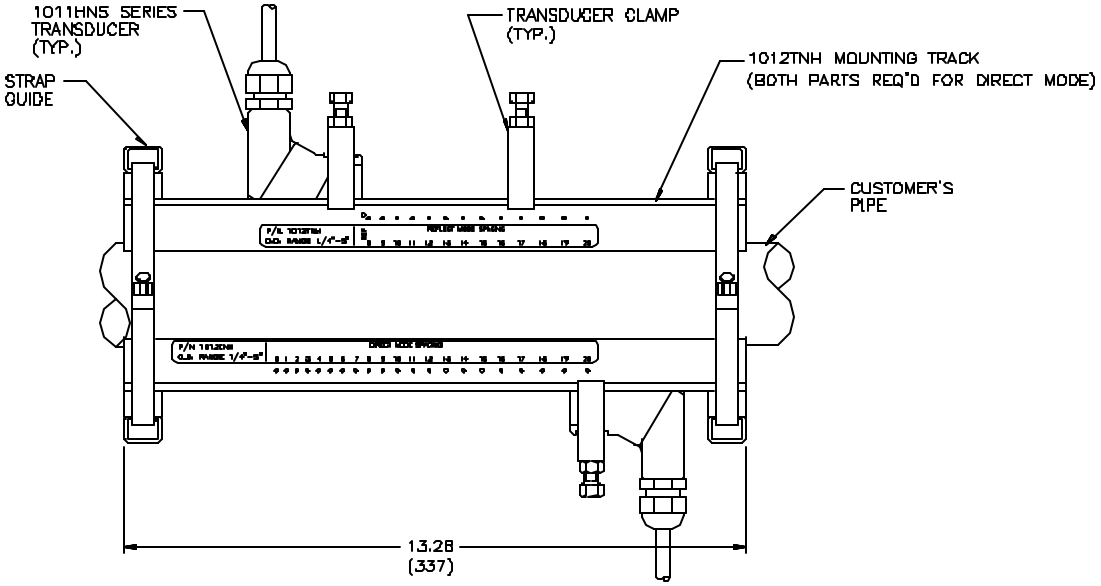
REFLECT MODE





DIRECT MODE





NOTE:

1. SEE DRAWING 1012TNH-7 FOR TRANSDUCER AND MOUNTING TRACK INSTALLATION INSTRUCTIONS.
2. SEE DRAWING 1011HNS-8 FOR TRANSDUCER OUTLINE DIMENSIONS.

DO NOT SCALE THIS DRAWING

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES (MM) TOLERANCES ON-

INCHES	(MM)
± .1	± 2

CONTRACT NO.

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ENG		DATE
PROD		DATE
APP'D		DATE

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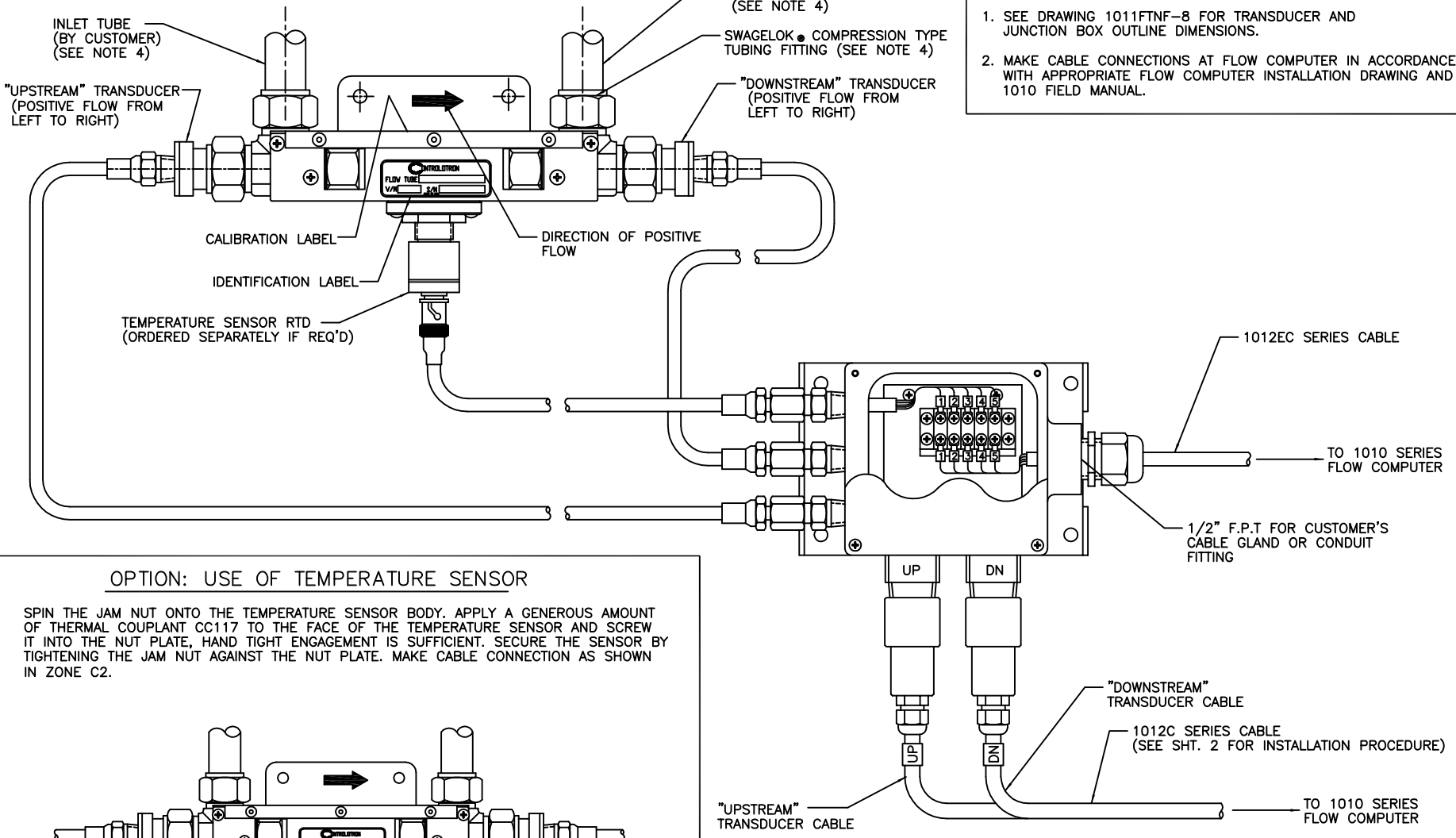
CONTROLOTRON
HAUPPAUGE, NY 11788

OUTLINE DIMENSIONS 1012TNH SERIES MOUNTING TRACK

SIZE	CODE IDENT NO.		REV.
C	21614	1012TNH - 8	A
SCALE: NONE	WT.	SHEET 1 OF 1	

R14: 1012TNH-8 rev.A

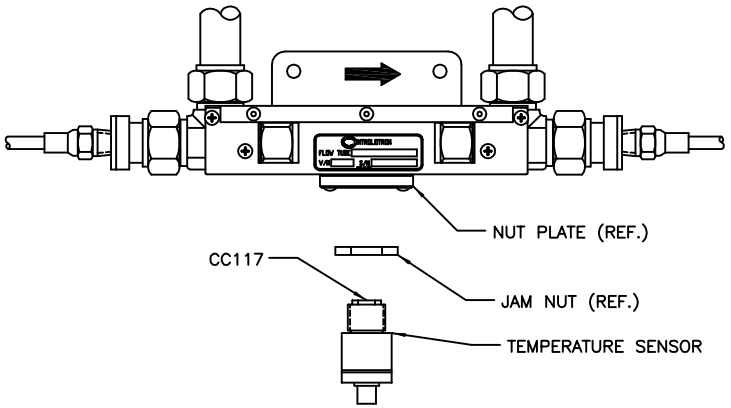


NOTES:

1. SEE DRAWING 1011FTNF-8 FOR TRANSDUCER AND JUNCTION BOX OUTLINE DIMENSIONS.
2. MAKE CABLE CONNECTIONS AT FLOW COMPUTER IN ACCORDANCE WITH APPROPRIATE FLOW COMPUTER INSTALLATION DRAWING AND 1010 FIELD MANUAL.

OPTION: USE OF TEMPERATURE SENSOR

SPIN THE JAM NUT ONTO THE TEMPERATURE SENSOR BODY. APPLY A GENEROUS AMOUNT OF THERMAL COUPLANT CC117 TO THE FACE OF THE TEMPERATURE SENSOR AND SCREW IT INTO THE NUT PLATE, HAND TIGHT ENGAGEMENT IS SUFFICIENT. SECURE THE SENSOR BY TIGHTENING THE JAM NUT AGAINST THE NUT PLATE. MAKE CABLE CONNECTION AS SHOWN IN ZONE C2.



DO NOT SCALE THIS DRAWING

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES TOLERANCES ON-

INCHES	(MM)
± .1	± 2

CONTRACT NO.

DR	H.J	DATE	7/19/99
CHK		DATE	
ENG		DATE	
PROD		DATE	
APPD		DATE	

CERTIFIED

DATE

CONTROLOTRON
HAUPPAUGE , NY 11788

INSTALLATION/OUTLINE 1010 SERIES FLOWTUBE

SIZE	CODE IDENT NO.		REV.
C	21614	1011FTNF-7	A
SCALE: NONE	WT.		SHEET 1 OF 2

R14: 1011FTNF-7 sht.1 rev.A
ER#1447

MATING 1012CNF NSERIES TRANSDUCER CABLES WITH 1011HNF SERIES TRANSDUCERS

a) REMOVE PROTECTIVE CAPS.

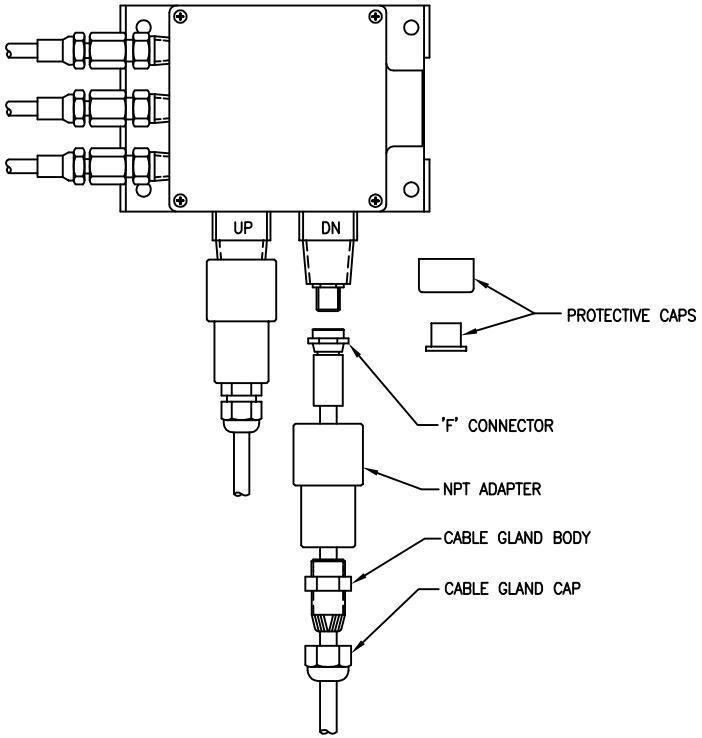
b) SEE APPROPRIATE CABLE ASSEBMLY DRAWING FOR 'F' CONNECTOR, NPT ADAPTER AND GLAND ASSEMBLY DETAIL.

c) MATE 'F' CONNECTORS, CABLES TO TRANSDUCER.

d) FOR BEST WEATHER SEAL, WRAP TEFLON PIPE TAPE (NOT SUPPLIED) AROUND MALE NPT THREADS ON TRANSDUCER HOUSING.

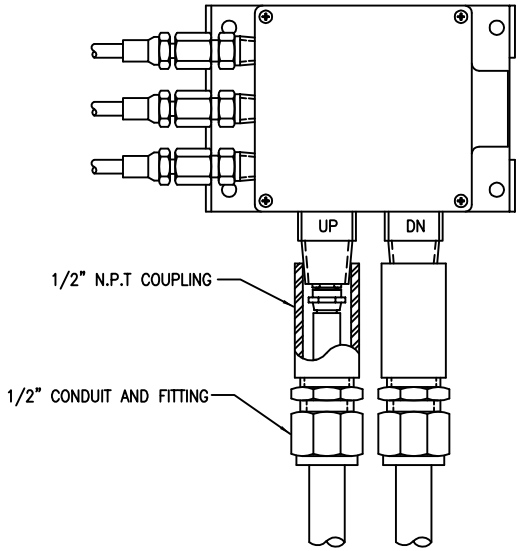
e) SCREW NPT ADAPTER TO TRANSDUCER HOUSING (HAND TIGHT IS SUFFICIENT).

f) TIGHTEN GLAND BODY WITH NPT ADAPTER AND SECURE CABLE BY TIGHTENING GLAND TOP NUT. (HAND TIGHT IS SUFFICIENT).



USE OF CONDUIT WITH TRANSDUCERS

THE TRANSDUCER JUNCTION BOX HAS INTEGRAL 1/2" N.P.T THREADS TO ACCEPT A CONDUIT COUPLING IF CONDUIT IS USED. MAKE CONNECTION AS SHOWN, THEN PASS COUPLING AND CONDUIT OVER THE CABLE AND SECURE TO THE TRANSDUCER JUNCTION BOX.



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INCHES	(MM)
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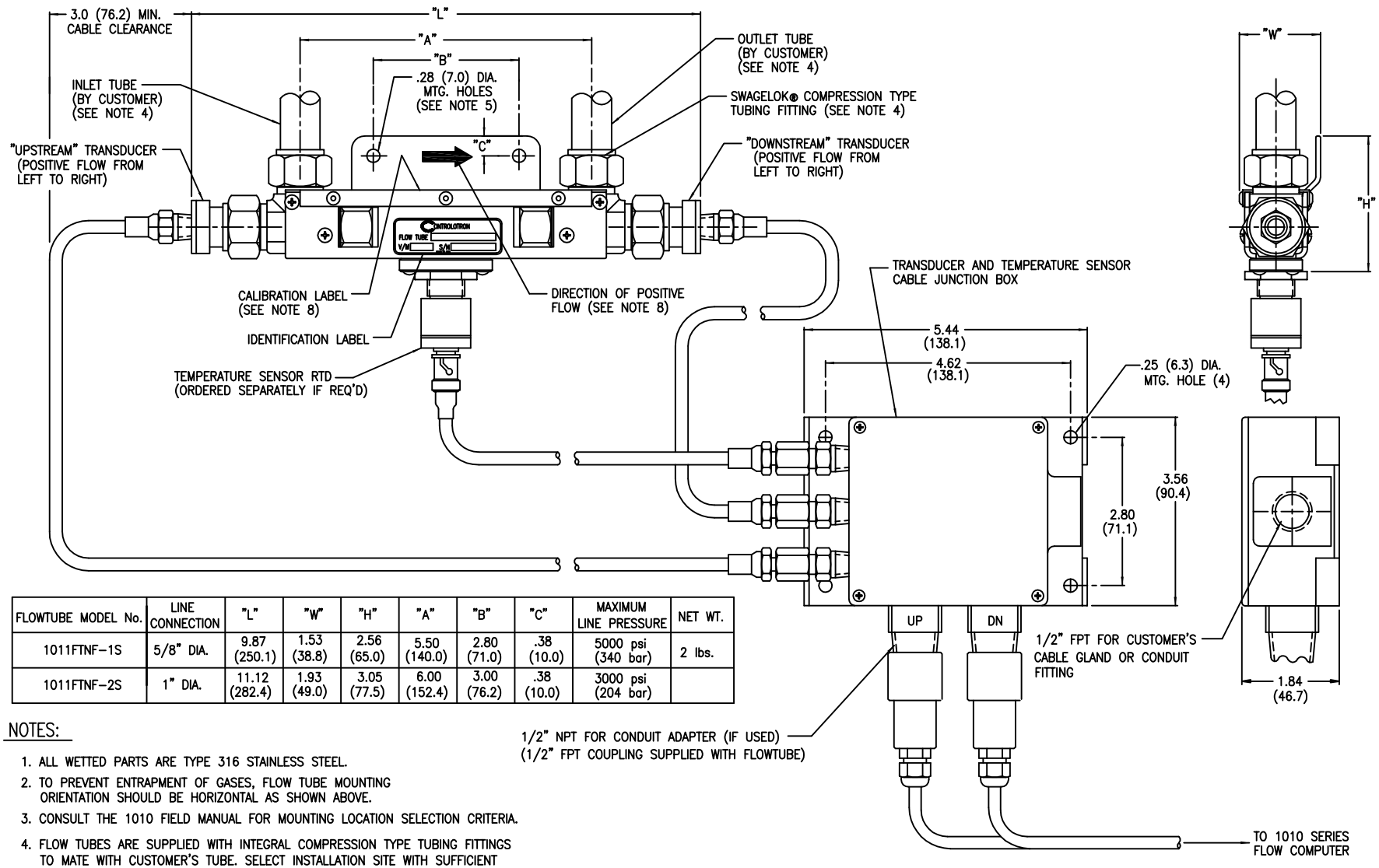
INSTALLATION/OUTLINE 1010 SERIES FLOWTUBE

SIZE	CODE IDENT NO.		REV.
C	21614	1011FTNF-7	A
SCALE: NONE	WT.		SHEET 2 OF 2

R14: 1011FTNF-7 sht.1 rev.A
ER#1447



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.

DO NOT SCALE THIS DRAWING

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES (MM)
TOLERANCES ON-
INCHES ± .1 (MM) ± 2

CONTRACT NO.

DR H.J DATE 7/19/99
CHK DATE
ENG DATE
PROD DATE
APPD DATE

CERTIFIED
DATE

CONTROLOTRON
HAUPPAUGE , NY 11788

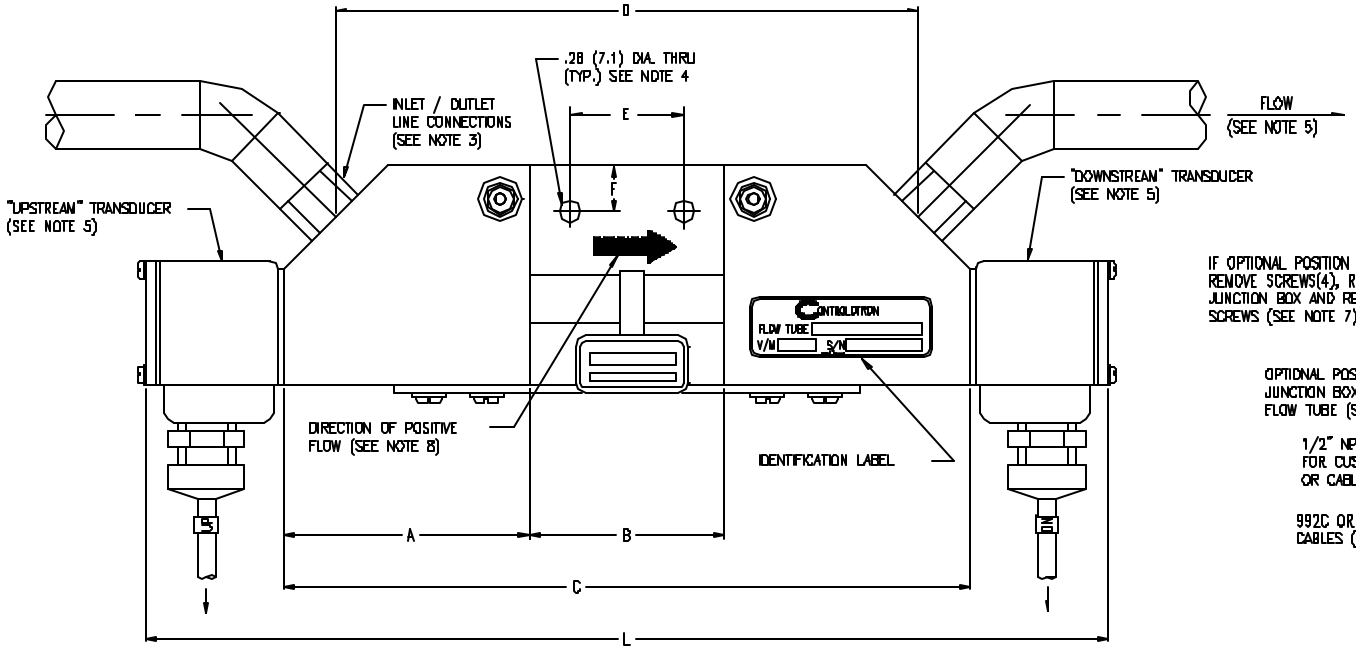
INSTALLATION/OUTLINE 1010 SERIES FLOWTUBE

SIZE	CODE IDENT NO.		REV.
C	21614	1011FTNF-8	A

SCALE: NONE WT. SHEET 1 OF 1

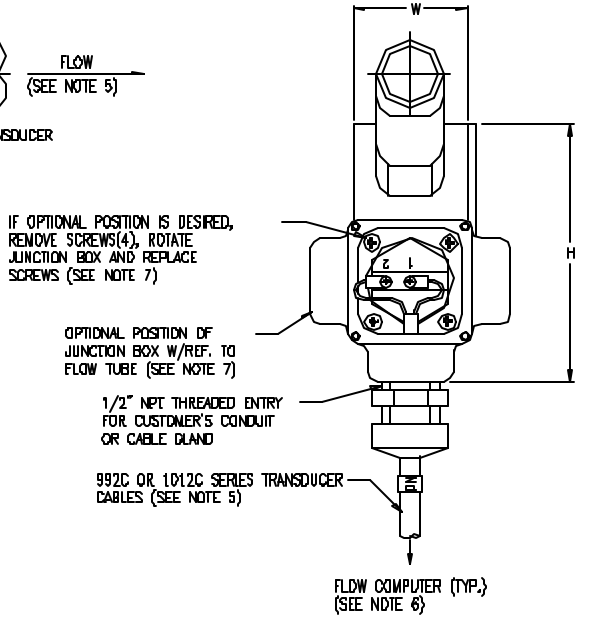
R14: 1011FTNF-8 sht.1 rev.A
ER#1447

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.



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	14.8 (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 ± .1 (MM) ± 2

CONTRACT NO.

DR	H.J	DATE 1/28/98
CHK		DATE
ENG		DATE
PROD		DATE
APPD		DATE

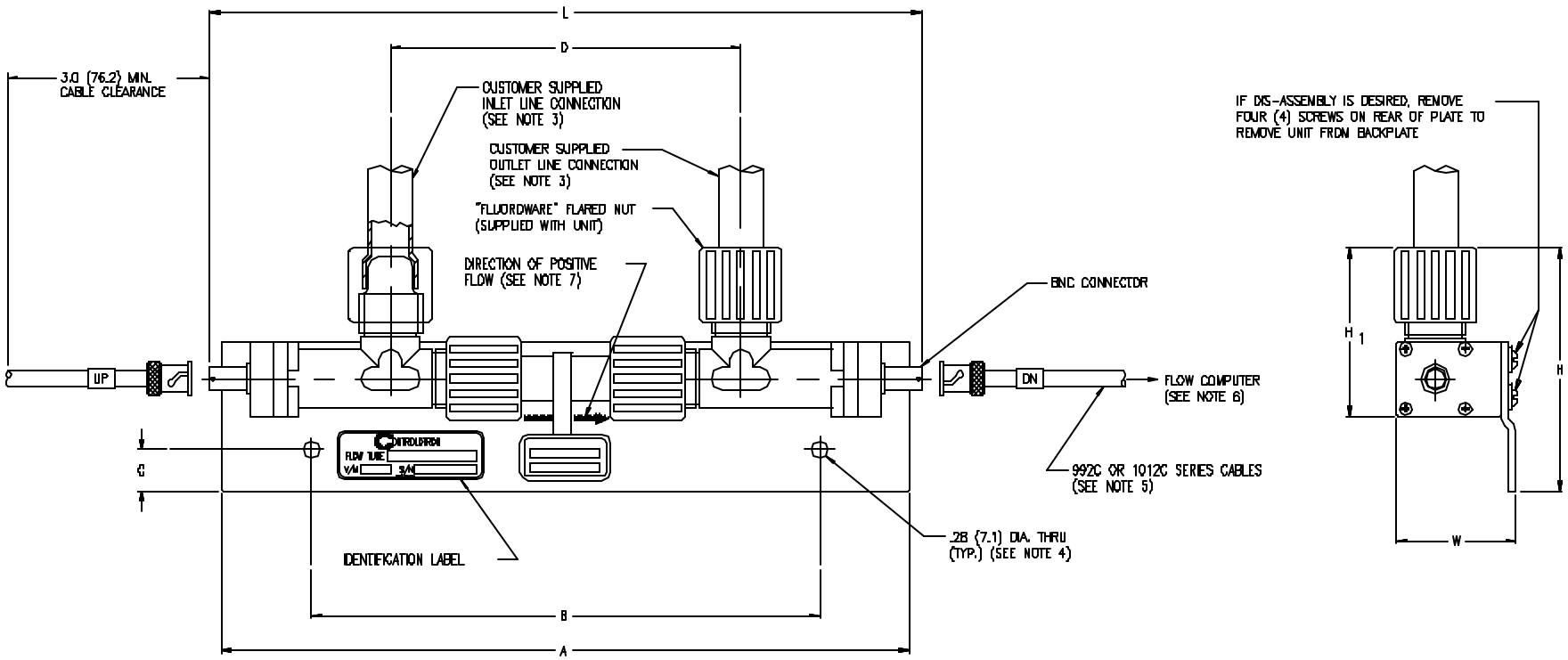
CERTIFIED
DATE

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
#3578,ECN#4089



FLOWTUBE MODEL No.	MATERIAL	LINE CONNECTION BORE DIA.	LINE CONNECTION TUBING SIZE	L	W	H	H_1	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)	4.08 (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. 55318
   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.

DO NOT SCALE THIS DRAWING
UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES (MM) TOLERANCES ON-
INCHES ± .1 (MM) ± 2

CONTRACT NO.

DR H.J DATE 9/16/96
CHK DATE
ENG DATE
PROD DATE
APPD DATE

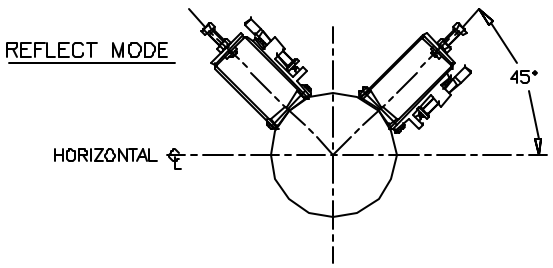
CERTIFIED
DATE

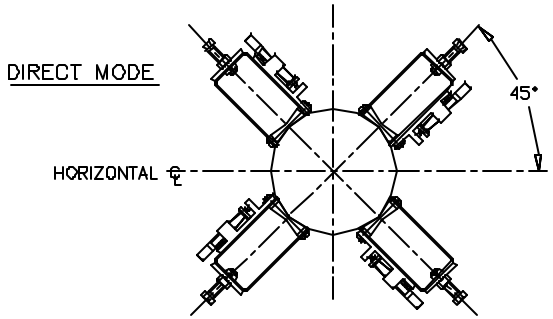
CONTROLOTRON
HAUPPAUGE, NY 11788

INSTALLATION / OUTLINE PFA-DFT FLOWTUBE

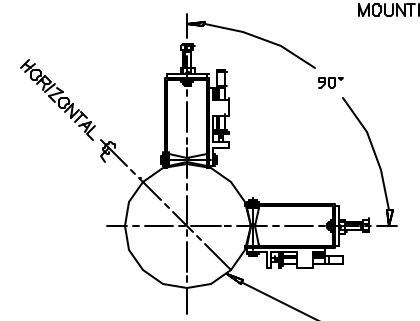
SIZE	CODE IDENT NO.		REV.
C	21614	992DFTP-T-8	B
SCALE: NONE	WT.	SHEET 1 OF 1	

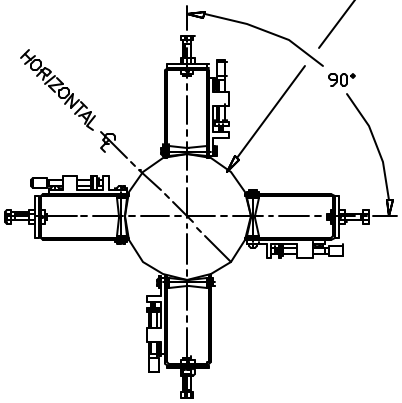
R14: 992DFTP-T-8 sht.1 rev.B
ER# 4089

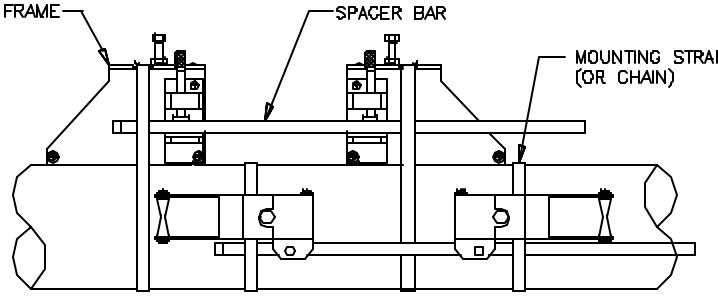




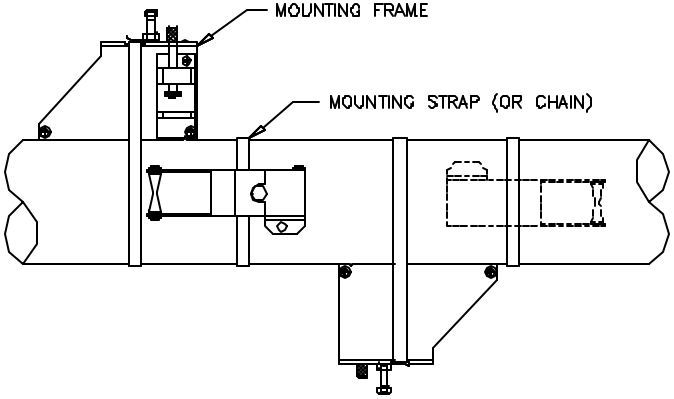
RECOMMENDED INSTALLATION
ON HORIZONTAL PIPES







POSITION FRAME ASSEMBLIES 90° APART (1/4 CIRCUMFERENCE)
BEFORE TIGHTENING ADJUSTING SCREW



NOTES:

1. USING THE INSTALLATION MENU AND THE PROCEDURE OUTLINED IN THE FIELD MANUAL, SELECT THE APPROPRIATE TRANSDUCERS AND MOUNTING FRAMES FOR THE MODE OF OPERATION CHOSEN FOR YOUR APPLICATION. REFLECT MODE IS PREFERRED.
2. SELECT MOUNTING LOCATION:
   a) TRANSDUCER SETS SHOULD BE MOUNTED SO THAT THE PLANES OF OPERATION OF THE TWO SETS INTERSECT ORTHOGONALLY; THAT IS, 90° OR 1/4 THE CIRCUMFERENCE OF THE PIPE APART.
   b) CHOOSE A LOCATION WHICH REMAINS FULL AT ZERO FLOW. ON HORIZONTAL PIPES, MOUNT AWAY AWAY FROM THE UNDERSIDE TO AVOID SEDIMENT BLOCKAGE OF ULTRASONIC BEAM. MOUNT AWAY FROM TOPSIDE TO AVOID BLOCKAGE DUE TO ENTRAPPED AIR.
   c) WHERE POSSIBLE, LOCATE MOUNTING FRAME ASSEMBLIES AS FAR AS POSSIBLE DOWNSTREAM FROM ANY FLOW DISTURBANCE TO ASSURE FULLY DEVELOPED AND STABLE FLOW PROFILE.
3. MOUNT FRAMES ON PIPE:
   a) REFER TO THE APPROPRIATE INSTALLATION DRAWING FOR THE PORTABLE OR DEDICATED TRANSDUCERS AND FRAMES SELECTED FOR USE. NOTE THESE DRAWINGS PROVIDE INSTRUCTIONS FOR SINGLE PATH INSTALLATIONS. DUAL PATH SYSTEMS ARE INSTALLED IN THE SAME FASHION BY OFFSETTING A SECOND SET OF MOUNTING FRAMES IN AN ORTHOGONAL PLANE AS SHOWN ABOVE.
4. CONDITION PIPE SURFACE:
   LOCALLY SMOOTH THE PIPE SURFACE AT EACH TRANSDUCER LOCATION AND INSTALL TRANSDUCERS IN ACCORDANCE WITH THE PROCEDURE DESCRIBED ON THE APPROPRIATE TRANSDUCER AND FRAME INSTALLATION DRAWING. MAKE SURE THAT TRANSDUCER PAIRS ARE INSTALLED AND CONNECTED TO THE FLOW COMPUTER CORRECTLY.
5. REFER TO THE APPROPRIATE OUTLINE DRAWINGS FOR TRANSDUCER AND MOUNTING FRAME OUTLINE DIMENSIONS.

DO NOT SCALE THIS DRAWING

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES (MM)
TOLERANCES ON-

CONTRACT NO.

DR	H.J	DATE 9/10/96
CHK		DATE
ENG		DATE
PROD		DATE
APPD		DATE

CERTIFIED

DATE

CONTROLOTRON
HAUPPAUGE . NY 11788

INSTALLATION DRAWING
DUAL PATH TRANSDUCER SET
WITH MOUNTING FRAMES

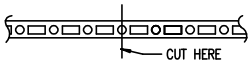
SIZE	CODE IDENT NO.		REV.
C	21614	1012F-DB-7	B

SCALE NONE | WT. | SHEET 1 OF 1

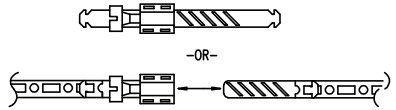
R14: 1012F-DB-7 sht.1 rev.B

STEP - 1 DETERMINE PROPER BAND LENGTH ONE OF TWO WAYS:
A) IF DIAMETER IS KNOWN, REFER TO BAND LENGTH TABLE OR CALCULATE BAND LENGTH = 3.14 x DIA.– 3.5".
B) IF DIAMETER IS NOT KNOWN, MEASURE CIRCUMFERENCE WITH STRING, TWINE, etc., AND SUBTRACT 3.5" (TO ALLOW LENGTH OF FASTENER) TO DETERMINE PROPER BAND LENGTH.

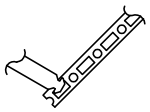
STEP - 2 MEASURE BAND TO PROPER LENGTH AND CUT THROUGH CENTER OF NEAREST ROUND HOLE WITH SHEARS, SNIPS, HACKSAW etc.



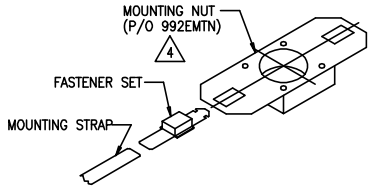
STEP - 3 EITHER MATE FASTENER HALVES AND THEN LINK TO STRAP ALREADY IN PLACE AROUND PIPE, OR LINK FASTENER HALVES INDEPENDENTLY TO STRAP ENDS (HOLD IN PLACE WITH TAPE IF (IF NECESSARY) AND ENGAGE FASTENER AFTER WRAPPING STRAP AROUND PIPE.

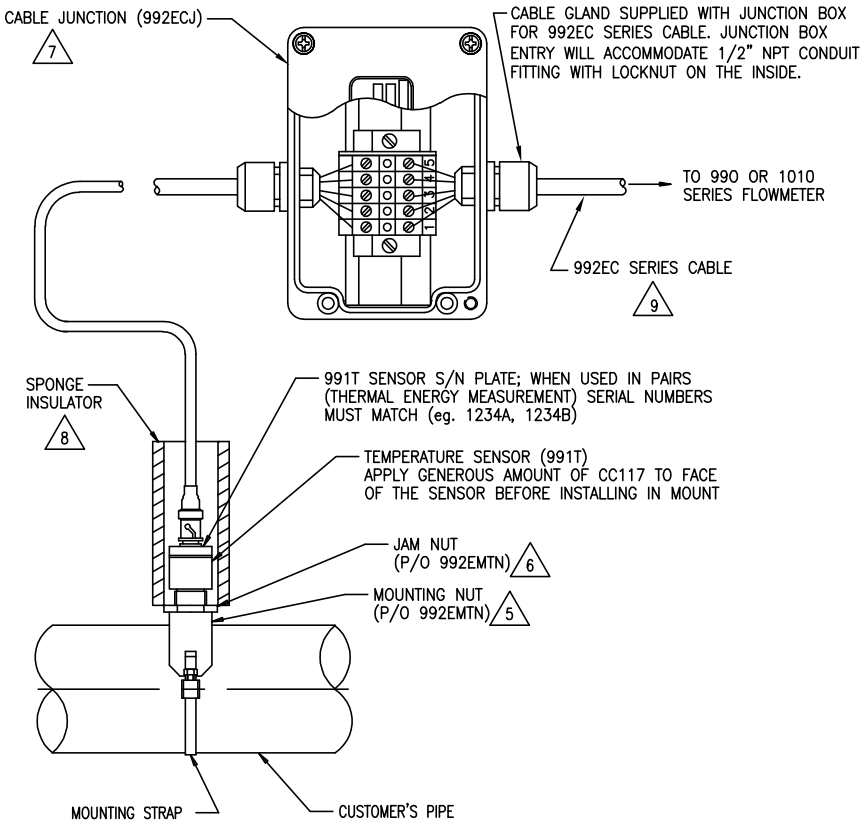


DIAGONALLY INSERT FASTENER END INTO RECTANGULAR SLOTS TO LINK WITH STRAP (INSERT AT LOCATION BEST SUITED FOR TIGHT FIT).

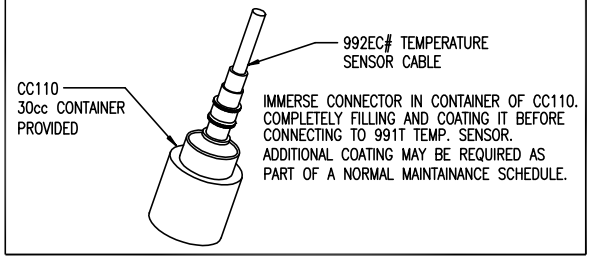


STEP - 4 MATE "T" ON FASTENERS WITH RECTANGULAR CUT–OUT ON MOUNTING NUT ASSEMBLY.
SIZE 2 MOUNTING ASSY'S INCLUDE FIXED LENGTH STRAPS TO MATE WITH FASTENERS ATTACHED TO MOUNTING NUT.
SIZES 3 & 4 MOUNTING ASSY'S INCLUDE A CUT–TO–FIT MOUNTING STRAP. (SEE STEP 3).





FOR HARSH OR HEAVY CONDENSATE ENVIRONMENTS:
SERVICE TEMPERATURE RANGE: -40°F TO +150°F



INSTALLATION PROCEDURE – SEE DRAWING REFERENCE 4

1. INSTALLATION OF THE DEDICATED NEMA 4 TEMPERATURE SENSOR FOR PIPES 1 1/4" – 48" DIAMETER REQUIRES THE FOLLOWING: THE SENSOR 991T(S), A MOUNTING ASS'Y 992EMTN(–2,–3,–4), AND A CABLE 992ECN–(LENGTH) IN TWO PARTS, JUNCTION 992ECJ AND CABLE 992ECC–(LENGTH).
2. TEMPERATURE SENSORS ARE SUPPLIED IN PAIRS (P/N 991T) FOR THERMAL ENERGY FLOWMETER APPLICATIONS OR SINGLY (P/N 991TS) FOR TEMPERATURE COMPENSATED MASS FLOWMETER APPLICATIONS AND INTERFACE DETECTION.
3. SELECT THE PIPE LOCATION WHERE TEMPERATURE IS TO BE MONITORED IN ACCORDANCE WITH RECOMMENDATIONS IN THE FIELD MANUAL.
4. CLEAN A SMALL AREA OF PIPE SURFACE (APPROXIMATELY 1" DIAMETER); REMOVE PAINT, SCALE, FOREIGN MATTER THAT CAN AFFECT GOOD THERMAL CONTACT.
5. CENTER THE MOUNTING NUT (PART OF 992EMTN) OVER THE CLEAN SPOT AND STRAP IN PLACE. ALLOW THE STRAP TO REACH APPROXIMATELY THE TEMPERATURE OF THE PIPE AND TIGHTEN SECURELY.
6. SPIN THE JAM NUT (PART OF 992EMTN) ONTO THE 991T SENSOR BODY. APPLY A GENEROUS AMOUNT OF THERMAL COUPLANT (SUPPLIED WITH 992EMTN) TO THE FACE OF THE SENSOR AND SCREW IT INTO THE MOUNTING NUT, HAND TIGHT ENGAGEMENT IS SUFFICIENT. SECURE THE SENSOR BY TIGHTENING THE JAM NUT AGAINST THE MOUNTING NUT.
7. SELECT A MOUNTING LOCATION FOR THE 992ECJ JUNCTION BOX. USE INTEGRAL MOUNTING FLANGES OR SECURE AT THE END OF RIGID CONDUIT. IF CONDUIT IS USED, REMOVE THE WATERTIGHT GLAND SUPPLIED WITH THE 992ECC CABLE. INSTALL THE 992ECC CABLE, MAKING WIRING CONNECTIONS 1–5 AS SHOWN.
8. SLIP THE SPONGE INSULATOR (SUPPLIED WITH 991T) OVER THE CONNECTOR AND CABLE PART OF JUNCTION 994ECJ. MATE THE JUNCTION CONNECTOR TO THE 991T. PUSH THE INSULATOR ONTO THE SENSOR BODY.
9. MAKE CABLE CONNECTIONS TO THE 994 OR 1010 SERIES METER IN ACCORDANCE WITH THE APPROPRIATE INSTALLATION. DRAWING.
10. SEE DRAWING 991TN–8 FOR OUTLINE DIMENSIONS.

PERMANENT INSTALLATION / SERVICE NOTE

INSULATION IN THE IMMEDIATE VICINITY OF THE 991T SENSOR SHOULD BE REMOVABLE TO ALLOW FOR TOOL ACCESS REQUIRED FOR PERIODIC REFRESHMENT OF CC117 THERMAL COMPOUND.

BAND LENGTH TABLE

PIPE DIA.	LENGTH TO CUT ON MARK	PIPE DIA.	LENGTH TO CUT ON MARK	PIPE DIA.	LENGTH TO CUT ON MARK
6"	14–3/16"	16"	45–7/8"	32"	95–3/8"
7"	16–3/4"	17"	48–7/16"	34"	101–5/8"
8"	20–1/2"	18"	52–1/8"	36"	107–7/8"
9"	23–1/8"	19"	54–3/4"	38"	114–1/4"
10"	26–7/8"	20"	58–1/2"	40"	120–9/16"
11"	29–3/8"	22"	64–7/8"	42"	127"
12"	33–5/16"	24"	71–1/8"	44"	133–5/16"
13"	33–3/4"	26"	76–1/4"	46"	139–5/8"
14"	39–1/2"	28"	85–5/8"	48"	145–15/16"
15"	42–1/16"	30"	88–7/8"		

DO NOT SCALE THIS DRAWING
UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES (MM) TOLERANCES ON–
INCHES ± .1 (MM) ± 2

CONTRACT NO.

DR H.J DATE 10/28/96
CHK DATE
ENG DATE
PROD DATE
APPD DATE

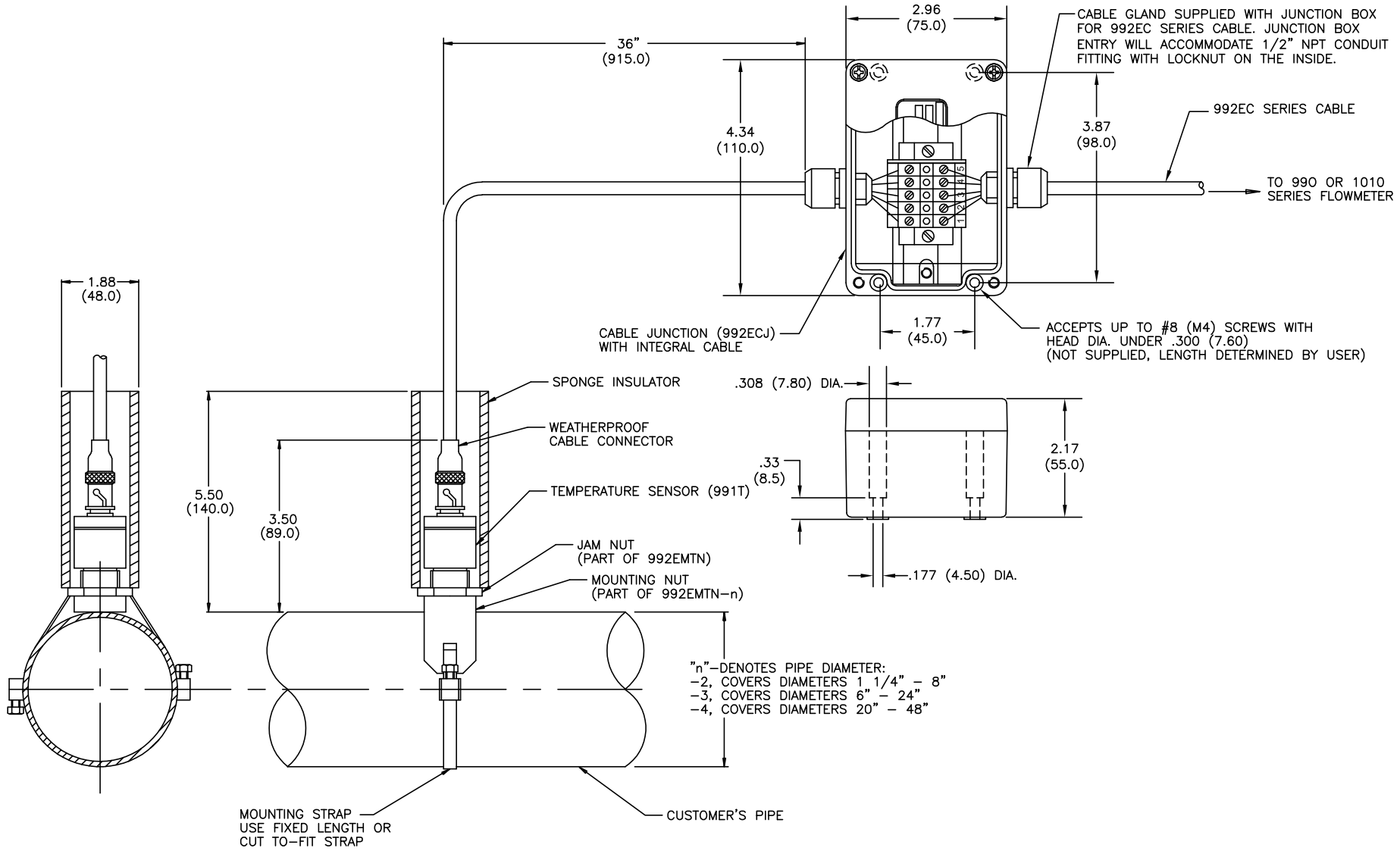
CERTIFIED
DATE

CONTROLOTRON
HAUPPAUGE , NY 11788

INSTALLATION DRAWING TEMPERATURE SENSOR DEDICATED, NEMA 4

SIZE	CODE IDENT NO.		REV.
C	21614	991TN - 7	G
SCALE: NONE	WT.	SHEET 1 OF 1	

CN#4860

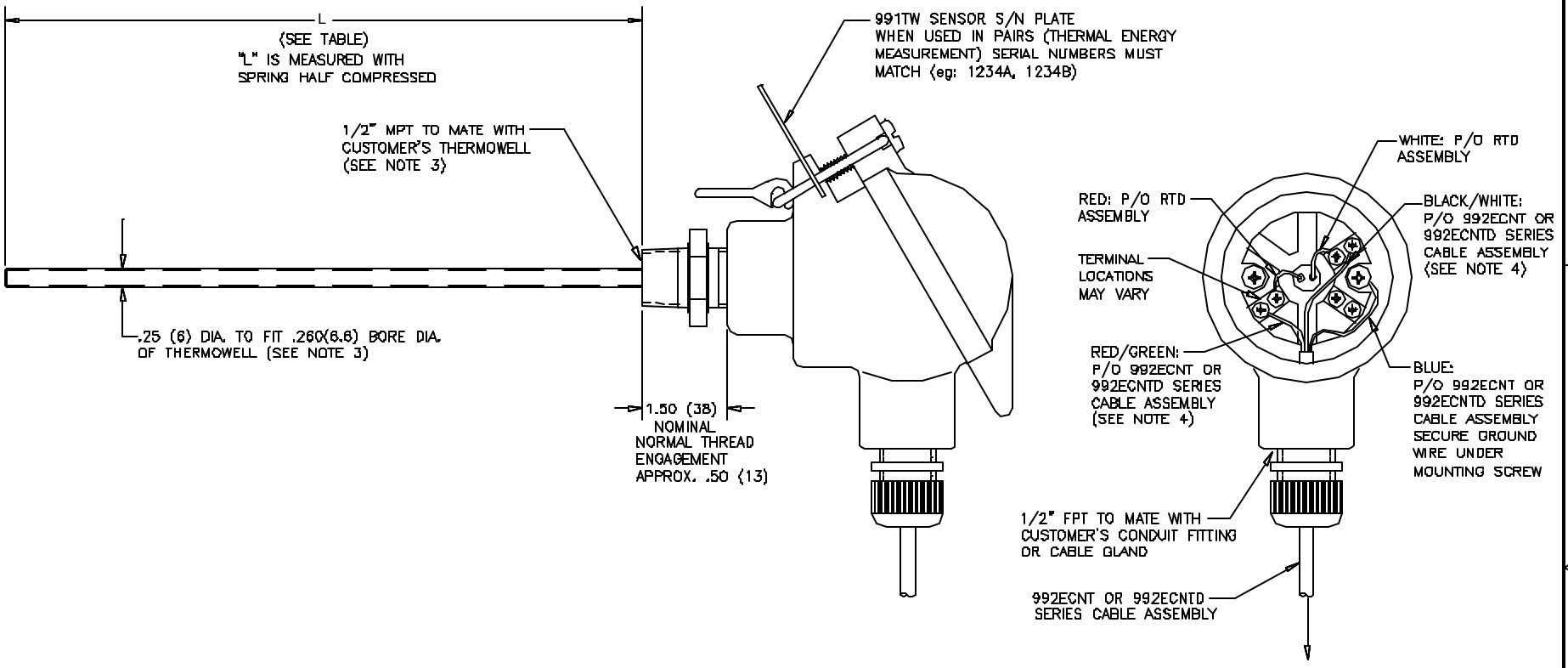


NOTES:

1. THE DEDICATED NEMA 4 TEMPERATURE SENSOR FOR PIPES 1 1/4" – 48" DIAMETER CONSISTS OF THE FOLLOWING: THE SENSOR 991T(S), A MOUNTING ASS'Y 992EMTN(-2,-3,-4), AND A CABLE 992ECN-(LENGTH) IN TWO PARTS, JUNCTION 992ECJ AND CABLE 992ECC-(LENGTH).
2. TEMPERATURE SENSORS ARE SUPPLIED IN PAIRS (P/N 991T) FOR THERMAL ENERGY METER APPLICATIONS OR SINGLY (P/N 991TS) FOR TEMPERATURE COMPENSATED MASS METER APPLICATIONS AND INTERFACE DETECTION.

DO NOT SCALE THIS DRAWING UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES (MM) TOLERANCES ON- INCHES ± .1 (MM) ± 2	CONTRACT NO. DR H.J DATE 10/28/96 CHK DATE ENG DATE PROD DATE APPD DATE CERTIFIED DATE	CONTROLOTRON HAUPPAUGE , NY 11788 OUTLINE DIMENSIONS TEMPERATURE SENSOR DEDICATED, NEMA 4 SIZE C · CODE IDENT NO. 21614 · 991TN - 8 · REV. F SCALE: NONE · WT. · SHEET 1 OF 1

CN#4860



PART No.	L (PROBE LENGTH)
991TW-1	5.50 (140)
991TW-2	8.50 (216)
991TW-3	11.50 (292)
991TW-4	14.50 (368)
991TW-5	17.50 (444)
991TW-6	23.50 (597)

*SPECIAL ORDER ONLY

GLAND SUPPLIED WITH CABLE IS SUITABLE FOR AMBIENT TEMPERATURE TEMPERATURE BELOW 225°F ONLY

NOTES:

1. TEMPERATURE SENSORS ARE SUPPLIED IN PAIRS (P/N 991TW) FOR THERMAL ENERGY FLOWMETER APPLICATIONS OR SINGLY (P/N 991TWS) FOR TEMPERATURE COMPENSATED MASS FLOWMETER APPLICATIONS.
2. MAKE RING CONNECTIONS USING 992ECNT OR 992ECNTD CABLE AS SHOWN. FOR WIRING CONNECTION TO THERMAL ENERGY OR MASS FLOWMETER COMPUTER SEE APPROPRIATE COMPUTER INSTALLATION DRAWINGS.
3. IF CUSTOMER REQUIRES THERMALWELLS IN PIPE, CUSTOMER MAY PURCHASE FROM: ALLOY ENGINEERING COMPANY BRIDGEPORT CONN., 06607 AS: 260L TYPE OR EQUIVALENT.
4. FOR WIRE CLAMP STYLE TERMINALS, REMOVE CRIMP LUGS FROM CABLE ASSEMBLY STRIP 1/4" AND MAKE WIRE CONNECTIONS INDICATED.

DO NOT SCALE THIS DRAWING
UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES (MM) TOLERANCES ON—
INCHES ± .1 (MM) ± 2

CONTRACT NO.

DR HJ DATE 5/8/91
CHK DATE
ENG DATE
PROD DATE
APPD DATE

CERTIFIED
DATE

CONTROLOTRON
HAUPPAUGE, NY 11788

INSTALLATION/OUTLINE
INSERT TEMPERATURE SENSOR

SIZE	CODE IDENT NO.		REV.
C	21614	991TW - 8	D
SCALE: NONE	WT.	SHEET 1 OF 1	

R14; 991TW-8 sht.1 rev.D

Index

Symbols

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W

Z

TRADEMARKS

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SIEMENS

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Web: www.siemens.com

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
Stand-ard	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

SIEMENS

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Get more information

www.siemens.com/flow

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CoC Ultrasonic Flow
Hauppauge, NY 11788
USA

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