

Ultrasonic flowmeters

SITRANS FUG1010 IP65 NEMA 7 Compact

Operating Instructions - September 2008



SITRANS F

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Special Cautionary Note Regarding Input Power Wiring for 1010X Flowmeters

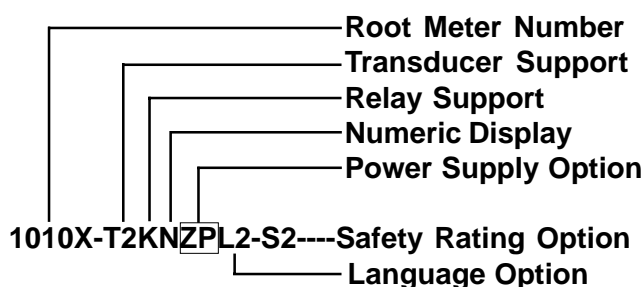
The compact area of the power wiring compartment located under the 1010GX Rear Housing Cover does not permit labeling for connecting the flowmeter to its AC or DC power source. The labeled numbers 1,2 and 3 of connector P8 prompt the user to consult the 1010DXS2-7 installation diagram in Appendix A for wiring details. To avoid damage to the flowmeter, especially in cases where it is difficult or impossible to consult the 1010DXS2-7 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 1010GX part number is on the identification label that is located on the 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 FUG1010GCX/GCDX UNIFLOW DEDICATED NEMA-7 GAS 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:1010GCXFM-3
September 2008

For use with Operating System
Software Version 3.01.06D or later

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.***

ERRATA

Digital Pgen Function and Wiring Procedure Update

NOTE: The following applies to System 1010DVX, 1010PVX, 1010SPVX, 1010SX, 1010GX, 1010GCX and 1010GCSX flowmeter installation manuals.

Replace the PGEN menu cell description and set up procedure in the Data Span/Set/Cal menu Span Data option list including any related menu graphics and text throughout the manual with the following:

PGEN

The [PGEN P/Unit Volume] menu cell entry controls a digital output pulse function and is available in Custody Transfer units only (designated by a “C” or “U” in their part number). It allows the assigning of PGEN digital signal pulses per unit of volume. For example, 1000 output pulses per unit volume (i.e., Barrrels, Cubic Feet, etc.).

The default PGEN value is configured to provide a 5000 Hz output frequency at a flow velocity of 100 ft/sec (30 meters/sec).

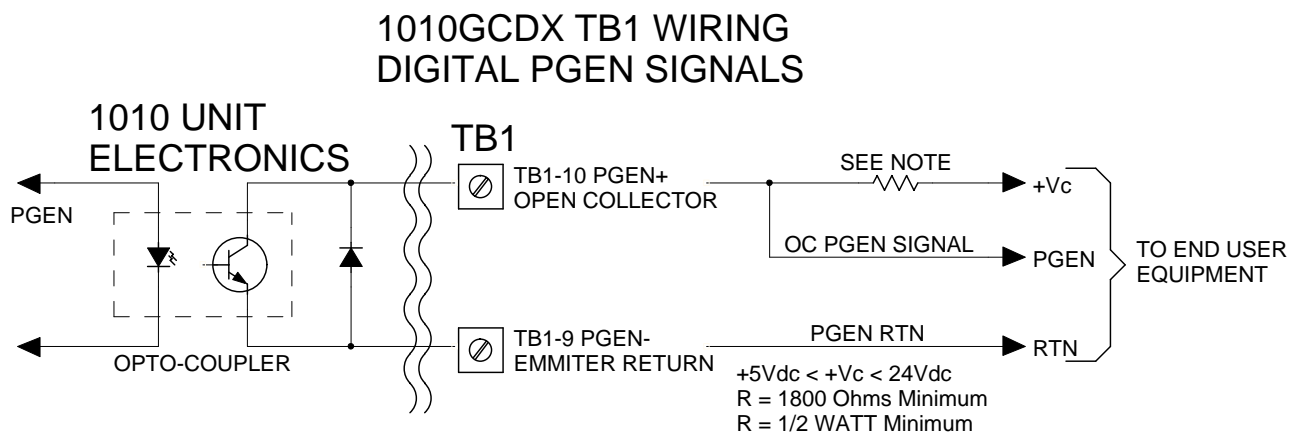
NOTE: The unit of volume is determined by the Volume Units initially selected from the [Total Volume Units] menu cell option list.

1010DVCDX, 1010PVCDX, 1010SPVCDX, 1010SCDX, 1010GUDX, 1010GCCDX and 1010GCSDX Installation Drawing 1010DXS2-7 (Sheet 4 of 4) (Ultra Performance Flowmeters)

TB1			
PIN#	SIGNAL	FUNCTION	NOTES
9	Pgen -	STATUS BIT RETURN	Digitally Synthesized Pulses User . Spanned and Proportional to Flow Rate.
10	Pgen +	STATUS OUTPUT	


PGEN Wiring Diagram

The unit must be wired as shown in the typical 1010X example below before assigning PGEN output pulses.




To change the default PGEN settings:

From the [Span Data] menu press 

From the [PGEN P/*Unit Volume*] menu cell, press  to activate the numeric entry.

Use the numeric keys to enter the desired number of PGEN pulses per unit volume.

NOTE: Ensure that the number entered will provide sufficient resolution while remaining within the 20 Hz to 5000 Hz pulse frequency range. Note that the PGEN output will stop sending pulses at flow rates corresponding to frequencies less than 20 Hz. In this case the PGEN value must be increased.

To store the data press 

ERRATA

Power Supply Wiring Procedure Update

NOTE: The following applies to System 1010X, 1010BX, 1010DVX, 1010PVX, 1010GX, 1010GCX, 1010GCSX, 1010SXF-2 and 1010SPVX Flowmeter installation manuals.

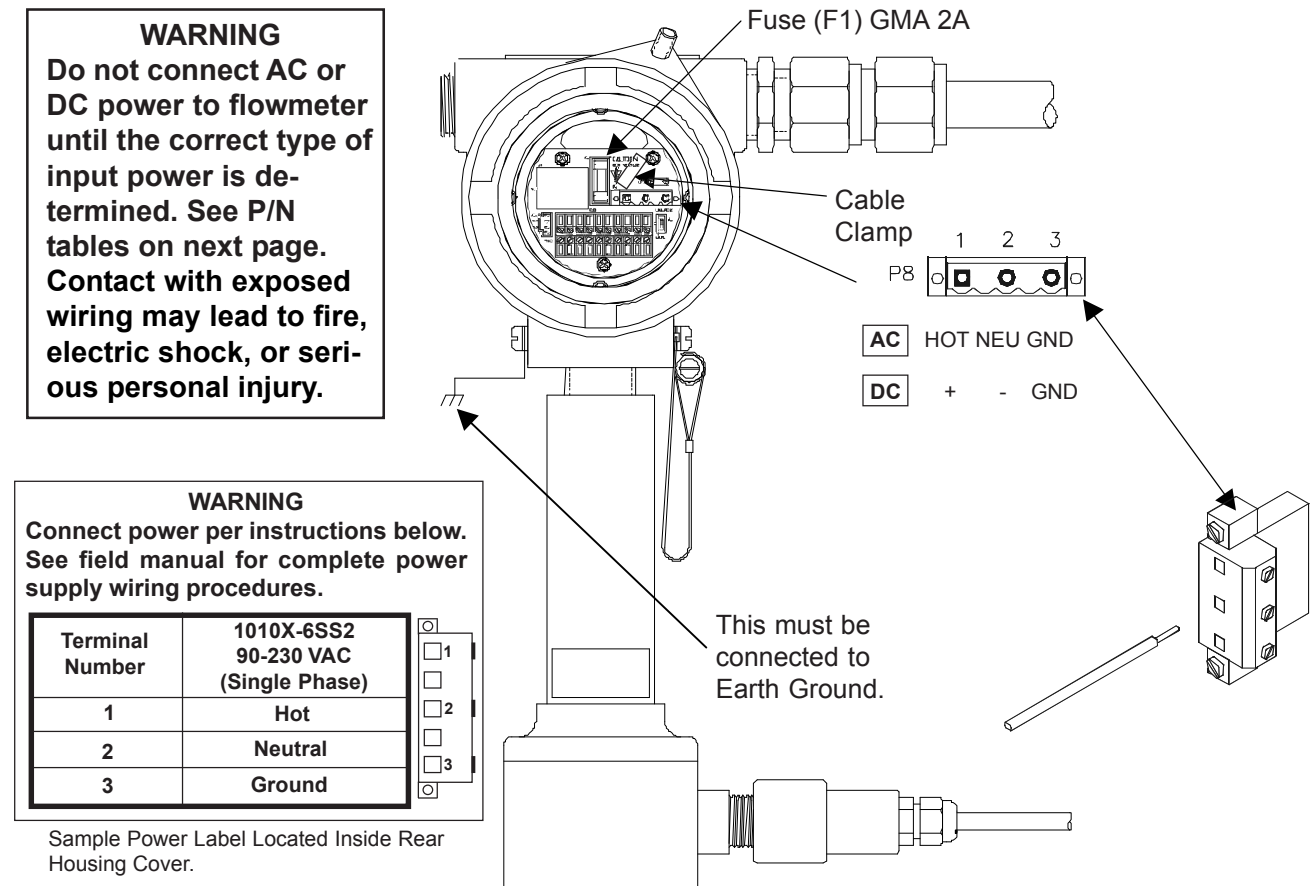
Replace the “Power Connections” description and set up procedure with the following. Note that paragraph numbers are different for all the above mentioned manuals. The example below is for the 1010X manual.

NOTE: For flowmeters refer to drawings 1010X-7 (1 of 3) & 1010DX-7 (1 of 3) and for Interface Detectors refer to drawings 1010BX-7 (1 of 3) & 1010BDX-7 (1 of 3).

2.2 POWER CONNECTIONS

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

The standard 1010X flow computer either requires 100/120/200 VAC or one of three 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.



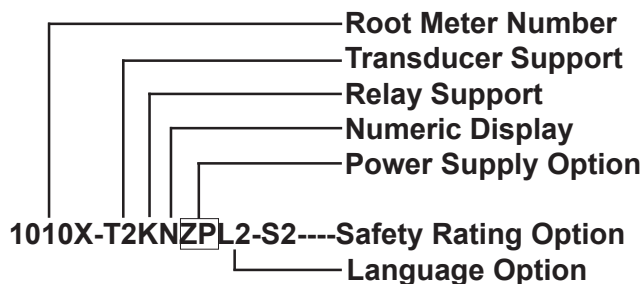
2.2.2 POWER SUPPLY WIRING

- Using a 1/16" Hex key, loosen the 1010X Rear Housing Cover locking setscrew.
- Unscrew the Rear Housing Cover and remove.

IMPORTANT: Power Supply label is located inside the Rear Housing cover.

- Locate power supply connector J8. Use the tables below and the part number of your unit to determine the correct input power source. (See also metal ID label on unit housing.)

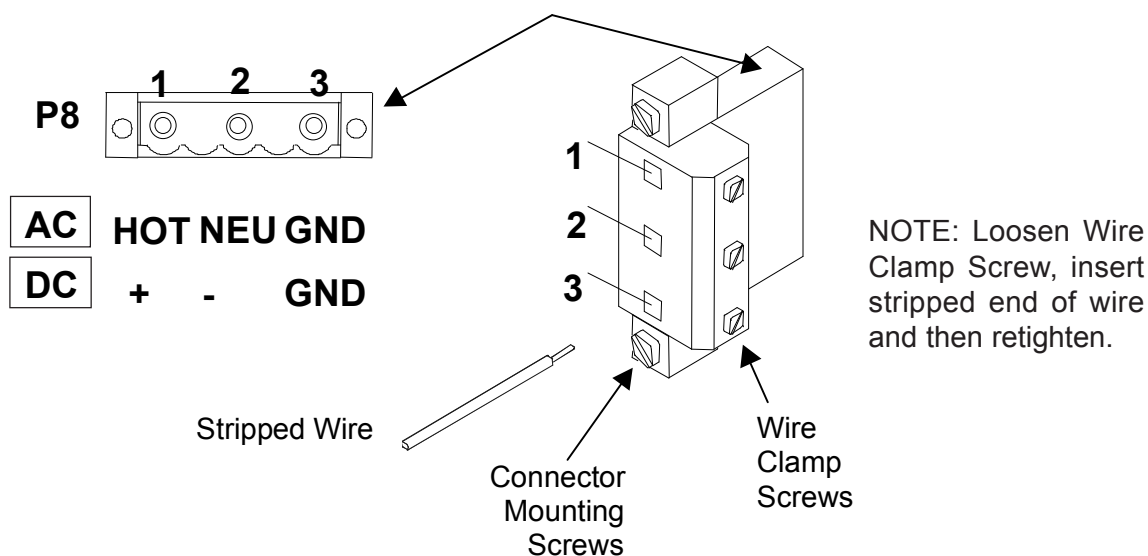
***Typical 1010X Part Number Construction:**



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

- 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.

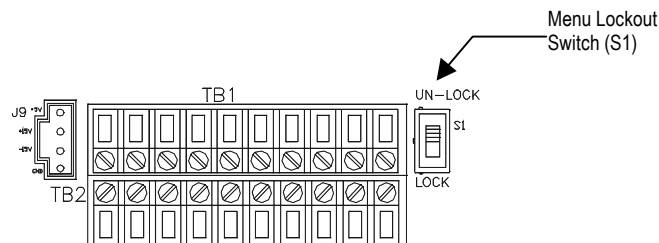
Input Power Connector (P8) Wiring

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 appropriate manual section for TB1 and TB2 signal wiring.)



MANUAL ADDENDUM

Digital P-Gen Applications Procedure Update

**Manual Addendum
September 2008**

Digital P-Gen Applications Procedure Update

INTRODUCTION

The following Digital P-Gen applications procedure is to be added to the Data Span/Set/Cal Menu section of the SITRANS liquid and gas flowmeter manuals listed below:

Gas Flowmeter Manuals

FUG1010 IP 65 (NEMA 4X) Clamp-On Gas Flowmeter manual (CQO:1010GCNFM-3)
 FUG1010 IP 65 (NEMA 7) Compact Clamp-On Gas Flowmeter manual (CQO:1010GCXFM-3)
 FUG1010 IP 65 (NEMA 7) Compact Insert Gas Flowmeter manual (CQO:1010GXFM-3)

Liquid Flowmeter Manuals

FUH1010 IP 65 (NEMA 4X) Clamp-On Flowmeter manual (CQO:1010DVNFM-3)
 FUH1010 IP 65 (NEMA 4X) Clamp-On Flowmeter manual (CQO:1010PVNFM-3)
 FUH1010 IP 65 (NEMA 7) Compact Clamp-On Flowmeter manual (CQO:1010DVXFM-3)
 FUH1010 IP 65 (NEMA 7) Compact Clamp-On Flowmeter manual (CQO:1010PVXFM-3)

DIGITAL P-GEN APPLICATIONS PROCEDURE

Adjusting the PGEN Output

The default setting for the Digital PGEN output provides a 5000 Hz frequency at an assumed maximum velocity of 100 ft/sec. In certain cases it may be necessary to change this default PGEN value. For example:

- If the PGEN signal cable is very long, then the added cable capacitance may prevent reliable RTU pulse detection at or near 5000 Hz. In this case it may be necessary to decrease the PGEN (Pulses / Unit Volume) setting using the equation below.

$$Pulses / UnitVolume = \frac{MaxFreq}{MaxFlow}$$

Where: *MaxFreq* = Maximum desired frequency (Hz)

MaxFlow = Maximum flow rate (Unit Volume / second)

- For very low operating flow rates, the pulse frequency may approach the 20 Hz limit of the PGEN output. In this case it may be necessary to increase the PGEN (Pulses / Unit Volume) setting.

$$Pulses / UnitVolume = \frac{MinFreq}{MinFlow}$$

Where: *MinFreq* = Minimum desired frequency (Hz). **Must be greater than 20 Hz!**

MinFlow = Minimum operating flow rate (Unit Volume / second)

Note: If STD VOL is selected then the "unit volume" for PGEN will represent Standard Volume, not actual volume.

Forcing the PGEN Output Frequency

To test the operation of the flowmeter with an RTU, or other pulse counting device, it may be necessary to force the PGEN output frequency, especially when the pipeline is not flowing during flowmeter commissioning. This can be accomplished by setting the AnCal diagnostic value to a flow rate corresponding to the desired frequency output. (Refer to the appropriate paragraph in your manual for operation of the AnCal function.)

The example below demonstrates how to calculate the AnCal flow rate based on the desired pulse output frequency and the entered PGEN (Pulses / Unit volume) setting:

For PGEN setting = **53** Pulses /CU FT and a desired frequency = **1000** Hz

1. Temporarily change flow rate units to *CU FT / SEC* (Use same volume units as Totalizer.)
2. Set AnCal = **1000 / 53** = 18.868 CU FT / SEC
3. 1000 Hz frequency should now be observed on the PGEN output.

MANUAL ADDENDUM

Digital Damping Procedure Update For Gas & Liquid Flowmeters

**Manual Addendum
September 2008**

Digital Damping Procedure Update for Gas & Liquid Flowmeters

INTRODUCTION

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

FUG1010 Gas Clamp-on Flowmeter Manuals

Digital Damping Control: (Hot Key 1 and 2)

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

Test Facilities Graph Screen

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

[MinDamp] Command

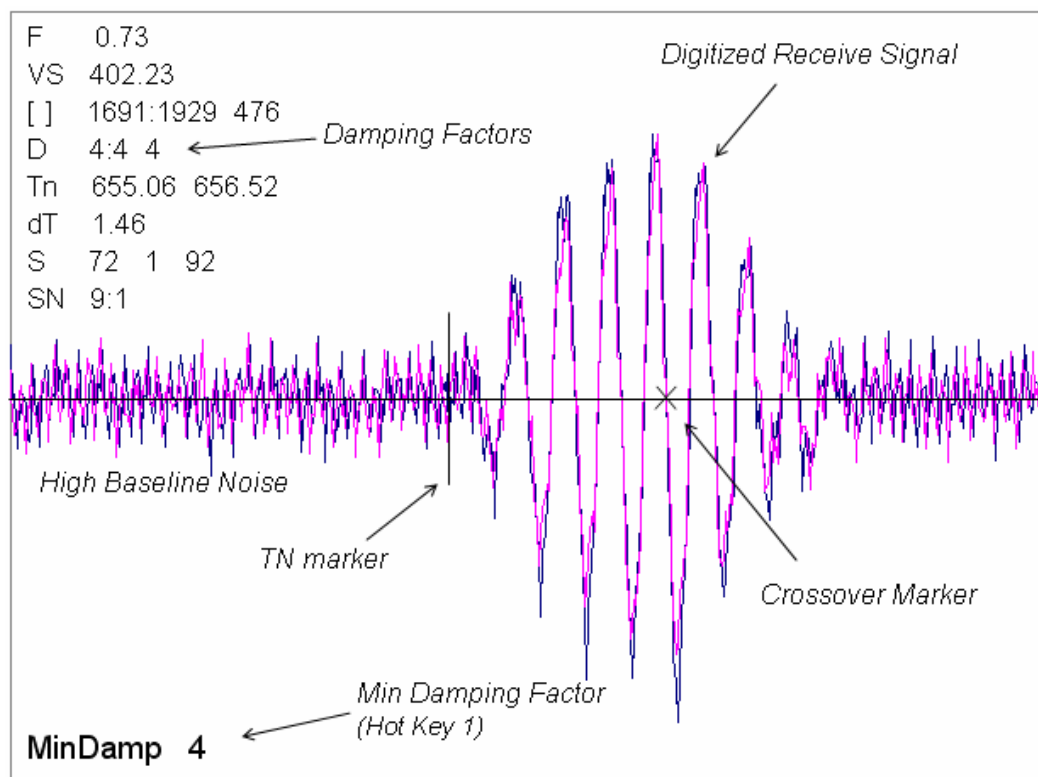
Pressing the <1> key will cause [MinDamp #] to appear on the command line at the lower left-hand corner of the screen. The number listed to the right of the command code represents the exponent in the FUG1010 exponential averaging routine, where the larger the number the greater the digital averaging.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

[MaxDamp] Command

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

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

1. To use the Test Facilities Graph Screen you must have a working site.
2. To activate the Test Facilities Graph Screen:
 - In the main menu, scroll to the [Diagnostic Data] menu and select [Test Facilities].
 - Scroll down to [Graph], press the <Right Arrow> and highlight [Yes]. Press <ENT> to select.
 - The Test Facilities Graphic Screen will appear on the meter display as shown below.



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

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

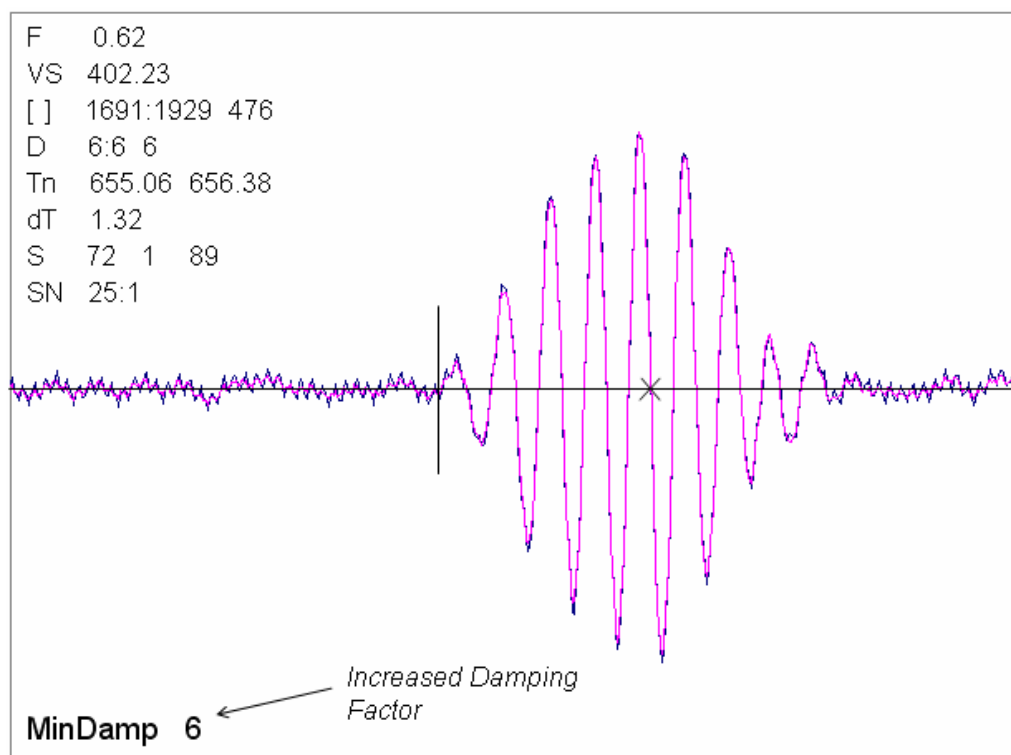
- Close proximity to pressure control valves which may generate in-band acoustic noise
- Very low acoustic signal levels (ALC < 40%)
- High electronic noise from variable frequency drives or other external equipment.

To INCREASE the Digital Damping:

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

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

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



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

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

To DECREASE the Digital Damping:

1. Press the <2> key while viewing the Test Facilities Graph Screen. The damping control [MaxDamp #] should appear on the command line at the lower left-hand corner of the screen.
2. Pressing the <-> key will decrease the MaxDamp Factor by one unit for each key press. To exit this mode, press the <0> key on the keypad.

Liquid Clamp-on Flowmeter Manuals

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

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

Digital Damping Control: (Hot Key 1 and 2)

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

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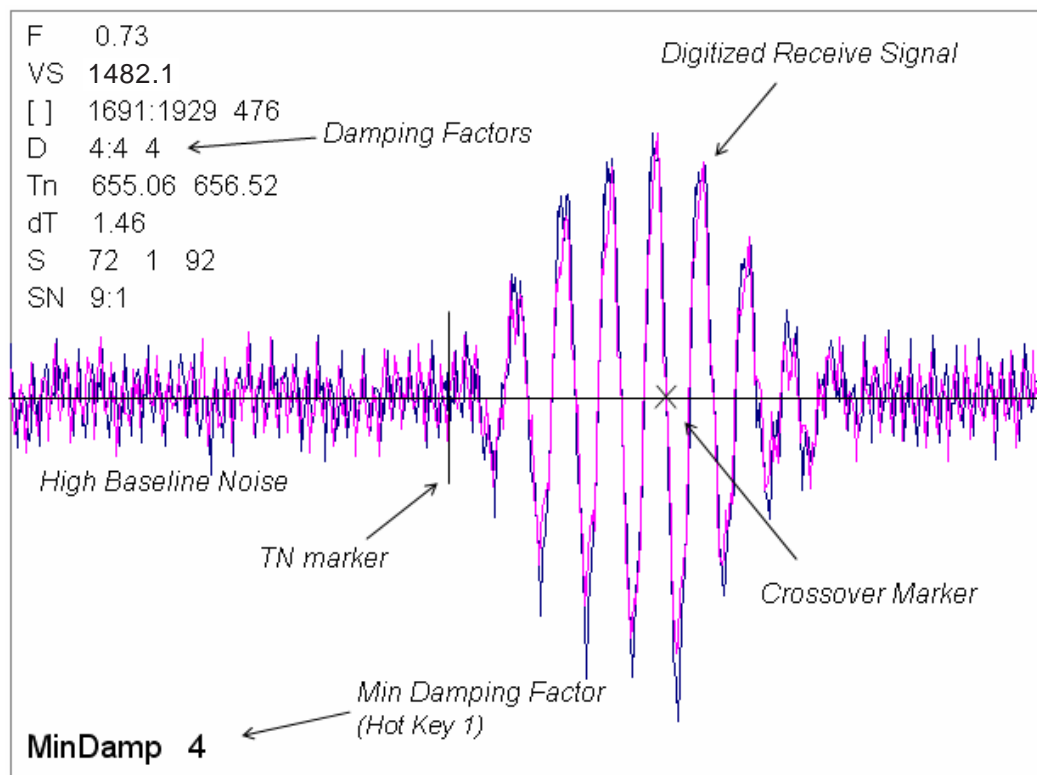
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Setting the Digital Damping Factor to a value HIGHER than the default value of 4 may be necessary in cases where the signal to noise ratio (SN) is found to be unacceptably low (<15:1), but only if the noise is determined to be asynchronous (i.e., not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

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

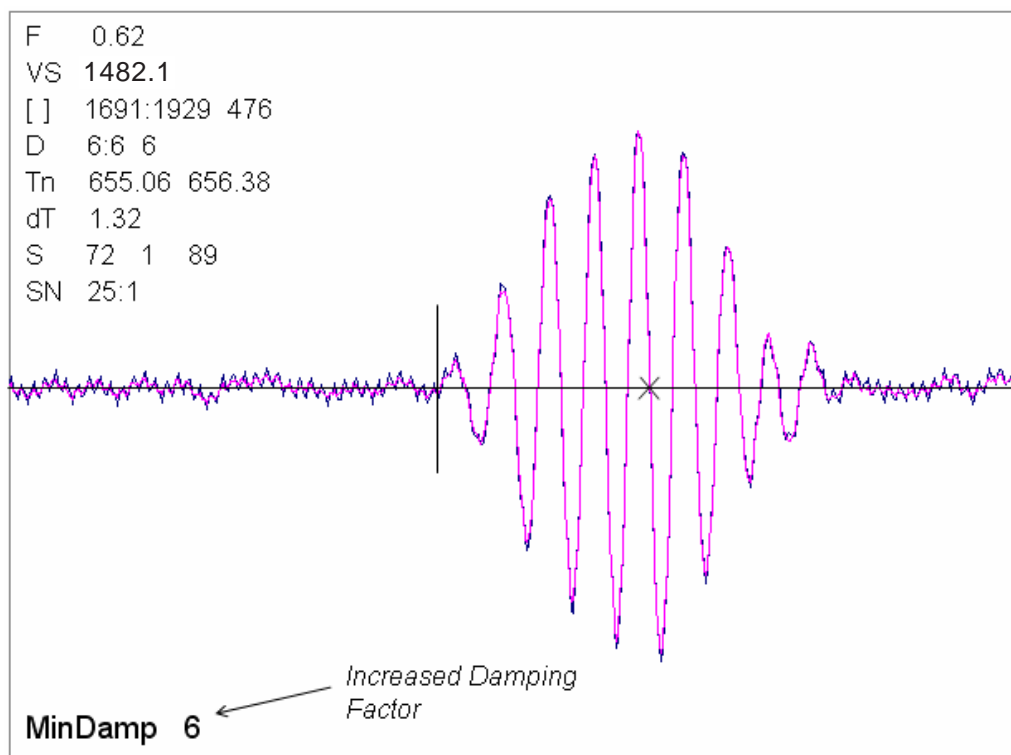
- Close proximity to pressure control valves which may generate in-band acoustic noise
- High un-dissolved gas solids content in liquid.
- High electronic noise from variable frequency drives or other external equipment.

To INCREASE the Digital Damping:

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

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To DECREASE the Digital Damping:

1. Press the <2> key while viewing the Test Facilities Graph Screen. The damping control [MaxDamp #] should appear on the command line at the lower left-hand corner of the screen.
2. Pressing the <-> key will decrease the MaxDamp Factor by one unit for each key press. To exit this mode, press the <0> key on the keypad.

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Couplant Installation Instructions

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1. INTRODUCTION TO THE 1010GCX/GCDX NEMA-7 FLOWMETER

Congratulations on purchasing the System 1010GCX/GCDX NEMA-7 flowmeter. For use in dedicated applications, the 1010GCX 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 Controlotron’s unique enhanced transit-time digitally coded Multi-Pulse™ technology.

1.1 1010GCX METER TYPES

1010GCX Single Channel and 1010GCDX Dual Channel System NEMA-7

The 1010GCX series flowmeters are available in Single and Dual Path versions. 1010GCX flowmeter components are housed under internal metal shields and are compliant with CE EMI/RFI specifications. The flowmeter includes a display providing flow rate and diagnostics data and includes an integral Magnetic Wand interface to access on-screen software setup menus. 1010GCX series flowmeters have hazardous area certification **EEx d [ia] IIC T5**.

CAUTION: *Please review the safety considerations below before proceeding.*

1.2 IMPORTANT SAFETY CONSIDERATIONS

The System 1010GCX Gas flowmeter is electrical equipment that operates from either an external DC or AC power source. Please observe all the electric safety codes, etc., that apply to your application. We recommend that only experienced personnel with knowledge of local electrical codes and operating safety procedures of the facility 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.

Controlotron 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 gas characteristics, perilous atmosphere, etc.), the end-user must ensure that only properly trained personnel are involved in the installation and operation.

1.3 SYSTEM HARDWARE DESCRIPTION

System 1010GCX 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 (see paragraph 1.4).

1.4 DESCRIPTION OF THE 1011GCS TRANSDUCERS

All Controlotron Ultrasonic Gas Systems use the “time-of-flight” technique for flow measurement and depending on the spool size and required accuracy, one or more ultrasonic beams may be employed. Clamp-on ultrasonic transducers are paired with a common serial number with either an “A” or “B” suffix to denote the two transducers of the pair.

Transducers are installed directly onto the outside surface of the pipe wall, which acts as a waveguide for the transmission of ultrasound into the gas medium. Since clamp-on transducers are 100% non-intrusive they cannot foul as a result of condensate or carbon buildup, and if necessary can be easily removed without disrupting flow and without need for special extraction tools.

1.5 GENERAL DESCRIPTION OF THE 1011GC CLAMP-ON TRANSDUCERS

All 1011GC Clamp-On ultrasonic gas transducers are rated for hazardous area use with an **EEX ia IIC T5** rating. Since these transducers are completely non-intrusive, a rapid decompression of the gas line will not adversely affect the transducers.

Transducers are installed with mounting hardware, which accurately positions the transducers on the outside wall of the spool body. The spacing between the transducers is controlled by use of an Indexing Strip. These Indexing Strips include numbered positions that are referenced by the flow meter electronics to insure accurate transducer spacing. A general description of the 1011GC transducers is listed below, along with their main features and operating limitations:

1010GCS Transducer code and operating limitations:

Transducer Code	Frequency Range	Transducer Description	Operating Temp Range	Maximum Operating Pressure	Wetted Material
1011GCSa-bT1-c	3 Mhz to 160 KHz	Clamp-On (external mount)	-40 to 150 deg F (-40 to 65 deg C)	To limit of Spool Flange Rating	None
1011GCSa-bT2-c			30 to 220 deg F (-1 to 104 deg C)		
1011GCSa-bT3-c			90 to 250 deg F (32 to 121 deg C)		

Where: a = Precision code
b = Size and frequency code
c = Safety code

1.6 INTRODUCTION TO THE 1010GCX OPERATING SYSTEM

The System 1010GCX software resides on Flash ROM chips. Software upgrades are easily implemented by simply replacing these chips either at the factory or in the field. 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.

1.6.1 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 Spool ID, 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. 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.

1.6.2 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 may invalidate the site setup, thus requiring a reinstallation.

1.6.3 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 than 300 feet, please contact Controlotron 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 1010GCX 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 (Pgen) varies from 0-5000 Hz in proportion to any user-selected data function (Single Path meters only)

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 16-inch pipe for flow above 1 ft/sec:

Calibration Accuracy	0.25% to 0.5% of rate (High precision transducers) 1.0% to 2.0% of rate (Universal transducers)
Repeatability	0.10% (High Precision transducers) 0.25% (Universal transducers)
Resolution	0.001fps (0.0003 m/s)
Flow Slew Rate	80 ft/sec ²

1.7 SPECIFICATIONS

NOTE: Refer to Appendix A Installation/Outline Dimension drawings for detailed transducer specifications.

Temperature: <i>Operational and Storage</i>	Operating Temperature Electronics: 14°F to 122°F (-10°C to 50°C) LCD display: 14°F to 122°F (-10°C to 50°C) Storage Temperature Electronics: -4°F to 140°F (-20°C to 60°C) <i>*Transducer temperature ratings depend on the individual transducer type(s).</i>
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 1 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	Stainless Steel Case Dial-up Modem One RTD temperature sensing channel (measures clamp-on liquid temperature) Blind System (programming via serial link only)

Application:

Natural Gas, Flare Gas, Process Gas, Fuel Gas

Pipe Sizes from 1" to 60" (25mm to 1525 mm). Smaller and larger pipes available on special order.

Transducers:

No. of Paths: 1 or 2 path systems (depending on body size and accuracy requirements).

Temperature Range: -40 to 250 F (-40 to 120 C)

Type: Nonintrusive, externally mounted

Performance Specifications:

Flow Range: 0 to ±150 ft/s (46 m/s) Bi-directional (depending on pipe size)

Repeatability: ±0.1%

Accuracy: ±0.5% with calibration

Rangeability: 50:1 (100:1 extended range)

Resolution: 0.001 ft/s (0.0003 m/s) typical

Flow Meter Computer / Transmitter:

Enclosure: NEMA 7/EEExd-rated Explosion Proof

Power Supply: 900-250VAC, 60/60 Hz, 9-36VDC for all models

Power Consumption: <15 Watts

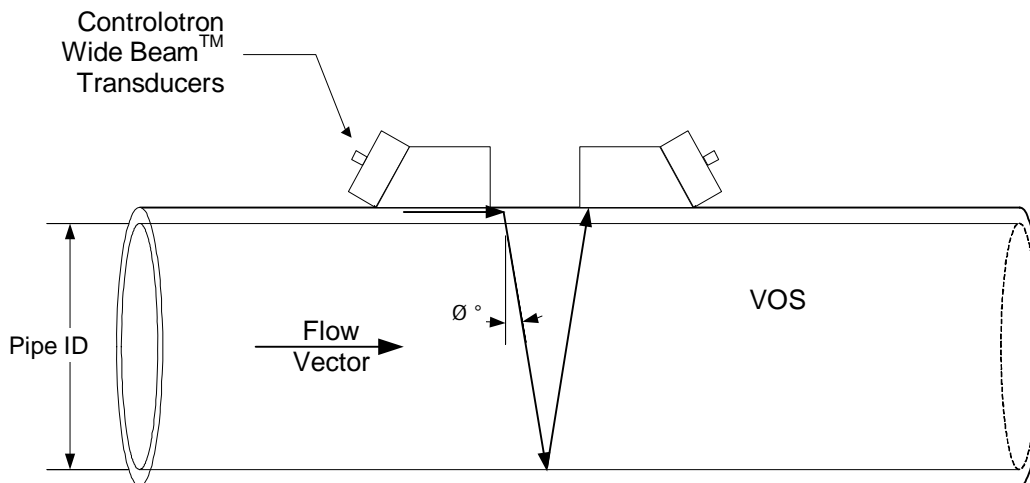
1.8 THEORY OF OPERATION

1.8.1 INTRODUCTION

The System 1010GCX Clamp-on Gas meter relies on the same Digitally Coded MultiPulse™ transit-time technology used in our patented 1010 line of liquid flowmeters. Two Wide-Beam™ ultrasonic transducers per measuring path, alternating as transmitter and receiver, are used to interrogate the gas flowing within the metering section. The resulting time of arrival for each direction of transmit (upstream and downstream) is then measured using a highly accurate and stable digital phase detection circuit.

Using this detection scheme, the 1010GCX Gas meter is capable of resolving the relative transit-time difference (dT) to within ± 100 psec. Considering typical gas flow transit-time differences ranging from 100×10^3 to 10×10^6 psec, the 1010GCX meter is capable of providing an exceptional turn-down ratio. The 1010GCX also incorporates a correlation technique which enables the system to detect very high flow velocities with the same high degree of resolution. The 1010 ultrasonic transducers are designed with sufficient beam divergence characteristics to insure that the receive transducer will always have sufficient signal to maintain operation under conditions of high beam blowing associated with high flow velocities.

With accurate signal arrival time available, the flow meter can compute the raw flow velocity from the measured upstream and downstream transit times.



$$\theta^\circ = \sin^{-1}(VOS / V_{\text{phase}})$$

$$T_L = 2 * ID / (VOS * \cos\theta)$$

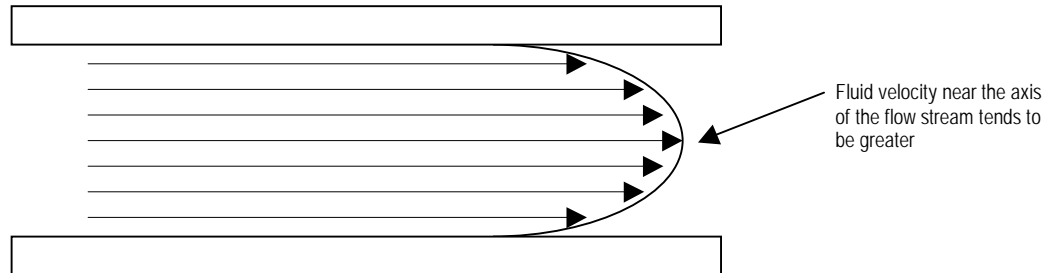
$$V_F = V_{\text{phase}} * DT / (2 * T_L)$$

Where:

- VOS = Velocity of Sound in Gas
- V_{phase} = Phase Velocity of Transducer
- ID = Pipe Inside Diameter
- T_L = Transit time in Gas
- DT = Measured Transit-Time difference

1.8.2 FLOW PROFILE COMPENSATION

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.



Although gas has a very low absolute viscosity, its kinematic viscosity can be greater than water. The 1010GCX flowmeter continually computes the kinematic viscosity (centistokes) by dividing the fixed viscosity entry (from gas parameters menu) by the computed gas density (see paragraph 1.8.3). The Reynolds number is then computed as follows:

$$Rn = \frac{645 * \text{Pipe ID} * V_F}{\text{Viscosity}} \quad \text{where viscosity} = cS = cP/\text{density}$$

The meter then uses this computation of Reynolds number to compensate the raw flow velocity for conditions of laminar or turbulent flow profile as defined by an internal Reynolds compensation table. The meter then converts the compensated flow velocity to volumetric flow rate.

$$\text{Rate} = V_F * \text{Comp}(Rn) * \text{Pipe area}$$

1.8.3 STANDARD VOLUME COMPENSATION

Due to the high compressibility of gas, volumetric flow rate and total are commonly reported in *standard volume* (or normal) units. This requires the 1010GCX flowmeter to dynamically compensate the actual measured volume to the volume anticipated at some specified reference pressure and temperature (referred to as base press and base temp in the Gas Parameters menu).

To compute this volume correction the flowmeter requires the input of actual operating temperature and pressure. With this information the flowmeter computes the standard flow rate as shown: Note: The flowmeter allows for a fixed entry of the gas compressibility factor or provides dynamic AGA8 compensation via an internal lookup table for standard volume compensation. If the gas composition varies significantly then an AGA8 volume compensating flow computer must be used where very high volume correction accuracy is required.

$$\text{Std. Rate} = Q_{\text{act}} \cdot \frac{P_{\text{act}}}{P_{\text{base}}} \cdot \frac{T_{\text{base}}}{T_{\text{act}}} \cdot \frac{Z_{\text{base}}}{Z_{\text{act}}}$$

where: Q = Volumetric flow rate
 P = Pressure (absolute)
 T = Temperature (absolute)
 Z = Compressibility
base = Base conditions (pressure and temperature)
act = Actual flowing condition (pressure and temperature)

1.8.4 MASS FLOW COMPUTATION AND SPECIFIC GRAVITY

The 1010GCX flowmeter includes two different methods for computing the actual density of the gas being metered. The first method takes advantage of the transit-time measurement of the gas sound velocity (VOS or V_s) along with the measured temperature and the input of the gas specific heat ratio to determine the average specific gravity of the gas. This method is suitable for lower pressure applications where the gas composition varies dramatically.

The second method requires the input of an AGA8 based volume compensation table, which contains both the Z-factor and gas density for a specified range of pressure and temperature. This method is suitable for any pressure and temperature as long as the gas composition does not vary significantly, however a new table can be generated and installed to accommodate changes in gas composition. As with the standard volume compensation, a flow computer and gas chromatograph should be used where very high accuracy is required.

2. POWER CONNECTIONS AND PRELIMINARY SETUP

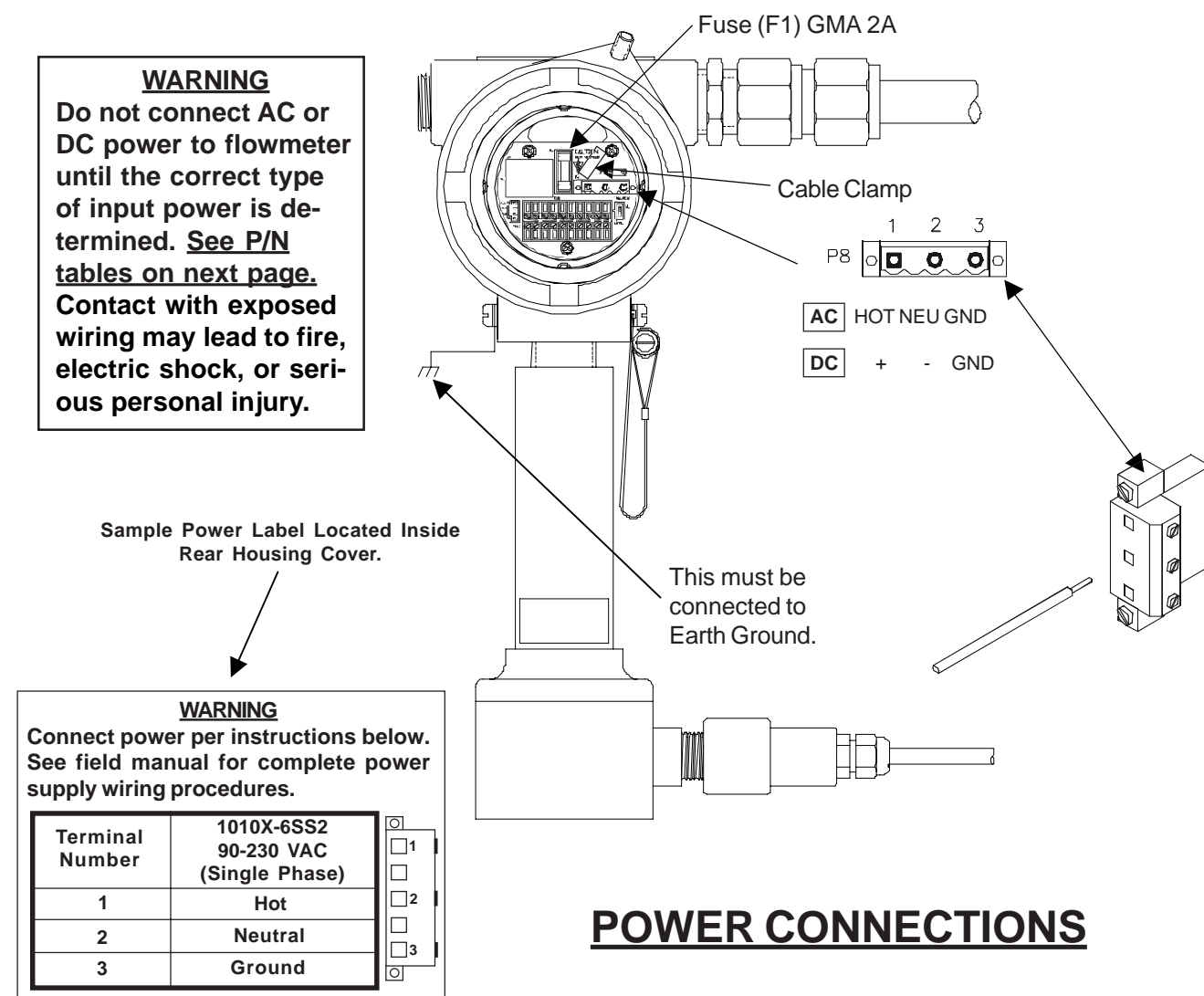
This section provides instructions for the safe installation of Controlotron's 1010GCX Clamp-on Gas system including AC/DC input power connections, menu lockout switch settings, flowmeter mounting procedures, connecting input/output signal wiring, temperature sensor installation and flowmeter power-up procedures.

2.1 POWER CONNECTIONS - (Refer to drawing 1010DX-7 Sheet 1 of 3)

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

CAUTION: Use conduit fittings or cable glands at all cable entries, including the input power wiring entry hole. Install weather tight seals at all unused holes.

The standard 1010GCX flow computer either requires 100/120/200 VAC or one of three 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.



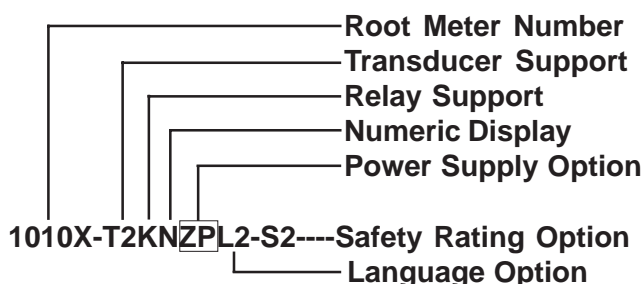
2.1.2 POWER SUPPLY WIRING

- Using a 1/16" Hex key, loosen the 1010X Rear Housing Cover locking setscrew.
- Unscrew the Rear Housing Cover and remove.

IMPORTANT: Power Supply label is located inside the Rear Housing cover.

- Locate power supply connector J8. Use the tables below and the part number of your unit to determine the correct input power source. (See also metal ID label on unit housing.)

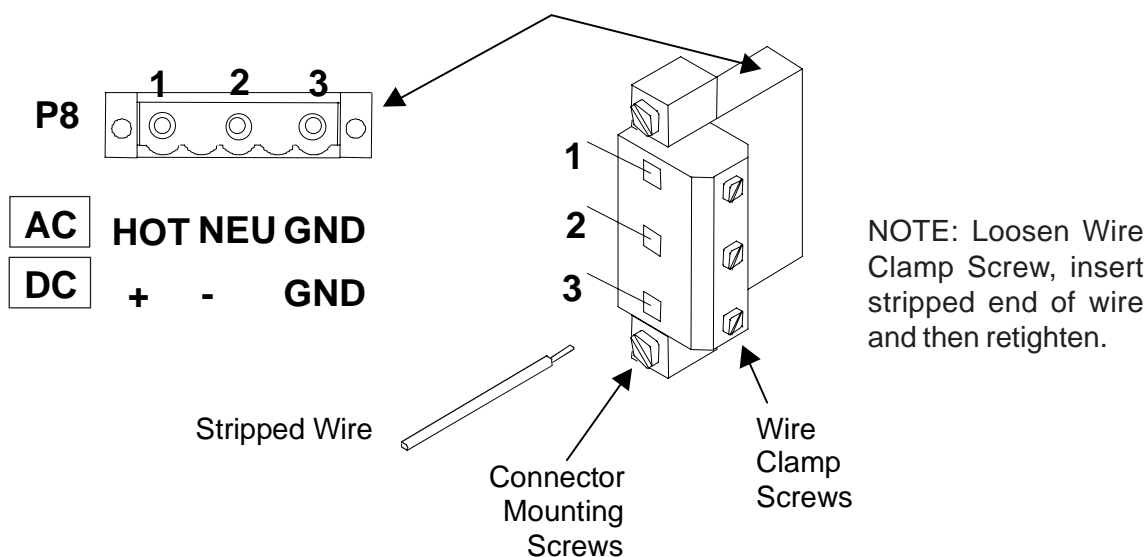
***Typical 1010X Part Number Construction:**



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

- 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.

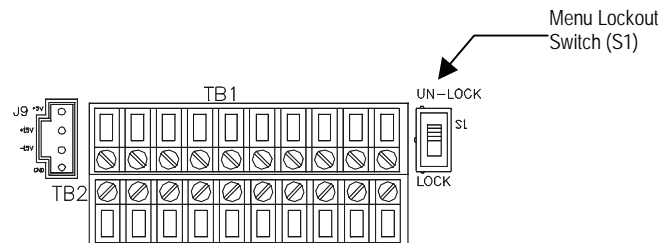
Input Power Connector (P8) Wiring

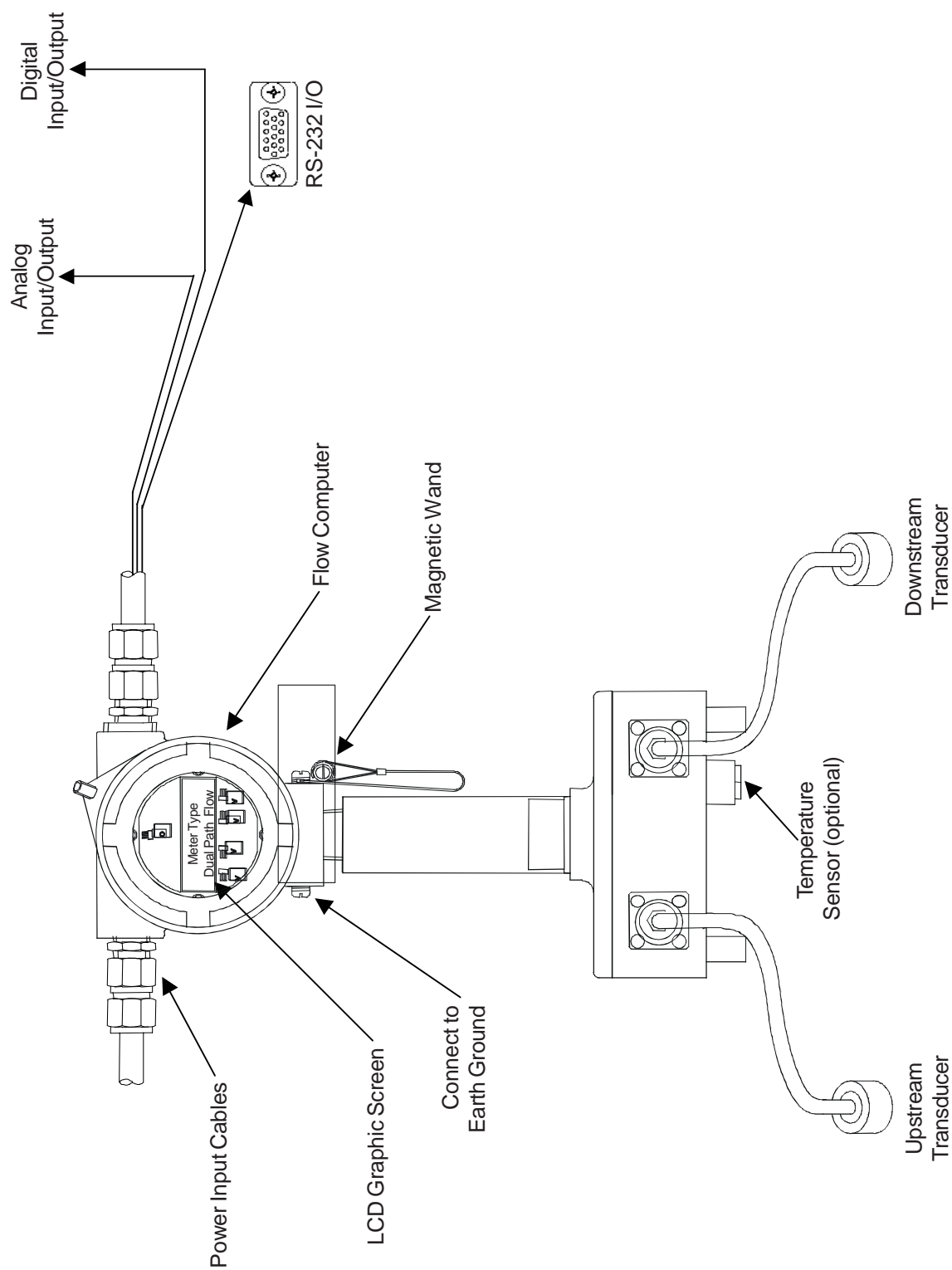
NOTE: The input power connector consists of a removable wire plug and PCB header located on the 1010X-8 I/O module. Two screws secure the wire plug to the header. The connector assembly is fully polarized for fast and easy mating. The wire plug accepts stranded or solid conductors of AWG 12 - 18. To 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 1010GCX includes a menu lockout switch to prevent unauthorized access to the Installation Menu. In addition, a password entry option is available (see Chan/Path 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 paragraph 2.4.1 Input/Output Wiring for TB1 and TB2 signal wiring.)

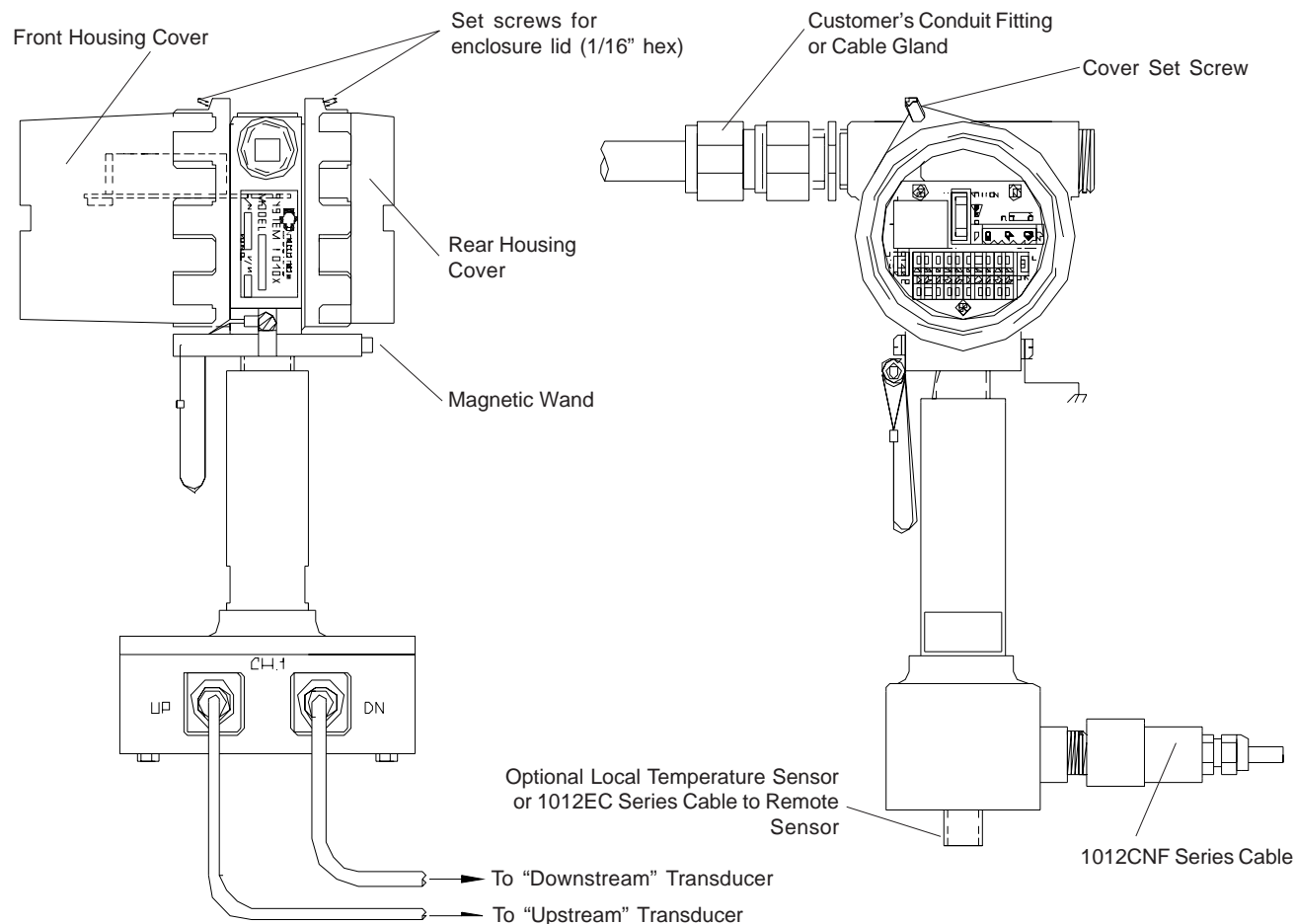


**1010GCDX INTERCONNECTION DIAGRAM**

2.3 MOUNTING THE 1010GCX FLOW COMPUTER

This section explains how to mount the flow computer assembly and how to complete the Input/Output wiring. Please refer to the engineering drawings located in Appendix A that provide important installation information that does not appear in this section.

The 1010GCX Flow Computer is shown below in the standard upright mounting position. Please refer to Installation/Outline Drawing 1010DXS2-8 in Appendix A of this field manual for outline dimensions, etc.

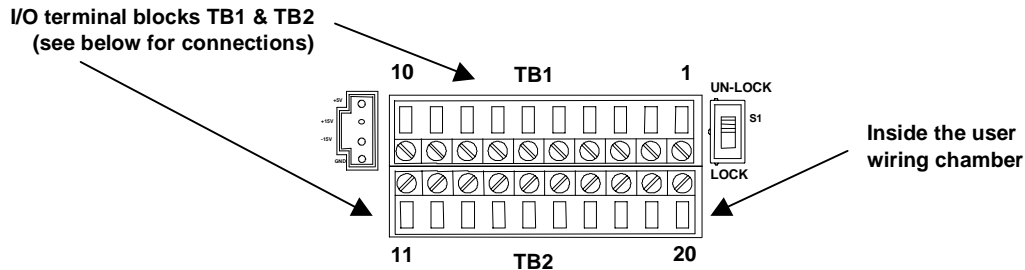


NOTE: All enclosure lids are secured with set-screws. This is required to maintain the explosion-proof ratings. You will need a 1/16" hex key to remove and replace enclosure lids.

2.4 INPUT/OUTPUT WIRING

The following tables and illustration describe the 1010GCX and 1010GCDX (Custody Transfer Model) input/output signals. Consult the Installation/Outline Drawings in Appendix A for details regarding I/O and transducer connections for your specific model.

2.4.1 1010GCX INPUT/OUTPUT WIRING (TB1 and TB2)



1010GCX INPUT/OUTPUT WIRING (TB1)

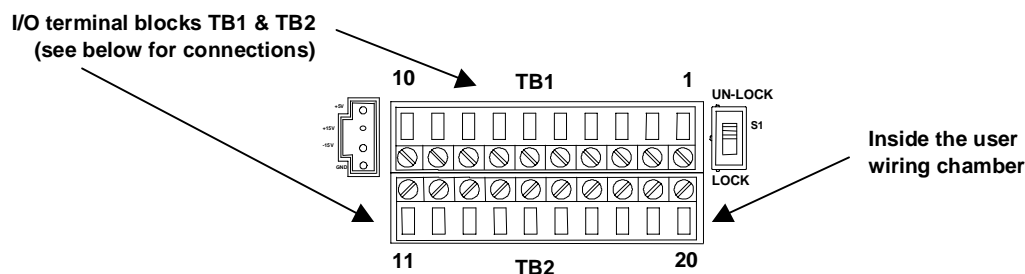
PIN#	SIGNAL	FUNCTION	NOTES
1	Io2 (-)	ISOLATED LOOP RETURN	4-20 mA output proportional to spanned selected variable.
2	Io2 (+)	ISOLATED LOOP SUPPLY	
3	Io1 (-)	ISOLATED LOOP RETURN	
4	Io1 (+)	ISOLATED LOOP SUPPLY	
5	ANIN 2	4-20mA Input CH. 2	4-20 mA input non-isolated
6	ANIN 1	4-20mA Input CH. 1	
7	STATUS (-) 1	STATUS BIT RETURN	CH. 1 Status Alarm Emitter
8	STATUS (+) 1	STATUS OUTPUT	CH. 1 Status Alarm Collector
9	STATUS (-) 2	STATUS BIT RETURN	CH. 2 Status Alarm Emitter
10	STATUS (+) 2	STATUS OUTPUT	CH. 2 Status Alarm Collector

1010GCX INPUT/OUTPUT WIRING (TB2)

PIN#	SIGNAL	FUNCTION	NOTES
11	Tx	RS-232 Transmit	Standard RS-232 Signals
12	RTS	RS-232 Request To Send	
13	DTR	RS-232 Data Term. Ready	
14	Rx	RS-232 Receive	
15	CTS	RS-232 Clear To Send	
16	GND	Ground	
17	D1 INPUT	Digital Input CH. 1	Isolated Digital Command Lines
18	D1 RETURN	Digital Return	
19	D2 INPUT	Digital Input CH. 2	
20	D2 RETURN	Digital Return	

2.4.2 1010GCDX INPUT/OUTPUT WIRING (TB1 and TB2) CUSTODY TRANSFER (Ultra Performance Flowmeter)

The following tables and illustration describe the 1010GCDX input/output signals for the Ultra Performance Custody Transfer flowmeter. Consult the Installation/Outline Drawings in Appendix A for details regarding I/O and transducer connections for your specific model.



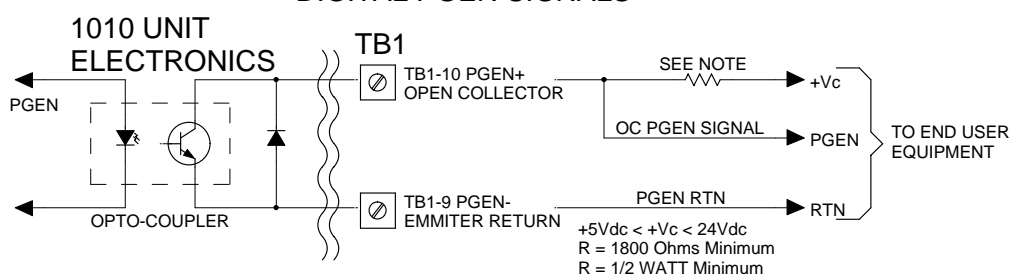
1010GCDX INPUT/OUTPUT WIRING (TB1)

PIN#	SIGNAL	FUNCTION	NOTES
1	Io2 (-)	ISOLATED LOOP RETURN	4-20 mA output proportional to spanned selected variable.
2	Io2 (+)	ISOLATED LOOP SUPPLY	
3	Io1 (-)	ISOLATED LOOP RETURN	
4	Io1 (+)	ISOLATED LOOP SUPPLY	
5	ANIN 2	ANALOG IN (4-20mA)	4-20 mA input non-isolated.
6	ANIN 1	ANALOG IN (4-20mA)	
7	STATUS (-) 1	STATUS BIT RETURN	CH. 1 Status Alarm Emitter
8	STATUS (+) 1	STATUS OUTPUT	CH. 1 Status Alarm Collector
9	PGEN -	PULSE OUTPUT -	Isolated PGEN Emitter (Custody Transfer meters-see below)
10	PGEN +	PULSE OUTPUT +	Isolated PGEN Collector (Custody Transfer meters-see below)

PGEN Wiring Diagram

The unit must be wired as shown below before assigning PGEN output pulses.

1010GCDX TB1 WIRING DIGITAL PGEN SIGNALS



PGEN

The [PGEN P/Unit Volume] menu cell entry controls a user assignable digital output pulse function and is available in Custody Transfer units only (designated by a "C" in their part number). It allows the user to assign PGEN digital signal pulses per unit of volume. For example, 100 output pulses per cubic foot of gas.

The default PGEN value is configured to provide a 5000 Hz output frequency at a flow velocity of 100 ft/sec (30 meters/sec).

NOTE: The unit of volume is determined by the Volume Units initially selected from the [Total Volume Units] menu cell option list (refer to paragraph 4.6.1).

To change the default PGEN settings:

From the [Span Data] menu press 

From the [PGEN P/Unit Volume] menu cell, press  to activate the numeric entry.

Use the numeric keys to enter the desired number of PGEN pulses per unit volume.

NOTE: Ensure that the number entered will provide sufficient resolution while remaining within the 20 Hz to 5000 Hz pulse frequency range. Note that the PGEN output will stop sending pulses at flow rates corresponding to frequencies less than 20 Hz. In this case the PGEN value must be increased.

To store the data press 

1010GCDX INPUT/OUTPUT WIRING (TB2)

PIN#	SIGNAL	FUNCTION	NOTES
11	Tx	RS-232 Transmit	Standard RS-232 Signals
12	RTS	RS-232 Request to Send	
13	DTR	RS-232 Data Term. Ready	
14	Rx	RS-232 Recieve	
15	CTS	RS-232 Clear to Send	
16	GND	Ground	
17	D1 INPUT	Digital Input CH. 1	Isolated Digital Command Lines
18	D1 RETURN	Digital Return	
19	D2 INPUT	Digital Input CH. 2	
20	D2 RETURN	Digital Return	

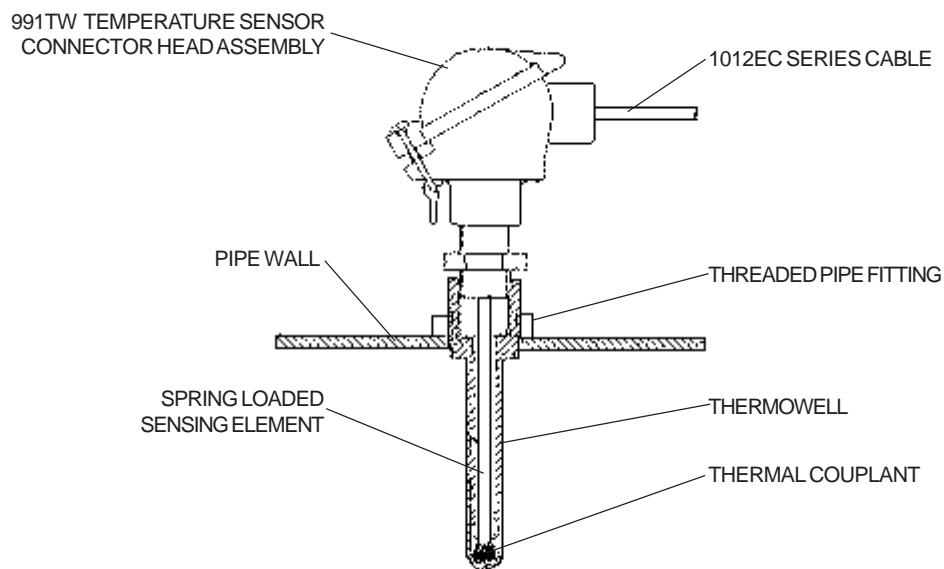
2.5 991TW THERMOWELL TEMPERATURE SENSOR (optional)

In order to accurately measure the gas temperature, the System 1010GCX flowmeter can operate with a 991TW Thermowell Resistive Temperature Device (RTD) sensor.

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

The 991TW insert sensors are designed to be used in pipes equipped with Thermowells. It incorporates 1000 ohm platinum RTD's for high precision. These temperature sensors 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 Controlotron Corporation.

The temperature sensor is 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.

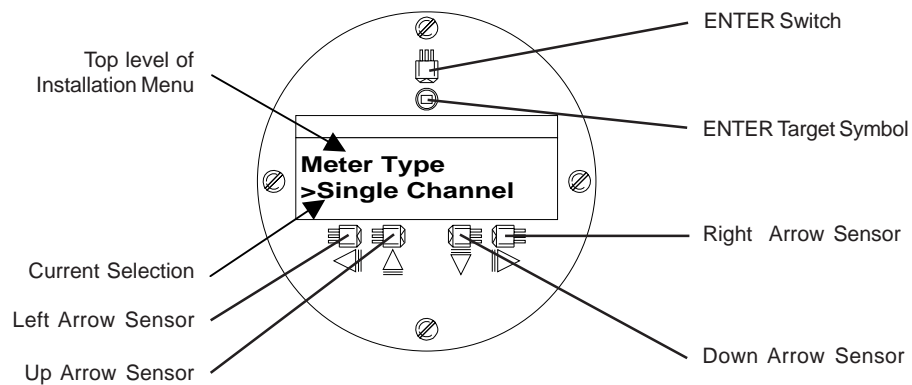


2.6 PRELIMINARY SETUP PROCEDURE

- Pressurize line, if necessary to achieve operation, and then check connections for leaks.
- Apply power to 1010GCX flowmeter.

Graphic Display Settings

- Within 30 seconds of power-up the flowmeter main display will become active.
- Using the Magnetic Wand, trigger the desired sensors to scroll between the available displays and modes (refer to Section 3).



NOTE: Typical display screen for factory-installed units.

3. GETTING STARTED

This section explains the two programming interfaces available for the 1010GCX 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.

3.1 IMPORTANT SAFETY CONSIDERATIONS

The System 1010GCX 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.

Controlotron 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.

3.2 FLOWMETER INSTALLATION SUMMARY

System 1010GCX 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 1010GCX contains a hierarchical menu structure consisting of sub-menus that contain individual menu locations we call menu cells.

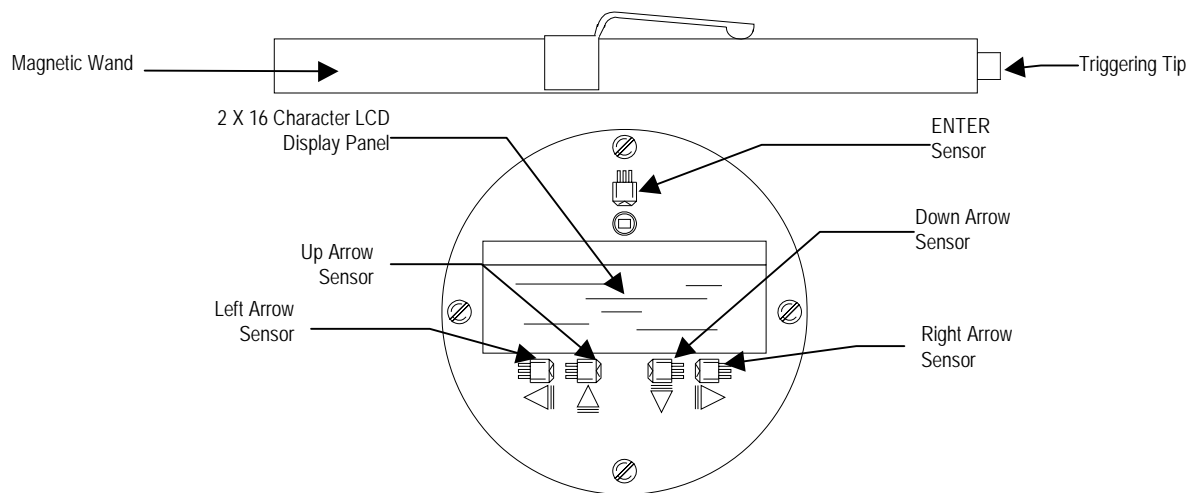
The Installation Menu Structure chart in this section appears comprehensive, however, do not let the size of the Installation Menu intimidate you. System 1010GCX is a universal instrument that serves many industries. Therefore, it provides a large number of functions and features. Most menu locations already have default values installed that never need to be edited unless you are interested in that specific function or feature.

3.3 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 1010GCX 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.

3.3.1 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 1010GCX MAGNETIC WAND AND LCD DISPLAY PANEL

3.3.2 OVERVIEW OF THE RS-232 INTERFACE

System 1010GCX 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™) serves as the interface. These programs reproduce the menu screens that appear on 1010 systems equipped with graphic display screens. Setup procedures for the 1010GCX 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.

Controlotron 2 Channel [1] XYZ	
Scroll saved Site Setup list and Enter	
Recall Site Setup	XYZ
Channel Enable	No
Create/Name Site	XYZ
Site Security	Off
Delete Site Setup	XYZ
Save Site	XYZ
Channel Setup	

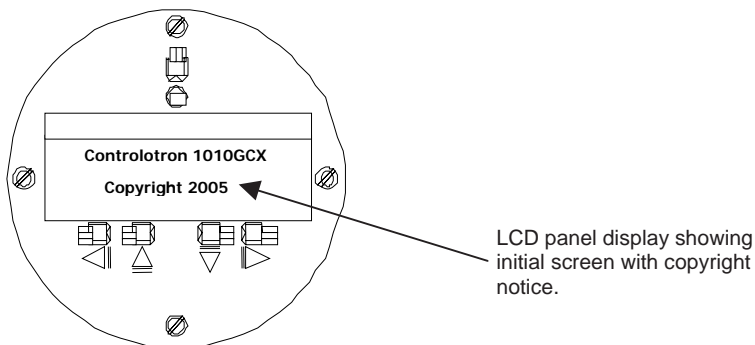
TYPICAL MENU SCREEN AS IT APPEARS IN A COMMUNICATION PROGRAM

3.4 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 Section 2 for Power Connections and Installation Drawing 1010DX-7 for wiring instructions before turning on unit.

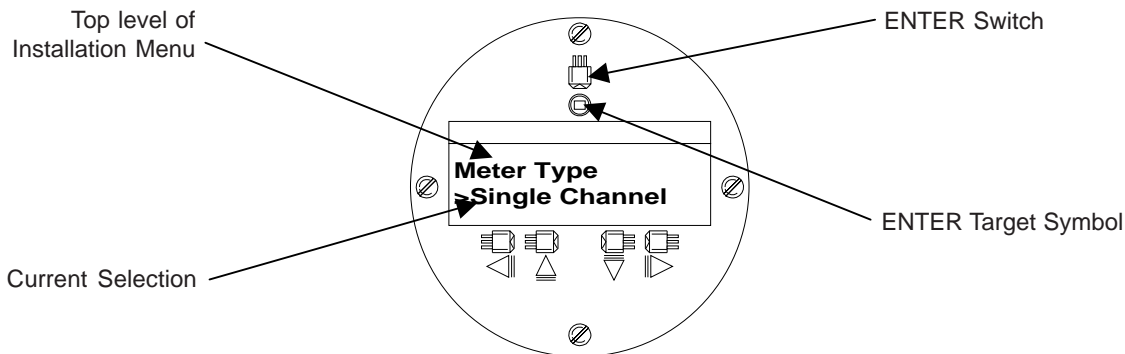
3.4.1 ACCESSING AND LEAVING THE INSTALLATION MENU

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.
- 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.

3.4.2 SYSTEM 1010GCX INSTALLATION MENU STRUCTURE

The 1010GCX 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 [Dual Path Flow] or [2 Channel Flow] and then [Channel 1] or [Channel 2]. Similarly, triggering the <Left Arrow> from either the [Dual Path Flow] or [2 Channel Flow] selections moves you back to [Meter Type].

INSTALLATION MENU STRUCTURE

Meter Type ⇌	Dual Path Flow ⇌	Chan/Path Setup ⇌	Recall Site Setup Channel Enable Create/Name Site Site Security Delete Site Setup Save/Rename Site
		Pipe Data ⇌	Select Path Pick Pipe Class Select Pipe Size Pipe OD (in) Pipe Material Wall Thickness Pipe ID (in) CC129 Thickness Pipe Configuration Anomaly Diams ThermExpCoef 1/F (Custody Transfer models) Mod of Elast PSI (Custody Transfer models)
		Gas Parameters ⇌	Base Temp. F Base Pres. PSIA Spec. Heat Ratio Viscosity (cP) Fixed MW g/mole Estimated Vs m/s Fixed Pres. PSIA Z Base Z Actual AGA8 Comp.

(continued)

INSTALLATION MENU STRUCTURE *(continued)*

Dual Path Flow ⇌	Pick/Install Xdcr ⇌	⇌ Install Path Transducer Model Transducer Size Xdcr Mount Mode Spacing Offset Number Index Spacing Method Ltn Value Install Complete? Zero Flow Adjust	
	Operation Adjust ⇌	⇌ Damping Control ⇌	⇌ Time Average SmartSlew
		⇌ Memory/Fault Set ⇌	⇌ Fault Memory
		⇌ Memory Delay <sec>	xxx (numeric entry)
	Flow/Total Units ⇌	⇌ Flow Vol Units Std Vol. Corr 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 ⇌	⇌ PGEN (Custody Transfer meters only) Max Flow (Units) Min Flow (Units) Max Flow2 (Units) Min Flow2 (Units) Max Vs m/s Min Vs m/s Max S.G. Min S.G. Max Base S.G. Min Base S.G. Max Viscosity cS Min Viscosity cS Max Temperature Min Temperature
		⇌ Set Alarm Levels ⇌	⇌ Hi Flow Low Flow High S.G. Low S.G. High Base S.G. Low Base S.G. Hi Viscosity cS Low Viscosity cS High Temperature Low Temperature Interface Vs m/s Interface S.G. Turbulence % Makeup Latch
		⇌ Calibrate Flow Rate ⇌	⇌ Intrinsic Kc

(continued)

INSTALLATION MENU STRUCTURE *(continued)*

Dual Path Flow ⇌	Data Span/Set/Cal ⇌	Calib. Table 1* ⇌	Index Variable 1 ⇌	⇌ None Flow Vs Viscosity <cS> Viscosity <cP> S.G. Valc Vaer Temp 1 Reynolds # Pressure Aux				
				⇌				
				⇌				
				⇌				
			⇌					
			⇌					
			⇌					
	⇌	⇌	⇌	Calib. Table 1	New Point			
				Table Active	No			
				Clear Table 1	No/Yes			
	⇌	⇌	⇌	Same as Calib. Table 1				
				Same as Calib. Table 1				
	Datalogger Setup ⇌	⇌	⇌	Datalogger Mode Datalogger Data Log Time Interval Datalogger Events				
	I/O Data Control ⇌	⇌	⇌	Analog Out Setup ⇌		⇌ Io1 / Io2 (single path meter has Io1 only) Pgen 1 (in single path meter only)		
				⇌ Relay Setup ⇌			⇌ Relay 1 Relay 2	
				⇌ Analog Inp Setup ⇌				
			⇌	⇌	⇌	lin1 - lin2 ⇌	Off/Input	⇌ Off Aux PSIA BARA Deg F Deg C
							⇌	
							⇌	
⇌								
Diagnostic Data ⇌	⇌	⇌	Path Select ⇌		⇌ 1 2 1 and 2			
			⇌ Path Enable ⇌			Yes/No		
			⇌ Flow Data ⇌					
		⇌	⇌	⇌	Flow Velocity F/S Total Vs m/s Signal mV Valc % Vtrb % Alarm Status AnCal			
					⇌			
					⇌			
					⇌			
		⇌	⇌	⇌	Application Info ⇌		⇌ TN uSec TL uSec DeltaT uSec Burst/Sec % Accepted Last Makeup Makeup Status	
					⇌			
					⇌			
⇌	⇌	⇌	Gas Data ⇌		⇌ TEMP1 TEMP2 Reynolds # Base S.G. Specific Gravity Temperature Pressure			
			⇌					

* Calibration Tables for Custody Transfer models only.

(continued)

INSTALLATION MENU STRUCTURE *(continued)*

Dual Path Flow ⇄	Diagnostic Data ⇄	Gas Data ⇄	⇄	Volume Corr. Viscosity (cS)
		Site Setup Data ⇄	⇄	fx (drive) N (burst length) Ltn in Vfmax Vs max m/s Vs min m/s 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

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) Inner Diameter (in) CC129 Thickness
				Delete Pipe ⇄
				⇄
	Datalogger Cntrl ⇄	⇄	Output Datalogger ⇄	No/Yes
	⇄	⇄	Circular Memory ⇄	No/Yes
	⇄	⇄	Est Log Time Left ⇄	--:--
	⇄	⇄	Clear Datalogger ⇄	No/Yes
	Memory Control ⇄	⇄	Data Memory Left ⇄	xxxx
	⇄	⇄	Defragment ⇄	No/Yes
	Analog Output Trim ⇄	⇄	Trim Io1 ⇄	⇄
	⇄	⇄	Trim Io2 ⇄	⇄
	⇄	⇄	Trim Pgen1* ⇄	⇄
	RTD Calibrate ⇄	⇄	RTD-1 ⇄	⇄
	⇄	⇄	RTD-2 ⇄	⇄
	Clock Set ⇄	⇄	Date Time	User Cal./Factory User Cal./Factory
	RS-232 Setup ⇄	⇄	Baud Rate Parity Data Bits Line Feed Network ID RTS Key Time	
	System Info ⇄	⇄	Version Reset Date/Time Op System P/N Checksum Code System Time	

*Not present in Custody Transfer flowmeters.

3.4.3 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., Makeup Latch).
- 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:

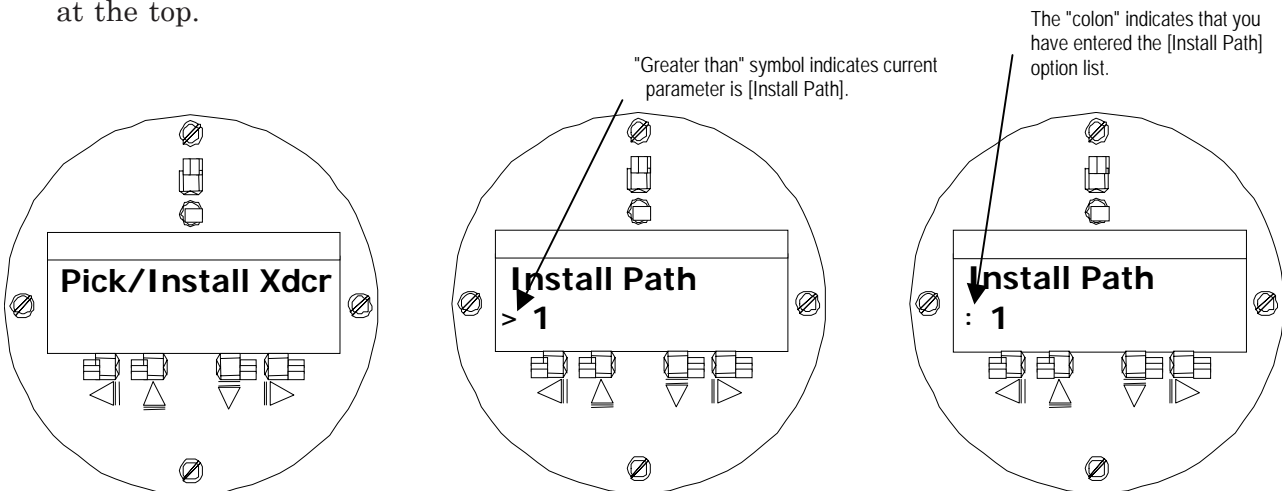
Right Arrow	▷
Left Arrow	◁
Down Arrow	▽
Up Arrow	△
Enter	⊙

How to Select Items from an Option List

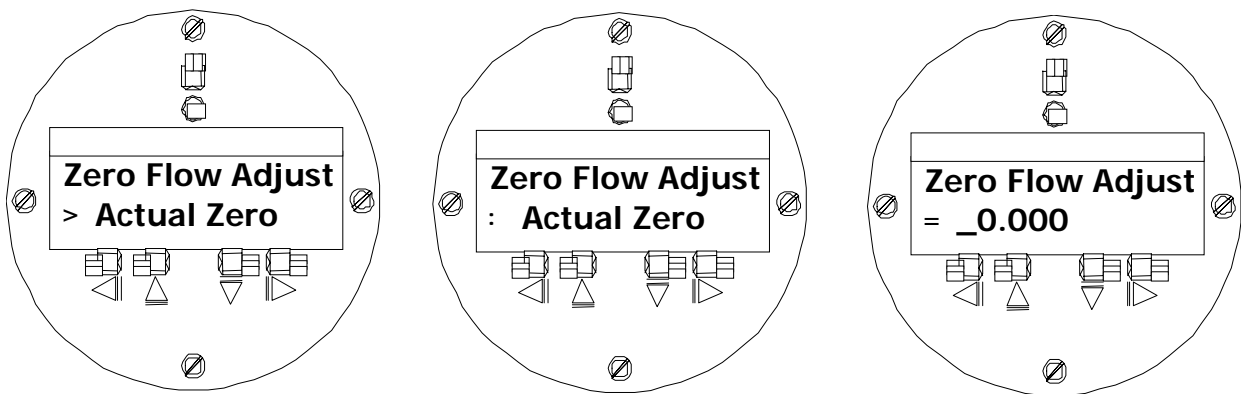
NOTE: Use the menu chart to see how to get to the [Pick/Install Xdcr] menu cell.

This section shows how to select an item from an option list. The following example explains how to change a Dual Path Flow meter [Pick/Install Xdcr] menu item, [Install Path], to [Fixed Time uSecs]. The left-hand figure below shows the [Install Path] menu cell. Notice that the second line is blank.

- Place the magnetic tip over the switch above the ▷ symbol and the [Install Path] menu cell appears. (The “greater than” symbol placed before the parameter indicates that it is the current selection.) Place the magnetic tip over the switch above the ▷ symbol again. Note that the (>) symbol changes to a colon (:) as shown on the *right-hand* figure below. You have now entered the [Install Path] 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 [Transducer Model]. This is the next item on the [Pick/Edit Xdcr] menu. Keeping the tip over the sensor activates an auto-repeat function to scroll the list automatically. Note that every trigger item changes to another item on the menu. 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 [Zero Flow Adjust] as shown on the *left-hand* figure below. Place magnetic tip over the▷switch symbol. This selects the [Zero Flow Adjust] option list. Place the magnetic wand over the <Up or Down> switch symbols to select an item from the option list. By placing the magnetic wand on the <Right> switch symbol numeric data can be entered as shown in the *left-hand* figure below (see *How to Enter Numeric Data* below). To return to the [Pick/Install Xdcr] to verify that the menu cell shows the new selection, place the magnetic wand on the <Left> switch symbol.



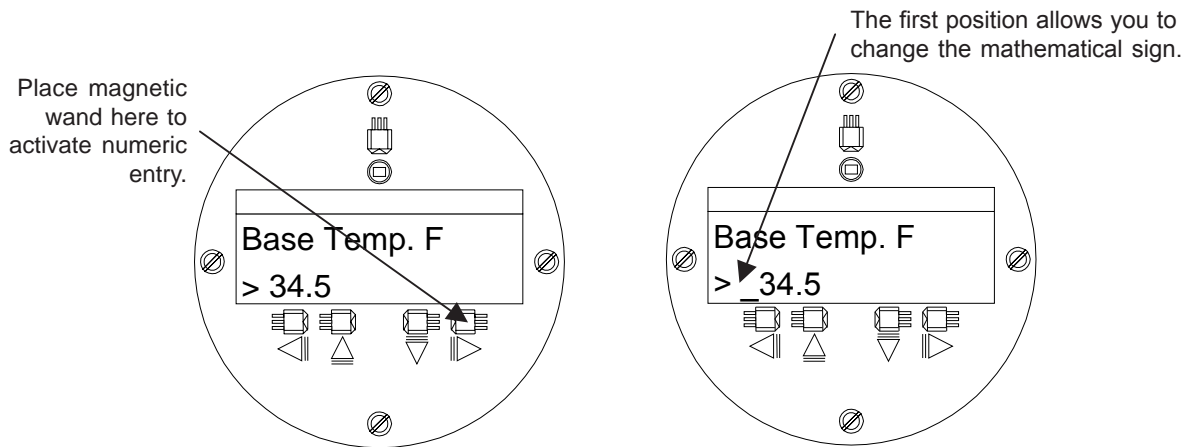
A Note on Multiple Select Option Lists

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 Δ and ∇ to move the cursor through the list. However, when you use \odot to select an item, the cursor moves to the next item in the option list. If you use \odot 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 \odot .

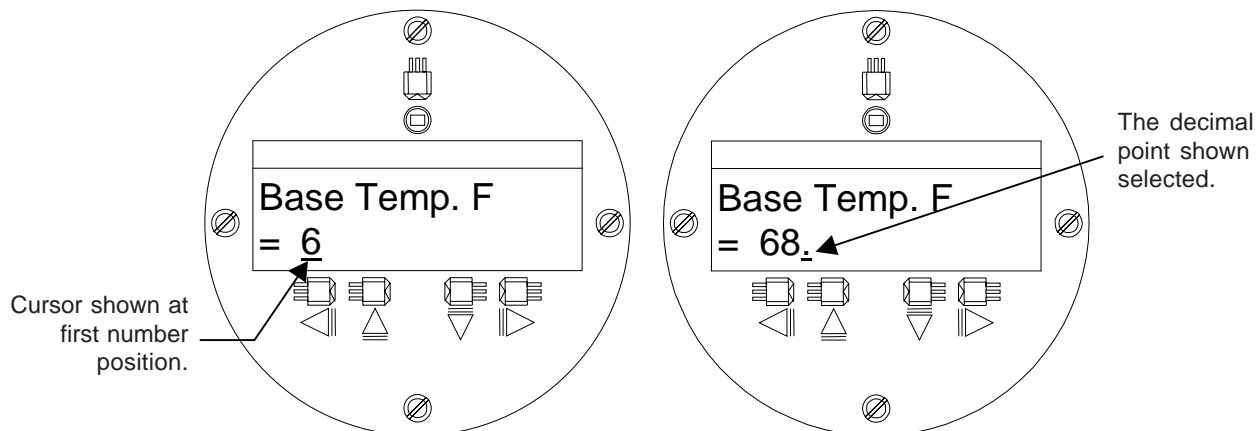
After selecting all the desired items, use \triangleleft to leave a multiple select option list.

How To Enter Numeric Data

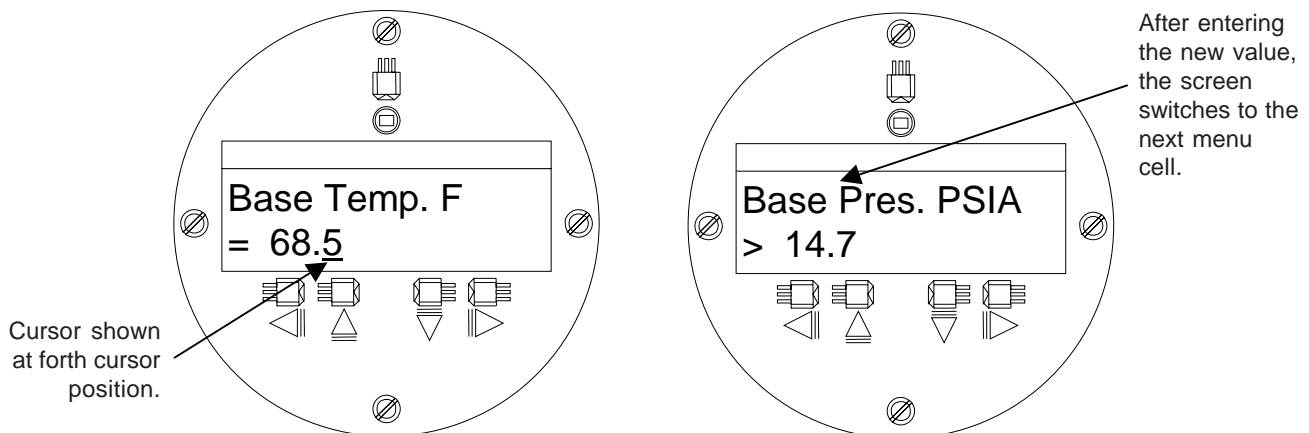
This section shows how to edit a numeric menu cell. The following example uses the [Base Temp. F] menu cell in the Gas Parameters menu. The left-hand figure on the next page shows the [Base Temp. F] menu cell. Notice that the second line shows the current Base Temp. F value: [34.5]. (The “greater than” symbol placed before the parameter indicates that it is the current selection.) This example explains how to change the Base Temp. F value to 68.5.



- Use \triangleright 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 \triangle or ∇ at the first position the value switches to a negative number.
- Use \triangleright 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 68.



- Use \triangle to scroll through the number list. Stop scrolling at numeral [6]. Use \triangleright to move to the second number position. Enter number [8]. Repeat and move to the third number position. Use ∇ to scroll list to decimal point as shown in the right-hand figure above.



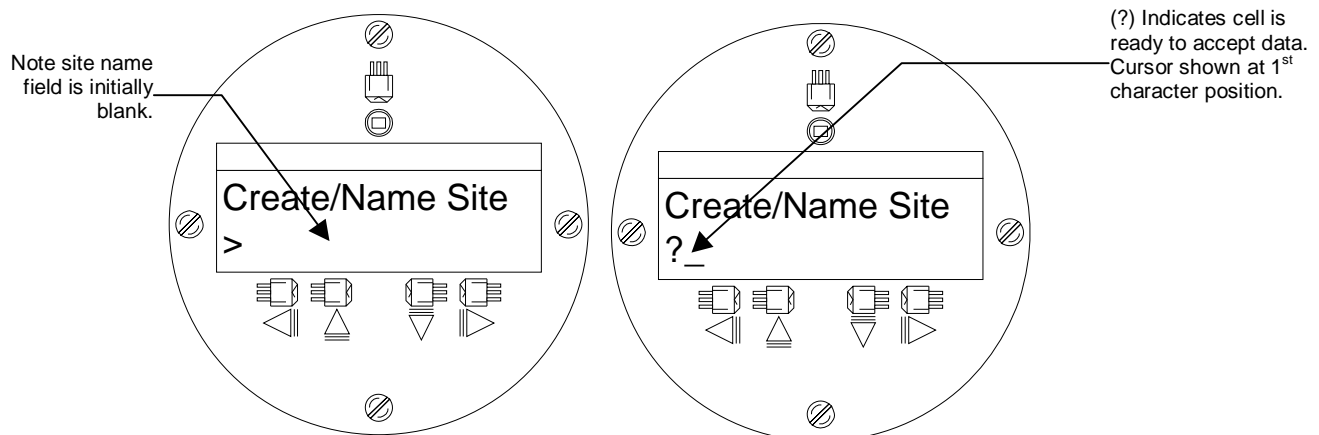
- Use \triangleright to move cursor to move to the last number positions. Use \triangle to scroll the number list as needed. Use \odot to register the new Base Temp. F value. This moves the screen to the next menu cell [Base Pres. PSIA] as shown in the previous right-hand figure. You can use \triangle to move back to [Base Temp. F] to check that the flow computer accepted the new value.

How to Enter Alphanumeric Strings

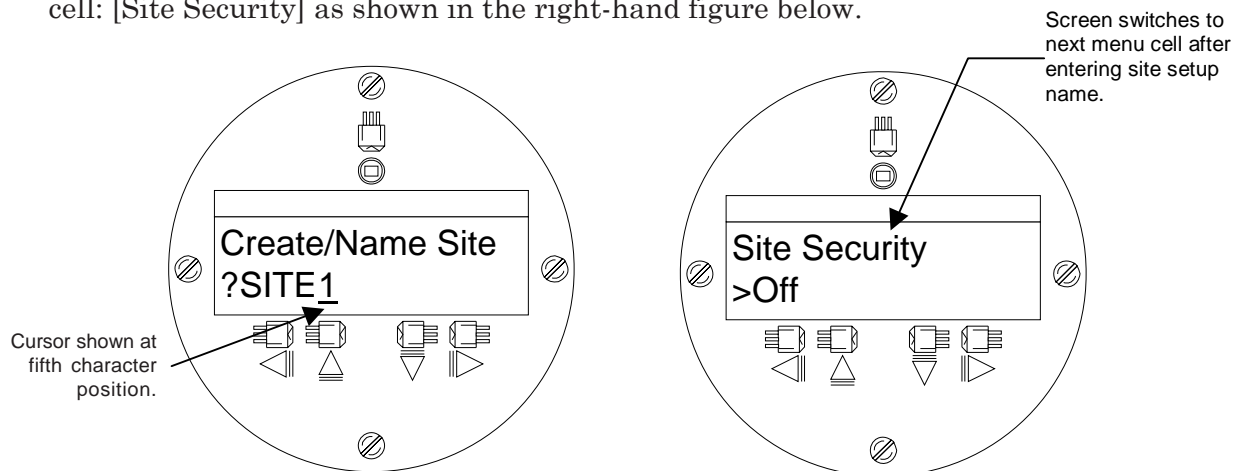
This section shows how to edit an alphanumeric menu cell. An alphanumeric string is a series of numbers and letters including the Quotation Mark, the Pound Sign symbols and/or a space. The meter uses these symbols to identify a specific site setup or user-modified table. Menu cells that accept alphanumeric 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 \triangleright 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 \triangle to scroll through the character list until you see [S]. Use \triangleright to move the cursor to the second position. Use ∇ to scroll the list back down to [I]. Use \triangleright to move the cursor to the third position. Use \triangle to scroll list to [T]. Use ENTER to move to the fourth position. Use ∇ to scroll list to [E]. Use \triangleright 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 \odot to create the new site setup: SITE1. This selects the next menu cell: [Site Security] as shown in the right-hand figure below.



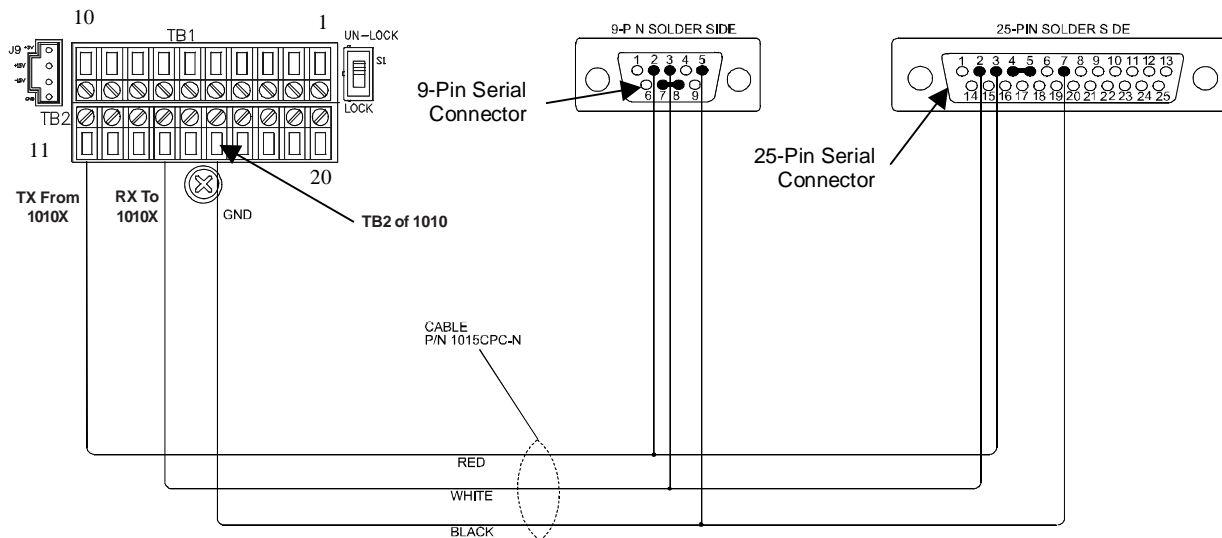
3.5 HOW TO USE THE RS-232 INTERFACE

This section describes the hardware, software and procedural requirements for programming System 1010GCX 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 Controlotron's serial interface cable (1015CPC-N) made specifically for this purpose. The Controlotron 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™) to serve as the data entry interface. We recommend these programs simply because they are free and universally owned. However, you can use your own favorite DOS or Windows-based software as long as it supports VT-100 emulation. These programs reproduce the menu screens that appear on our 1010 systems with graphic display screens (screens shown in this section are actual HyperTerminal™ screen captures). The site setup procedure for System 1010GCX and our graphic display systems (e.g., 1010GN) are virtually identical.

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

3.5.1 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 1010GCX 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 CONTROLOTRON 1015CPC-N INTERFACE CABLE

3.5.2 ESTABLISHING COMMUNICATIONS USING HyperTerminal™ (WIN 95/98™)

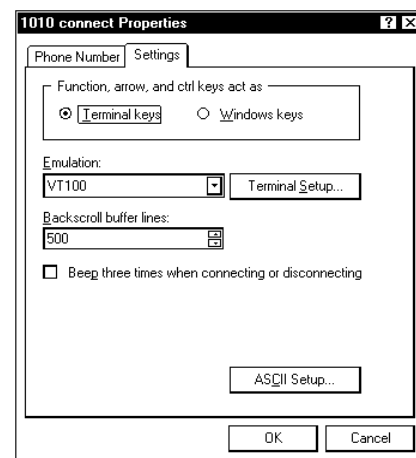
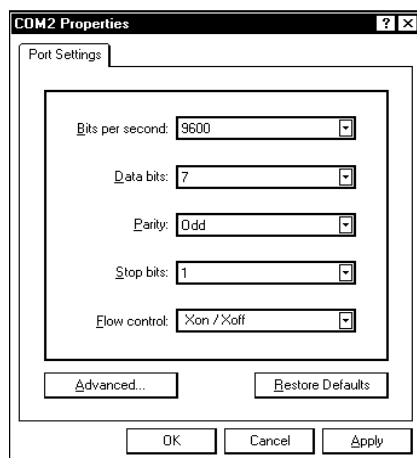
This section shows how to communicate with 1010GCX using the Windows 95/98™ based communication program HyperTerminal™. It assumes that you're familiar with Windows 95/98™ and have a basic understanding of serial communications.

All IBM compatible 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 has two serial ports, COM 1 will be the 9-pin connector and COM 2 will be the 25-pin connector. However, port designations can vary from manufacturer to manufacturer, so you will have to positively identify the COM port you wish to use for the flow computer interface. Connect cable between the flow computer and your PC using either the 25-pin or the 9-pin connector, depending upon the architecture of the port.

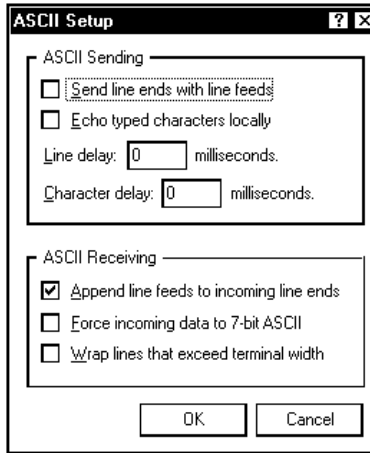
NOTE: Be aware that on some laptop computers, the available COM ports may be assigned to peripheral devices, such as a modem, mouse or an infrared port, etc. Therefore, you may not have a COM port available for this interface. In such a case, refer to your PC manual for instructions on how to reassign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

The following example explains how to set up HyperTerminal™:

- From the Windows 95/98™ desktop, Left-Click on the [START] button.
- Holding down the left mouse button, move the highlight up to [Programs], then across to [Accessories]. Slide the highlight down to [HyperTerminal], then release the left mouse button.
- Within the HyperTerminal™ window, move the mouse pointer down to [Hyperterm.exe] and then double-click the left mouse button.
- This selects the [Connection Description] dialog box. Enter a name for your connection (e.g., 1010GCX). You can optionally select an icon for this connection by clicking on one of the icons displayed in the scrolling frame at the bottom of the window. Click [OK].
- This selects the [Phone Number] dialog box. Move cursor to the arrow at right of [Connect Using] field. Left click on arrow to expand field and move the highlight down to [Direct to Com 1 (or 2)] depending on the port connected to the interface cable. Click [OK] to select [Com 1 (or 2) Properties] Dialog box. Set up your RS-232 parameters as shown (below left). Left-click on the [OK] button.
- You will now see a blank terminal screen. Next click [File] on the top menu bar. Drag the highlight down to [Properties] and then left-click.
- Left-click [Settings] tab. Expand the [Emulation] box by clicking the <Down Arrow> on the right-hand side. Drag the highlight down to [VT-100] and then left-click to select it as shown (below right).



Next, left-click on the [ASCII Setup] button. In the [ASCII Sending] dialog box, ensure that the [Send line ends with line feeds] and the [Echo Typed characters locally] are UNCHECKED. In the [ASCII Receiving] dialog box, left-click to place a check mark before [Append line feeds to incoming line ends] dialog. When your screen looks like the example below, left-click the [OK] button.



- You are now ready to communicate with the 1010GCX. 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.
- The next time you want to use HyperTerminal™; Click on *Start*. Drag to *Programs*. Drag to *Accessories*. Drag to *HyperTerminal*, and click. Double-click icon you selected for the connection.

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

3.5.3 ACCESSING THE INSTALLATION MENU

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

- Establishing a connection with the flowmeter automatically initiates *Command* mode. You will see a blank screen. Press <ENT> a few times until [**? For Help**] appears on the terminal screen.
- Type: ? (question mark) and then press <ENT> to see a list of the available commands. Type: [**menu**] and then press <ENT> to access the top level of the Installation Menu.

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

Data Display Mode

After you complete the installation, and the meter is operating normally, you can use <CTRL + L> on your PC keyboard to toggle between *Installation Menu* mode and *Data Display* mode (strike <L> while holding down <CTRL> key). Note that the 1010GCX RS-232 interface does not support graphics. Therefore, if you use HyperTerminal™ to view the data display screens, you will see the data in alphanumeric form only. You can use the PC's <Up Arrow> and <Down Arrow> to switch between available display screens.

3.5.4 DATA ENTRY USING THE RS-232 INTERFACE

The following is a step-by-step example of how to enter data for a Dual Path 1010GCSX gas 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: 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 <CTRL + L> to toggle between a flow display screen and the last accessed menu location.

Controlotron	Dual Path
Select Meter Type	
Meter Type	Dual Path Flow
Meter Facilities	

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

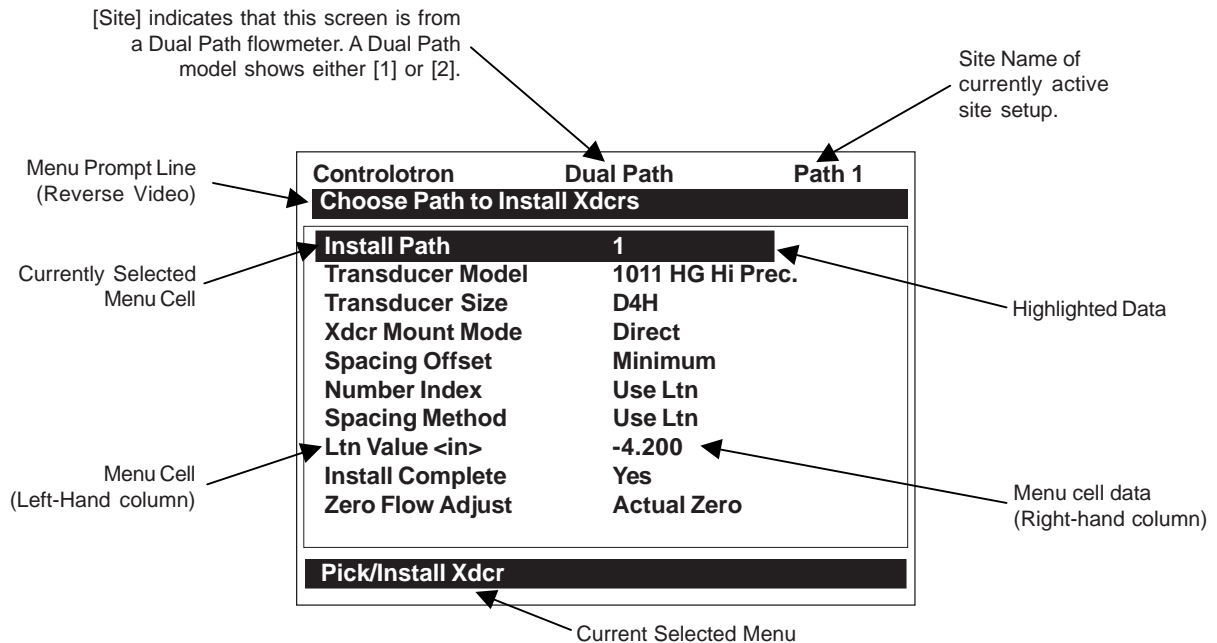
3.5.5 NAVIGATING THROUGH THE INSTALLATION MENU

After successfully accessing the Installation Menu, you can begin to set up the 1010GCSX. The following table shows the PC keyboard Installation Menu navigation keys.

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

3.5.6 INTRODUCTION TO THE 1010GCX MENU SCREENS

This section introduces the System 1010GCX 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 Pick/Install Xdcr 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 1010GCSX INSTALLATION MENU SCREEN

EXPLANATIONS OF INSTALLATION MENU CALLOUTS

Current Selected Meter Type	[Site] indicates Dual Path Gas Meter operating mode selected.
Menu Prompt Line	When a menu cell is selected, a reverse text prompt appears on the top of the screen to explain the function of the cell.
Currently Selected Menu Cell	Selecting a menu cell causes it to highlight in the right-hand column.
Highlighted Data	The right-hand column show the current value highlighted. Pressing the <Right Arrow> provides access to an option list or numeric field section.
Menu Cell	A menu cell is an individual location within a menu (e.g. Spool ID) that stores data (i.e., either in 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. For example, the Edit/Install Meter menu includes option list items and some 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., Path Length).

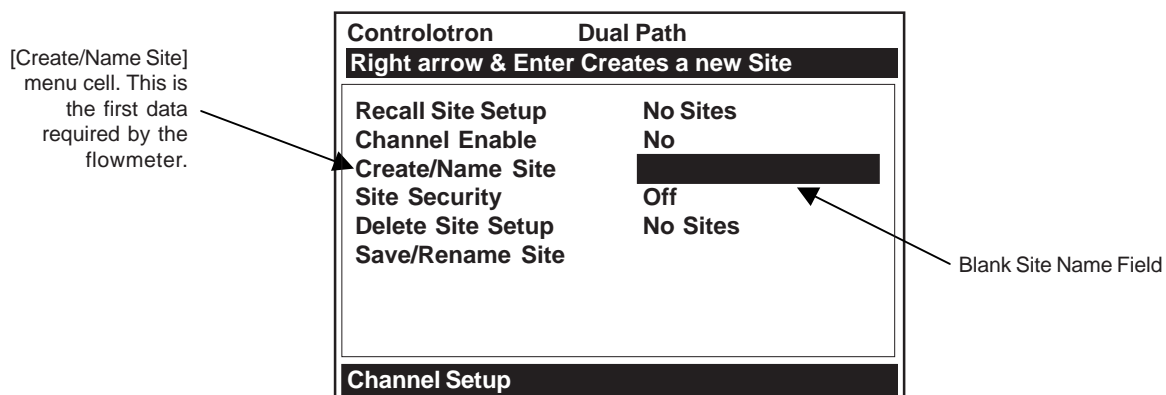
3.6 DATA ENTRY PROCEDURES USING THE RS-232 INTERFACE

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:

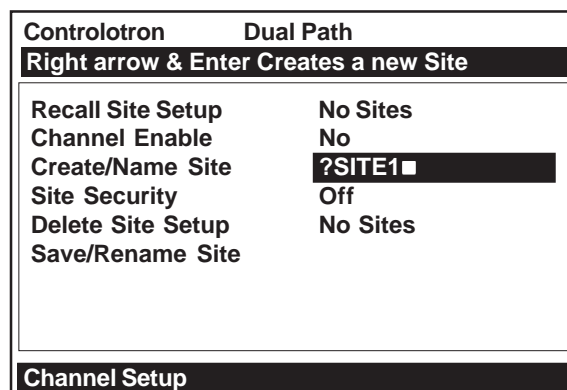
- Another series of menu cells (that become left-hand column items when selected).
- An alphanumeric string (e.g., a site name).
- An item from a scrollable option list (e.g., a Relay Setup selection).
- A numeric entry (e.g., an Axial Offset).

3.6.1 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 1010GCX 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.



After you finish typing the string, press <ENT> to register it. This creates a new site setup called [SITE1]. This action prepares the 1010GCX 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.

Controlotron	Dual Path]	SITE1
Use with Care -- Turn Security On or Off		
Recall Site Setup	No Sites	
Channel Enable	No	
Create/Name Site	SITE1	
Site Security	Off	
Delete Site Setup	No Sites	
Save/Rename Site	SITE1	
Channel Setup		

3.6.2 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.*

Controlotron	Dual Path	SITE1
Assign Alarm Data function to each relay		
Analog Out Setup		
Relay Setup		
Analog Inp Setup		
I/O Data Control		

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

Controlotron	Dual Path	SITE1
Select a function for Relay 1		
Relay 1	>Off	
Relay 2	Power On	
	High Flow	
	Low Flow	
	Flow Alarm	
	Fault Alarm	
	Turbulence	
	SG Interface	
	Reverse Flow	
	Batch Tot	
Relay Setup		

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

To select an option list item, move the cursor to the item and then press the <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].

Controlotron	Dual Path	SITE1
Select a function for Relay 2		
Relay 1	Fault Alarm	
Relay 2	Off	
Relay Setup		

Multiple Select Option Lists

Certain option lists allow you to make more than one selection. For instance, the Datalogger Data option list allows you to select any or all of the available data items for your reports. You can use the <Up and Down Arrows> to move the cursor through the list. If you press <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 the <Right Arrow>. Use the <Left Arrow> to leave any multiple select option list.

Controlotron	Dual Path	SITE1
Select Datalogger Data		
Datalogger Mode	+Site Id	
Datalogger Data	+Date	
Log Time Interval	+Time	
Datalogger Events	Flow	
	Average Flow	
	Raw Flow	
	Total	
	Vs	
	Valc	
	Vtrb	
	Alarms	
Datalogger Setup		

3.6.3 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 keypad.

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

Controlotron	Dual Path	SITE1
Data Span, Set and Calibrate control		
Chan/Path Setup Pipe Data Gas Parameters Pick/Install Xdcr Operation Adjust Flow/Total Units Data Span/Set/Cal Datalogger Setup I/O Data Control Diagnostic Data		
Dual Path		

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

Controlotron	Dual Path	SITE1
Span 0% and 100% Values for Analog Data		
Span Data Set Alarm Levels Calib. Flow Rate Chan Not Setup		
Data Span/Set/Cal		

- Press the <Right Arrow> again and [Max Flow CU FT/HR] will appear. To change the [Max Flow CU FT/HR] 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.

Controlotron	Dual Path	SITE1
Set 100% <20 mA> flow rate		
Max Flow CU FT/HR	=0.00	
Min Flow CU FT/HR	0.00	
Max Vs m/s	0.00	
Min Vs m/s	0.00	
MAX SG	0.00	
MIN SG	0.00	
Span Data		

Controlotron	Dual Path	SITE1
Set 100% <20 mA> flow rate		
Max Flow CU FT/HR	1846	
Min Flow CU FT/HR	0.00	
Max Vs m/s	0.00	
Min Vs m/s	0.00	
MAX SG	0.00	
MIN SG	0.00	
Span Data		

4. THE 1010GCX INSTALLATION MENU

CAUTION: The 1010GCX flowmeter menu parameters may have been pre-set at the factory. The following section is provided for user reference should it be needed. *Highlighted paragraph headings within this section indicate those menu cells that should be used only if the site needs to be completely installed.*

For example: **THE CHANNEL/PATH SETUP MENU**

Use care particularly when changing Site Setup and Transducer Install menu cells. Note also that the 1010GCX may be shipped with a factory preset Site Setup that is recallable.

Programming System 1010GCX 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 meters.

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

Manual Conventions

- When the text refers to a keypad 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., [Gas Parameters], [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 a 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 [Recall Site Setup] or [Create/Rename Site] commands. These commands overwrite all data present in Active Memory.
- 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 install parameters, even if the data from the recalled site setup is identical. Always issue the [Create/Rename Site] to begin a new site setup. This will fill all the menu cells with defaults to eliminate the possibility of retaining unwanted parameters.
- 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 systems defaults.

4.1 THE CHANNEL/PATH SETUP MENU

The Channel/Path Setup 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] menu cell allows you to disable and enable a measurement path. Be aware that site name option lists only show sites that are consistent with the currently selected meter type.

CHANNEL/PATH SETUP MENU STRUCTURE

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

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

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

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

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

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

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

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

Controlotron

Dual Path [1]

XYZ

Scroll saved Site Setup list and Enter

Recall Site Setup

Channel Enable

Create/Name Site

Site Security

Delete Site Setup

Save/Rename Site

Channel/Path Setup

XYZ

Yes

1

Off

1

1

4.1.1 HOW TO RECALL A SITE SETUP

The [Recall Site] 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 the keys is shown; this means press this key)*

1. Press the <Right Arrow> to access the list of saved site names.
2. Use the <Down Arrow> to move the cursor to the Site Name.
3. Press <ENT>. 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 install.
4. Press <ENT> to recall the stored site setup. This enables the measurement path for immediate operation.

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

This disables the measurement path until you repeat the Pick/Install Spool routine.

4.1.2 HOW TO ENABLE AND DISABLE A MEASUREMENT PATH

The flowmeter disables a measurement path until the completion of the required Site Setup entries and the transducer installation procedure. The meter enables the measurement path automatically after it receives all required site data and completes the Spool install routine. (The *Site Enable* menu cell allows you to disable or enable a measurement path 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 path that is currently unused but active; for example, if the transducers have been removed for servicing.

To disable a path that is operating:

1. Press the <Right Arrow> to access the [Channel Enable] option list.
2. Use the <Up or Down Arrow> to move the cursor to [No].
3. Press <ENT> to disable the measurement path.

To enable a path:

1. Press the <Right Arrow> to access the [Channel Enable] option list.
2. Use the <Up or Down Arrows> to move the cursor to [Yes].
3. Press <ENT> to enable the measurement path.

4.1.3 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 the site storage memory.

To create and name a new Site Setup:

1. Press the <Right Arrow> to access the first character position.
2. Use the <Up or Down Arrow> to select a character, then press the <Right Arrow> to highlight to next character position.
3. Use the <Up or Down Arrow> to select the second character.
4. Repeat this process to select all the characters (8 max.) you want to use to identify the new Site Setup.
5. Press <ENT> to create the new Site Setup.

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

4.1.4 HOW TO ENABLE/DISABLE SITE SECURITY

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

Activate Site Security with care. Once activated, the only way to deactivate it is via the Site Security [Off] command. However, the cursor will not move to the Site Security option list until you enter the correct password. Therefore, it is essential that you never forget or misplace the password. The only way to deactivate Site Security without knowing the password is to return the unit to Controlotron. However, the process the factory uses to remove site security will eliminate any existing site data as well. The flowmeter will allow an <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 1010DX-7).

CAUTION: MAKE CERTAIN THAT YOU RETAIN A COPY OF THE PASSWORD IN A SECURE LOCATION.

To activate Site Security:

1. Press the <Right Arrow> to access [Site Security] option list.

2. Press the <Up or Down Arrows> to scroll the option list to [On], then press <ENT>. [Enter Code?] appears at the top of the display screen.
3. Use the numeric keys or the <Up or Down Arrows> to move the cursor to the first character position.
4. Press the <Right Arrow> to move the cursor to the second character position.
5. Repeat the selection process for the second character. Continue this process until all the required characters (8 max.) appear in the field.
6. Press <ENT> to store code. [Confirm Code ?] appears at the top of the display screen.
7. Re-type the code exactly as described above.
8. This moves the cursor to the [Site Security] option list.
9. Use the <Up or Down Arrows> to scroll the option list to [Site Security: On]. Once you turn on Site Security, you must enter the correct code to turn it off.
10. Press <ENT> to activate Site Security

4.1.5 HOW TO DELETE A SITE SETUP

If you attempt to save a Site Setup when the memory is full, the screen will show [Memory Full]. If you receive this message after issuing a Save/Rename Site command, then you will have to delete an unneeded Site Setup to clear memory space. Note that Datalogger storage and Site Storage share a common memory pool. Therefore, a large amount of logged data could also trigger the [Memory Full] message. See [Meter Facilities/Datalogger Control] for instructions on how to clear Datalogger memory. Using the Defragment Command may also allow additional sites to be stored (see Meter Facilities/Memory Control Menu).

To delete a stored Site Setup:

1. Press the <Down Arrow> to highlight [Delete Site].
2. Press the <Right Arrow> to access the [Delete Site] option list.
3. Move the cursor to the site name of the site setup you want to delete.
4. Press <ENT> to delete the obsolete site setup.

4.1.6 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 may select up to eight characters. If you decide to use numbers or a decimal point in the site name, you can type these characters directly from the keypad.

To Save or Rename a Site Setup:

1. Press the <Right Arrow> to access the first character position.
2. Use the <Up/Down Arrows> to select a character, then press the <Right Arrow> to highlight to next character position.
3. Use the <Up/Down Arrows> to select the second character. Repeat this process to select all the characters (8 max.).
4. Press <ENT> to save the site data present in Active Memory.

If Contolotron's *Flowtalk* software is used to save or restore sites, you can avoid creating illegal file names by not using spaces or decimal points (.) in your site names.

4.2 THE PIPE DATA MENU

CAUTION: The pipe data is set at the factory to conform to the flowmeter's associated spool. Use caution when changing these menu cells or factory settings will be lost.

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 Custody Transfer version of this 1010 operating system includes routines that will compensate the measured raw flow rate for dynamic changes in the pipe dimensions, caused by variations in line temperature and pressure supplied to the flowmeter. To account for variations in pipe material, two new data entry items (Thermal Expansion Coefficient and Modulus of Elasticity) have been added to the 1010 Pipe Data menu screen (see sample menu screen on next page). The equation used to automatically compute the change in pipe inside diameter is:

$$d_1 = d_0(1 + \alpha(T_1 - T_0)) \cdot \left(1 + d_0 \frac{(P_1 - P_0)}{E w}\right)$$

Where:

d_0 = inside diameter of pipe at STP

d_1 = inside diameter of pipe after temperature and pressure change.

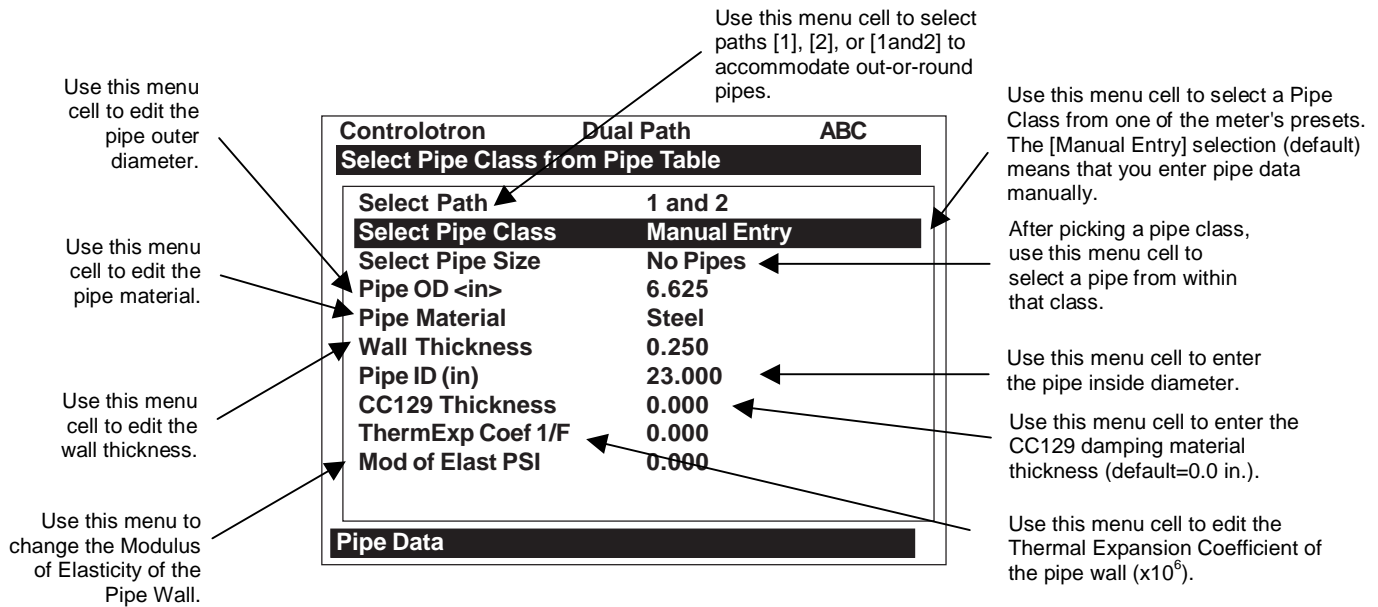
w = pipe wall thickness

T_0 and P_0 = Standard temperature and Pressure

T_1 and P_1 = Operating temperature and Pressure

α = Coefficient of Thermal Expansion of Pipe material

E = Modulus of Elasticity of pipe material



Use this menu cell to select paths [1], [2], or [1and2] to accommodate out-or-round pipes.

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

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

Use this menu cell to enter the pipe inside diameter.

Use this menu cell to enter the CC129 damping material thickness (default=0.0 in.).

Use this menu cell to edit the Thermal Expansion Coefficient of the pipe wall ($\times 10^6$).

Use this menu cell to edit the pipe outer diameter.

Use this menu cell to edit the pipe material.

Use this menu cell to edit the wall thickness.

Use this menu to change the Modulus of Elasticity of the Pipe Wall.

Controlotron	Dual Path	ABC
Select Pipe Class from Pipe Table		
Select Path	1 and 2	
Select Pipe Class	Manual Entry	
Select Pipe Size	No Pipes	
Pipe OD <in>	6.625	
Pipe Material	Steel	
Wall Thickness	0.250	
Pipe ID (in)	23.000	
CC129 Thickness	0.000	
ThermExp Coef 1/F	0.000	
Mod of Elast PSI	0.000	
Pipe Data		

The default value for each of these new parameters is 0.0. A value of zero effectively disables the pressure and temperature pipe volume compensation routine. When entering a value for the thermal expansion coefficient and modulus of elasticity, keep in mind that the numeric entry already includes an exponent multiplier. For the Thermal Expansion Coefficient the multiplier is 10^{-6} and for the Modulus of Elasticity the multiplier is 10^6 .

Typical values for each parameter are shown below:

Pipe Material	Thermal Expansion Coef	Modulus of Elasticity
Mild Carbon Steel	$6.20 \times 10^{-6} \text{ F}^{-1}$ ($11.16 \times 10^{-6} \text{ C}^{-1}$)	$30 \times 10^6 \text{ psi}$ $2.07 \times 10^6 \text{ bar}$
304 Stainless	$9.60 \times 10^{-6} \text{ F}^{-1}$ ($17.28 \times 10^{-6} \text{ C}^{-1}$)	$28 \times 10^6 \text{ psi}$ $1.93 \times 10^6 \text{ bar}$
316 Stainless	$8.83 \times 10^{-6} \text{ F}^{-1}$ ($15.89 \times 10^{-6} \text{ C}^{-1}$)	$28 \times 10^6 \text{ psi}$ $1.93 \times 10^6 \text{ bar}$

NOTE: Do not enter exponents of above values.


To determine the F,C, psi or bar values, check the unit designation in the left-hand column of the [ThermExp Coef] or [Mod of Elast] menu cells shown above.

PIPE CONFIGURATION

The [Pipe Configuration] menu cell in the Pipe 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) will cause the flowmeter to use the conventional Reynolds Compensation Table when compensating for liquid flow profile behavior.

Controlotron Dual Path [1] Path 1

Disignate Pipe Shape Near Transducers

Select Path	1
Select Pipe Class	Manual Entry
Select Pipe Size	No Pipes
Pipe OD <in>	6.625
Pipe Material	Steel
Wall Thickness	0.250
Pipe ID	
CC129 Thickness	
Pipe Configuration	Fully Developed
Anomaly Diams.	1 Elbow
ThermExp Coef 1/F	Dbl Elbow +
Mod of Elast PSI	Dbl elbow -
Pipe Data	Valve

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

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

Pipe Configuration Menu Structure

Pipe 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.
Db1 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.

SELECT PATH MENU CELL (1010GCS Spool meters only)

CAUTION: If the spool meter was factory pre-configured then the Pipe Data menu should not be modified.

The [Select Path] menu allows the pipe dimensions to be entered independently for each transducer path to accommodate out-of-round pipes. If the pipe is considered to be perfectly round, or if it is impossible to determine the pipe dimensions along each path, then simply select Path [1 and 2] before entering the nominal pipe dimensions. This dimension will be applied to both measurement paths as well as the “virtual” or average path. If the independent path dimensions are known:

1. First select Path [1 and 2] then install the average pipe dimensions. This dimension should represent the average OD and WT of the individual path dimensions.
2. Next select one of the individual paths (Path 1 for example) and install the specific pipe dimensions along its associated measurement plane. Then select the next path (Path 2 in this example) and install its associated pipe dimensions. *Note: This menu item only appears in 1010GCS spool meters, where the installer has access to the internal pipe diameter.*

THE PIPE DATA MENU STRUCTURE

Pipe Data ⇨	Select Path ⇨	1, 2, or 1 and 2		
	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	<i>Set pipe parameters manually</i>	
		ASA Stainless Steel* 1SS10 2SS10 3SS10 4SS10 6SS10 8SS10 Metric DN Steel 15_DN 20_DN 25_DN 40_DN 50_DN 80_DN 100_DN 150_DN 200_DN 250_DN 300_DN 350_DN 400_DN 500_DN 600_DN Metric SGP Steel 20A-SGP 25A-SGP 32A-SGP 40A-SGP 50A-SGP 65A-SGP 80A-SGP 90A-SGP 100A-SGP 125A-SGP 150A-SGP 175A-SGP 200A-SGP 225A-SGP 250A-SGP 300A-SGP 350A-SGP 400A-SGP 450A-SGP 500A-SGP Copper Tube Table 1" type K 1" type L 1" type M 2" type K 2" type L 2" type M	Copper Table Tube 4" type K 4" type L 4" type M 6" type K 6" type L 6" type M ASA Carbon Steel 1CS40 1CS80 2CS40 2CS80 3CS40 3CS80 4CS40 4CS80 6CS40 6CS80 8CS40 8CS80 10CS40 10CS XS 12CS STD 12CS XS 16CS STD 16CS XS 18CS STD 18CS XS 20CS STD 20CS XS 24CS STD 24CS XS 30CS STD 30CS XS 36CS STD 36CS XS 1-1/2 S40 1-1/2 S80 Cast Iron Table 6" cls C 10" cls C 12" cls C 16" cls C 20" cls C	ASA Plastic 1P40 1P80 2P40 2P80 3P40 3P80 4CS40 4P80 6P40 6P80 8P40 8P80 10P 40 10P XS 12P STD 12P XS 16P STD 16P XS 18P STD 18P XS 20P STD 20P XS 24P STD 24P XS 30P STD 30P XS 36P STD 36P XS Ductile Iron Table 6" cls 52 8" cls 52 10" cls 52 12" cls 52 16" cls 52 24" cls 52

(continued)

THE PIPE DATA MENU STRUCTURE *(continued)*

Pipe Data (cont.) ⇨	Pipe OD (in / mm) ⇨	xx.xx (numeric entry). <i>(Auto if specific pipe is selected)</i>
⇨	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) Teflon Titanium
⇅	⇅	
⇨	Wall Thickness ⇨	x.xxx (numeric entry)
⇨	Pipe ID (in) ⇨	x.xxx (numeric entry)
⇨	CC129 Thickness ⇨	x.xxx (numeric entry)
⇨	ThermExp Coef 1/F ⇨	0.000
⇨	Mod Elast PSI ⇨	0.000

*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.


4.2.1 HOW TO SELECT A PIPE CLASS

The 1010GCX 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.

4.2.2 HOW TO SELECT A PIPE SIZE

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

4.2.3 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 keypad's numeric keys to type the exact outer diameter of the pipe in inches or millimeters.



To register the Pipe OD press 

4.2.4 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 <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 

4.2.5 HOW TO ENTER THE WALL THICKNESS


The wall thickness of the pipe is one of the required parameters. The flowmeter 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.

To enter the Pipe Wall Thickness:

To enable numeric entry press 

Use the keypad's numeric keys to type exact wall thickness (use in/mm).

To register the pipe wall thickness press 


4.2.6 PIPE ID (in. or mm)

This menu cell allows the direct entry of the Pipe Inside Diameter. If the internal pipe diameter is well known (as may be the case with meter tube or honed pipe) then this dimension should be entered here. An accurate pipe ID will provide the best intrinsic meter accuracy for gas applications, where the flow error will be proportional to the ratio of indicated cross-sectional area to actual cross-sectional area.

$$\text{Flow Error} = \frac{\text{ID}_{\text{ind}}^2}{\text{ID}_{\text{act}}^2}$$

Observe that the meter will automatically re-compute the indicated pipe outside diameter (OD) when the Pipe ID is changed. The wall thickness (Pipe WT) will be unaffected by any change to the OD or ID entry. Although the pipe WT dimension is not as critical as the pipe ID, it is recommended that the wall thickness be measured (via ultrasonic wall thickness gauge) to insure the proper transducer selection and accurate sound velocity measurement.

To enter the Pipe Inside Diameter:

Highlight the [Pipe ID] menu cell and press 

Use the keypad's numeric keys to type exact Pipe ID (use in/mm).

To register the Pipe ID press 

4.2.7 CC129 THICKNESS

CC129 is the part number for the pipe wall damping material used with all clamp-on gas meters. This material is applied to the outside of the pipe wall and is used to absorb any acoustic energy that remains in the pipe wall. The 1010GC flowmeter uses this numeric entry of CC129 thickness to more accurately compute the gas sound velocity from the total transit-time. Please refer to the installation/outline drawings for installation and final thickness of the CC129 damping material to be applied to the pipe. Highlight [CC129 Thickness] and numerically enter and register the CC129 Thickness as shown in paragraph 4.2.6 above.

NOTE: The units of measure for the “CC129 Thickness” will be the same as indicated for the Pipe OD and Pipe ID.


4.2.8 ThermExp Coef

Use this menu cell to set the Thermal Expansion Coefficient.

To enter the Thermal Expansion Coefficient value:

To enable numeric entry press 

Use the number keys to type the Thermal Coefficient value.

To register the data press 


4.2.9 Mod of Elast PSI (Custody Transfer models only)

Use this menu cell to set the Modular Elasticity in .

To enter the value of Modulus of Elasticity:

To enable numeric entry press 

Use the number keys to type the Modular Elasticity PSI value.

To register the data press 

4.3 THE GAS PARAMETERS MENU

This menu becomes available after picking a Meter Type and Measurement Path. We recommend that you edit the Gas Parameters immediately after creating a new Site Setup, however any item in the Gas Parameters menu (except for “Estimated Vs m/s”) can be altered at any time, even during normal meter operation. The default settings are probably suitable for most applications, however if reliable data can be provided regarding the gas specific heat ratio, gas viscosity or gas compressibility factor, these settings should be modified.

The 1010 Gas flowmeter uses the Gas Parameters data to establish the specific gravity and the volume correction factors required for mass flow or standard volume computations. The Gas Parameters menu allows you to edit the base temperature and base pressure settings that the computer uses when it applies the *standard volume correction* to the measured volumetric output. The specific heat ratio item is required for the computation of the average gas specific gravity. The Viscosity (cP) item is needed for proper flow profile compensation. The fixed MW (molecular weight) item allows you to force the flowmeter to use a specific molecular weight for well-defined gases. The fixed Temperature and Pressure items allow you to set these parameters when external pressure and temperature (analog inputs) are not available. The meter is also capable of providing an AGA8 volume compensation for fixed gas compositions. This is accomplished by creating an offline lookup table that contains the compressibility and density values for a defined range of pressure and temperature. Once completed, the table must be downloaded to the 1010GCX (refer to paragraph 4.3.9).

The list below shows the defaults and description for all the Gas Parameters menu items. Each item in the gas parameters menu can be edited by the user. Pressing the <Right Arrow> key on any of these menu items will enable numeric entry, allowing you to override the default values.

Controlotron	Dual Path	SITE 1
Base Temp. F	60.0	
Base Pres. PSIA	= 14.700	
Spec. Heat Ratio	1.30	
Viscosity (cP)	0.0100	
Fixed MW g/mole	0.00	
Estimated Vs m/s	350	
Fixed Pres. PSIA	14.700	
Z Base	1.000	
Z Actual	1.000	
AGA8 Comp.	No	
Gas Parameters		

GAS PARAMETERS MENU STRUCTURE AND DEFAULTS

Gas Parameters	Base Temp	60°F (15.5°C)	Enter reference temperature in C or F.
	Base Pres. PSIA	14.7 psia (1.014 bara)	Enter reference pressure in PSIA or BARA.
	Spec. Heat Ratio	1.3	Enter gas specific heat ratio (constant pressure to constant volume.)
	Viscosity (cP)	0.010 centipoise	Enter absolute gas viscosity in centipoise.
	Fixed MW g/mole	0.0 grams/mole	Enter fixed molecular weight to override automatic computation.
	Estimated Vs m/s	450 m/sec	Enter the nominal sound velocity of the gas if significantly different from this default.
	Fixed Pres. PSIA	14.7 psia (1.014 bara)	Enter fixed operating pressure if external input is not available.
	Z Base	1.000	Enter the compressibility factor for the gas at base conditions.
	Z Actual	1.000	Enter fixed compressibility factor where pressure, temperature and gas composition do not vary significantly.
	AGA8 Comp	YES/NO	If a valid AGA8 table is installed (see para. 4.3.9) then select [YES] to activate the AGA8 compensation (Std. Vol. Comp from the Flow/Total Units menu must also be selected).

4.3.1 BASE TEMP and BASE PRES. PSIA

The base temperature and base pressure represents the conditions to which the reported volumetric flow rate and volumetric total will be compensated to (standard or normal conditions) as described in the equation below. The required units for data entry are determined by the [Preferred Units] menu cell (English or Metric) selected in the Meter Facilities menu. If Metric units are selected then the units for temperature and pressure will be degrees Celsius and BARA (absolute) respectively. For English units, temperature and pressure will be in degrees Fahrenheit and PSIA.

$$Q_{\text{base}} = Q_{\text{act}} \cdot \frac{P_{\text{act}}}{P_{\text{base}}} \cdot \frac{T_{\text{base}}}{T_{\text{act}}} \cdot \frac{Z_{\text{base}}}{Z_{\text{act}}}$$

where: Q = Volumetric flow rate

P = Pressure (absolute)

T = Temperature (absolute)

Z = Compressibility

base = Base conditions (pressure and temperature)

act = Actual flowing condition (pressure and temperature)

4.3.2 SPEC. HEAT RATIO

The specific heat ratio refers to the ratio of the gas specific heat at constant pressure to specific heat at constant volume. This ratio (along with the measure gas temperature and sonic velocity) allows the flow computer to compute (dynamically) the average specific gravity of the gas. The default value of 1.3 is suitable for most gases, but should be modified if this value is known for your specific application.

4.3.3 VISCOSITY (cP)

The absolute gas viscosity (along with the measured gas density and raw flow velocity) is used by the flow computer to compute the instantaneous Reynolds number. The Reynolds number is then used to derive the correction factor the required flow profile compensation.

The expected units for viscosity is “centipoise”. The default value of 0.01 is suitable for most gases, but should be modified if this value is known for your specific application.

The Reynolds number is computed as indicated:

$$Rn = 645 \cdot \frac{\rho \cdot id \cdot V_f}{cP}$$

where: ρ = density at flowing conditions (g/cc)

id = spool inside dia (in)

V_f = Flow velocity (ips)

cP = absolute gas viscosity (centipoise)

4.3.4 FIXED MW g/mole

The flow computer uses the measured gas temperature, sonic velocity and specific heat ratio to compute the average specific gravity of the gas being measure. This feature is useful for identification of the gas as well as for proper reporting of mass flow in cases where the gas composition varies.

In cases where the gas composition does not vary significantly, a fixed value for molecular weight can be entered here. A non-zero value for Fixed MW (grams/mole) will override the automatic computation of specific gravity. Setting Fixed MW back to 0.0 will cause the automatic specific gravity computation to resume.

4.3.5 ESTIMATED Vs

The [Estimated Vs] menu cell allows the numerical entry for the nominal sound velocity of natural gas. Consult Controlotron Technical Service Group for gases other than natural gas.

NOTE: Changing the Estimated Vs will require repeating the Transducer Install procedure (refer to paragraph 4.4).

4.3.6 FIXED TEMP and FIXED PRES. PSIA

The 1010GCX flowmeter can accept temperature and pressure input from an external direct sensing instrument. If you do not have external temperature or pressure available, then the meter will automatically use the fixed value(s) as the assumed gas temperature and/or pressure. Keep in mind that for proper reporting of volume corrected flow, mass flow or specific gravity, the flowmeter must have reliable temperature and pressure input. However, if the operating temperature and pressure is very constant, then fixed values may be used where higher accuracy is not required.

NOTE: For meters with on-board RTD temperature capability, the [Fixed Temp] parameter will not be present. In this case, a fixed value for temperature can be set by spanning the analog input 4mA setting to the desired temperature value. Providing the analog input path is not connected to any current source, the valued returned will be the 4 mA temperature value. (See paragraph 4.10.3 for details regarding the use of analog inputs).

The required units for data entry are determined by the [Preferred Units] menu cell (English or Metric) selected in the [Meter Facilities] menu. If [Metric] units are selected then the units for temperature and pressure will be degrees Celsius and BARA (absolute), respectively. For English units, temperature and pressure will be in degrees Fahrenheit and PSIA.

4.3.7 Z Base

The [Z Base] menu cell allows entry for the compressibility factor, at base conditions, for a given gas composition. If using the internal AGA8 compensation, Z Base should be set appropriately for the gas composition.

4.3.8 Z Actual

The [Z Actual] menu cell allows for a fixed entry of the compressibility factor in cases where pressure, temperature and gas composition do not vary significantly. If standard volume compensation is desired (refer to paragraph 4.6.2 STD VOL CORR) then enter the average compressibility factor for the specific gas application.

4.3.9 AGA8 COMP

All 1010GCX gas flowmeters include a facility for performing internal volume compensation using an AGA8 lookup table. This volume correction method is suitable and accurate for applications where the gas composition does not vary significantly or where the gas is infrequently sampled (not automatically sampled).

NOTE: In cases where automatic sampling is performed, a gas flow computer must be used in conjunction with the 1010GCX to provide the most accurate volume compensated flow output.

The internal AGA8 lookup table provides the meter with the actual gas density (Kg/M^3) and compressibility factor (Z Actual) for the indicated pressure and temperature (as obtained via the analog input or fixed P/T entry). These values are then used to compute either mass flow rate or standard volume corrected flow rate as indicated in the Flow/Total Units menu.

The table must first be generated externally using a software package which computes the appropriate density and compressibility factors for the specified gas composition. *Note: Controlotron recommends using SonicWare (Lomic Inc.) to generate this lookup table.* After the lookup table is generated and appropriately formatted, it can then be downloaded to the 1010GCSX via the serial data port. At any time during operation a new table may be downloaded to the 1010GCSX, should a change in gas composition require the calculation of new Z-factors and Density values.

The AGA8 lookup table is essentially a 10 x 10 array or grid containing both Z-factor and Density, with a 10 point temperature and 10 point pressure index. Based on the current temperature and pressure measurement, Z-factor and Density are interpolated to provide accurate volume correction. The table should be configured to cover the full range of operating temperature and pressure, however, if the measured pressure or temperature fall outside the table limits the 1010GCX lookup algorithm will extrapolate the Z-factor and Density values accordingly.

If a gas composition was provided to Controlotron with the purchase order, then the meter may already be configured for the specified gas composition and would be indicated in the documentation provided with each meter. If a new table or an updated table is required, follow the AGA8 table generation and installation instructions below.

NOTE: Table values are installed into the meter using a facility providing direct access to many system variables without error handling, therefore, care should be exercised during the formatting of this table prior to downloading to the meter.

When generating an AGA8 lookup table follow these guidelines (refer to Example #1).

- The table values for pressure must be arranged in ascending order and consist of exactly 10 points. The units of entry must be **PSIA**.
- The table values for temperature must be arranged in ascending order and consist of exactly 10 points. The units of entry must be degrees **Kelvin**.
- The table values for Density and Z-factor must be entered for each combination of entered temperature and pressure (100 points for each). The units of entry for density must be **Kg/m³**.

AGA8 Table Generation and Installation Instructions

1. Start by first creating the gas composition file within the SonicWare software application.
2. Next customize the output units by selecting PSI absolute and degrees Kelvin.
3. Now determine the application range for pressure and temperature with sufficient margin to insure that the measured temperature and pressure always falls within the table limits.
4. Compute the temperature increment for 10 points: $T_{incr} = (T_{max} - T_{min}) / 9$, then round off T_{incr} to the next higher integer. Now recomputed $T_{max} = T_{min} + 9 * T_{incr}$.
5. Repeat Step 4 to compute the pressure increment “ P_{incr} ,” “ P_{min} ” and “ P_{max} .”
6. From the SonicWare menu select [Perform Range Calculation] and [Varying T & P], then enter the temperature and pressure range and increments from Steps 4 and 5. Verify that there are exactly 10 “temp. points” and 10 “pres. points” indicated.
7. Select [Density] and [Z-factor] from the output data menu, then click on [Compute].
8. From the SonicWare toolbar select [Table] then [Copy All]. These tables can now be pasted into EXCEL (see Example #1). Select “General” formatting to remove any commas from the data.
9. The final text file must follow the syntax indicated in the example shown on the next page. To accomplish this the data needs to be manipulated within EXCEL and then saved as a comma separated file, then further modification will be necessary (using a text editor) to obtain the final text file format shown in Example #2.

NOTE: The data strings must conform to the syntax rules listed below.

10. Save the final AGA8 text file in an appropriate directory on your PC.
11. Now that the file is properly formatted, it can be downloaded to the 1010GCSX flowmeter using HyperTerminal™ or other communication software. With the RS-232 baud rate set to 9600 or lower, confirm that the meter is properly communicating with the terminal program.

NOTE; If the flowmeter is actively measuring flow the channel must be disabled by either using the meter keypad or HyperTerminal™. In HyperTerminal™ type: MENU. Select the Chan/Path menu and then [Channel Enable]. Select the [No] option.

12. Select the desired default channel for download of the AGA8 table. In HyperTerminal™ type “cv 0” for Single Channel systems or “cv 2” for Dual Beam systems. Press <ENT>.
13. Select [Send Text File] from the HyperTerminal™ menu and proceed to transfer the AGA8 compensation file created in Step 10.

Syntax for entry of the pressure and temperature index array is:

cv pres_grid[i] pressure_i where i = 0 to 9

cv temp_grid[j] temp_j where j = 0 to 9

Syntax for entry of the density and Z factor values is:

cv dens_grid[k] density_k where k = 0 to 99

cv z_grid[k] zfactor_k where k = 0 to 99

To simplify the creation of the AGA8 table file, the data can be arranged with comma separators indicating the next item in the array. In this way the “cv” command does not have to be issued for each data point.

For example, the string below loads all temperature points for the entire temperature array from point 0 to point 9 or (0 to 87 deg C).

cv temp_[0] 273.0, 283.0, 293.0, 303.0, 313.0, 323.0, 333.0, 343.0, 353.0, 363.0

14. Once the table is installed, set the [AGA8 Comp] menu to [Yes] to enable AGA8 compensation. Note that the [Std. Vol Comp] menu must also be set to [Yes] if standard volume flow output is desired.

EXAMPLE #1Density (kg-m/m³) vs. Pressure and Temperature

	100	250	400	550	700	850	1000	1150	1300	1450
273	5.4641	13.7105	22.4055	31.5813	41.2659	51.4778	62.2197	73.4705	85.1762	97.2428
283	5.2928	13.2438	21.5764	30.3107	39.462	49.0368	59.0296	69.4174	80.1557	91.1746
293	5.1324	12.8109	20.8158	29.1586	37.8464	46.8787	56.2454	65.9241	75.8769	86.0497
303	4.9819	12.4082	20.1146	28.107	36.3869	44.9499	53.7836	62.8666	72.1668	81.6406
313	4.8402	12.0322	19.4653	27.1416	35.059	43.2106	51.5835	60.1575	68.9049	77.7902
323	4.7067	11.6801	18.8618	26.251	33.8433	41.6306	49.5998	57.7324	66.0045	74.3861
333	4.5806	11.3497	18.299	25.4258	32.7244	40.186	47.7979	55.5432	63.4009	71.3457
343	4.4612	11.0388	17.7724	24.6582	31.6897	38.8579	46.1506	53.5524	61.045	68.6067
353	4.3481	10.7456	17.2785	23.9418	30.729	37.631	44.6363	51.731	58.8988	66.121
363	4.2408	10.4686	16.8138	23.2712	29.8337	36.4927	43.2375	50.0554	56.9319	63.8507

Z-factor vs. Pressure and Temperature

	100	250	400	550	700	850	1000	1150	1300	1450
273	0.9825	0.9571	0.9318	0.9066	0.8817	0.8575	0.8341	0.8119	0.7913	0.7729
283	0.9842	0.9615	0.9389	0.9166	0.8947	0.8735	0.8531	0.8338	0.816	0.7999
293	0.9858	0.9654	0.9452	0.9254	0.9061	0.8874	0.8696	0.8528	0.8372	0.8232
303	0.9872	0.9689	0.9508	0.9332	0.9161	0.8996	0.8839	0.8692	0.8556	0.8434
313	0.9884	0.972	0.9558	0.9401	0.9249	0.9104	0.8966	0.8837	0.8718	0.861
323	0.9896	0.9747	0.9603	0.9463	0.9328	0.9199	0.9077	0.8964	0.886	0.8766
333	0.9906	0.9772	0.9643	0.9518	0.9398	0.9284	0.9176	0.9077	0.8986	0.8904
343	0.9915	0.9795	0.9679	0.9567	0.946	0.936	0.9265	0.9177	0.9098	0.9026
353	0.9923	0.9815	0.9711	0.9612	0.9517	0.9428	0.9344	0.9268	0.9198	0.9136
363	0.9931	0.9834	0.9741	0.9652	0.9568	0.9489	0.9416	0.9348	0.9288	0.9234

EXAMPLE #2

```

cv temp_grid[0] 273,283,293,303,313,323,333,343,353,363
cv pres_grid[0] 100,250,400,550,700,850,1000,1150,1300,1450
cv dens_grid[0] 5.4641,13.7105,22.4055,31.5813,41.2659,51.4778,62.2197,73.4705,85.1762,97.2428
cv dens_grid[10] 5.2928,13.2438,21.5764,30.3107,39.462,49.0368,59.0296,69.4174,80.1557,91.1746
cv dens_grid[20] 5.1324,12.8109,20.8158,29.1586,37.8464,46.8787,56.2454,65.9241,75.8769,86.0497
cv dens_grid[30] 4.9819,12.4082,20.1146,28.107,36.3869,44.9499,53.7836,62.8666,72.1668,81.6406
cv dens_grid[40] 4.8402,12.0322,19.4653,27.1416,35.059,43.2106,51.5835,60.1575,68.9049,77.7902
cvdens_grid[50] 4.7067,11.6801,18.8618,26.251,33.8433,41.6306,49.5998,57.7324,66.0045,74.3861
cv dens_grid[60] 4.5806,11.3497,18.299,25.4258,32.7244,40.186,47.7979,55.5432,63.4009,71.3457
cv dens_grid[70] 4.4612,11.0388,17.7724,24.6582,31.6897,38.8579,46.1506,53.5524,61.045,68.6067
cv dens_grid[80] 4.3481,10.7456,17.2785,23.9418,30.729,37.631,44.6363,51.731,58.8988,66.121
cv dens_grid[90] 4.2408,10.4686,16.8138,23.2712,29.8337,36.4927,43.2375,50.0554,56.9319,63.8507
cv z_grid[0] 0.9825,0.9571,0.9318,0.9066,0.8817,0.8575,0.8341,0.8119,0.7913,0.7729
cv z_grid[10] 0.9842,0.9615,0.9389,0.9166,0.8947,0.8735,0.8531,0.8338,0.816,0.7999
cv z_grid[20] 0.9858,0.9654,0.9452,0.9254,0.9061,0.8874,0.8696,0.8528,0.8372,0.8232
cv z_grid[30] 0.9872,0.9689,0.9508,0.9332,0.9161,0.8996,0.8839,0.8692,0.8556,0.8434
cv z_grid[40] 0.9884,0.972,0.9558,0.9401,0.9249,0.9104,0.8966,0.8837,0.8718,0.861
cv z_grid[50] 0.9896,0.9747,0.9603,0.9463,0.9328,0.9199,0.9077,0.8964,0.886,0.8766
cv z_grid[60] 0.9906,0.9772,0.9643,0.9518,0.9398,0.9284,0.9176,0.9077,0.8986,0.8904
cv z_grid[70] 0.9915,0.9795,0.9679,0.9567,0.946,0.936,0.9265,0.9177,0.9098,0.9026
cv z_grid[80] 0.9923,0.9815,0.9711,0.9612,0.9517,0.9428,0.9344,0.9268,0.9198,0.9136
cv z_grid[90] 0.9931,0.9834,0.9741,0.9652,0.9568,0.9489,0.9416,0.9348,0.9288,0.9234

```

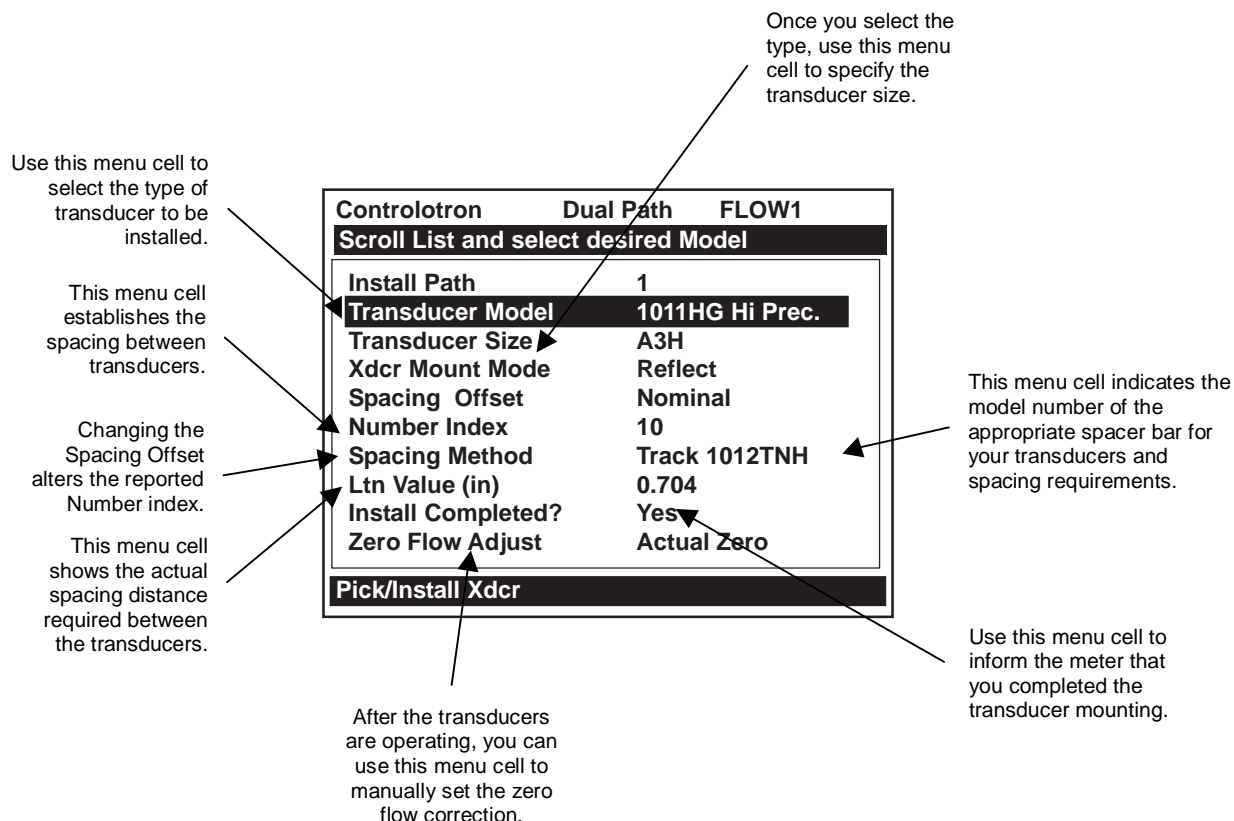
4.4 THE PICK/INSTALL XDCR MENU

Use this menu after creating a new site setup in the Channel/Path Setup menu, and defining the spool parameters in the Pipe Data menu.

Based on pipe data (and optionally application data) entries, the Pick/Install Xdcr menu automatically identifies the most suitable transducers for the application. 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 flowmeter 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 Completed?] menu cell to inform the flowmeter that you completed the physical mounting of the transducers. You can define the zero flow values once the transducers are operational.

NOTE: Before preceeding to mount transducers, it is recommended to refer to Section 2 for Gas Spool installation procedures. Refer to the Pick/Install Xdcr menu and menu structure shown below for menu cell descriptions and details.



PICK/INSTALL XDRC MENU STRUCTURE

⇕	Pick/Install Xdcr ⇨	Install Path ⇨ ⇕	1 2	
		Transducer Model ⇨ ⇕	1011G Universal 1011HG Hi Precision	
		Transducer Size ⇨	1011G Universal	1011HG High Precision
		⇕	⇕ A1 A2 B1 B2 B3 C1 C2 C3 D1 D2 D3 E1 E2 E3	⇕ A1H A2H A3H B1H B2H C1H C2H D1H D2H D4H
		Xdcr Mount Mode ⇨ ⇕	⇕ Direct Reflect	
		Spacing Offset ⇨ ⇕	⇕ Minimum Nominal Maximum	
		Number Index ⇨	4 <i>(generated)</i>	
		Spacing Method ⇨	Spacer Bar [P/N]	⇨ *auto P/N generation
		Ltn Value <in> ⇨	2.00 (generated)	
		Install Complete? ⇨	⇕ No Install	*[Yes] indicates successful install
		Zero Flow Adjust ⇨ ⇕	⇕ AutoZero ZeroClr Reversamatic Actual Zero ZeroMatic*	*Reflect mount only

4.4.1 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 flowmeter to adjust its transmit/receive functions accordingly. You can choose from either the [1011G Universal] or [1011HG High Precision] transducer lists.

You should consider using 1011 high precision transducers for most gas metering applications. 1011 Universal transducers should only be used when the wall thickness of the pipe exceeds the limit of the 1011 High Precision transducers or when the diameter to wall thickness is considered too small. The system default is [1011G Universal]. If this suits the application, bypass this menu cell by pressing the <Down Arrow>.

To select a Transducer Type:

To access the [Transducer Model] option list press 

To move the cursor to the required transducer model press  

To store your selection press 

4.4.2 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 flowmeter 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 flowmeter and use any size, as long as the mounting method accommodates the pipe's diameter. The flowmeter 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 press 

4.4.3 HOW TO SELECT A XDCCR MOUNT MODE

The flowmeter 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 gas or pipe material exhibits high sonic attenuation, thereby preventing operation in the Reflect configuration.

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 

4.4.4 HOW TO USE THE SPACING OFFSET

After you select the mounting method, the flowmeter 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. Index strips 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 flowmeter reports “Use Ltn,” you have to measure the distance between the upstream and downstream transducers. The flowmeter issues the actual distance between the transducers in inches or millimeters (See Ltn). Please consult Section 2 or 5 for details on how to use the Ltn measurement. 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 1010 uses a pair of precisely matched transducers. Therefore, you can select either one for the Reference position. You must connect the Up transducer cable to the transducer mounted on the upstream side of the mounting track. This lets the meter display the flow direction correctly.

It is important that you note each transducer’s serial number and its Index position during the original installation because to reinstall the flowmeter successfully, you must remount each transducer in its original position. Transducer pairs have matching serial numbers except for the appended letters “A” and “B.” This helps you to identify each transducer.

To select a different Spacing Offset

To access to [Spacing Offset] option list press 

To move the cursor to the desired offset press  

To store selection press 

4.4.5 THE NUMBER INDEX MENU CELL

Selecting the Spacing Offset allows the flowmeter 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 flowmeter bases its Number Index selection on the pipe diameter and estimated liquid sonic velocity (Vs) you entered in the Gas Parameters menu. When you invoke the [Install Complete?] routine, the flowmeter actually measures the gas sonic velocity (Vs). In some cases, it may prompt you to re-space the transducers to another number index.

4.4.6 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.

NOTE: Ltn may be a negative number for direct mount on very small pipes where the transducer spacing overlaps.

4.4.7 HOW TO USE [INSTALL COMPLETE?]

Use the [Install Complete?] menu cell to inform the flowmeter 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 [Dual Path Flow] 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 2 for procedures).

NOTES

- *Mount the transducers using the selected mode (direct or reflect). Please refer to the transducer mounting procedures detailed in Section 2.*
- *When using Index Strips, 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 6 for appropriate type and part number.*
- *The pipe must be pressurized to the minimum gas pressure required for operation.*

After transducers are properly mounted, the flowmeter 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] menu cell and then press <ENT> (unless otherwise directed to do so by Controlotron's Technical Service Department).

Controlotron	Dual Path	SITE1
Key [Install] after mounting transducers		
Install Path	1	
Transducer Model	1011 Universal	
Transducer Size	B3	
Xdcr Mount Mode	Direct	
Spacing Offset	Minimum	
Number Index	4	
Spacing Method	Track 1012TP	
Ltn Value (in)	0.217	
Install Complete?	No	
Zero Flow Adjust	Channel Not Setup	
Pick/Install Xdcr		

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

Controlotron	Dual Path	SITE1
Key [Install] after mounting transducers		
Install Path	1	
Transducer Model	1011 Universal	
Transducer Size	B3	
Xdcr Mount Mode	Direct	
Spacing Offset	Minimum	
Number Index	4	
Spacing Method	Track 1012TP	
Ltn Value (in)	0.217	
Install Complete?	Yes	
Zero Flow Adjust	Channel Not Setup	
Pick/Install Xdcr		

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

NOTE: If the transducers have been installed successfully but the Estimated Vs (sonic velocity) has been changed, the Pick/Install Xdcr menu cell [Install Complete?] option list will also display the [Transfer Install] function selection. The Transfer Install function allows the transducers to be optimally positioned for a different fluid, without the need for a new Initial Makeup procedure (see the Water Calibration addendum in this manual for details).

Force Transmit Procedure

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

1. On a PC, after [Install] is selected press <ENT>. If using the Magnetic Wand, after [Install] is selected, touch the <ENT> sensor.

Controlotron	Dual Path	SITE1
Key Install after mounting transducers		
Install Path	1	
Transducer Model	1011G Universal	
Transducer Size	B3	
Xdcr Mount Mode	Direct	
Spacing Offset	Minimum	
Number Index	4	
Spacing Method	Track 1012TP	
Ltn Value (in)	0.217	
Install Complete?	No	
Zero Flow Adjust	Channel Not Setup	
Pick/Install Xdcr		

Controlotron	Dual Path	SITE1
Drive 11		
Install Path	1	
Transducer Model	1011G Universal	
Transducer Size	B3	
Xdcr Mount Mode	Direct	
Spacing Offset	Minimum	
Number Index	4	
Spacing Method	Track 1012TP	
Ltn Value (in)	0.217	
Install Complete?	Install	
Zero Flow Adjust	Channel Not Setup	
Pick/Install Xdcr		

2. While the flowmeter is going through the drives (see menu screen above), press the <ENT> again. A typical menu screen will appear as shown below *only when using a PC* 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.

NOTE: When using a PC the <ALT> and <Enter> keys must be pressed before the flowmeter scans through all the drives, or the selection of the detection mode and the Force Transmit function must be initiated again.

Controlotron	Dual Path	SITE1
ForceN	fx=8	m=7
ALC=50		
Install Path	1	
Transducer Model	1011G Universal	
Transducer Size	B3	
Xdcr Mount Mode	Direct	
Spacing Offset	Minimum	
Number Index	4	
Spacing Method	Track 1012TP	
Ltn Value (in)	0.217	
Install Complete?	Install	
Zero Flow Adjust	Channel Not Setup	
Pick/Install Xdcr		

Controlotron	Dual Path	SITE1
Detection Fault		
Press [ENT]		
Install Path	1	
Transducer Model	1011G Universal	
Transducer Size	B3	
Xdcr Mount Mode	Direct	
Spacing Offset		
Number Index		
Spacing Method		
Ltn Value (in)		
Install Complete?	Install	
Zero Flow Adjust	Channel Not Setup	
Pick/Install Xdcr		

3. To exit Force Transmit, press the <Left Arrow> and a Detection Fault prompt will appear (see above). Press the <Left Arrow> again and the flowmeter will return to the Edit/Install Xdcr menu and highlight the [Zero Flow Adjust] menu cell.
4. *To force a frequency*, repeat steps 1 and 2 above, but press <Right Arrow>. The following typical display line will appear:




Drive
=0

Using numeric keys or Magnetic Wand enter the frequency and press <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 flowmeter 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 gas 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 1010 will show you a pop-up window with the measured Vs as shown below.



Measured Vs m/s 1470

This means that the flowmeter 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 to type a different value. However, only edit the Measured Vs when you are certain of 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 flowmeter 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 flowmeter is now ready to report flow.

In cases where the actual Vs differs noticeably from the estimated Vs, the flowmeter 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 completes 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 the numeric keys to type the new Vs value (in meters-per-second).

To store the corrected Vs press 

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

To repeat the Initial Makeup process press 

After the flowmeter 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.

4.4.8 ZERO FLOW ADJUST MENU

Unlike turbine meters ultrasonic transit-time meters provide active flow measurement right down to zero flow, however, the measurement of the transit-time delta is dependent on the similarity or “match” of the electronics, cables and ultrasonic transducers. Consequently some flow offset (or zero offset) may be present in any installation. To eliminate this residual zero offset Controlotron has developed several different methods to insure proper zero flow compensation. The following paragraphs describe each method and when they should be used.

AutoZero

When the 1011 transducers are mounted in the Reflect Mode configuration (see paragraph 5.2) 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 can-not be mounted in the Reflect Mode configuration. Flow must be stable during the entire process.

ZeroMatic™

When ZeroMatic™ is invoked the flowmeter first performs the same analysis as described above in the AutoZero routine. However, after this analysis is complete the flowmeter continues to interrogate the pipe wall signal and update the zero offset value under normal operation, such that the flowmeter dynamically compensates for changing conditions which would normally result in zero drift. ZeroMatic™ will only operate with the transducers mounted in the Reflect Mode configuration and is recommended for applications which experience large temperature extremes.


NOTE: Invoking ZeroMatic™ will clear any existing “fixed” or memorized zero offset. If any zero offset remains after flow is stopped, an Actual Zero can be performed without interrupting ZeroMatic™ operation. To disable ZeroMatic™, invoke it again, but then press <Left Arrow> to abort the installation.


NOTE: The ZeroClr command only resets the memorized zero offset registers not those set when the AutoZero routine is invoked.

Using Actual Zero

NOTE: Flow must be stopped with the line blocked (if possible) before invoking this function.

To invoke Actual Zero:

Access the [Zero Flow Adjust] option list by pressing 

Press . 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  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 Reflect Mount is not possible, then use the ReversaMatic™ routine to establish the zero flow level.

To invoke ReversaMatic:

- To access the [Zero Flow Adjust] option list press 
- Move the cursor to [ReversaMatic]. Press  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 **Reverse Xdcrs/ Press ENT** prompt.
- Now remount the transducers for normal operation (in their original orientation). When re-mounting 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.

ZeroMatic™ (optional function)

NOTE: ZeroMatic™ is used in the Reflect Mode only. Invoking ZeroMatic™ clears any existing fixed zero offset.

Use this menu cell to select the ZeroMatic™ option. If conditions permit the use of the Auto Zero function then the ZeroMatic™ option can be used as well.


To select and enable the ZeroMatic option:

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

To access the [Zero Flow Adjust] option list press .

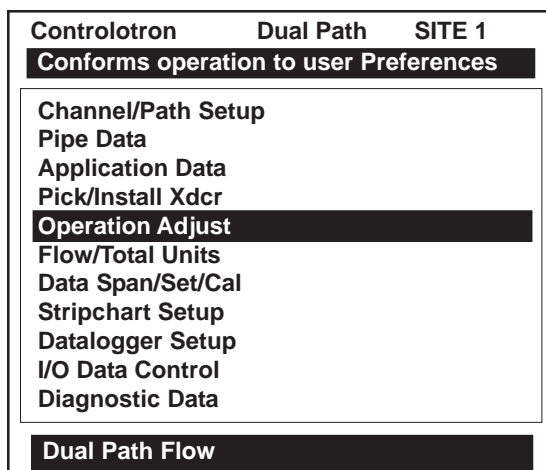
NOTE: If ZeroMatic™ is not running, the [Actual Zero] menu item will be displayed next to the [Zero Flow Adjust] menu cell.

Controlotron	Dual Path	SITE1
Conforms Indicated flow to Actual Zero		
Install Path	1	
Transducer Model	1011G Universal	
Transducer Size	B3	
Xdcr Mount Mode	Reflect	
Spacing Offset	Minimum	
Number Index	7	
Spacing Method	Track 1012TP	
Ltn Value (in)	0.778	
Install Completed?	ZeroMatic	
Zero Flow Adjust	Actual Zero	
	ZeroClr	
	Auto Zero	
	Reversamatic	
Pick/Install Xdcr		

Select the [ZeroMatic] menu cell by pressing  or  then press .

Controlotron	Dual Path	SITE1
ZeroMatic Active		
[6:.....:0]		
Install Path	1	
Transducer Model	1011G Universal	
Transducer Size	B3	
Xdcr Mount Mode	Reflect	
Spacing Offset	Minimum	
Number Index	7	
Spacing Method	Track 1012TP	
Ltn Value (in)	0.778	
Install Completed?	Yes	
Zero Flow Adjust		
Pick/Install Xdcr		

When the initial makeup of ZeroMatic™ is complete the screen will return to the Pick/Install Xdcr menu and automatically highlight [Operation Adjust], which is the next menu cell.



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.

4.5 THE OPERATION ADJUST MENU

This menu becomes available after picking a meter type and measurement path. 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, (usually a very low flow rate), below which, the flow output will be forced to zero. You can also select the meter response to a continuous Fault condition.

Use this menu cell to select either SmartSlew™ or Time Average output damping.

Use this menu cell to enter a flow rate deadband threshold. Flow rates below this level will be reported as zero flow.

Controlotron	Dual Path	SITE1
Determine Fault Memory Delay		
Damping Control	Smart Slew	
Deadband Control	0.000	
Memory/Fault Set	Memory	
Memory Delay <sec>	120	
Operation Adjust		

Use this menu cell to select meter response to a fault condition. Fault drops outputs to zero. Memory retains last valid reading for duration of Memory Delay.

Use this menu cell to enter the duration (in sec.) that you want the meter to maintain its last reading for during a fault condition. The hidden cell only appears if you select Memory Mode.

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)

4.5.1 DAMPING CONTROL

System 1010 provides two different data output filter types, SmartSlew™ and Time Average. SmartSlew™ (recommended) provides the best combination of data smoothing and quick response to sudden rate changes. It performs data scatter damping during steady flow periods while maintaining the ability to respond instantaneously to changing flow rates. SmartSlew™ values range from [1 to 9]. The default is [6]. Pick a higher number to slow meter response to a rate change.

Time Average allows you to select a standard output delay. You enter a value (in seconds), which sets the time it takes the meter to respond to a rate change. The default is 10 seconds. You can enter any amount of time up to 60 seconds maximum.

To edit the default SmartSlew™ setting:

1. Press the <Right Arrow> three times to access the SmartSlew™ option list.
2. Scroll the numeric list to the desired choice.
3. Press <ENT> to register the new value.

To select Time Average:

1. Press the <Right Arrow> to access the [Damping Control] option list.
2. Move the cursor down to [Time Average]. Press <ENT>.
3. Press the <Right Arrow> to enable Time Average entry.
4. Use the numeric keys to type the new Time Average setting.
5. Press <ENT> to register the new value.

4.5.2 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):

1. Press the <Right Arrow> to enable numeric entry.
2. Use the numeric keys to type in the desired rate (using selected flow rate units).
3. Press <ENT> to register the new value.

4.5.3 MEMORY/FAULT SET

Certain situations (e.g., excessive turbulence) 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.

However, for some applications, occasional temporary Fault conditions may be a normal part of the process and therefore 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:

1. Press the <Right Arrow> to access the [Memory/Fault Set] option list.
2. Move the cursor down to [Memory].
3. Press <ENT> to make selection.
4. This moves the highlight to [Memory Delay <sec>].

Memory Delay (sec)

Selecting [Memory] activates the suppressed [Memory Delay] menu cell. Memory Delay (sec) allows you to specify the amount in 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:

1. Press the <Right Arrow> to enable numeric entry.
2. Use the number keys to type the delay amount in seconds.
3. Press <ENT> to register the new value.

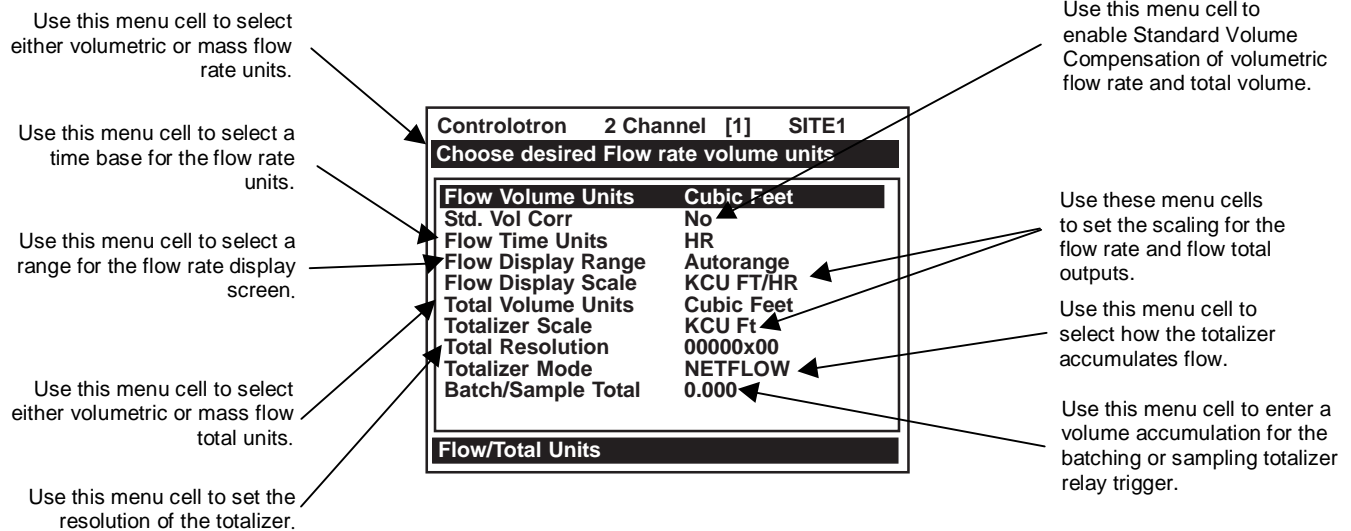
4.6 THE FLOW/TOTAL UNITS MENU

The [Flow/Total Units] menu is available after selecting a meter type and measurement path. Use the [Flow/Total Units] menu to select mass and volumetric flow units and an associated time base. Independent volume/mass units can be selected by the Totalizer. 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) flow total only*
NEGFLOW *Negative (reverse) flow total only*
NETFLOW *The net of the Positive and Negative flow (default)*

The flow computer stores positive and negative accumulations in separate independent registers. It develops the NETFLOW output by summing the positive and negative totalizer registers. You use the keypad's function and numeric keys to control the flow totalizer registers.



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

<Fn><1>	CLEAR (also clears overflow)	Resetting the Totalizer registers clears all total data accumulated during operation. <i>Note: In Dual-Beam mode, the Totalizer operates only on the virtual system channel (Ch 3). Therefore, in this case, the CLEAR trigger would be <F3> <1></i>
<Fn><2>	NOTOT(Totalizer Freeze)	Invoking the NOTOT command disables the Totalizer. Totalization will not resume until you repeat the Fn and Numeric 2 key sequence. When you activate NOTOT, an N precedes the TOTAL symbol (i.e., [NTOTAL]) on the LCD Screen.
<Fn><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.
<Fn><4>	CLEAR (Batch/Tot Register)	Clears the Batch Sample totalizer register. See Batch/Sample Tot.

THE FLOW/TOTAL UNITS MENU STRUCTURE

Flow/Total Units ⇨	Flow Volume Units ⇨	Volume Units ⇨	⇅ Cubic Feet Cubic Meters Pounds Kilograms Tons Metric Tons Ft/Sec (Vel) M/Sec (Vel)
		⇅	
		Std Vol Corr ⇨	⇅ No Yes
		⇅	
		Flow Time Units ⇨	⇅ MIN HR DAY SEC
		⇅	
		Flow Disp. Range ⇨	⇅ Autorange High
		⇅	
		Flow Disp. Scale ⇨	⇅ CU FT/HR KCU FT/HR MCU FT/HR
		⇅	
⇅		Total Vol. Units ⇨	⇅ <i>Same as Flow Volume Units except Velocity</i>
		⇅	
		Totalizer Scale ⇨	⇅ CU FT KCU FT MCU FT
		⇅	
		Total Resolution ⇨	⇅ 0000000X 00000X00 000000X0
		Totalizer Mode ⇨	⇅ NEGFLOW NETFLOW POSFLOW
		⇅	
		Batch/Sample Tot ⇨	x.xxx (numeric entry)
		Reset Totalizer ⇨	No/Yes

4.6.1 FLOW VOLUME UNITS

The [Flow Vol 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 computed gas specific gravity to convert volumetric flow to mass flow. The default, English Units, is [Cubic Feet].

To select a Volumetric or Mass Unit:

1. Press the <Right Arrow> to access the [Flow Volume Unit] option list.
2. Use the <Up or Down Arrow> to move the cursor to the required units.
3. Press <ENT> to store selection.

4.6.2 STD VOL CORR

The [Std Vol Corr] menu cell (Standard Volume Correction) allows you to enable or disable the reporting of standard volume flow and total volume.

To enable or disable the Std Vol Corr::

1. Press the <Right Arrow> to access the [Std Vol Corr] option list.
2. Use the <Up or Down Arrow> to move the cursor to the required selection (NO or YES).
3. Press <ENT> to store selection.

4.6.3 FLOW TIME UNITS

The [Flow Time Units] option list allows you to select a flow display time base. The system default is [Minutes]. If this suits the application, press the <Down Arrow> to bypass this menu cell.

To select a Time Unit:

1. Press the <Right Arrow> to access the [Flow Time Units] option list.
2. Use the <Up or Down Arrow> to move the cursor to the required time units.
3. Press <ENT> to store the time units.

4.6.4 FLOW DISPLAY RANGE

The [Flow Disp. 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:

1. Press the <Right Arrow> to access the [Flow Disp. Range] option list.
2. Use the <Up or Down Arrow> to move the cursor to the required display range.
3. Press <ENT> to store selection.

4.6.5 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., KCU FT/HR). The [Flow Disp. 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:

1. Press the <Right Arrow> to access the [Flow Disp. Scale] option list.
2. Move the cursor to the desired display scale.
3. Press <ENT> to register selection.

4.6.6 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 computed gas specific gravity along with the indicated

pressure and temperature to convert volumetric total to mass flow. The default English Volume Units is [Cubic Feet]. If this suits the application, press the <Down Arrow> to bypass this menu cell.

To change the default setting:

1. Press the <Right Arrow> to access the [Total Vol. Units] option list.
2. Use the <Up or Down Arrow> to move the cursor to the desired Total volume units.
3. Press <ENT> to store selection.

4.6.7 TOTALIZER SCALE

After you select totalizer units, the meter automatically computes a prefix to provide the best combination of capacity and resolution (e.g., KCU FT/HR). 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). Therefore, always keep this prefix in mind when you enter totalizer-related data.

To select a different Totalizer Scale:

1. Press the <Right Arrow> to access the [Totalizer Scale] option list.
2. Move the cursor to the desired display scale.
3. Press <ENT> to register selection.

4.6.8 TOTAL RESOLUTION

The meter assigns multiplier prefixes for the flow total units you selected (e.g., KCU FT). It provides three resolution (or capacity) levels. Therefore, actual Totalizer display units depends 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 0.5 pulses per second (0.5 Hz).
- b) The meter sends a totalizer output pulse for every advance of the rightmost visible totalizer digit.

It is therefore possible for a high flow rate to persist long enough to exceed the relay output's 0.5 Hz rate. If this occurs, the meter will store excess pulses in an overflow buffer, then route them back to the relay when the flow rate drops enough to allow the TOTCNT output to "catch up." However, exceeding the 0.5 Hz rate for long periods could cause an excessive accumulation of buffered pulses. These will continue to trip the relay after the flow rate lessens, or even stops. If this occurs, an external Totalizer driven by the output will be unable to indicate the current flow total. Therefore, you should select a resolution to ensure that, even at the maximum expected flow rate, the TOTCNT pulse will not be activated more than 0.5 times per second for any appreciable length of time. Note that resetting the Totalizer also clears the overflow buffer.

To change the default resolution:

1. Press the <Right Arrow> to access the [Total Resolution] option list.
2. Move the cursor to the required resolution.

3. Press <ENT> to store selection.

4.6.9 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

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:

1. Press the <Right Arrow> to access the [Totalizer Mode] option list.
2. Use the <Up or Down Arrow> to move the cursor to the required Totalizer mode.
3. Press <ENT> to store selection.

4.6.10 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 Tot] menu cell. The numeric entry must reflect the selected flow total units. The [Totalizer Disp. Scale] menu cell shows the applicable flow total units. The sign of the Batch/Sample Total determines positive or negative accumulations. The sign of the Batch/Sample Total determines positive or negative accumulations.

NOTE: The Batch/Sample total relay requires the same consideration for exceeding the maximum pulse rate as the TOTCNT relay (see Total Resolution).

To enter a Batch/Sample Volume:

1. Press the <Right Arrow> to activate numeric entry.
2. Use the numeric keys to type the desired Batch/Sample TOT accumulation.
3. Press <ENT> to store data.

4.6.11 RESET TOTALIZER

Use this function to set all 1010 Totalizer registers, including the overflow registers, 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).

4.7 THE DATA SPAN/SET/CAL MENU

This menu becomes available after picking a Meter Type and Measurement Path. However, some functions will only be active after the transducers are installed and operating properly.

Use the [Data Span/Set/Cal] menu to set the range for analog outputs and setpoints for Alarm relay outputs. Additionally, the Calibrate Flow Rate menu allows you to apply external adjustments to the meter's intrinsic primary outputs.

THE DATA SPAN/SET/CAL MENU STRUCTURE

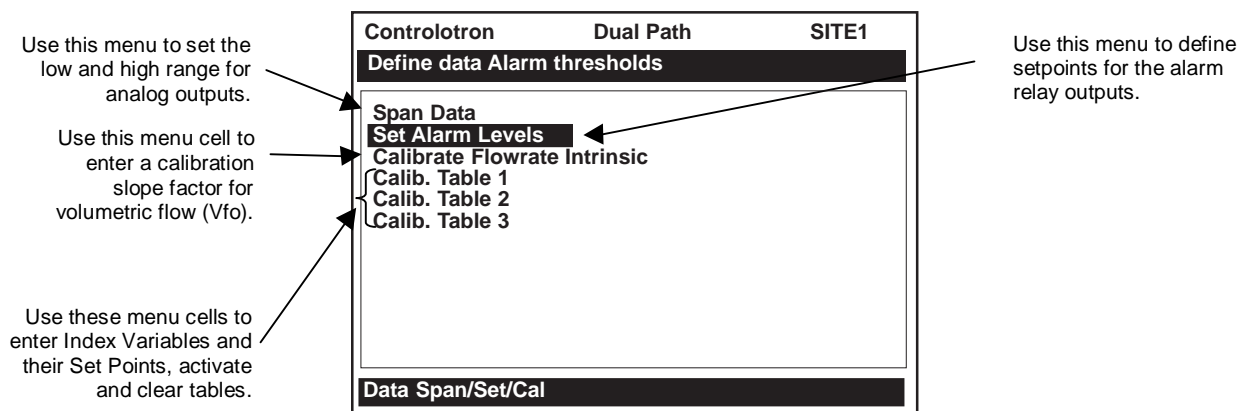
Data Span/Set/Cal ⇌	Span Data ⇌	⇌	PGEN P/(Units)* Max Flow (Units) Min Flow (Units) Max Flow2 (Units) Min Flow2 (Units) Max Vs m/s Min Vs m/s Max S.G. Min S.G. Max Base S.G. Min Base S.G. Max Viscosity cS Min Viscosity cS Max Temperature Min Temperature	xxxx.xxx (numeric entry) x.xxx (numeric entry) x.xxx (numeric entry) x.xxx (numeric entry) x.xxx (numeric entry) x.xxx (numeric entry) x.xxx (numeric entry) x.xxx (numeric entry) x.xxx (numeric entry) x.xxx (numeric entry) x.xxx (numeric entry) x.xxx (numeric entry) x.xxx (numeric entry) x.xxx (numeric entry)
	Set Alarm Levels ⇌	⇌	Hi Flow Low Flow High S.G. Low S.G. High Base S.G. Low Base S.G. Hi Viscosity cS Low Viscosity cS High Temperature Low Temperature Interface Vs m/s Interface S.G. Turbulence % Aeration % Makeup Latch ⇌	x.xxx (numeric entry) x.xxx (numeric entry) x.xxx (numeric entry) x.xxx (numeric entry) x.xxx (numeric entry) x.xxx (numeric entry) x.xxx (numeric entry) x.xxx (numeric entry) x.xxx (numeric entry) x.xxx (numeric entry) x.xxx (numeric entry) x.xxx (numeric entry) x.xxx (numeric entry) OFF ON
	Calibrate Flowrate ⇌	⇌	Intrinsic Kc	x.xxx (numeric entry)
	Calib. Table 1 ⇌	⇌	Index Variable 1 ⇌	Flow Vs Viscosity (cS) Viscosity(cP) S.G. Valc Vaer Temp1 Reynolds # Pressure Aux

*Present in Custody Transfer flowmeters only.

(continued)

THE DATA SPAN/SET/CAL MENU STRUCTURE *(continued)*

Data Span/Set/Cal ⇨	Calib. Table 1 ⇨ ⇕	Calib. Table 1 ⇨	New Point ⇨	⇕ Cal. Index Value PosFlow Corr NegFlow Corr Accept/Clear	x.xxx x.xxx x.xxx ⇕ Accept Pt. Clear Pt.
		Table Active 1 ⇨	No		
		Clear Table 1 ⇨	⇕ No Yes		
	Calib. Table 2 ⇨ ⇕	Index Variable 2 ⇨	Same List as Index Variable 1		
		Calib. Table 2 ⇨	New Point	⇕ Cal. Index Value PosFlow Corr NegFlow Corr Accept/Clear	x.xxx x.xxx x.xxx ⇕ Accept Pt. Clear Pt.
		Table Active 2 ⇨	No		
		Clear Table 2 ⇨	⇕ No Yes		
	Calib. Table 3 ⇨ ⇕	Index Variable 3 ⇨	Same List as Index Variable 1		
		Calib. Table 3 ⇨	New Point	⇕ Cal. Index Value PosFlow Corr NegFlow Corr Accept/Clear	x.xxx x.xxx x.xxx ⇕ Accept Pt. Clear Pt.
		Table Active 3 ⇨	No		
		Clear Table 3 ⇨	⇕ No Yes		



4.7.1 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 the analog outputs. The flow outputs operate as follows:

Vfo <i>Spanned volumetric or mass flow:</i>	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 always is lower than positive flow, whatever its absolute magnitude. For example, for a flow measurement range of -30 CF/M to +10 CF/M, the 4 mA span will be -30 CF/M, and the 20 mA span will be +10 CF/M.
Vfab <i>Spanned absolute volumetric flow rate:</i>	Vfab is the absolute magnitude of the volumetric flow rate (Vfo). There are no menu cells provided to span this output. Vf 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 CF/M and -30 CF/M, spans the Vfab output from 0 CF/M to 30 CF/M.
Vs <i>Spanned gas sonic velocity:</i>	Vs is the sonic velocity in meters-per-second (m/s) of the flowing gas. 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.
Vsg <i>spanned gas specific gravity:</i>	Vsg is the inferred operating specific gravity of the gas. The min. and max. Vsg entries establish the Vsg span. Max Vsg defines 100% of span and Min Vsg defines 0% span.

Maximum span values represent:

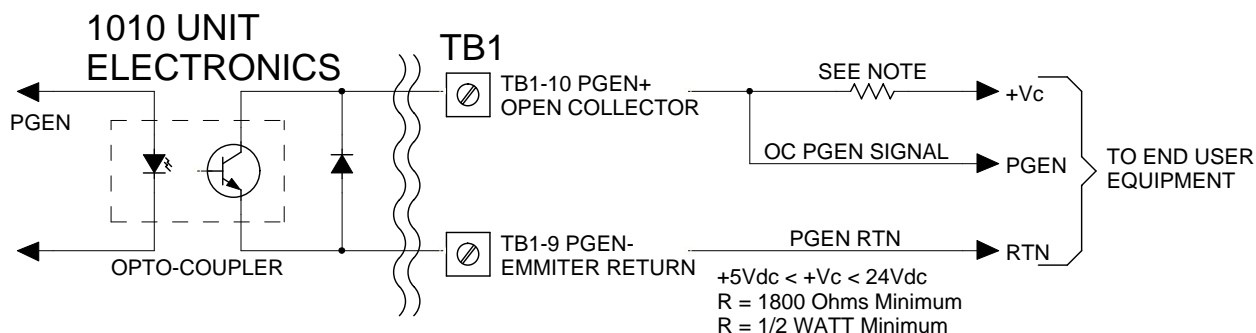
100% of span
Current output of 20 mA
Voltage output of 10 Vdc

Minimum span values represent:

0% of span
Current output of 4 mA
Voltage output of 0 Vdc

PGEN Wiring Diagram

1010GCDX TB1 WIRING DIGITAL PGEN SIGNALS



PGEN

The [PGEN P/*Unit Volume*] menu cell entry controls a user assignable digital output pulse function and is available in Custody Transfer units only (designated by a “C” in their part number). It allows the user to assign PGEN digital signal pulses per unit of volume. For example, 100 output pulses per cubic foot of gas.

The default PGEN value is configured to provide a 5000 Hz output frequency at a flow velocity of 100 ft/sec (30 meters/sec).

NOTE: The unit of volume is determined by the Volume Units initially selected from the [Total Volume Units] menu cell option list (refer to paragraph 4.6.1).


To change the default PGEN settings:

From the [Span Data] menu press 

From the [PGEN P/*Unit Volume*] menu cell, press  to activate the numeric entry.

Use the numeric keys to enter the desired number of PGEN pulses per unit volume.

NOTE: Ensure that the number entered will provide sufficient resolution while remaining within the 20 Hz to 5000 Hz pulse frequency range. Note that the PGEN output will stop sending pulses at flow rates corresponding to frequencies less than 20 Hz. In this case the PGEN value must be increased.

To store the data press 

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) as noted above.

To enter the Max Flow range setting:

1. Press the <Right Arrow> to activate numeric entry.
2. Use the numeric keys to type the maximum flow rate (100% of range).
3. Press <ENT> to store the data.

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 set the Min Flow range:

1. Press the <Right Arrow> to activate numeric entry.
2. Use the numeric keys to type the minimum flow rate (0% of range).
3. Press <ENT> to store data.

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 Flow2

The [Max Flow2] 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.

Min Flow2

The [Min Flow2] 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). Enter the data using the flow rate units you selected.

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 1500 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 0 m/sec.

Max S.G.

The [Max S.G.] menu cell stores the maximum range value for the specific gravity output. The specific gravity appears on the Stripchart display and can drive any analog output or alarm relay. The [Max S.G.] menu cell restricts this parameter to a maximum range of 100.

Min S.G.

The [Min S.G.] menu cell stores the minimum range value for the specific gravity output. The specific gravity can be displayed on the Stripchart and drive any analog output or alarm relay. The [Min S.G.] menu cell restricts this parameter to a minimum range of 0.

Max Base S.G.

The [Max Base S.G.] menu cell stores the maximum range value for the Specific Gravity of a gas at base temperature. The specific gravity (S.G.) will be displayed as the maximum on the Stripchart.

Min Base S.G.

The [Min Base S.G.] menu cell stores the minimum range value for the Specific Gravity of a gas at base temperature. 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.

4.7.2 SET ALARM LEVELS

The Set Alarm Levels menu allows you to select system alarm functions. Alarms appear locally on the LCD digital display. In addition, you can use the [Relay Setup] menu to assign the these functions to system's relays. You may select from high or low flow rate, gas interface (Vs) and gas turbulence alarm functions. The entry of all alarm setpoints is accomplished using the selected rate units. In addition, 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.

Press the <Right Arrow> to access the [Set Alarm Levels] menu.

Hi Flow

The [Hi Flow] alarm menu cell allows you to set the HI Alarm relay trip-point and the position of the HI Alarm cursor on the Stripchart Display. The entered value must fall within the volumetric flow (Vfo) analog span for the HI Alarm cursor to appear on the Graphic Screen.

To set the High Flow alarm:

1. Press the <Right Arrow> to activate numeric entry.
2. Use the numeric keys to type the Hi Flow Alarm setpoint in the selected flow rate units.
3. Press <ENT> to store data.

Low Flow

The [Low Flow] menu cell allows you to set the LO Alarm relay trip-point and the position of the LO Alarm cursor on the Stripchart Display. The entered value must fall within the volumetric flow (Vfo) analog span for the Low Alarm cursor to appear on the Graphic Screen.

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

High S.G.

This selection sets the High S.G. alarm function for the gas specific gravity.

Low S.G.

This selection sets the Low S.G. alarm function for the gas specific gravity.

High Base S.G.

The [High Base S.G.] menu cell sets the high Base S.G. alarm relay setpoint.

Low Base S.G.

The [Low Base S.G.] menu cell sets the low Base S.G. alarm relay setpoint.

High Viscosity cS

The [High Viscosity cS] menu cell sets the high gas 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 gas 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/sec) and Interface SG

The 1010 gas meter continuously measures the gas velocity of sound (Vs) and computes the gas specific gravity. Therefore, it can infer the type of gas is in the line at any given time. The Interface Vs or Interface SG provides a facility which can cause a relay alarm to trigger in response to a change in gas composition.

When the gas SG equals or exceeds the entered setpoint, the meter will indicate an interface SG alarm condition. Likewise if the measure gas sound velocity (Vs) exceeds the entered setpoint, the meter will indicate an interface alarm condition.

To enter an Interface Vs or SG alarm setpoint:

1. Press the <Right Arrow> to activate numeric entry.
2. Use the numeric keys to type the Interface value (meters/sec for Vs or SG).
3. Press <ENT> to store the data.

Turbulence %

The ability of System 1010 to operate with substantial gas non-homogeneity (possibly caused by water vapor mixing) surpasses all other transit-time systems. Some applications may require an alarm indication if turbulence exceeds a particular level. Therefore, the meter detects the turbulence level and provides this data as an output. The turbulence percentage triggers the alarm relay whenever it meets or exceeds the threshold you set in this menu cell. The turbulence percentage (Vtrb %) appears in the Flow Data section of the Diagnostic Data Menu. In addition, the digital display screen shows the current turbulence percentage.

NOTE: Severely non-homogeneity may induce meter fault. The 50% default usually allows enough leeway for continued operation. For intermittent faults, see memory interval in the Output Control menu.

To set the Turbulence % Alarm:

1. Press the <Right Arrow> to move the cursor to activate numeric entry.
2. Use the numeric keys to type the Turbulence percentage setpoint.
3. Press <ENT> to store data.

Makeup Latch

A fault condition could interrupt system operation temporarily. After recovery from the fault, the meter executes an in-process makeup to restore operating parameters. During the In-Process Makeup, the meter sets a Makeup Alarm flag, which it clears upon completion. Therefore, unless you were monitoring the unit continuously, you could miss the fact that an In-Process Makeup occurred. The Makeup Alarm Latch alerts you that the system implemented an In-Process Makeup by holding the Makeup Alarm active until you reset it manually by the simultaneous keystrokes: <Fn>6 (where “n” represents the measurement path).

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:

1. Press the <Right Arrow> to access the [Makeup Latch] option list.
2. Move the cursor to select either [On or Off].
3. Press <ENT> to turn Makeup Latch [On] or [Off].

4.7.3 CALIBRATE FLOWRATE AND CALIBRATION TABLES

System 1010 equipment provides three ways to condition the calibration performance of its flowrate output: Intrinsic (factory set), Kc, and Calibration Tables 1 through 3. Access to these calibration options is found in the [Calibrate Flowrate] menu cell and the three [Calib. Table] menu cells of the Data Span/Set/Cal menu (refer to Data Span/Set/Cal menu on next page). The intrinsic calibration of the 1010 is excellent as confirmed by numerous laboratory and field trials under diverse application conditions. Controlotron can confidently say that in any given application, the majority of conventional flowmeters can not match the system's measurement range or its linearity.

Intrinsic

When selected, the meter uses no slope adjustment at all. Output data is still zeroed and corrected for Reynolds number, but no slope adjustment is imposed on the meter's flow register. 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) and Kc (Slope Correction) 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 and Kc 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.

Data Span/Set/Cal Menu (Calibration Section)

Data Span/Set/Cal ⇨	Calibrate Flowrate ⇨	Intrinsic			
		Kc	x.xxx		
	Calib. Table 1 ⇨	Index Variable ⇨	⇅ Flow Vs Viscosity (cS) Viscosity (cP) S.G. Valc Vaer Temp1 Reynolds # Pressure Aux		
		⇅			
		Calib. Table 1 ⇨	New Point ⇨	⇅ Cal. Index Value PosFlow Corr NegFlow Corr Accept/Clear	x.xxx x.xxx x.xxx ⇅ Accept Pt. Clear Pt.
		⇅			
		Table Active 1 ⇨	No		
		Clear Table 1 ⇨	⇅ No Yes		

NOTE: 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.

Kc Factor


To obtain the Kc factor, compare flow total data taken simultaneously from the 1010 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 1010 and the reference standard.

Selecting the Kc Factor


When the [Kc] menu cell is selected, the meter imposes this % slope adjustment of its rate output. Output data is zeroed and corrected for the Reynolds number (flow profile compensated), however, in addition, a percent change in the rate output is imposed based on the data entered in this cell. The number entered by the user is evaluated into a slope correction factor by dividing it by 100 and algebraically adding it to 1. The resulting factor is used as a multiplier on the rate register of the instrument. Thus an entry of -3% will multiply the rate register by 0.97, for example.

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 the numeric keys to type 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 calibrated value.

To store the data press . Note that Kc now appears in the right-hand column of the [Calibrate Flow Rate] menu cell with its value. also note that the Kc value can be viewed on the site printout.

Calibration Tables 1 through 3

System 1010 instruments offer a unique methodology by which a particular flow response of an instrument may be linearized or optimized by tabulating the results of a series of calibration exercises or collected batch data points. In essence, the meter allows the user to select any of a wide variety of system variables (flowrate, pressure, viscosity, etc.) as a pointer into a table of calibration factors (up to 32). As the system variable is updated, the value of the table's output factors (or positive and negative flow) is re-evaluated and used as a modifier for the current rate register. Note that the flow register is still zeroed and Reynolds number compensated normally and these slope corrections are in addition to these fundamentals. Kc is still active when this facility is being used.

To install a Calibration Table, proceed as follows:

1. The user selects a **system variable** that appears to correlate strongly with calibration shifts observed.

2. A table of values is formed comprised of the values that this index could assume over the range of system operation. Remember, the tables created do not extrapolate beyond their end points, they "clip."
3. A calibration factor, a number usually close to 1.00, is entered as a positive and a negative flowrate correction factor (termed *PosFlow Corr* and *NegFlow Corr*) for each of the desired index points.

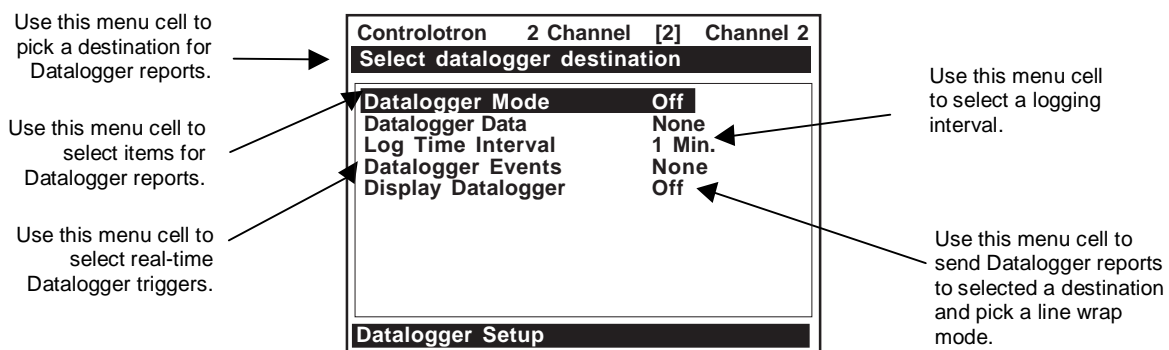
The table may contain up to 32 pairs of these slope correction factors. Note that the **Kc factor**, **unlike these slope correction factors**, is entered as a signed percent change in rate, while these factors are simply rate multipliers. As points are entered, the point editor will provide list access to the already entered points plus access to the [New Point] menu cell, used to add a new point. The table may be created in its entirety and then activated by selecting [Yes] in the [Table Active] menu cell. The entire table may be cleared by selecting [Yes] in the [Clear Table] menu cell.

Note that the flowmeter allows you to use [Aux] as an [Index Variable] input. Effectively you may slope modulate the flowmeter's output based on the value of a 4 - 20 mA input signal. Since the table of slope correction coefficients resides between the meter's internal flow register(s) and the flow register, which actually provides reports to the user, poorly formed or defective Calibration Tables may severely impact the performance of the instrument. Take precautions before enabling these calibration tables. Although we recognize that it is unlikely that all three tables would ever be employed in a real installation, three tables are offered for maximum user flexibility. Since the tables can be disabled without being destroyed, 2 or 3 optimization strategies may be tested by this means in order to determine which approach is most effective.

4.8 THE DATALOGGER SETUP MENU

The menu becomes available after picking a Meter Type and Measurement Path. The integral Datalogger records data for eventual display on the Graphics Screen, or for connection to an 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.

You can view Datalogger reports on the graphics display screen or transmit them via the RS-232 Serial Port to external printers or computers. Note that a single-path meter uses a compression algorithm to maximize Datalogger storage. This disables back scrolling of datalogger reports.



4.8.1 DATALOGGER MODE

The [Datalogger Mode] option list allows you to disable 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:

1. Press the <Right Arrow> to access the [Datalogger Mode] option list.
2. Press <Up or Down Arrow> to move the cursor to the desired mode.
3. Press <ENT> to store the selection.

THE DATALOGGER SETUP MENU STRUCTURE

Datalogger Setup ⇨	⇨	Datalogger Mode ⇨ ⇅	⇅ Off Memory RS-232 Output
		⇨ Datalogger Data ⇨ ⇅	⇅ None Site Id Date Time Path Flow Flow Average Flow Flow Velocity Raw Flow Total Path Vs Vs Path Valc Valc Vtrb S.G. Base S.G. Path Alarms Alarms Temperature Path Delta T 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 Relay 2 Relay 1 Spacing Fault Alarm Turbulence Interface Flow Alarm Memory Makeup

4.8.2 DATALOGGER DATA

You can set the Datalogger to record any or all of the data offered on the Datalogger Data option list. However, you should be aware that recording unneeded data wastes valuable system RAM. However, we recommend that you always select [Site ID] (name) and [Time] to identify each line of data. The [Datalogger Data] option list provides the following items:

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.
Flow Velocity	Linear flow velocity in f/s and m/s depending on preferred units.
Raw Flow	The uncompensated flow rate in in ³ /sec (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.
Vrtb	The turbulence percentage recorded at the time of the report.
S.G.	The computed Specific Gravity at the time of the report.
Base S.G.	The computed Specific Gravity at base temperature and pressure at the time of the report.
Alarms	The letter codes of any alarms active at the time of the report (see below).
Temperature	The computed temperature at the time of the report.
Delta T (uSecs)	The Up to Down transit-time difference measured at the time of the report.
Analog Inputs	Any data appearing on an auxiliary input at the time of the report (temperature, pressure).

*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.

Alarm Letter Codes and Descriptions

S..... Transducer spacing requires adjustment
 R Flow above High setting or below Low setting
 F Three continuous seconds without new data update
 T Current turbulence percentage exceeds the alarm setpoint
 M Displaying last valid reading for a selected interval during a Fault condition
 K In-Process Makeup occurred
 I Gas Vs exceeds Vs Interface setpoint
 Z..... 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:

1. Press the <Right Arrow> to access the [Datalogger Data] option list.
2. Move the cursor to a desired data item then press <ENT> to select it. Note that a plus sign (+) appears before the item.

To deselect Datalogger Data:

1. Move the cursor to the data item then press <CLR>. Note that this removes the plus sign (+) from the item.
2. After selecting/deselecting all desired items, press the <Left Arrow> to leave the [Datalogger Data] option list.

4.8.3 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:

1. Press the <Right Arrow> to access the [Log Interval] option list.
2. Move the cursor to desired interval.
3. Press <ENT> to store your selection.

4.8.4 DATALOGGER EVENTS

System 1010 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 gas interface, or a short turbulence alert). Note that 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:

1. Press the <Right Arrow> to access the [Datalogger Events] option list.
2. Move the cursor to a desired item then press <ENT> to select it. Note that a plus sign (+) appears before the item.

To deselect Datalogger Events:

1. Move the cursor to the item then press <CLR>. Note that this removes the plus sign (+) from the item.
2. After selecting all desired items, press the <Left Arrow> to leave the [Datalogger Events] option list.

NOTE: The Datalogger uses a compression scheme that precludes backward scrolling.

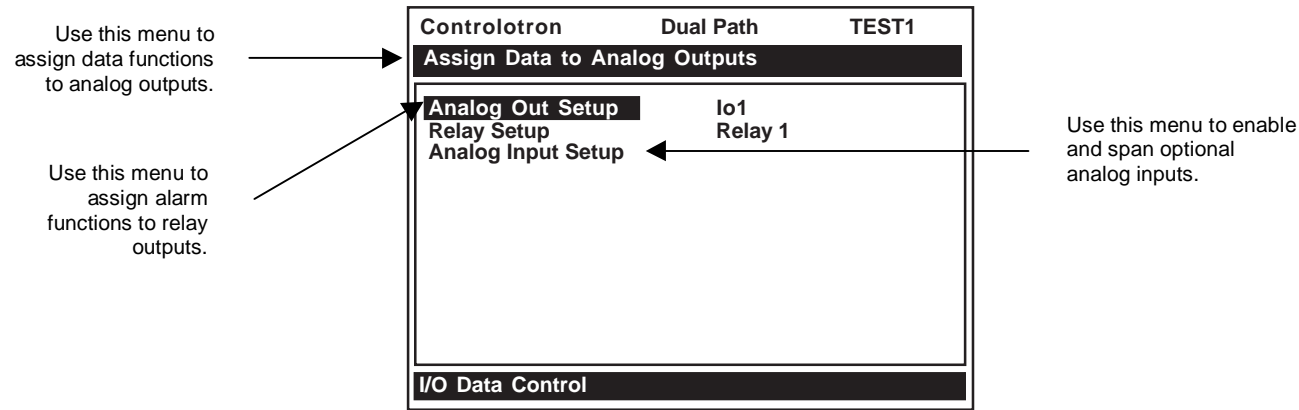
Important point about Datalogger resources and dual-path systems

When logging data on both measurement paths simultaneously, please be aware that 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 path generated the report.

4.9 THE I/O DATA CONTROL MENU

This menu becomes available after picking a Meter Type and Measurement Path.

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.



THE I/O DATA CONTROL MENU STRUCTURE

(Note: For Dual Path flowmeters: “1” = Path 1, “2” = Path 2 and “S” represents the system or average channel. These characters appear to the left of the option list parameter.)

I/O Data Control	⇒	Analog Out Setup	⇒	Io1 - Io2	⇒	⇅	Vfo Vfo2 Vf T1 lin1 lin2 Base S.G. Viscosity Vs Valc Vtrb Vsg
	⇒	Relay Setup	⇒	Pgen1** Relay 1	⇒	⇅	*See Io option list Off Power On S.G. Base S.G. High Viscosity Low Viscosity Hi Temperature Low Temperature High Flow Low Flow Flow Alarm Fault Alarm Spacing Turbulence Interface Reverse Flow BatchTot Pos Total Neg Total Fltwarn Soft Fault
					</		

*The Dual Path meter has two analog inputs (Iin1 and Iin2), two analog outputs (Io1-Io2), one Pgen and two Relay functions. Note: Single Path meters have Io1 only.

** Pgen1 is available in Single Path meters only.

4.9.1 ANALOG OUTPUT SETUP

System 1010 provides current, voltage and pulse-rate analog outputs. [Analog Output Setup] allows you to assign data functions for these signals. The computer's terminal strip contains the analog output terminals.

System 1010 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.
Digital Pgen*	User selective pulses per unit flow.

*Digital Pgen replaces Pgen in Custody Transfer flowmeters.

Analog Out Setup Data Categories (for Dual Path flowmeter)*

Vfo	Spanned volumetric/mass flow rate
Vfo2	Additional spanned volumetric/mass flow rate
Vf	Spanned unsigned flow magnitude
Vs	Spanned liquid sonic velocity
Valc	Receive signal amplitude
Vtrb	Relative degree of gas turbulence
Vsg	Spanned specific gravity
Base S.G.	Spanned SG referenced to user temperature**
Viscosity	Gas viscosity in centistoke units
T1	Current gas temperature
Iin1, Iin2	Represents a re-transmit of the analog input signals (e.g., Pressure and Temp inputs can be transmitted on the 4/20 mA output).

*Dual Path meters have the data categories listed above plus characters 1 (Path 1), 2 (Path 2) and S (System).

** See paragraph 4.3 Gas Parameters Menu to set Base Temp F or C.

Assigning Io Output Functions

The Io analog output is a self-powered, isolated 4-20mA DC signal that varies linearly in relation to a selected data function. Some models feature auxiliary current outputs that are loop powered.

CAUTION: Do not connect self-powered Io outputs to a powered loop.

The flowmeter's 4-20 mA outputs provide a "Fault" indication by dropping to approximately 2 mA when the flowmeter's primary sensing mechanism is unable to measure the flowrate and fault is declared. This fault current is generated regardless of the variable currently selected for that output.

To assign a function for the current output:

1. From the [Analog Out Setup], press the <Right Arrow> twice to access the [Io] option list.
2. Press the <Up or Down Arrow> to move the cursor to the desired data function.
3. Press <ENT> To store selection.

Assigning Pgen Output Functions

The Pgen analog output is a pulse rate signal whose configuration is detailed in Installation Drawing 1010DXS2-7. It varies linearly from 0-5000 Hz in relation to a selected data function. (Note: Replaced by Digital PGEN option for Custody Transfer flowmeters.)

To assign a function to the Pgen output:

1. Press the <Right Arrow> to access the [Pgen] option list.
2. Press the <Up or Down Arrow> to move the cursor to the desired data function.
3. Press <ENT> To store selection.

PULSE OUTPUT (Pgen Wiring)

1010GCCDX

Installation Drawing 1010DX-7 (Sheet 4 of 4)

(Ultra Performance Flowmeters)

TB2

PIN#	SIGNAL	FUNCTION	NOTES
9	PGEN -	Pulse Generator Return (Isolated PGEN Emitter)	Digitally synthesized pulses User spanned and proportional to Flow Rate.
10	PGEN +	Pulse Generator Return (Isolated PGEN Collector)	

4.9.2 RELAY SETUP

Use this menu to assign a function to channel relays. System 1010 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 sec. If totalizer pulses exceed this rate, excess pulses are stored in an overflow register. This allows the relay to “catch up” when flow decreases enough.

NOTE: Using the <Fn>1 Totalizer clear command also clears all channel totalizers plus the overflow register described in the last paragraph.

Assigning Relay 1 and 2 Functions

System 1010GCX, depending on the model, provides at least two alarm relays. Please refer to the Hardware Installation Drawing for wiring details. Relays respond to any of the alarm conditions/data functions included on the Relay Option List.

Relay Option List

Not Used	Not Active
Power Off	Power Off alarm occurs when power fails
S.G	Specific Gravity value relay trip-point
Base S.G.	S.G. value relay trip-point at reference temperature
High Viscosity	Kinematic viscosity (centistokes) exceeds high Setpoint
Low Viscosity	Kinematic viscosity (centistokes) falls below Low Setpoint
Hi Temperature	Hi 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
Spacing	Transducer spacing requires adjustment
Turbulence	Turbulence percentage exceeds alarm setpoint
Interface	Interface setpoint exceeded
Reverse Flow	Flow is in negative direction

(continued)

Relay Option List *(continued)*

BatchTot	Batch/Sample total advances
Pos Total	Positive total volume advances by 1 digit
Neg Total	Negative total volume advances by 1 digit
Fltwarn	System fault warning
Soft Fault	Fault condition - memory mode active

To assign functions to Relay 1:

1. Press the <Right Arrow> to access the [Relay1] option list.
2. Press the <Up or Down Arrow> to move the cursor to the desired Relay assignment
3. Press <ENT> to store selection.
4. Repeat procedure for [Relay 2].

4.9.3 ANALOG INPUT SETUP

The Analog Input Setup function assigns an active analog input to a measurement channel/path. The meter provides two DC current input ports for single channel or Dual Path 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 for pressure 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 temperature, pressure and others (see table below).

(Keep in mind that the flow computer expects “absolute” pressure. If the external device reports “gauge pressure” then be careful to span the pressure input so that 4mA represents 1 ATM (14.7 PSIA or 1.014 BARA) and not 0.0.

NOTE: Refer to the appropriate Installation Drawing for the locations of these inputs and the wiring procedure.

I/O Data Control ⇒	Analog Inp Setup ⇒	lin1 ⇒	Input ⇅	⇅ Off Aux PSIA BARA Deg F Deg C
⇅	⇅	⇅	4 mA	<i>numeric entry</i>
			20 mA	<i>numeric entry</i>
		lin2	See lin1 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 lin1 and lin2 are both assigned to represent pressure (PSIA), the meter will only use the pressure input from lin1.

Setting up the Analog Current Input

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

From Analog Input setup:

1. Press the <Right Arrow> once to access the desired input port [Iin1- Iin2] option list.
2. Move the cursor to down to the desired port and then press <Right Arrow> twice. Scroll <Down Arrow> to select the desired input parameter then press <ENT>. (Select from a list of PSIA, BARA, Deg F, Deg C, AUX or Off.) The cursor moves to [4 mA].
3. Press the <Right Arrow> to enable numeric entry.
4. Type the numeric value corresponding to a 4 mA input signal.
5. Press <ENT> to store the data. This moves the cursor to [20 mA].
6. Press the <Right Arrow> to enable numeric entry.
7. Type the numeric value corresponding to a 20 mA input signal.
8. Press <ENT> to store the data.

4.10 THE DIAGNOSTICS DATA MENU

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 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. The available diagnostic data depends on the flowmeter type and channel configuration. All diagnostic items are available when you select [Dual Path Flow] for [Path 1] or [Path 2]. Some items are not available (N/A) when you select virtual channel [1 and 2].

DIAGNOSTIC DATA MENU STRUCTURE

Diagnostic Data ⇨	⇨	Path Select ⇨	⇨ ⇩	1 2 1 and 2
		⇩		
	⇨	Path Enable ⇨	⇨	Yes/No
	⇨	Flow Data ⇨	⇨ ⇩	Flow Flow Vel F/S Total Vs m/s Signal mV Valc % Vtrb % Alarm Status Ancal
		⇩		
	⇨	Application Info ⇨	⇨ ⇩	TN uSec TL uSec DeltaT uSec Burst/Sec % Accepted Last Makeup Makeup Status
		⇩		
	⇨	Gas Data ⇨	⇨ ⇩	TEMP 1/2 Reynolds # Specific Gravity Base S.G. Temperature Pressure Volume Corr. Viscosity cS
		⇩		
	⇨	Site Setup Data ⇨	⇨ ⇩	fx (drive) N (burst length Ltn in Vfmax Vs max m/s Vs min m/s Samples/Cycle Max Damping Min Damping HF
		⇩		
	⇨	Test Facilities ⇨	⇨ ⇩	Makeup Tx Up Tx Dn Fixed ALC Tx Up Fixed ALC Tx Dn Fixed ALC
		⇩		
	⇨	Print Site Setup ⇨	⇨	No/Yes
	⇨	Date Site Created:		xx.xx.xx xx.xx.xx

4.10.1 MAIN DIAGNOSTICS SCREEN

This is the main Diagnostics Data screen. It provides menus that show Flow, Application, Gas Data and Site Setup information. In addition, the Test Facilities menu provides test/control functions to optimize operation, analyze application conditions and to recover system operation. As shown below, diagnostics provides five menus and two menu cells:

Controlotron	Dual Path	SITE1
Real-Time flow-related data		
Path Select	1	
Path Enable	Yes	
Flow Data		
Application Info		
Gas Data		
Site Setup Data		
Test Facilities		
Print Site Setup	No	
Date Site Created:	07.17.01	13.47.36
Diagnostic Data		

MAIN DIAGNOSTIC MENU DESCRIPTION

Flow Data	This menu shows flow rate, total and alarm data.
Application Info	This menu shows current meter operating status .
Gas Data	This menu shows current Reynolds #, measured temperature and pressure as well as molecular weight and computed volume correction.
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 the date and time when the current site was created.

4.10.2 FLOW DATA MENU

This menu provides a “live” display of all primary output data.

Controlotron	Dual Path	SITE1
Current Flow Rate and Units		
Flow KCU FT/HR	-0.05	
Flow Vel F/S	-0.60	
Total KCU FT	3.2895	
Vs m/s	334.79	
Signal mV	10.8	
Valc %	56	
Vtrb	0	
Alarm Status	-----	
AnCal KCU FT/HR	0.000	
Flow Data		

FLOW DATA MENU ITEMS

Flow	This is a real-time (updated) flow rate display in current rate units (e.g., KCU FT).
Flow Vel F/S	Linear flow velocity in f/s and m/s, depending on preferred units.
Total	This is a real-time (updated) flow total display in current total units (e.g., KCU FT).
Vs m/s	Current gas sonic velocity (Vs) in m/s. The Vs value depends on the gas composition and its operating temperature and pressure. This menu cell allows “fine-tuning” when highlighted. Press the [+] or [1] key to increase, or the [-] or [2] key to decrease the reading. CAUTION: Incorrect usage can result in reduced accuracy.
Signal (mV)	Xdcr signal strength (in mV). This is the amplitude of the transit-time receive signals. Very low pressure or attenuative gas could cause a low value.
Valc %	Input Amplifier gain indication. Larger % indicates a stronger gas signal.
Vtrb %	This shows the current percent of turbulence 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: R = Flow Rate Alarm (High or Low rate threshold exceeded) F = Fault Alarm T = Turbulence Alarm M = Memory Activated (Fault Suppressed) K = Makeup Flag (May be latched) I = Interface Alarm
AnCal	Flow Rate Simulator for calibrating external devices, etc. Highlight this item then press the <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.

Vs m/s

This menu cell shows the current gas sonic velocity in 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. **(When using the magnetic wand, touch the Enter sensor to increase the reading; touch the <Right Arrow> sensor to decrease the reading.)** The pipe diameter and transmission frequency determines the effective increase or decrease per key press. Sonic velocity (Vs) adjustment is a diagnostic tool intended for our technicians or experienced users only. Improper use will affect the meter accuracy.

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. *Note: [Std Vol Comp.] must be set to [No] to obtain the desired AnCal value.* 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:

1. Move the cursor to the AnCal menu cell. Press the <Right Arrow> to enable numeric entry. Note that an equal sign (=) appears before the number.
2. Type the desired flow rate using current rate units (e.g., 65.00 KCU FT/HR). Note that the [Flow] menu cell now reflects the artificial rate.
3. Move the cursor away from the menu cell to turn AnCal off.

Controlotron	Dual Path	SITE1
Flow Rate Simulation Control		
Flow KCU FT/HR	2.14	
Flow Vel F/S	-0.60	
Total KCU FT	3.3048	
Vs m/s	334.00	
Signal mV	10.0	
Valc %	56	
Vtrb %	13	
Alarm Status	-----M---	
AnCal KCU FT/HR	> 2.140	
Flow Data		

When AnCal is invoked the Alarm Status indicates memory.

Note that the [Flow] menu cell immediately reflects the AnCal entry. Over time, the Total display will also increase.

4.10.3 THE APPLICATION INFO MENU

This menu provides a live display of the basic timing data used by meter during operation.

Controlotron	Dual Path	SITE1
Time between transit and receive		
TN uSec	586.483	
TL uSec	605.721	
DeltaT uSec	6.25	
Burst/Sec	82	
% Accepted		
Last Makeup	(Re)Start	
Makeup Status	Measurement	
Application Info		

APPLICATION INFO MENU ITEMS

TN uSec	The total elapsed time between the transmission and reception of a sonic pulse.
TL uSec	The total time a sonic pulse takes to travel through the liquid.
DeltaT nSec	This is the instantaneous result of subtracting the down from the up transit times. Note: This will appear to be more active than dampened flow readings.
Burst/Sec	Number of transmissions per second under current operating conditions. The following factors influence this parameter: aeration, pressure transients, signal strength variation.
% Accepted	The running tally of accepted and rejected up/down burst sets.
Last Makeup	Reason for last Makeup (signal reacquisition). Press the meter's [Help] key at this menu cell to see a glossary of all the possible reasons for a Makeup.
Makeup Status	Current stage of Makeup routine. [Measurement = normal operation]

4.10.4 THE GAS DATA MENU

This menu shows the current Reynolds number used by the meter to implement flow profile compensation, as well as operating pressure and temperature and computed gas properties.

Actively displays pressure and temperature from either analog input, computation or fixed gas parameters menu.

Controlotron	Dual Path	SITE1
Current Reynolds number		
TEMP 1	0.00 F	
TEMP 2	0.00 F	
Reynolds #	784	
Specific Gravity	1.718 OFF	
Base S.G.		
Temperature	102.20 Deg F	
Pressure	26.30 PSIA	
Volume Corr.	1.65	
Viscosity cS	4.756 OFF	
Gas Data		

GAS DATA MENU ITEMS

TEMP1	Measured temperature from Channel 1 RTD.*
TEMP2	Measured temperature from Channel 2 RTD.
Reynolds #	1010 corrects the current flow rate in accordance with this Reynolds number. This number is determined from pipe ID, current flow rate and gas kinematic viscosity.
Specific Gravity	Actual specific gravity of gas computed as follows: molecular weight of gas divided by molecular weight of air.
Base S.G.	Specific Gravity measured at base temperature.
Temperature	Measured temperature (analog input or from RTD input).
Pressure	Measured pressure (Analog input or from gas parameters menu.)
Volume Corr.	Flow rate/total multiplier used to correct the measure volume to standard volume.
Viscosity cS	Kinematic viscosity of gas.

* If the analog input for temperature is enabled, it will override the internal RTD temperature measurement and TEMP1 will reflect the analog input temperature instead. For Dual Path operation only TEMP1 is used for volume correction.

4.10.5 THE SITE SETUP DATA MENU

This menu provides data pertaining to transducer characteristics and operation. Some menu items are for technical support interpretation only.

Controlotron	Dual Path	SITE1
Current transmit drive code		
fx (drive)	275	
N (burst length)	38	
Ltn in	-1.244	
Vfmax FT/SEC	39.679	
Vs max m/s	450.00	
Vs min m/s	300.00	
Samples/Cycle	20	
Max Damping	4	
Min Damping	4	
H F	-0.120	
Site Setup Data		

SITE SETUP MENU ITEMS

fx (drive)	Current Transmit drive code selected during Initial Makeup. The drive code controls the sonic transmit signal.
N (burst length)	Transmit burst duration selected during Initial Makeup. To change the N count press <Right Arrow>. At equal sign enter numeric value (1 to 9 only).
Ltn in	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.
Samples/Cycle	Digital sampling rate.
Max Damping	Maximum signal damping. Use to average data when an unstable condition occurs. Magnetic Wand: Use <ENTER> sensor to increase; use <Right> sensor to decrease. RS-232 link: Use <+> or <ENTER> keys to increase; use <-> (minus) or <Right Arrow> keys to decrease.
Min Damping	Minimum signal damping. Use to average data when an unstable condition occurs. Magnetic Wand: Use <ENTER> sensor to increase; use <Right> sensor to decrease. RS-232 link: Use <+> or <ENTER> keys to increase; use <-> (minus) or <Right Arrow> keys to decrease.
HF	Flow registration correction parameter.

Introduction to [HF] Menu Item

All 1010 flowmeters with version 3.01.02 and later operating systems include a new Diagnostics Menu item that permits the entry of a flow registration correction parameter labeled [HF]. This “HF” parameter is the input for a proprietary algorithm which automatically compensates for signal beam blowing in pipes utilizing either 1011 clamp-on or insert transducers, thereby extending the upper flow limit of all 1011 flowmeters. This algorithm provides the most benefit for clamp-on gas meters where high flow velocities and low gas sound velocities create the most challenging conditions for digital signal processing routines.

Using the [HF] Menu Item

Two methods for adjusting this parameter are provided via the [HF] menu cell, located within the “Diagnostics / Site Setup” submenu. The “Manual” method provides direct entry of this parameter and is primarily intended for the advanced user, whereas the “Automatic” method allows the 1010 flowmeter to automatically measure the required correction and install the parameter.

Guidelines for using the [HF] menu item are described below:

- This menu is only accessible for the transducer channels, not the virtual (average flow) channel of the flowmeter. (i.e., Diagnostics Path 1 or Path 2, but not Path 1 & 2).
- The 1010 flowmeter will inhibit the “Automatic” installation of the [HF] parameter if the flow rate is insufficient (too low) to accurately measure the required correction. If the maximum flow rate for the application is relatively low then this correction should not be required.
- If the flow rate is very high and the flowmeter is reporting erroneous or unstable flow, then the flowmeter may already be having trouble resolving the upstream and downstream

signals. In this event, it may be necessary to first lower the flow rate to a moderate level before performing the “Automatic” HF adjustment. Once this is done the flowmeter should be able to properly measure the highest flow rates without problems.

- The limits of the “HF” parameter are +/- 0.7 and 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.

Controlotron	Dual Path	4SS10G
Access Path/Channel Diagnostic Data		
Channel /Path Setup		
Pipe Data		
Gas Parameters		
Pick/Install Xdcr		
Operation Adjust		
Flow/Total Units		
Data Span/Set/Cal		
Stripchart Setup		
Datalogger Setup		
I/O Data Control		
Diagnostic Data		
Dual Path Flow		

Controlotron	Dual Path	4SS10G
Transducer Setup Data		
Path Select	1	
Path Enable	Yes	
Flow Rate		
Application Info		
Gas Data		
Site Seup Data		
Test Facilities		
Print Site Setup	No	
Date Site Created:	04.09.0314.52.23	
Diagnostic Data		

“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.

Controlotron	Dual Path	4SS10G
fx (drive)	29	
N (burst length)	5	
Ltn in	5.316	
Vf max CU	Adjustment	
Vs max m/s	>Manual	
Vs min m/s	1355.00	
Samples/Cycle	29	
Max Damping	4	
Min Damping	4	
HF	>-0.000	
Site Setup Data		

Controlotron	Dual Path	4SS10G
fx (drive)	29	
N (burst length)	5	
Ltn in	5.316	
Vf max CU	>Manual	
Vs max m/s	= -0.120	
Vs min m/s	1355.00	
Samples/Cycle	29	
Max Damping	4	
Min Damping	4	
HF	>-0.000	
Site Setup Data		

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

Controlotron	Dual Path	4SS10G
fx (drive)	29	
N (burst length)	5	
Ltn in	5.316	
Vf max CU		
Vs max m/s		
Vs min m/s	1355.00	
Samples/Cycle	29	
Max Damping	4	
Min Dampaing	4	
HF	>-0.120	
Site Setup Data		

“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.

Controlotron	Dual Path	4SS10G
fx (drive)	29	
N (burst length)	5	
Ltn in	5.316	
Vf max CU	Adjustment	
Vs max m/s	>Automatic	
Vs min m/s	1999.99	
Samples/Cycle	29	
Max Damping	4	
Min Damping	4	
HF	>-0.000	
Site Setup Data		

Controlotron	Dual Path	4SS10G
fx (drive)	29	
N (burst length)	5	
Ltn in	5.316	
Vf max CU	>Automatic	
Vs max m/s	= 0.026	
Vs min m/s	1999.99	
Samples/Cycle	29	
Max Damping		
Min Damping		
HF	>-0.026	
Site Setup Data		

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

4.10.6 THE TEST FACILITIES MENU

The Test Facilities menu provides commands for system analysis and recovery. The most useful for the end-user are [Makeup] command. Using these routines under the supervision of our technical support staff will help us to provide technical analysis and solutions.

Controlotron	Dual Path	SITE1
Right arrow invokes an InProcess Makeup		
Makeup	No	
Tx Up	No	
Tx Dn	No	
Fixed ALC	No	
Tx Up Fixed ALC	No	
Tx Dn Fixed ALC	No	
Test Facilities		

To start a Test Routine:

- Use the <Up or Down Arrow> to scroll the cursor to the test routine you want to use.
- Press the <Right Arrow> to access the test option list. Use the <Up or Down Arrow> to move the asterisk to [Yes].
- Press <ENT> to start the routine.
- Press <Left Arrow> to end the routine.

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 Complete?] command.

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  to start the makeup routine.

Digital Damping Control: (Hot Key 1 and 2)

The 1010 permits user modification of the digital averaging used by the signal processing routines. In general, the default damping values selected by System 1010 will provide optimal performance over a wide range of transit time applications. However, in extreme cases of unstable flow profile, low signal levels or high aeration it may be necessary to override these default settings to permit uninterrupted and reliable flow measurement.

The 1010 Graph Screen includes the capability to access a set of command codes, which enable a user to override a number of default setup parameters. The most important parameter is the *digital damping control*, which can be accessed by pressing number <1> or <2> on the keypad while in the graph screen mode.

Pressing the <1> key will cause [MinDamp #] to appear on the command line at the lower left-hand corner of the screen. The number listed to the right of the command code represents the exponent in the System 1010 exponential averaging routine, where the larger the number the greater the digital averaging. Pressing the <+> key will increase the damping value. Likewise, pressing the <-> key will decrease the damping value. To exit this mode, press the <0> key on the keypad.

Pressing the <2> key will bring up the [MaxDamp] command. The function of this parameter is similar to the [MinDamp] command described above, however, the two parameters interact in the following manner. The MinDamp value must not exceed the MaxDamp value, therefore increasing the MinDamp value above the previous MaxDamp value will set both parameters to the same value. In most cases, it is preferred that both damping parameters be set to the same value, however, in cases where rapid response to changes in liquid sound velocity is required, the two values may be set differently.

4.10.7 TROUBLESHOOTING TIPS

The System 1010 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 Controlotron 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 site setup.
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: <i>[Channel Setup → Channel Enable → Yes]</i> . Note that a channel cannot be enabled until its transducers are operating.
Clr Active Memory?	Response to pressing the F4 key. Use the F4 function to restore operation if a severe event (e.g., a violent power surge) disrupts system operation.
Clr Saved Data?	Response to pressing the F4 key, then selecting [No] for Clr All Data?
<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.
No Sites	Response to an attempt to recall or delete a site setup when no Sites are stored.
Not Installed	Response to an attempt to access a menu function that is not included.
Detection Fault Press <ENT>	Appears if the meter cannot complete an Initial Makeup. It means that the pipe and/or gas 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 re-installing the transducers at a different letter index, 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 gas or pipe wall sonic conductivity or extreme gas turbulence.

NOTICE: If you receive a Detection Fault message, it is strongly recommended that you contact Technical Service for further orientation.

4.11 USING THE 1010GCX 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 1010GCSX 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.

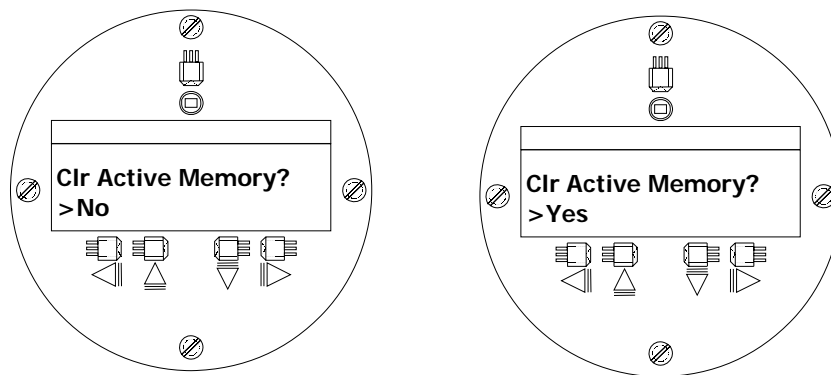
The reset sequence operates on two levels. The first level deletes all the data currently in Active Memory, but leaves Datalogger data and all stored Site Setups intact. This is the most desirable method since to restore operation all you have to do is reload a saved Site Setup. If this fails then you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




4.11.1 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 1010GCSX Gas flowmeter 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 then 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?]**

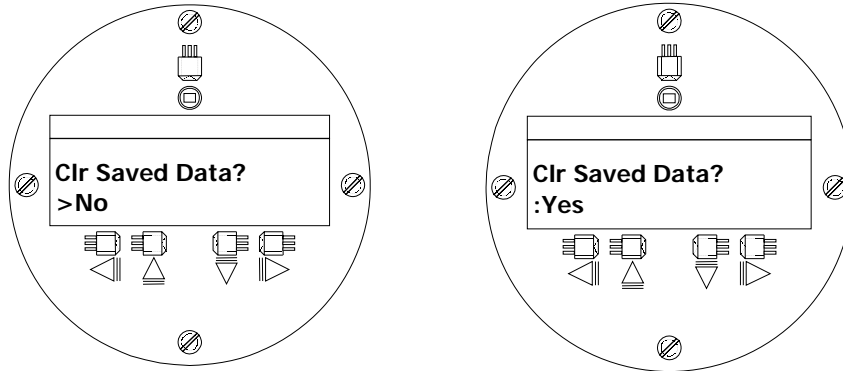


- Trigger  Note that the greater than (>) symbol changes to a (:) colon. Trigger  to change the second line to [Yes] (as shown in the right-hand figure above).
- Trigger  to clear the contents of Active Memory (but preserve any stored Site Setups).
- To restore operation, create a new site setup or recall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



- 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.

4.11.2 SYSTEM RESET USING THE RS-232 INTERFACE

The 1010GCX Gas meter 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 3.5.1 for details on how to setup an RS-232 interface with a PC.

To clear Active Memory using the RS-232 Interface:

- Turn off power (if it is currently on). Turn power on. As soon as you apply power type the @ character three times. The prompt: **[Clr Active Memory? 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 <ENT> to clear all Active Site Data (but not saved Site Setups).
- To restore operation, press <ENT> 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:

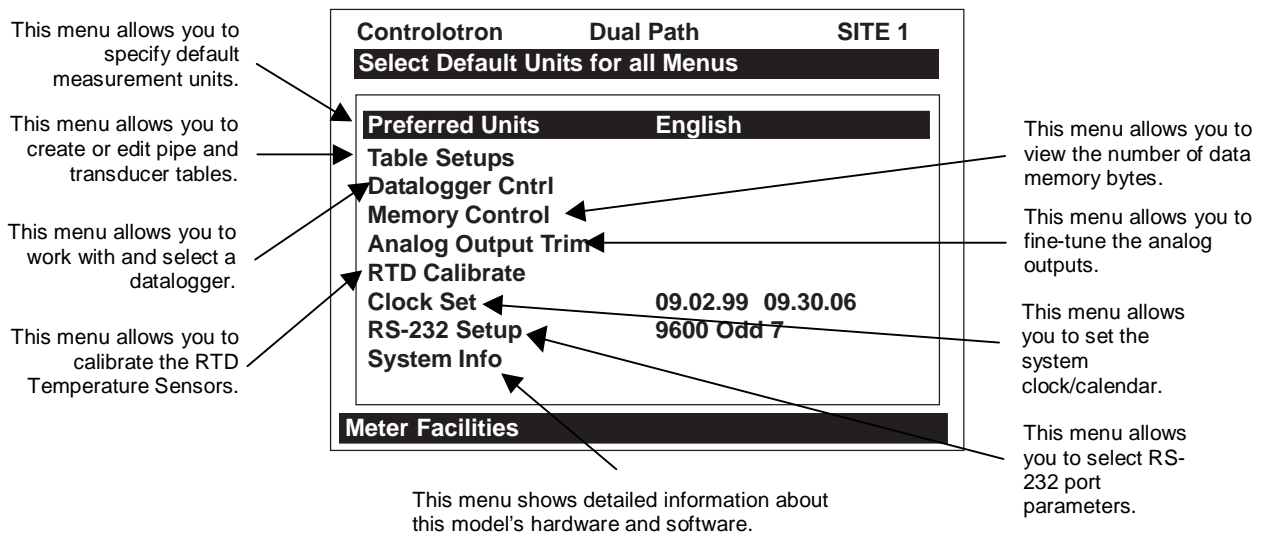
- Turn off power (if it is currently on).
- Turn power on. As soon as you apply power type the @ character three times. The prompt: **[Clr Active Memory? No]** appears at the top of the screen. Press the <Down Arrow>. Note that the prompt switches to **[Clr Saved Data? No]**.

- Press the <Right Arrow> and then the <Down Arrow> to switch the option list to [**Clr Saved Data? Yes**]. Press <ENT> to clear all Dynamic Memory.
- To restore operation, press <ENT> 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).

4.12 THE METER FACILITIES MENU

Meter Facilities functions are available immediately after pressing <MENU>. 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 (refer to Section 5, paragraph 5.6 for Meter Facilities 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.



4.12.1 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:

1. Press the <Right Arrow> to access the [Preferred Units] option list.
2. Use the <Up or Down Arrows> to move the cursor to [Metric].
3. Press <ENT> to register your selection.

4.12.2 THE TABLE SETUPS MENU

The [Table Setups] menu 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 

Table Setups	⇒	⇅	Pipe Table
			Transducer Type

Pipe Table

The factory-programmed pipe table describes over sixty standard English and metric pipes. The table can save you programming steps by loading all required data at once from option list selection. The Pipe Table configuration is [PIPE CLASS → PIPE NAME]. Pipe Class presents a list of standard metric and English Pipe classifications. Selecting a class (e.g., ASA Carbon Steel) conditions the Pipe Name option list to all the stored pipes within that class (see Menu Chart above). 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* ⇅ 1SS10 2SS10 3SS10 4SS10 6SS10 8SS10 Metric DN Steel 15-DN 20-DN 25-DN 40-DN 50-DN 100-DN 150-DN	ASA Carbon Steel ⇅ 1CS40 1CS80 2CS40 2CS80 3CS40 3CS80 4CS40 4CS80 6CS40 6CS80 8CS40 8CS80 10CS40 10CS_XS
					ASA Plastic ⇅ 1P40 1P80 2P40 2P80 3P40 3P80 4P40 4P80 6P40 6P80 8P40 8P80 10P40 10P_XS


(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)*

<div>↕</div>	<div>↕</div>	<div>↕</div>	<div>↕</div> <div>200-DN</div> <div>250-DN</div> <div>300-DN</div> <div>350-DN</div> <div>400-DN</div> <div>600-DN</div> <div>↗ Metric SGP Steel</div> <div>↕</div> <div>20A-SGP</div> <div>25A-SGP</div> <div>32A-SGP</div> <div>40A-SGP</div> <div>50A-SGP</div> <div>65A-SGP</div> <div>80A-SGP</div> <div>90A-SGP</div> <div>100A-SGP</div> <div>125A-SGP</div> <div>150A-SGP</div> <div>175A-SGP</div> <div>200A-SGP</div> <div>225A-SGP</div> <div>250A-SGP</div> <div>300A-SGP</div> <div>350A-SGP</div> <div>400A-SGP</div> <div>450A-SGP</div> <div>500A-SGP</div>	<div>↕</div> <div>12CS_STD</div> <div>12CS_XS</div> <div>16CS_STD</div> <div>16CS_XS</div> <div>18CS_STD</div> <div>18CS_XS</div> <div>20CS_STD</div> <div>20CS_XS</div> <div>24CS_STD</div> <div>24CS_XS</div> <div>30CS_STD</div> <div>30CS_XS</div> <div>36CS_STD</div> <div>36CS_XS</div> <div>1-1/2S40</div> <div>1-1/2S40</div> <div>1-1/2S80</div>	<div>↕</div> <div>12P_STD</div> <div>12P_XS</div> <div>16P_STD</div> <div>16P_XS</div> <div>18P_STD</div> <div>18P_XS</div> <div>20P_STD</div> <div>20P_XS</div> <div>24P_STD</div> <div>24P_XS</div> <div>30P_STD</div> <div>30P_XS</div> <div>36P_STD</div> <div>36P_XS</div>							
						<div>↗ Cast Iron Table</div> <div>↕</div> <div>6" cls C</div> <div>10" cls C</div> <div>12" cls C</div> <div>16" cls C</div> <div>20" cls C</div>	<div>↗ Copper Tube Table</div> <div>↕</div> <div>1" type K</div> <div>1" type L</div> <div>1" type M</div> <div>2" type K</div> <div>2" type L</div> <div>2" type M</div> <div>4" type K</div> <div>4" type M</div> <div>6" type K</div> <div>6" type L</div> <div>6" type M</div>					
								<div>↗ Ductile Iron Table</div> <div>↕</div> <div>6" cls 52</div> <div>10" cls 52</div> <div>12" cls 56</div> <div>16" cls 52</div> <div>24" cls 52</div>				
						↗	↗		↗	Outer Diameter (in)	↗	x.xxx (numeric entry)
						↗	↗	↗	Wall Thickness (in)	↗	x.xxx (numeric entry)	
						↗	↗	↗	Inner Diameter (in)	↗	x.xxx (numeric entry)	
								↗	CC129 Thickness	↗	x.xxx (numeric entry)	
			Delete Pipe	↗	↗	Choose Pipe Class	↗	*See Create/Edit Pipe				
			↗	↗	↗	Pick Pipe Name	↗	*See Create/Edit Pipe				



Scroll option list to a class that provides the closest match to your pipe. Press  .



To select the [Pipe Class] press . This moves the highlight to [Choose Pipe Name].

To access the [Pipe Name] option list press .




Scroll the option list   to a pipe name and press  to select it.



This loads Outer Diameter and Wall Thickness for the selected pipe.

The highlight moves to [Outer Diameter]. Press  to enable numeric entry. Type the actual pipe OD using the appropriate English or metric units. Press  to store the OD. The highlight moves to [Wall Thickness].

Press  to enable numeric entry. Type the actual wall thickness using the appropriate English or metric units. Press  to store the wall thickness.

Select a Liner Material and enter its thickness (if required).

Press  to leave the Create/Edit Pipe menu. This triggers the Save Pipe pop-up Window. Note that the second line lists the name of the selected pipe. Press  and then press  to use this name.

To use a new name, press  and then use the appropriate arrow keys to rename the pipe (8 chars. Max.). Press . 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 [Pipe Class] option list .

Scroll the option list   to the class that contains the pipe to be deleted.

To select [Pipe Class] press . This moves the highlight to [Choose Pipe Name].

To access the [Pipe Name] option list press .

Scroll the option list to the pipe to be deleted by pressing  .

To remove it from the pipe table press .

4.12.3 THE DATALOGGER CONTROL MENU

The Datalogger Setup menu in the Channel/Path 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 Setup menu is measurement channel specific, this Datalogger Control 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.

Datalogger Control 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] menu 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. For convenience sake, the Display Datalogger command is essentially a duplicate of the menu cell in Datalogger Setup. It sends Datalogger data to the graphic screen with or without line wrapping. For dual-channel systems with logging enabled on both channels, a screen dump from menu will show data from both channels. 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.

Press the <Right Arrow> to access the Datalogger Control Menu.

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 Setup 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 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 correctly. 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:

1. Check the flow computer-to-external device connections and your RS-232 Setup parameters (see RS-232 Setup).
2. Press <Right Arrow> to access the [Output Datalogger] option list.
3. Press <Up or Down Arrows> to scroll the cursor to [Yes].
4. Press <ENT> to transmit Datalogger contents to external device via the serial port.
5. Press the <Left Arrow> to stop printout.

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-Path systems include Circular Memory and Single Path 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 path 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.).

All active paths in the Channel/Path Setup menu must be disabled. To disable active Paths, select the [Channel Enable] menu cell and then [No].

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 paths that you disabled earlier to begin logging.

Est Log Time Left

Est Log Time Left is a “view-only” menu cell that shows an estimate of the amount of Datalogger time remaining in hours and minutes. This menu cell becomes active after you enable datalogging. Selecting Circular Memory and/or event-based datalogging (see Datalogger Setup), blanks the field [Est Log Time Left] and is based on the log interval and data selections made in the Datalogger Setup. For Single-Channel flowmeters, this time is an estimated minimum since data compression is employed for improved storage efficiency.

Clear Datalogger

If you use the Datalogger in its default mode, eventually you will use all the memory available for Datalogger storage. When this occurs, you will not be able to log more data until you free up the memory. The Clear Datalogger command erases ALL stored Datalogger data. Therefore, you should evaluate the currently stored data, and print any valuable information before using this command. *Note: Saved Sites also consume datalogger RAM.*

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 

4.12.4 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 1010 is equipped with - either 900k expanded or 170k standard RAM.

Press the <Right Arrow> to view the amount of memory bytes available.

MEMORY CONTROL MENU

Data Memory Left	⇒	XXXXX
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.

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.

4.12.5 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.

NOTE: The current and Pgen trimming will be limited by the 12-bit resolution of the meter's D/A Convertor (DAC).

Press the <Right Arrow> to access the [Analog Output Trim] menu.

ANALOG OUTPUT TRIM MENU STRUCTURE

Analog Output Trim ⇅	⇅	Io1 (Io2)	⇅	⇅ Operate Trim @ 4mA ⇅	Indicated mA = x.xx (Single Path only) Indicated Hz = xxxx
		Pgen1	⇅	⇅ Operate Trim @ 1kHz ⇅	

Current Output Trim (Io1 & Io2)

(Note: Can be trimmed to within .005 mA of nominal.)

To calibrate a current output (Io1 or Io2):

1. Set up the multimeter to read Amps, then connect it to the supply and return terminals of the current output under test.
2. Move the highlight to the port to be tested, press the <Right Arrow>, then press the <Down Arrow> to move the cursor to [Trim @ 4mA].
3. Press <ENT>. This triggers a 4.00 mA pop-up window. The multimeter should now be reading 4.00 mA.
4. If the multimeter reading does not match, use the numeric keys to type in the multimeter reading.
5. 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.
6. Re-check the multimeter to make sure that it is now reading 4mA.

Pgen Output Trim (Pgen 1) Not available in Custody Transfer flowmeters.

(Note: Can be trimmed to within 1.25 Hz of nominal.)

To calibrate a pulse rate output (Pgen1):

1. Connect a frequency counter to the supply and return terminals of the pulse rate output under test.
2. Move the highlight to the port to be tested, press the <Right Arrow>, then press the <Down Arrow> to move the cursor to [Trim @ 1kHz].
3. Press <ENT>. This triggers a 1 kHz pop-up window. The frequency counter should now be reading 1 kHz.
4. If the frequency counter reading does not match, use the numeric keys to type in the frequency counter reading.
5. 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.
6. Re-check the frequency counter to make sure that it is now reading 1 kHz.

4.12.6 THE RTD CALIBRATE MENU *(optional)*

The RTD Calibrate Menu appears on all 1010N models. Use this menu to calibrate the 991T or 1011TN RTD Temperature Sensors to an external standard. It is important to note that Controtron 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/Gas 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°F (0°C) 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 the <Right Arrow>.

RTD CALIBRATION MENU STRUCTURE (Single Path 1010)

RTD Calibrate ⇨	RTD 1 ⇨	↕ Factory User Cal
	RTD 2 ⇨	↕ 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 the RTD you want to calibrate (RTD1 or RTD2).

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

Move the highlight to [User Cal] or [Factory] Cal then press <ENT>. This triggers the pop-up window:

Calib @ deg F
=32.0

To enable numeric entry press <Right Arrow>, then type in the reading of the reference thermometer (e.g., 72.0).

Calib @ deg F
=72.0

To recalibrate the RDT sensor press <ENT>. To verify the calibrated reading, go to [Diagnostics/Liquid Data] to check the current RTD output. Make sure that it coincides with the reading of the reference thermometer. Repeat for the other RTD if necessary.

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.

4.12.7 THE CLOCK SET MENU

The Clock Set menu 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 (<i>date entry</i>)
	Time	xx.xx (<i>time entry</i>)

Notice:

All Controlotron flowmeters include a real-time clock to provide a convenient date/time stamp for display screens and datalogger reports. The operating system does not rely on the date and time-of-day for any flowmeter operation. Therefore, the "Turn Of The Century" will have no effect on the proper functioning of any of our systems. Regarding the arrival of the year 2000, since our real-time clock uses a six-digit code for month/day/year [MM.DD.YY], the first day of the year 2000 will be: [01.01.00].

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, 2001 by typing 12.07.01. 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:

1. Press the <Right Arrow> to enable numeric entry.
2. Use the numeric keys to type the date (MM.DD.YY).
3. Press <ENT> to store the date. 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:

1. Press the <Right Arrow> to enable numeric entry.
2. Use the numeric keys to type the time (HH.MM).
3. Press <ENT> to store the time. This moves the cursor to [RS-232 Setup].

4.12.8 RS-232 SETUP

Use the [RS-232 Setup] menu to set the operating parameters of the serial I/O port. Settings include baud rate, parity, data bits, line feed, network I.D 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 transfers 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 HyperTerminal™, that includes a field for stop bits, select 1 stop bit.

Controlotron	Dual Path	SITE 1
Match to connected Device		
Baud Rate	9600	
Parity	odd	
Data Bits	7	
Line Feed	Yes	
Network ID	0	
RTS Key Time	0.2 Secs	
RS-232 Setup		

RS-232 SETUP MENU STRUCTURE

<div>↕</div> <div>⇒</div> <div>⇒</div> <div>⇒</div> <div>⇒</div> <div>⇒</div>	RS-232 Setup	⇒	<div>Baud Rate</div> <div>↕</div>	⇒	<div>↕</div> <div>300</div> <div>1200</div> <div>2400</div> <div>4800</div> <div>9600</div> <div>38400</div>
		⇒	<div>Parity</div> <div>↕</div>	⇒	<div>↕</div> <div>None</div> <div>Odd</div> <div>Space</div> <div>Even</div> <div>Mark</div>
		⇒	<div>Data Bits</div> <div>↕</div>	⇒	<div>↕</div> <div>7</div> <div>8</div>
		⇒	<div>Line Feed</div> <div>↕</div>	⇒	<div>↕</div> <div>Yes</div> <div>No</div>
		⇒	<div>Network ID</div> <div>↕</div>	⇒	<div>xx (numeric entry)</div>
		⇒	<div>RTS Key Time</div> <div>↕</div>	⇒	<div>↕</div> <div>0.2 Secs</div> <div>0.4 Secs</div> <div>0.6 Secs</div> <div>0.8 Secs</div> <div>1.0 Secs</div> <div>2.0 Secs</div> <div>3.0 Secs</div> <div>4.0 Secs</div>

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:

1. Press the <Right Arrow> to access the [Baud Rate] option list.
2. Move the cursor to the required baud rate.
3. Press <ENT> to store selection. 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:

1. Press the <Right Arrow> to access the [Parity] option list.
2. Move the cursor to the required parity setting.
3. Press <ENT> to store the data. 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:

1. Press the <Right Arrow> to access the [Data Bits] option list.
2. Use the <Up or Down Arrow> to move the asterisk to the required bit setting.
3. 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 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:

1. Press the <Right Arrow> to access the [Line Feed] option list.
2. Use the <Up or Down Arrow> to move the asterisk to [Yes] Line Feed enabled, or [No] Line Feed disabled.
3. Press <ENT> to store the data. 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

1. Press <Right Arrow> to enable numeric entry.
2. Use the numeric keys to type the Network ID number.
3. Press <ENT> to store Network ID. 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:

1. Press <Right Arrow> to access the [RTS Key Time] option list.
2. Use the <Up or Down Arrow> to move the asterisk to the required RTS time.
3. Press <ENT> to store the data.

4.12.9 SYSTEM INFO

This menu provides general information about the flowmeter.

SYSTEM INFO MENU STRUCTURE

Version	This is the meter’s operating system version number. Controlotron’s 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. Controlotron’s Technical Services Group may request this number during a consultation.
Code	Software Compile Date/Time. Operating System identifier. Controlotron’s Technical Services Group may request this number during a consultation.
System Time	Use to set system time and date. Format: xx.xx.xx. xx.xx.xx

4.13 DATA DISPLAY SCREEN

The alphanumeric display of the 1010GCX 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 1010GCX system. Once a measurement path 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 1010GCX system. On power-up the 1010GCSX will display one of the following:

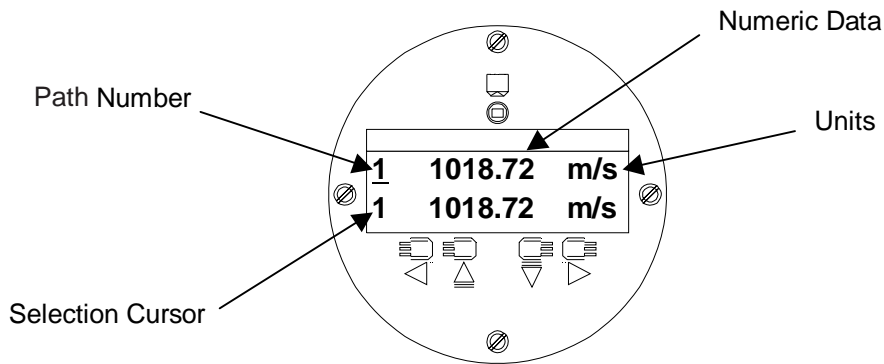
- The scrolling Controlotron Welcome Screen (i.e., if no path had been previously activated), or
- The active path's last data screen displayed prior to turning off the instrument.

After successful path 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 sound velocity data.

- First Character - Displays the path 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 path 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 path

units the *path 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.

5. SYSTEM 1010 APPLICATION NOTES

System 1010 is an extremely versatile transit-time flowmeter that operates on fluids including low or high pressure gases. Please review the following application guidelines to obtain the best service from this equipment.

System 1010 provides a simple menu-driven interface for site programming. During the installation procedure, you provide the system with information regarding the physical installation (e.g., pipe ID and transducer parameters). Based on your selections, the flow computer optimizes operation automatically. However, the system cannot protect itself from a critical data entry error. Therefore, satisfactory performance depends also on the accuracy of the information that you provide.

For normal operation, the flow computer only needs a receive signal of sufficient amplitude to activate its automatic gain controlled detection circuits. In almost all cases, adverse application conditions reduce system performance, or cause apparent operational failures. Finding the culprit application condition usually reveals an appropriate remedy.

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).

NOTE: Only install transducer pairs with matching serial numbers.

5.2 OVERVIEW OF SYSTEM PERFORMANCE

We base our system performance specifications on acceptable fluid sonic conductivity and other pertinent application conditions. Obviously, the diversity that characterizes fluid flow, makes it impractical for us to cover all possible application conditions that have the potential to reduce performance.

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

5.2.1 ACCURACY

Be aware that 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 0.30% to 0.5%, depending on application conditions.

Two common data-entry mistakes may reduce performance. If you enter an incorrect fluid viscosity value, you could compromise the intrinsic flow profile compensation curve. In addition, you could reduce accuracy by incorrectly identifying the transducers. Measured sonic velocity (Vs) errors usually reveal this problem. This can be resolved by simply returning to the appropriate menu cells, entering the correct values, then repeating the transducer installation.

5.2.2 REPEATABILITY

Some applications emphasize 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.

5.2.3 DATA STABILITY

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

Data Scatter

Data scatter is defined as a rapid variation in flow readings (within a span of about 0.1 to 5 seconds). Minimal data scatter (approximately 0.005 to 0.01 ft/sec) is a natural by-product of the digital computation that extracts the extremely small difference in the up vs. down sonic transit time. However, 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 reading when the meter measures extremely low flow rates. Poor fluid sonic conductivity could attenuate the sonic signal to a level that increases data scatter. You should check the signal level (Valc %) item on the Diagnostic Menu. Usually, this condition 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 defined as a long-term cyclical flow deviation resulting from the variation of fluid temperature or fluid 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.

5.3 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 mis-tracking more quickly and smoothly than any other competing transit-time flowmeter.

5.3.1 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.

5.3.2 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, System 1010 includes controls to smooth its 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 as often as every 0.25 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 fluid 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. However, SmartSlew™ instantaneously reduces the time constant whenever the trend of flow changes, even for a short duration. This permits the flow output to quickly follow 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.

5.3.3 NOTES ON FLUID CONDITIONS

Successful transit-time flow measurement depends on sonic transmit signals traveling through the fluid and arriving at the receive transducer without excessive attenuation. Receive signals can be scattered by fluids carrying dispersed particulate matter, either of a solid or non-homogeneous nature. This is especially apparent if the dispersed material is of different sonic impedance than the base fluid. High levels of CO₂ gas can also cause signal attenuation.

5.3.4 ERRONEOUS FLUID PARAMETER SPECIFICATION

The viscosity of the fluid 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 Dept. can provide reliable viscosity data for most fluids.

5.3.5 TURBULENCE

Gases, having large quantities of condensate or water vapor, may cause sonic beam scattering. In large quantities, they can reduce the sonic signal strength and cause rapid variations in the receive signal amplitude. This rapid amplitude variation is related to the "Turbulence" variable, where 100% represents the maximum level of turbulence. System 1010 can operate suc-

cessfully with a larger amount of turbulence than any other transit-time flowmeter. Therefore, it measures and reports the aeration level as the analog output, Vtrb %. This represents the relative degree of turbulence detected within the flow stream. The flow computer reports the Vtrb level until it impedes operation and forces a Fault Alarm. The Vtrb output accommodates applications requiring an aeration indicator. You can use the turbulence percentage as an alarm relay set-point. Vtrb appears also on the graphic display screen. The system will issue a fault alarm before aeration reaches a level that impairs flow measurement.

5.4 OVERVIEW OF SYSTEM 1010GCSX MEMORY RESOURCES

System 1010GCSX memory resources include both Read-Only-Memory (ROM) and battery-backed Random Access Memory (RAM). The ROM memory contains the system operating instructions, the on-line help text, the default data, and the pipe, transducer and fluid 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. In addition, this action creates an immediate Site Setup, based on the meter's defaults. Therefore, to make the meter operational, you only have to enter required data (e.g., pipe and transducer data) and optionally edit other default settings to suit your application. When you program the meter, all your entries are retained in the Active Memory. This allows you to use the meter immediately after finishing a Site Setup. However, you are not limited to one set of site parameters. System 1010 allows you to copy site data from Active Memory to Site Storage Memory.

Site Storage Memory provides a permanent storage area for several inactive Site Setups. The multi-site storage feature allows rapid reinstallation at many different 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 dynamically, depending on the demands of each facility. Therefore, an unusually large Datalogger file may reduce the amount of site storage memory available. On the other hand, 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.

5.5 REFERENCE TABLES

The following tables provide reference data that may be required during site setup.

SYSTEM 1010 REYNOLDS COMPENSATION FACTORS FOR DIAMETRAL BEAM TRANSMISSION

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 <ENT> to select the item.
Cursor	This refers to the highlighted text and the arrow cursor that you move via the arrow direction when navigating through menus or menu cells.
Data Entry	Refers to data entered into a menu cell (either numeric or option list selection).
Datalogger Memory	Memory segment that stores data items logged during operation. You can view the Datalogger contents either on-screen or transmit it to an external device via the RS-232 serial port. The amount of Datalogger memory depends on how many sites reside in Site Storage memory.
ENTER Key	Use the <ENTER> key to store a current numeric value or option list item.
Flow Computer	Refers to the meter itself (system refers to the meter and transducers combined).
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.
LAPTOT	Refers to a system function that freezes the Totalizer display, while the Totalizer continues to update its registers.
Standard Volume	Rate or volume anticipated at conditions indicated by the entered base pressure and temperature.
Local Display	Refers to the 1010GCSX integral display.
Menu	Sub-sections of the Installation Menu that are used to define specific functions (e.g., RS-232).

TERM	EXPLANATION
Menu Cell	A location within a Menu where you define either a single numeric value or option list selection that supports the Sub-Menu's function. Certain view-only menu cells show reference data appropriate to the current application.
NEGFLOW	Totalizer mode for negative flow total only.
NETFLOW	Totalizer mode that combines positive and negative flow totals.
NOTOT	System function that disables the internal Totalizer.
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 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.
Site Name	A user-entered name that meter associates with a stored Site Setup. You retrieve 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 meter 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.
Transducer	Transit-time ultrasonic gas transducer.
Register	Refers to a memory location used by the flow computer to store data such as the flow total, etc.
Vtrb	The meter's turbulence percent output.
Vps	The sonic propagation velocity of a pipe.
Vs	The sonic velocity of the gas.

5.6 THE NEMA DUAL PATH MENU CHART

This section shows the 1010 Permanent Dual Path Menu Chart.

THE METER MENU

Meter Type ⇨	Dual Path Flow ⇨	Chan/Path Setup
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THE CLAMP-ON GAS MENU

Clamp-on Gas ⇨	Chan/Path Setup ⇨	⇅ Recall Site Setup Channel Enable Create/Name Site Site Security Delete Site Setup Save/Rename Site	
	Pipe Data ⇨	⇅ Select Path Pick Pipe Class Select Pipe Size Pipe OD (in) Pipe Material Wall Thickness (in) Pipe ID (in) CC129 Thickness Pipe Configuration Anomaly Diams ThermExpCoef 1/F (Custody Transfer models) Mod of Elast PSI (Custody Transfer models)	
	Gas Parameters ⇨	⇅ Base Temp. F Base Pres. PSIA Spec. Heat Ratio Viscosity (cP) Fixed MW g/mole Estimated Vs m/s Fixed Pres. PSIA Z Base Z Actual AGA8 Comp.	
	Pick/Install Xdcr ⇨	⇅ Install Path Transducer Model Transducer Size Xdcr Mount Mode Spacing Offset Number Index Spacing Method Ltn Value Install Complete? Zero Flow Adjust	
	Operation Adjust ⇨	⇅ Damping Control ⇨ ⇅ Deadband Control ⇨ ⇅ Memory/Fault Set ⇨ ⇅ Memory Delay <sec>	⇅ Time Average SmartSlew 0.000 ⇅ Fault Memory xxx (numeric entry)
	Flow/Total Units ⇨	⇅ Flow Vol Units Std Vol Corr Flow Time Units Flow Disp. Range Flow Disp. Scale Total Vol. Units Totalizer Scale	

(continued)

CLAMP-ON GAS MENU *(continued)*

Clamp-on Gas ⇌	Flow/Total Units ⇌	⇌	Total Resolution Totalizer Mode Batch/Sample Tot Reset Totalizer	
	Data Span/Set/Cal ⇌	⇌	Span Data ⇌	⇌ PGEN (Custody Transfer meters only) Max Flow Min Flow Max Flow2 Min Flow2 Max Vs m/s Min Vs m/s Max S.G. Min S.G. Max Base S.G. Min Base S.G. Max Viscosity cS Min Viscosity cS Max Temperature Min Temperature
	⇌	⇌	Set Alarm Levels ⇌	⇌ Hi Flow Low Flow High S.G. Low S.G. High Base S.G. Low Base S.G. Hi Viscosity cS Low Viscosity cS High Temperature Low Temperature Interface Vs m/s Interface S.G. Turbulence % Makeup Latch
	⇌	⇌	Calibrate Flow Rate ⇌	⇌ Intrinsic Kc
			Calib. Table 1* ⇌	Index Variable 1 ⇌ None Flow Vs Viscosity <cS> Viscosity <cP> S.G. Valc Vaer Temp 1 Reynolds # Pressure Aux
⇌	⇌	⇌	⇌	Calib. Table 1 New Point
				Table Active No
				Clear Table 1 No/Yes
				Calib. Table 2* Same as Calib. Table 1
				Calib. Table 3* Same as Calib. Table 1
⇌	Datalogger Setup ⇌	⇌	Datalogger Mode Datalogger Data Log Time Interval Datalogger Events	
⇌	I/O Data Control ⇌	⇌	Analog Output Setup ⇌	⇌ Io1 / Io2 (Single Path meter has Io1 only) Pgen 1 (In Single Path meters only)

*Calibration Tables in Custody Transfer models only.

(continued)

CLAMP-ON GAS MENU (continued)

Clamp-on Gas ⇌	I/O Data Control ⇌	Relay Setup ⇌	⇌	Relay 1 Relay 2			
		⇌	Analog Inp Setup ⇌	⇌	lin1 - lin4 ⇌	Off/Input ⇌	⇌ Off Aux PSIA BARA Deg F Deg C
		⇌		⇌		⇌	
				⇌	4 mA	0.000	
				⇌	20 mA	0.000	
	Diagnostic Data ⇌	Path Select ⇌	⇌	⇌	1 2 1 and 2		
		⇌	Path Enable ⇌	⇌	Yes/No		
		⇌	Flow Data ⇌	⇌	Flow Velocity F/S Total Vs m/s Signal mV Valc % Vtrb % Alarm Status AnCal		
		⇌	Application Info ⇌	⇌	TN uSec TL uSec DeltaT uSec Burst/Sec % Accepted Last Makeup Makeup Status		
		⇌	Gas Data ⇌	⇌	TEMP1 TEMP2 Reynolds # Base S.G. Specific Gravity Temperature Pressure Volume Corr. Viscosity (cS)		
		⇌	Site Setup Data ⇌	⇌	fx (drive) N (burst length) Ltn in Vfmax Vs max m/s Vs min m/s 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		

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) Inner Diameter (in) CC129 Thickness
			⇨	⇕ Delete Pipe ⇨ ⇕	⇕ Choose Pipe Class Pick Pipe Name
	Datalogger Cntrl ⇨ ⇕	⇨	Output Datalogger ⇨	No/Yes	
		⇨	Circular Memory ⇨	No/Yes	
		⇨	Est Log Time Left ⇨	--:--	
		⇨	Clear Datalogger ⇨	No/Yes	
	Memory Control ⇨ ⇕	⇨	Data Memory Left ⇨	xxxx	
		⇨	Defragment ⇨	No/Yes	
	Analog Output Trim ⇨ ⇕	⇨	Trim Io1 ⇨	⇕ Operate Trim @ 4mA	
		⇨	Trim Io2 ⇨	⇕ Operate Trim @ 4mA	
		⇨	Trim Pgen1* ⇨	⇕ Operate Trim @ 1 kHz	
	RTD Calibrate ⇨ ⇕	⇨	⇕ RTD-1 RTD-2	⇕ User Cal./Factory User Cal./Factory	
	Clock Set ⇨ ⇕	⇨	⇕ Date Time		
	RS-232 Setup ⇨ ⇕	⇨	⇕ Baud Rate Parity Data Bits Line Feed Network ID RTS Key Time		
	System Info ⇨ ⇕	⇨	⇕ Version Reset Date/Time Op System P/N Checksum Code System Time		

*Not present in Custody Transfer flowmeters.

APPENDIX A

ENGINEERING DRAWINGS

SYSTEM 1010GCX NEMA-7 FLOWMETER

Flow Computer Drawings

1010DXS2-7	Installation Wiring, 1010DX Series Flowmeter, Agency Approved
1010DXS2-8	Outline Dimensions, 1010X Series Flowmeter, Agency Approved
1013S-S2-7	Installation Guide, Connection Diagram Selection, Agency Approved 1011S Series Transducers
1010-341	Connection Diagram, 1010 System, Explosion Proof/Flame Proof, Flow Computer
1010-342	Connection Diagram, 1010 System, Explosion Proof/Flame Proof, Flow Computer
1011GCS-8	Outline Dimensions, 1011GCS Series Plastic Body Transducers
1012WS-8	Outline Drawing, Weld Seal Clamp-On Transducer Enclosure
1012WSM-8	Installation/Outline, Adjustable Mounting Strap
1012WS-1-7	Weld Seal Installation Instructions, Single Enclosure
1012WS-2-7	Weld Seal Installation Instructions, Dual Enclosure

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D

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C

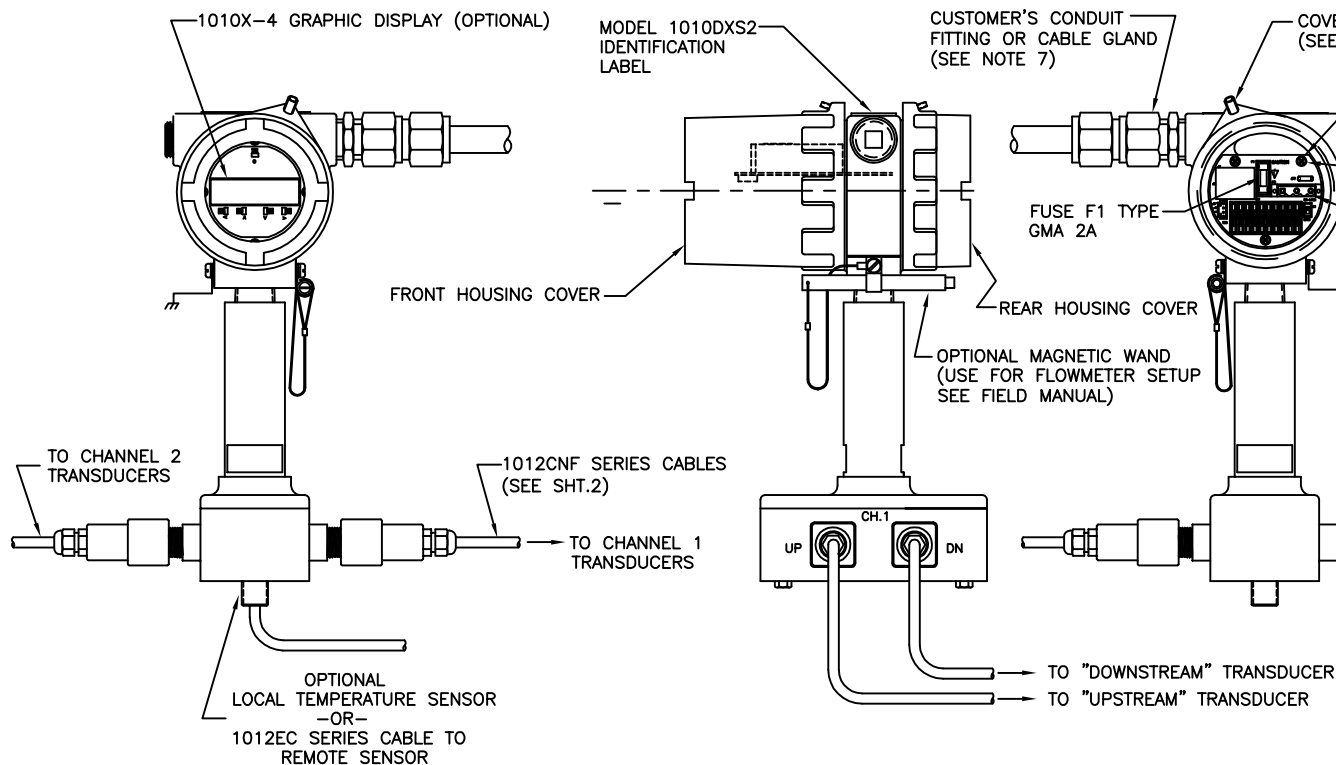
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B

B

A

A



CAUTION:

CONSULT LABEL INSIDE THE REAR HOUSING COVER TO CONFIRM POWER SUPPLY MODULE TYPE BEFORE APPLYING POWER TO INPUT TERMINALS.
 MODULE 1010X-6SS2: 90-230 VAC, SINGLE PHASE
 MODULE 1010X-6ZNS2: 9-36 VDC, NEGATIVE GROUND
 MODULE 1010X-6ZPS2: 9-36 VDC, POSITIVE GROUND

NOTES:

- SEE DRAWING 1010DXS2-8 FOR OUTLINE DIMENSIONS.
- SEE 1010X FIELD MANUAL AND TRANSDUCER INSTALLATION DRAWINGS FOR WIRING TO FLOW TRANSDUCER.
- TEMPERATURE SENSOR TERMINAL BLOCK IS INCLUDED ONLY IN UNITS REQUIRING TEMPERATURE SENSOR INPUTS. SEE TEMPERATURE SENSOR INSTALLATION DRAWING.
- SET POWER INPUT OFF BEFORE OPENING COVERS, SERVICING FUSE OR CONNECTIONS.
- 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.
- OBSERVE FOLLOWING LIMITS WHEN INSTALLING TRANSDUCER CABLES IN CONDUIT:
 MAX. PULL TENSION: 80 lbs.
 MIN. BEND RADIUS: 2-1/2 INCHES
- USE EEXd CABLE GLANDS OR INSTALL EXPLOSION PROOF CONDUIT SEALS WITHIN 2" OF FLOWMETER. INSTALL EXPLOSION PROOF PLUGS AT ALL UNUSED CABLE ENTRY HOLES.
- 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.
- RTD TEMPERATURE SENSING OPTION IS AVAILABLE TO EITHER FLOW CHANNEL UNDER MENU CONTROL.

CHANGES TO THIS DOCUMENT REQUIRE
SAFETY AGENCY APPROVAL

DO NOT SCALE THIS DRAWING UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES (MM) TOLERANCES DIM-		CONTRACT NO.		SIEMENS Siemens Energy & Automation, Inc. Process Instrumentation Business Unit CoC Ultrasonic Flow - Hauppauge, Long Island, NY 11788	
		DR H.J. DATE 2/8/99 CHK DATE ENG DATE PROD DATE APPD DATE			
INCHES ± .1 (MM) ± 2		CERTIFIED DATE		INSTALLATION WIRING 1010DX SERIES FLOWMETER AGENCY APPROVED	
		SIZE C CODE IDENT NO. 21614 SCALE NONE WT.		1010DXS2 - 7 REV. H SHEET 1 OF 4	

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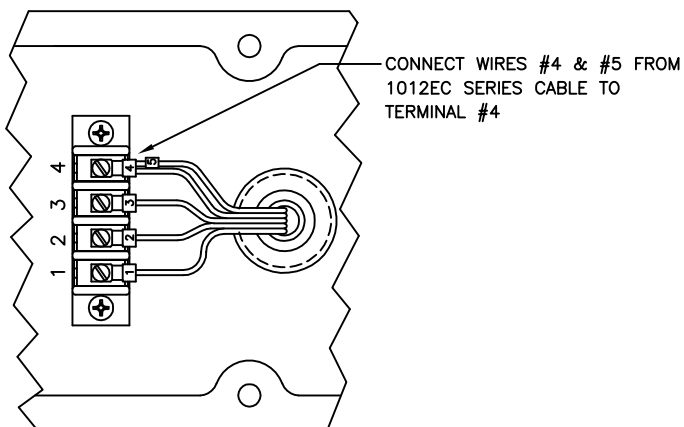
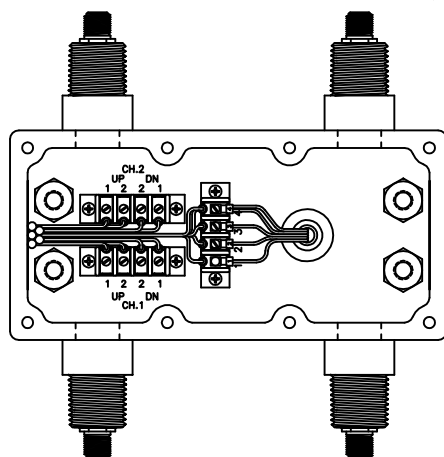
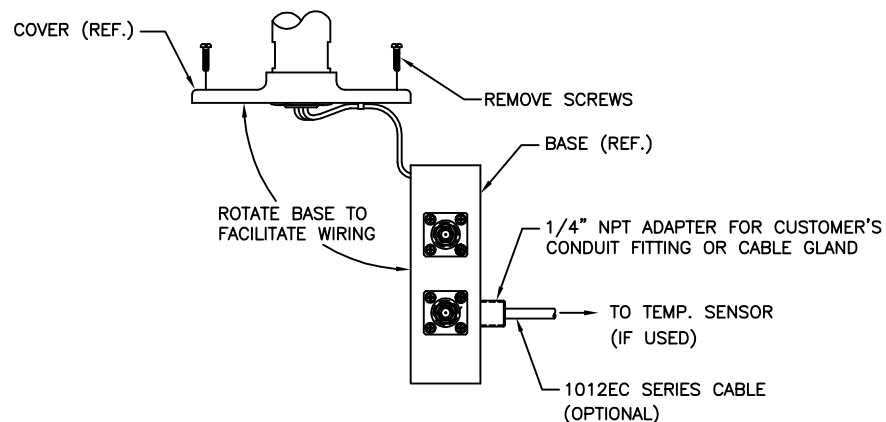
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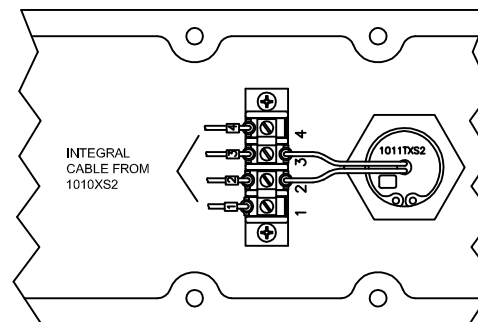
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TEMPERATURE SENSOR CABLE CONNECTION/REMOTE SENSOR

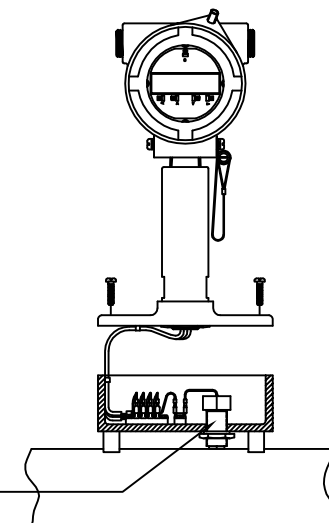


LOCAL TEMPERATURE SENSOR CONNECTION FOR UNITS WITH LOCAL TEMPERATURE SENSOR OPTION



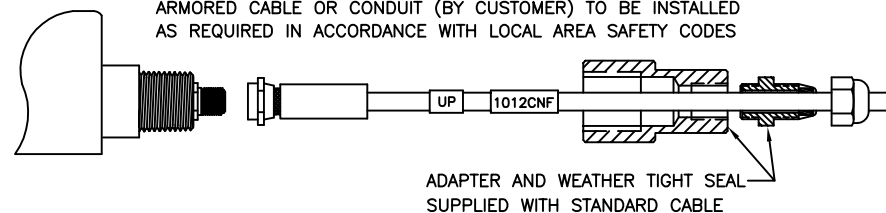
1011TXS2 TEMP SENSOR

SENSOR MOUNTED IN
1010XS2 JUNCTION BOX
SEE DRAWING 1011TXS2-8



FLOW TRANSDUCER CABLE CONNECTION

STANDARD CABLE CONNECTION DETAIL SHOWN BELOW.
ARMORED CABLE OR CONDUIT (BY CUSTOMER) TO BE INSTALLED
AS REQUIRED IN ACCORDANCE WITH LOCAL AREA SAFETY CODES



CHANGES TO THIS DOCUMENT REQUIRE
SAFETY AGENCY APPROVAL

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 2/8/99
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

INSTALLATION WIRING
1010DX SERIES FLOWMETER
AGENCY APPROVED

SIZE	CODE IDENT NO.	1010DXS2 - 7	REV.
C	21614		H
SCALE	NONE	WT.	SHEET 2 OF 4

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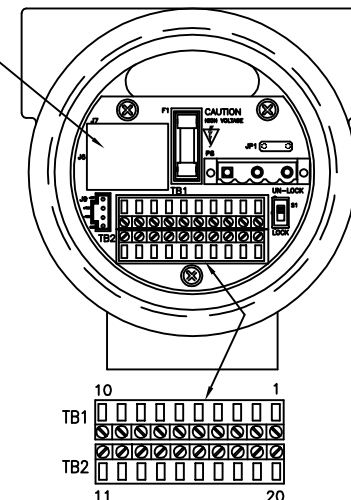
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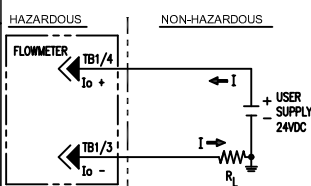
TERMINAL BLOCK WIRING CONNECTIONS (FOR STANDARD, HIGH PRECISION AND ENHANCED PERFORMANCE FLOWMETERS, SEE ZONE B1 FOR ORIENTATION)

	PIN #	SIGNAL	FUNCTION	DESCRIPTION	USE	LOAD	WIRING	CABLE LENGTH	NOTES
TB1	1	Io2-	ISOLATED LOOP RETURN	4-20mA OUTPUT PROPORTIONAL TO SPANNED, SELECTED VARIABLE,	4-20mA ASSIGNABLE AND SPANNABLE UNDER MENU CONTROL	SEE SCHEMATIC 'A'	SHIELDED 24 GA. INSTRUMENT CABLE	1000 FT. MAX. WITHOUT FACTORY APPROVAL	REF. SCHEMATIC "A" CONNECT USER LOOP SUPPLY TO +24VDC.
	2	Io2+	ISOLATED LOOP SUPPLY						
	3	Io1-	ISOLATED LOOP RETURN						
	4	Io1+	ISOLATED LOOP SUPPLY	4-20mA INPUT NON-ISOLATED	USER ASSIGNABLE DEPENDING ON MODEL - MAY BE AUX, PSI, ETC.	SEE SCHEMATIC 'B'		REF. SCHEMATIC "B"	
	5	ANIN 2	4-20mA INPUT CH.2						
	6	ANIN 1	4-20mA INPUT CH.1						
	7	STATUS -1	STATUS BIT RETURN	CH.1 STATUS ALARM EMITTER	USER ASSIGNABLE VIA. MENU SELECTION	'FAILSAFE' VoH IS NORMAL NON-INDUCTIVE LOAD SEE SCHEMATIC 'C'		REF. SCHEMATIC "C"	
	8	STATUS +1	STATUS OUTPUT	CH.1 STATUS ALARM COLLECTOR					
	9	STATUS -2	STATUS BIT RETURN	CH.2 STATUS ALARM EMITTER					
	10	STATUS +2	STATUS OUTPUT	CH.2 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 RETURN	SEE SCHEMATIC 'D'		1000 FT. MAX. WITHOUT FACTORY APPROVAL	REF. SCHEMATIC "D"
	18	D1 RETURN	DIGITAL RETURN						
	19	D2 INPUT	DIGITAL INPUT CH.2						
	20	D2 RETURN	DIGITAL RETURN						

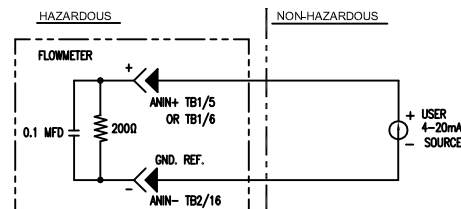
1010X-8S2 MODULE
SEE TABLE ABOVE FOR
I/O CONNECTIONS



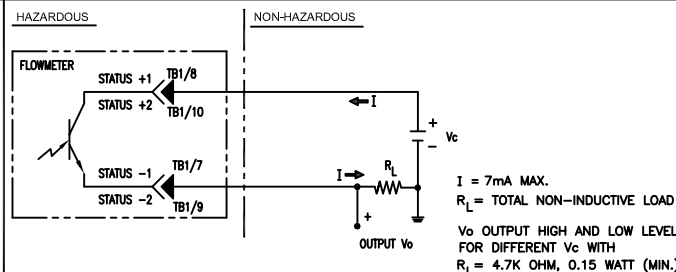
CHANGES TO THIS DOCUMENT REQUIRE
SAFETY AGENCY APPROVAL



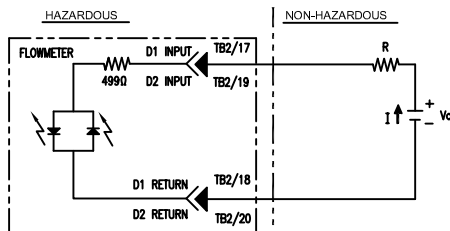
R_L : 1000 OHM MAX.
 I = 4-20mA
 R_L = LOOP WIRE RESISTANCE (BOTH WAYS)
PLUS USER'S INPUT LOAD
RESISTANCE
SCHEMATIC "A"
ISOLATED 4-20mA OUTPUT



DO NOT REVERSE POLARITY
LOAD: 200 OHM PLUS TWO WAY WIRE RESISTANCE
SCHEMATIC "B"
4-20mA ANALOG INPUT



SCHEMATIC "C"
ISOLATED STATUS / ALARM



V_c : 2 VDC MIN. TO 12 VDC MAX.
FOR V_c = 5 VDC TO 12 VDC USE
 R = 2.4K OHM, 0.1 WATT (MIN.)
FOR V_c LESS THAN 5 VDC,
SELECT R TO ACHIEVE I = 1.1mA MIN.

SCHEMATIC "D"
ISOLATED DIGITAL INPUTS

DO NOT SCALE THIS DRAWING
UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES (MM)
TOLERANCES DIM-

INCHES (MM)
 $\pm .1$ $\pm .2$

CONTRACT NO.

DR H.J. DATE 2/8/99
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

INSTALLATION WIRING
1010DX SERIES FLOWMETER
AGENCY APPROVED

SIZE	CODE IDENT NO.	1010DXS2 - 7	REV.
C	21614		H
SCALE	NONE	WT.	SHEET 3 OF 4

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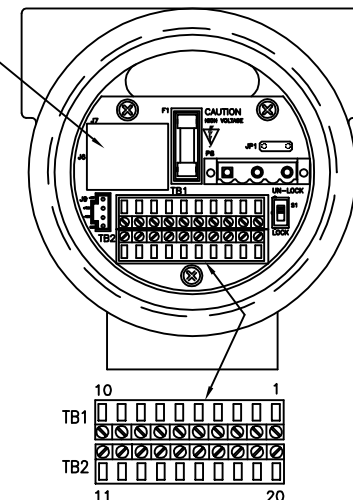
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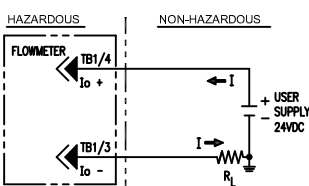
TERMINAL BLOCK WIRING CONNECTIONS (FOR ULTRA PERFORMANCE FLOWMETERS, SEE ZONE B1 FOR ORIENTATION)

	PIN #	SIGNAL	FUNCTION	DESCRIPTION	USE	LOAD	WIRING	CABLE LENGTH	NOTES	
TB1	1	Io2-	ISOLATED LOOP RETURN	4-20mA OUTPUT PROPORTIONAL TO SPANNED, SELECTED VARIABLE,	4-20mA ASSIGNABLE AND SPANNABLE UNDER MENU CONTROL	SEE SCHEMATIC 'A'	SHIELDED 24 GA. INSTRUMENT CABLE	1000 FT. MAX. WITHOUT FACTORY APPROVAL	REF. SCHEMATIC "A" CONNECT USER LOOP SUPPLY TO +24VDC.	
	2	Io2+	ISOLATED LOOP SUPPLY							
	3	Io1-	ISOLATED LOOP RETURN							
	4	Io1+	ISOLATED LOOP SUPPLY	4-20mA INPUT NON-ISOLATED	USER ASSIGNABLE DEPENDING ON MODEL - MAY BE AUX, PSI, ETC.	SEE SCHEMATIC 'B'		REF. SCHEMATIC "B"		
	5	ANIN 2	4-20mA INPUT CH.2							
	6	ANIN 1	4-20mA INPUT CH.1	CH.1 STATUS ALARM EMITTER	USER ASSIGNABLE VIA MENU SELECTION	'FAILSAFE' VoH IS NORMAL NON-INDUCTIVE LOAD		REF. SCHEMATIC "C"		
	7	STATUS -1	STATUS BIT RETURN							
	8	STATUS +1	STATUS OUTPUT	CH.1 STATUS ALARM COLLECTOR	DIGITALLY SYNTHESIZED PULSES USER SPANNED AND PROPORTIONAL TO FLOW RATE					
	9	PGEN -	DPGEN RTN	ISOLATED PGEN EMITTER						
	10	PGEN +	DPGEN 0 C	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 CH.1	ISOLATED DIGITAL COMMAND LINES	FREEZE TOTALIZER CH.1 RETURN	SEE SCHEMATIC 'D'		1000 FT. MAX. WITHOUT FACTORY APPROVAL	REF. SCHEMATIC "D"	
	18	D1 RETURN	DIGITAL RETURN							
	19	D2 INPUT	DIGITAL INPUT CH.2							FREEZE TOTALIZER CH.2 RETURN
	20	D2 RETURN	DIGITAL RETURN							

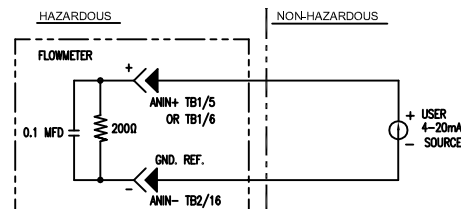
1010X-8S2 MODULE
SEE TABLE ABOVE FOR
I/O CONNECTIONS



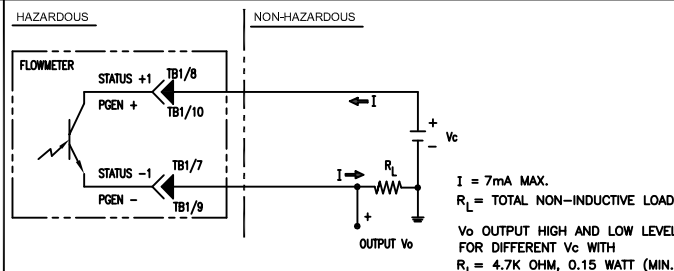
CHANGES TO THIS DOCUMENT REQUIRE
SAFETY AGENCY APPROVAL



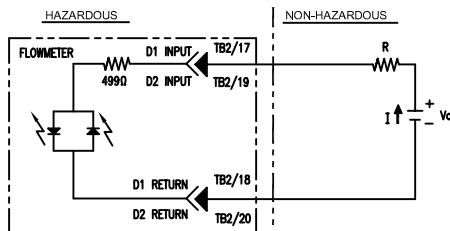
R_L : 1000 OHM MAX.
 I = 4-20mA
 R_L = LOOP WIRE RESISTANCE (BOTH WAYS)
PLUS USER'S INPUT LOAD
RESISTANCE
SCHEMATIC "A"
ISOLATED 4-20mA OUTPUT



DO NOT REVERSE POLARITY
LOAD: 200 OHM PLUS TWO WAY WIRE RESISTANCE
SCHEMATIC "B"
4-20mA ANALOG INPUT



SCHEMATIC "C"
ISOLATED STATUS / ALARM OR PGEN OUTPUTS



SCHEMATIC "D"
ISOLATED DIGITAL INPUTS

V_c : 2 VDC MIN. TO 12 VDC MAX.
FOR V_c = 5 VDC TO 12 VDC USE
 R = 2.4K OHM, 0.1 WATT (MIN.)
FOR V_c LESS THAN 5 VDC,
SELECT R TO ACHIEVE I = 1.1mA MIN.

DO NOT SCALE THIS DRAWING
UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES (MM)
TOLERANCES DIM-

INCHES (MM)
 $\pm .1$ $\pm .2$

CONTRACT NO.

DR H.J. DATE 2/8/99
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

INSTALLATION WIRING
1010DX SERIES FLOWMETER
AGENCY APPROVED

SIZE	CODE IDENT NO.	1010DXS2 - 7	REV.
C	21614		H
SCALE	NONE	WT.	SHEET 4 OF 4

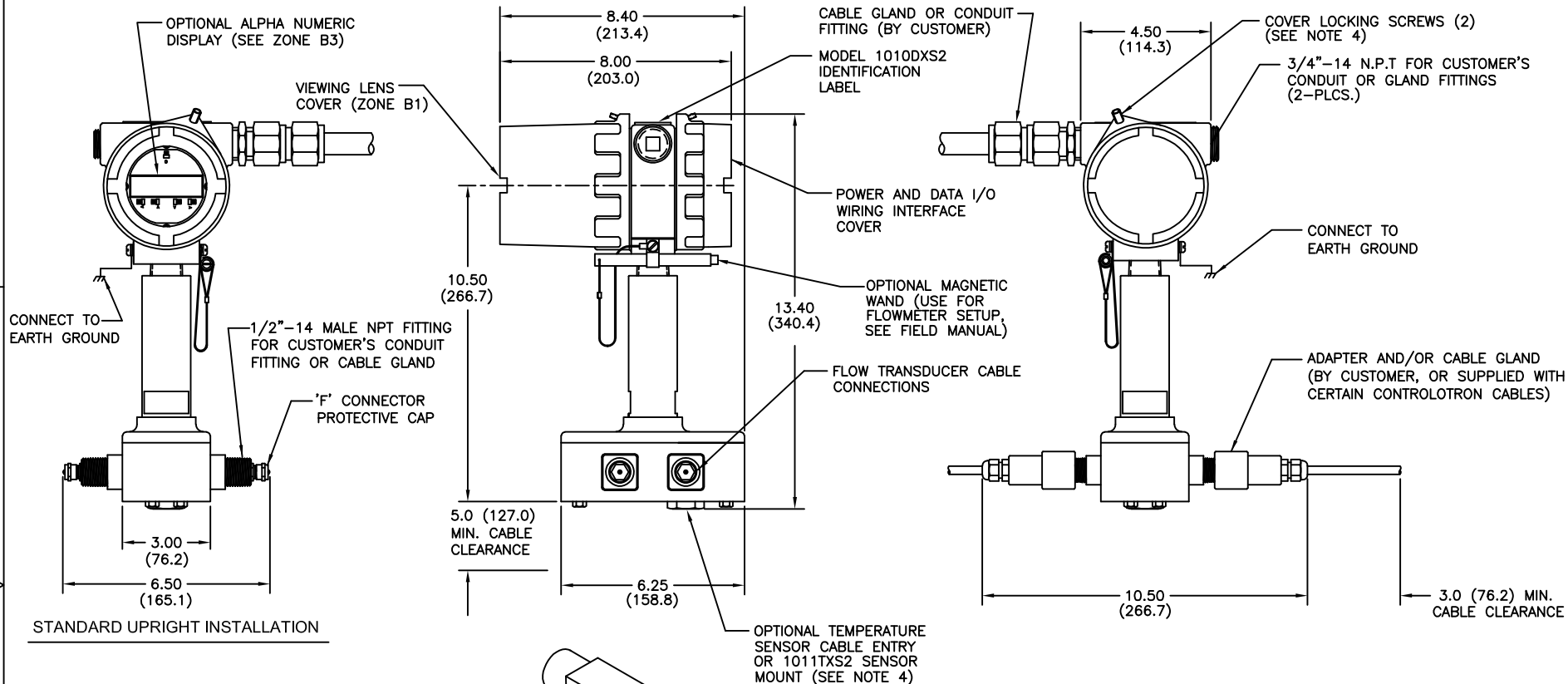
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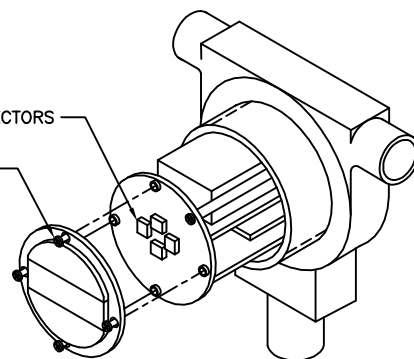
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DISPLAY MODULE CONNECTORS
(SEE NOTES 3c & 3d)
DISPLAY CAPTIVE SCREWS
(SEE NOTE 3b)



*SHOWN WITH VIEWING LENS

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

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

NOTES:

- NET WEIGHT: 9.8 lbs. (4.4 Kg) MAX.
- SEE DRAWING 1010DXS2-7 AND THE 1010 INSTALLATION MANUAL FOR INSTALLATION WIRING AND SETUP INSTRUCTIONS.
- SECURE ALL COVERS BY TIGHTENING COVER LOCKING SETSCREWS. (1/16" HEX KEY)
- SEE DRAWING 1011TXS2-8 FOR INSTALLATION AND WIRING OF OPTIONAL INTEGRAL TEMPERATURE SENSOR.

DO NOT SCALE THIS DRAWING

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES AND
TOLERANCES ON-

INCHES (MM)
± .1 ± .2

CONTRACT NO.

DR H.J. DATE 2/8/99

CHK. DATE

ENG. DATE

PROD. DATE

APPD. DATE

CERTIFIED

DATE

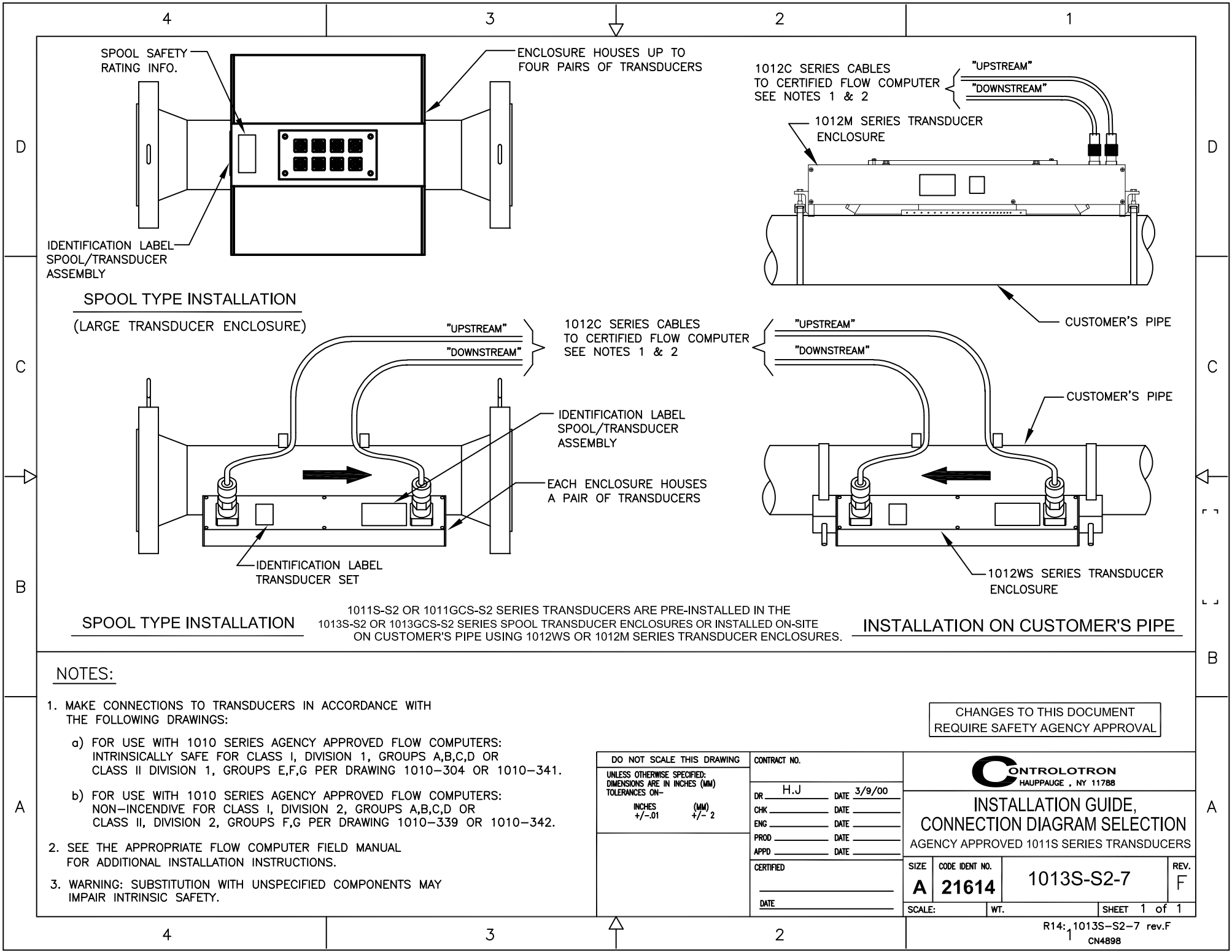
CONTROLOTRON
HAUPPAUGE, NY 11788

OUTLINE DIMENSIONS 1010X SERIES FLOWMETER

SIZE	CODE IDENT NO.	REV.
C	21614	C
SCALE: NONE	WT.	SHEET 1 OF 1

CN4271

R14: 1010DXS2-8 rev.C



NOTES:

1. MAKE CONNECTIONS TO TRANSDUCERS IN ACCORDANCE WITH THE FOLLOWING DRAWINGS:
- a) FOR USE WITH 1010 SERIES AGENCY APPROVED FLOW COMPUTERS: INTRINSICALLY SAFE FOR CLASS I, DIVISION 1, GROUPS A,B,C,D OR CLASS II DIVISION 1, GROUPS E,F,G PER DRAWING 1010-304 OR 1010-341.
 - b) FOR USE WITH 1010 SERIES AGENCY APPROVED FLOW COMPUTERS: NON-INCENDIVE FOR CLASS I, DIVISION 2, GROUPS A,B,C,D OR CLASS II, DIVISION 2, GROUPS F,G PER DRAWING 1010-339 OR 1010-342.
2. SEE THE APPROPRIATE FLOW COMPUTER FIELD MANUAL FOR ADDITIONAL INSTALLATION INSTRUCTIONS.
3. WARNING: SUBSTITUTION WITH UNSPECIFIED COMPONENTS MAY IMPAIR INTRINSIC SAFETY.

CHANGES TO THIS DOCUMENT
REQUIRE SAFETY AGENCY APPROVAL

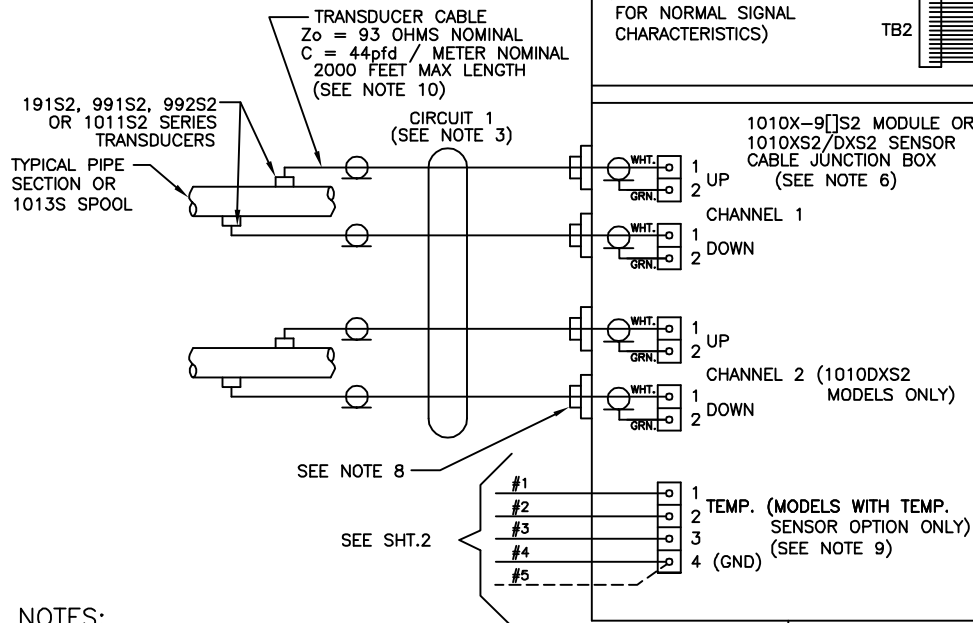
DO NOT SCALE THIS DRAWING		CONTRACT NO.		CONTROLTRON HAUPPAUGE, NY 11788	
UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES (MM) TOLERANCES ON-		DR. H.J. DATE 3/9/00			
INCHES +/- .01		(MM) +/- 2		CHK. DATE	
		ENG. DATE		PROD. DATE	
		APPD. DATE		CERTIFIED	
		DATE		SIZE CODE IDENT NO.	
				A 21614 1013S-S2-7	
				REV. F	
				SCALE: WT. SHEET 1 of 1	

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

NOTES:

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

CHANGES TO THIS DOCUMENT REQUIRE
SAFETY AGENCY APPROVAL

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	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	80mA 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	80mA 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

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	G
SCALE: NONE	WT.	SHEET 1 OF 4

4

3

2

1

HAZARDOUS LOCATIONCLASS I, II, DIV. 1 FOR GRPS. B, C, D, E, F, G
EEx d [Ia] II T5**1010XS2 OR 1010DXS2 SERIES FLOW COMPUTER
EXPLOSIONPROOF / FLAMEPROOF ENCLOSURE**

D

D

991TS2 OR 991TSS2

992ECJ OR 992ECJD

1012EC SERIES
CABLE (TYP.)1
2
3
4
TEMP
(GND)1010XS2 AND 1010DXS2
SERIES FLOW COMPUTERS
HAVE TERMINALS FOR
ONE TEMPERATURE SENSOR
CABLE CONNECTION

991TWS2

-OR-
1
2
3
4
TEMP
(GND)

991TAS2

-OR-
1
2
3
4
TEMP
(GND)INTEGRAL JUNCTION BOX
(P/O 991TAS2)

991TDS2

-OR-
1
2
3
4
TEMP
(GND)

SEE NOTE 9 ON SHEET 1

INTEGRAL JUNCTION BOX
(P/O 991TDS2)

1011TXS2

-OR-
1
2
3
4
TEMP
(GND)

B

B

1012-57-1 OR -2
JUNCTION BOX

1011TXS2

-OR-
1
2
3
4
TEMPCIRCUIT 1
(SEE NOTE 3)1011TXS2 AND ASSOCIATED WIRES ARE
HOUSED WITHIN THE 1010XS2, 1010DXS2
OR 1012-57-1 OR -2 JUNCTION BOX

TYPICAL TEMPERATURE SENSOR CONNECTIONS

CHANGES TO THIS DOCUMENT REQUIRE
SAFETY AGENCY APPROVAL

A

A

DO NOT SCALE THIS DRAWING

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

CONTRACT NO.

DR H.J. DATE 3/25/99

CHK DATE

ENG DATE

PROD DATE

APPD DATE

CERTIFIED

DATE

CONTROLTRON
HAUPPAUGE, NY 11788**CONNECTION DIAGRAM**1010 SYSTEM, EXPLOSIONPROOF/FLAMEPROOF
FLOW COMPUTER

SIZE

CODE IDENT NO.

1010-341

REV.

G

SCALE: NONE

WT.

SHEET 2 OF 4

4

3

2

1

CN4737

4

3

2

1

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 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

NOTES: (CONT'D FROM SHT.1)

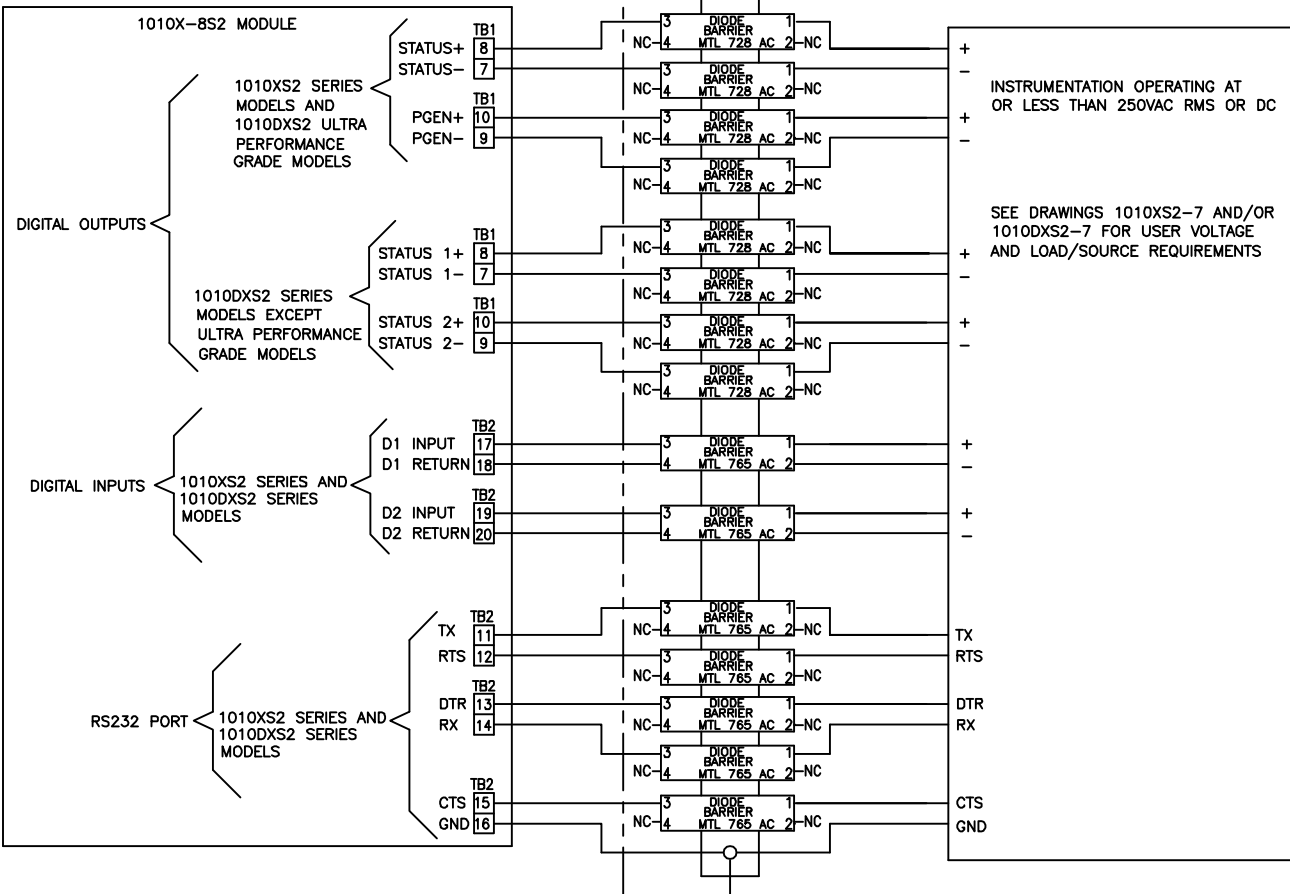
- ANY COMBINATION OF OUTPUTS MAY BE USED WHEN EACH IS CONNECTED TO DIODE BARRIERS AS SHOWN.
- DIODE BARRIERS PINS 3 AND 1 MAY BE INTERCHANGED WITH PINS 4 AND 2 ON MTL 765AC BARRIERS.
- ANY SAFETY BARRIER MAY BE USED IF IT IS CERTIFIED FOR:
 - THE APPLICABLE HAZARDOUS LOCATION RATING.
 - MEETS OR EXCEEDS THE WORKING VOLTAGE RATING OF THE SPECIFIED BARRIER.
 - 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
(SEE TABLE, ZONE C4 FOR DIODE BARRIER CHARACTERISTICS)

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

- "NC" INDICATES NO CONNECTION
- PINS 2 AND 4 ON MTL 728AC ARE GROUND.



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

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	G
SCALE: NONE	WT.	SHEET 3 OF 4

4

3

2

1

CN4737

4

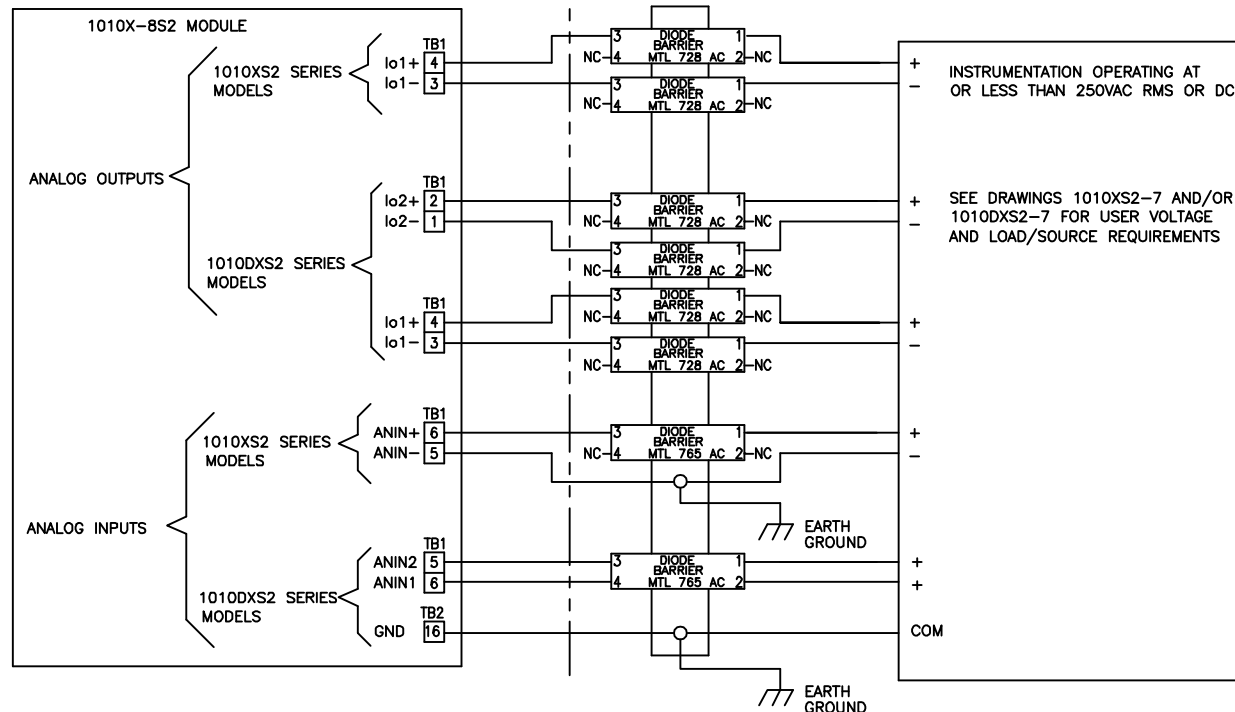
3

2

1

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

NON-HAZARDOUS OR ZONE 2/DIVISION 2 LOCATION

HAZARDOUS LOCATIONCLASS I, II, DIV. 1 FOR GRPS. B, C, D, E, F, G
EEx d [Ia] II T5DIODE 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		SIZE C CODE IDENT NO. 1010-341 REV. G	
PROD. DATE		SCALE: NONE WT. SHEET 4 OF 4	
APPD. DATE			
CERTIFIED			
DATE			

4

3

2

1

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

HAZARDOUS LOCATION

ZONE 2 OR CLASS I, II, DIV. 2 FOR GRPS. A, B, C, D, F, G

1010X-8S2 MODULE
(SEE NOTE 4)INPUT/OUTPUT SIGNALS
(SEE TABLES AT RIGHT
FOR NORMAL SIGNAL
CHARACTERISTICS)P8
1
2
3CIRCUIT 2
(SEE NOTE 3)AC / DC
HOT / +
NEU / -
EARTH GROUNDTB1
TB2TO INSTRUMENTATION
OPERATING AT OR
LESS THAN 250VAC
RMS OR DC
(SEE NOTE 6)CIRCUIT 3
(SEE NOTE 3)1010X-9[S2] MODULE OR
1010XS2/DXS2 SENSOR
CABLE JUNCTION BOX
(SEE NOTE 4)191S2, 991S2, 992S2
OR 1011S2 SERIES
TRANSDUCERSTYPICAL PIPE
SECTION OR
1013S SPOOLTRANSDUCER CABLE
 $Z_o = 93$ OHMS NOMINAL
 $C = 44$ pfd / METER NOMINALCIRCUIT 1
(SEE NOTE 3)1 WHIT. 1
2 GRN. 2 UP
2 GRN. 2 DOWN1 WHIT. 1
2 GRN. 2 UP
2 GRN. 2 DOWNCHANNEL 2 (1010DX-S2
MODELS ONLY)

SEE NOTE 7

SEE SHT.2

1 1
2 2 TEMP. (MODELS WITH TEMP.
SENSOR OPTION ONLY)
3 3
4 4 (SEE NOTE 8)
5 5ENCLOSURE EARTH
GROUND

NOTES:

- WARNING: SUBSTITUTION WITH UNSPECIFIED COMPONENTS MAY IMPAIR NON-INCENDIVE CIRCUITS.
- USE 1010X MANUAL FOR OPERATION AND MAINTENANCE INSTRUCTIONS.
- CIRCUITS 1, 2, AND 3 MUST BE IN SEPARATE CONDUIT.
- MODULE PART NUMBER SUFFIX MAY VARY DEPENDING ON FLOW COMPUTER MODEL.
- SEE INSTALLATION WIRING DRAWING 1010XS2-7 OR 1010DXS2-7.
- ALL SIGNAL AND POWER WIRING MUST MEET APPLICABLE ELECTRICAL CODE FOR THE HAZARDOUS LOCATION.
- TRANSDUCER CABLE CONNECTIONS ARE VIA. EXTERNAL 'F' CONNECTORS ON MODELS EQUIPPED WITH SENSOR CABLE JUNCTION BOX.
- 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

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

1010XS2 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

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	F
SCALE: NONE	WT.	SHEET 1 OF 2

4

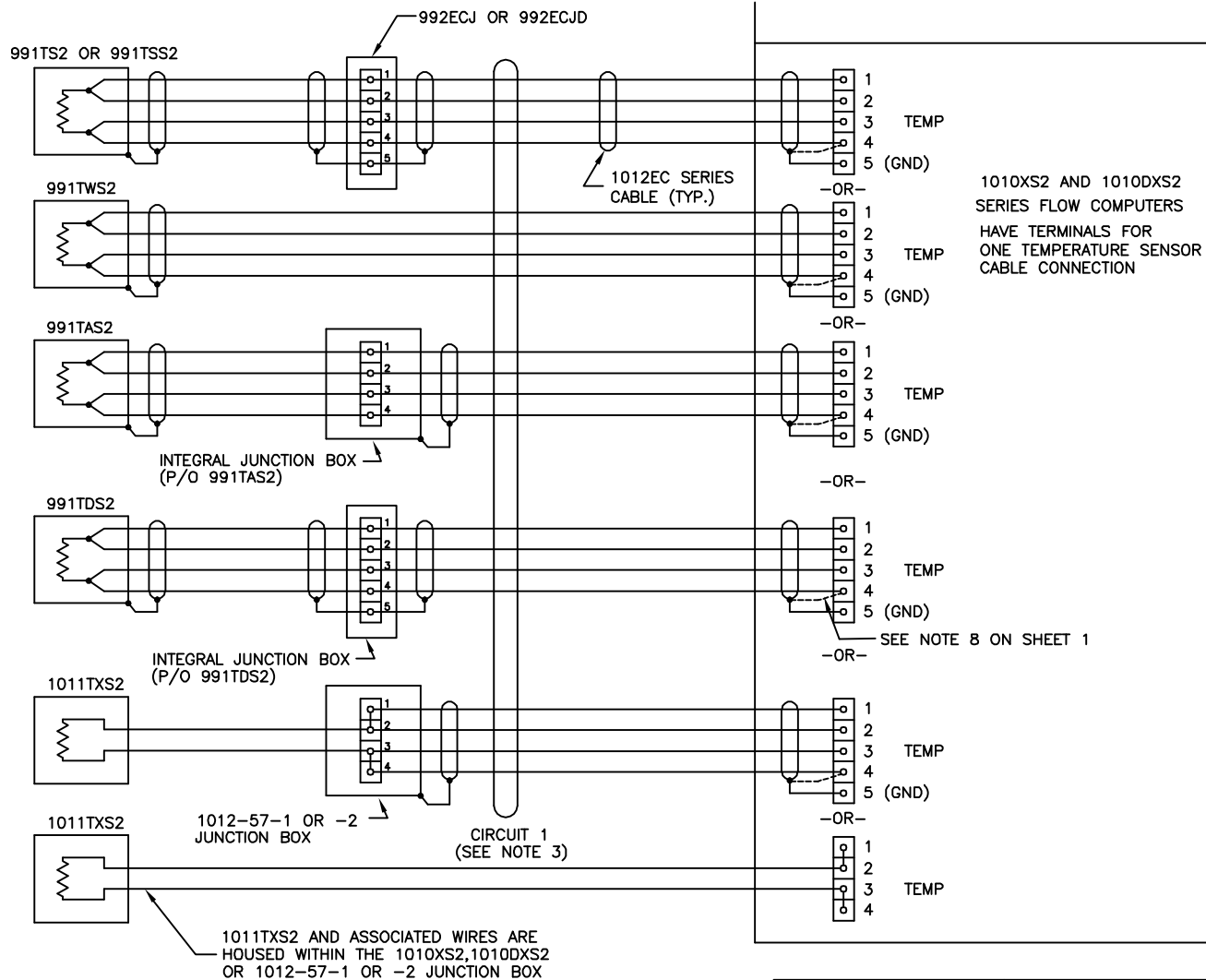
3

2

1

HAZARDOUS LOCATION

ZONE 2 OR CLASS I, II, DIV. 2 FOR GRPS. A, B, C, D, F, G

**1010XS2 OR 1010DXS2 SERIES FLOW COMPUTER
EXPLOSIONPROOF / FLAMEPROOF ENCLOSURE****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— DECIMALS— ANGLES—
+/- 0.015 XX+/-0.01 +/ -0.30°
XXX+/-0.005

CONTRACT NO.

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

CERTIFIED

DATE

CONTROLTRON
HAUPPAUGE, NY 11788

CONNECTION DIAGRAM1010 SYSTEM, EXPLOSIONPROOF/FLAMEPROOF
FLOW COMPUTER

SIZE

CODE IDENT NO.

C**21614****1010-342**

REV.

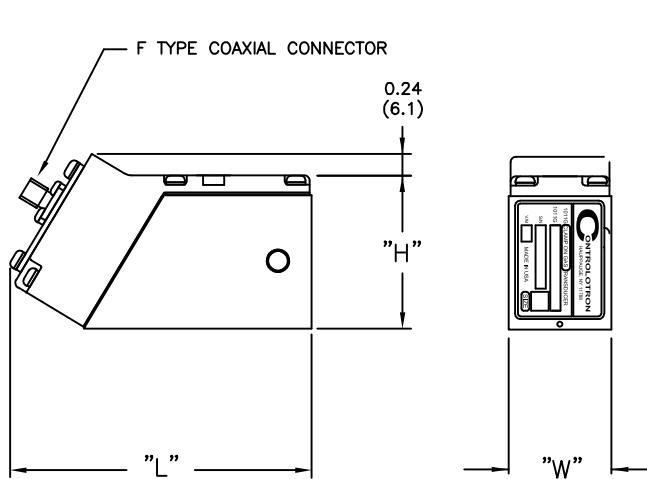
F

SCALE: NONE

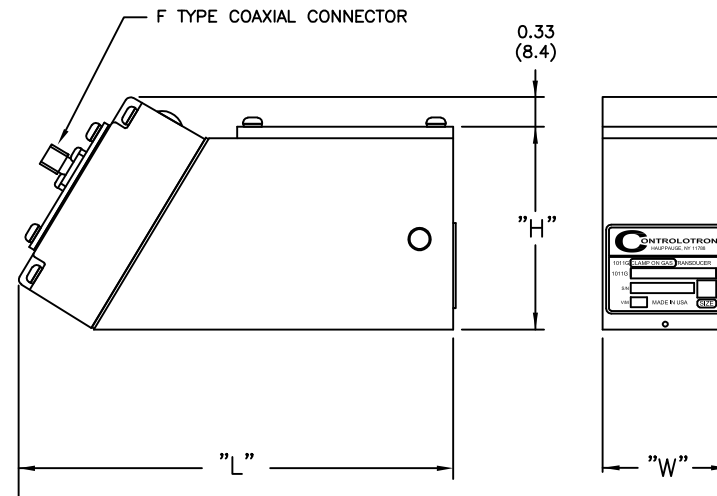
WT.

SHEET 2 OF 2

CN4737



SIZE "A" & "B"




SIZE "C" & "D"

TRANSDUCER PART NUMBER	L	W	H
1011GCS*-A3	2.2 (56)	1.1 (28)	1.7 (43)
1011GCS*-B1	2.6 (66)	1.1 (28)	1.7 (43)
1011GCS*-B2	3.3 (84)	1.1 (28)	1.7 (43)
1011GCS*-B3	3.9 (99)	1.4 (35)	2.2 (56)
1011GCS*-C1	4.8 (122)	1.4 (35)	2.2 (56)
1011GCS*-C2	6.3 (160)	2.0 (51)	3.3 (84)
1011GCS*-C3	7.2 (183)	2.0 (51)	3.3 (84)
1011GCS*-D1			
1011GCS*-D2			
1011GCS*-D3			
1011GCS*-D4			

* SEE NOTE 2

NOTES :

1. TRANSDUCERS ARE SUPPLIED IN MATCHED PAIRS, BOTH TRANSDUCERS OF A PAIR HAVE THE SAME SERIAL NUMBER WITH A & B SUFFIXES (eg. 1234A, 1234B).
2. COMPLETE TRANSDUCER PART NUMBER INCLUDES CODE FOR PRECISION LEVEL.

DO NOT SCALE THIS DRAWING		CONTRACT NO.		 OUTLINE DIMENSIONS 1011GCS SERIES PLASTIC BODY TRANSDUCERS	
UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES TOLERANCES ON-		DR. H.J. DATE 11/21/02 CHK. DATE ENG. DATE PROD. DATE APPD. DATE			
INCHES (MM) ± .1 ± 2		CERTIFIED DATE		SIZE C CODE IDENT NO. 21614	1011GCS - 8
				SCALE: NONE	WT.
				SHEET 1 OF 1	

4

3

2

1

D

D

C

C

B

B

A

A

SERIES 1012C CABLE ASSY'S

PATH 1 UP STREAM
TRANSDUCER CABLE CONNECTION

4.50(114mm) BEND ALLOWANCE

* "A"
SEE CHARTPATH 1 DOWN STREAM
TRANSDUCER CABLE CONNECTION

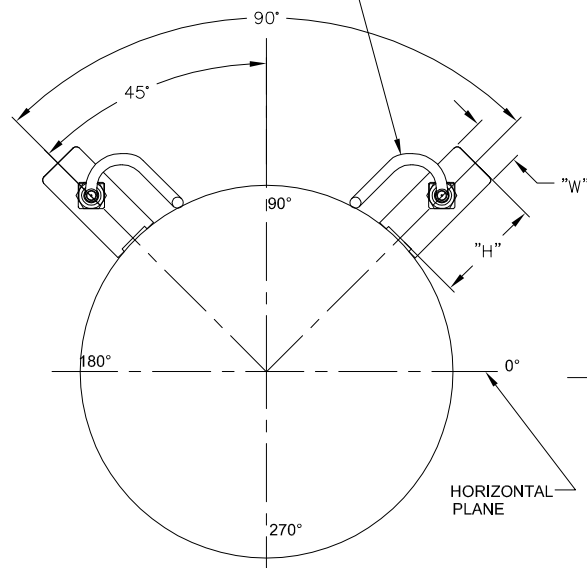
REMOVABLE TOP COVER

1012WS SERIES
WELD SEAL DUAL
ENCLOSURETO FLOW
COMPUTER

IDENTIFICATION LABEL

FLOW

CUSTOMER SUPPLIED PIPE

1012WSM-*
ORDERED SEPARATELY
SEE NOTE 2

REFLECT DUAL PATH SHOWN

SEE SHEET 3 FOR DIRECT MOUNT

WELD SEAL ASSY NUMBER	DIM "A"	INDEX RANGE ^Δ	DIM "B"	DIM "L"	DIM "H"	DIM "W"	XDCER	SPACER BAR
1012WS-D2**	29.5(749mm)MIN/85.0(2159mm)MAX	23-62	11.19 (284mm)	15.0 (381mm)	5.0 (127mm)	2.2 (55.9mm)	D	TWO PIECE BAR
1012WS-C2**	26.0(660mm)MIN/81.5(2070mm)MAX	23-47	9.50 (241mm)	13.0 (330mm)	3.5 (89mm)	1.6 (40.6mm)	C	SINGLE BAR
1012WS-E2**	29.5(749mm)MIN/85.0(2159mm)MAX	23-62	11.19 (284mm)	15.0 (381mm)	6.0 (152mm)	2.2 (55.9mm)	E	TWO PIECE BAR

^ΔSEE NOTE 3

DUAL ENCLOSURE

NOTES:

- FOR INSTALLATION PROCEDURE SEE 1012WS-2-7
- 1012WSM-* MOUNTING STRAP KITS ARE ORDERED TO MATCH PIPE SIZE. SEE 1012WSM-8
TWO MOUNTING STRAP KITS REQUIRED (INDEPENDENT OF NUMBER OF PATHS INSTALLED)
- DIMENSION "A" IS DETERMINED BY LTN . LTN IS DEPENDENT ON PIPE SIZE AND SOUND VELOCITY OF LIQUID.

DO NOT SCALE THIS DRAWING

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

CONTRACT NO.

DR M.KEENAN DATE 2/6/02

CHK _____ DATE _____

ENG _____ DATE _____

PROD _____ DATE _____

APPD _____ DATE _____

CERTIFIED

DATE

SIEMENSSiemens Energy & Automation, Inc.
Process Instrumentation Business Unit
CoC Ultrasonic Flow - Hauppauge, Long Island, NY 11788OUTLINE DRAWING
WELD SEAL CLAMP ON
TRANSDUCER ENCLOSURE

SIZE

C

CODE IDENT NO.

21614**1012WS-8**

REV.

G

SCALE: 1/4

WT.

SHEET 1 OF 3

4

3

2

1

CN#5277

4

3

2

1

D

D

C

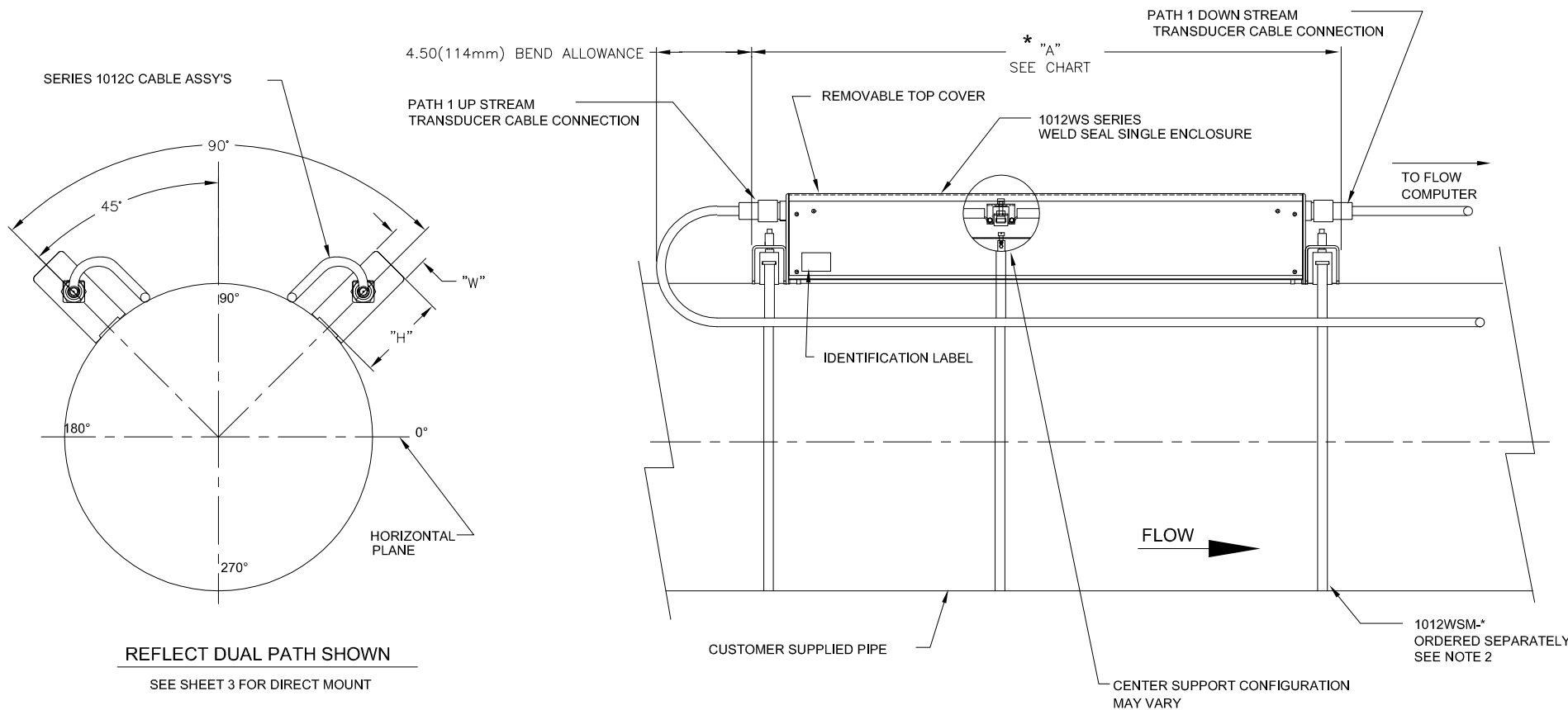
C

B

B

A

A



REFLECT DUAL PATH SHOWN

SEE SHEET 3 FOR DIRECT MOUNT

WELD SEAL ASSY NUMBER	INDEX RANGE ^Δ	DIM "A"	DIM "H"	DIM "W"	XDCER
1012WS-E1**	14-27	31.0(787mm)	6.0 (152mm)	2.2 (55.9mm)	E
1012WS-D1**	10-26	31.0(787mm)	6.0 (152mm)	2.2 (55.9mm)	D
1012WS-C1**	10-28	28.0(711mm)	4.6 (117mm)	1.6 (40.6mm)	C
1012WS-B1**	12-29	26.0(660mm)	3.5 (89mm)	1.3 (33mm)	B
1012WS-A1**	12-29	26.0(660mm)	3.5 (89mm)	1.3 (33mm)	A

^ΔSEE NOTE 3

SINGLE ENCLOSURE

NOTES:

- FOR INSTALLATION PROCEDURE SEE 1012WS-1-7
- 1012WSM-* MOUNTING STRAP ASSEMBLIES ARE ORDERED TO MATCH PIPE SIZE. SEE 1012WSM-8
TWO MOUNTING STRAPS KITS REQUIRED (INDEPENDENT OF NUMBER OF PATHS INSTALLED)
- LTN IS DEPENDENT ON PIPE SIZE AND SOUND VELOCITY OF FLUID.

DO NOT SCALE THIS DRAWING UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES (MM) TOLERANCES ON— INCHES (MM) ± .1 ± 2		CONTRACT NO. DR <u>M.KEENAN</u> DATE <u>2/6/02</u> 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 DRAWING WELD SEAL CLAMP ON TRANSDUCER ENCLOSURE		SIZE C	CODE IDENT NO. 21614
		1012WS-8		REV. G	
		SCALE: 1/4		WT.	SHEET 2 OF 3

4

3

2

1

CN#5277

4

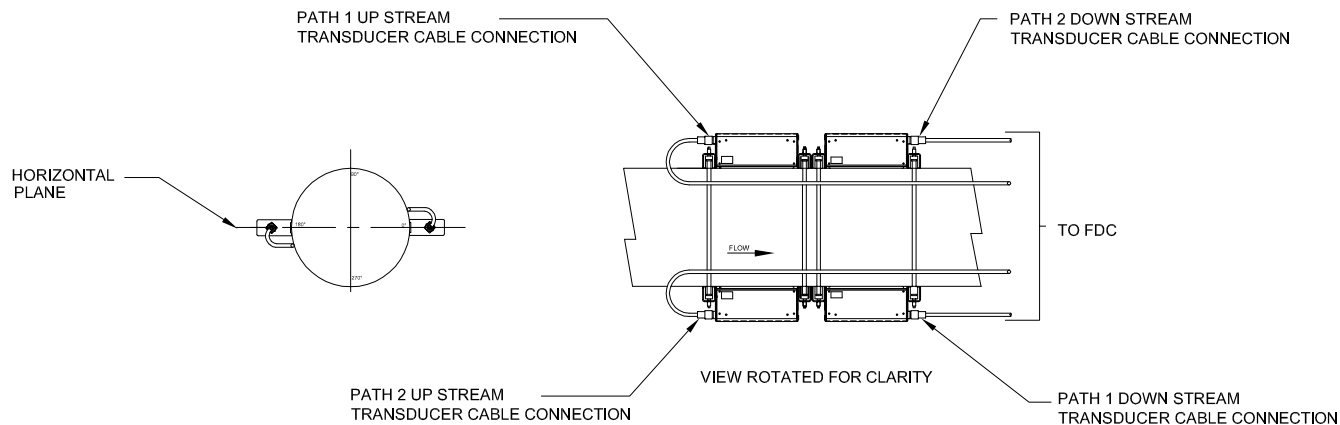
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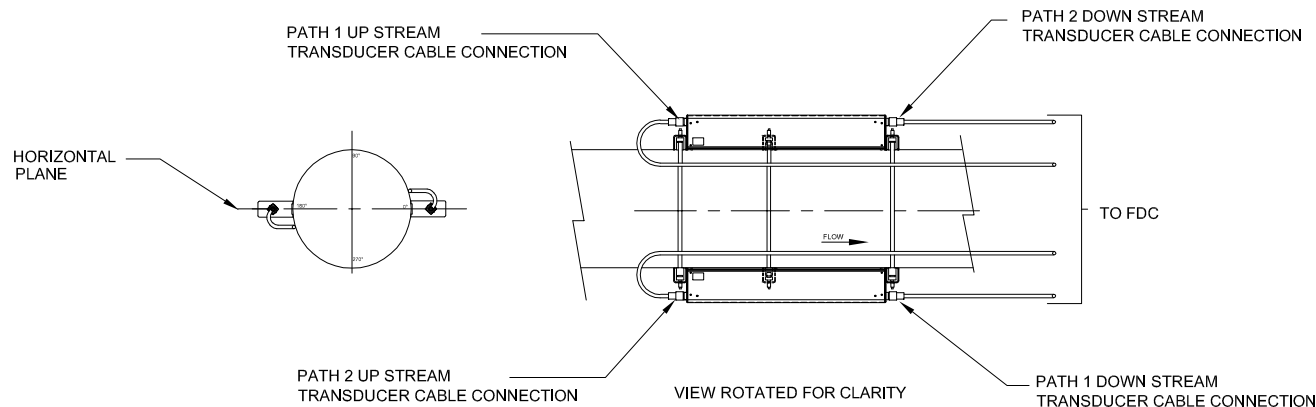
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DIRECT MOUNT DUAL PATH DUAL ENCLOSURE

C

C



DIRECT MOUNT DUAL PATH SINGLE ENCLOSURE

B

B

A

A

DO NOT SCALE THIS DRAWING UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES (MM) TOLERANCES ON— INCHES (MM) ± .1 ± 2	CONTRACT NO.		SIEMENS Siemens Energy & Automation, Inc. Process Instrumentation Business Unit CoC Ultrasonic Flow - Hauppauge, Long Island, NY 11788			
	DR <u>M.KEENAN</u>	DATE <u>2/6/02</u>	OUTLINE DRAWING WELD SEAL CLAMP ON TRANSDUCER ENCLOSURE			
	CHK _____	DATE _____				
	ENG _____	DATE _____				
	PROD _____	DATE _____	SIZE C	CODE IDENT NO. 21614	1012WS-8	REV. G
	APPD _____	DATE _____	SCALE: 1/4			WT.
	CERTIFIED _____					
	DATE _____					

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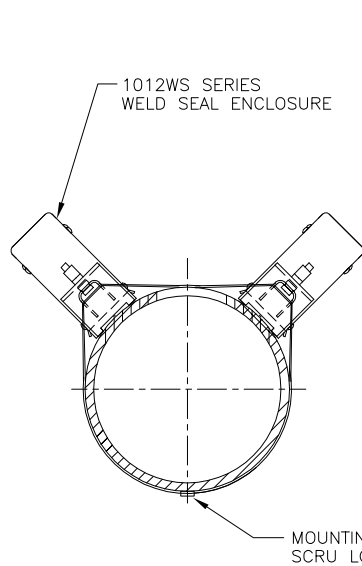
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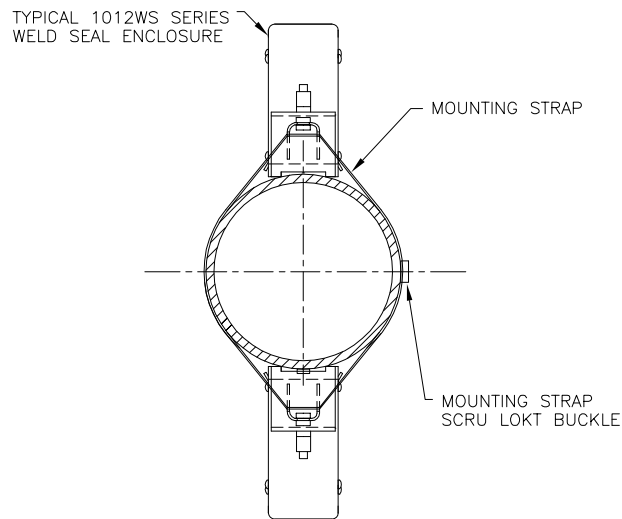
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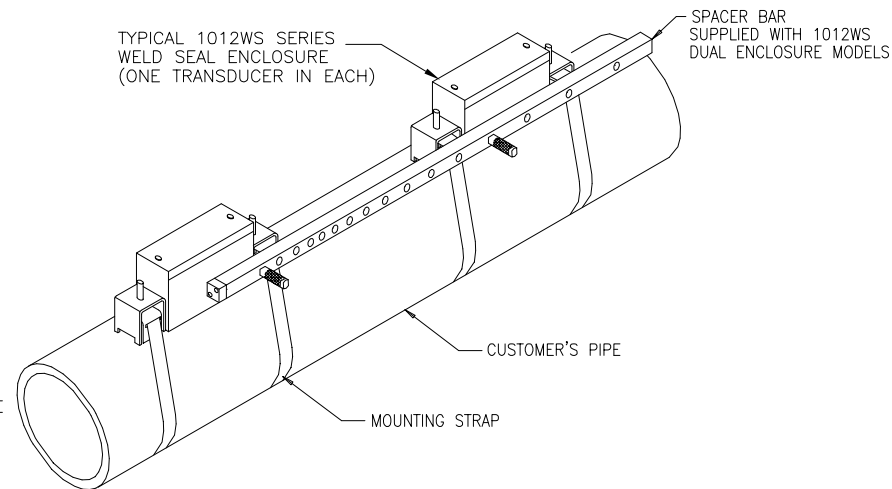
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DUAL BEAM REFLECT

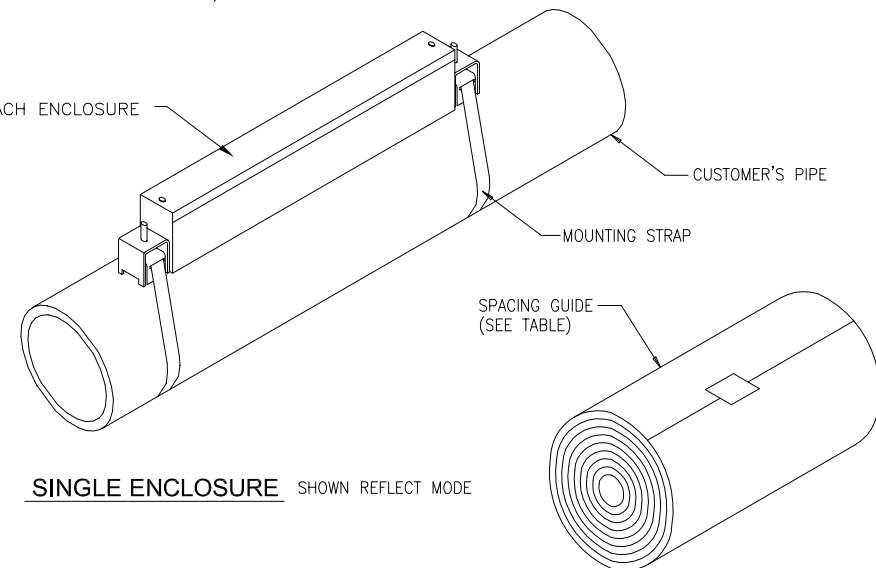


DUAL BEAM DIRECT (DIRECT MOUNTING IS ALWAYS DUAL BEAM)



DUAL ENCLOSURE SHOWN REFLECT MODE (TWO STRAP KITS REQUIRED)

TWO TRANSDUCERS IN EACH ENCLOSURE



SINGLE ENCLOSURE SHOWN REFLECT MODE

NOTES:

1. MOUNTING STRAP KITS ARE TO FASTEN WELD SEAL ENCLOSURES TO THE PIPE.
2. SEE 1012WS-7 INSTALLATION PROCEDURE
3. SEE 1012WS-8 ENCLOSURE OUTLINE DRAWING

STRAP MTG. KIT PART No.	PIPE DIA.	BAND SIZE (QTY)	SPACING GUIDE P/N (DESCRIPTION)
1012WSM-1	2"-13" (50,330)	15' (4.57m) OF 1/2"(13mm) BAND AND (2) FASTENERS	1012-145-1 (2" x 45") (51 x 1143)
1012WSM-2	13"-24" (330,609)	27' (8.23m) OF 1/2"(13mm) BAND AND (2) FASTENERS	1012-145-2 (4" x 81") (102 x 2057)
1012WSM-3	24"-48" (609,1,219)	52' (15.9m) OF 1/2"(13mm) BAND AND (2) FASTENERS	1012-145-3 (4" x 155") (102 x 3937)
1012WSM-4	48"-60" (1,219,1,524)	64' (19.5m) OF 1/2"(13mm) BAND AND (2) FASTENERS	1012-145-4 (6" x 196") (152 x 4978)
1012WSM-5	60"-84" (1,524,2,134)	90' (27.4m) OF 1/2"(13mm) BAND (2 PCS., x 45'(13.7M) EACH) AND (2) FASTENERS	NOT SUPPLIED
1012WSM-6	84"-120" (2,134,3,048)	130' (39.6m) OF 1/2"(13mm) BAND (2 PCS., x 65'(19.8M) EACH) AND (2) FASTENERS	NOT SUPPLIED

DO NOT SCALE THIS DRAWING

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

INCHES	(MM)
± .1	± 2

CONTRACT NO.

DR M.KEENAN DATE 1/21/02

CHK _____ DATE _____

ENG _____ DATE _____

PROD _____ DATE _____

APPO _____ DATE _____

CERTIFIED

DATE

SIEMENS

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

INSTALLATION / OUTLINE ADJUSTABLE MOUNTING STRAP

SIZE
CCODE IDENT NO.
21614

1012WSM - 8

REV.
D

SCALE: NONE

WT.

SHEET 1 OF 1

CN#5277

Installation Instructions



1012WS-1-7

Weld Seal Installation Instructions

Inspection Proc	Test Proc	Prep By	Date	Approval	Initial	Date
NA	NA	G VanPopering	10/29/01	Engineering:	DR	05/04/05
Covered Assemblies: 1012WS <u>Single Enclosure</u> (Reflect and Direct-X Modes)				Valid By:	IR	05/04/05

Change Log

Document Rev	Change Description	Date	Change By	Approved
A/-	Original Release	04/18/02	GV	MF
A/1	(CN4763) Added reference to Fixed Spacer, CC110, Clean Gasket	06/24/03	GV	MF
A/2	(CN5000) Added reference to proper unpacking and disassembly	04/25/05	GV	MF
B	(CN5157) Changed LOGO to Siemens. Updated Fig 3-B	08/14/06	GV	MF

Tools Required

1) Hex Key Set	S.A.E. 5/32 and 1/8 In.
2) Phillips Head Screwdriver	#2
3) 7/16" Socket	Deep throat
4) 7/16" Wrench	Open end
5) Razor Blade	
6) Flat Blade screwdriver	
7) Torque limiting driver/wrench	in/lbs
8) Grease Pencil	For marking pipe

Compounds Used

1) CC128	Super Lube
2) CC110	G662 Silicone Grease

General Notes

Pre Assembly Note:

- Using the installation menu and the procedure outlined in the FDC Field Manual, confirm that you have the appropriate transducers and Enclosure Set for operation on the chosen pipe.
- Select mounting location
 - Choose location that remains full at zero flow.
 - Where possible, locate enclosure ass'y 10 pipe diameters or more from elbow or valve to ensure fully developed and stable flow profile.
 - On horizontal pipe sections, select horizontal plane to avoid sediment or gas blockage of ultrasonic beam.
 - Multiple beam applications see drawing 1012WS-8 and/or **Fig 1-1** of this procedure.
- Prepare pipe for enclosure mounting.
 - Remove grit, corrosion, coating or heavy paint. (Avoid grinding which could cause distortion of the pipe surface)
 - Clean and degrease surface.
 - Do not mount over frost.
 - Do not mount on the seam of the pipe.
 - Locally, smooth the pipe surface to accept the transducers. Use the abrasive pad provided.

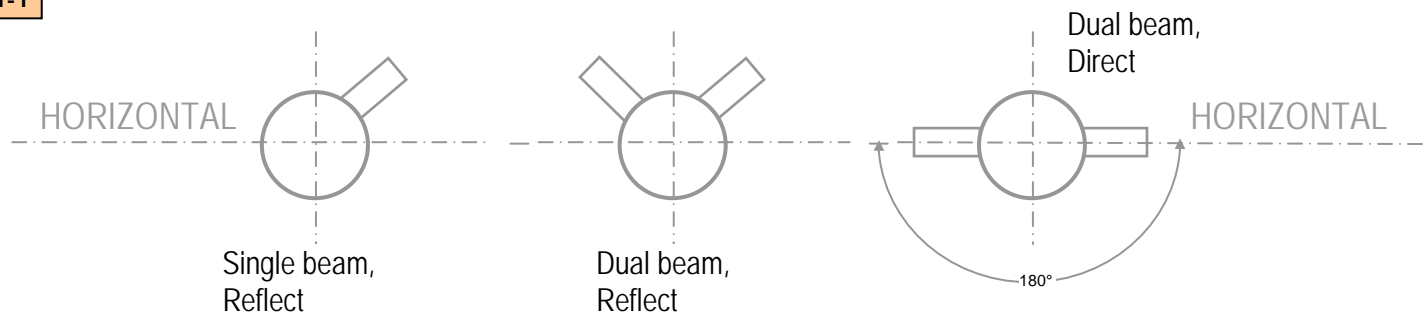
(Note: It is recommended two people be available to perform this procedure.)

SIEMENS

1012WS-1-7

Page 1 of 9

Fig 1-1



Mount above horizontal plane on pipe. Avoid mounting directly on top and bottom of horizontal pipes.

Step 1: Mounting the straps.

- Unpack and disassemble the enclosure. Remove the *Covers*. Remove the *Keepers*. Remove the *Clamp assembly*. Loosen the transducer *clamping screw*. Retain all hardware for future use. **See Fig 1-1, 1-2**
- Determine the correct spacing required as outlined in the FDC Menu and Field Manual.
- Place the assembly on the pipe and mark the pipe at each strap location using chalk or a grease pencil. **See Fig 1-3.**
- Prepare straps for mounting. Cut strap to length. Strap length should be twice the pipe circumference plus 6 inches. Orient all hardware to the outside of the radius. Remove *setscrew* from *Screw-Lock Buckle*. Retain for later use. **See Fig 1-4** {Note: For Reflect mode, install one keeper for each path (i.e. Dual Beam Reflect will have two keepers at each strap location). For Direct-X mode install two keepers at each strap location.}
- Mount the straps at the previously marked locations. Loop once around the pipe and feed the open end of the strap through the *Screw-Lock Buckle* and the *Keeper/s* as shown in Fig 1-5. Pull the loose end to remove most of the slack. Continue with another loop around the pipe and through the *Screw-Lock Buckle* a second time. Pull tight to remove slack.

Continue to Step 1-R for mounting in Reflect Mode.
Continue to Step 1-D for mounting in Direct-X Mode.

Fig 1-1

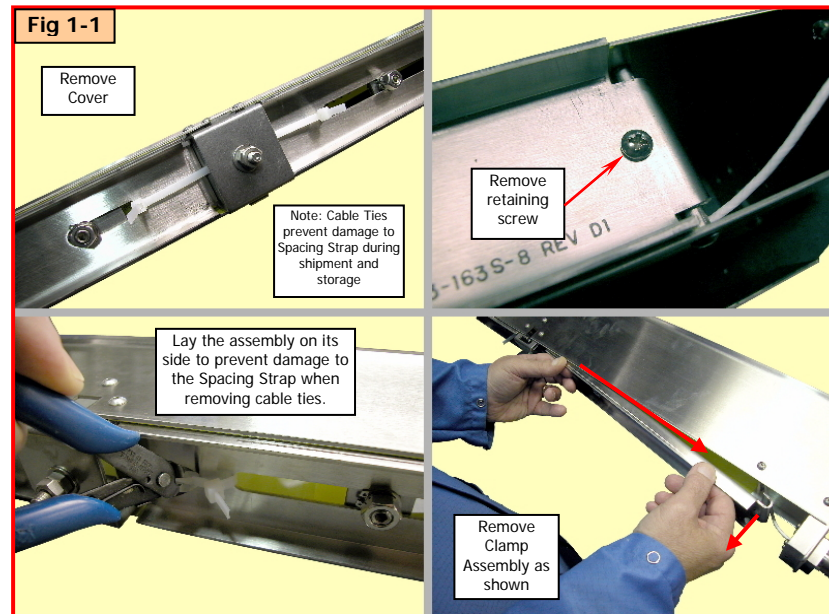


Fig 1-2

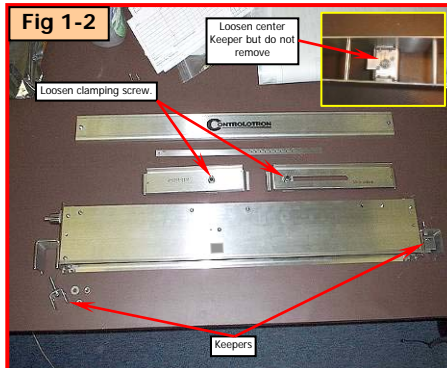


Fig 1-3

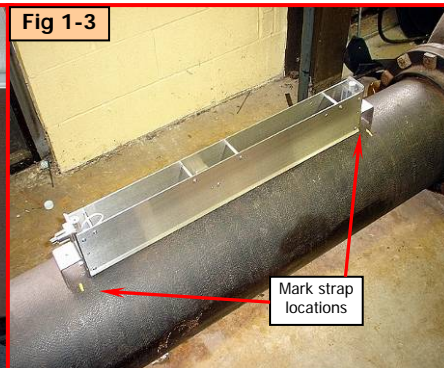


Fig 1-4

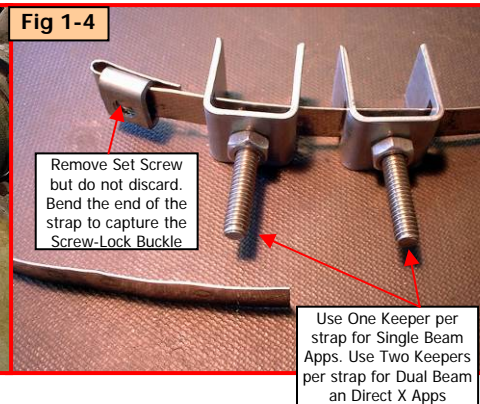
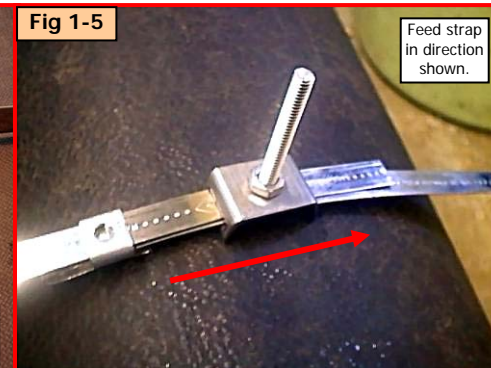


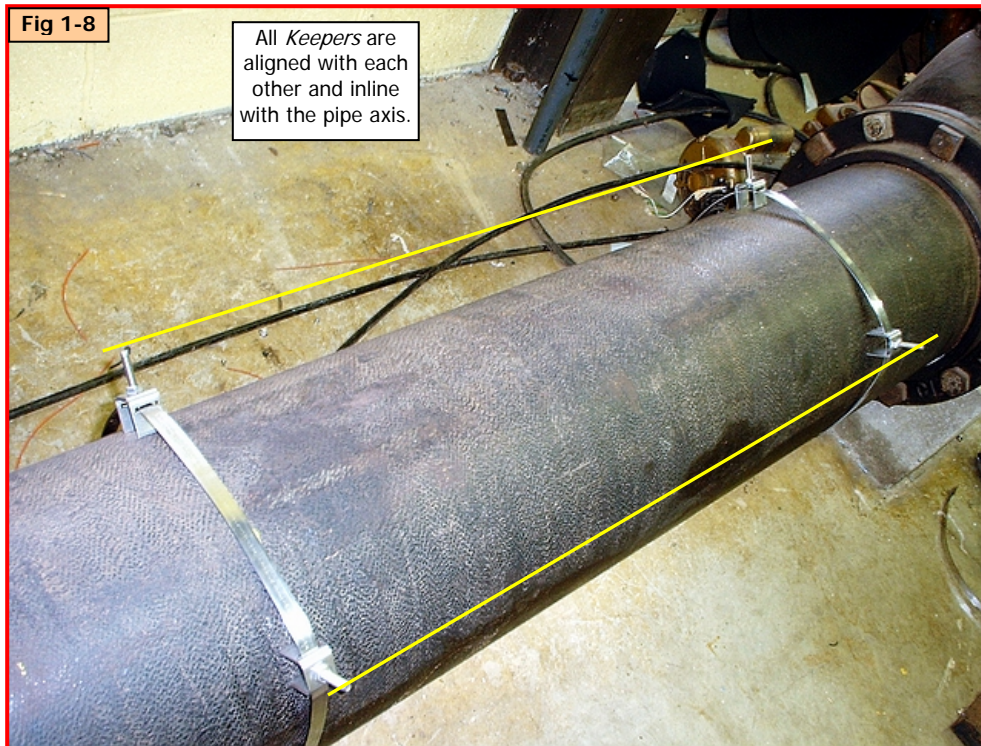
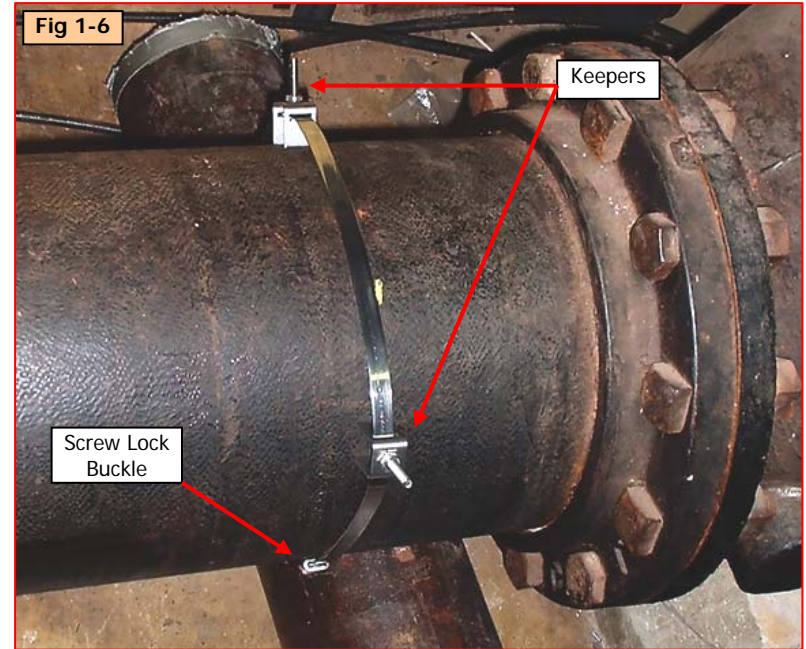
Fig 1-5



Step 1-R: Mounting the Straps For Reflect Mode

- A. Determine the mounting plane of the path/s
See Fig 1-1 and refer to General Notes on page 1 of 8. Take up the slack in the strap and locate the *keeper/s* at the selected plane/s. Locate the *Screw-Lock Buckle* 180 degrees from nearest *Keeper* or best location. **See Fig 1-6.**
- B. Bend the loose end of the strap to prevent it from loosening while you install and tighten the *setscrew* you retained from Step 1-C. **See Fig 1-7.**
- C. **Fig 1-8** shows the final results of Step 1-R.

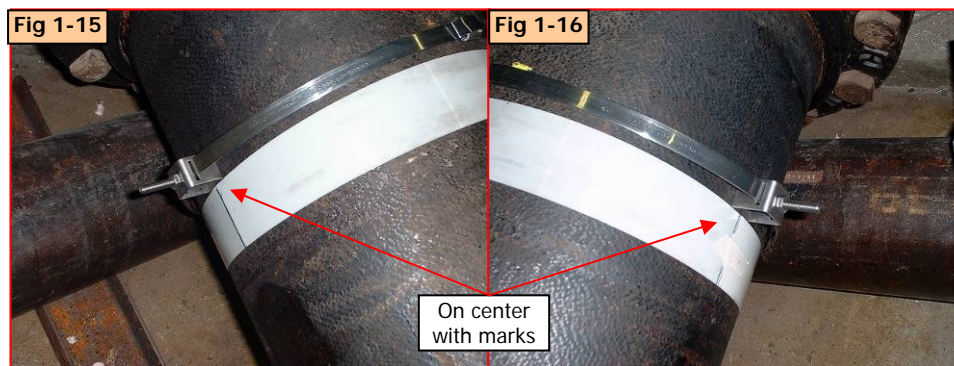
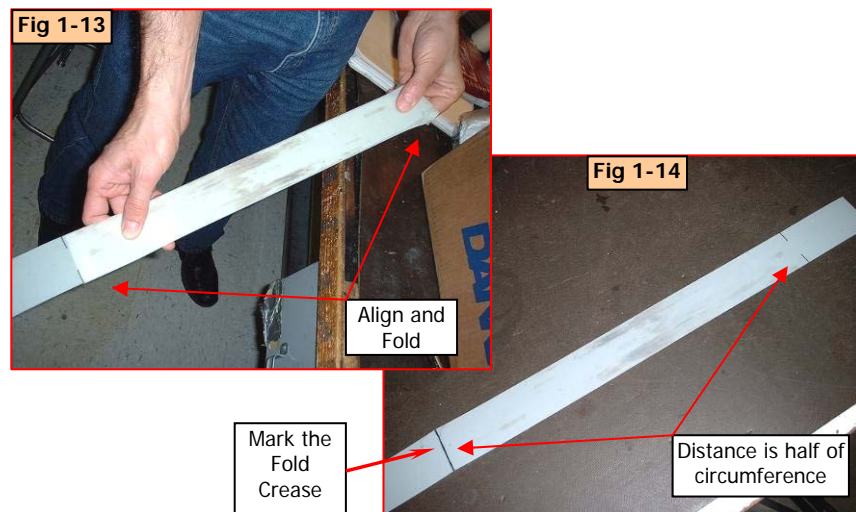
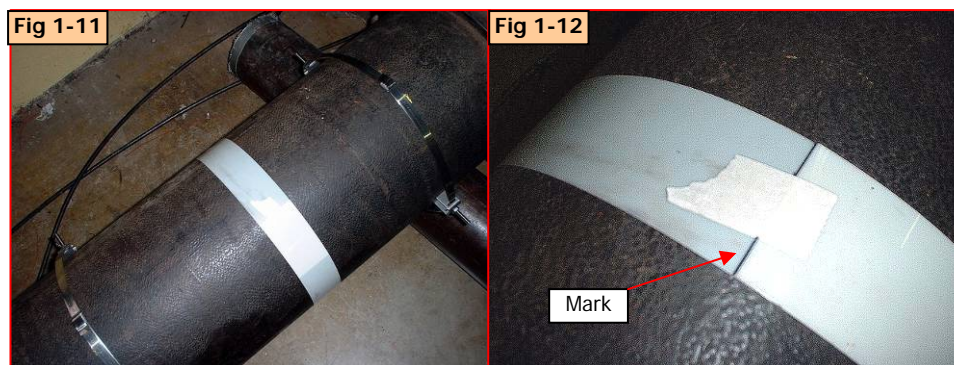
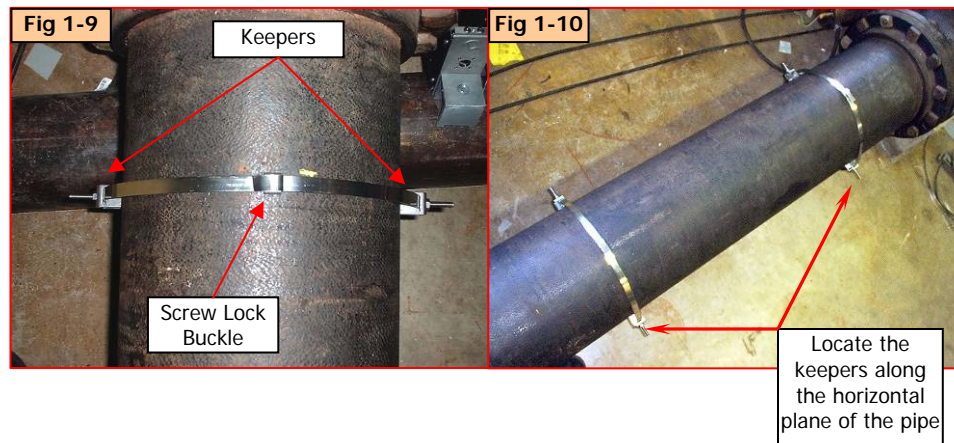
Continue to Step 2.



Step 1-D: Mounting the Straps for Direct-X Mode

- A. Roughly Locate the *Keepers* on the horizontal plane of the pipe. See Fig 1-9 and 1-10.
- B. Using the Mylar material provided, make a template. Tightly wrap the Mylar strip around the pipe and overlap the ends. Cut off any excess. Temporarily tape the end together. Mark the template with a marker where the ends overlap. See Fig 1-11 and -1-12.
- C. Remove the template. Align the mark with the other end of the template and fold the Mylar while maintaining alignment. Mark the fold crease with a marker. (Note: If you lay the template out on a table you will observe that the distance between marks is half the actual circumference of the pipe). See Fig 1-13 and 1-14.
- D. Reinstall the template. Locate it next to one of the most outer strap locations. Align the marks of the template to the horizontal plane of the pipe. Now align the *keepers*, on center, with the marks on the template. See Fig 1-15 and 1-16. (Note: It is important to maintain alignment of this set of keepers throughout the remaining process. This is the reference point when mounting the housings and aligning and manipulating the remaining Keepers.)

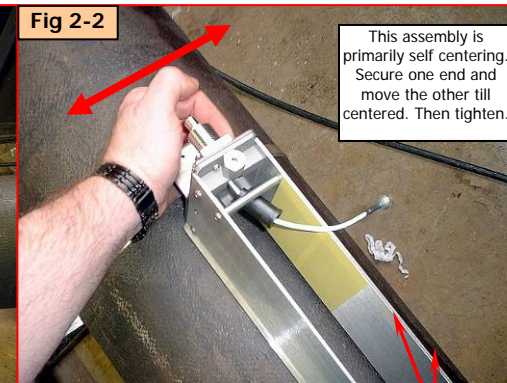
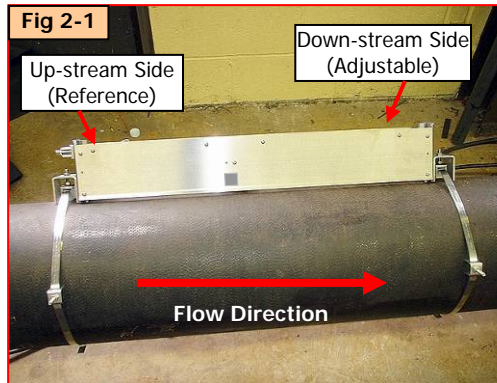
Continue to Step 2.



Step 2: Mounting the Enclosure

- A. Place the *Enclosure assembly* over the *Keepers* and slip into place. You may be required to align and manipulate the *Keeper studs* into their respective holes. Be aware of Up-stream vs. Down-stream. **See Fig 2-1** (Note: When mounting Direct-X Mode, maintain alignment of *Keepers* as outlined in step "1-D" section "H". Orient the enclosures so the fixed transducers of both paths are located at the same end of the pipe.)
- B. Install retaining nuts at every Keeper location. Tighten ONE end, just enough to keep assembly from moving. Rock the other end, perpendicular to the pipe, to allow the assembly to find center. Tighten nut just enough to keep assembly from moving. **See Fig 2-2** (Note: When mounting Direct-X Mode, maintain alignment of *Keepers* as outlined in step "1-D" section "H".)
- C. Visually verify the assembly to be in line with the pipe axis by comparing the top edge of the assembly to the linear axis of the pipe. Adjust if necessary. **See Fig 2-2**
- D. Tighten all retaining nuts just enough to keep assembly from moving.
- E. Repeat steps **A** through **E** for remaining paths.
- F. Fully tighten all retaining nuts to approximately 20 – 25 in/lbs. **Lock in place with second nut.**
- G. When you have mounted the enclosures and fully tightened the retaining nuts you may now install the middle strap. Simply feed the strap through the center Keeper. Wrap around the pipe twice and tighten as you did the previous straps. See Fig 2-3 and 2-4

Continue to Step 3



Step 3: Install the Transducers.

- A. Apply a thin bead of CC128 to the bottom side of the *transducers* along their center length. **See Fig 3-1.**
- B. **Visually confirm the presence of insulating tape on the inside walls of the enclosure.** Insert the Fixed *Transducer* into the *Enclosure* at the Reference location. Don't land the transducer on the pipe at this time. Install the cable. **See Fig 3-2 through 3-4.** Fill *connector* with CC110 grease prior to connection. Backfill the *protective boot* and slide into place. (Note: Be careful not to catch or compromise the insulating tape while inserting the transducer.)
- C. Land the transducer onto pipe. Butt the front face of the transducer against the center support. **See Fig 3-5.** Secure the spacing strap as shown in **Fig 3-6.** Lift up on spring clip to install.

(Note that on some assemblies, the spacing strap will be fixed to the center support. In this case the Reference transducer is adjustable and the spacing strap is used to space both the reference and the moveable transducers. **See Fig 3-A**) (Note: If this is a Clamp-on Gas application using size C1 or D1 transducers, use "ALT" hole to position the Reference Transducer. **See Fig 3-B**)

(Note: For direct mode, each enclosure will have one transducer from each opposing set. {I.E. The enclosure at path 1 will have, mounted in the Up-stream location, the "A" transducer from set "1" and mounted in the Down-stream location will be transducer "B" from set "2". The enclosure at Path 2 will have, mounted in the Up-stream location, the "A" transducer from set "2" and mounted in the Down-stream location will be transducer "B" from set "1"}))

Continued on next page...

Fig 3-1



Fig 3-2



Fig 3-3



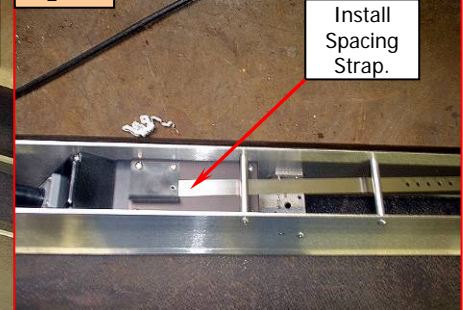
Fig 3-4



Fig 3-5



Fig 3-6



Step 3: Install the Transducers.

- D. Install *bracket* at outside hinge. Bracket hooks over the hinge. See Fig 3-7.
- E. Drop *bracket* in place. Slide forward to latch. Secure *bracket* by installing screw at hinged location. Tighten Clamping Screw to secure transducer. Where applicable, locate clamping screw over index pin of transducer. (Torque to 15 in/lbs) Secure with hex nut. See Fig 3-8.
- F. Install the adjustable transducer into the enclosure. Slide the transducer into the enclosure but do not land onto pipe. Install the cable. Install the spacing strap at the desired Number Index. Land the transducer to the pipe. See Fig 3-9 and 3-10.
- G. Secure the bracket and slide the Clamping Screw assembly into place. Where applicable, locate the Clamping Screw over index pin on the transducer. Tighten clamping screw to 15 in/lbs to secure the transducer. See Fig 3-11.
- H. Verify LTN by comparing the calculated value from the FDC to the actual distance from transducer front face to transducer front face. (Transducer edge is visible at bottom of side plates.)
- I. Complete the make-up process and verify the operation of the installation before continuing to final step. Adjustment of transducer spacing may be required.

Fig 3-7

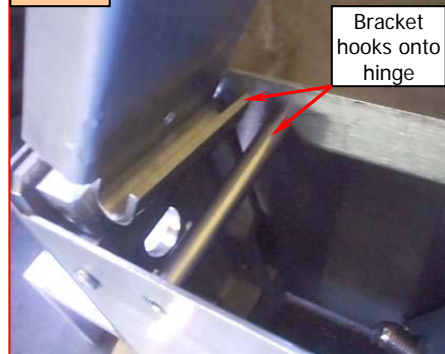


Fig 3-8

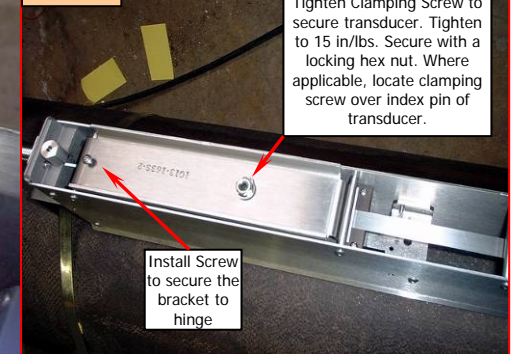


Fig 3-9



Fig 3-10



Fig 3-11



Fig 3-A

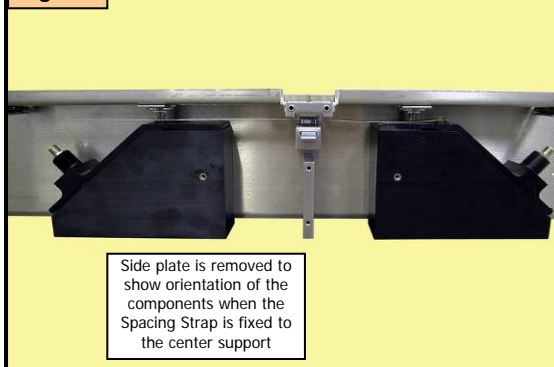
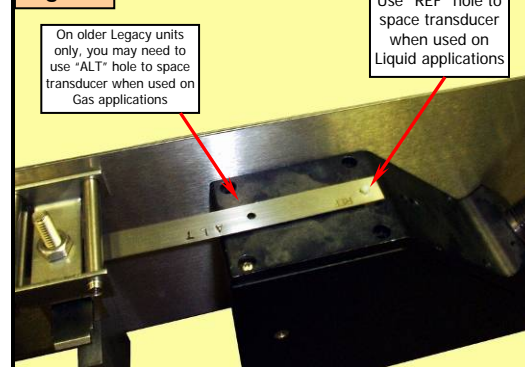


Fig 3-B





Step 4: (Optional) Weld assembly to pipe. If you desire, you may weld the assembly to the pipe.

Considerations:

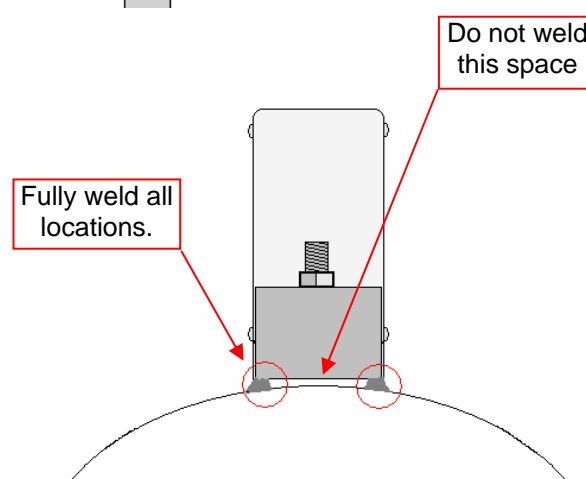
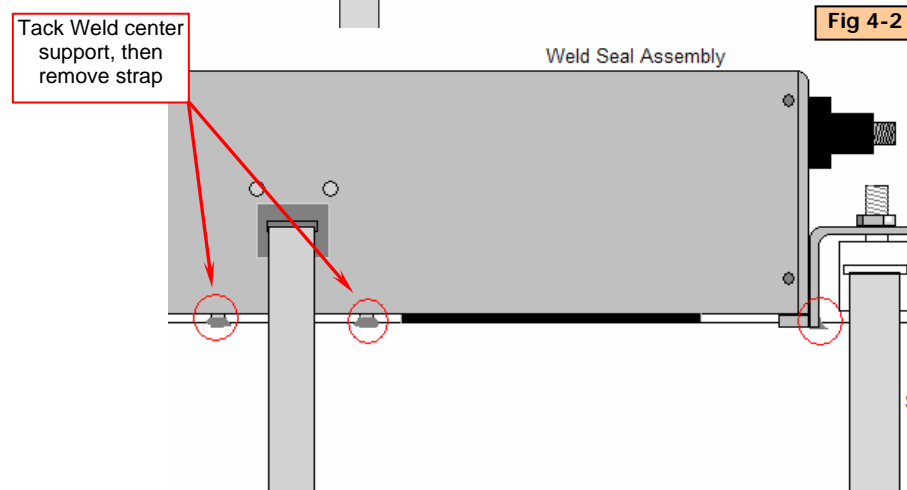
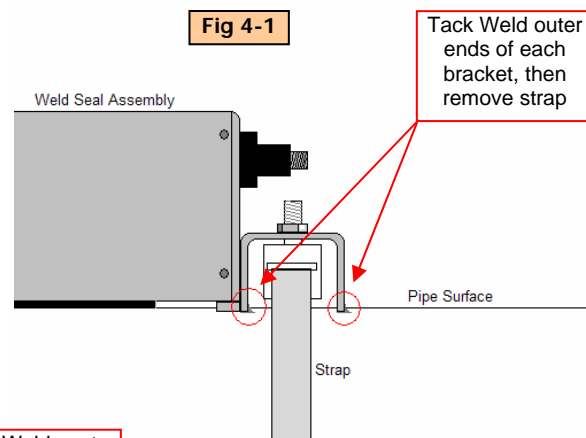
1. It is recommended you remove the transducers prior to welding.
2. Removal of the side plates may be required in some situations where the gap between the pipe and the enclosure is diminished due to a large pipe diameter. Retain all hardware.

Procedure:

- A. While strap is in place, Tack Weld at the outer ends of each bracket as shown in **Fig 4-1**.
- B. Tack weld the center support. **See Fig 4-2**
- C. **IMPORTANT:** Do not weld the center of the bracket. The space is necessary for maintaining proper operation.
- D. Remove the straps and fully weld all locations. **See Fig 4-3.**
- E. Reassemble if side plates were removed.
- F. Reinstall transducers per Step 3.

Note: Bracket Material is Type 316 Stainless Steel, Suitable for welding to both Stainless Steel and Carbon Steel pipes.

Continue to Step 5



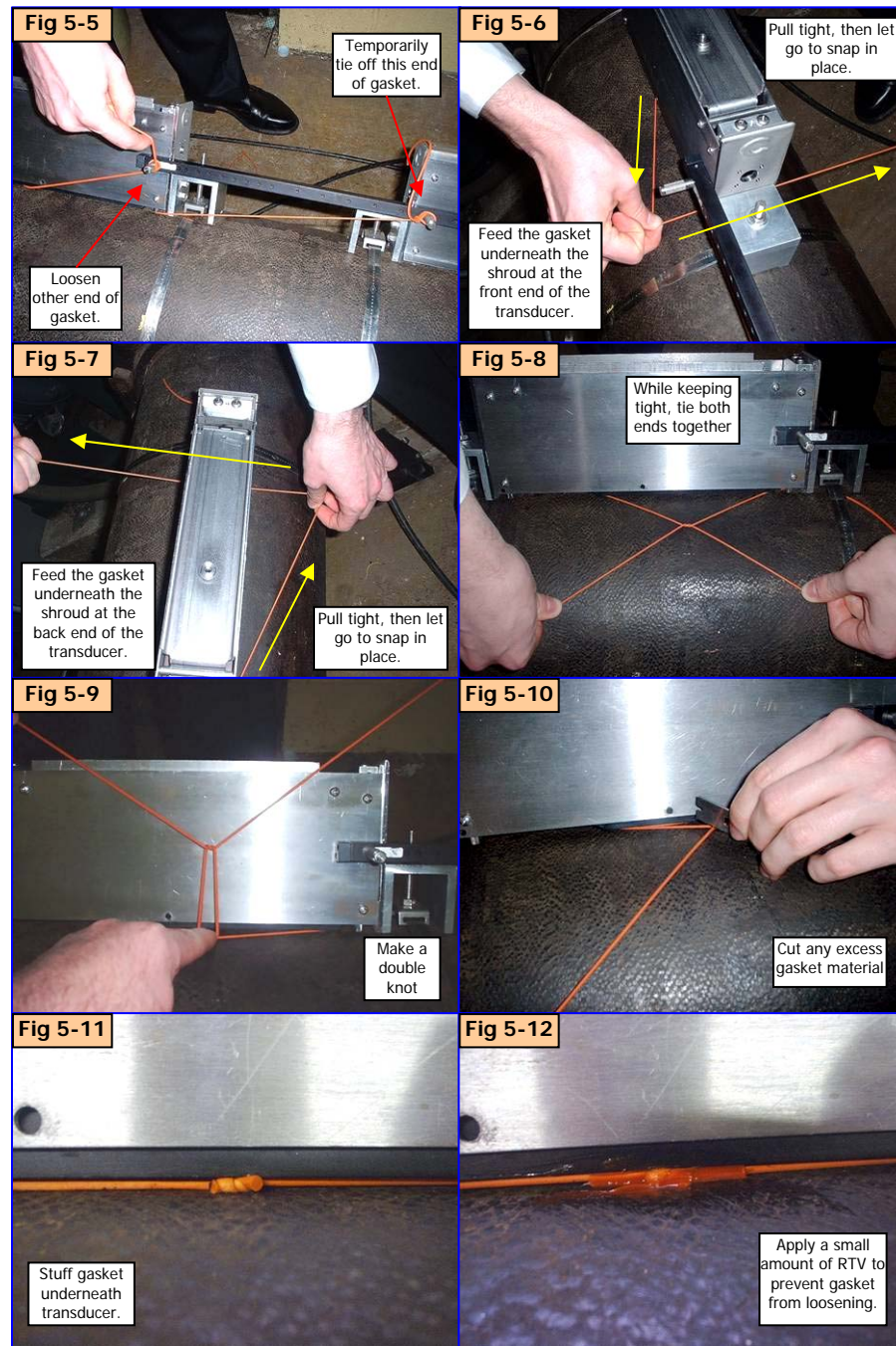
Step 5: Install Gasket Seal. Two people may be required to perform this step.

The procedure below is a recommended process. Any suitable method for achieving a snug inner ring is acceptable.

Follow **Fig's 5-1 to 5-12**. Surfaces must be clean and dry. Clean away any excess coupling compound. Do not allow any slack to occur in the gasket throughout this step. It must remain tight at all times. **Gasket Must Remain Clean and Free of Grease at all times.** If the gasket should become contaminated, remove and use acetone to clean.

The Idea here is to seal the exposed gap between the transducers footprint and the pipe. Wrap the transducer footprint, twice, with the O-ring gasket material provided, then tie to secure in place. The inner layer performs the function of seal. The second outer layer protects and backs up the first.

Install the *Housing Covers* and remove the *spacer bar* to complete this procedure.



Installation Instructions



1012WS-2-7

Weld Seal Installation Instructions

Inspection Proc	Test Proc	Prep By	Date	Approval	Initial	Date
NA	NA	G VanPopering	10/29/01	Engineering:	DR	03/22/06
Covered Assemblies: 1012WS <u>Dual Enclosure</u> (Reflect and Direct-X Modes)				Valid By:	N/A	N/A

Change Log

Document Rev	Change Description	Date	Change By	Approved
A/-	Original Release		GV	
A/1	Added provisions for welding to pipe (Page 8 Step 5)		GV	
A/2	Fixed Typo Step 2 Paragraph A,C (Notes)	03/16/06	GV	DR
B	(CN5157) Changed LOGO to Siemens	08/14/06	GV	MF

Tools Required

1) Hex Key Set	S.A.E. 5/32 and 1/8 In.
2) Phillips Head Screwdriver	#2
3) 7/16" Socket	Deep throat
4) 7/16" Wrench	Open end
5) Razor Blade	
6) Flat Blade screwdriver	
7) Torque limiting driver/wrench	in/lbs

Compounds Used

1) CC128	Super Lube
2) CC110	G662 Silicone Grease

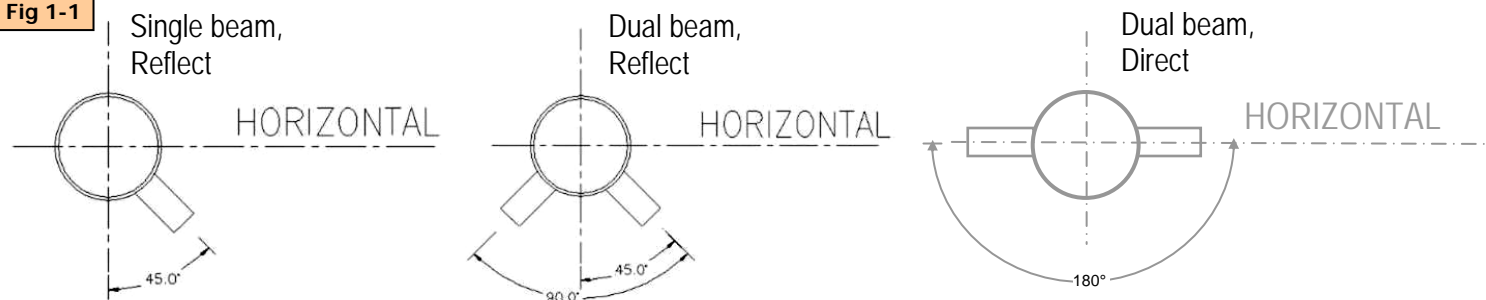
General Notes

Pre Assembly Note:

- Using the installation menu and the procedure outlined in the FDC Field Manual, confirm that you have the appropriate transducers and Enclosure Set for operation on the chosen pipe.
- Select mounting location
 - Choose location that remains full at zero flow.
 - Where possible, locate enclosure ass'y 10 pipe diameters or more from elbow or valve to ensure fully developed and stable flow profile.
 - On horizontal pipe sections, select horizontal plane to avoid sediment or gas blockage of ultrasonic beam.
 - Multiple beam applications see drawing 1012WS-8 and/or **Fig 1-1** of this procedure.
- Prepare pipe for enclosure mounting.
 - Remove grit, corrosion, coating or heavy paint. (Avoid grinding which could cause distortion of the pipe surface)
 - Clean and degrease surface.
 - Do not mount over frost.
 - Do not mount on the seam of the pipe.
 - Locally, smooth the pipe surface to accept the transducers. Use the abrasive pad provided.

(Note: It is recommended two people be available to perform this procedure.)

Fig 1-1



Step 1: Mounting the straps.

- Disassemble the enclosure. Remove the *Covers*. Remove the *Keepers*. Remove the *Clamping Bracket*. Loosen the transducer *clamping screw*. Retain all hardware for future use. **See Fig 1-2A**
- Determine the correct spacing required as outlined in the FDC Menu and Field Manual. Lay out the parts on a bench or table and install the spacer bar using the FDC Calculated spacing index. **See Fig 1-2B.**
- Place the assembly on the pipe and mark the pipe at each strap location using chalk or a grease pencil. **See Fig 1-3.**
- Prepare straps for mounting. Cut strap to length. Strap length should be twice the pipe circumference plus 6 inches. Orient all hardware to the outside of the radius. Remove *setscrew* from *Screw-Lock Buckle*. Retain for later use. **See Fig 1-4** {Note: For Reflect mode, install one *keeper* for each path (i.e. Dual Beam Reflect will have two *keepers* at each strap location). For Direct-X mode install two *keepers* at each strap location.}
- Mount the straps at the previously marked locations. Loop once around the pipe and feed the open end of the strap through the *Screw-Lock Buckle* and the *Keeper/s* as shown in Fig 1-5. Pull the loose end to remove most of the slack. Continue with another loop around the pipe and through the *Screw-Lock Buckle* a second time. Pull tight to remove slack.

Continue to Step 1-R for mounting in Reflect Mode.

Continue to Step 1-D for mounting in Direct-X Mode.

Fig 1-2A

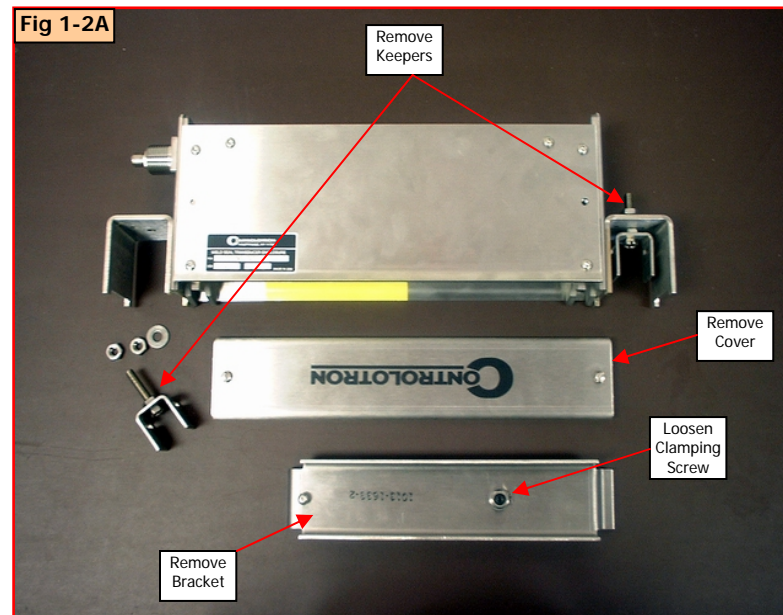


Fig 1-2B

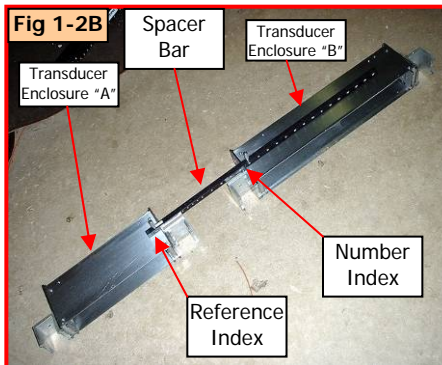


Fig 1-3

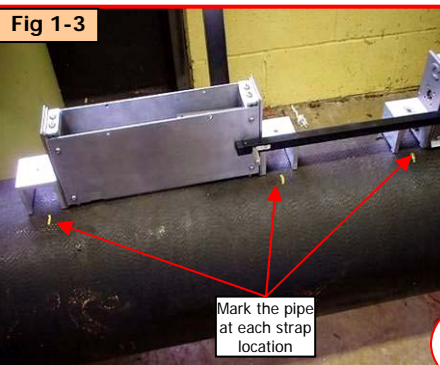


Fig 1-4

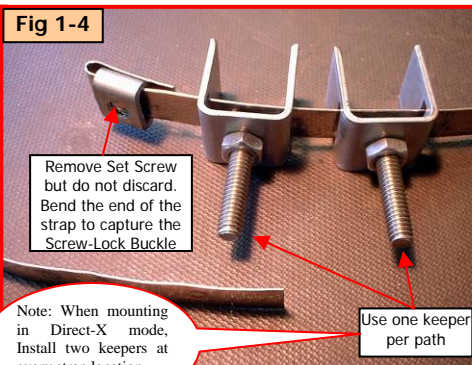
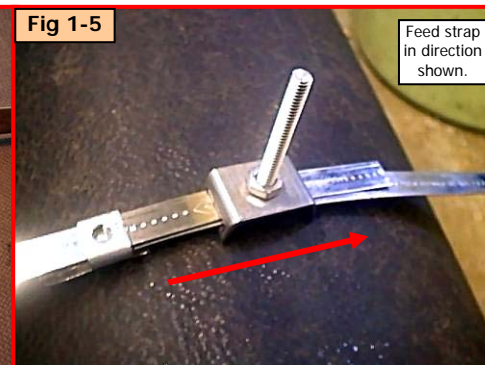


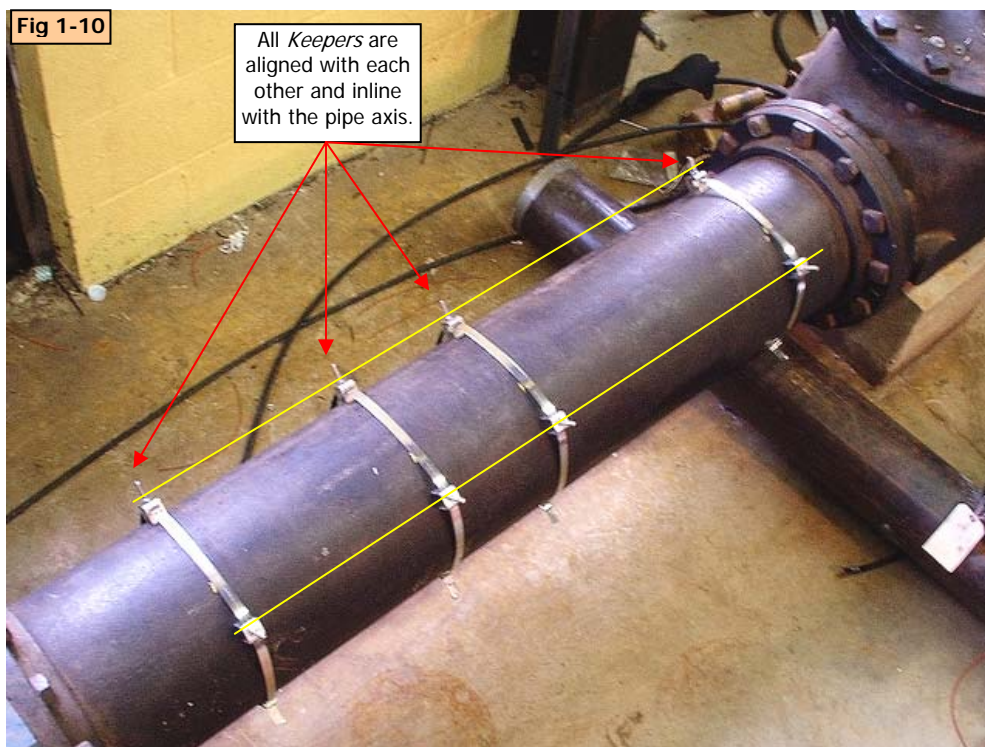
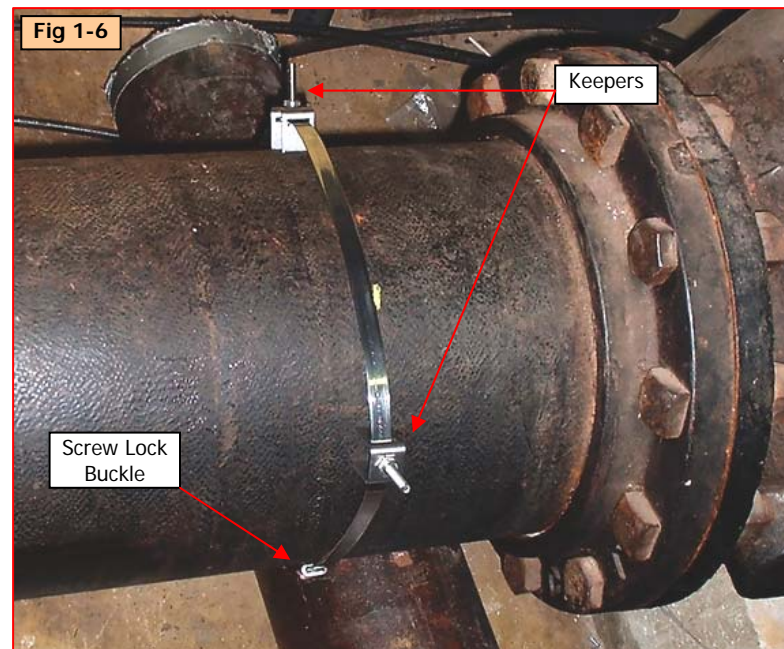
Fig 1-5



Step 1-R: Mounting the Straps For Reflect Mode

- A. Determine the mounting plane of the path/s
See Fig 1-1 and refer to General Notes on page 1 of 8. Take up the slack in the strap and locate the *keeper/s* at the selected plane/s. Locate the *Screw-Lock Buckle* 180 degrees from nearest *Keeper* or best location. **See Fig 1-6.**
- B. Bend the loose end of the strap to prevent it from loosening while you install and tighten the *setscrew* you retained from Step1-C. **See Fig 1-9.**
- C. **Fig 1-10** shows the final results of Step 1-R.

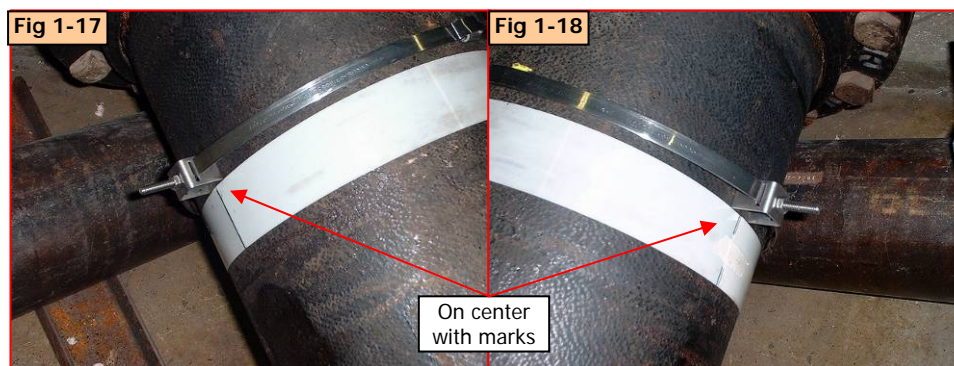
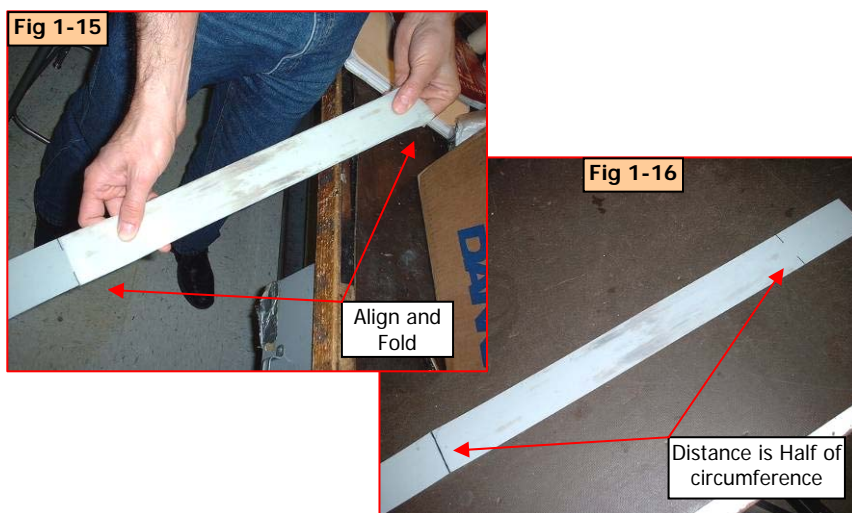
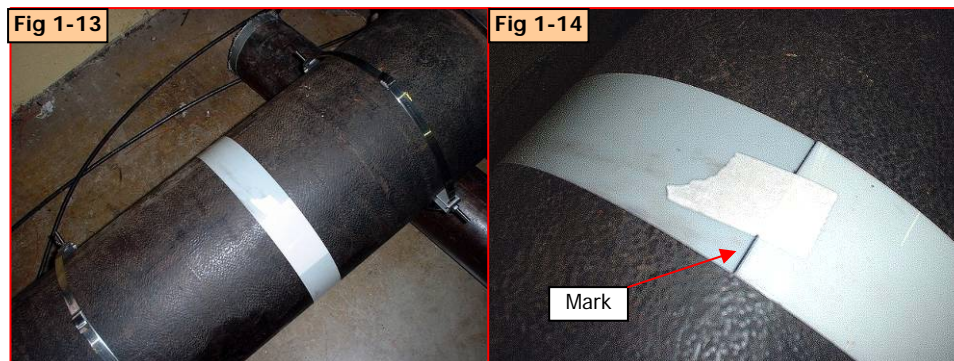
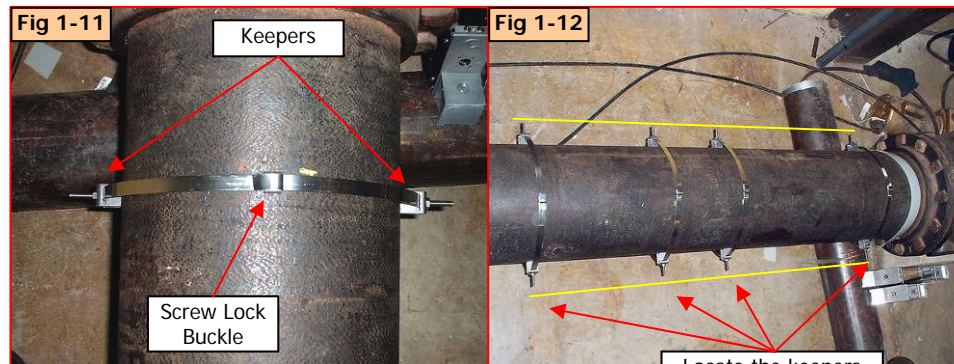
Continue to Step 2.



Step 1-D: Mounting the Straps For Direct-X Mode

- A. Roughly Locate the *Keepers* on the horizontal plane of the pipe. See Fig 1-11 and 1-12.
- B. Using the Mylar material provided, make a template. Tightly wrap the Mylar strip around the pipe and overlap the ends. Cut off any excess. Temporarily tape the end together. Mark the template with a marker where the ends overlap. See Fig 1-13 and -1-14.
- C. Remove the template. Align the mark with the other end of the template and fold the Mylar while maintaining alignment. Mark the seam with a marker. (Note: If you lay the template out on a table you will observe that the distance between marks is half the actual circumference of the pipe). See Fig 1-15 and 1-16.
- D. Reinstall the template. Locate it next to one of the most outer strap locations. Align the marks of the template to the horizontal plane of the pipe. Now align the *keepers*, on center, with the marks on the template. See Fig 1-17 and 1-18. (Note: It is important to maintain alignment of this set of keepers throughout the remaining process. This is the reference point when mounting the housings and aligning and manipulating the remaining Keepers.)

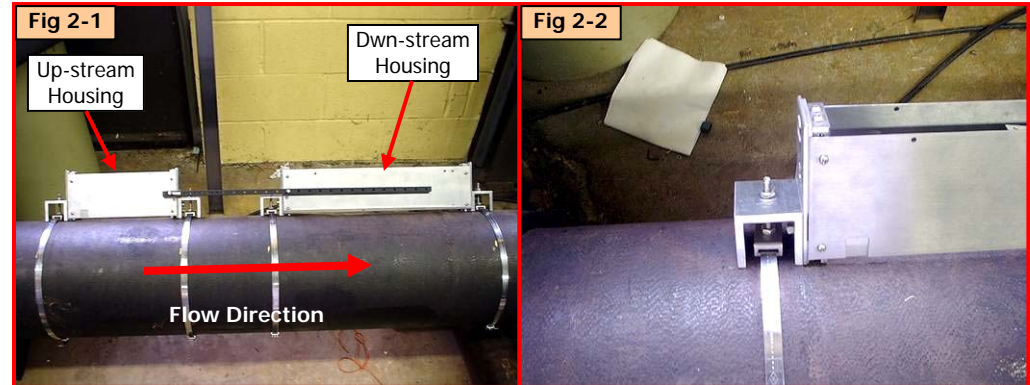
Continue to Step 2.



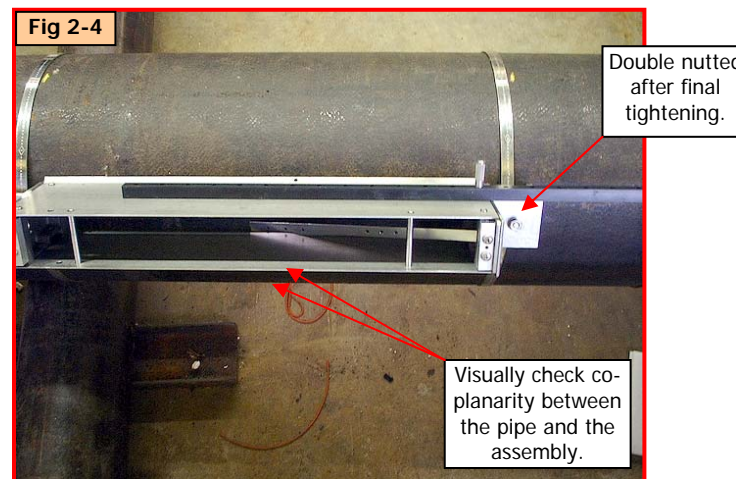
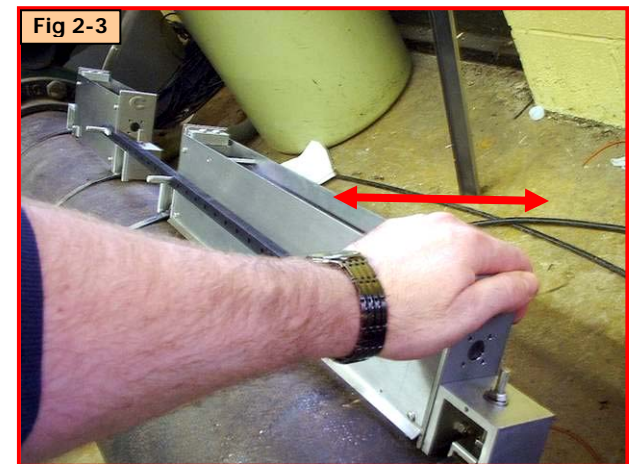
Step 2: Mounting the Enclosure

- A. Place the *Enclosure assembly* over the *Keepers* and slip into place. You may be required to align and manipulate the *Keeper studs* into their respective holes. Be aware of Up-stream vs. Dwn-stream. **See Fig 2-1** (Note: When mounting Direct-X Mode, maintain alignment of *Keepers* as outlined in step "1-D" Paragraph "D".)
- B. Install retaining nuts at every Keeper location. Tighten ONE end, just enough to keep assembly from moving. **See Fig 2-2**
- C. Rock the other end, perpendicular to the pipe, to allow the assembly to find center. Tighten nut just enough to keep assembly from moving. **See Fig 2-3** (Note: When mounting Direct-X Mode, maintain alignment of *Keepers* as outlined in step "1-D" Paragraph "D".)
- D. Visually verify co-planarity with the pipe by comparing the top edge of the assembly to the linear axis of the pipe. Adjust if necessary. **See Fig 2-4**
- E. Tighten all retaining nuts just enough to keep assembly from moving.
- F. Repeat steps **A** through **E** for remaining paths.
- G. Fully tighten all retaining nuts to approximately 20 – 25 in/lbs. Lock in place with second nut.

Continue to Step 3



This assembly is primarily self centering. Secure one end and move the other till centered. Then tighten.



Step 3: Install the Transducers.

- A. Apply a thin bead of CC128 to the bottom side of the *transducers* along their center length. **See Fig 3-1.**
- B. Visually confirm the presence of insulating tape on the inside walls of the housings. Insert *Transducer* into *housing*. (**Note: Be careful not to catch or compromise the insulating tape while inserting the transducer.**) Secure the spacing strap as shown in **Fig 3-2**. Lift up on spring clip to install.
- C. Drop *transducer* into place. Install the cable. **See Fig 3-3 and 3-3A.** Fill *connector* with CC110 grease prior to connection. Backfill the *protective boot* and slide into place.
- D. Install *bracket* at outside hinge. Bracket hooks over the hinge. **See Fig 3-3 and 3-4.**
- E. Drop *bracket* in place. **See Fig 3-5.**
- F. Slide forward to latch. **See Fig 3-6.**
- G. Secure *bracket* by installing screw at hinged location. **See Fig 3-7.**
- H. Tighten *Clamping Screw* to secure *transducer*. (Torque to 15 in/lbs) Secure with hex nut. **See Fig 3-8.**
- I. Verify LTN by comparing the calculated value from the FDC to the actual distance from transducer front face to transducer front face. (**transducer edge is visible at bottom of side plates.**)
- J. Complete the make-up process and verify the operation of the installation before continuing to final step. Adjustment of transducer spacing may be required. If this is so, one of the housings for that path must be repositioned to the re-specified spacing index.

Continue to Step 4

Fig 3-1



Fig 3-2



Fig 3-3

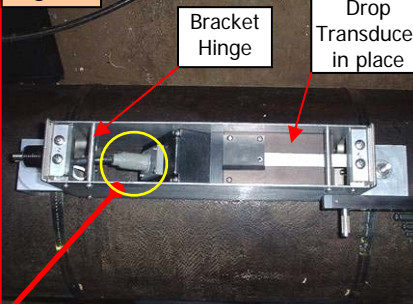


Fig 3-4

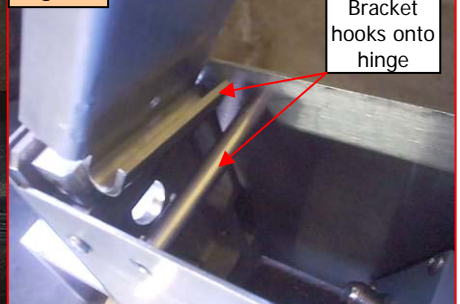


Fig 3-5



Fig 3-6

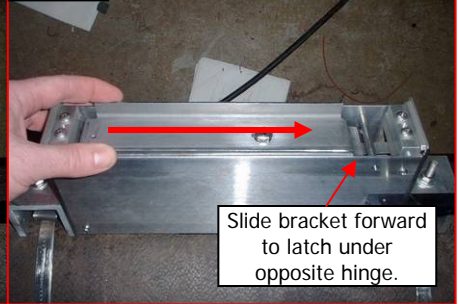


Fig 3-7



Fig 3-8

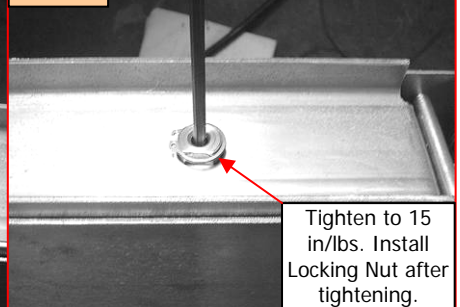
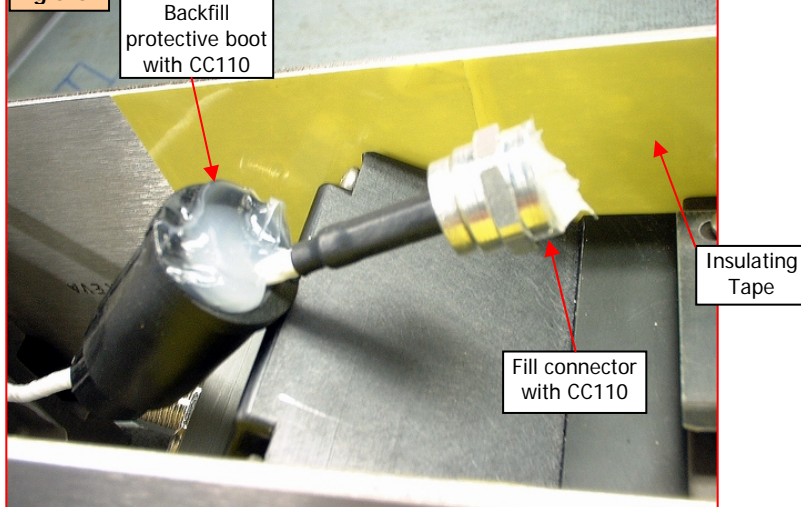


Fig 3-3A



Step 4: Install Gasket Seal. Two people may be required to perform this step.

The procedure below is a recommended process. Any suitable method for achieving a snug inner ring is acceptable.

Follow **Fig's 4-1 to 4-12**. Do not allow any slack to occur in the gasket throughout this step. It must remain tight at all times.

The Idea here is to seal the exposed gap between the transducers footprint and the pipe. Wrap the transducer footprint, twice, with the O-ring gasket material provided, then tie to secure in place. The inner layer performs the function of seal. The second outer layer protects and backs up the first.

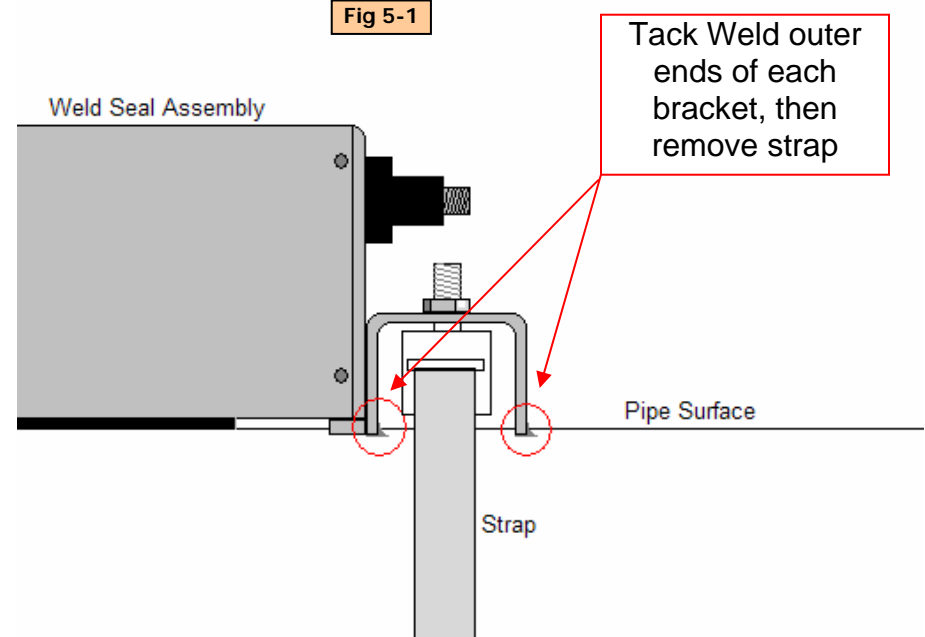
Install the *Housing Covers* and remove the *spacer bar* to complete this procedure.



This photo shows what a final installation should look like. Only one path is represented here.



Fig 5-1

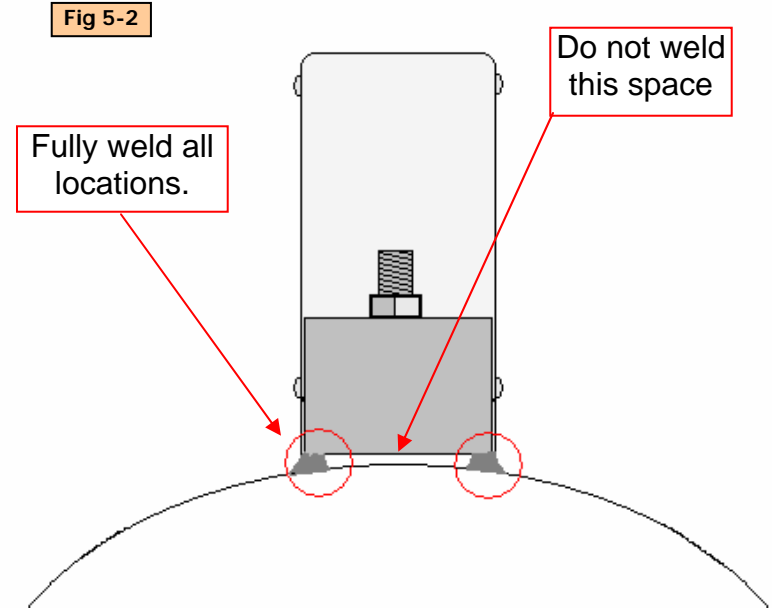


Step 5: (Optional) Weld assembly to pipe. If you desire, you may weld the assembly to the pipe.

- A. While strap is in place, Tack Weld at the outer ends of each bracket as shown in Fig 5-1.
- B. **IMPORTANT:** Do not weld the center of the bracket. The space is necessary for maintaining proper operation.
- C. Remove the straps and fully weld all locations. See Fig 5-2.

Note: Bracket Material is Type 316 Stainless Steel, Suitable for welding to both Stainless Steel and Carbon Steel pipes.

Fig 5-2



SIEMENS

CC129A Dry Film Couplant/Damping Material Installation Instructions

Installation Instructions
CC129A-7 Revision D
CN4973 February 2005

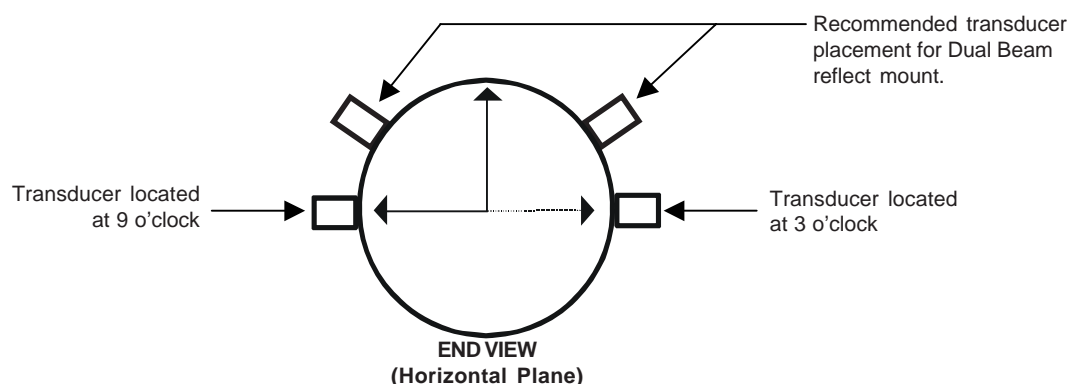
CC129A DRY FILM COUPLANT/DAMPING MATERIAL Installation Instructions

Siemens CC129A dry film couplant/damping material is an adhesive backed viscoelastic polymer sheet that provides excellent acoustic coupling without concern for couplant washout. For Clamp-On gas applications this material effectively absorbs unwanted pipe noise to lower the minimum pressure required for flow measurement.

NOTE: In the following paragraphs, references to the 9 o'clock position indicate the section of horizontal pipe that is closest to you.

1. SELECTING A LOCATION FOR TRANSDUCER MOUNTING

- Locate the transducers downstream from the center of the longest available straight run. A location 20 pipe diameters or greater downstream from the nearest bend or reducer will provide the best flow profile conditions.
- Avoid installing the transducers downstream of control valves, compressors or any other equipment that could possibly interfere with the acoustic signal. 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 (e.g., 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. For liquid flow measurement 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.*

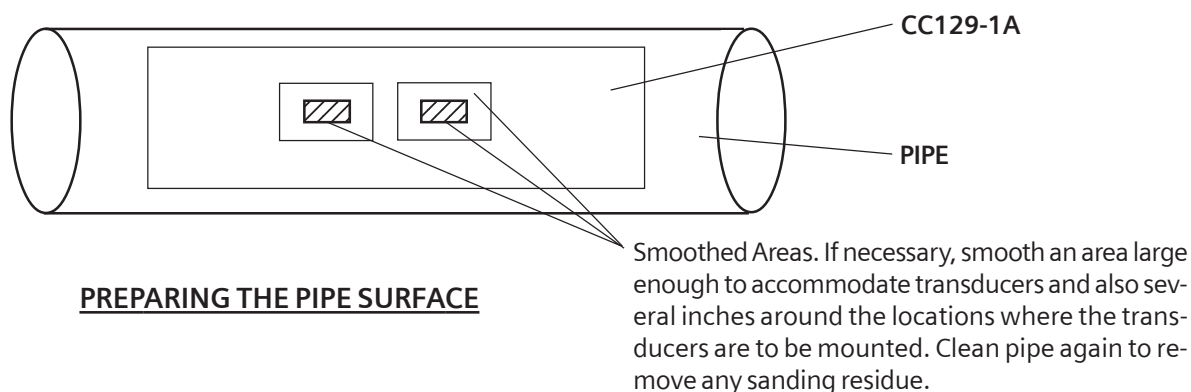


2. PREPARING THE PIPE SURFACE

- Pick a mounting location with the longest straight run. You must have easy access to at least one side of your pipe. For uninterrupted operation the mounting location must remain fully pressurized, even at zero flow.
- Decide on your mounting mode (direct or reflect). Always use Reflect Mode whenever possible or as recommended by the flowmeter installation menu. 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 surface. Degrease the entire pipe surface where the CC129-1A damping material is to be applied and remove any grit, corrosion, rust, loose paint, etc.

NOTE: The effectiveness of the damping material is dependent on how well the CC129 adhesive bonds to the pipe surface.

- If necessary, use the abrasive material provided to create a smooth contact surface for the transducers (see diagram below).



- Make sure that you have a matched pair of transducers. They both should have the same S/N number but marked with either an "A" or "B" (e.g., 100A and 100B).

3. CC129A DRY FILM COUPLANT/DAMPING MATERIAL

Each CC129-1A kit contains one or more 9" x 36" (229 mm x 914 mm) sheet(s) of CC129-1A film to be cut and applied to the surface of the pipe whose flow is to be measured.

Depending on the transducer size code multiple layers of CC129-1A may be required for optimal damping. Refer to Table 1 below for the correct CC129-1A kit P/N and final CC129 coating thickness specified for each transducer size.

NOTE: Each CC129-1A kit contains the correct number of damping sheets (packaged in a mailing tube) for the associated transducer size code.

Table 1. CC129 Damping Material Thickness for 1010 Clamp-On Gas Systems

Transducer Size	CC129-1A Kit P/N	Required Layers	Final Thickness (in)	Final Thickness (mm)
B1H	CC129-1A-1	1	0.027	0.69
B2H	CC129-1A-1	1	0.027	0.69
B3H	CC129-1A-1	1	0.027	0.69
C1H	CC129-1A-1	1	0.027	0.69
C2H	CC129-1A-1	1	0.027	0.69
D1H	CC129-1A-2	2	0.054	1.37
D2H	CC129-1A-3	3	0.081	2.06
D3H	CC129-1A-2	2	0.054	1.37
D4H	CC129-1A-4	4	0.108	2.74

<i>Operating Temperature Range</i>	<i>Installation Temperature</i>
<i>Range</i> -10 to 250°F (-23 to 93°C)	32 to 120°F (0 to 50°C)

3.1 CUTTING AND INSTALLING CC129A COUPLANT SHEETS

Orientation of the CC129-1A is not critical. Cut the sheet to achieve the best coverage and use of material. The full size (9" x 36") sheet may be difficult to apply. Cutting the sheet to manageable pieces will not affect efficiency. DO NOT INSTALL TRANSDUCERS ON SEAMS.

3.1.1 SIZING SHEETS FOR PIPES 6-INCHES AND UNDER

- Cut the 36-inch sheet length in half. The 18-inch length will be applied along the axis of the pipe.
- Leave the sheet at the full 9-inch width for pipes over 3 inches in diameter. Cut width as needed to avoid significant overlap on pipes under 3 inches in diameter.
- Cut any additional sheets as required (see Table 1 for proper number of CC129-1A layers).

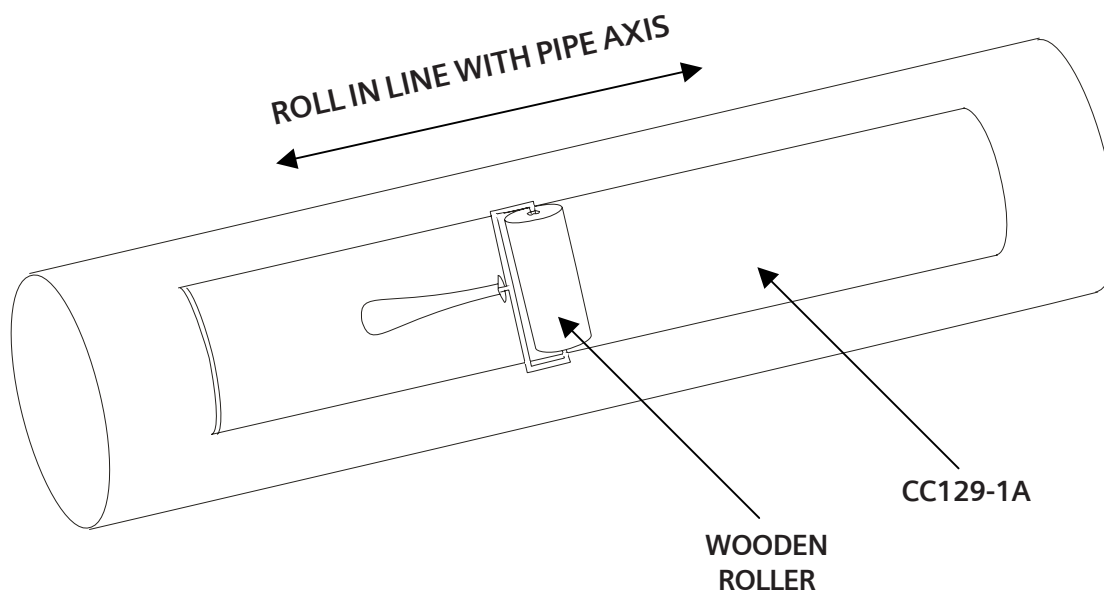
3.1.2 SIZING SHEETS FOR PIPES OVER 6 INCHES

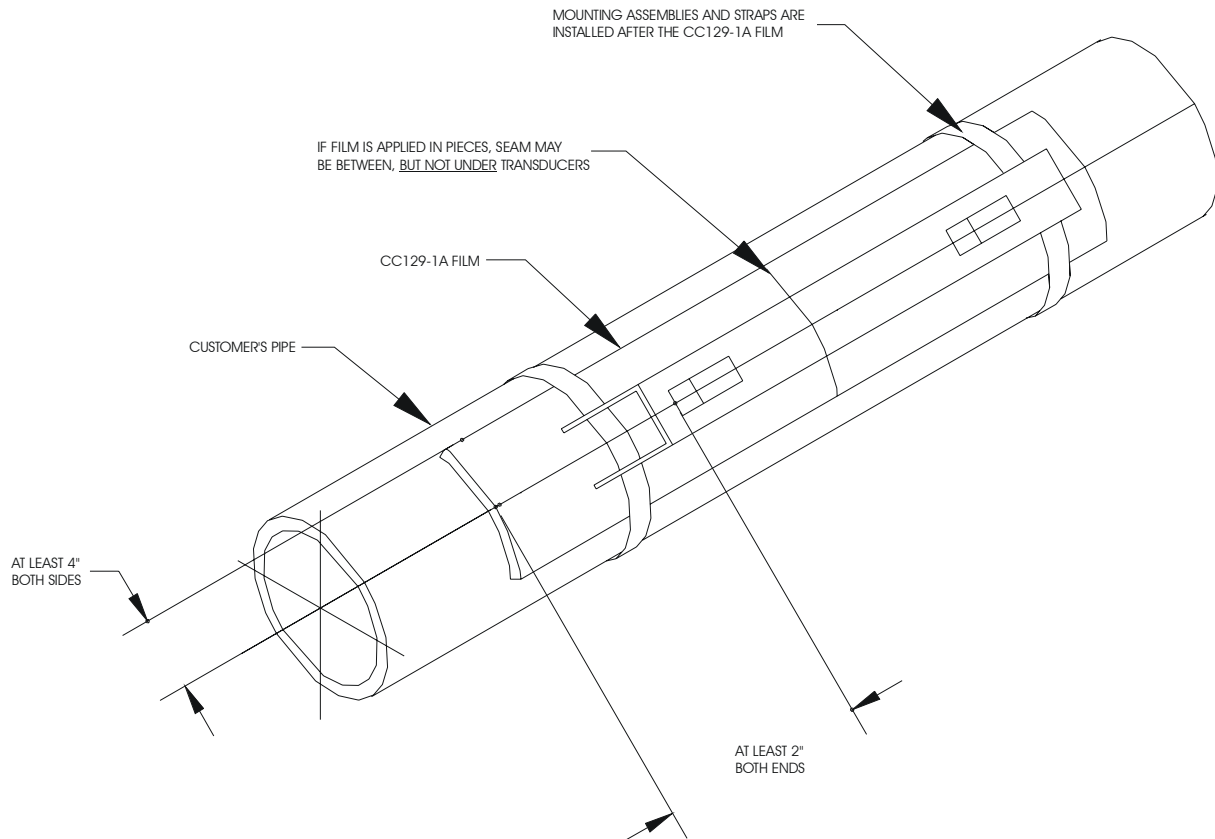
- Use the full CC129-1A sheet dimensions. The 36-inch length will be applied along the pipe axis.
- Depending on the transducer size code multiple layers may be required. Refer to Table 1 for the correct number of CC129-1A layers to apply.

3.1.3 APPLYING CC129A COUPLANT SHEET TO PIPE

- Verify that the ambient and pipe temperature fall within the temperature limits specified below Table 1. *Note that operating and installation temperatures are not the same.*
- Determine the proper location of the transducers (refer to paragraph 1 above).
- Thoroughly clean and degrease the selected pipe area with a suitable solvent (see Cautions in para. 3.1.5).

- After determining the best sheet cutting pattern from suggestions above, mark the pipe for the starting edge of the dry couplant sheet position.
- Partially peel the sheet backing 1 to 2 inches from the starting edge, then carefully locate and press against the pipe surface.
- While pressing firmly and sliding your hand against the sheet (along the pipe surface), slowly peel away the backing such that it prevents the trapping of air.
- Apply the film slowly and carefully so that the sheet does not wrinkle, stretch or overlap, especially under the transducer contacting surfaces.
- Use the wooden hand roller supplied to smooth the film and assure adhesion to the pipe surface.
- Apply additional layers (if required) while avoiding any seams under the transducers.
- Use the wooden hand roller on each layer applied.
- Record final thickness of CC129-1A (from Table 1) for later entry into the 1010GC flowmeter.





3.1.4 MOUNTING TRANSDUCERS

Install the mounting assemblies and transducers directly on top of the CC129-1A material. Use liquid couplant (CC128) for all clamp-on gas installations or if signal amplitude is low or marginal.

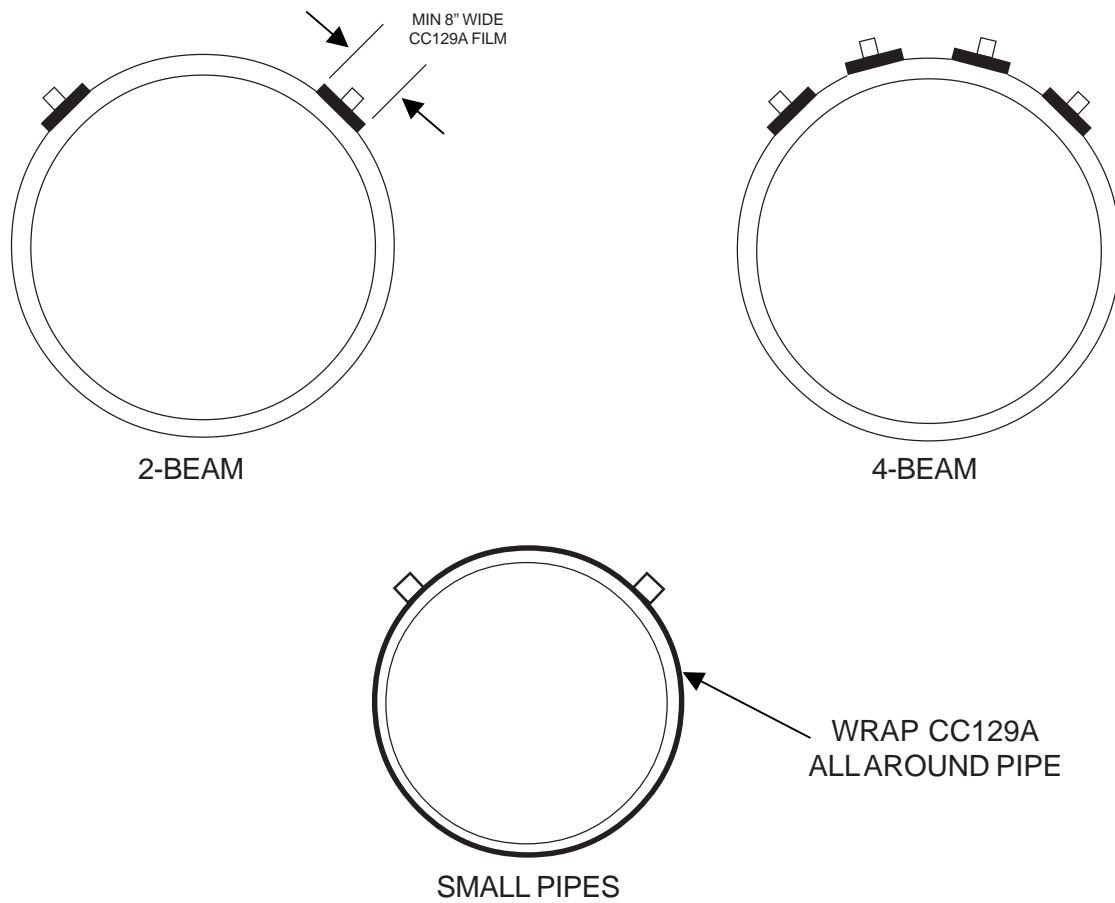
Follow the instructions in the manual for installing the transducers into the mounting assemblies and securing.

- Connect transducer cables.
- Return to the flowmeter and select menu cell [Install Complete] [Yes], then press <ENT>.
- Allow the system to successfully complete its initial makeup.

3.1.5 CAUTIONS ON THE USE OF CC129A DRY FILM COUPLANT

- **Don't** clean the transducers or pipe surface with MEK, acetone, trichloroethane, trichloroethylene, toluene, freon (and its vapors), chloroform, and xylene.
- **Don't** use on oily or greasy pipe surfaces. It will interfere with adhesion.

3.1.6 MULTI-BEAM INSTALLATIONS



NOTE: Contact Siemens (www.siemens.com) for additional recommendations on use of CC129A Dry Film Couplant/Damping Compound.

3.2 GRACE ICE AND WATER SHIELD DAMPING MATERIAL

An alternate (lower cost) pipe damping material referred to as "Grace Ice and Water Shield" can be considered for use with 1010 Clamp-On Gas systems. This opaque material has a black tar like appearance with a very tenacious adhesive backing. Its lower operating temperature range and difficult removal from the pipe must be considered before installing this alternate material. Refer to the web site (www.graceconstruction.com) for a local distributors of this roofing underlayment material.

The installation and sizing of the Grace material is identical to that of CC129-1A. Refer to Table 2 below for the recommended number in layers for each transducer size. (Operating / Installation temperature ranges can be found just below Table 2.)

Table 2. Grace Ice and Water Shield Damping Material Thickness for 1010 Clamp-On Gas Systems

Transducer Size	Required Layers of Grace	Thickness (in)	Final Thickness (mm)
B1H	1	0.038	0.97
B2H	1	0.038	0.97
B3H	1	0.038	0.97
C1H	1	0.038	0.97
C2H	1	0.038	0.97
D1H	1	0.038	0.97
D2H	2	0.076	1.93
D3H	1	0.038	0.97
D4H	3	0.114	2.90

<i>Operating Temperature Range</i>	<i>Installation Temperature</i>
<i>Range</i> -10 to 150°F (-23 to 65°C)	32 to 120°F (0 to 50°C)

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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

[illegible]

STAINLESS STEEL, HASTELLOY "C" & TITANIUM^Δ 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^Δ 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
Standard	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
	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	0.312	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 [⊗]	0.500	0.500	0.500	0.500	0.500	0.500	0.500
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	0.500	0.500	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	0.500	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	0.500	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	0.500	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.

^Δ These materials are generally available in Schedules 40 and 80 only.

[⊗] Wall thickness identical with thickness of "Standard Weight" pipe.

◇ 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 "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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Industry Automation Division
CoC Ultrasonic Flow
Hauppauge, NY 11788
USA

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